

# Bitcoin as a monetary system: Examining attention and attendance

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## Abstract

### OBJECTIVES OF THE STUDY

This thesis has three objectives. First, the past development of monetary systems is studied to see how Bitcoin is positioned as the forerunner of a new category. Second, the attitudes and expectations of Finnish stakeholders are studied to recognize the general perception and future outlook for Bitcoin. Third, bitcoins are examined as an investment instrument by studying price drivers and the degree of predictability of future returns.

### DATA AND METHODOLOGY

The qualitative methods are based on a literature review and an interview study conducted with Finnish stakeholders from different financial institutions and Bitcoin start-ups. The quantitative methods consist of market sizing calculations, a regression analysis, and Granger tests. The regressions utilize novel variables network hashrate, network transactions, and bitcoin supply as explanatory variables for bitcoin price. Also bitcoin price and Google Trends SVI are used as explanatory variables. The market sizing calculations are based on M2 monetary aggregates for USD, EUR, and JPY.

### FINDINGS OF THE STUDY

The thesis develops a categorization for decentralized cryptocurrencies that takes into account the historical development of monetary systems. The interview study reveals optimism for the technology behind Bitcoin and other decentralized systems, while all interviewees accept the uncertainty of Bitcoin's survival. The stakeholders perceive the main challenges of Bitcoin to be technological weaknesses, trust, and reputational issues. In terms of market sizing, it is clear that Bitcoin is not currently a serious threat to fiat currencies. The price driver analysis revealed a momentum effect in price returns, as well as an inflationary effect caused by the increasing supply. Network hashrate was found to forecast future bitcoin returns. The results from the Granger tests challenge the causalities of the regressions.

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**Keywords** bitcoin, cryptocurrencies, blockchain, virtual currencies, regulation, central banking, monetary policy, decentralization, disintermediation, monetary systems, Google, hashrate, Granger, momentum, inflation, Mt.Gox, gold, cypherpunks, cryptography, free market, intrinsic value

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## 1. Introduction

“The one thing that’s missing but that will soon be developed is a reliable e-cash, a method whereby on the internet you can transfer funds from A to B without A knowing B or B knowing A, the way in which I can take a twenty-dollar bill and hand it over to you and there is no record of where it came from and you may get that without knowing who I am.”

- Milton Friedman, interviewed in 1999 (Friedman, 2012)

### 1.1. Background

After the Gulf War in the early 1990s, Iraq was prevented from importing its official banknotes it had been printing in England using Swiss-made plates. This forced the establishment of a new Dinar to enable the control of supply in the country while the old Swiss dinars were officially abandoned. However, due to unsophisticated printing methods in Iraq, the new currency was quickly counterfeited and the Swiss dinars continued to hold purchasing power especially in the northern Kurdish areas of Iraq. As a result, during the period of roughly a decade until the invasion in 2003, there existed an alternative money that was not an official currency, had a frozen supply, and appreciated in value against the official currency. (Foote, Block, Crane and Gray, 2004)

As the Swiss dinars in Iraq, bitcoin is an alternative money that is not officially recognized as a currency and has a predetermined maximum supply that will be reached on a predetermined date. In addition, bitcoin transactions are cleared by a P2P network so that financial intermediaries are not necessary for two individuals to execute a transaction. During the existence of the system bitcoin’s value has been steadily increasing against official currencies even though massive price crashes have also occurred. Although the economic impact of bitcoin is still extremely small, time will tell whether it will survive and become a forerunner of a new wave of monetary systems.

#### 1.1.1. Origins and description

Cryptocurrency Bitcoin is “an electronic payment system based on cryptographic proof instead of trust” that was introduced in 2008 in a white paper by Satoshi Nakamoto (2008), a pseudonymous developer or a group of developers. What makes Bitcoin different

from earlier similar innovations is its way of utilizing proof-of-work and timestamps in a decentralized network of nodes as a solution to the double-spending problem. In brief, this new method eliminates the need for a trusted third party to clear transactions between two parties. The protocol and software Bitcoin (with an upper case B) is a software run by a P2P network of computers enabling a decentralized ledger of payments in units of bitcoins (with a lower case letter b). Even though according to the original white paper (Nakamoto, 2008) the initial purpose was to introduce a payment system, the potential of the system go far beyond merely clearing transactions in bitcoins. Accordingly, there is a whole industry being developed around Bitcoin, as numerous start-ups want to embrace this new technology to provide new services. Furthermore, following Bitcoin's footsteps, there are already more than 460 alternative cryptocurrencies in circulation, each with its own community (Cryptocurrency directory, 2014). With its first mover advantage, Bitcoin has the largest network and community behind it. However, since any one can freely participate in the network of their choice, there are no formal reasons for why a competing cryptocurrency could not replace Bitcoin at some point in the future.

As a means of payment bitcoin differs from traditional fiat currencies in four fundamental ways. First, it is not governed by a central authority but instead by a P2P network of computers that anyone can join or leave at will. Second, transactions between parties can be executed through the network without a financial institution acting as an intermediary. Third, the value of the currency is freely defined by the demand of the market, and not subject to central banking policies. This indicates that the intrinsic value of bitcoin can be argued to be zero. Fourth, the supply of bitcoins increases at a predetermined decreasing rate until the year 2140 when the supply of bitcoins will become fixed at 21 million (Controlled supply, 2014). The implied assumption is that in order for bitcoins to become a widely used method of payment, the value of a single bitcoin will need to become quite high because there can be no changes, including quantitative easing, made to the protocol without a network majority measured in computational power. These four main reasons make Bitcoin an extremely interesting financial phenomenon.

### *1.1.2. Price history*

The changes in the price of bitcoin have attracted a lot of attention, especially during the year 2013. Based on the trades executed at one of the fist public bitcoin exchanges

Mt.Gox (History, 2013a), Fig. 1 is the graph of bitcoin prices on a logarithmic scale and Fig. 2 is the graph of daily logarithmic returns. Both graphs start at the inception of the exchange on July 17, 2010 and end at January 31, 2014. An investor would be interested in the price of a single bitcoin, however, it is good to keep in mind that the usefulness of the payment system should be measured as the joint value of all bitcoins in use.

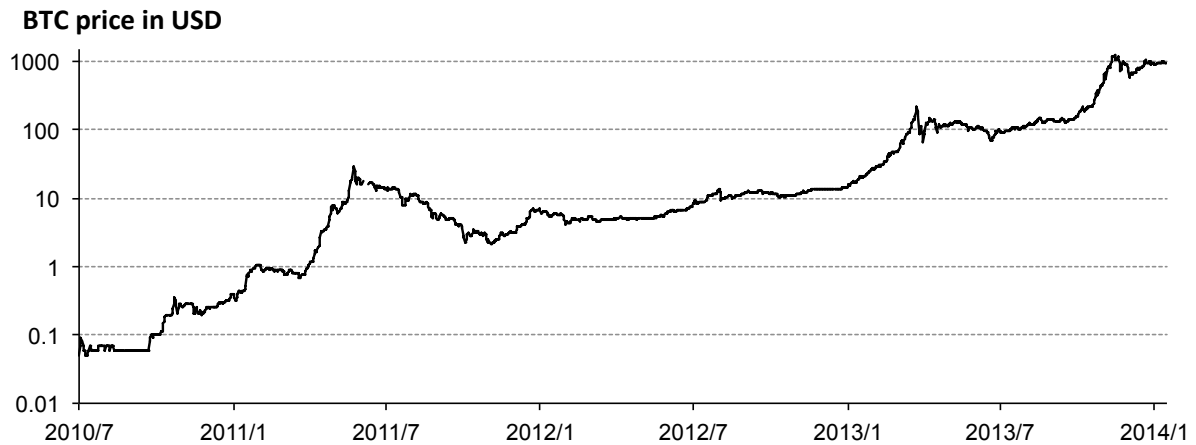


Figure 1: Bitcoin prices at Mt.Gox from Jul 17, 2010 to Jan 31, 2014 (data from <http://bitcoincharts.com>)

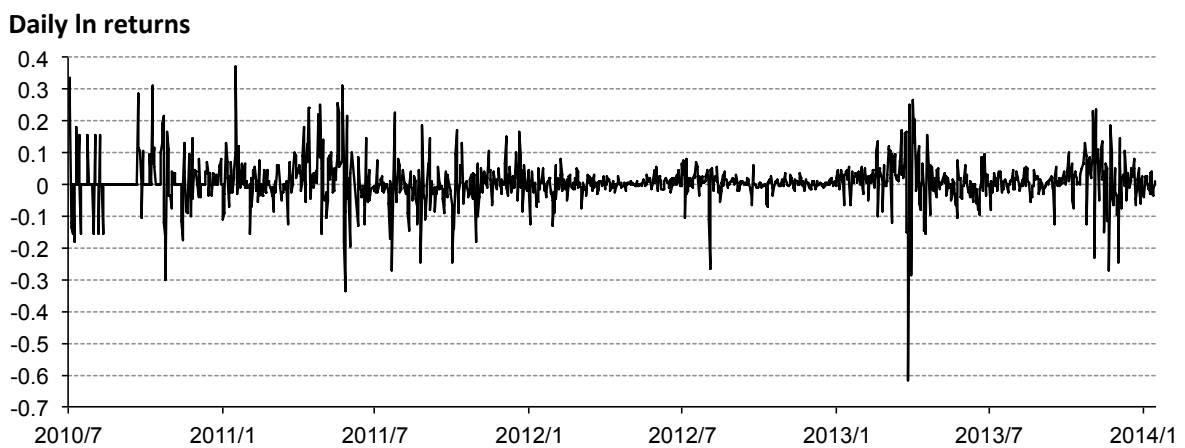


Figure 2: Daily ln returns of bitcoin (data from <http://bitcoincharts.com>)

Even though there has been significant volatility in bitcoin's price throughout its existence, the year 2013 saw the biggest absolute changes in bitcoin price. The price of one bitcoin went from USD 13.37 on January 1 to USD 266.00 on April 10 and back to USD 54.25 on April 12. After this the price steadily increased to USD 215.00 by November 1, which was followed by an extremely rapid increase in value to the all-time high of USD



1,242.00 on November 29. This was followed by a sharp decrease so that on December 18 the price touched USD 455.00. In January 2014, bitcoin was traded between USD 771.00 and USD 1093.68. This level of volatility is not a desired feature for a currency used for payments. However, in a long term a substantial increase in price is needed for the system to be useful in a wider use because the supply is strictly controlled. When looking at bitcoin as an investment, high volatility makes it very interesting for speculators.

When compared to some of the biggest pricing bubbles in the history, bitcoin seems to fit in quite well. In fact, only during the time of one year between November 29 of 2012 and 2013, the price of one bitcoin went from USD 12.15 to 1,242.00 resulting in a single-year growth of more than 10,100 %. The fact that bitcoin is freely priced by the market without any tangible underlying fundamentals makes its valuation process extremely challenging and very different compared to other financial instruments. The traditional models with cash flows, dividends, or multiple comparisons are not applicable, and the lack of clear intrinsic value makes Bitcoin difficult to understand. Even former Federal Reserve Chairman Alan Greenspan has commented that he does not understand “where the backing of Bitcoin is coming from” (Kearns, 2013). It is clear that the volatility of the price is an indicator of market uncertainty. On one hand, the intrinsic value can be understood to be zero but on the other hand, the potential usefulness of bitcoins and the Bitcoin system is understood to be highly valuable, generating speculative demand.

Based on the data from Mt.Gox, the history of public trading of bitcoin has included five significant price crashes. The first one occurred in November 2010 when bitcoin price decreased 70% in three days by going from USD 0.47 to 0.14. The second price crash came seven months later in June of 2011 when the price decreased 67% in three days by going from USD 31.50 to 10.25. While the reasons for these two crashes are not clear, at the time the market capitalization of the system was much lower so it is possible that individual speculators caused these crashes. It is also possible that some early adopters were cashing out their bitcoins and causing the price to crash. The third price crash occurred in August 2012 when the price decreased 51% by going from USD 15.40 to 7.58 in only two days. As reported by RT (Bitcoin ponzi scheme, 2012), this crash was likely a result of a mass panic caused by the closure of an alleged ponzi scheme named Bitcoin Savings & Trust that offered to pay suspiciously high interest on bitcoin deposits. The service did not refund investors' assets and caused widespread distrust toward the whole Bitcoin system. The fourth price crash

occurred in April 2013 when the price crashed 80% by going from USD 266.00 to 54.25 in three days. This was due to the fact that the largest bitcoin exchange at the time, Mt.Gox, was overwhelmed with the increased number of investors and its servers were not able to handle the traffic, resulting in exchange downtime. After one day of declining prices, the company issued a press release (2013) to calm down investors but this was not enough to regain trust and the price continued to plummet. The fifth price crash occurred in December 2013 when the price of bitcoin decreased 54% by going from almost its all time high of USD 1240 to 576 in 3 days. This crash was a result of the ban in China that prohibited financial institutions from dealing bitcoins (Gough, 2013). This news was met with fear of similar bans elsewhere and also by disappointment in the potential of Bitcoin in the Chinese market, where it had started to establish an increasingly significant position. Table 1 summarizes the main information about these five price crashes. During February 2014, there was also significant price deterioration on Mt.Gox. However, this price crash is different from the previous ones as it only fully affected one exchange. This event is further discussed in Section 4.

<b>Date</b>	<b>Price Drop</b>	<b>Concurrent Event</b>
November 7-10, 2010	70%	-
June 9-12, 2011	67%	-
August 17-19, 2012	51%	Bitcoin Savings & Trust (Ponzi scheme)
April 9-12, 2013	80%	Mt.Gox overload
December 4-7, 2013	54%	China's ban on financial institutions

*Table 1: A summary of the five price crashes of bitcoin based on price data from Mt.Gox*

Due to the enormous price increase and huge volatility in the value of bitcoins during 2013, the phenomenon has started to receive mainstream media attention and more and more people are aware of this new virtual currency. Since the innovation combines finance and economics with fairly advanced technological concepts, it can seem too complex and risky for laymen. However, the underlying idea can be simplified to the issue of disintermediation, and the open source nature of the project is a way of guaranteeing the trustworthiness of the

software development steered by the Bitcoin Foundation (Liu, 2013). One interesting piece of information related to the novelty of Bitcoin is that according to a recorded interview released by Wikileaks (2013), the CEO of Google, Eric Schmidt was still unaware of Bitcoin on April 19, 2013. It seems that the first four years of its existence, Bitcoin was known mainly by cypherpunks and interested hobbyists. It has been during the year 2013 that Bitcoin has been able to catch the attention of the general public including technology professionals.

### *1.1.3. Official status*

Even though Bitcoin has not been officially recognized as a currency by any government, it is being monitored by central banks and governmental authorities around the world. Due to its new characteristics, it does not seem to fit any of the traditional instrument class and thus is unregulated in most countries. A recent report “Regulation of Bitcoin in Selected Jurisdictions” published by the Global Legal Research Center at the Law Library of Congress (2014) reveals that, in general, Bitcoin is met with scepticism and a few countries have a clearly prohibitive stance on it. According to the report, the most prohibitive legislation can be found in China, Thailand, and Iceland. In China, banks and payment institutions are not allowed to deal bitcoins. Thailand and Iceland have a general prohibition on the use of bitcoin. Warnings for using bitcoins have been given at least by the central banks of Cyprus, Finland, France, India, Netherlands, Portugal, Singapore, and Taiwan. Additionally the European Banking Authority has issued a warning on bitcoin because its unregulated and unprotected status does not offer consumer protection. After the report by the Library of Congress was published, also Russia has taken a prohibitive stance on cryptocurrencies including bitcoin (Hille and Foley, 2014).

While the general regulatory environment is still undecided about bitcoin, there is a growing interest in embracing this new technology. Businesses have started to recognize the potential of Bitcoin as a payment system, and the most recent notable names to accept bitcoins include publicly traded companies Overstock.com (Brandom, 2014), Zynga (Franzen, 2014), and TigerDirect (Kharif, 2014). There are also hundreds of smaller merchants that start accepting Bitcoins every day through third party service providers such as BitPay that is already serving more than 15,000 merchants (Spaven, 2013). These third party service providers of bitcoin payments make it possible for payment receivers to receive fiat currencies and eliminate the exposure to bitcoin price volatility. While the unclear

regulatory environment might be hindering the adoption of bitcoins, the signal from the private sector seems to be increasingly supportive and the stated examples show that it is not only small businesses that are showing interest. Commercial banks are still very careful with Bitcoin and tend to avoid giving out statements about it. One interesting case of an accidental statement occurred on February 10, 2014 when OP-Pohjola, one of the largest commercial banks in Finland, published a statement about Bitcoin on its website (see Appendix A). The statement was quickly removed by the bank but was accessible through Google's cache for a few days after the incident. It seems that the statement was not originally authorized for publication and contained erroneous information that shows how even Finance professionals can have difficulties in understanding how this new system works. For example, it was stated that "the mining process requires in-depth knowledge of programming" and that "bitcoins can be physically stored on a hard drive".

#### *1.1.4. Non-money uses of Bitcoin technology*

The Bitcoin technology is not only used for settling bitcoin transactions. It is a decentralized ledger that can also be used for other purposes, and therefore the usefulness and value of the technology is not necessarily fully reflected by the price of a bitcoin. Additional applications of the technology can be built on top of the Bitcoin network that verifies and stores information announced on the network or alternatively on top of a similar alternative network that also verifies and stores information announced on the network. Some examples of non-currency applications of the technology are Namecoin, Commitcoin, and Proofofexistence. Namecoin (<https://www.namecoin.org>) is used to maintain a decentralized DNS server that cannot be censored the same way as conventional DNS servers. Commitcoin (Clark and Essex, 2012) can be used to set up a voting system that can function without a trusted third party to handle the counting of votes. Proofofexistence (<http://www.proofofexistence.com>) is a service that can be used to prove that a specific file was in your possession at a certain point in time without the need to share the file itself. One possible future application of Bitcoin is ownership transfer and verification without a third party (Hidden flipside, 2014). This could be applied to stocks, cars, or even houses that could be directly connected to the blockchain to verify the proper owner.

## *1.2. Scope of the thesis*

This thesis investigates bitcoin as an investment and also examines the Bitcoin phenomenon from a Finnish perspective. The thesis has three main objectives. The first objective is to reflect the Bitcoin system with the development of monetary systems using a literature review. The second objective is to gain an understanding of the dynamics of the Bitcoin industry in Finland. This is done by analyzing interviews conducted with selected stakeholders. This analysis focuses on general reactions, as well as drivers and barriers of bitcoin adoption. The third objective is to gain new understanding of the price behaviour of bitcoin. The thesis does not discuss further the non-currency implementations of Bitcoin technology.

The scope of the thesis is summarized in the following four research questions:

- How is Bitcoin positioned in relation to the past development of monetary systems?
- What is the general perception and future outlook of Bitcoin among Finnish stakeholders?
- How can bitcoin value be estimated through market sizing?
- What are the price drivers of bitcoin?

## *1.3. Research methods*

The thesis is divided into three parts according to the research questions. While the analyses of monetary system development and Finland's industry reactions are based on qualitative research, the analysis of value drivers of bitcoin is based on quantitative methods. Qualitative research utilizes literature and interviews. The literature review covers the main developments of monetary systems, the limited body of academic research available on Bitcoin, and the use of investor attention and Google Trends in finance research. Interviews are conducted to understand how the phenomenon is seen by different actors consisting of financial institutions and entrepreneurs. To gain access to more recent information, the thesis also utilizes online sources including reputable news sites and blogs.

The price behaviour of bitcoin is investigated by analyzing the price data of bitcoin from two different angles. First, a market sizing approach is introduced as a way to understand the economic impact of Bitcoin. Second, price behaviour is investigated through

regressions and Granger causality tests. The purpose is to characterize price behaviour and improve the understanding of the value drivers of bitcoin by investigating a selected set of relevant variables. The quantitative analyses are based on publicly available data gathered from online sources that are explained in Section 4.

#### *1.4. Thesis structure*

The thesis proceeds with a literature review section that has four purposes. First, it highlights the main developments of monetary systems and reflects these on Bitcoin. Second, the literature review looks at the available research on bitcoins. Third, investor attention and the use of Google Trends data for analyzing instrument prices are discussed. Fourth, the section is concluded by stating how this thesis contributes to the existing body of research. The third section of the thesis examines opinions in the Finnish Bitcoin industry by analyzing interviews conducted with Finnish stakeholders. The fourth section introduces the data sources and the variables used in the quantitative analyses. The fifth section introduces and explains the selected quantitative methods. The sixth section presents the results of the quantitative analyses. Finally, the seventh section discusses the overall findings of the thesis, suggests areas for further research, and concludes with final words.

## **2. Literature review**

The literature review is organized in four sections. The first section highlights the main developments of monetary systems and reflects these on the Bitcoin system. The second section establishes an overview of the available research on Bitcoin. The third section discusses the use of investor attention and Google Trends data in analyzing instrument prices. The fourth section concludes the literature review by stating how this thesis contributes to the existing body of research.

### *2.1. Development of monetary systems*

The Bitcoin system can be analyzed as a monetary system. It is characterised by decentralized control, predetermined rate of supply, a distributed issuance based on attendance in mining, and an interest rate of zero. This section looks at the development of monetary systems and related monetary theory. Also similarities to the Bitcoin system found

in literature before the emergence of Bitcoin are discussed.

### *2.1.1. Payment systems*

Throughout history, different monetary systems have emerged under the influence of practical demand and developments in monetary policies. Initially, the practical need for money, a commonly accepted medium of exchange, emerged from bartering. This development was given an invisible hand explanation by Karl Menger (1892) who explained that in many cases a direct exchange of commodities is not possible because some commodities are indivisible and thus the matching process of supply and demand is tedious, resulting in search costs. This practical need results in a natural convergence to one or a limited number of widely accepted commodities to be used in trading. Menger explains that this process has led to the use of gold and silver as money as well as a unit of account in advanced civilizations. His explanation also includes the view that no single collective decision was made for reaching the observed outcome. To further economize the costs involved in bartering through commodity money, the emergence of coinage has been observed in an unregulated competitive environment (White, 1984). The practical need for easy authentication of the value of coins was met with brand names that were able to build trust among traders decreasing the authentication costs in the trade process, and ultimately leading to the government monopolizing the coinage function (Ibid). The next development with monetary systems was the introduction of bank liabilities that led to an interbank clearinghouse system (Ibid). In a simplified view, the transition from this system to the current fiat money system is conducted through two steps: 1) replacing specie with specie-redeemable liabilities issued by a government-made central bank 2) suspending central bank liability redeemability. This results in a centralized control of the nominal quantity of money (Ibid). As a result, noncommodity money without intrinsic value gains exchange value (Ibid).

In a paper examining banking in the theory of finance, Eugene Fama describes the main function of banks to be “the maintenance of a system of accounts in which transfers of wealth are carried out with bookkeeping entries” (Fama, 1980). He goes on to describe that an efficient “pure accounting system of exchange” would have a “pure nominal commodity or unit of account” that takes the role of the numeraire. Fama’s view is independent of “physical medium or the concept of money” as only “numeraire or relative prices” need to be determined. Fama concludes with a futuristic scenario, in which the term “money” is

forgotten and the government decides to introduce a pure nominal commodity, a “unit”, with no physical representation or intrinsic usefulness that yields an interest rate of zero. The scenario describes the challenge of establishing supply and demand functions for the “unit” that determine its relative value to other goods. Fama’s proposed solution is to generate demand for “units” by imposing a reserve requirement for spaceship owners, whose services are desired by most citizens. Among other possibilities, Lawrence White (1984) discusses Fama’s system as a potential competitive payment system and describes the necessary conditions for such a new system to be able to replace the current system. White’s analysis concludes that a replacement is possible if “transactions conducted in the second money grow in relative importance, or because the first money experiences an exogenously caused ongoing relative decline in purchasing power”. He also states that “the convenience of traders in the present world” is what dictates the used money and unit of account. The system described by Fama fits quite well with Bitcoin in which the numeraire is not connected to the physical world, the interest rate is zero, and it is challenging to determine its value relative to other goods. One clear difference is that Fama’s system is introduced by the government, whereas Bitcoin was introduced by an unknown author.

### *2.1.2. Monetary policies*

The development of monetary systems has resulted in the government-controlled monopoly of the supply of money. The optimal monetary policy has always been a subject of debate and still continues to raise contradicting views among academics and experts. For a monetary system to be able to function properly, the supply of money needs to be controlled in a suitable way. Milton Friedman has published books and papers on monetary policies and in his discussions he brings up the possibility that explicit government control of the money supply can lead to irresponsible government actions (Friedman, 1948). He suggests that this danger could be avoided by moving to a “metallic currency” and by eliminating “any government control of the quantity of money”, which would encourage a “balanced actual budget”. Being lenders of the last resort, central banks have obtained a unique economic position. If the governments that influence central banks are selected through a process of free democracy with honest decision-makers, theoretically the end results should be a reasonably well-functioning system. However, the problems encountered with this system show that there exist flaws that have, and will be, abused. While the authentication costs of money mentioned earlier can be reduced with the trust and reputation of a government, Friedman’s



view introduces an opposing factor to consider, the abuse of power that can destroy this trust. One could suggest that this setting creates a severe moral hazard. One of the monetary policy options proposed by Friedman is the k-percent rule, which dictates that the money supply should increase at a constant rate regardless of the economic cycles (Friedman and Schwartz, 2008). This policy has some similarities with the Bitcoin system, in which the quantity of money increases at a predetermined rate.

### *2.1.3. Centralization*

One defining aspect of a monetary system is its degree of centralization. There are varying views on the optimal degree of centralization of a monetary system but the historical development has been toward a more regulated and centralized system. One could pinpoint the first clear sign of today's system to the year 1844 when the Parliament of the United Kingdom passed the Bank Charter Act (1844) restricting the issuance of notes and ultimately giving the Bank of England exclusive note-issuing power. This controversial act fuelled the debate between the British banking school and currency school and it was seen as a victory for the currency school who argued that the Bank of England could stabilize the economy by controlling prices through the control of circulating currency (Skaggs, 1999). The inevitable progress towards the centralization of reserves was criticized by Walter Bagehot (1878) who argued that this type of centralization was not a good idea and was against the natural system of each bank holding its own reserves.

Lawrence White (1983) writes about this “pyramiding of reserves” and discusses free banking in Scotland for a century before the Act of 1844. During that time free competition led to a well-functioning system that did not require a central bank but only a central clearing house. According to White, there are two reasons why the same was not possible in the United States so called free banking in the 19<sup>th</sup> century. First, the inter-regional banking restrictions demoted the circulation of trustworthy bank notes, and second, the requirements for banks to hold state bonds resulted in suboptimal diversification of bank assets. While the current system has arguably been able to facilitate economic growth in many parts of the world, there is a continuous debate about the optimal degree of centralization. There exists the historical example of successful free banking in Scotland, which shows that perhaps free competition in banking and monetary systems could be beneficial after all. The benefit of competition in general is that it is a discovery process (Hayek, 2002). Therefore, the

intervention of the government in the competitive process of money and monetary systems can be seen to be a suspicious way of defining systems that have an extremely significant impact on the daily lives of all citizens. This can be seen as a sacrifice of optimal efficiency for the sake of centralized control.

#### *2.1.4. Money categorization*

One way of summarizing the development of monetary systems is to emphasize specific examples and the path of development. This can be done by selecting three distinct systems that differ fundamentally from each other. This section will examine three systems by comparing their two properties: measure of wealth and numeraire physical value. First, there is commodity money that is limited in quantity and thus represents an absolute measure of wealth inside the system. The numeraire in this system is a unit of a physical good. Second, there is specie-redeemable money that has a government-issued numeraire. Even though the numeraire is tied to a physical good, the quantity of money is controlled centrally with government influence, resulting in a relative measure of wealth. Third, there is unredeemable government-issued money, fiat money. This is similar to the second system, however, there is no link to a physical good. This development path can be continued by including a fourth category, decentralized cryptocurrency, namely Bitcoin. This fourth system has a numeraire that arises from the system itself and is not tied to a physical good. The quantity of money is strictly limited so that inside the system, measure of wealth is absolute.

