



Department of Real Estate & Construction Management  
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## **Future Currency**

Is Bitcoin here to stay?

A case study on the cryptocurrency, Bitcoin

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## Abstract

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Title	Is Bitcoin here to stay? - A case study on cryptocurrency, Bitcoin
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The concept of money has been around since we started using goods and commodities as means of payment. So for thousands of years people have been used to trading goods and services for money. The evolution of money as a tool for exchange started out with people using cocoa seeds, shells and other precious objects, that progressed into the use of precious metals, such as gold and silver. In recent centuries we have found ourselves using fiat currency and now, with the evolution of the Internet, we might be on the verge of the next step in the evolution cycle of money.

Enter Bitcoin, which is the first decentralised digital currency that uses cryptography. The purpose of this thesis is to explore the positive and negative aspects of Bitcoin so far, and will investigate what the future might hold for the invention of this cryptocurrency.

## Sammanfattning

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Titel	Är Bitcoin här för att stanna? – En undersökning av kryptovalutan, Bitcoin
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Begreppet pengar har funnits sedan vi började använda varor och råvaror som betalningsmedel. I tusentals år har människor tagit för vana att använda pengar till att handla med varor och tjänster. Utvecklingen av pengar som ett verktyg för handel började med användandet av kakao frön, snäckor och andra föremål som ansågs värdefulla, som sen har utvecklats till användningen av ädla metaller, som guld och silver. Under de senaste århundradena har vi använt fiat valuta och nu, med utvecklingen av Internet, kan vi vara på väg in i nästa steg i utvecklingscykeln av pengar.

In kommer Bitcoin, som är den första decentraliserade digitala valuta som använder kryptering.

Syftet med denna uppsats är att undersöka de positiva och negativa aspekterna av Bitcoin, och kommer att undersöka hur framtiden ser ut för uppfinningen av denna kryptovaluta.

## Acknowledgement

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I would like to thank everyone who has contributed to the making of this thesis: My supervisors Inga-Lill Söderberg and Björn Berggren, as well as all of the respondents of my interviews.

Brittemira Abdi

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# 1. Introduction

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*This section will start by presenting the reason why this topic was chosen and why it is important and necessary to investigate cryptocurrencies. It will continue with purpose, restrictions and a description on what the disposition of the thesis will be.*

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## 1.1 Background

Money and trading transactions are part of most people's everyday life. It has been like that since thousands of years ago, when different valuable objects such as shells, cocoa seeds, precious metals etc. were used in exchange of goods or services. These were called commodity money.

Since the Internet developed in the early 90's, there have been many virtual currencies. One that has particularly caught a lot of people's and authorities' attention is Bitcoin.

Bitcoin is a cryptocurrency\* that was invented in 2009 by Satoshi Nakamoto, which is an alias for a person or a group of people. What makes Bitcoin stand out from other types of currencies is that it is the first decentralised digital currency that uses cryptography for security.

The fact that so many are talking about Bitcoin and this new technology interested me. As there is a tendency, especially from the younger generations, to be attracted to new innovative tools and techniques, Bitcoin seems to have a good innovational potential and perhaps economy wise as well.

That is why I think it is crucial to investigate it further and analyse what its effect on the current traditional currency system might be.

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\*Cryptocurrency is a digital currency that uses cryptography for security.

## 1.2 Purpose

The main purpose of this thesis is to explore the good and bad aspects of Bitcoin, as well as analysing whether or not this cryptocurrency is viable enough to coexist with other types of currencies.

## 1.3 Restrictions

This paper focuses on one specific cryptocurrency, which is Bitcoin. The reason of this decision is that right now there is a lot of attention put upon this tool and at the same time much more accessible data and information about it. The empirical data collected for this thesis will come from actors in the Swedish financial sector. Nevertheless there will be some macroeconomic models used to support the theory section of this paper. These models are applied on all financial markets, not only the Swedish one.