In terms of quantity of money, this fourth system can be suggested to represent a step backwards in development. However, fiat money is still a relatively young concept so some of its advantages and disadvantages might still be unknown, and therefore such development would be difficult to fully evaluate. Fig. 3 summarizes these four discussed systems and their characteristics in terms of numeraire physical value and measure of wealth. If a numeraire is tied to a physical good, its physical value is absolute. A relative physical value of a numeraire might inherently be difficult to implement in a way that trust is generated, however, it can potentially result in better overall efficiency. If the units in the monetary system represent only a relative measure of wealth inside the system, long-term saving of the units is discouraged. An absolute measure of wealth ensures a certain purchasing power inside the system also after a long period of holding time. The measure of wealth represents the nature of the money supply in the system.

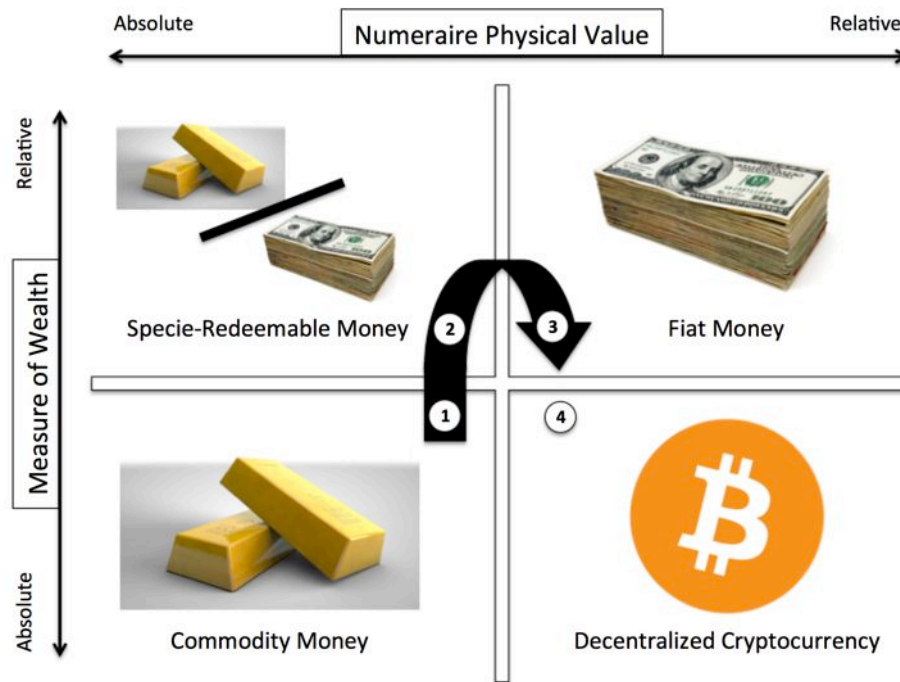


Figure 3: A summary of monetary system development with decentralized cryptocurrency as a proposed fourth category

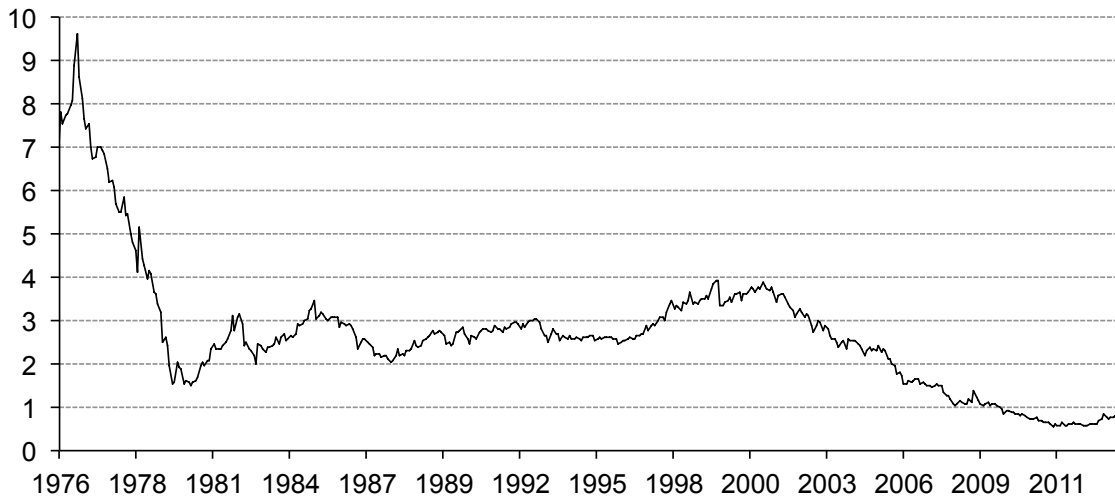
#### 2.1.5. The roles of money

According to Scitovsky (1969), money serves three functions: a unit of account, a medium of exchange, and a store of value. While the first two of these were discussed in the previous sections, the last of the three is also an important function. Due to its price volatility Bitcoin has been widely criticized for its bad characteristics as a store of value, however, it is important to note that the system requires a period of deflation for it to gain value. One could suggest that this process continues until the system finds its role and the demand levels off. While Bitcoin has been going through a strong deflationary process, it is difficult to say whether a levelling of demand will occur. As a comparison, one can look at how the USD has performed as a store of value. Since gold has safe-haven characteristics (Baur and Lucey, 2010; Coudert and Raymond, 2011), one can consider it a reliable long-term measure of value. Therefore, the value of USD in gold is a reasonable measure of how well the USD has performed as a store of value. Fig. 4 shows the price of 1000USD in gold since the beginning of 1976. According to this measure, the USD has not been a very reliable store of value. The recent development has been such that after the year 2000, USD has lost roughly three quarters of its value measured in gold. It is also good to note that the graph excludes the

preceding period of 4,5 years immediately after the Nixon shock, during which the dollar lost two-thirds of its value measured in gold.

### USD price in spot gold

oz/1000USD



*Figure 4: USD price in spot gold based on data from the World Gold Council, [http://www.gold.org/investment/statistics/gold\\_price\\_chart/](http://www.gold.org/investment/statistics/gold_price_chart/)*

The role of Bitcoin is currently very small in terms of its economic impact. However, it represents a totally new breed of financial instruments that enable a new approach to monetary systems and monetary policy. Never before has it been possible for two individuals to conduct verifiable transactions without an intermediary. This advancement has solved “the Byzantine Generals Problem” in which a group of parties unsure about each other’s trustworthiness can anonymously arrive at a collective decision (Lamport, Shostak and Pease, 1982). Even though Lamport et al discuss the handling of component failure in a computer system, the Bitcoin system can be seen to solve this problem in the area of computer networks and transaction disintermediation. When reflected on the historical challenges of monetary systems, it can be seen that the Bitcoin system eliminates search costs and authentications costs. It is good to note that even the use of dollar or euro notes cause authentication costs because there are counterfeits in circulation. Ultimately this leads to the need for authentication equipment and methods when dealing with large sums of money. Authentication costs also have an impact on how trust is understood and approached in a monetary system.

One can split trust in a monetary system into two parts. First, there is trust in money and its purchasing power. Second, there is trust in the system and transaction functionality. Trust in bitcoin's purchasing power is low due to its price volatility and legal position. As discussed in Section 1.1.2, there have already been five significant price crashes during the relatively short history of bitcoin. The price volatility can however be argued to be a part of the development and introduction phase of Bitcoin, indicating that once bitcoin has found its place in the economy as a payment method and an alternative money, its price volatility will decrease to a more convenient level. Another perspective to bitcoin's purchasing power is its legal position. While this is continuously under discussion and debate, it feels safe to say that it is not in the interest of governments and central banks to give up the control of monetary policy decisions. This leads to the conclusion that bitcoin will not likely be accepted as a direct method of payment for taxes. With this assumption, even if the use of bitcoins increases so that individuals and businesses will have more and more of their income and outlays in bitcoin, ultimately tax obligations will need to be met with fiat currency. This will cause law-abiding bitcoin users to be reliant on bitcoin-fiat exchanges, and therefore vulnerable to government intervention. This is why the legal position of Bitcoin is crucial for its acceptance even though the technological execution of the core system is very resilient to such exogenous interventions.

The second part of trust, involving system and transaction functionality, is complicated in the case of Bitcoin. The system can be used in a way that enables two parties to conduct a transaction without any trust in other entities. The user only needs to trust the network security that is based on the assumption that a single actor will not gain majority control of the Bitcoin network measured in computational power, the hash rate. This kind of use is optimal in terms of trust in the system and transaction functionality because the distributed network can be seen as a distributed trust system where the bitcoin clearing mechanism has proven to be very robust. Having stated this, in practice, users interested in bitcoin only as a money will not likely want to get involved in bitcoin mining and wallet security management. They will most likely use third party service providers for purchasing bitcoins through an exchange and managing digital wallets. Trusting these third parties is comparable to the current monetary system in which banks are trusted. However, the difference is that many Bitcoin service providers lack the sophistication and reputation that would make them trustworthy. The most recent, and perhaps the most significant example of an unreliable bitcoin exchange is the bankruptcy of Mt.Gox in February 2014 (Takemoto and

Knight, 2014). While the system trust has a good foundation and potential based on the Bitcoin core system, its short history shows that there is a long way for Bitcoin and especially the service providers to fully utilize this potential in practice. In a future scenario with wider bitcoin acceptance, free competition should promote trusted services and eliminate malfunctioning services. Whether the process of free competition is too costly for incautious consumers is another topic of discussion related to government control and regulation.

Considering Fama's (1980) description of the main function of banking being the management of bookkeeping entries and his envisioned competitive monetary system, it seems that in some ways Bitcoin meets the ideals of the famous economist. Coupled with the presented arguments for free competition of money and banking, one could suggest that Bitcoin could possibly develop into a significant complement to the current systems. The role that Bitcoin can achieve depends on three main factors. The two latter ones are based on White's (1984) arguments about competitive payment systems. First, Bitcoin must gain a legal position, in which it is allowed to be a competitor as a money and a payment system. Second, Bitcoin transactions must grow in importance, through either as a payment method or through other applications. Third, there needs to be some crisis or crises with the prevailing system that deteriorates the purchasing power of fiat currencies.

## *2.2. Academic research on Bitcoin*

One typical characteristic of the academic research and publication process is the lag between the time of writing and the publication of an article. Given the fact that Bitcoin has been in existence for roughly five years, it is understandable that there is not much academic research available on it. At its inception Bitcoin was interesting only to a very small group of technology enthusiasts, and even during the extensive media coverage in November of 2013, this new phenomenon was dubbed "small change" for practitioners and "primarily a technological, not an economic, innovation" by Erik Madsen, an economics PhD student from Stanford Graduate School of Business (Madsen, 2013). Although this is just the public opinion of one person, it is a good example of how the economic and technological sides of the phenomenon can be seen to be at different levels of significance. While there is no denying that the current market value of bitcoins is merely a drop in the ocean in the global economy, the general consensus is that the technology itself is truly innovative and potentially disruptive. When looking at the academic research, the distinction between these two sides

needs to be considered.

When looking at the available body of research, the first observation is that the top journals for finance have zero publications mentioning Bitcoin. The searches for “bitcoin” in *Journal of Finance*, *Journal of Financial Economics*, *Review of Financial Studies*, and *Journal of Financial and Quantitative Analysis* yielded no results. When looking at the less prestigious journals, the results were no better. The following journals also had zero published articles on Bitcoin: *Financial Management*, *Journal of Banking and Finance*, *Journal of Corporate Finance*, *Journal of Empirical Finance*, *Journal of Financial Intermediation*, *Journal of Financial Markets*, *Journal of Futures Markets*, and *Mathematical Finance*. An interesting detail was found in the analysis of the publications in *Journal of Financial Services Marketing* from 2000 to 2012. In this analysis, Bitcoin was identified as one of omitted topics that should be covered in the future (Grant, Stiehler and Boon, 2013). Given the lack of prestigious academic sources on the topic and the untraditional and interdisciplinary nature of Bitcoin, it seems acceptable to look at less prestigious publications for more information.

Considering the past extensive media coverage and the potential of Bitcoin also as an economic innovation, one could expect to find some research on this topic through search engines for academic research. The search engines EBSCO, ProQuest, SSRN, and ScienceDirect reveal a number of relevant articles that can be used to obtain an overall picture of available bitcoin research. While each search engine returned between 13 and 72 search results for “bitcoin” in academic sources, most of the articles were related to technology, regulation, or social implications of early use of Bitcoin in illegal market places. The most relevant articles were chosen based on the relevance of the content related to the research questions of this thesis. Additionally to the abovementioned search engines, Google Scholar was used to find a list of 125 articles that cited the original white paper on Bitcoin by Satoshi Nakamoto (2008). This list was analyzed to find the relevant articles that were not covered by the earlier searches. Table 2 summarizes the search results of each search engine and the number of relevant articles.

Search Engine	Results for “bitcoin”	Relevant Articles
EBSCO	13	3
ProQuest	72	10
SSRN	27	4
ScienceDirect	45	1
Google Scholar*	125	3

(The search engines were used in the abovelisted order so that overlapping search results are not included in the number of relevant articles.)

\*Articles linked to the original white paper by Satoshi Nakamoto (2008)

*Table 2: Search results on multiple academic search engines – updated January 8, 2014*

The relevant articles can be grouped under four themes. The first theme includes discussions on the development and acceptance of Bitcoin. The second theme includes discussions about the role of money and its regulation. The third theme includes different ways of categorizing Bitcoin as a system and an instrument. Finally, the fourth theme includes discussions from the perspective of investing in bitcoin.

### *2.2.1. Development and acceptance*

Depending on one’s perspective, the significance of Bitcoin can be seen very differently. As mentioned earlier, the technological aspect is clearly significant. Michael (2013) investigates the disruptive technologies of the future and presents Bitcoin as one of the three technologies that will challenge authorities. The other two are File Sharing and 3D Printing. However, there is no denying that the current state of Bitcoin is still uncertain and it is easy to argue that it will be difficult for the technology to gain wider acceptance. Evans-Pughe (2012) argues that it is Bitcoin’s user friendliness that is hindering its acceptance, describing the current development phase as the Internet without the Web browser. Even though the Internet and online services have developed significantly since the early days of the Internet, for some reason the technology giants have not been able to take over the banking industry. Valentine (2012) examines the fact that in the 1990s Microsoft and Yahoo were expected to disintermediate banks. However, it is clear that this has not happened and banks have been able to operate essentially the same way as before. According to Valentine “banks leveraged the trust of the customer base”. She argues that this trust and the higher convenience required of a new service together explain why personal finance management has



not seen the large-scale adoption envisioned in the 1990s. Perhaps Bitcoin will be able to push forward this development.

The acceptance of Bitcoin is constantly growing as more and more merchants are accepting it as a form of payment either directly or through a third-party service provider. Some small areas, such as Kreuzberg in Germany, have a very high level of acceptance but the volatility of bitcoin's exchange rate is a challenge to its credibility on a wider scale (Neroth, 2013). According to finance professionals, lack of liquidity, nonexistent formalized market, inability to hedge exposures, lack of security, and lack of market regulation are the other important reasons to avoid being involved in Bitcoin (Stark, 2013). For now, bitcoins simply seem to be too risky. However, another perspective by Luther (2013) emphasizes the scepticism toward the current financial system and the uncertainty of future purchasing power of existing monies. In his paper Luther looks for reasons why Bitcoin has not gained a wider acceptance and finds that network effects and switching costs must be the main reasons for this. He even states that cryptocurrencies such as Bitcoin will not likely achieve wide acceptance without "significant monetary instability or government support". One example of monetary instability causing consumers to use a system without an official approval is the case of Swiss Dinar in Iraq (Grinberg, 2011). In this case, arguably significant monetary instability was the reason for consumers to use money that was officially abandoned and did not have any intrinsic value. On the other hand, it is good to remember that in the case of Swiss Dinar, it was the previous system that people were willing to use, making such transition to Bitcoin different in the case of monetary instability. Interestingly, one can also compare the acceptance of Bitcoin to earlier similar systems, and notice that it has actually been very successful. Barber et al. (2012) use this perspective and compared Bitcoin to other e-cash schemes. They find multiple ways in which Bitcoin seems to be superior to previous systems but the most crucial factor seems to be the successful design of incentives to participate in the Bitcoin network. In evaluating the long-term potential of Bitcoin the paper also closely examines the weaknesses and flaws of the system and concludes that if implemented correctly, "the core design could support a robust decentralized currency".

Cedillo (2013) presents another interesting perspective of monetary development and describes how the shadow banking industry has come up with many financial innovations that the rest of the financial world has later embraced. His discussion also states that even the European Central Bank has recognized that its regulatory framework lags behind

technological developments by years. One can categorize Bitcoin to be a part of shadow banking because it is a monetary system that operates outside of the official financial system. In this regard Bitcoin might represent such an innovation that the official financial world will embrace in one form or another in the future.

### *2.2.2. The role of money and regulation*

This topic was discussed in Section 2.1 from a general perspective. The literature that looks at this topic from the Bitcoin perspective brings some new thoughts to the discussion. Lemieux (2013) looks at how a wide acceptance of Bitcoin is not in the interest of governments. It would lead to the loss of control making execution of monetary policy difficult or even impossible. This could fundamentally change the way states are financed. According to Lemieux, it is very uncertain whether the regulatory state allows Bitcoin to be developed further. He even states that the regulatory state could simply kill the experiment. Although, technologically killing the Bitcoin network is extremely difficult if not impossible, regulation can be used to affect the gateways between fiat currencies and bitcoins (Varriale, 2013). A more futuristic account of Bitcoin regulation is given by Plassaras (2013), who envisions how the IMF could potentially enable a quasi-membership for virtual currencies such as Bitcoin to collect a stockpile of bitcoins for absorbing maturity mismatch losses to stabilize exchange rates. The paper discusses that an IMF membership would be a way of avoiding negative effects of a future speculative attack on fiat currencies carried out by bitcoin holders. Plassaras does not estimate what the market value of bitcoins would need to be for such an attack to be possible. Even though an IMF membership could theoretically stabilize the exchange rates, in practice collecting a sufficient stockpile would be problematic.

### *2.2.3. Categorization*

Due to its novel features, it is very difficult to categorize Bitcoin. Even though it has some characteristics of money, commodity, and even stock, there is no direct fit with any one of these traditional categories. Toma (2012) describes Bitcoin simply as an “Electronic Money System” that can be also used for mobile payments. Yermack (2013) addresses the categorization of Bitcoin as a currency by stating: “Bitcoin appears to behave more like a speculative investment than like a currency”. This argument is based on bitcoin’s volatility and the fact that the daily exchange rates of bitcoin exhibit virtually zero correlation with fiat

currencies. Also more sophisticated attempts at categorizing cryptocurrencies are available. Wells (2011) proposes five categories for digital currency systems: Barter Exchange Software Systems, Non-Bank Digital Currency Payment Systems, Digital Precious Metal Systems, Online Value Transfer Software Systems, and Online Stored Value Transaction Software Systems. According to Wells, Bitcoin belongs to the category of Online Value Transfer Software Systems. While Wells focuses on only digital currency systems, Bergstra and de Leeuw (2013) take a more general perspective and talk about Informational Money. More specifically, they categorize Bitcoin as Exclusively Informational Money (EXIM) because the Informational Coins of an EXIM “can be in control of an agent but are not owned by any agent”. Selgin (2013) looks at the historical development of monetary systems and categorizes Bitcoin as Synthetic Commodity Money. According to Selgin “A synthetic commodity money need not be supported either by legal-tender status or by being receivable for public payments, though such attributes might of course contribute to its value and purchasing-power stability”.

#### 2.2.4. *Investing*

As an investment, bitcoin is a very high-volatility and high-risk instrument. To gain a better understanding of this risk, it would be important to understand the drivers of this volatility and how bitcoins could be used in investment portfolios. Based on data from Hommes et al. (2008), Husler et al. (2013) examines the emergence of bubbles that exhibit faster-than-exponential growth. The bubble and crash of Bitcoin in April of 2013 is mentioned as such an example. The study utilizes a learning-to-forecast laboratory experiment with human subjects and concludes that these types of super-exponential bubbles can occur in such a setting. In fact, a common feature of such bubbles is found to be that prices are only loosely connected to fundamentals. This study helps to understand how the dramatic price swings have been possible because bitcoin is completely disconnected from fundamentals. Another interesting study on the drivers of bitcoin price is the paper by Kristoufek (2013), who examines the connection of Google Trends data and Wikipedia activity to the price of bitcoin. This study is discussed in more detail in Section 2.3.

Briere et al. (2013) study bitcoins as a part of an investment portfolio by conducting spanning tests to evaluate the usability of bitcoin in a diversified portfolio. Their example portfolio includes worldwide stocks, bonds, hard currencies, commodities, hedge funds, and real estate. The study finds that including bitcoins in the portfolio offers significant

diversification benefits in terms of mean-variance trade-offs.

### 2.3. *Investor attention and Google Trends*

In finance, investor attention has been studied from many angles. For example, there exists evidence of the limits of human attention in investments. Hirshleifer et al. (2009) show that distracting information has a clear effect on investor behaviour. While attention seems to be limited, when retail investors decide to pursue an active trading strategy they seem to underperform the market (Barber and Odean, 2000). This type of overconfidence is further emphasized with men who seem to be trading more actively than women, resulting in worse performance (Barber and Odean, 2001). With the evidence for attention limitations and overconfidence of attention utilization there is a clear logic between investor attention and investment performance on an individual level.

Also the connection between attention and asset performance has been studied. Gervais et al. (2001) show the connection between attention, in terms of trading volume, and positive stock performance. In this paper, trading volume is used as a proxy for investor attention. Also analyst coverage has been studied, and Hong et al. (2000) find that the momentum effect is stronger for stocks with low analyst coverage. The implication is that higher attention in terms of information distribution will speed up the consensus formation of the market price. Although analyst attention cannot be directly compared to attention of the general public, one can assume that analyst coverage will increase attention in general, and thus analyst attention can be considered a proxy for attention in general. The effects of news coverage and extreme performance has been studied by Barber and Odean (2008), who show that attention generated through these methods will determine the choice set for individual investors buying decisions.

One of the newer measures of attention is Google Trends SVI that measures the popularity of search terms over time. In the current information age, most publicly available information is generously accessible to anyone with Internet access. In today's world, this access is considered a measure of development but also a component of basic human rights in the developed world. In this setting, an online phenomenon such as Bitcoin will gain attention through the Internet. The attention can be measured in multiple ways, but Google searches present a very significant part of this attention. Based on data from a NASDAQ-listed

research company Comscore, in December 2013, Google processed 67.3% of all online searches (Lella, 2014). Paired with the fact that 93% of all online traffic originates from search engines (Bianchini, 2011), it is clear why the publicly available Google Trends data are useful and can be considered a good proxy for online attention and attention in general. In a way, this measure is more direct measure of general attention than the previously mentioned measures because SVI does not only represent activities related to investing but it also involves other activities. Depending on the use, this can be either a benefit or a disadvantage. The use of SVI data in finance was introduced by Da et al. (2011), who show that Google searches represent the attention of investors, and especially retail investors. They find that SVI has predictable power over stock performance. Further research shows that SVI for company products has predictable power over revenue surprises (Da, Engelberg and Gao, 2010a). Da et al. (2010b) also find that a higher SVI results in a stronger momentum effect, which can be explained by increased overconfidence when an individual investor searches for information. If the momentum effect is assumed to be purely a behavioural phenomenon and represents a deviation from the true value of an asset, this finding combined with the previously mentioned analyst coverage study by Hong et al. (2000) together indicate that SVI represents the activities and intent of retail investors that seem to represent overconfident and speculative activity.

Considering the discussed literature, it seems that an individual's higher attention for an asset will not improve the individual's investment performance but higher attention on a larger scale will affect the pricing process of the market. On one hand, the momentum effect is decreased by higher analyst coverage but increased by a higher SVI. This indicates that SVI is a good measure of general attention that does not weigh expert activity more than the activity of an average retail investor. When looking at studies on bitcoin, the only paper found utilizing Google Trends has been the paper by Kristoufek (2013) in which the relations between bitcoin and search queries in Google Trends and Wikipedia are analyzed. The study uses a data set that ends in June 2013, after which a lot has happened with the price of bitcoin. For Google Trends, Kristoufek uses weekly data, which decreases the accuracy of the results because significant bitcoin price swings can occur in just a couple of days. Kristoufek analyzes cointegration and presents the results as impulse-response functions. Positive and negative feedback is separated by a dummy variable that compares the current price with a moving average. While Google Trends data show meaningful results for only positive feedback, Wikipedia data show a meaningful relation for both positive and negative feedback.

#### 2.4. *Contribution to existing research*

The qualitative part of the thesis contributes to the existing literature by reflecting the properties of bitcoin on the historical development of monetary systems. Also, the thesis introduces a new way of categorizing cryptocurrencies from the perspective of development of monetary systems. This approach emphasizes the development path of the past monetary systems and reflects this on Bitcoin.

The quantitative part of the thesis contributes to the existing literature in five ways. First, the time frame of price data for bitcoin is extended to the end of January 2014 so that it includes another period of extreme volatility during the last month of 2013 not included in the data of Kristoufek (2013). Second, Google Trends SVI data are extracted in a way that gives daily values, whereas Kristoufek's study uses weekly values. Third, three new variables, Bitcoin network hashrate, bitcoin transactions quantity, and the exact increases in bitcoin supply, are introduced as explanatory variables for bitcoin price. The quantitative methods used in this thesis differ from the ones used by Kristoufek, but the results will have a dimension of comparability in examining the relation between bitcoin price and Google Trends SVI. Fourth, dummy variables are used to examine the effect of five instances of bitcoin price crashes. Fifth, a simple approach of market sizing is used to understand the relative size of Bitcoin and to examine some future scenarios.

Including the price crash of December 2013 will increase the usability of the study. By having another steep increase followed by a rapid decrease in the price can decrease the chance of coincidence in quantitative findings. By including this price crash in the data, meaningful and statistically significant relations are more likely to hold also in a future event of extreme volatility as the probability for coincidence decreases.

The use of daily values for Google Trends SVI is possible with a data extraction method requiring some manual work. The method is relatively easy and gives access to daily data, and therefore much greater detail compared to weekly data. This data extraction method is further explained in Section 4.2. Due to the level of daily volatility of bitcoin prices, the use of weekly data for Google Trends SVI might have been the reason why Kristoufek was not able to find a meaningful relation between negative feedback and price response.

The three new variables are used to describe some relevant characteristics of the Bitcoin system. Bitcoin network hashrate represents the amount of computing power that is utilized by the Bitcoin network. It is the sum of the computing power of all computers running the Bitcoin software. The author is not aware of any studies that utilize these variables as drivers of bitcoin returns. The hashrate variable has many dimensions and it is driven mainly by two factors: the technological developments of mining equipment and the level of attendance to the network. These drivers are further discussed in Section 4.3. Bitcoin transactions quantity represents the total amount of transactions processed by the Bitcoin network. This measure represents the transaction use of bitcoin but has its own limitations that are discussed in Section 4.4. The exact increases in the bitcoin supply are examined to see if there is an inflationary process in the system. The variable is based on the number of new bitcoins added to the network as rewards for mining, further discussed in Section 4.5.

### **3. Interviewing Finnish stakeholders**

This section develops an overview of the state and direction of the Finnish Bitcoin industry by analyzing interviews conducted with Finnish stakeholders. The interviews were conducted to hear how different actors, including financial institutions and entrepreneurs, see the phenomenon. The three main themes in the discussion were the general perception, the biggest challenges, and the future outlook of Bitcoin. All interviews were conducted as unstructured discussions that were guided with a set of prepared questions that aimed to guide the discussion toward the presumed areas of interest of each interviewee.

#### *3.1. Interviewees*

The interviews were conducted between January and May of 2014. Eight interviews were conducted to cover three perspectives: the central bank, commercial banks, and bitcoin entrepreneurs. All interviews were conducted in Finnish and transcribed to English using recordings. The transcripts were checked and approved by each interviewee (see Appendices B-I). Even though it is still quite common for financial institutions to not give out public statements about Bitcoin, all interviewees granted the permission to publish the interviewees. Table 3 contains a list of the interviewees and their basic information.

<b>Organization</b>	<b>Interviewee(s)</b>	<b>Position(s)</b>	<b>Perspective</b>	<b>Appendix</b>
<b>Bank of Finland</b>	Päivi Heikkinen	Head of Division, Financial Stability and Statistics	Central bank	B
<b>Bank of Finland</b>	Juha Tarkka	Adviser to the board	Central bank	C
<b>Nordea</b>	Jussi Mekkonen	EVP Deputy Head of Banking	Commercial Bank	D
<b>OP-Pohjola</b>	Hanna Äijälä	VP, New Businesses	Commercial bank	E
<b>Nordnet Finland</b>	Niklas Odenwall Thomas Brand	Country GM Business Developer	Commercial bank	F
<b>LocalBitcoins</b>	Jeremias Kangas	CEO	Bitcoin entrepreneur	G
<b>Bittiraha, (Prasos)</b>	Henry Brade	CEO	Bitcoin entrepreneur	H
<b>Coinmotion, (Movila)</b>	Teemu Päivinen	CFO	Bitcoin entrepreneur	I

*Table 3: List of interviewed Finnish stakeholders*

All of the interviewed banking organizations are household names in Finland. Nordea and OP-Pohjola represent the perspectives of traditional commercial banks with an extensive physical presence and a wide selection of online services. Nordnet represents newer online-based banking services. The three interviewed bitcoin start-ups all provide services related to buying and selling of bitcoins. Each of them has their own approaches and supplementing services.

### *3.2. General perception*

In general, Bitcoin was met with interest by all of the interviewees, including the central bank representatives. It is understood to be technically something new that differs from the previously existed financial systems and instruments. Heikkinen from the Bank of Finland said that they have noticed that the technology “includes a lot of good things”. An even more excited account was given by Brand from Nordnet who compared the technological innovation to the discovery of electricity and steam power. As explained by



Coinmotion's Päivinen, the main benefits of the system are easy transfers and low transaction costs. The issue of transaction costs in the system is not simple, and its challenges are discussed in the next section. Another approach to evaluating the benefits of using Bitcoin was mentioned by Kangas from LocalBitcoins who stated that Bitcoin provides sovereignty, meaning that it gives total control over your payment traffic and eliminates the risk of third party intervention. This latter approach seems to reflect elements of cryptoanarchistic ideology.

One topic discussed with many of the interviewees was how the phenomenon should be understood. More specifically, there were different approaches to naming the distinct elements of Bitcoin. Heikkinen from the Bank of Finland made a distinction between a technology and a currency. Äijälä from OP-Pohjola listed three elements: a technology, a money, and a payment system. Similarly, Brand from Nordnet listed a technology, a money, and an ideology as the three elements. Brade from Bittiraha made a distinction between a payment system and a commodity and Päivinen from Coinmotion talked about a payment system and a store of value. This shows that whenever Bitcoin is discussed, it is important to clarify what is meant. As a general rule it seems that a distinction should be made at least between a technology, and a unit used in transactions to avoid misunderstandings.

Another definition-related topic is whether bitcoin can be considered money or not. According to the Bank of Finland's Heikkinen, the answer is no because there is no one to guarantee its existence. She also questioned whether there really exists demand for a currency that is not centrally guaranteed. Also Brand from Nordnet was clear in his opinion that bitcoin is "certainly not money". Nordnet's Odenwall named bitcoin a "speculative immaterial currency". Another opinion was given by OP-Pohjola's Äijälä who said that bitcoin could be seen to meet the criteria of money. This opinion is based on the following three roles of money: measure of value, store of value, and something that can be used to settle payments. Additionally, LocalBitcoins' Kangas compared bitcoin to cash, which suggests a view that bitcoin can be considered money.

Another comparison that is quite often made is the comparison between bitcoin and gold. This comparison was also met with various opinions among the interviewees. Nordea's Mekkonen said that the comparison is bad because it is challenging to compare a physical object with an imaginary unit. According to Heikkinen from the Bank of Finland, price

behaviour is the only similarity between the two. LocalBitcoins' Kangas thought that the comparison serves as a useful simplification when explaining Bitcoin to laymen. Coinmotion's Päivinen thought that in terms of examining the store of value characteristic, the comparison is useful. More favourable opinions about the comparison were also presented. Tarkka from the Bank of Finland identified two common characteristics: the freedom from governmental abuse and a principal similarity about the scarcity of the supply. Similarly, Nordnet's Brand pointed out that while gold prices can be manipulated through extensive central bank reserves, bitcoin is free from such central bank policies. Bittiraha's Brade stated that bitcoin could become more stable than gold but added that it would not necessarily behave like gold. Finally, another comparison was introduced by OP-Pohjola's Äijälä, who suggested a comparison between bitcoin and squirrel pelts. Even though initially this comparison was made to undermine the importance of bitcoin, according to Äijälä, the comparison is interesting because squirrel pelts were a commonly used and well-functioning payment method during a certain time period.

In terms of the overall discussion around Bitcoin, it has involved some of the biggest authorities in the finance world ranging from central banks of world super powers to other authorities and large corporations. According to Nordea's Mekkonen this can also be seen as a signal that conveys a message of importance. It makes spectators wonder whether there really is something important about the phenomenon. From the Bank of Finland's perspective, the phenomenon has increased in importance. According to Heikkinen, the Bank of Finland has followed different virtual currencies already since 2007 and recently there has been more resources allocated to more systematically follow these phenomena. Nevertheless, Heikkinen also mentioned that replacing a technology with another does not change the basic rules of the economy, and that they still have much bigger and more interesting things to think about.

### *3.3. Biggest challenges*

While the technology is very promising and exciting, there is a long list of challenges that it is facing at the moment. One major challenge is that the technology is difficult to understand. While some interviewees emphasized how difficult Bitcoin is to understand, others focused on how it is misunderstood and how it could be made easier to understand. Heikkinen from the Bank of Finland and Äijälä from OP-Pohjola both found the Bitcoin system very difficult to understand and Äijälä even said that there are "many nerdy sci-fi

themes involved” that make it confusing. Nordnet’s Brand on the other hand stressed how the technology is often misunderstood and seemed to understand Bitcoin quite well. Bittiraha’s Brade had a very constructive approach as he acknowledged these problems but focused on how Bitcoin could be made easier and safer.

Another challenge is that there are some weaknesses also in the core Bitcoin technology. Heikkinen from the Bank of Finland stressed this challenge, although she also added that she hopes that the technology develops further. LocalBitcoins’ Kangas gave more details about one specific weakness. He explained that currently Bitcoin can only process seven transactions per second, whereas VISA is processing 4000 transactions per second. In the current state of increasing use, this limitation is leading to increasing transaction costs because transactions are competing for fast processing. Another related challenge is that currently the transaction cost is not related to the value of the transfer but to the amount of data written in the blockchain.

One challenge with all financial and monetary systems is generating trust. The current state of Bitcoin is still affected by its past reputation and trust is definitely an issue for the Bitcoin industry as a whole. Nordnet’s Brand characterized the general attitude towards bitcoin to be general distrust. Also the lack of trust was identified by OP-Pohjola’s Äijälä as one of the key factors for Bitcoin not being ready for wider adoption. Heikkinen from the Bank of Finland brought up issues like price manipulation with bitcoin and other such issues that question the motivations of some stakeholders. Another trust issue discussed was the possibility for anonymity with the use of Bitcoin. According to Heikkinen, this is both a benefit and a weakness. It is a feature that some users want to have but it might prevent authorities from supporting the technology. According to OP-Pohjola’s Äijälä, the criticism related to anonymity applies only to the first uses of Bitcoin, and are overemphasized compared to similar problems with physical cash. Nordnet’s Brand also discussed the stigmatized reputation of Bitcoin that is due to mainly its first uses.

Related to the issue of trust is the issue of regulation and categorization of Bitcoin. While Nordnet’s Brand stated that more academic research is needed to better understand Bitcoin before categorizations are made, Coinmotion’s Päivinen stated that Bitcoin should have its own category and policy. According to Heikkinen from the Bank of Finland, Bitcoin could be included in the existing category of e-money if the definition is slightly revised.

LocalBitcoins' Kangas did not seem to be worried about the categorization and stated: "Bitcoin is Bitcoin". Perhaps this comment summarizes how this challenge should be approached. It seems that Bitcoin is indeed quite unique compared to anything that has preceded it, and thus, requires to be regulated with care as a new category, while keeping in mind the possible future applications of the core technology.

One topic discussed in moderate detail was the impact of speculation and the challenges it poses. According to Tarkka from the Bank of Finland, in general, money demand is volatile and speculative demand is seen to create price volatility. Speculative demand seems to be very strong and prominent in the case of Bitcoin. It seems that OP-Pohjola's Äijälä represent a quite common opinion when she states that speculation creates a negative impact on the reputation of the payment system. However, she also points out that all major currencies are subjects of speculation but there seems to be no determined maximum level of speculation that can be allowed. Bittiraha's Brade adds another perspective by stating that speculation has increased liquidity in the system. Due to this increased liquidity, currently it is possible to process two million euros in bitcoins quite well through the large exchanges without affecting the exchange rate. This would have been simply impossible couple years ago.

One of the practical challenges faced by bitcoin start-ups is the unwillingness of commercial banks to cooperate with them. According to LocalBitcoins' Kangas, a typical Bitcoin startup dies in less than six months due to banking problems. Bittiraha's Brade confirms that some Bitcoin companies have had problems getting bank accounts and according to him, regulation clarification would increase banks' confidence to act in these situations. The third interviewed Bitcoin entrepreneur Päivinen from Coinmotion also agreed that banks seem to be uncertain about Bitcoin. He suggested that one approach would be for authorities to cooperate with Bitcoin developers in regulatory matters. OP-Pohjola and Nordnet representatives mentioned that they follow the policies of the central bank and that their operations are tightly regulated. In other words, even if they wanted to operate in the Bitcoin space, they might be legally prohibited to do so. Even though there is not clear prohibition, the uncertainty surrounding this industry and its regulation is enough to avoid involvement due to reputational risks. Matters are further complicated by the fact that according to Brade from Bittiraha, the Financial Services Authority of Finland has not taken a stand on the issue based on their view that bitcoin is not money. According to Tarkka from

the Bank of Finland, the authorities are worried about a possibility of bitcoin-demoninated money markets or debts. These types of activities would make the authorities very sceptical. Tarkka reminds that in China, a ban for financial institutions has been issued. The important distinction in this regard is that as long as bitcoin is only outside money, and no one's debt, the risks to financial stability is small. If a lender of last resort would be needed for bitcoin, there would be a need for centralized reserves.

Another challenge for Bitcoin is the extent of the current system's success. As discussed in the literature review, external shocks to the current system through financial crises might attract new users to Bitcoin. Nordea's Mekkonen challenged this assumption by stating that in history security has been preferred over novelty in transitions. Therefore, the collapse of Euro would cause the Monetary Union member nations to adopt their previous currencies. Mekkonen also reminded that in crises, the power of economic decision makers are overestimated and in the end decisions are typically made based on politics. Even though this observation is important, one could suggest that if the crisis is caused by the same actors that would be monitoring the new system, a separate, independent, and decentralized alternative could be attractive. On the other hand, if Bitcoin's role will be a parallel system rather than a replacing system, such crises would not necessarily have dramatic effects on Bitcoin adoption.

#### *3.4. Future outlook*

The most pessimistic outlook for Bitcoin's future was presented by Heikkinen from the Bank of Finland who said that the technological limitations of Bitcoin "will most likely kill the system itself, sooner or later". When discussed about the role of Bitcoin with commercial banks, OP-Pohjola's Äijälä hypothesized that banks will end up as winners due to their competitive advantage through consumer trust. She also stated that Bitcoin has incredible potential as a payment system. Bitcoin entrepreneurs also acknowledge the risks involved, and LocalBitcoins' Kangas stated that the price of bitcoin can go to zero or to a five or six-digit number because the risk is very high. He also reminded that the transaction system is only the first application of the blockchain. The outlook for price volatility was met with optimism. Bittiraha's Brade explained that the price volatility has been stabilizing from the levels in 2010 and 2011 but also added that it is impossible for bitcoin to reach the stability of fiat currencies. Brade hypothesized that the effects of speculation will become smaller

because there is no unlimited increase potential. Nordnet's Brand thought that volatility will not be a problem in the long run.

The long-term potential of the current application of Bitcoin as a payment system was met with scepticism by many of the interviewees. The Bank of Finland's Heikkinen said that the current cryptocurrency would be replaced by another due to the technology failing. Both Nordea's Mekkonen and OP-Pohjola's Äijälä envisioned a new system that would build on Bitcoin's foundation and ideas. Coinmotion's Päivinen mentioned that a new scheme could obtain a replacing role by compromising on some issues between governments and consumers. Bittiraha's Brade reminded that Bitcoin has a very clear network advantage compared to the current competitors. The large-scale success of the system was discussed with Nordeas Mekkonen, and he said that there needs to be clear benefits for using the system because ideology alone is not enough for a large-scale adoption.

In general, decentralized systems were seen to have a bright future. According to Nordea's Mekkonen, virtual currencies that are independent of central banks will get a foothold sooner or later. Nordnet's Brand and LocalBitcoins' Kangas both said that decentralized systems will become much more popular. According to Bittiraha's Brade, the new applications of the technology can become a threat to many jobs in finance due to disintermediation on many fronts. Even though Brade does not expect total bans of Bitcoin in many countries, Kangas mentioned that in the case of bans, a decentralized exchange model could be adopted. Interestingly, Heikkinen from the Bank of Finland mentioned that the Bitcoin system has some analogies with one of their reports on an envisioned model for a distributed central bank.

When asked if Bitcoin would affect their work in the future, the commercial bank representatives gave a range of answers. Nordea's Mekkonen assumed that bitcoin will not affect his work in a significant way. Nordnet's Odenwall ruled out the possibility to provide bitcoins as an investment product to his customers due to too many uncertainty factors. OP-Pohjola's Äijälä said that she could see the payment system being embraced by her organization in one way or another. For example eliminating fraud and conducting more efficient cross-border transactions are topics of interest to banks.

#### 4. Data

This section describes the data used in the quantitative analyses. All of the analyses are based on publicly available data gathered from online sources. Five sets of data are used for the value driver analysis: bitcoin price, Google Trends SVI for bitcoin, the network hashrate of the Bitcoin network, the number of transactions handled by the Bitcoin network, and the total number of mined bitcoins. All five sets were used with daily data points for the regressions and Granger analyses. Additionally five dummy variables were used to flag the five price crashes described in Section 1.1.2. The time frame of the data was selected based on availability and a significant event in February 2014. The starting point of the time frame is based on exchange rate availability. Mt.Gox, one of the first public bitcoin exchanges started its operations on July 17, 2010, and thus has provided the longest nearly continuous set of price data for bitcoin. There is only a one-week period between June 20 and June 26 of 2011 where price data are unavailable because the exchange was taken temporarily offline due to a security breach (Bevand, 2011). Remarkably, albeit having been the largest bitcoin exchange for many years, and arguably the best-known service to buy and sell bitcoins, Mt.Gox announced on February 28, 2014 that it would file for bankruptcy (Takemoto and Knight, 2014). Due to the technical difficulties that led up to this announcement, there was a deviation in the bitcoin price at Mt.Gox compared to the other large bitcoin exchanges from the beginning of February. Fig. 5 shows this deviation compared to two other major exchanges BTCe and Bitstamp. Due to this deviation, the end point of the time frame for the used data was set at January 31, 2014. This time frame of roughly three-and-a-half years, consisting of 1,289 days, covers most of Bitcoin's existence including all five price crashes discussed in Section 1.1.2. Daily data were used as this frequency was the highest available for all variables.

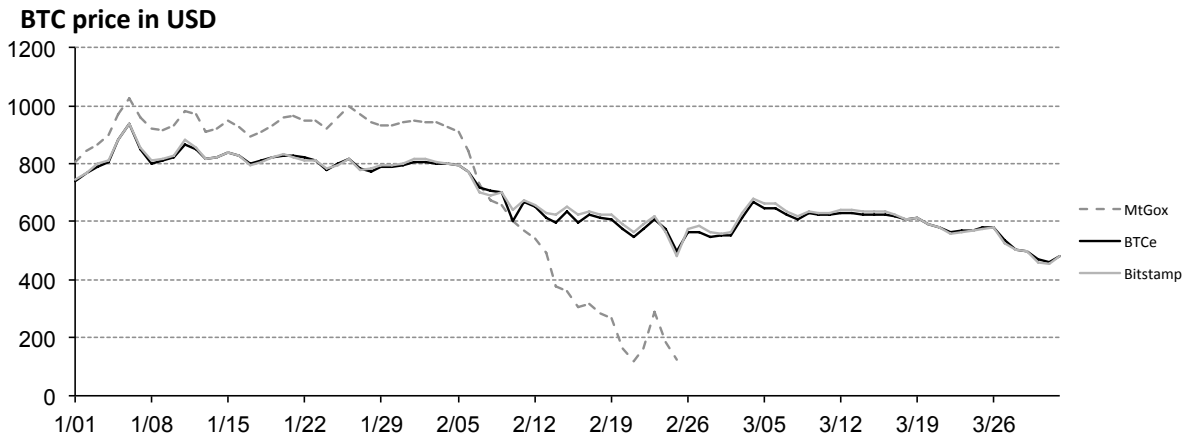


Figure 5: BTC price deviation between exchanges in 2014

#### 4.1. Bitcoin price

There are fundamentally two approaches to track the value of bitcoin. One approach is to look at the exchange price of a single bitcoin. The other approach is to look at the market capitalization of bitcoin, that is, the market value of all existing bitcoins combined. The former approach is chosen due to two reasons. The first reason is that it is difficult to know the true supply of bitcoins in the system due to lost wallets. Each bitcoin wallet has a 32-byte private key that is required to spend bitcoins in the wallet (Private key, 2013). If this private key is lost, the bitcoins in the wallet are also lost and can never be accessed again. Therefore it follows that there exists many lost wallets and the total amount of mined bitcoins does not represent the total amount of bitcoins available for use. The second reason is that when investors make investment decisions they most likely follow the exchange price of a single bitcoin at one of the exchanges. Therefore, measuring the relation between attention and price is most sensible using the information that is used for investment decisions. The main argument that would support using market capitalization is that looking only at the price of a single bitcoin ignores the constantly increasing supply of bitcoins, as a new block is mined roughly every ten minutes giving currently a reward of 25 new bitcoins. An efficient market argument would be that since the predetermined rate of increase of the supply is known, the current price incorporates also the expected increases in supply. However, the real increase in supply deviates from the planned due to lags in mining difficulty adjustments. This inflationary effect can be mitigated by incorporating the amount of mined bitcoins as a proxy for the total supply. By using this inaccurate measure of bitcoins available for use in an explanatory variable, rather than the dependent variable, decreases the impact of its



inaccuracy on the end results. Even though the end results might be similar with the two approaches, it is an important distinction to make so that it is completely clear what is being investigated.

The USD price of bitcoin at Mt.Gox is used as the price of bitcoin. The price data set is retrieved from the website [bitcoincharts.com](http://bitcoincharts.com) that collects trade data from most of the public bitcoin exchanges. Although the site is not transparent about the people or the organization behind it, the open nature of the industry means that if data are inaccurate, there would be an immediate response and a fairly simple website such as this one would quickly be replaced by a competitor. On the other hand, there is the risk that the information published by exchanges themselves is not reliable. There exists a severe reputational risk for exchanges if they fake trading data. Regardless, there has been one widely reported case of fake trade data when a Chinese bitcoin exchange OKCoin was accused by the Bitcoin community of showing higher trade volume than what was realistically possible (Charlton, 2013). One could however assume that this type of activity is not typical, as the risk of a ruined reputation is very severe for an exchange. The site [bitcoincharts.com](http://bitcoincharts.com) has also been used in many other studies. For example, Kristoufek (2013), Grinberg (2011), Yermack (2013), Brière et al. (2013), Lemieux (2013), Moore and Christin (2013), Teigland et al. (2013), Brezo and G Bringas (2012), Villasenor et al. (2011), Bronk et al. (2012), Hanley (2013), and Christin (2013) all rely on the integrity of the website. It also seems that [bitcoincharts.com](http://bitcoincharts.com) is the data source of choice for authorities. For example the FBI used [bitcoincharts.com](http://bitcoincharts.com) in its 2012 report and stated: “While this information may contain biases, the FBI assumes the information is generally indicative of the true state of the Bitcoin economy” (FBI, 2012). Also the Chicago Fed Letter on Bitcoin published in December 2013 used [bitcoincharts.com](http://bitcoincharts.com) data (Velde, 2013). Similarly, the Virtual Currency Schemes report by the European Central Bank from October 2012 used data from [bitcoincharts.com](http://bitcoincharts.com) (ECB, 2012). Fourth example of an authority using [bitcoincharts.com](http://bitcoincharts.com) is the Congressional Research Service Report from December 2013 that was prepared for the members and committees of the U.S. Congress (Elwell, Murphy and Seitzinger, 2013). The unit of this variable is the daily weighted average price in USD.

#### 4.2. *Google Trends SVI*

Google Trends’ help page explains Trends data as follows: “Google Trends analyzes a percentage of Google web searches to determine how many searches have been done for the

terms you've entered compared to the total number of Google searches done during that time” with the limitation of ignoring “repeated queries from a certain user over a short period of time” (Where trends, 2014). It is important to understand that Google Trends SVI is a relative measure, not an absolute measure of popularity. In this sense, it seems sensible to use it as a measure of attention as absolute popularity would not consider how popular other search items are. The actual data are as values between 0 and 100 relative to the maximum of each query, which results in some challenges for the data retrieval process. Even though daily data are available, it is only available when retrieving a maximum time period of three months. The user interface of Google Trends lets the user to enter five time periods, so daily data are available for five three-month periods for one query. Also for each query, the data are scaled relative to the global maximum of the whole query. Following the method of Mikko Eloranta in his Master’s thesis (2014) the daily data are retrieved through the following three steps:

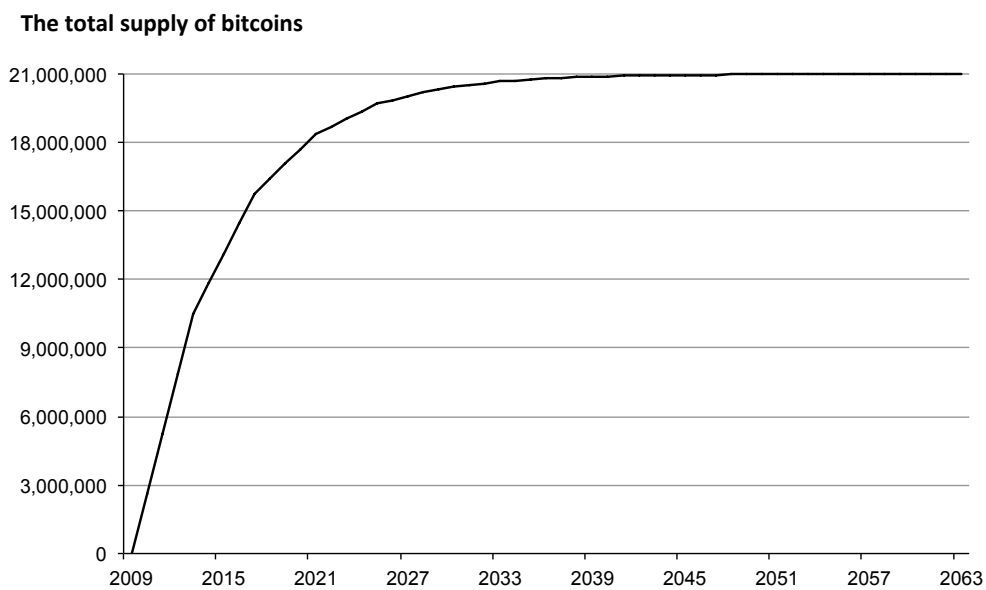
- 1) Locate the global maximum for the time frame in question
- 2) Include the three-month period with the global maximum as one of the five three-month periods in the query and select the other four three-month periods so that one year of the time frame is covered
- 3) Repeat the previous step as many times as needed to cover the whole time frame.

After each query, the data are exported as comma-separated values files that can be combined to obtain daily values that are scaled in relation to the global maximum of the whole period. The unit of this variable is a scaled daily index value that has an integer value between zero and 100.

#### 4.3. *Network hashrate*

Hashrate is a measure of the computational power used in the mining process. The supply of bitcoins follows an algorithm set by the system. Roughly every ten minutes a new block is mined granting currently a prize of 25 bitcoins to the miner who first solves the hash of the SHA-256 cryptographic function. The prize is halved roughly every four years to slow down the increase of the money supply (Controlled supply, 2014). The cap of 21 million bitcoins is reached sometime around the year 2140. As the total computational power of the Bitcoin network increases every time someone joins the network, the difficulty of the cryptographic problem needs to be adjusted. The difficulty of the hash that is accepted is

adjusted every 2,016 blocks so that the time taken to solve a block remains at around ten minutes, resulting in a difficulty adjustment approximately every two weeks (Difficulty, 2014). Fig. 6 gives a graphical representation of the estimated supply of bitcoins up to year 2063 when 99.99% of all bitcoins will have been mined. It is good to note that over 95% of all bitcoins will have been mined in 2028. This decreasing rate of increase must be the reason for a common misunderstanding that the cap of 21 million bitcoins will be reached earlier than 2140.



*Figure 6: The theoretical total supply of bitcoins up to year 2063*

The computational power used, the hashrate, is the number of hashes that a miner is able to attempt per second when looking for the correct solution. The network hashrate is the total hashrate of all miners in the network. The data are available at the website [blockchain.info](http://blockchain.info) that provides a variety of statistics about the Bitcoin network. Like [bitcoincharts.com](http://bitcoincharts.com), it is a trusted source of statistics data and the “most popular bitcoin wallet and block explorer” and has “over 1.1 million registered users and 200 million page views per month” (About us, 2014). The unit of this variable is the daily average gigahashes per second used by the network.

The network hashrate can be considered a measure of both attention and attendance. It is the amount of computational power that people are willing to allocate to the Bitcoin system. In this regard it is also a measure of confidence placed on the system. Another perspective is

to see the hashrate as a measure of security. The higher the network hashrate is, the more difficult it would be for any single party to terrorize the network. If one party controlled a majority of the network hashrate the system could potentially be compromised. Even though it can be argued that network hashrate might explain price behaviour, the causality is not clear. One counterargument is that many of the miners would not have joined the Bitcoin network unless the price was soaring. The Granger causality test is used to get an additional perspective to the issue of causality.

#### 4.4. *Network transactions*

As a by-product of the mining process, the Bitcoin network is continuously verifying transactions. The transactions are all recorded to the Blockchain, a public ledger. Therefore, the number of total transactions is also publicly available information. One way to access this information is to install mining software and download the whole blockchain with all bitcoin transactions ever executed. This information is also conveniently available through the website [blockchain.info](http://blockchain.info). In other words, if you have a public key of a bitcoin wallet, you can use it to see all transactions to and from this wallet. The website also allows you to easily trace payments from wallet to wallet. Additionally, the website provides charts and data for the number of transactions executed daily. The problem with this statistic is that it counts all transactions, including transaction with the same person acting as both the sender and the recipient. One could argue that these one-party transactions do not represent the usefulness of bitcoins as money. However, they can also be considered useful if they are done for a reason, even if this reason is just to reorganize personal finances. Therefore, including all transactions in the network transactions variable is accepted. The unit of this variable is transactions per day.