## 1.4 Disposition

The thesis starts with a short background on money, the importance of money in our everyday life and an introduction on money of the “new technology”. This section consists as well on reasons why it is important to investigate and write about it. This will help the reader to get a general view on what this paper will investigate and the purpose of it. The second chapter will present the chosen methods of extracting relevant information for the empirical evidence and theory sections. This chapter will also present the respondents for the interviews and why they were thought to be of great relevance for this paper. Chapter three will give a background on the history of money and currency and emphasize the differences between the two. Chapter four gathers all the needed material for the case study on Bitcoin followed by a chapter, which treat Bitcoins theoretical roots. Chapter six will present all the material collected from the interviews. The seventh chapter will be the analysis where I will examine all the material gathered for this thesis to then conclude with a discussion part.



## 1.5 Audience

This paper targets anyone who has an interest in macroeconomics and currency systems. It however requires some basic knowledge in macroeconomics and how the financial system works. Its main focus relies on the cryptocurrency called Bitcoin, which is why the thesis aims to reach an audience that is interested to know more about this new type of currency.

## 2. Method

### 2.1 General

The study started by gathering information about the history of money and the importance of it. To do this successfully a study visit at the Swedish Royal Coin Cabinet took place before the writing process began.

There is one main methodology chosen to achieve thorough theory knowledge relevant to the question as well as well-balanced empirical evidence. As there is no hypothesis posed as a research question for the thesis, which would probably impose a quantitative method, a qualitative research method was chosen to be more adequate and effective for this thesis.<sup>1</sup> Three of the most common QRMs are *participant observation*, *In-depth interviews* and *focus groups*.

The collected information used to write this thesis came from two types of sources; primary and secondary sources. My primary ones are articles, lecture, research papers, studies and journal publications. The secondary sources consist on interviews with pertinent actors on the Swedish financial sector and respondents with the best knowledge required on the topic. They provided the greatest part of the material that was used to analyse and discuss on different issues of Bitcoin.

These sources were very useful on gathering relevant and up to date information about Bitcoin.

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<sup>1</sup> Qualitative Research Method: A data Collector's Field Guide

## 2.2 Respondents

Here follows a presentation of the respondents that were interviewed.

*Tristan Edwards, Safello*

Tristan Edwards is UI\* designer Safello, which is a newly founded company, based in Stockholm that brands itself as an easy and secure way into the Bitcoin world and its usage. His work consists on designing and building services that are easy to use for everyone who wants to use bitcoins.

*Cecilia Hermansson, Senior Economist at Swedbank, Ph. D. (KTH)*

Holds this position at one of the largest Swedish banks and has a wide economic background. She is currently working on her PhD at the Royal Institute of Technology (KTH).

*Björn Segendorf, Adviser at The Riksbank*

Björn Segendorf is an adviser on the Riksbanks financial stability department. He has written many articles and papers for the Riksbank as well as been recently interviewed from different newspapers about different exciting concerns on Bitcoin.

## 2.3 Basis for the interviews

All the interviews were different from one another. In order to extract distinctive information from the respondents I studied a large amount of material on cryptocurrency and specifically Bitcoin as well as macroeconomic models that the traditional currency system is based on. The order in which the interviews were conducted is of importance too. Having first heard the team from Safello and their

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\* User interface

perspective on Bitcoin, made it easier to have a confrontation with the other two respondents who are more traditionalists and support the current currency system.

## 2.4 Conducted interviews

The first interview took place at Safello after a 30 minutes lecture that Tristan Edwards and Ludvig Öberg held on Bitcoin and services that Safello offers. The lecture was divided in two parts. And after each part there was a Q & A space where everyone from the audience could ask questions to Ludvig and Tristan. In order to make relevant questions, prior to the lecture and interview at Safello, I gathered information on how Bitcoin works and what concerns many authorities have posed.

The interview with Cecilia Hermansson took place at the Royal Institute of Technology, where she is currently working on her PhD. It consisted of questions that aimed to understand an economist's point of view and opinion on Bitcoin. The material from this interview was gathered by making notes during the interview.

The third and last interview was with Björn Segendorf and took place at the Riksbank. The respondent was already familiar to the questions I was going to ask, but there were also other questions that came up during the interview. This interview, as well as the lecture at Safello, was recorded as they were expected to be the longest.

### 3. History of money and currency

It was just over 4 000 years ago when the first monetary societies first appeared.

Back then we used commodities as money that had intrinsic value, such as life stocks or seeds, which later turned into the use of precious metals, like gold and silver.

Bartering or the trading of goods and services without the exchange of money was being practised which was very inefficient and difficult to divide.

Metal-based currencies restrict the money supply because metal deposits are naturally limited. However, during the industrial revolution in the nineteenth century, the rapidly growing economy needed a means of payments that could adapt flexibly to this growth.

The goldsmiths of the past, who were the world's first bankers, accidentally invented currency when they gave out receipts for the gold they stored as a service to the public. Those receipts quickly became the first choice of use when trading among each other since it was far easier to carry and divide, than gold itself. It did not take long until the goldsmiths realised that people rarely asked for their gold back, since they could trade with their notes just as well as the gold itself, and never everyone at the same time. This became the birth of fractional reserve lending, when the goldsmiths started to issue more notes than there was value of gold in their vaults. As long as people had trust that their gold was safely in the vaults, they could continue printing out notes, or currency, for gold they did not have. Which devalued the supply of gold in the vaults.

Hence, the important difference between money and currency is that they both are a medium of exchange, a unit of account, they are portable, somewhat durable, divisible and fungible or interchangeable, but only money has a store of value, which means that it does not lose value over time, like all paper currency does today.

For example the German Mark in 1923, the value of money fell by 50% or more per day. Nearly everyone spent their money as quickly as possible on bread, shares, or other “safe” assets. However, this rapid circulation only served to stoke inflation even further. At the end, even the 144 printers working for the Reichsbank could not keep up with its demand for banknotes. Emergency money issued by the cities and local authorities, as well as by banks and other enterprises, started being circulated.

Although banknotes with a face value of trillions of Marks were issued, the vast demand for money led to paper shortage. Printers used anything that could be found-including wood, wool and silk.

In the “Geldmuseum der Deutschen Bundesbank” you can read a sign that says, “money is whatever goes”, but buyers still took the value of the goods on *trust* when making their purchase. A variety of crises are known in the economy, such as inflation crises, currency crashes, currency debasement, the bursting of asset price bubbles, banking crises, external debt crises, and domestic debt crises. Lack of confidence and lack of trust influence all.

Money is still a question of confidence even today, or rather it is the faith of being able to purchase the same goods or services tomorrow that drives the confidence in money, or more accurately, currency, today.

Whatever form it takes, reliable money has two characteristics; it is genuine, and it is stable. People can rely on its value.

After 1971 when the US Dollar, being a world reserve currency, was taken off the gold standard, immediately turning almost all currencies into fiat currency, which means that they are not backed by anything other than IOUs or ‘promise to pay’ from the banks with some insurances from the government, should the banks default. Throughout the history of money, not one single fiat currency has survived for any longer period of time. They all fall in value and eventually reach zero since you can keep on printing. This is somewhat regulated with central banks in modern times, since they must ensure that the money supply is restricted. But will it be enough to make our current currencies anything more than a column in future museums? There were plenty of failed currencies displayed at the Royal cabinet.

A private Swedish bank, Stockholms Banco, issued the first banknotes in Europe in 1661. People who deposited their copper coins at the bank were given a receipt in the form of a banknote. These banknotes became an extremely popular alternative to the heavy and impractical copper plates and soon the bank had issued many more banknotes than it could redeem.

A few years later Stockholms Banco collapsed. The Swedish Parliament subsequently established Riksbankens Sänders bank in 1668. In the early 1700s the bank began to use transfer bills. These bills could then be transferred to a new owner if desired.