#### 4.5. *Bitcoin supply*

The computers attending to the mining process are rewarded with new bitcoins. All bitcoins that have ever existed have been created through this same mining process. However, as discussed in Section 4.1 losing the private key of a wallet will leave the bitcoins in the wallet inaccessible. The pseudonymity of the system means that there is no way of verifying which bitcoins are accessible and available for use. Therefore the total market capitalization of bitcoins is always an estimate based on the estimate of total bitcoins in circulation. When

examining the rate of increase, in the long run, the theoretical supply of bitcoins should be quite close to the historical supply. However, due to the two-week delay in difficulty adjustment discussed in Section 4.3, in the short-run, the actual supply of bitcoins deviates from the predetermined theoretical rate. The daily data about the exact number of mined bitcoins can be conveniently accessed through the website [blockchain.info](http://blockchain.info). This information is used to construct a variable to act as the proxy for total bitcoins in circulation. When this is done, it is good to remember that the real increase in supply from newly mined bitcoins would be proportionally larger if lost wallets could be taken into account. The unit of this variable is millions of bitcoins.

#### *4.6. Data for market sizing*

The data used for market sizing consists of money supply information for USD, EUR, and JPY and the data are gathered from the websites of Federal Reserve, European Central Bank, and Bank of Japan respectively. It is good to note that the definitions for monetary aggregates differ between currencies. Based on a monetary aggregate comparison published by the Federal Reserve (O'Brien, 2007), the monetary aggregate M2 is used for all three currencies. Some differences among the M2 aggregates include that for USD, the M2 aggregate also includes some small money market mutual funds, and that for JPY the M2 aggregate also includes quasi-money, including some foreign currency bank deposits. Nevertheless, all three M2 aggregates can be considered to represent the approximate money supplies that cover the currency in circulation and short-term deposits. The reason why M1 is not used is that the Bitcoin system can potentially be seen to replace also some banking activities, and thus short-term savings should also be included in market sizing calculations.

#### *4.7. Summary of variables and data*

The five variables used in regressions are bitcoin price, Google Trends SVI, network hashrate, network transactions, and bitcoin supply. Table 4 summarizes the variables and data by listing the following information on each variable: abbreviation, variable, description, and data source.

Abbreviation	Variable	Description	Data source
P	bitcoin price	The weighted average USD trading price at Mt.Gox exchange.	bitcoincharts.com
SVI	Google Trends SVI	A scaled variable that shows the popularity of a search term relative to other searches (scale: 0-100)	google.com/trends
HSH	network hashrate	The total computational power of the Bitcoin network as the daily averages of gigahashes per second.	blockchain.info
TRS	network transactions	The number of transactions processed by the Bitcoin system daily.	blockchain.info
S	bitcoins supply	The total number of bitcoins mined in millions of bitcoins.	blockchain.info

*Table 4: A summary of variables used for regressions*

Additionally, five dummy variables are used to isolate the effects of the five price crashes identified in Section 1.1.2. The duration of these price crashes are three to four days. Each dummy variable flags the consecutive days of each price crash so that the regressions that incorporate the dummy variables will consider these events to be caused by something external to the explanatory variables.

The values of P, HSH, and TRS have increased exponentially over time and through visual inspection it can be concluded that these three data sets are clearly non-stationary. The natural logarithm is used to improve the usability of the data and the first differences of this transformation are visually inspected to confirm that the used data are stationary. The values of SVI are problematic because this variable provides a discrete set of integers on the scale of 0-100. Since zeroes are also included a logarithmic transformation is not possible. Even though some exponential increases and decreases can be found, the data set as a whole seems to be stationary close to zero and therefore raw values are used. The data of S seem to be trending but relatively linear. For this variable the raw values were scaled to millions of bitcoins. (see Appendix J for a visual comparison between raw values, logarithmic transformations, and first differences).

The five variables are examined with multiple time horizons. Each time horizon looks at the change in the value of the variable during a time period indicated by two values in brackets. The notation  $P[a, b]$  is used for all five variables, where  $a$  is the starting point and  $b$  is the end point of the time period examined. Both  $a$  and  $b$  are reported as relative horizons and their unit is days. The one-day, one-week, and one-month forward-looking changes are examined only for P, and they are the dependent variables used in the regressions. One-day, one-week, and one-month past performances are examined for all five variables. The descriptive statistics of all time horizons of all variables are summarized in Table 5.

Variable	Mean	Std. Dev.	Min	Max	Numerical transformation
P[0,1]	0.0078	0.0658	-0.62	0.37	natural logarithm
P[0,7]	0.0543	0.2028	-1.19	1.08	natural logarithm
P[0,30]	0.2346	0.5086	-0.97	2.11	natural logarithm
P[-1,0]	0.0076	0.0660	-0.62	0.37	natural logarithm
P[-7,0]	0.0531	0.2028	-1.19	1.08	natural logarithm
P[-30,0]	0.2307	0.5095	-0.97	2.11	natural logarithm
SVI[-1,0]	0.0195	3.0396	-27	33	no transformation
SVI[-7,0]	0.1513	5.9275	-48	61	no transformation
SVI[-30,0]	0.9992	9.3244	-74	75	no transformation
HSH[-1,0]	0.0117	0.1332	-0.86	0.66	natural logarithm
HSH[-7,0]	0.0839	0.1744	-0.50	0.87	natural logarithm
HSH[-30,0]	0.3671	0.4129	-0.65	1.95	natural logarithm
TRS[-1,0]	0.0037	0.2580	-3.27	2.88	natural logarithm
TRS[-7,0]	0.0272	0.3835	-3.58	3.61	natural logarithm
TRS[-30,0]	0.1184	0.4738	-3.14	3.22	natural logarithm
S[-1,0]	0.0068	0.0023	0.0017	0.0159	scaled to millions
S[-7,0]	0.0482	0.0163	0.0181	0.1413	scaled to millions
S[-30,0]	0.2080	0.0645	0.0971	0.3921	scaled to millions

*Table 5: The descriptive statistics of all time horizons of all variables*

The correlation matrix reveals some moderate levels of covariation between some variable pairs. First, past month's change in P is correlated with past month's change in SVI, past week's change in HSH, past month's change in HSH, and past month's change in TRS with coefficients of 0.46, 0.37, 0.51, and 0.34 respectively. Past week's change in HSH is correlated with past day's change in S with a coefficient of 0.37. Past month's change in HSH is correlated with past day's, week's, and month's changes in S with coefficients of 0.34, 0.34, and 0.32 respectively (see Appendix K for the full correlation matrix).

The data used for market sizing calculations consist of the money supply information for USD, EUR, and JPY summarized in Table 6.

<b>Data</b>	<b>Description</b>	<b>Data source</b>
USD money supply	Monetary aggregate M2	Federal Reserve
EUR money supply	Monetary aggregate M2	European Central Bank
JPY money supply	Monetary aggregate M2	Bank of Japan

*Table 6: A summary of data used for market sizing calculations*

## 5. Methods

The main purpose of the quantitative analyses is to find explanations to the valuation and price behaviour of bitcoin. The selected methods can be divided into two parts. The first part of the methods is based on market sizing. This perspective considers bitcoin as a currency that will replace a portion of the existing money supply. The second part is an analysis based on regressions that utilize five explanatory variables: past bitcoin returns, Google Trends SVI, network hashrate, network transactions, and bitcoin supply. These variables are used to investigate the predictability of bitcoin returns. As mentioned earlier, the causality of some variables is not clear and the regressions are supplemented with Granger causality tests.

### 5.1. Market sizing

To develop an understanding of the potential long-term value of Bitcoin, a simple market sizing approach is introduced. Bitcoin is considered a currency that could potentially replace a portion of existing money supplies. The world currencies USD, EUR, and JPY are explored. This method has some similarities with two previously released studies. An analysis by Bank of America Merrill Lynch (Woo, Gordon and Iaralov, 2013) considered three uses for bitcoin: e-commerce, money transfer, and store of value. With one set of assumptions the analysis justifies a maximum fair value of USD 1300 for bitcoin. Bergstra and de Leeuw (2013) briefly explore another approach. Their calculation assumes that by 2040, Bitcoin



would have replaced half of all money worldwide. With further assumptions that all money worldwide is  $10^{14}$  euros and the probability of Bitcoin survival is 0.001%, the calculation resulted in a valuation of 50 euros per bitcoin. These types of market sizing calculations are very sensitive to the underlying assumptions, and therefore should not be considered accurate valuations. They are merely suggestions on how the valuation of bitcoin could be approached. The market sizing approach used in this thesis is a simple money supply replacement calculation that helps to understand the current magnitude of the phenomenon and to examine some future scenarios.

## 5.2. Regressions

The linear regression method is a simple and useful way of describing relations between multiple variables. The introduced variables are used to establish regression models with bitcoin price as the dependent variable. Explanatory variables SVI, HSH, TRS, and S are used with multiple time perspectives. SVI measures attention through Google Trends search data, HSH measures attendance in the form of total computing power in the Bitcoin network, TRS measures attendance through the amount of transactions processed, and S measures the total supply of bitcoins in the form of total bitcoins mined. The time horizon notation in brackets represents the relative time frame in days, and is explained in Section 4.7. For the explanatory variables, past changes are examined with daily, weekly, and monthly perspectives.

The first set of regressions use past values of explanatory variables to explain the future values of the dependent variable with same time horizons for past and future perspectives. The regression model

$$P[0, k] = \beta_0 + \beta_{SVI}SVI[-k, 0] + \beta_{HSH}HSH[-k, 0] + \beta_{TRS}TRS[-k, 0] + \beta_S S[-k, 0] \quad (1)$$

is used, where  $\beta_{SVI}$ ,  $\beta_{HSH}$ ,  $\beta_{TRS}$ , and  $\beta_S$  are the coefficients for SVI, HSH, TRS, and S respectively and  $\beta_0$  is the constant term. This model is repeated for three different values of  $k$ : 1, 7, and 30. All three cases are repeated with the addition of five dummy variables for the five price crashes:

$$\begin{aligned}
P[0, k] = & \beta_0 + \beta_{SVI}SVI[-k, 0] + \beta_{HSH}HSH[-k, 0] + \beta_{TRS}TRS[-k, 0] \\
& + \beta_S S[-k, 0] + \beta_{C1}C1 + \beta_{C2}C2 + \beta_{C3}C3 + \beta_{C4}C4 + \beta_{C5}C5
\end{aligned} \tag{2}$$

The second group of regressions use all past information from all five variables to predict bitcoin returns. The regression model

$$\begin{aligned}
P[0, k] = & \beta_0 + \beta_{P[-1,0]}P[-1,0] + \beta_{P[-7,0]}P[-7,0] + \beta_{P[-30,0]}P[-30,0] \\
& + \beta_{SVI[-1,0]}SVI[-1,0] + \beta_{SVI[-7,0]}SVI[-7,0] + \beta_{SVI[-30,0]}SVI[-30,0] \\
& + \beta_{HSH[-1,0]}HSH[-1,0] + \beta_{HSH[-7,0]}HSH[-7,0] + \beta_{HSH[-30,0]}HSH[-30,0] \\
& + \beta_{TRS[-1,0]}TRS[-1,0] + \beta_{TRS[-7,0]}TRS[-7,0] + \beta_{TRS[-30,0]}TRS[-30,0] \\
& + \beta_{S[-1,0]}S[-1,0] + \beta_{S[-7,0]}S[-7,0] + \beta_{S[-30,0]}S[-30,0]
\end{aligned} \tag{3}$$

is repeated for three values of  $k$ : 1, 7, and 30. Again, all three cases are repeated with the addition of the five price crash dummy variables. All together 12 regressions are examined.

### 5.3. *Granger causality*

The problem with regressions is that even if a statistically significant relation is found, the regression itself does not consider the causality of the variables. It can be stated that the regression assumes that explanatory variables cause the changes in the dependent variable. It is possible that a statistically significant regression result is completely useless in real world if causality is not carefully considered. Especially the causalities between bitcoin price and Google Trends SVI, as well as bitcoin price and network hashrate are intuitively ambiguous. There are arguments that support both directions of causality for both of these variable pairs. The causality between bitcoin price and network transactions can be argued using sensible arguments. One could suggest that having a higher number of transactions in the network means that the network is used more for transactions, and thus, the value of bitcoin becomes higher as a wider use makes it more useful. One counterargument for this would be that bitcoin transactions could be a way for a user to arrange funds, resulting in transaction noise. Another argument is that bitcoin transactions can also be used for alternative applications and not only for transferring bitcoins. Some of the alternative uses of the Bitcoin system are briefly discussed in Section 1.1.4.

The Granger causality test, introduced by Clive Granger (1969), is a method used to examine causality between time series. The term itself can be misleading because, strictly speaking, the test does not examine causality but predictability. However, due to the terminology used widely in literature, also the term ‘Granger causality’ is used in this thesis. In short, the test utilizes time-lagged values in statistical tests to determine if certain variables have predictive power over others. Since causality in general has also strong philosophical dimension, the test can only be said to reveal if a variable Granger-causes another. Granger (1988) explains the concept in one of his more recent papers using a few equations. Given two vectors of economic time series  $\mathbf{y}_t$  and  $\mathbf{x}_t$ , with a context vector  $\mathbf{w}_t$ , there are two information sets:

$$J_t: \quad \mathbf{x}_{t-j}, \mathbf{y}_{t-j}, \mathbf{w}_{t-j}, \quad j \geq 0, \quad (4)$$

and

$$J'_t: \quad \mathbf{x}_{t-j}, \mathbf{w}_{t-j}, \quad j \geq 0, \quad (5)$$

so that  $J'$  excludes the information in vector  $\mathbf{y}_t$ . If it is assumed that there exists no function  $g(\cdot)$  such that  $\mathbf{y}_t = g(\mathbf{w}_{t-j}, j \geq 0)$  and let  $f(\mathbf{x} | J)$  be the conditional distribution of  $\mathbf{x}$  given  $J$ , the following definitions of causality are deemed appropriate:

$\mathbf{y}_t$  does not cause  $\mathbf{x}_{t+1}$  with respect to  $J_t$  if

$$f(\mathbf{x}_{t+1} | J_t) = f(\mathbf{x}_{t+1} | J'_t), \quad (6)$$

and  $\mathbf{y}_t$  is a ‘prima facie’ cause of  $\mathbf{x}_{t+1}$  with respect to  $J_t$  if

$$f(\mathbf{x}_{t+1} | J_t) \neq f(\mathbf{x}_{t+1} | J'_t). \quad (7)$$

It is important to understand that a successful Granger test does not guarantee causality. However, it can be used as one tool among others to improve the overall analysis.

## 6. Results

This section presents the results of the quantitative Market sizing, regressions, and Granger tests are discussed in separate sections. Each section is accompanied by an analysis and the overall discussion of thesis results is presented in Section 7.1.

### 6.1. Market sizing

The results for market sizing calculations are presented as a range of values that represent a fair price for bitcoin given a range of scenarios. The method is examined so that a fairly wide range of outcomes is produced. This analysis is based on the assumption that bitcoins will replace a portion of the existing money supply. Central banks publish information regularly about the money supply in the form of monetary aggregates. Table 7 summarizes the M2 monetary aggregate information for USD, EUR, and JPY in January and February of 2014. From the change between January and February it is seen that the money supply is constantly changing, and the market sizing calculations need to be updated every time new monetary aggregate information is available. The values from February 2014 are used for the calculations.

Currency	January 2014	February 2014
USD	11.0 trillion (EUR 8.08 trillion)	11.1 trillion (EUR 8.16 trillion)
EUR	9.25 trillion	9.27 trillion
JPY	866 trillion (EUR 6.21 trillion)	861 trillion (EUR 6.17 trillion)

*Table 7: A summary of M2 monetary aggregates with EUR conversions done at January 31, 2014 rates of EUR/USD=1.3611 and EUR/JPY=139.44 taken from <http://www.oanda.com/currency/historical-rates/>*

Based on these figures one can formulate scenarios that assume a certain level of replacement in these currencies. The first assumption is that the supply of bitcoins is 15 million. If all mined bitcoins remained available, this figure would be reached in year 2017. However, since some bitcoins are lost forever and some are kept inactive for other reasons,

this long-term scenario is an educated guess for the maximum number of active bitcoins. The other assumption is what portion of money supply will be replaced. This is calculated for multiple scenarios where 0.1%, 0.5%, 2%, 10%, and 50% of each currency and all three currencies are replaced. Finally, reverse calculations are done to see what level of replacement is implied with bitcoin prices of EUR 100, EUR 400, EUR 1500, and EUR 10,000. Tables 8 and 9 summarize these market-sizing calculations.

<b>Replacement</b>	<b>USD</b>	<b>EUR</b>	<b>JPY</b>	<b>USD+EUR+JPY</b>
0.1 %	544	618	411	1,573
0.5 %	2,720	3,090	2,057	7,867
2 %	10,880	12,360	8,227	31,467
10 %	54,400	61,800	41,133	157,333
50 %	272,000	309,000	205,667	786,667

*Table 8: Market sizing calculations for the value of bitcoin in EUR when replacing a portion of the money supply*

<b>Bitcoin price, EUR</b>	<b>USD</b>	<b>EUR</b>	<b>JPY</b>	<b>USD+EUR+JPY</b>
100	0.02 %	0.02 %	0.02 %	0.01 %
400	0.07 %	0.06 %	0.10 %	0.03 %
1,500	0.28 %	0.24 %	0.36 %	0.10 %
10,000	1.84 %	1.62 %	2.43 %	0.64 %
50,000	9.19 %	8.09 %	12.16 %	3.18 %

*Table 9: Market sizing calculations that show the implied replacement level for certain price points of bitcoin*

It is good to remember that these calculations are only potential future scenarios and do not consider the probability of success. Therefore, these figures can be used to calculate an

implied success rate implied by bitcoin prices from the exchanges. Table 10 shows the implied success rates for levels of currency replacements based on the weighted average trade price at Mt.Gox during the last week of January 2014.

<b>Replacement</b>	<b>USD</b>	<b>EUR</b>	<b>JPY</b>	<b>USD+EUR+JPY</b>
0.1 %	129.71 %	114.17 %	171.54 %	44.85 %
0.5 %	25.94 %	22.83 %	34.31 %	8.97 %
2 %	6.49 %	5.71 %	8.58 %	2.24 %
10 %	1.30 %	1.14 %	1.72 %	0.45 %
50 %	0.26 %	0.23 %	0.34 %	0.09 %

*Table 10: Implied success probabilities at different replacement levels based on the weighted average trade price of EUR 705.60 during the last week of January 2014 at Mt.Gox*

Based on the market sizing calculations for bitcoin begin a currency, it seems that the current valuations of bitcoin do not imply much optimism about the future. A replacement level of 0.1% for the three world currencies could be achieved with a bitcoin valuation of EUR 1,573. Even though this is not extremely far from some prices seen during the past half-a-year, any greater replacement levels are still far away, and in short or medium term, it is difficult to see bitcoin challenging any of the major currencies with its size. On the other hand, a replacement level of 0.1% might still be enough for bitcoin to find its own place and to survive as a supplement to the current monetary system. Recent market prices imply an expected success probability of 44.85% for this scenario.

## 6.2. Regressions

Different combinations of the explanatory variables and their time horizons were used to explain bitcoin returns. Table 11 summarizes the results of all 12 regressions.

	P[0,1]				P[0,7]				P[0,30]			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Constant	0.0090 (1.42)	0.0089 (1.57)	0.0067 (1.02)	0.0061 (1.02)	0.0408** (2.20)	0.0457** (2.55)	0.0532*** (2.88)	0.0543*** (3.01)	0.3793*** (8.70)	0.3720*** (8.52)	0.3281*** (7.43)	0.3113*** (7.17)
P[-1,0]			0.1879*** (2.77)	0.1031* (1.82)			0.1589 (1.23)	-0.0194 (-0.17)			0.2206 (0.84)	-0.1282 (-0.53)
P[-7,0]			-0.0134 (-0.59)	0.0078 (0.37)			-0.0403 (-0.76)	0.0071 (0.14)			0.3662*** (3.16)	0.4729*** (4.30)
P[-30,0]			0.0159** (2.16)	0.0186*** (2.56)			0.1019*** (5.00)	0.1058*** (5.24)			0.0681 (1.24)	0.0696 (1.29)
SVI[-1,0]	-0.0010 (-0.76)	0.0003 (0.24)	-0.0007 (-0.47)	0.0003 (0.24)			-0.0024 (-0.72)	0.0004 (0.13)			-0.0030 (-0.51)	-0.0001 (-0.02)
SVI[-7,0]			-0.0005 (-0.61)	-0.0009 (-1.48)	0.0003 (0.18)	0.0020 (1.33)	0.0005 (0.31)	0.0004 (0.23)			0.0012 (0.42)	-0.0001 (-0.05)
SVI[-30,0]			-0.0003 (-0.69)	0.0003 (0.97)			-0.0015* (-1.70)	-0.0001 (-0.16)	-0.0010 (-0.68)	0.0010 (0.61)	-0.0035* (-1.80)	-0.0017 (-0.87)
HSH[-1,0]	0.0017 (0.11)	0.0062 (0.40)	0.0035 (0.19)	0.0022 (0.13)			0.0034 (0.06)	-0.0013 (-0.02)			-0.1729 (-1.38)	-0.1779 (-1.42)
HSH[-7,0]			-0.0086 (-0.53)	-0.0098 (-0.65)	0.0661** (1.96)	0.0853** (2.55)	-0.0960* (-1.87)	-0.0965* (-1.89)			-0.1460 (-1.19)	-0.1501 (-1.23)
HSH[-30,0]			0.0062 (0.96)	0.0109* (1.85)			0.0463** (2.38)	0.0566*** (2.97)	0.2327*** (6.33)	0.2568*** (7.00)	0.1738*** (3.35)	0.1997*** (3.89)
TRS[-1,0]	0.0023 (0.38)	0.0006 (0.10)	0.0007 (0.12)	-0.0021 (-0.36)			0.0097 (0.43)	0.0052 (0.22)			0.0216 (0.39)	0.0123 (0.21)
TRS[-7,0]			0.0030 (0.58)	0.0044 (0.86)	0.0099 (0.69)	0.0109 (0.76)	0.0134 (0.67)	0.0140 (0.69)			-0.0435 (-1.11)	-0.0407 (-1.02)
TRS[-30,0]			-0.0038 (-0.85)	-0.0035 (-0.85)			-0.0277** (-2.03)	-0.0272** (-2.09)	0.0410 (1.46)	0.0476* (1.69)	0.0166 (0.52)	0.0242 (0.77)
S[-1,0]	-0.2334 (-0.25)	0.1279 (0.15)	-1.1627 (-0.65)	-0.1535 (-0.09)			2.7596 (0.41)	4.1348 (0.64)			54.3760*** (3.66)	59.5695*** (4.09)
S[-7,0]			-0.0302 (-0.10)	-0.2544 (-0.84)	0.1325 (0.34)	0.0843 (0.22)	0.9135 (0.75)	0.4787 (0.41)			6.8646*** (2.79)	5.9202** (2.43)
S[-30,0]			0.0240 (0.33)	0.0438 (0.61)			-0.4345** (-2.04)	-0.3893* (-1.84)	-1.1245*** (-4.98)	-1.1054*** (-4.89)	-4.2220*** (-7.69)	-4.1185*** (-7.49)
Price crash dummies	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
N	1,287	1,287	1,258	1,258	1,275	1,275	1,252	1,252	1,229	1,229	1,229	1,229
R-squared	0.0022	0.1289	0.0551	0.1954	0.0044	0.0713	0.0656	0.1473	0.0395	0.0638	0.1102	0.1419

Table 11: Regression results with dependent variables in the first row, regression numbers in the second row, and the explanatory variables in the left column. The corresponding  $t$ -statistics are presented in parentheses below each coefficient. The markings \*, \*\*, and \*\*\* represent significance at 10%, 5%, and 1% significance levels respectively.

The regressions are conducted for three different dependent variables: bitcoin returns of the following day, week, and month. The explanatory variables consist of past performance of all five variables: P, SVI, HSH, TRS, and S. P measures bitcoin returns, SVI measures attention through Google Trends search data, HSH measures attendance in the form of total computing power in the Bitcoin network, TRS measures attendance through the amount of transactions processed, and S measures the total supply of bitcoins in the form of bitcoins mined. The time horizon notation in brackets represents the relative time frame in days, and is explained in Section 4.7. Additionally price crash dummies are used in six of the regressions to isolate the five price crashes discussed in Section 1.1.2. All instances use a robust regression to avoid the adverse effects of heteroskedasticity.

Overall, the R-squared values of the regressions are at a reasonable level. Only regressions 1 and 5 have very low R-squared values meaning that their predictability is very low. The use of the dummy variables is seen to increase the R-squared values significantly. The increase is larger for regressions with short-term dependent variable and smaller for regressions with long-term dependent variable. One explanation for this is that the sudden price crashes often experience a rapid partial recovery, and therefore the effects of such price crashes on the weekly or monthly figures are less significant. The use of the dummy variables does not seem to have a clear effect on the statistical significance of the results.

It is good to note that when comparing regressions, the comparison of coefficient sizes is problematic since different time frames are included in dependent and explanatory variables. The inclusion of both logarithmic values and level values also makes it difficult to compare coefficient sizes between some variables. This is especially true when regressing with all past time horizons of all five variables. Nevertheless, the levels of statistical significance of coefficients give some indication of the strength of the relations.

#### *6.2.1. Price momentum*

The results of regressions 3, 4, 7, 8, 11, and 12 indicate that there is a clear momentum effect in bitcoin price. Especially it seems that past month's bitcoin returns can be used to forecast next day's and next week's bitcoin returns, and past week's bitcoin returns can be used to forecast next month's bitcoin returns. Bitcoin price has had long periods of constant increases, and therefore an overall momentum is not totally unexpected. However, the findings suggest that further examination of such momentum patterns might reveal more interesting information.

#### *6.2.2. Inflationary effect*

The coefficients of bitcoin supply show that there is a highly statistically significant negative relationship between past month's increase in bitcoin supply and the bitcoin returns of the following week and the following month. This is evidence of an inflationary effect of the increasing supply of bitcoins and, in short, means that an increase in the bitcoin supply results in a decrease in price. The Bitcoin system is commonly described to be free of inflation. This claim seems to be based on a misunderstanding, and perhaps what is meant is



that Bitcoin is free of quantitative easing. Interestingly, past day's and past week's increases in supply have a positive effect on the following month's bitcoin returns. One explanation for this could be that the short-term increases in supply represent attendance in the system and drive speculative demand. The effect seems to cool down after each bi-weekly difficulty adjustment and the longer-term increases in supply are seen to represent the steady inflationary effects of the increasing supply.

### *6.2.3. Hashrate effect*

The hashrate variable reveals an interesting relationship. Past month's change in network hashrate can be used to predict the following month's bitcoin returns. Also a similar relationship is found for the following week's bitcoin returns. This seems reasonable if hashrate is seen as a measure of security. In this regard, sudden daily increases and decreases would not affect the price because it is common knowledge that there are computers constantly joining and leaving the Bitcoin network. However, a long-term trend would indicate changes in trust toward the system and therefore affect the value of the system, and thus, the price of bitcoin. Another perspective is that the hashrate represents the assets invested in the system because it is expensive to allocate computational power to Bitcoin. Therefore, a higher investment in the system would indicate a higher market valuation of the system. If this perspective would be further investigated, the decreasing price per hash over time would need to be considered to assess the overall investments in the network. This is challenging because mining setups range from personal computers to professional bitcoin mining companies that use very different hardware for the same mining process.

### *6.2.4. Other findings*

Interestingly, no statistically significant relation was found between SVI and P. The finding by Da et al. (2011), that Google Trends SVI could predict price performance, seems to not apply in the case of bitcoin. This can be considered surprising as one of the highest correlation coefficients were found between the monthly changes in SVI and P. It seems that the causality between these two variables might be reverse in reality. Instead of people using Google to search for bitcoin before investing, increases in price cause people to use Google to search for bitcoin.

### 6.3. Granger causality

The Granger tests are conducted using the data sets of same-day single-day changes of the variables. The methods itself incorporates lagged values. The Granger analysis is conducted with four lags and the results are presented in Table 12. Four lags were chosen to match the Schwarz-Bayesian information criterion of P[0,1], one of the dependent variables used for the regressions. Four tests were conducted to examine the relation between P[0,1] and each of the following four variables: SVI[0,1], HSH[0,1], TRS[0,1], and S[0,1].

Variable caused	Variable causing	Prob > chi2	Granger causality (Yes / No)
P[0,1]	SVI[0,1]	0.338	No
SVI[0,1]	P[0,1]	0.000	Yes
P[0,1]	HSH[0,1]	0.628	No
HSH[0,1]	P[0,1]	0.002	Yes
P[0,1]	TRS[0,1]	0.865	No
TRS[0,1]	P[0,1]	0.016	Yes
P[0,1]	S[0,1]	0.707	No
S[0,1]	P[0,1]	0.160	No

Table 12: Granger analysis results

The results indicate that there is Granger causality, or an element of predictability, between three out of the eight examined cases. P Granger-causes SVI, HSH, and TRS. This result questions the causality of the regression analysis and would support the view that actually bitcoin price is the driver of search volumes, network attendance, and transaction activity. This is in line with the uncertainty surrounding causality discussed in Section 5.2. Further research should address the question of causality in the case of bitcoin price and Bitcoin network characteristics.

## 7. Conclusion

This section concludes the thesis by discussing the main findings and giving suggestions for further research. First, the literature review findings are discussed. Second, the findings from the conducted interviews are discussed. Third, the results from the quantitative methods are discussed. Fourth, suggestions for further research are given. The section is

concluded with final words.

### *7.1. Discussion*

Bitcoin is a new and innovative system that is different from any system that has existed before. As a monetary system, it combines some characteristics from previous systems and can be seen as a step towards a new direction in the development of monetary systems. Whether its inception marks the start of a new era in monetary systems will remain to be seen. The fact that the supply is strictly limited sets some limitations to the widespread adoption of the system. History has shown that the demand of money will not adjust to supply but rather that the supply needs to adjust to the demand to stabilize the economy. However, if Bitcoin is able to find its own market space, it can obtain a stable position. To some extent, this has happened, as the use of Bitcoin is increasing. However, it seems that the potential of Bitcoin is much greater than its current use.

The conducted interviews gave some interesting insight into the world of some Finnish stakeholders. Even though Bitcoin technology was met with interest and excitement by all interviewees, the reality is that Bitcoin has some major challenges in the way of wider adoption. Some of the major challenges are difficulty to understand the system, core technology weaknesses, trust, and reputational issues. Nevertheless, the long-term potential of decentralized systems in general is seen to be significant. Disintermediation will likely happen on many fronts due to this new technology and the survival of different applications will be highly dependent on the regulatory environment. Finally, even Bitcoin entrepreneurs accept the fact that the survival of Bitcoin is very uncertain.

The price performance of bitcoin has been very impressive during the existence of the currency. Even though there have been a number of major price crashes and the volatility has been extremely high, the overall trend has been deflationary. In terms of its overall market capitalization, the current price levels would justify only a fraction of a percentage replacement of world currencies. This finding has two sides. First, due to its small economic size, Bitcoin is not currently a serious threat to fiat currencies. Second, if Bitcoin's full potential is realized on a wider scale, its price could reach dramatically higher levels. In terms of price drivers, the regressions show that there seems to be a momentum effect with the price performance, while network hashrate seems to forecast future bitcoin returns. Additionally,

the results revealed an inflationary effect caused by increases in the bitcoin supply. No statistically significant relation was found between Google Trends SVI and bitcoin price. These findings were challenged by the Granger causality tests that suggested a reverse causality for some of the explanatory variables. Overall, the investigation of price drivers of bitcoin gives the impression that the valuation process is difficult to anchor to the selected data about the network. It seems that currently the unpredictable speculative element of bitcoin valuation is dominating the utility valuation, resulting in unpredictable prices that are very sensitive to external factors.

## *7.2. Suggestions for further research*

The available research on Bitcoin is very limited especially in the area of finance and investments. With such a fundamentally new phenomenon, there exist countless avenues for exploration. One of the most fundamental questions regarding bitcoin as a money is the question of explaining its price behaviour. Even though it might be impossible to develop an exact numerical model, there might be some heuristic models that could add to the understanding of the valuation process. This could be done for example by taking the perspective of looking at Bitcoin as a pre-IPO technology start-up with a promising outlook, or by looking at bitcoins as a limited collection of paintings by a famous artist as discussed in one of the interviews.

Related to valuation, another relevant area of study would be to take a closer look at the historical price behaviour. For example the price behaviour could be studied as an autocorrelation process and further studies could be carried out based on the freely available intraday trading data of bitcoin that is available up to a one-minute frequency. Another interesting aspect would be to explore bitcoin as a multilisted instrument and investigate the price differences between different exchanges. Whereas some traditional financial instruments can be typically multilisted on two exchanges, bitcoin is listed on tens of exchanges. Considering that the traded unit is exactly the same at all exchanges, it might be interesting to look at exchange liquidity, accessibility, and other relevant factors. This study could be expanded to include alternative cryptocurrencies, which would also increase the sample size for quantitative analyses. A natural extension of this topic would be to examine the optimization of cryptocurrency portfolios.

Since the phenomenon is so new, there might be also some interesting event studies that could be carried out to enhance the understanding of bitcoin. For example, the five bitcoin price crashes could be investigated closely to try to find possible indicators and reasons for such events. Another interesting event study could look at the reward halving of bitcoin mining in the beginning of 2013. To decrease the amount of bitcoins rewarded for each newly mined block, the reward is halved every 210,000 blocks, or roughly every four years. This halving has a direct effect on mining profitability and it would be interesting to investigate if the price of bitcoin reacts to this event. There has only been one reward halving so far and the next one will likely occur sometime in the end of 2016.

More futuristic topics are also available. If Bitcoin grows to become economically more significant and the value of bitcoin increases dramatically, there might be an avenue to explore in looking at how bitcoin interacts with fiat money supplies. For example it might be possible for some relations to develop between bitcoin price and money aggregates of fiat currencies. This could further open up other promising areas of research. When considering more theoretical topics, there are also many perspectives that have not yet been explored. For example, the demand for money in the Bitcoin system is something that could establish a theoretical foundation for other areas of research related to Bitcoin. This is especially interesting because the utility of the Bitcoin system does not only emerge from its monetary use but also from multiple other applications that have not all yet been implemented. Nevertheless, some insights could be obtained by reflecting bitcoin demand on the demand of fiat currencies. Another main avenue for theoretical research is the decentralization in financial services. Especially the absence of a central bank in the Bitcoin system is an interesting feature that might have implications that could be identified to build a theoretical foundation for understanding Bitcoin and other similar systems.

### *7.3. Closing words*

The four research questions of this thesis were successfully addressed through a variety of methods. The historical development of monetary systems was examined so that Bitcoin's place and a possible direction of future development were identified. The interview analysis revealed attitudes and expectations among Finnish stakeholders that paint a comprehensive picture of where the industry is and where it might be going. Market sizing was used to understand the relative significance of Bitcoin and the moment but also the


potential it might hold. Regressions and Granger analyses were used to gain new understanding of some price driver candidates for bitcoin. The first three research questions were fully answered and the fourth research question was partially answered. Some relations were found and other price drivers were eliminated. One of the greatest challenges in identifying price drivers for bitcoin is the uncertainty surrounding the different aspects of causality.

## Appendices

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## Appendix A: OP-Pohjola Bitcoin statement February 10, 2014

Retrieved from Google's cache on February 12, 2014:



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Sisäänkirjautuminen

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Henkilöasiakkaat > [Opastus](#) > [Bitcoin-rahalla ei ole suojaa](#)

Sivukartta

Haku

### Bitcoin-rahalla ei ole suojaa

10.2.2014

**Nörtit ovat luoneet internetiin jäljittämättömän valuutan, bitcoinin.**

Digitaaliset pankkipalvelut ovat arkea ja kännykällä maksettaessa raha menee omalta pankkitililtä. Sen sijaan kohuttu bitcoin on puhdasta virtuaalirahaa, elektroninen vaihdannan väline, jolla ei ole fyysisistä olomuotoa.

Bitcoin luotiin neljä vuotta sitten internetissä. Sitä oli kehittämässä japanilainen ja suomalainen tietotekniikan tuntiija. Idea on, että virtuaalirahaa ei välitä pankki tai luottokorttiyhtiö, vaan sen vaihto on suoraan ostajan ja myyjän välistä.

Virtuaalirahajärjestelmä perustuu matematiikkaan. Sen jälkiä ei voi seurata.

**Miksi bitcoin on luotu?**

Tarkoitus on ollut kehittää salattu valuutta osoituksena, että tällainen on mahdollista ja että tällainen saattaisi ehkä tulevaisuudessa olla enemmänkin käytössä.

Sen kehittäjien mielestä valtiolla ei ole oikeutta rajoittaa internetiä, eikä keskuspankeilla pitäisi olla oikeutta kontrolloida valuuttoja.

Ohjelmoinnin näkökulmasta Bitcoinin luominen on taidonnäyte. Se vaatii syvää osaamista.

**Mistä bittirahaa saa?**

Ostamalla tavallisella rahalla, vaihtamalla sitä tavaraan tai palveluihin tai louhimalla itse tietokoneohjelman avulla, mikä onnistuu vain harvoille ohjelmoijille. Louhiminen tarkoittaa syvälle menevää ohjelmointitietämystä, joka vaatii koodikielen hallintaa ja valtaisa tietokoneen suorituskykyä.

Nettisivuilla on markkinapaikkoja, joissa on bitcoinin myynti- ja ostoilmoituksia. Suomeenkin on perustettu LocalBitcoins, joka tarjoaa alustan virtuaalivaluutan vaihtajille.

Jotta bitcoinin voi ottaa käyttöön, pitää asentaa tietokoneeseen tai kännykkään virtuaalinen lompakko.

**Mihin bittirahaa voi käyttää?**

Varsin rajattuihin ostoksiin ja palveluihin netissä. Yhdysvalloissa on palveluja, joita voi maksaa bitcoinilla, ostaa esimerkiksi lahjakortteja, pelejä, latauksia, aikuisviihdettä tai pelata rahapelejä.

Suomessa ei ole juurikaan kauppia, jotka hyväksyvät tämän bittivaluutan. Yhdessä Asematunnelin levykaupassa valuutta hyväksytään.

Ostajat ja myyjät ovat anonymisiä, koska netissä esiinnyttään salanimillä. Toisen lompakkoon ei periaatteessa pääse, sillä se avautuu vain käyttäjätunnusten ja salasanojen kautta. Bitcoinilla maksetaan asioita, kun halutaan, ettei ostaja pysty jäijittämään.

Bitcoin on alusta myös rahanpesulle, veronkierrolle ja rikolliselle käyttäytymiselle. Yhdysvalloissa salatuun verkon suojusta toimineelta kauppapaikalta sai ostetuksi huumeita. Asiakkaat maksoivat hankinnat bitcoineilla. Poliisit saivat kuitenkin kiinni huumekaupan, jossa liikkui kymmenien miljoonien dollarien arvosta bitcoineja.

**Riskisijoitus**

Monet nörtit pitävät netissä bitcoineja pikemmin sijoituskohteena kuin varsinaisena maksuvälineenä ja tekevät sillä "valuuttakauppaa".

Hajautettu järjestelmä laskee uusia bitcoineja liikkeelle ennalta sovituin matemaattisen kaavan mukaisesti. Yksikön luojat ovat määrittäneet katon, että bitcoineja voi olla olemassa enimmillään 21 miljoonaa kappaletta.

Virtuaalivaluuttaa voidaan jakaa murto-osiin kahdeksaan desimaaliin asti ja kauppaa voi käydä vaikka 0,001 bitcoinilla.

Bitcoin on olemassaolonsa aikana nostanut arvoaan: vuonna 2010 se oli noin 7 centtiä, talvella 2014 vajaat 600 euroa.


Bitcoinin arvo heilahtelee, kun ihmiset hamstraavat sitä ja odottavat, että hinta nousee ja myyvät sitten eteenpäin. Hinta romahtaa välillä rajusti ja nousee taas. Se on varsin riskialtis yksikkö, jota pitäisi koko ajan seurata. Jotkut käyttäjät vaihtavat nopeasti oikeaa rahaa bitcoineiksi ja ostavat välittömästi sillä tuotteen tai palvelun, ettei sen arvo ehdi romahtaa.


Tietomurtoja on jo tapahtunut. Hakkerit ovat päässeet murtautumaan bitcoineja pitävälle serverille tai kotikoneelle ja ovat pystyneet varastamaan omistajalta bitcoin-valuutan.


Myös bitcoin-lompakon salasanoja hakkerit ovat pystyneet varastamaan, se ei ole helppoa mutta siinäkin on onnistuttu.

Riski on siinä, että valuutta on fyysisesti jossakin tietokoneen kovalevyllä ja kovalevy

Asiakaspalvelu

 [Viestit](#)

 [Puhelin](#)

 [Ajanvaraus](#)

**Puhelinpalvelu**   [Kysyttyä](#)

Puhelinpalvelumme ovat avoimia arkinen kello 8-18, hätäpalvelu 24 h.

[Katso puhelinnumerot](#)

[Etsi kontoria](#)

[Anna palautetta](#)



tuhoutuu. Silloin ei rahaa voi saada mistään järjestelmästä takaisin.

#### Ei täytä rahan kriteerejä

- Bitcoin ei nykyisessä muodossaan täytä virallisen rahan tai maksuvälineen kriteerejä. Sen käyttö nojaa vain maksajan ja maksunsaajan keskinäiseen sopimukseen, eikä sen ostovoimasta tai vakaudesta vastaa mikään julkinen taho. Se voi menettää kokonaan arvonsa. Ihmisten täytyisi olla tietoisia riskeistä. Olemme tottuneet siihen, että yhteiskunnassa on aina joku taho jonka puoleen voimme kääntyä jos asiat eivät toimi kuten on sovittu. Virtuaalimaailmassa ei tällaista ole, toimistopäällikkö Päivi Heikkinen Suomen Pankista muistuttaa.

On ennen aikaista sanoa, että bitcoin mullistaisi maksuliikennettä. Suomen Pankki kuitenkin seuraa virtuaalisten valuuttojen kehitystä ja niiden mahdollisia vaikutuksia maksu- ja rahoitusjärjestelmään.

Euroopan pankkiviranomainen (EBA, European Banking Authority) varoittaa kuluttajia virtuaalirahasta, koska kuluttaja ei ole mitenkään suojattu käyttäessään bittivaluuttaa. EBA muistuttaa myös, että systeemiä voi käyttää alustana rahanpesulle ja väärinkäytöksille.

Myöskään Euroopan keskuspankki ei pidä bitcoinin kaltaista elektronista rahaa oikeana valuuttana.

Yhdysvalloissa keskustellaan paljon siitä, että virtuaalivaluuttojen välittäjiä alettaisiin säännellä rahanpesun estämiseksi. Nämä välittäjät ovat markkinapaikkoja internetissä. Kaikkialla ja erityisesti USA:ssa pohditaan, mitä ihmiset ostavat ja myyvät, kun he käyvät kauppaa virtuaalivaluutoilla, onko se lähempänä arvopaperia kuin vaihdannan väline.

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**Appendix B: Bank of Finland, Heikkinen interview transcript**Date:

January 22, 2014

Location:

Bank of Finland, Snellmaninaukio, Helsinki

Interviewer:

Timo-Pekka Huhtinen

Interviewee:

Päivi Heikkinen – Head of Division for Oversight of Financial Markets Infrastructure, Bank of Finland

**TPH:**

What do you think of the Bitcoin phenomenon and what is your general attitude toward it?

**PH:**

It is very interesting as a technology and as a phenomenon. You can look at virtual currencies from different perspectives. As a central bank, we are a monetary authority that monitors the reliability and efficiency of payment systems. As a market phenomenon it is interesting in terms of behavioral aspects and technological aspects. We have noticed that as a technological phenomenon it includes a lot of good things. The technology also has some weaknesses that, with the current setup, will most likely kill the system itself, sooner or later.

**TPH:**

I've understood that the primary task of Bank of Finland is to maintain price stability. Being very small, this phenomenon seems to have no real impact.

**PH:**

We look at price stability and the stability of the finance system. This includes the faultless operation of different channels in finance. Today, especially after the crisis, we are developing tools and analyses for macroeconomic supervision, and supervision of European banks. This means that our focus is more on the finance system. In this regard, a virtual currency is also more interesting to us related to finance systems than to price stability. However, as stated earlier, it is still relatively small as a phenomenon and in terms of number of transactions and market capitalization. This doesn't mean that it can't be significant for individual players, and personally I think that even a central bank cannot hide behind the systemic risk and only look at phenomena worth hundreds of billions. Smaller things matter also when they have a societal impact. This impact can emerge from the functionality of the society, general trust, payment services, or functionality of the finance system.

**TPH:**

In the hallway you mentioned that sometimes the news sources cite you incorrectly. You recently gave a statement to Bloomberg regarding Bitcoin. Were your comments quoted accurately?

**PH:**

Yes, the Bloomberg article was factual. I talked about how difficult it is to categorize Bitcoin, and that it seems to be closer to a commodity than money. However, when a Finnish news site had used the Bloomberg article as a source they quoted the Bank of Finland saying that Bitcoin is a raw material. Actually we have been following virtual currencies since 2007, when we published the first article in our finance market report. In 2012, we published a short description of Bitcoin, and we received useful feedback from the Bitcoin community. However, this publication was also quoted very selectively in some forums. If an inaccurate statement is spread out to the world, changing it is a battle you cannot win and you just have to accept it.

**TPH:**

When we look at the technology in a broader scope, we have the possibilities to transfer ownership and make other contracts without intermediaries. Do you see this more as a threat or as an opportunity?

**PH:**

The technology is extremely interesting and definitely provides opportunities. Sometime around 2010 we published an article on a distributed central banking model. In the European context this study was light years ahead of its time. However, here I see some analogies with those discussions. I definitely don't see threats in the technology and there can be many opportunities when it is implemented correctly. We are still in the early stages of development.

**TPH:**

Some consider the technology revolutionary. From the supervision perspective, this distributed pseudonymous system can be challenging. If we assume that Bitcoin continues to grow, what tools do you think the central bank will use?

**PH:**

There are some benefits from having a decentralized system. In the case of Bitcoin, there is the possibility for anonymous activity. This is also its weakness. As I've understood it, all transactions are verified by the distributed system, and it can take a long time to get a transaction verified. We are talking about tens of minutes or even longer times. Also a small part of the payments are given as transaction costs to decrease the friction of payment traffic. This is similar to transaction fees and service fees in banking. In my blog, I talk about how the basic rules of economy do not change if we replace a technology with another. Also the technology is very difficult to understand, which can lead to erroneous payments. However, maybe a centralized verification process tied to a similar system could ensure a proper verification in a more efficient manner. We've also seen some reports about how 80% of all mined bitcoins are controlled by 1% of users, which raises some questions.

**TPH:**

You mentioned that you've been following these phenomena since 2007.

**PH:**

Yes, we've been aware of these. In 2007 the Linden Dollar was born and there was even some central bank joining the second life economy. We were interested in how the virtual world interacts with the real world.

**TPH:**

Have you recently increased your resources in following these phenomena?

**PH:**

Yes, recently we have increased our resources in this area. Before it was more good-to-know information that was investigated if something popped up. Now Bitcoin has been in the news quite a lot and it has been claimed to be an excellent payment method. This was a reason for us to look into it more systematically.

**TPH:**

As you said, Bitcoin is very difficult to categorize. It is not a currency, due to the legal definition of currency. If we assume that Bitcoin will remain as a parallel system, do you think that a new category needs to be defined?

**PH:**

Definitely I think this is required. The current e-money definition that we have stipulates an issuer who will convert official money into e-money. Perhaps by revising this definition we could include Bitcoin. However, this would not help regulation because it is difficult to target a distributed network. However, we can target the service providers in the market who buy and sell bitcoins. If these services are offered to the general public, this activity is in fact subject to authorization. Also providing investment services is subject to authorization. Then you would have to walk across the street to talk to the Financial Supervisory Authority. This would be a way to approach regulation and this has been done in some countries. In the US bitcoin exchanges are required to register as money service businesses, and then they are required to have some information on clients and cooperate in money laundering investigations. The central bank of France published a paper in December and stated that the mediation activities should be subject to authorization. Let's see how this discussion progresses in Europe.

**TPH:**

Relating to the topic of issuers, Bitcoin seems to be the first scheme without a central issuer, which makes it a forerunner in terms of the technology but brings new challenges also in legislation.

**PH:**

Yes, the current legislation does not apply to a currency or means of payment with no central authority. This is the reason why we systematically try to call it a tool for exchange. Of course in standard language we can talk about currencies. Virtual currencies are tools for exchange among their communities of users. It is not money in this regard. Money probably requires someone to guarantee its existence and this someone is typically the issuer. This guarantee cannot be found in the decentralized system. Who knows, there might be a built-in feature that causes it to destroy itself and then it doesn't exist anymore.

**TPH:**

On the other hand, Bitcoin is based on open source code, so anyone, even a government employee could go through it and check the features.

**PH:**

I don't understand code myself but I've seen some articles that call into question the integrity of this code, and question if the system really works the way it is said to work. Of course I

don't have the competence to evaluate this and to me it is quite irrelevant.

**TPH:**

Have you received any messages from the ECB regarding how to give statements about Bitcoin?

**PH:**

No, we have freedom of speech to give our own statements. Initially we thought about it after the 2012 report, and the basis for giving out statements was that there was a lot of talk about this new and revolutionary payment system. When things like these are said to the general public, we are required to bring up the facts and also tell about the risks. Also our January statement was from this perspective. Personally I'm not fascinated by getting publicity and we have much more bigger and more interesting things developing that I would rather use my time for.

**TPH:**

There have been many central banks reporting that they are following and investigating Bitcoin. I have the feeling that some countries are waiting for the ECB to give a guideline or issue a statement because the problem is that Bitcoin does not fit the existing definitions. Do you think this type of a statement or guideline would be helpful?

**PH:**

As I'm part of the system, I don't want to publicly make requests like these. We are following what happens and working on this topic in our organization and communicating with other relevant authorities. For example, the European Banking Authority issued a warning, and they are probably investigating this. So far I think all central banks have had the same general position, so there are no arbitrage opportunities. In Hong Kong I think they have considered including virtual currencies in the e-money regulation.

**TPH:**

We have the three criteria for money: measure of wealth, store of value, and means of payment. If the price of bitcoin stabilizes at some point, could you say that it fulfills these criteria?

**PH:**

There are some things that stabilize and then people lose interest in the origins and just accept it. For example people still live in San Diego, even though according to all earthquake experts, sooner or later the city will sink somewhere. It's just one characteristic of human behavior and of course this could happen. What would be the consequences? It would depend on its size and importance as a tool for exchange. This could lead to regulation. Even though regulators are sometimes slow, I think they will have enough time to think this through before the price of bitcoin stabilizes.

**TPH:**

How do you see the comparison to gold from your point of view? Do you see more similarities or differences?

**PH:**

The price behavior has some similarities but that's it. With gold we have the fact that central banks have a lot of gold. We have historical examples of states selling their gold, which has

had a strong impact on the gold price. I don't know if it is in anyone's interest to keep the price of bitcoin very stable. Sadly, when following this world, I've become somewhat skeptical about people's motivations. There are those actors clearly benefitting from an increasing price who want to present the topic in a light that makes the price go up. Also in this regard, I think the market is very different compared to gold.

**TPH:**

If we look five years forward, do you think Bitcoin will become a thing of the past or do you think it will survive?

**PH:**

I think that it will be replaced by some other virtual currencies that have addressed some of the problems of Bitcoin. As a technology, it is something that I hope will develop. The current phase is the Ford T-Model that cannot be compared to the modern fuel-efficient models with computers and seat warming. Maybe the concept still needs to develop but at some point the traditional issuers could consider utilizing a similar technology. These are just my personal guesses. I wonder if there really exists demand for a currency that is not centrally guaranteed? We had something like this in the 18<sup>th</sup> and the beginning of the 19<sup>th</sup> centuries where all banks or anyone could issue their own money. This proved quite problematic in terms of trade and being a store of value. Therefore, it was found that it is good to have someone who sits on top of the system and guarantees the value. If we look at history, we see that the tools for trade are often standardized and controlled in some way, so that the user doesn't need to worry about where it can be used and what its value is.

**Appendix C: Bank of Finland, Tarkka interview transcript**Date:

January 27, 2014

Location:

Bank of Finland, Snellmaninaukio, Helsinki

Interviewer:

Timo-Pekka Huhtinen

Interviewee:

Juha Tarkka – Adviser to the Board, Bank of Finland

**TPH:**

So we were talking about gold and Bitcoin.

**JT:**

Yes, Bitcoin has been said to be free from governmental abuse that can occur with the power to issue money. Gold also has this property. If the driver is distrust in governmental activities you could think that the price of bitcoins might correlate with gold.

**TPH:**

In one of your articles “The Market for Electronic Cash Cards”, you talked about the transaction demand of money and the transaction domain. Could Bitcoin find its own transaction domain?

**JT:**

This is possible. You would need to think with which types of transactions it would fit the best. Large or small, online or other, asset or retail? At least Amazon is not yet accepting bitcoins. I’ve understood that there are also other similar currencies in circulation?

**TPH:**

Yes, there are about one hundred different virtual currencies in existence already. It is interesting to note that bitcoins are typically used to buy these other virtual currencies.

**JT:**

This is interesting, and it tells something about Bitcoin. This is perhaps its transaction domain. However, it is tricky if there is no tangible commodity, good, or a service on the other side. I guess you could consider these virtual coins as financial products.

**TPH:**

In your article you also talk about something being “socially welfare-improving”. In the case of Bitcoin how would you measure this?

**JT:**

In our article we investigate if there are savings in transaction costs. If we find a product that fits well in some transaction domain in a way that the total transaction costs in the society are reduced, it would be welfare-improving. In our study, risk factors, income distribution effects,

and competition effects are ignored. With regards to competition, we could look at transaction costs and consumer surplus.

**TPH:**

How about change resistance, is it included in these variables?

**JT:**

No, and consumer surplus is compared in a setting where all transaction costs are defined by the marginal transaction cost. This makes it a little difficult. If we were to think that bitcoins would replace circulating banknotes we would need to consider the resulted welfare loss. Lawrence White has looked into this. It would be interesting to figure out if the interest forgone by Bitcoin holders is a part of welfare losses.

**TPH:**

In general what do you think about a monetary system that has a predetermined plan for increasing the money supply that ends at a certain date at a certain amount, and where demand directly defines the price. Is there any possibility for the price to stabilize?