In the 1800s and 1900s paper money becomes increasingly widespread but coins continue to be used. Many countries began to issue paper money. Colonial powers in particular had paper money printed for use in Africa, Asia and Oceania. Large printing works have mainly been established in England, France and Germany.

The beginning of the digital or virtual money that took us into a new era of money started in Sweden during the 1920s and 1930s when NK (Nordiska Kompaniet) used bricks made out of brass with client numbers on them as credit cards. In the 1950s we saw the birth of plastic cards in the USA. The benefits of using credit cards were to avoid having to handle coins and bills in larger quantities. They brought a huge change to our way of paying for goods and services.

In the late 90s the technology, with the help of Internet, started to evolve rapidly. The fact that information was so easily spread and accessible, contributed to people starting to invent new tools. One of these important inventions is the topic of this thesis, Bitcoin. Bitcoin was invented in 2009 by Satoshi Nakamoto. It is a currency that uses cryptography for security, therefore commonly called cryptocurrency. Bitcoin is part of a new era of currencies, the digital currency era, which we are now living in.

Currently, there are other digital currencies in use out there, such as Facebook's and Google's own ones, which are used to buy things within their networks.

## 4. Case study on Bitcoin

### 4.1 Short background on Bitcoin

“Probably the most successful and controversial – virtual currency scheme to date”- is how ECB defines Bitcoin on a publication on virtual currency schemes 2012.

Bitcoin is a completely decentralised network, in other words, there is no centralised authority regulating or controlling its performance. The fact that it is based on a peer-to-peer transactions network<sup>2</sup>, makes it possible to exclude all third parties. These digital coins, bitcoins, are transferred directly from person to person via the net, without going through a bank or a clearinghouse, which means that the transfer fees are lower.

You can use bitcoins in every country. All you need is a simple setup in order to connect to the Bitcoin network and start purchasing. Your accounts cannot be frozen and there are no prerequisites or arbitrary limits<sup>3</sup>.

What stimulated the invention of this currency was basically the increasing mistrust on financial institutions, which serve as third parties in processing the electronic payments. Completely non-reversible transactions are not really possible, since financial institutions cannot avoid mediating disputes. The cost of mediation increases transaction costs, limiting the minimum practical transaction size and cutting off the possibility for small casual transactions, and there is a broader cost in the loss of ability to make non-reversible payments for non-reversible services, is what is stated on Bitcoin: A Peer-to-Peer Electronic Cash System article released from Satoshi Nakamoto.

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<sup>2</sup> Look up: Definitions, Appendix

<sup>3</sup> Bitcoin.org



The market price of one Bitcoin since it was created:



Figure 1 The market price of one Bitcoin since 2009

As one can notice from this graph, there have been some rough price fluctuations in the past year (2013), which peaked on 1,151 USD per bitcoin at the end of last year and then started and kept dropping during the beginning of 2014. Today, if we refer to graph one Bitcoins market value reaches approximately 570 USD.

#### 4.1.1 Characteristics of the Bitcoin system<sup>4</sup>

- No authority is responsible for issuing and managing the Bitcoin system. It has operational rules open to everyone (transparent). No discretionary intervention is expected to happen.
- In order to verify that an owner does not double-spend\* a coin, the Bitcoin system uses a timestamp procedure on a peer-to-peer basis. All Bitcoin

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<sup>4</sup> Iwamura, Kitamura, Matsumoto, (February 2014)

\* Definitions, Appendix

transactions are organized in the log into blocks<sup>\*</sup>, which contain a sequence number called a timestamp, and the cryptographic hash<sup>\*</sup> of the previous block, some metadata, a nonce, and a set of valid Bitcoin transactions. The block forms a hash chain; each new block contains the cryptographic hash of its predecessor, allowing anyone to verify the no preceding block has been modified.