**JT:**

In Milton Friedman's work "A Program for Monetary Stability" from the 1960s, he argues that a good monetary supply is based on a predetermined rate of increase that cannot be changed. This represents the monetarism school of thought of monetary policy that was popular in the 1970s and the beginning of the 1980s but was later abandoned in practical economic policy. The idea is that a good monetary policy is based on a steady predetermined increase of the money supply. The economy adjusts to this and there is price stability and no surprises. Friedman also said that it would be good if the rate of increase would be so low that prices would decrease to the point where holding on to money would not cause losses, which would maximize total welfare. This k-percent rule was difficult in practice when it was attempted in the 1970s and early 1980s in the US, Great Britain, and Switzerland. The reason was that the demand for money proved to be very volatile. Steady supply of money did not lead to a steady demand and as a result, there were very large changes in interest rates in the countries that tried this policy. Central banks had to end it and learned that the supply of money needs to be flexible for the markets to remain stable. Charles Goodhart is an authority on the topic of how the supply of money needs to adapt to the demand of money to reach a stable situation. This is a complement to Friedman's idea that a stable money supply would cause the demand to stabilize. It is speculative demand for money that makes its demand volatile. If the demand for money emerged only through transaction demand and the transaction domain was stable, we could have a stable system with a steady supply. If there is a strong speculative element, there will be strong price changes. In a normal monetary system, this would be seen as movements in short-term interest rates. Bitcoin on the other hand does not have a market interest rate the same way there is a dollar interest rate and a yen interest rate.

**TPH:**

How strong is the speculative demand for fiat currencies?

**JT:**

It is important to understand that banks hold central bank money and use it not only to clear interbank payments, but also as an alternative store of liquidity. Banks' willingness to hold central bank money fluctuates too much. We've seen this after the euro crisis when bank



reserves have increased enormously. Due to the fact that the interbank market dried up, banks started to hoard vast amounts of central bank money. This is one form of instability. As a response, central banks around the world have let the supply of central bank money to increase. If this was not done, and banks would've had the increased demand, the short-term market interest rates would have skyrocketed and this would've not fit very well with the recession. There are times when no one is interested in holding much central bank money but then there are times when safe havens are needed. This causes instability in the demand of fiat money. With fiat money, discretion can be practiced to control the supply, which gives the opportunity to stabilize the interest rates. This also creates an opportunity for abuse. In the case of Bitcoin there is no lender of last resort so this type of stabilizing activity is not possible, which can lead to more instability especially if we were to have bitcoin-denominated bonds or banks operating in bitcoin-denominated deposit accounts.

**TPH:**

I have the impression that Bitcoin will not replace other systems but it could be a parallel system.

**JT:**

This could be possible if a transaction domain is found in which it dominates.

**TPH:**

We briefly talked about the comparison to gold. With gold there are derivatives that governments can use to control the price, so in this regard it is different from Bitcoin.

**JT:**

There is principal similarity about the supply. Of course central banks have large gold reserves that they could use to dominate the market even over a long period of time, if needed. Some gold proponents strive for a stateless free market-based monetary system. Bitcoin reminds me of this ideal that is challenging for gold because most gold is controlled by governments. The difference is that gold has its intrinsic value and industrial use that Bitcoin is lacking. The mining process of bitcoin does not produce anything else useful. If mining would produce some other benefit then it would matter. The lack of intrinsic value means that its long-term value has to be based on the savings in transaction costs. Even if the intrinsic value of gold is only a small part of the market value, it can be used as a starting point for deducing the price. Bank notes don't have intrinsic value either. Their value is based on how much you save in transaction costs by using notes compared to for example, commodities.

**TPH:**

Could you say that the value of fiat money is based on it being backed up by a government and its right to collect taxes?

**JT:**

This relates to the legal tender property that is waning because today you are not required to accept notes as a payment in all cases. Cash can always be used to pay taxes and on the dollar note it even says: "This note is legal tender for all debts public and private". This means that if you owe someone and if you've offered notes as a payment for the debt, then legally you've settled the debt. The law protects the creditor only until an official method of payment is offered. If you don't accept the payment in notes, the debt becomes void. The same goes for public debt. The government can pay its debts using notes and taxes can be paid using official means of payments.. The legal tender considerations remain in the background in normal

circumstances, however. In reality, things are not so simple: today you can normally pay your taxes using deposit money denominated in fiat money.

**TPH:**

If we think about a scenario that Bitcoin would grow significantly, what would it require from the European Central Bank and the Bank of Finland?

**JT:**

This is difficult to say and I can only speculate. For example China has banned banks from dealing with Bitcoin. It is important to distinguish between inside money and outside money introduced by Gurley and Shaw a long time ago. Inside money is something that is someone's asset and someone else's debt. For example bank deposits are inside money. Outside money can be someone's asset while not being someone else's debt. Gold is an example of outside money. Often banknotes in circulation are also considered outside money. The question about how to deal with bitcoins is related to this. As long as it is in the form of outside money and bitcoins are not anybody's debt, the risks to financial stability are probably small. However, if we have bitcoin-denominated financial markets and banks with bitcoin-denominated deposits that are used to issue bitcoin-denominated mortgages, we would have bitcoin-denominated debts and outstanding accounts. Central banks were established to act as the lender of last resort. If we had bitcoin-denominated credit institutions, a destabilized situation could lead to liquidity problems, panic, and bank runs. I think that in this case even if the used currency was unofficial, the societal effects could be so significant that the authorities would need to act somehow to avoid chaos. To prevent these types of situations, the authorities would be very skeptical about bitcoin-denominated money markets or debts. There would be no way to stabilize the market. I think that the phenomenon will become interesting in terms of monetary policy if or when we see bitcoin-denominated money markets and credit institutions emerging. As long as we only have it as outside money without derivatives or deposits, the damage caused by instability should not spread outside of the user group. Central banks really need to consider if banks are allowed to participate in the bitcoin market. China banned this activity already. It could also be the case that China was more concerned about money laundering and money transfers than the stability of banks.

**Appendix D: Nordea Mekkonen interview transcript**Date:

May 5, 2014

Location:

Nordea, Aleksanterinkatu 36B, Helsinki

Interviewer:

Timo-Pekka Huhtinen

Interviewee:

Jussi Mekkonen – Executive Vice President, Deputy Head of Banking

**TPH:**

What do you think of the Bitcoin phenomenon and what is your general attitude toward it?

**JM:**

We have been following it but not that actively. We are aware of it. It is interesting, as it seems to be the first serious virtual currency scheme, and now it has encountered numerous problems. It might be the beginning of something so that bitcoin might not be the currency but it can be the foundation for an ideology.

**TPH:**

You said that you don't actively follow Bitcoin. Do you have an assigned employee who follows the phenomenon?

**JM:**

I think that there is no one person assigned for this. There might be many product divisions that are interested in the news and some employees might have owned bitcoins to understand how it works.

**TPH:**

Are you aware of any dialogue about Bitcoin with other banks, regulators, or other entities?

**JM:**

I think that there has been no official dialogue. I cannot follow all discussions and memos but I have not come across Bitcoin anywhere this way.

**TPH:**

Do you see Bitcoin more as a transaction system or more as a new currency with an anti-government and anti-central-banking ideology?

**JM:**

This is a big question and I cannot directly answer this. However I can comment this as a spectator of the economy. I've understood that Bitcoin has been banned in Russia and China. Also the European Central Bank, Bank of Finland, and the Federal Reserve have commented on Bitcoin. It is quite remarkable that such authorities have commented and taken such measures with something as negligible as Bitcoin. In this way it raises questions if there is

something important about it. There must be something interesting about it.

**TPH:**

Bitcoin has also been called Gold 2.0. How does this sound to you if we consider the predetermined limited supply?

**JM:**

This could be discussed more extensively but to me it sounds like a bad comparison because gold exists physically and it has different uses: industrial use, jewellery use, consumer use, and perhaps also other uses. Therefore it has a valuation similar to raw materials. However, this raw material valuation does not form a significant part of the value. Nevertheless it has a history that goes back centuries, the gold standard with central banks, and the gold bar is something that exist. I think that something totally imaginary is still very far from this type of valuation.

**TPH:**

If we think of the valuation process what could we consider to be the drivers? There has been talk about attention and usability for transactions. How do you think this type of imaginary unit can have value?

**JM:**

We are now talking about very fundamental issues. How is the value of an asset determined? For example what is the value of a piece of art or the value of a piece of land, or what is the value of a share in a listed company and what is it based on? Most of the time when you do valuation you have a market where you can check the price of the day. Then there are analysts that have authority to evaluate what the value should be or where it is going. Whether it is a company, or a painting, or a piece of land in Kerava, there are arguments that can be used in valuation. These are lacking with Bitcoin.

**TPH:**

It is interesting that you mentioned the valuation of art because it sounds like it could have similarities to Bitcoin. With companies we can forecast earnings, which is impossible with art. Maybe this could be something to consider with Bitcoin.

**JM:**

Well I cannot say. There are probably many dissertations on this topic so there would be something to study. In a way, if an artist is dead, all of his or her paintings exist already. There won't be any more of these objects. To most people investing in art is often more like a hobby and not serious investing.

**TPH:**

If we take one step back and think about our economy, there have been many crises that we have survived from. In your position, as you observe the current system, how do you see it and do you think that it is something that will last for a long time?

**JM:**

When we look at the economic history, there have been many currencies and unions that have disappeared. In principle, currencies tend to stand for long periods of time. For example with the euro there have been different times, and in 2010 when the dialogue was very critical, there were many commentators who said that the euro would collapse. Back then when I also

needed to give comments about this, I used to say: “of course it will collapse, the question is when”. The collapse didn’t come in 2010 and it might not happen in the upcoming few years but I doubt euro will remain for centuries. Also, I think that euro will not be destroyed by economic influences but political influences. With the latest crisis we saw that political influences were destroying euro and in the end political influences saved it. Economic influences were weaker than political influences, and this will probably repeat in the future. If there is political will, euro will most likely survive, and if there is political will, the dollar will survive. At times, I think the power of economic influences and economic decision makers are overestimated. During the worst time of the euro crisis, politics made a comeback and people suddenly started to listen to politicians, and not economists. During historical transitions, politics takes a bigger role, and economic actors are not in charge because decisions are made based on politics. This is also the setting in Ukraine. If it were economic influences that were in charge the setting would be totally different. However, the decisions are made based on politics so we have the setting that we have.

**TPH:**

At the moment I think that Bitcoin will not gain wider acceptance unless the current economic system faces severe crises. What do you think about this?

**JM:**

It is difficult to say and this be viewed in many ways. If we had a stable economic setting, there might be a chance for an alternative system to safely develop itself and gain market share in a forecastable environment. There must also be some benefits for using the alternative and ideology is not enough. Ideology can give you some support with early adopters who want to try out new ideas, but they are a small minority. The large group needs to benefit somehow. In a way I believe in rational utility, so that people need to feel that they win if they use this alternative system, it must be welfare-improving. Bitcoin is far from this because it is very volatile. At the moment, nobody’s economic well-being is improved by switching to this system because it increases risks. However, in a stable environment a good alternative could slowly win market share or it could suddenly win a large chunk of market share like Whatsapp that suddenly acquired hundreds of millions of users. However it is a different scenario if the current system deteriorates. I don’t know if I’m right or wrong but if we lose the current level of stability then typically we return to the previous system and don’t adopt a new one. It is a typical reaction during political, historical, and economic transitions: try to go back to the old state. In the case of euro collapsing, the EMU nations would most likely go back to their old currencies as quickly as possible. Theoretically it is possible, but it seems unlikely that during a transition a new solution could get a foothold, as there is already so much uncertainty otherwise. I think that people prefer security to novelty in the case of a transition, and especially in the case of a quick and uncontrolled transition. Bitcoin is a difficult phenomenon because it is not an economic phenomenon or a finance phenomenon. I doubt that it can be convincingly linked to finance theory but more with political and economic history. What has happened during transitions and what types of innovations are the winners in the end.

**TPH:**

Do you think Bitcoin will affect your work in a significant way?

**JM:**

With the current development I would say no. If this phenomenon was to increase its market share significantly. I don’t know the exact numbers but let’s say if its size increased a

thousand-fold and would be massively larger, then it could stand out from the noise.

**TPH:**

As mentioned, the economic impact of Bitcoin is very small so it remains to be seen if it will become more significant or if in the future it will be seen an interesting experiment.

**JM:**

What I've heard from some smart people is that a virtual currency that is independent from central banks, in one way or another is seen to get a foothold sooner or later. Time will tell if it is Bitcoin or some other system that will do this.

**TPH:**

Yes, the technological innovation is very significant but as we discussed about politics, having a good technological solution is not enough because political decisions can totally change the environment.

**JM:**

Yes, and also innovation dynamics are important. What causes an innovation to become a dominant solution? Rarely it is the technologically superior one. There are numerous examples of this; VHS is a classic because it was technologically the worst solution around. There are other reasons for a technology to gain a dominant position.

## **Appendix E: OP-Pohjola Äijälä interview transcript**

Date:

February 11, 2014

Location:

OP, Vääksyntie 4, Helsinki

Interviewer:

Timo-Pekka Huhtinen

Interviewee:

Hanna Äijälä – VP New Businesses, OP-Pohjola & CEO, Pivo Oy

**TPH:**

What potential do you see for Bitcoin in developed countries such as Finland compared to developing countries?

**HÄ:**

We follow the unbanked markets in which the traditional finance industry or banking industry does not exist. I remember reading that there are only 20 well-functioning currencies in the world with central banks as their issuers. This means that there are 175 markets without their own functional currency. If we take this perspective, we see that in Finland it is easy to ignore these changes. However, I believe that when mass adoption occurs, it doesn't matter if it starts in western countries or elsewhere. If the mass adoption is massive enough it can start from the unbanked markets. For example with payments, I follow Kenya and M-Pesa where they have a well-functioning mobile payment network that has emerged only due to the fact that traditional finance markets didn't exist. When we think about Nokia-mania, which tried to push mobile payments, it never took off in western countries. Next, they tried Asia, and India but it had been built so that you had to open a bank account to use the service. The result was that mass adoption was not achieved but in communities there were persons who had a bank account and shared his or her access to the system with others. In practice, these were often used to top up prepaid accounts for mobile phones. In a way, we need to understand that we cannot control all of the development inside the developed world. For example, Bitcoin could prove to be so efficient as a payment system that it could change attitudes on what is legal, allowed and desired. The reason why traditional financial institutions don't have public opinions on Bitcoin, can be traced back to the statement by Päivi Heikkinen from Bank of Finland in January in which she stated that bitcoin is not a real currency. In our industry it's that simple. Our right to operate is so tightly regulated with central bank at the core that our opinion needs to follow the opinion of the central bank. Reputation and trust are so important that all credibility issues need to be considered carefully. Personally I'm very interested in Bitcoin and I have some colleagues who are also interested. As a developer, the mind set is a bit different. Even if a phenomenon is outside your operations, you need to be aware of it if it's relevant, and be ready to see different scenarios that would require different actions. Following this phenomenon is not assigned to anyone but if you're interested in payment traffic you might be interested in this. When I look at my email traffic, the first time I encountered bitcoin was 2-3 years ago when some local newspapers asked us about our position. I received these requests and I noticed that I had to establish some kind of a position on this issue. I discussed this with our risk management regarding information security, and I

had the feeling that we might have to establish an official position. Risk management didn't find Bitcoin very significant and compared it to the use of squirrel pelts for payment. Now as I reread the emails I think that squirrel pelts were a functional method of payment. It had a value based on the fact that supply was scarce as with bitcoins. The reason we don't use squirrel pelts anymore is related to other issues, such as other currencies and information technology. However, it met many of the requirements for money.

**TPH:**

It is also interesting that from the technology perspective Bitcoin is seen as a revolutionary innovation comparable to the steam engine because it differs from previous innovations by functioning without a central authority. We see two sides, the technological innovation and the economic impact. When we take this to the finance world it is not that simple with all the regulations. Even if something is possible, it doesn't mean that it will be implemented.

**HÄ:**

I also distinguish between bitcoin as money and as a payment system. Also the third thing, the IT innovation, is its own area. I've tried to develop framework for myself over the last two years for this. The reason we started to get these requests two years ago was due to the Kangas brothers whom I've never met. At the time I could not find much information about Bitcoin. There was only a Wikipedia article set up by developers and maybe a TechCrunch article and then some Finnish sources. Then I realized that they were one of the first ones with sites like vannehaku.net where you could find Bitcoin. When I looked into it I realized that the Kangas brothers were involved, and perhaps it was a small group that actively promoted Bitcoin and wanted to see how banks would react. When I think about money, there is the narrow definition that refers to central bank money and is something that the central bank issues. This is a narrow definition of money. Money is also a measure of value and therefore a tool for exchange. It is also a store of value, which is based on an agreement. Also money is said to be something that can be used to settle a payment or pay back a debt. So bitcoin can really be seen to meet these criteria. Of course we know that the store of value is difficult with comparisons to tulips etc. but anyone who receives bitcoin can exchange it to fiat currency right away. Also in the history, when we look at official currencies, they have really not maintained their value, which has not been due to lack of control but actually bank control might have caused the volatility. Whatever arguments you use against Bitcoin, you can find similar arguments for fiat currencies from the past few decades. This is one of the reasons why Bitcoin is so tricky. Also it is said that money needs to be accepted, transferrable, and measurable. In the finance world we know that trust and acceptance is important, so at this point Bitcoin is seen as a system based on distributed trust. However, as a money, tool for exchange, store of value, it is not trusted and not ready. If you think about price stability, even in the founding documents of the EU we have the goal to maintain price stability. I don't know how well this has been accomplished but this criterion does not support bitcoin as money. If we think about user friendliness, we also need to consider it as a consumer product. When we developed PIVO we realized that mobile payments couldn't yet beat card payment. 20-30 years ago we understood that payment card beats the cheque but in some European countries it has not yet happened. We know that for something to succeed, it needs to be understood and usable by almost all possible users. For example if an old person doesn't understand it, the success will be limited. When we talk about anonymity with Bitcoin, we agree that fighting money laundering and terrorism is important. On the other hand, we know that the only legal payment method is cash that is not really traceable and is anonymous. We know that electronic payments are encouraged for fighting the black market, money laundering and terrorism. I'm not sure what the threat of Bitcoin is in this regard. In 1999



Milton Friedman said that the market is still missing an e-cash with similar anonymity properties as cash. I understand the criticism due to the origins of Bitcoin that are in the Tor network and drug trade. I think that the criticism about the anonymity of Bitcoin emerges from its first uses. When you look past this first impression, it is very close to ideal money, close to cash. There is also the topic of cost efficiency in transactions. One thing we noticed is that there are many new players that try to enter the market, for example with person-to-person payment solutions. These emerge often from network operators. Then there are device companies and Google and other players. Perhaps many of them have tried to increase the value of the payment moment and somehow add value to the process of payment but as a financial institution looking over massive payment traffic, we have accepted the fact that transactions themselves do not have value. In Finland, cash is not used that much and we have been good at adopting electronic payment systems. This also means that transactions are very cheap so that they are free for consumers and very cheap for stores. The costs emerge from the resources used to maintain networks of thousands of financial actors in a multi-currency world that requires clearing and settlement mechanisms. Also there needs to be an actor that is trusted by everyone. This system is expensive and is based on massive economies of scale. The mobile solutions that try to add value to payments fail because they don't accept the fact that payments don't have intrinsic value. The current system based on massive volumes and a central trusted authority will work quite well until there is an even better system. If we look at Bitcoin as a payment system instead of a currency, we can understand its incredible potential. As money, the interface between Bitcoin world and real world is still difficult for me to understand and I have a hard time understanding how a bitcoin ATM works. If I, as a professional, don't fully understand it, I don't think it will be consumer friendly enough for a long time. Bitcoin is a decentralized trust system that does bookkeeping. Google is interested in payments, not because they want to enter the commoditized market of payments, but because it is bookkeeping. Archeologists dig out these Greek stones in which they hope to find philosophy but after a while they realize that they are all bonds. This has really happened. If you understand that payments are only data and information about who owes to whom and then evaluate Bitcoin, you see the potential. In this network you can also transfer ownerships and give signatures globally in real time. This is extremely interesting and also the reason why banks are interested.

**TPH:**

If I go back to the topic of trust, it is good to note that most people don't understand how banks and central banks operate, and how much of this is controlled by a few big actors including private entities. It seems that consumers settle in using something that banks have accepted and recommended. This is relevant with Bitcoin because in order for an average consumer to start using it, a trusted entity needs to recommend it to them. In a way, the system decentralizes trust regarding transactions but you still need to trust the system itself.

**HÄ:**

It is similar to the banking crisis when you could read the papers that the whole system will collapse due to lack of trust. I realize that to an outsider this explanation sounds too simple but inside the financial industry it is known that in the end everything is based solely on trust. In a way, the economy is not complete. Perhaps we judge some systems because they're not something we expect them to be.

**TPH:**

From the perspective of Bitcoin proponents, they are stuck because people are used to the setting that banks control the payment space. However, banks are not allowed to enter the

Bitcoin space. On the other hand, I understand the problem that demand of money is not stable, which has led me to believe that Bitcoin cannot be a replacement for the current system but it can have its own place and it is constantly looking for it. After 2008, there has been a lot of talk about trust, and I see Bitcoin as a net waiting to catch those who get fed up with the current structure, in the case of new financial crises.

**HÄ:**

In the past, trust was tied to the fact that we had the gold standard. Similarly, Bitcoin is based on a scarce resource, so it can feel like going back to something old. To me it also feels funny that there is a decided year when the mining will end. It also doesn't help to see news articles about how early miners have made a lot of money, and recently perhaps also lost. Then we have these mining centers in Iceland. There are so many nerdy sci-fi themes involved that it can be confusing to understand Bitcoin. I can imagine that from the IT perspective this is a revolutionary step in solving some problems. I've also been talking with some economists about the speculation aspect and it's often asked if a good currency can also be a target of continuous speculation? I don't know if there is an answer. Most currencies are used for speculation but with Bitcoin speculation has a dramatic effect. It has a negative impact on Bitcoin's reputation as a payment system. I haven't come across an analysis that would stipulate the amount of speculation that should be tolerated. All known currencies are used for speculation.

**TPH:**

Some think that even though speculation increases volatility, it has also increased liquidity and thus helped Bitcoin to grow. In the long run it would still need to grow, and sustainably. It is a supply-demand setting where supply is known. Due to the demand side, I'm not sure if it's ever possible to achieve a steady price. On the other hand, I'm not sure if a steady price is even needed for transaction use.

**HÄ:**

When thinking about online transactions between individuals and between companies, we have for example many large-scale transactions that are based on the assumption that the value is stable. The position is also often hedged because there can be a long delay between delivering items and receiving the payment. In online B2C payments transactions are mostly instant, so with a sufficient trade volume and quick conversions, a very stable price is not necessarily required. Maybe Bitcoin is not required to fit all uses to be successful. Maybe there can be some specific uses for Bitcoin that would be sufficient to justify its existence. Online trade is so massive that Bitcoin could well find its place, especially in the more expensive cross-border trades. On top of this, if it can tap into the unbanked world, it could be successful. Currently the only thing connecting the Mozambican peanut farmer to the world trade is PayPal. Without it, the farmer could only sell their good at the market. I think that Bitcoin could drive development in these types of settings. For PayPal, it would be difficult to earn money through Bitcoin. Twitter is known for banning payment methods that have used tweets, and Apple takes measures to reserve the payment space for itself. Before there is a revenue model, these players tend to ban competitors' services.

**TPH:**

When thinking about Bitcoin's role, where do you think it could be in five years?

**HÄ:**

From the perspective of a financial institution, I think that as a payment system it could be

something that we will embrace in one way or another. For example as we've seen with PIVO, as a company we are at a point where we can deviate from our main business model and try out new things. It's possible that we could be involved in utilizing the payment system through some kind of an experiment if it's legally allowed. As money or currency, we will need to wait for the position of the regulator. You would need a big crystal ball to know what will happen in five years. In general, taking positions with different issues has sped up because world phenomena have sped up. If we look at the definition of money and forget about the side effects, such as the use on Tor network, it is important to remember that there is no fraud. This is a big problem with card payments. If the regulator takes a favorable position, then we would be allowed to act accordingly and Bitcoin or something similar could be in some kind of use. Another direction of development can be that there is a successful start-up that causes the financial institutions to actively work with the regulators to drive adoption. One more possibility is that Bitcoin will be examined very critically, which could still lead to something new built on top of Bitcoin's ideas, with strict regulations and protections. This wouldn't be as efficient and cheap as Bitcoin but would still try to meet the demand while fending off the threat. This would leave Bitcoin in the history as a phenomenon that started something. If I had to state some probabilities I would say that it is equally likely that Bitcoin will survive or that it will collapse. In the finance industry trust can be approached differently in different places. In UK, people don't care if their banking is handled by a bank or a supermarket as long as it's a familiar brand. If you ask the same in Finland 75% would say that banks should handle banking. It would be interesting to see how the explosion of investment banking in 2008 has affected trust in retail banking. I have the feeling that banks might end up as the winners just because of the trust. I don't know if banks could ever accept a decentralized system.

**TPH:**

If we talk about beneficiary problems and Bitcoin, is it so that banks are required to know the final beneficiary of a payment?

**HÄ:**

Yes, banks base this knowledge on account ownership. We still allow shared accounts but we don't encourage them. In the case of Bitcoin this is a problem. Do we accept that it is only cash or are we required to know the exact recipients? With cash, I can give 20 euros to a friend and no one would care about it.

**TPH:**

Bitcoin entrepreneurs are aware that these requirements might become stricter and are preparing by collecting more information about their customers.

**HÄ:**

This could increase trust and familiarity, and make it more customer-friendly.

**TPH:**

This is also close to the question of anonymity. If we had knowledge about wallet ownership, then we would have a totally public system because all transactions are public information. All anonymity would be lost.

**HÄ:**

This is true. At the moment banks have the payment traffic information that is not public but can be accessed if needed.

**TPH:**

How do you see the dialogue between regulators, banks, and tax authorities?

**HÄ:**

I think that the dialogue is good. The Federation of Finnish Financial Services is a good location for discussions. They also continuously discuss recent topics and phenomena with the tax authorities and Bank of Finland. One example of cooperation is that in January Bank of Finland set up the Payment Council, with members from banks, Ministry of Finance, and so on. Its purpose is to look at the current state and trends of payments. There are two teams led by Päivi Heikkinen and Kari Kemppainen from Bank of Finland. Topics include Real-Time Economy and ICT 2015. These cover electronic identities and efficient payments that are also related to the Bitcoin phenomenon. The task of these teams is not to make any decisions but to analyze and give statements and recommendations. At OP-Pohjola we also have direct relations with the tax authorities that we use to discuss open interfaces tax-collection improvements. Today there are no joint industry decisions to start doing something specific together, so standards don't create competitive advantage for individual actors but create societal efficiency. Also today we have many different players in the industry with different backgrounds, different geographical focus, and so on, so making consensus decisions would be very difficult. In the past we had only a few banks that had the same customer profiles. Today, due to the lack of new industry standards, individual players need to come up with commercial initiatives for development to occur. This can prevent some things from proceeding but gives space for initiatives based on commercial interests.

**TPH:**

In the US, the regulation is focused on the exchange between bitcoins and fiat currencies. At the moment it looks like it will be regulated quite heavily, which would benefit the big players. Do you think Bitcoin should be regulated this way?

**HÄ:**

It could be in the interest of the US. I don't know how much they want to limit start-up activity in this area to gain control. It sounds likely that it will be regulated. It would feel like a natural development. I think that the world is not settling any more for strictly regulated activities. In finance I see how this challenges us in a good way. It feels like the regulated space is left for the finance industry but the customer experience is left to others. With Bitcoin, even if it was heavily regulated, it would probably touch the payment space and not the user experience space, so start-ups would still be able to provide services and compete.

**Appendix F: Nordnet Odenwall & Brand interview transcript**Date:

January 16, 2014

Location:

Nordnet Finland, Yliopistonkatu 5, Helsinki

Interviewer:

Timo-Pekka Huhtinen

Interviewees:

Niklas Odenwall – Country General Manager, Nordnet Finland

Thomas Brand – Business Developer, Nordnet Finland

**TPH:**

So what do you think about this phenomenon in general and have you thought about providing bitcoins as an investment product to your customers?

**NO:**

Well, as a phenomenon it is interesting. No, we will not provide this as an investment product because we only provide official investments. This is such a speculative product and it is not even an official currency. I think it is great that new things are brought to the market but our investment philosophy is to be quite careful, so that we want to keep away from these types of marginal phenomena that carry a significant risk. We want to rather educate our customers to understand what is in the portfolio and what needs to be considered in investing. Of course if you want to add a little bit of bitcoins to your portfolio there is a high risk with potentially high rewards but there is a risk to lose everything. That's fine but it's not something that we would recommend to a beginner. If you want high risk, there is always Lotto and their weekly thrills on the television if that's your thing. This would not be investing but rather speculation. As a phenomenon it is interesting to see where this goes.

**TB:**

If you think about Bitcoin as a phenomenon you always need to separate three things. First, there is the technology or the Bitcoin protocol, which enables the blockchain and distributed computing anonymously. The second thing is the bitcoin money and instantaneous clearing of transactions. The third thing is the ideological phenomenon that has strong influences from crypto-anarchist views and some anti-government perceptions that envision life without centralized power including central banks. We can talk about a non-governmental currency comparable to the Euro but without the central governance. The system is self-governing and executes its own monetary policies. This is all based on how much computing power people are willing to give to the system. As a phenomenon in all aspects, as a protocol, a technological implementation, as well as a societal phenomenon it is very very interesting and unfortunately still very much misunderstood.

**TPH:**

As mentioned, Bitcoin is a huge technological innovation and a decentralized trust system. In the long run, do you see how it could significantly affect your work or do you consider this scenario very unlikely?

**NO:**

Well, let's say that it would have to get some kind of official status of a currency. Either IMF or some other entity would need to recognize it as a currency, which would on the other hand contradict the initial idea and make it just another currency. If the intention is to keep it free I don't know how this would happen. In practice, for us to consider this would require a higher degree of stability. Of course stocks can also be volatile but someone can estimate their value. In the case of bitcoin, the price is very sensitive to external shocks that can be unconnected to bitcoin. In a way the price is very uncertain. The settling mechanism seems to be working, and I think that's positive. It is good to have new things but I don't see this as a listed product with us anytime soon because it has too many uncertainty factors.

**TB:**

I will have to agree that at the moment for us to provide this as an investment product is very unlikely, just because of the volatility and general distrust towards Bitcoin. If you think in the long run, this type of settling system based on peer-to-peer networking is very innovative and according to a Googler can be compared to the www protocol or the http protocol because it is such a revolutionary system because it solves the double spending problem that existed with previous such systems. However, there exists a social stigmatization of Bitcoin especially due to the Silk Road case and DoS attacks against Mt.Gox. These events cause price volatility that prevents the system of meeting the requirements of a stable payment system. Bitcoin is certainly not money. It does not meet the requirements of being a measure of value, a widely accepted means of payment, or store of value. It is something else. What is it? That a theoretical question that should be given more attention in academic research. As a company we are interested in competitive advantage, and personally I don't see how our company could provide a competitive service compared to some of the big players. And if you think about banking more generally, holding bitcoin wallets would be a problem. Also as mentioned, low actual liquidity, high volatility, competition, and especially price formation are the problems. The price is a problem because bitcoin does not have an intrinsic value as currency or gold. The value of fiat currency is fundamentally based on a debt relationship, on a central bank promise that you can use this currency to fulfil your debt payments. Bitcoin cannot do this at the moment because it is not recognized as a currency. As a service provider, Bitcoin is not the first commodity or the first investment that our customers are considering and seeing as a potential investment. And of course if we hosted bitcoin wallets and the customer would lose their wallet code, who would be responsible? So this also involves information security risks. This type of a totally new service would be difficult to implement. As a speculative alternative investment it is ok for people who understand the risks. We sell investment instruments but simultaneously we are also a bank that is subject to central supervision. In other words, we are either bound by our own terms, terms in the customer agreement, the terms of the exchange, or the marketplace. With Bitcoin, such terms do not exist so drafting a contract would be tricky.

**TPH:**

We've seen how governments and central banks comment on Bitcoin. We had the Finnish tax authority give a guide regarding bitcoin but the situation is still very unclear.

**NO:**

I respect the tax authority for taking this concrete step to do something. It is true that they are lagging behind since Bitcoin has a negative image. Some people probably see it as a speculative investment and probably want to pay taxes. However the problem is the

stigmatization and the bad reputation for being used to buy weapons and drugs and you name it. Of course before this guide by the tax authority, this was a very easy tax heaven.

**TPH:**

We've talked about the illegal uses of Bitcoin. Recently there have also been Overstock.com with billion dollar revenue and Zynga using Bitcoin. Then there is also eToro who provide bitcoin as an investment through a CFD scheme.

**TB:**

In these cases we have to consider what is the interest of the recipient to hold bitcoins or do they want to instantly convert the bitcoins to fiat currency. The high volatility is a big problem. For example an attack against a major exchange would cause price peaks and price swings. Bitcoin is very revolutionary. It can be compared to the discovery of electricity or steam power. These types of decentralized systems will most likely be a part of our everyday lives in the future. You don't need PayPal or Visa because you can handle the transactions personally. Everything is dependent on the entrepreneurs who try to see and forecast the uncertain future regarding what the consumers will demand. What is very important is the network effect that requires a technology to gain wide acceptance for it to be valuable. Publicity in the press helps this as more people hear about Bitcoin and want to become a part of it. Volatility will not be a large problem in the long run, and the more exchanges we have the better the liquidity will also get. There are many interesting developments.

**TPH:**

Regarding the reasons for accepting bitcoins for payments, there are much lower transaction costs and a third party like BitPay can do the conversion to fiat currency and also bear the currency exchange risk. Overstock.com did this implementation with Coinbase, and the CEO does not see why other companies would not accept bitcoins for payments.

**NO:**

Well asking this from Overstock CEO is like asking a chicken to compliment its own eggs, so the validity of his comment to me is zero. However, it's different when outsiders, like the players in the finance world start commenting. What we see as a problem before it can really become mainstream is to get a stable exchange rate for it, and this will take time. We don't know whether it will be Bitcoin or a competing cryptocurrency. This is based on trust between two people, and if Bitcoin crashes their value becomes zero. If they're now worth more than a grand and you bought them before Cyprus, that's excellent but it's still very risky. It's speculative but I think it's good to bring up. However, before it will be an investment product with us or a service we provide, it needs to become much more stable and more regulated before we can even discuss it. If someone asks should I invest in bitcoin, I would ask what their risk-tolerance is and can they lose all of their money. After this maybe a small portion could be invested. It is very speculative.

**TB:**

I think governance uncertainty is very important. When there is no regulation we don't know how bitcoins can be used for payments, and how the regulators and tax authorities respond. This is also a risk for service providers. Also the large exchanges are a problem. If an OP bank building burns down the value of euro is probably not affected. What makes bitcoin brilliant is its way of setting monetary policy objectives that can be price stability, inflation target, or a nominal GDP target. It can be pretty much anything. It enables many creative solutions. However, if you want to stop bitcoin you would have to stop the Internet. If for

example the SEC started closing bitcoin exchanges, there would be new players but uncertainty would certainly increase. It would be an external shock and affect the price of the currency. It is remarkable that the computing power of Bitcoin is many times larger than the previously most powerful decentralized computation system SETI. This has been achieved without anyone centrally telling people to mine bitcoins, but people can trust each other over a decentralized network. I think that central banking makes a regulated marketplace more efficient but in the long run we might end up with a decentralized system even with stock trading.

**TPH:**

So bitcoin is certainly not officially a currency. Could it be considered a virtual commodity? What is the likelihood that it will become a more widely accepted method of payment? We also talked about gold and you said that it has intrinsic value. However, this intrinsic value is very small compared to its market value, so do you see more similarities or differences between gold and Bitcoin?

**TB:**

Personally I see many similarities between gold and Bitcoin. We have to remember that Bitcoin has no intrinsic value. The value is based on it being a decentralized payment method and on future expectations. This is combined with the network effect. Fiat currency has a forced value by being a means of paying your debts. Regarding gold, its trade value is largely based on speculation about inflation and monetary policy. So the reason to buy gold is based on a post-apocalyptic scenario. Bitcoin has all the characteristics of a means of payment and the transaction costs are almost zero. It can be said to be a fair and just system. The money that is created is given to whoever gives enough computational power for the system's use. If I didn't trust central banks, I would buy bitcoins and gold. However, I would prefer bitcoin because the value of gold is tied to central bank policy. For bitcoin, lousy central banking policy will only lead to increase in value.

**NO:**

I also see some similarities but they also have many differences. I don't think that we will ever go back to Bretton Woods and Bitcoin will not replace that. However, it can be a good addition because it has many good characteristics but it's not yet ready. I think when we talk about apocalyptic scenarios and the Terminator, when computers are not working any more, what is it that you use to buy the last ticket on the ferry? I usually ask is it even diamonds or gold, or is it just something more basic, clean water and food?

**TB:**

There are many similarities but the ideology between gold and Bitcoin is a bit different. People who buy gold typically sell short for example an index and buy gold to hedge their position. Central banks can also affect gold prices. Recently gold prices have been declining and there is much speculation for the reasons. The prices shouldn't be declining when we have a stabilizing environment in the monetary policies and pressures for inflation. People who are involved in Bitcoin are typically younger and often have an ideological perspective. People investing in gold do not have the same ideological perspective. Of course we don't interview our customers about their political views but their portfolios show that when for example they are uncomfortable with central banking policies they short something and buy gold.



**TPH:**

If we consider risky investments, the value can go to zero very quickly. Do you have data about your customers, how many of them use warrants for hedging and how many use them for speculation?

**NO:**

It has not been studied recently. Unfortunately when we think about risk allocation, it seems that many of our new customers come after sensational news has been published. For example Talvivaara has been one of these cases. Even if we advise our customers to dump it, they don't necessarily listen to us. I'm not saying that it's right or wrong. The investor decides for themselves what to do but it is important to know what you're getting into. It's like investing in stocks by random without an analysis or a strategy, without understanding the risk you're taking. It's like buying a lottery ticket. We see that people act like lemmings with these cases without understanding. That's one of the main reasons why I wouldn't even consider bitcoins. It would also be practically impossible at the moment due to the regulatory environment. I don't want to offer phenomena to our customers. Of course publicly listed companies can also be phenomena. With Talvivaara, even an insignificant piece of positive news can result in a daily jump of 15 or 20 percent, or even more. Last year I think the largest daily jump was 83%. People look for these quick wins even though they don't understand the probabilities of successfully buying low and selling high.

**TB:**

When we come back to hedging, being able to do that only requires knowledge of finance basics. You should know how put and call work and understand the terms of a warrant and a certificate. You need to know a little bit of math and be able to use a Black-Scholes calculator, understand strike, exercise price, and knockout. We have to study the intentions of our customers. There are always two types of activity: investing and speculation. A speculator is not interested in tomorrow's value as long as it's higher than today. An investor has a strategy, a profile, and a risk tolerance level. The next step is allocation of resources and looking at macro events and interest rates. If we wanted to know what is used for hedging it depends on intentions. For warrants it seems that the activity is more speculation than hedging. People who hedge positions know exactly what they are doing and don't need our help with it. Also when a customer wants to trade warrants, they need to do an aptitude test for that product before they can trade it.

**TPH:**

I was just thinking that of course a customer might have investments with multiple services, but could you use your customer portfolios as proxies to see if products are used for hedging? I'm not sure if this type of study would be against privacy agreements.

**NO:**

For internal use we can study anything as long as the sample is large enough. Publishing the findings is a different matter. I don't think this has been studied but I have the feeling that those types of investments are mainly speculation and they feel that it's exciting. Of course there are those who hedge positions with these products but they are the minority. It seems that people are interested in how they learn and want to develop themselves, and trying new things is exactly it.

**TPH:**

Of course using these products is not mathematically overly complicated but it always

requires time to figure out things. Your service is good for making these instruments available but not everyone has the time to get familiar with them.

**TB:**

Everything we do must support the everyday life of the customer. Investing needs to fulfill a need of the customer. In investing you can always learn new things. It takes only a couple of clicks to buy Talvivaara or Outokumpu but understanding why you did it, requires much more. Most of us don't go back to revise what we have learned, which requires internal motivation. Also with Bitcoin, people are not interested because they want to live an easy life. For example setting up a wallet is very easy but it can be difficult to understand for someone unfamiliar with it. I'm not saying that it's impossible but it requires a different mindset.

**TPH:**

Before I go, can I ask you to give your own definition of what Bitcoin is at the moment and what it will be in the future? My opinion is that at the moment it's a virtual commodity and in the long run it will be a virtual currency that operates parallel to fiat currencies. Its use will increase significantly from the current state.

**TB:**

Do you mean the protocol or the currency?

**TPH:**

The currency.

**NO:**

I would say that it is a speculative immaterial currency.

**TB:**

I would say that it's revolutionary. I agree with your definition that it will be a virtual currency but everything is based on the innovative implementation and the mentality change that it brings. Most people don't look behind Bitcoin and ignore the fundamental change and new possibilities it can bring. It will be a massive change.

**Appendix G: LocalBitcoins Kangas interview transcript**Date:

March 25, 2014

Location:

LocalBitcoins, Vanha talvitie 11, Helsinki

Interviewer:

Timo-Pekka Huhtinen

Interviewee:

Jeremias Kangas – CEO, LocalBitcoins

**TPH:**

How do you feel banks are treating Bitcoin companies?

**JK:**

A typical Bitcoin startup dies in less than six months often due to banking problems. In Finland, the infrastructure is exceptionally good on a global scale so we don't have huge problems. So far Bitcoin startups have concentrated on trading services so you need some kind of a connection to the real economy and the old systems. The question is: where can you find this connection? For example, we are the market leader in Great Britain due to the simple fact that banks there have taken an aggressive position against bitcoin exchanges. Our model only connects individual traders and provides an escrow service. We are only a platform or a technology provider. In this regard we don't have significant funds in our bank accounts the same way as typical exchanges so we're not dependent on banks because they cannot freeze our accounts.

**TPH:**

What do you think about the future for Bitcoin?

**JK:**

In the long run, say in a few decades, I'm positive that decentralized systems like these will be much more common due to their resilience and efficiency. However, you have to admit that Bitcoin lives by crises. When you have Cyprus or something similar, the interest grows. It helps if the old system has problems.

**TPH:**

In your opinion, how is the demand for this type of system generated?

**JK:**

I think it's about very tangible benefits like transaction costs. Of course transaction costs are such a small part of the economy that they are hardly a basis for economic decisions. This is probably the reason why financial service providers are switched so rarely. You switch banks more rarely than you switch your wife. Easiness of transferring money can be another factor. Then there are the speculative reasons. On average, holding bitcoins has been wealth-adding compared to holding euros. If you can't come up with a better investment option, you keep your wealth in a currency. In this case you want to choose the currency that is the best store of

value. Of course, this wouldn't necessarily work with Bitcoin if you have a short-term perspective.

**TPH:**

Do you think there should be a collective voice in Finland for Bitcoin companies?

**JK:**

We've received some contacts about this but for us, Finland makes up only 0.04% of our revenue and is not interesting as a market. We don't have any plans to focus on Finland. The only exception is our ATM business that we've started locally in Finland to get experience. Also with that the idea is to later sell them globally. Being global is one of the core characteristics of our company. We want to bring Bitcoin everywhere. Of course, we are interested in regulation etc. because our company is located in Finland.

**TPH:**

Do you see Bitcoin more as a monetary system or more as a transaction system?

**JK:**

I would just say that Bitcoin is Bitcoin because it's an innovation that hasn't existed in the past. The transaction system is only the first application of the blockchain. Inside the scene, there has been a lot of talk about more advanced transactions, decentralized securities, and so on. There is much hype but we're still waiting for the first practical implementations and for these to take off. There's talk about programmable contracts. In the future, you might find a startup by programming the founding documents instead of doing paperwork. You could program vesting rights and so on.

**TPH:**

What is your opinion about Ethereum?

**JK:**

Most of these applications could be built on top of normal Bitcoin transactions. Ethereum seems to be more talk than actions. There are other similar projects like Mastercoin and Colored Coins. These ideas are often used to collect funding. I'm skeptical whenever a project starts by collecting funding and making big promises. I've met some of the people behind Ethereum but they don't have the technological track record, which is another issue. Of course I don't know everything about this project.

**TPH:**

What do you think about the comparison to gold?

**JK:**

Well, gold is quite useless as a currency and you can't forecast its supply accurately. In a way it's a good comparison for laymen because Bitcoin is quite difficult to explain. I have a hunch that it might make sense to sell gold now because Bitcoin might be taking its place as the instrument used for speculating against fiat currencies.

**TPH:**

In your opinion, what drives the value of Bitcoin?

**JK:**

Based on my experiences so far, I think the most important aspect is the sovereignty it provides. If you own bitcoin, you have total control over them and their use. You also have better privacy compared to traditional electronic transactions that are always monitored and controlled in some ways. In this sense, bitcoin is comparable to cash. I think this characteristic becomes valuable especially during crises. In Finland, the benefits are difficult to see because we have a good and stable banking system. The situation is different in many places around the world. I also like the possibility to automatize my transactions as much as I want. Of course it's my own responsibility to take care of any safety issues with this.

**TPH:**

It is also important to consider the trust of consumers. How can services generate trust?

**JK:**

That's an interesting process. I'm personally hoping that what we've seen recently is just a part of the initial phase of the technology. In the long run there will be large, stable, and trusted companies.

**TPH:**

The price of Bitcoin seems to be largely based on speculation and the component of transactions seems to be quite small. What do you think about the pricing process?

**JK:**

I haven't thought about it that much. Liquidity must be a relevant factor. I think a well-functioning intermediary service for bitcoin payments can also add value. Of course in the short-run we have large effects from single announcements or pieces of news. The number of transactions might not necessarily be that relevant in the end. What is clearly relevant is the adoption of bitcoins by merchants. Now it looks like many stores are implementing it with revenue-adding effects.

**TPH:**

What is your estimation about how much of the total bitcoin trade is done through public exchanges and how much is done OTC?

**JK:**

I don't know. We're not that interested in those numbers. We do some cash trade but more than 90% of our own revenue comes from online. For us, OTC is just a niche. Some people also use our platform just to get in contact with each other and then do their own OTC trades. Our volume is 1-5% from the global trade so we are maybe the sixth or seventh largest service in the world. However, I'm not sure if most trades are executed through public exchanges. I know for a fact that our platform indirectly employs many people as currency traders. When someone has a clientele in their vicinity, they might be handling a meaningful volume themselves. That's the understanding that I have. OTC can be more expensive but people might be willing to pay for comfort and speed. Especially during Bitcoin manias, people are willing to pay high premiums to get in. Also the hedge funds that hold bitcoins seem to be getting their bitcoins through OTC deals, or that's what I've heard at different Bitcoin conferences. I think OTC has two uses. One group includes the very small transactions that are done due to ease and speed. The other group includes very large transactions when good service is important and the party is not interested in dealing with an exchange.

**TPH:**

Where do you see Bitcoin in five years and what could be its price?

**JK:**

Well the price can be zero, or it could be even in five or six digits. The risk is very high so I doubt that the price will remain at the levels we have today. If the adoption continues at the current phase, it will be reflected in the price sooner or later. Also the transaction use will gradually increase. There are also some challenges with the infrastructure. At the moment, Bitcoin cannot scale up to very large transaction volumes. It can do 7 transactions per second whereas VISA processes 4000 transactions per second or something. My prediction is that there will be some kind of a clearing system built on top of the current system, so that among consumers you would rarely see real bitcoin transactions. The scalability can be a challenge. We already have increasing transaction costs because a block cannot accommodate all transactions. Thus, you'll have to pay to get your transaction included. When transaction costs increase, the system becomes less attractive, and people will either find other alternatives or use the old system. Another big problem is how transaction costs are determined. You pay for the space you use in the blockchain that doesn't correlate with the value of the transaction.

**TPH:**

Would you prefer rigorous regulation or a freer regulatory environment for Bitcoin?

**JK:**

Regardless of regulation, you can't really control it on the individual user level. In the long run regulation is irrelevant because I think a cryptoanarchistic future is realistic. If it is not officially recognized, it will be underground. If bans are issued, then exchanges might also adopt decentralized models. In the case that centralized exchanges would experience problems, our service could act as an intermediate step towards decentralized services. We are also centralized and public so we could be destroyed. Overall, I don't think that the demand will vanish. I think it would be good to have regulation that supports startups. Having a lot of startups can lead to having some big companies. I think Bitcoin is also good for Finland because it is possible to start companies that are "born global". Our company is a good example of this because 99.96% of our revenue comes from abroad but we employ people in Finland.

**Appendix H: Bittiraha Brade interview transcript**Date:

January 29, 2014

Location:

Hanko Sushi Kluuvi, Aleksanterinkatu 9, Helsinki

Interviewer:

Timo-Pekka Huhtinen

Interviewee:

Henry Brade – CEO, Prasos (parent company of Bittiraha)

**TPH:**

There has been some interesting recent developments with the New York hearings and other news. What do you think about the state of Bitcoin at the moment?

**HB:**

At the New York hearing, the arguments were at a level that you could notice that they know what they are talking about. Of course there were also bad arguments. In Business Insider there was a study that 51% of IT professionals would be willing to receive their salary in bitcoins. I was really surprised by this result. IT professionals are early adopters but this tells about how in the US the awareness of Bitcoin has risen very high, at least in some industries. A couple large online stores have started accepting bitcoins now, Overstock and Tigerdirect. I think Tigerdirect had sales worth of 500,000 in three days. I was really surprised that it is actually used that much. Of course it's much less than other payment methods but still. We are talking about revenue amounts that are meaningful and all players will take notice. NewEgg has now been considering Bitcoin but Amazon gave a statement that clearly said that they are not currently interested. I think that if the adoption develops one step further from this then Amazon needs to take notice because they would be losing a group of customers. In Finland, we've had much less development on this front. I think that there will be happening a lot this year. I know many online stores and services that are considering Bitcoin adoption. The thing is that you need to have references from one industry, after which it is easier to sell the solution to other stores in that industry. In Finland, we don't have many references so this is difficult. In the US, there are these references, so the development is much quicker.

**TPH:**

In Finland, there's the restaurant Vegemesta that accepts bitcoins but I don't know if there exist many other brick and mortar stores that accept it.

**HB:**

There's a dentist who accepts bitcoins in Helsinki and a few other places. There are some here and there, and more popping up.

**TPH:**

I think Overstock.com, with one billion revenue, was the first large merchant to adopt Bitcoin. Then we had Tigerdirect with two billion revenue. I think eBay has been giving some promising statements.

**HB:**

Yes, I think both eBay and PayPal with the same owners have both openly said that they're interested. Even the CEO of PayPal has said that he owns bitcoins and likes the concept. In the same interview he said that the average consumer is not ready for it. They are following the development. I agree that there are some challenges. How do you make it easy enough for the average consumer while making it safe? I think these two aspects need answers and there are many companies working on solutions. The answers are coming but it takes some time before the services reach this level. However, when this level is reached I believe that companies like PayPal and eBay will welcome Bitcoin with open arms. Also the regulation aspect is developing. It is a source of concern for big companies. Recently eBay announced the release of an unclassified section in which it will not act as an intermediary. There you can also buy and sell virtual currencies. This is the step they're taking now.

**TPH:**

Some financial institutions have said to be afraid to offer bitcoins as an investment product due to its risk. However, there are many other investment products with extremely high risks. Perhaps, the real obstacle is regulation that is unclear at the moment.

**HB:**

I recently got to discuss this with a senior employee at a bank, and this seems to be the issue. The FSA has not taken a stand on the issue in Finland at all. They just ignore the issue by saying that it's not money and is not our responsibility. There are also beneficiary problems with payments because it's not defined in regulation. When you send bitcoins to a wallet, you really don't know who the receiver is because the address itself is reasonably anonymous. You can't directly link a wallet with an identity. This poses some challenges. Of course with cash you also need to do some compromises, so Bitcoin is a bit similar. In case the regulation becomes stricter, we are prepared to acquire licenses and collect more customer information. We've already seen that at large exchanges; they need to verify identities. This helps to supervise one step but everything inside the Bitcoin network cannot be followed. I believe that the stricter the rules get at the large hubs, the more demand there is for other channels. These other channels can for example help you to set up a face-to-face meeting where you can exchange cash for bitcoins. Of course exchanges are easier to use than setting up a face-to-face meeting but if someone wants to emphasize privacy, then they would choose to deal in cash. I think that the vast majority of trade can be monitored by regulating the centralized exchanges.

**TPH:**

Let's talk about your service a little more. You have the forum, some guides, bitcoin trade, bitcoin accessories, news and so on. What direction are you emphasizing in the future?

**HB:**

We have many services but the main service is Bittipörssi, the buying and selling of bitcoins. We have seen some growth with the invoice service that can be used to pay your bills with bitcoins for places where it is not accepted directly. The most common uses are for paying rent, mortgage installments, credit card bills, and bills for online stores. We launched this service in November or December. The volume is still very small compared to Bittipörssi that is growing very rapidly. In both November and December we had nearly two million euros trade volume with it. On average, it's been doubling every six months. We have some interesting products coming up that can be used to circumvent the problem with direct



purchasing of bitcoins. We can have purchase buttons for preloaded paper because in this case we don't have the beneficiary problem as the paper wallet is sent to address X. We will soon release this product internationally because we can mail it anywhere. In practice, the buyer can lock the price at the moment of purchase and you don't need to wait. At the moment, the only way to buy bitcoins in real time is through our ATM machines. We will expand the network in Finland. We are also exporting our services to Estonia this spring, including ATM machines. We have a big product in works that competes with investment products. We want to provide a storage or vault solution that would be extremely safe. We've been planning and building this for a long time and I think that we will release it this year. In practice, it will solve the problem of safety for people without the technological know-how. It will be easy to just buy some bitcoins and put them in the vault. At the moment we're not providing any storage services because we wanted to avoid the security burden and the customer service burden. We just have some instructions on setting up bitcoin wallets. Now we've noticed that it's a problem because some users feel unsafe storing their own bitcoins. I also understand this even though I'm very IT-minded myself. It has taken a long time for me to become comfortable with my own wallets and stop worrying about them. We need to eliminate these sources of worries with good solutions. If banks were to provide this service, they would probably also provide storage services and take care of the safety side. We have the capability to do this and we are known and trusted. We have a good starting point due to our reputation. At the same time we will be giving a face-lift to our company to achieve a more businesslike look that matches the trust aspect. We are paranoid about safety so we will test the system first by storing some of the company's own bitcoins with it before we offer this to anyone else. There have been so many instances of services getting hacked that we really want to get it right.

**TPH:**

When you receive bitcoins in your service do you convert them into euros or do you somehow hedge your position?