- The Bitcoin Network is secured by individuals called *miners*. Miners are rewarded with newly generated bitcoins for verifying transactions. After they are verified, the transactions are recorded in a public ledger, which is a public book of account. Any player may choose to become a miner and mine new blocks that add new transactions to the log. A new block is a valid addition to the log if its nonce is chosen so that the new block's hash is less than a target value. This procedure is called the proof-of-work.
- Bitcoins software is completely open source, meaning that anyone can review the code.
- The Bitcoin system controls new Bitcoin issues every 10 minutes by its program. The only new source of bitcoins is made from mining, which can be described as gaining bitcoins by solving complex mathematical equations using computers<sup>5</sup>.
- Incentive is paid for the proof-of-work. Every few years the creation rate of Bitcoin is halved, specifically, it was 50 Bitcoins in 2009-2012, 25 bitcoins in 2013-2016, 12.50 bitcoins in 2017-2020, 6.25 in 2021-2024, until it will reach zero in 2040. By that time will 21 million bitcoins be in circulation.

#### 4.2 How Bitcoin works<sup>6</sup>

Bitcoin as previously said is an open source, purely peer-to-peer version of electronic cash that would allow online payments to be send directly from one party to another

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\* Definitions, Appendix

\* Definitions, Appendix

<sup>5</sup> Investopedia, (Aug 2013) All about the Bitcoin ETF

<sup>6</sup> Bitcoin.org

without going through a financial institution. (Satoshi Nakamoto, Bitcoin.org). The creators of Bitcoin propose a solution to the double-pending problem using a peer-to-peer network. The network timestamps transactions by hashing them into an ongoing chain of hash-based proof-of-work, forming a record that cannot be changed without redoing the proof-of-work. This electronic payment system will be based on cryptographic proof instead of trust making so possible for any two parties to transact directly with each other without needing a trusted third party as an intermediary.

### 4.2.1 Transactions

On this paper the authors define an electronic coin as a chain of digital signatures. Each owner transfers the coin to the next by digitally signing a hash of the previous transaction and the public key, which is a passcode, of the next owner and adding these to the end of the coin. Afterwards a so-called payee can verify the signatures to verify the chain of ownership. We need a way for the payee to know that the previous owners did not sign any earlier transactions and the only way to confirm the absence of one is to be aware of all transactions. To accomplish this without a trusted party, transactions must be publicly announced.

The following picture illustrates a chain of Bitcoin transaction:

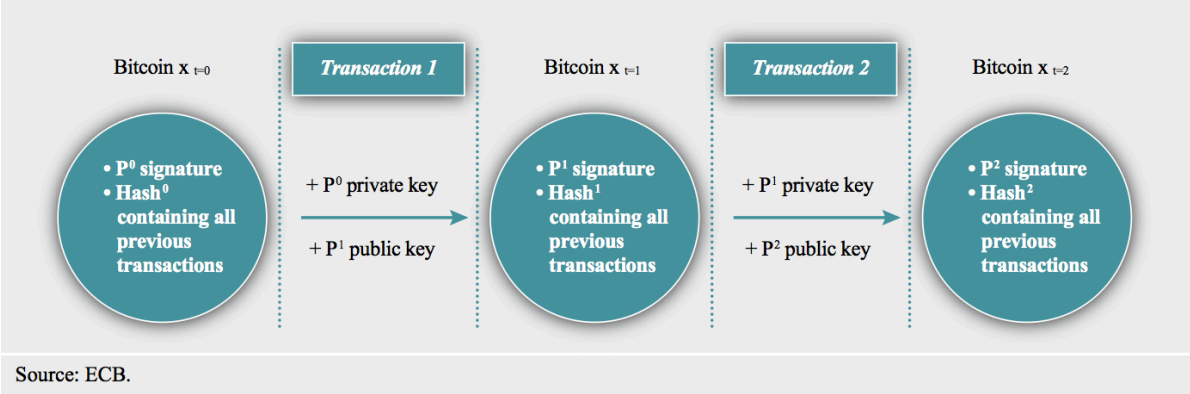


Figure 2 A Chain of Bitcoin transactions

### 4.3 Media

There have been hundreds of different articles regarding Bitcoin in the written media. A great part of the articles express a slight scepticism in the digital currency, fewer state their enthusiasm for the new innovative technology.

There are many who wonder how is Bitcoin to be defined tax wise. Dagens Nyheter, on an article from February this year states that for the Tax Board and the Tax Agency Bitcoin is an on-going issue. Recently, both authorities among other things come to the conclusion that exchanging of Bitcoin is to be counted as service<sup>7</sup>.

Meanwhile, faced with the dilemma whether to treat Bitcoin as currency or property for tax purpose, the U.S. government chose the latter<sup>8</sup>.

### 4.4 Research papers

Bitcoin: Asset or currency?<sup>9</sup>

Kaplanov (2012) concludes that Bitcoin rather resembles a community currency. Krohn-Grimberghe and Sorge, 2013, have examined the features of Bitcoin and come up with a legal classification. The Internal Revenue Service (IRS) and the Financial Crimes Enforcement Network (FINCEN) do recognize Bitcoin as a virtual and convertible currency but they however do not refer to it as a “real” currency because Bitcoin does not have a legal tender status in any country (FINCEN, 2013; IRS, 2014).

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<sup>7</sup> Dagens Nyheter, (Feb 9, 2014) Bitcoin fortfarande ickefråga i riksdagen

<sup>8</sup> Bloomberg, (Mar 25, 2014) Bitcoin is Property, not Currency, in Tax system: IRS

<sup>9</sup> Glaser, F., Bitcoin: Asset or Currency? Revealing users hidden intentions

## 5.Theory

### 5.1 The Austrian school of economics

This is an economic school of thought that has its origin in Vienna in the late 19<sup>th</sup> century from the works of Carl Menger.

The topic of interest to Bitcoin is the theory of the business cycle, which was discovered and set forth by the economist Ludwig von Mises who at the time was a professor at the University of Vienna<sup>10</sup>. The definition for business cycles from an economist's point of view consists on fluctuations in aggregate economic activity that an economy experiences over a period of time, which might last from a year to longer than a decade<sup>11</sup>.

According to the Austrian theory, business cycles are the inevitable consequence of monetary interventions in the market, whereby an excessive expansion of bank credit causes an increase in the supply of money through the money creation process in a fractional-reserve banking system, which in turn leads to artificially low interest rates. When that happens, the entrepreneurs, guided by deformed interest rate signals, enter on overly ambitious investment projects that do not match the consumers' preferences at that time (their decisions regarding near-term and future consumption). Sooner or later, this instability can no longer be sustained and leads to a recession, during which firms need to liquidate any failed investment projects and readapt (restructure) their production structures in line with consumers' preferences at that point in time. As a result, many Austrian School economists call for this process to be abandoned by getting rid of the fractional-reserve banking system and returning to money based on the gold standard, which cannot be easily manipulated by any authority.<sup>12</sup>

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<sup>10</sup> Rothbard, M. (2009) Economic Depressions: Their Cause and Cure

<sup>11</sup> Definition: Economic Cycle Research Institute (ECRI)

<sup>12</sup> ECB (2012) Virtual Currency schemes

Here are some ideologies that are generally shared by Bitcoin supporters:

- They see Bitcoin as a good starting point or a solution to end the monopoly central banks have in issuing money.
- They are strongly against the current fractional-reserve banking system through which banks can extend their credit supply above their actual reserves and, simultaneously, depositors can withdraw their funds in their current accounts at any time.
- The Bitcoin scheme takes inspiration by the former gold standard.<sup>13</sup>

## 5.2 Monetary aspects of Bitcoin

The Bitcoin scheme is designed as a decentralized system where no central monetary authority is involved. Bitcoins can be bought on different platforms. However, the only ‘new’ money supply fueled into the system is created and introduced into the system only via the mining activity, by rewarding the “miners” who perform the crucial role of verifying all transactions made, with new Bitcoins. Therefore, the supply of money does not depend on the monetary policy of any virtual central bank, but rather evolves based on interested users performing a specific activity<sup>14</sup>. As stated in 4.1.1 last point, the creation rate of Bitcoin has been technically designed in such a way that the money supply will develop at a predictable pace. In order to receive newly created Bitcoins the algorithms that should be solved (i.e. the new blocks to be discovered) become more and more complex and thus more computing resources are necessary.