**HB:**

We have income in both euros and bitcoin. We also invest in bitcoin. This is a part of our strategy. So we look at the whole situation in terms of how much we have in bitcoin and how much in euros. At the moment all bitcoin we receive we keep as bitcoin. If we've suddenly received a lot of bitcoins we might consider selling some of it but we don't do this automatically. We don't stress about it. Our main principle is that if the company has some unused funds somewhere, we can convert them into bitcoin. We believe in it and our existence is based on the assumption that Bitcoin will be successful. As money, it's scarce, so if it gains wider adoption, the value will rise. I've heard that many other Bitcoin companies have the same approach. I think this is appropriate in the long run. Of course in the short run the value can fluctuate but we won't panic sell if the price goes down. If there are funds that are needed soon, we need to consider more carefully what should be done because the short-term volatility risk is quite high. It can suddenly drop so a totally different strategy is required for a short-term perspective. With merchants, I don't see any problems with this. Of course it's possible to instantly convert bitcoins so that the merchant receives euros. We've partnered with BitPay to provide this service in Finland. If the company receives bitcoins, there are some questions about accounting practices and taxation. For someone without this knowledge it's easier to use BitPay and receive euros. In terms of the currency risk I don't see a problem because typically bitcoin revenue is very little part of the total revenue. Even if all received bitcoin are held as bitcoin it is difficult to develop into a significant economic risk. I'm also seeing the price of bitcoin stabilizing. Compared to what it was in 2010 and 2011, now the

percentage changes have been getting smaller. If Bitcoin gets much bigger, I think it will start to stabilize and hedging wouldn't be needed that much. However, I think even in the best scenario it will take a very very long time before bitcoin could get even close to the stability of a central-bank-controlled currency. Bitcoin is a scarce commodity and a target of speculation. Even food is a target of speculation, and people speculate on potato and rice. This has an effect on the prices. My view is that Bitcoin could become more stable than gold. Ok, with gold we have the scarcity and its historical position and respect. However gold is not used as a means of payment or money. It's old-fashioned in this sense. And even paper money is not tied to gold any more so it has been sort of left out. Theoretically bitcoin has the potential to become a store of value due to its scarcity. On top of this it can become a means of payment with the characteristics of cash. This combination can make it something that can develop into a gold 2.0. I think it is very important that you don't only think about it as an investment or a commodity or only as a payment network. It is definitely both.

**TPH:**

I've been thinking if it is possible for the volatility of the bitcoin price to decrease. In a way, at the moment I feel that this is very unlikely because demand in fiat currencies is also very volatile and requires central banking activities to remain stable.

**HB:**

At some point there are some boundaries. I think that at some point the effect of speculation will become smaller. So far a lot of the rise has been about following the trend. Of course there are people interested in the impact it can have as a payment solution. Before long, I think the influence of speculation will get smaller compared to the other influences because there is no unlimited increase potential. You can't expect it to behave like gold because it will be in a category of its own with the payment use combined to its characteristics. I personally think that it's impossible for it to become stable to the level of fiat currencies. In the future there will be services to easily hedge risks, both for the merchants and consumers. A good thing about speculation is that it has increased the value of the whole system. In the past it would have been difficult for you to buy a house using bitcoins because the liquidity wasn't been sufficient. This has been improving and at the moment there is absolutely no problem selling a house in bitcoins and liquidating the bitcoins right away. I think that at the moment if you use multiple exchanges, you could process two million euros through the system quite well. If you go for a larger sum of money, then the exchange rate would be affected. The current state is much better than what it was two years ago. Speculators add liquidity. Now we've seen relative stability with bitcoin, and people are looking for adrenaline rush with altcoins. There's Doge coin, which really surprised me and might be soon challenging even Litecoin. I'm not very interested in altcoins because Bitcoin has a clear network advantage.

**TPH:**

I was looking at the hashrates and I noticed that Doge has surpassed Litecoin in terms of the network hashrate.

**HB:**

Yes, often a new coin will get attendees because the mining profitability is higher. However, with Dogecoin there has been something special about it. It wasn't just about the basic miners that follow the profitability of mining different altcoins. We'll see how it develops but I think it will be extremely difficult to challenge Bitcoin. There are some interesting developments in building these other applications on top of Bitcoin and on top of other similar networks. In the long run I think this can be a threat to many jobs in finance. The technology can potentially

lead to disintermediation on many fronts.

**TPH:**

How is your competition in Finland?

**HB:**

There are some new players and we now have more pressure to improve our service. We are working on making it better in terms of usability and speed. We've increased resources in payment execution and customer service. We are also developing our organization to be ready for further growth. In addition, we are working on improving automations to speed up things. I've heard that Coinmotion claims to be able to provide instant purchases, and this is something I'm eager to see. Maybe they've solved the beneficiary problem in some other way through identification of customers. Our idea is to keep it simple and minimize the work done by the customer. Coinmotion is a part of a new wave of Bitcoin companies. Originally they were doing something else and now they've seen the opportunity that Bitcoin provides. The first generation of Bitcoin companies like us consists mainly of Bitcoin fans. We also attract more experienced users that want to keep the service simple. Providing services to inexperienced users will be tedious in terms of providing customer service.

**TPH:**

Is there a community for Bitcoin entrepreneurs in Finland and how is the dialogue with the regulators coordinated?

**HB:**

There's more happening in the US where the whole industry is more developed. The Bitcoin Foundation, based in the US is the hub for this. One of their main objectives is to lobby for sensible Bitcoin regulation. We would need something similar in Finland. I've been in contact with the Bitcoin Foundation about setting up a branch in Finland that would bring together different entrepreneurs and different stakeholders. Something like this could be good to have for coordinating efforts. So far we don't have that much cooperation and the companies are independently in dialogue with banks, tax authorities, etc. There have also been mixed messages. For example, LocalBitcoins weren't able to get an account at Nordea but we've had no problems with them. The tax authority published a guideline about Bitcoin that was very lacking especially with regards to bitcoin mining. According to the instructions, no costs can be deducted from the generated revenue, which is weird for ASIC devices that cannot be used for anything else. This shows that the understanding is lacking. It would be in the interest of all users that we would get a wise regulation for bitcoin in Finland. I'm a little afraid that the regulation can develop in a direction that increases the barriers of entry, making it difficult for start-ups to enter the industry. This might be happening in the US, favoring the large companies. I hope that the market remains flexible and open. As a company we're not afraid of competition because it forces us to improve. We still have advantages that we're going to leverage, including visibility and customer base. In principle, competition is always good for the consumer and leads to better services at lower prices. In the US, for example Circle, with a lot of funding and big name employees, has been giving out statements that they wish for heavy regulation, whereas small start-ups hope for no regulation. The Bitcoin Foundation needs to lobby for something in between. This can also develop in a country-specific manner. For example, it is still unclear what the VAT policy of Bitcoin is in Finland. It's weird that gold doesn't have VAT but silver does. The margin of exchanges is typically between 0.5% and 10%. If you add a 24% VAT, there will be nothing happening after that. We've decided to commission a study about this through an external advisory to get a definite answer.

**TPH:**

For example these types of issues could be figured out together with other Bitcoin companies in a coordinated manner.

**HB:**

Yes, it would be beneficial. With the Bitcoin boom, we've been very busy and no one has had time to set up an organization like that. If there is someone who would start and run it, I could be a part of it. I hope this will happen in the future.

**TPH:**

Perhaps it will happen after the industry grows a little bit.

**HB:**

Clarifying regulation would help banks to be more confident in providing services to Bitcoin companies. There has been some strict regulation for example in Thailand, where Bitcoin is not prohibited but discouraged through warnings. In US, the negative aspects have been openly discussed and they also bring up the positive aspects. Also senators have agreed that regulation needs to balance between the benefits and challenges. If the approach remains smart, I don't think there will be a total ban in many places. In China the problem was that the growth was so explosive that they couldn't control it. In the future, it's possible that the regulation will be relaxed but they will need to gain control before that.

**Appendix I: Coinmotion Päivinen interview transcript**Date:

January 24, 2014

Location:

Movila/Coinmotion, Hiomotie 19, Helsinki

Interviewer:

Timo-Pekka Huhtinen

Interviewee:

Teemu Päivinen – CFO, Movila (parent company of Coinmotion)

**TPH:**

What is your general opinion about bitcoin as a currency and Bitcoin as a system?

**TP:**

As a currency, at the moment Bitcoin is the only reasonable virtual currency because it has enough volume and it is most accepted. The competing currencies cannot reach a similar state because it just wouldn't be in anyone's interest. Bitcoin is the only one that is pushing forward the ideology of virtual currencies. Of course the main positive aspects are easy transfers and low transactions costs. There has been a lot of criticism about the wasteful nature of the mining process, which has resulted in competing schemes that try to utilize the mining process in a useful way. For example Primecoin calculates prime numbers and Bitcloud makes it possible for miners to offer computing power and storage through the network.

**TPH:**

There are many different possible applications for this technology. Do you think a payment system is the best application and what do you think about the other uses?

**TP:**

I think that at the moment it works best as a simple payment system and a store of value. It would need to be developed a lot before it would be very useful for other applications. At the moment, the biggest advantage is that it is an international currency that doesn't incur currency exchange costs. The cost structure is the same anywhere you use it. Due to this reason, the payment system use is the most attractive application. It's possible that there will be radical changes in Bitcoin at some point because it has an active development team. One way to find ways of regulating Bitcoin would be for the authorities to cooperate with the developers.

**TPH:**

What do you think about the comparison to a commodity, or the comparison to gold? Do you see more similarities or differences?

**TP:**

A comparison to gold or stock is ok because it is a store of value. It should have its own category that would be taxed in a way similar to gold. It is close to the money used on some

gambling sites and inside some games.

**TPH:**

Can you tell me more about Coinmotion and the service that you are going to provide?

**TP:**

Our main idea is that in the future the value of virtual currencies will be based on transaction use. However, at the moment the price is largely based on speculation. The more transactions we will have the closer the price will be to its fair value as a means of payment. At Coinmotion, we've developed a platform that merges the use, storage, buying, and selling of bitcoins. This enables a few things. First, we don't need to transfer the bitcoins inside our system and we can keep them safe. If a merchant uses our tools, their bitcoin in cold storage wouldn't need to move and we could pay the customer in euros to their bank account. This protects the assets of the customer, improves transaction safety, and speeds up the transaction process because the verification by the Bitcoin protocol wouldn't be necessary. Second, for people to use this for payments, the adoption needs to be as simple as possible. In the past, Finnish people who've wanted to buy Bitcoin have had to make a SEPA transfer to an exchange that already takes days. Depending on the exchange, it can also take some time before the funds are visible on the account. Alternatively, there is Bittiraha that does the same process by hand for you but takes a few days to process as well. In the case of Bittiraha, you are required to setup your own wallet and keep it safe, which can be problematic. The last option is to use LocalBitcoins where you can find good prices but it is not very suitable for quick buying. Therefore, the only solution is to provide an instant buying process similar to what you have when buying almost anything else. This would lower the threshold of adopting Bitcoin and would make it easy to take positions in bull and bear markets. We have done some smart tricks to make the purchases instant. We will also have tools like stop-loss and trading-loss that are typically absent in Bitcoin services. These tools help you to protect your assets. In all aspects the service should be so simple to adopt and use that people couldn't find reasons not to use it.

**TPH:**

Do you also execute buy/sell orders at other exchange on behalf of the customer?

**TP:**

We are not an exchange but a meta-exchange, meaning that we execute transactions on multiple exchanges at the most favorable prices possible. Another part is that we want to have a clear pricing so that you know what you will get. With some services you don't know the exact price when you place an order. The same goes for exchanges where you can place an order but you don't know if it will be executed. With us you know the price exactly at the moment of purchase. We take a small currency risk with this solution.

**TPH:**

What is the spread in your system? I think it is 0.6% at MtGox and 0.2% at BTC-e.

**TP:**

Our spread is much higher because our risks are much higher compared to a typical exchange. For most people it makes sense to pay a small premium if you can then handle the purchase domestically. We take a 3% commission on purchases and sales but this will probably decrease when our volume increases. Another reason that a meta-exchange is more efficient and safer is that we can ensure liquidity even at times when some exchanges are down. For

example, during high peaks, Bitstamp is known to stop working. When we make use of multiple exchanges, there is the best probability for orders to go through. We emphasize safety and ease of use. The US-based Coinbase has a similar basic idea and they have a lot of volume even though their premium is higher, just because it is easy to get into and it is reliable. We will also be expanding to other Nordics that don't really have exchanges. In Russia there is an exchange, but BTC-e has some withdrawal limits that limit the use. The Russian market could also be something we might consider.

**TPH:**

Do you have plans to integrate merchant systems, such as payment terminals, to your service?

**TP:**

Well, these will not be a part of the first phase. The basic service will be out quite soon and will include payment buttons for online merchants. In addition, we will have API's for other software such as games. We are also developing POS integration, and we have a guy who has been developing these systems. There are many stumbling blocks that slow down the pace, so that we will need to wait and see for a while before we attempt it. For POS, one option would be to have QR codes, which is not that good. Then there is NFC but this is not available on iPhones. The most interesting option we are looking into is that there would be a payment card tied to a Coinmotion account. The payments would be done in bitcoins but we could make the payments to the merchants in euros because we are allowed to do this conversion for them.

**TPH:**

Would this be similar to what BitPay is doing?

**TP:**

Yes, BitPay has done this quite well. However, we see that there are significant benefits from also having also the consumers in the same system. BitPay has and will have problems with the transaction speed and safety.

**TPH:**

Bitstamp has also gained some market share.

**TP:**

Yes, they are now the biggest in Europe and for some reason they have bank accounts in Slovenia. Well, in a way these exchanges are our competitors but on the other hand our service is built on top of them so it is quite interesting. In a way, we compete for visibility but cooperate in other ways. In Finland, we have Bittiraha and LocalBitcoins but they are both quite different services. In Sweden, there is a small start-up called Safello with a small team. They are not yet very far. They went to market at an earlier phase and currently they only have enabled buying. From our perspective, it is important to also have storage and other services.

**TPH:**

In your experience, which Finnish commercial banks are most cooperative with companies like you?

**TP:**

At least, Danskebank has granted purchase buttons to a Bitcoin company in Denmark called

Bitcoin Nordic. I think their volume is quite low but they have some interesting things like some sort of payment notes that are sold a lot somewhere in Africa. Nordea seems to have a quite strict policy against Bitcoin and I haven't heard that there have been problems with OP. The banks still seem to be uncertain about this, as there hasn't existed anything like this in the past.

**TPH:**

Is there a community of Bitcoin entrepreneurs in Finland?

**TP:**

I wouldn't talk about a community for Bitcoin entrepreneurs but at least the existing services are interacting with each other. There is more of a community among Bitcoin users in Finland. We don't have too many Bitcoin companies yet and we haven't been in contact with others that much because one part of our strategy is to be a surprise to a certain extent. We are more involved in general entrepreneur communities and less specifically in Bitcoin communities. One of the challenges of Bitcoin is that it started by attracting suspicious activity that doesn't necessarily work as a very good foundation for an open community.

**TPH:**

Unfortunately the first impressions of Bitcoin have been negative.

**TP:**

With our service each user will have to register and link the account to a bank account and confirm everything through email. Due to this, we won't get all possible customers but we believe that this is the way to get it accepted on a larger scale.

**TPH:**

Where do you see Bitcoin in five years? How likely is it that it has died away and how likely is that its use has dramatically increased?

**TP:**

I don't think that it will die as a concept. Now it seems that Bitcoin will be the big virtual currency but of course it's possible that it will be another one that compromises on some issues between governments and consumers. There have been some large merchants getting into Bitcoin and this will continue. Mass adoption would require governments or regions to have compatible regulations and tax policies for Bitcoin. I suspect that for example EU will have to give a clear statement on it and then the other countries would follow. At the moment it seems that no government knows what they should do, and there are many disagreements. Most likely the US will be the first one to set an example. They don't like anonymity but the US is a capitalist country that sees the potential benefits of being a market leader. There are quite a lot of big names and money behind some Bitcoin companies in the US. Perhaps the EU will follow suit.

**TPH:**

Yes, it seems that one of the problems is that Bitcoin doesn't fit any of the current instrument categories.

**TP:**

It needs its own category and policy. Interestingly in Sweden some authority categorized it as a currency but another authority said that it's not a currency so nobody knows what it is.

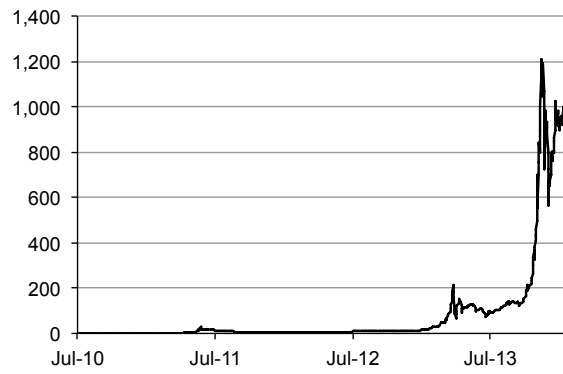
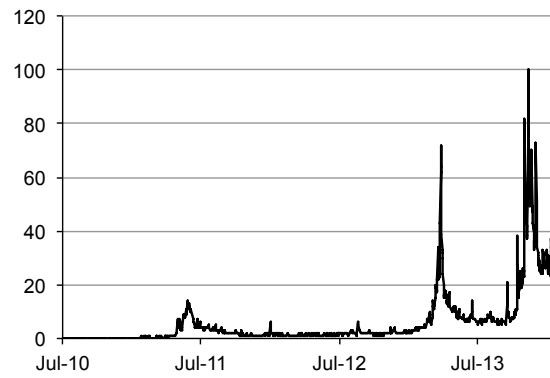
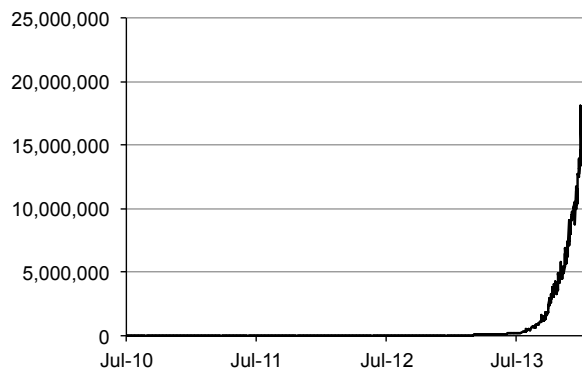
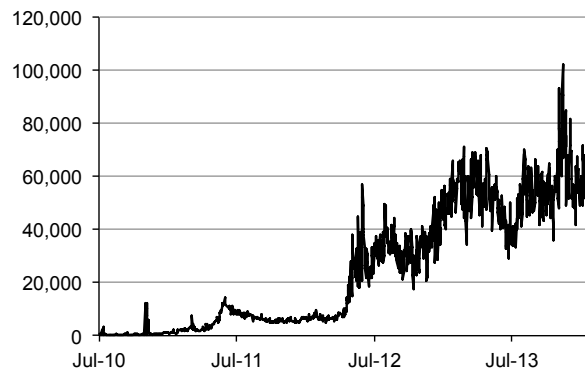
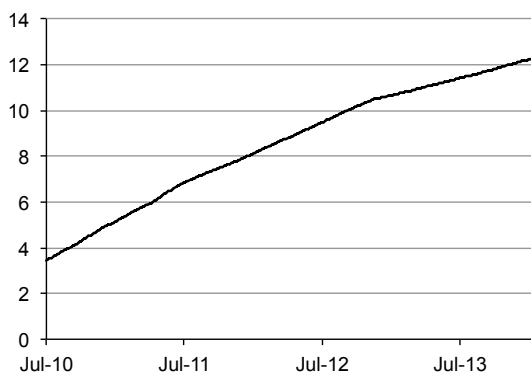


**TPH:**

What do you think about government's setting up virtual currencies?

**TP:**

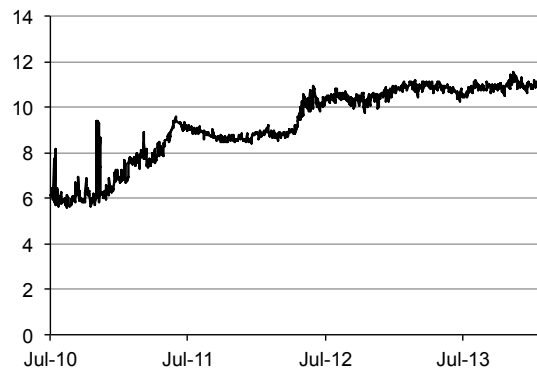
I don't think there are any benefits from countries or companies to have their own virtual currencies because then the international benefits and open nature are not there. I see them more like a sort of customer loyalty programs. I don't see them as a threat to real virtual currencies.

**Appendix J: Graphs of variables and transformations****P (raw)****SVI (raw)****HSH (raw)****TRS (raw)****S (raw)**

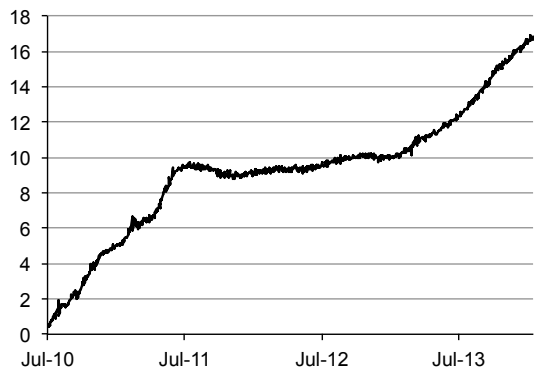
**P (ln transformation)**



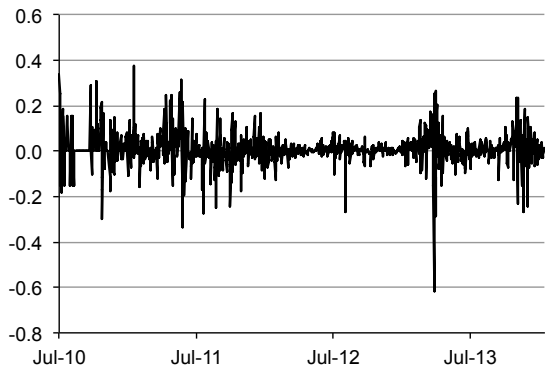
**TRS (ln transformation)**



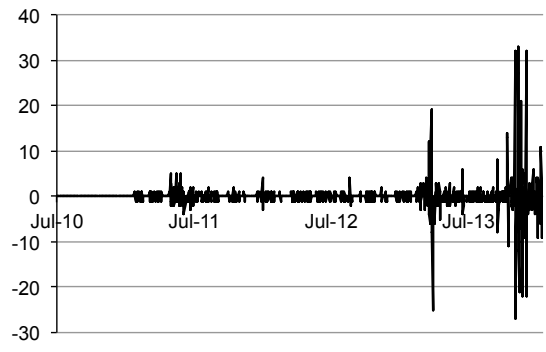
**HSH (ln transformation)**



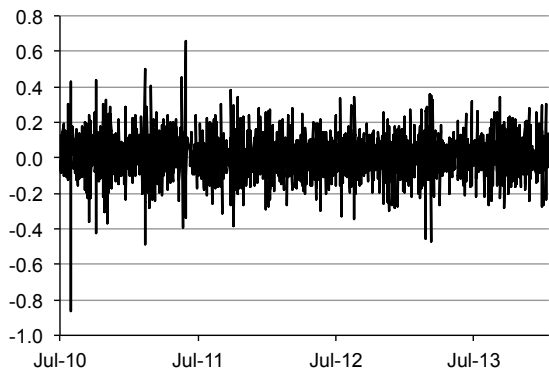
**P[0,1]**



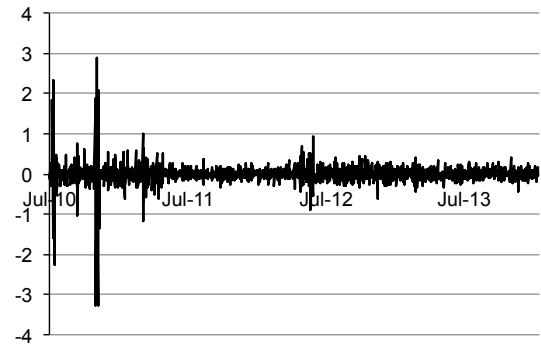
**SVI[0,1]**



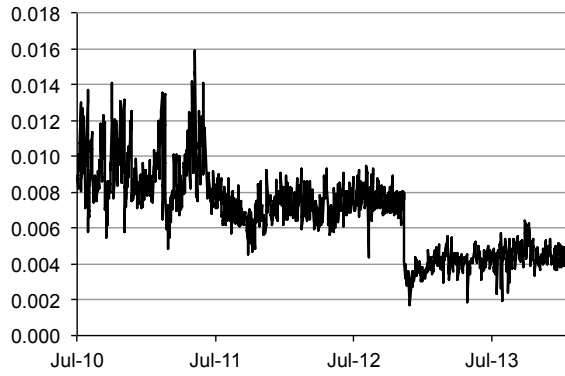
**HSH[0,1]**



**TRS[0,1]**



**S[0,1]**



**Appendix K: Correlation matrix**

Note: Shaded areas indicate correlations between overlapping variables.

	P[0,1]	P[0,7]	P[0,30]	P[-1,0]	P[-7,0]	P[-30,0]	SV[0,1]	SV[-1,0]	SV[-7,0]	SV[-30,0]	HSH[0,1]	HSH[-1,0]	HSH[-7,0]	HSH[-30,0]	TRSF[0,1]	TRSF[-1,0]	TRSF[-7,0]	TRSF[-30,0]	SI[0,1]	SI[-1,0]	SI[-7,0]	SI[-30,0]	
P[0,1]	1.00																						
P[0,7]	0.43	1.00																					
P[0,30]	0.24	0.58	1.00																				
P[-1,0]	0.20	0.10	0.11	1.00																			
P[-7,0]	0.10	0.12	0.22	0.44	1.00																		
P[-30,0]	0.12	0.22	0.22	0.24	0.58	1.00																	
SV[0,1]	0.03	-0.03	0.00	0.15	0.13	0.06	1.00																
SV[-1,0]	-0.04	-0.04	-0.01	0.03	0.12	0.05	0.13	1.00															
SV[-7,0]	-0.06	0.01	0.02	-0.05	0.18	0.16	-0.26	0.26	1.00														
SV[-30,0]	-0.02	0.03	0.02	0.00	0.17	<b>0.46</b>	-0.05	0.23	0.42	1.00													
HSH[0,1]	0.00	0.01	0.03	0.03	0.05	0.07	-0.01	0.04	0.01	0.02	1.00												
HSH[-1,0]	0.01	0.01	0.03	0.02	0.04	0.07	-0.03	-0.01	0.00	0.01	-0.43	1.00											
HSH[-7,0]	0.03	0.07	0.15	0.04	0.18	<b>0.37</b>	-0.02	0.00	0.02	0.07	-0.32	0.43	1.00										
HSH[-30,0]	0.07	0.15	0.15	0.06	0.20	<b>0.51</b>	0.00	0.01	0.05	0.13	-0.09	0.24	0.60	1.00									
TRSF[0,1]	0.03	0.01	0.01	0.05	0.02	0.02	0.09	0.01	-0.02	-0.01	0.07	-0.07	0.01	0.01	1.00								
TRSF[-1,0]	0.01	0.01	0.00	0.03	0.01	0.02	0.02	0.09	0.02	0.03	-0.11	0.08	0.03	0.01	-0.12	1.00							
TRSF[-7,0]	0.01	0.03	0.01	0.02	0.12	0.12	-0.02	0.04	0.10	0.03	-0.04	0.03	0.03	0.03	-0.33	0.46	1.00						
TRSF[-30,0]	0.01	0.02	0.04	0.03	0.09	<b>0.34</b>	-0.01	0.05	0.05	0.16	0.00	0.02	0.11	0.16	-0.25	0.30	0.45	1.00					
SI[0,1]	0.01	0.01	0.04	0.03	0.09	0.20	-0.01	0.01	0.00	-0.06	0.23	0.06	0.21	0.27	0.03	-0.02	0.05	0.05	1.00				
SI[-1,0]	0.00	0.02	0.03	0.01	0.08	0.20	-0.01	-0.01	-0.01	-0.07	-0.12	0.23	<b>0.37</b>	<b>0.34</b>	0.02	0.03	0.07	0.07	0.18	1.00			
SI[-7,0]	0.01	0.02	0.00	0.00	0.02	0.20	-0.01	-0.01	-0.04	-0.07	0.00	0.02	0.24	<b>0.34</b>	0.01	0.01	0.06	0.06	0.20	0.83	1.00		
SI[-30,0]	0.00	-0.01	-0.07	0.00	0.01	0.12	-0.01	-0.01	-0.02	-0.09	0.01	0.01	0.11	<b>0.32</b>	0.01	0.01	0.05	0.05	0.18	0.83	0.84	1.00	

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