The fact that the Bitcoin creation is previously determined, it will stop at 21 million bitcoins, in theory implies that, any central authority or participant wanting to print extra money cannot adjust the issuance of money. According to Bitcoin supporters, the system is supposed to avoid inflation, as well as the business cycles originating from extensive money creation. However, the system has been accused of leading to a

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<sup>13</sup> ECB (2012)

<sup>14</sup> ECB (2012)

deflationary spiral. The total supply of Bitcoins is expected to grow geometrically until it reaches a finite limit of 21 million. However, if for any reason the number of Bitcoin users starts to grow exponentially, and assuming that the velocity of money does not increase proportionally, a long-term appreciation of the currency can be expected or, in other words, a depreciation of the prices of the goods and services quoted in Bitcoins (ECB 2012). People would want to hold their Bitcoins and not consume it, thereby aggravating the deflationary spiral.

According to the Economists article on Virtual currency<sup>15</sup>, the deflation hypothesis imposes an assumption that is not realistic at this stage, which is that many more people will want to receive Bitcoins in return for goods or in exchange for paper money. However, Bitcoin is still quite immature and illiquid (the 6.5 million Bitcoins are shared by 10,000 users) which is a clear disincentive for its use. Moreover, Bitcoin is stateless therefore not directly linked to the goods and services produced in a specific economy, but linked to the goods and services provided by merchants who accept Bitcoins. These merchants may also accept another currency (for instance US dollars) and therefore, the fact that deflation is anticipated could give rise to a situation where merchants adapt the prices of their goods and services in Bitcoins.

### 5.3 Macroeconomics of Bitcoin

Here I present a model that J. Wang of Bitquant Research laboratories has come up with. It is not yet a model to be applied, but only intended to primarily stimulate a discussion on the topic.

Dr. Joseph Chen-Yu Wang has a doctorate in astronomy from the University of Texas at Austin with over 20 years software development experience, and was a Vice-President in the quantitative research division of JPMorgan.

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<sup>15</sup> Economist, The (2011a)

*“This is a simple model, extracted working paper, for the macroeconomic behaviour of Bitcoin based on the economic equation of exchange. According to this model, the value of Bitcoin is determined largely by the willingness of Bitcoin holders to save Bitcoin and not by its transaction use. Therefore the model predicts that increased use of Bitcoin will not cause its value to rise, but that the value of Bitcoin in terms of fiat currency will be almost solely determined by the willingness of Bitcoin holders to pull Bitcoin out of circulation. The model suggests that Bitcoin will not fall victim to a liquidity trap as suggested by some economists.”<sup>16</sup>*

$$M \times V = P \times Q$$

M is the normal amount of money

V is the velocity of money

P is the price level

Q is the index of real expenditure

- All quantities are expressed in units of fiat currency
- Set the P to 1
- The value of M is now the value of Bitcoin as measured in fiat currency units.
- Number of Bitcoin in circulation = nb; the price of a single Bitcoin = pb
- Substitute  $M = nb \times pb$

$$Pb = Q/nbV$$

As it is stated on Wang's working paper:

Nb is an externally determined and slowly changing variable. The main determinant of the price of Bitcoin is the interaction between the levels of Bitcoin usage the velocity of Bitcoin.

Dynamics of Bitcoin:

- Likelihood that Bitcoin is saved =  $l(s)$ ; likelihood that Bitcoin is transacted =  $l(t)$ ; will sum to 1
- $v(s)$ ;  $v(t)$

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<sup>16</sup> Wang, J., (February 2014), A simple macroeconomic model of Bitcoin



Implications of Dr. Wang's model:

- The price of Bitcoin is determined almost solely by the likelihood that a given Bitcoin will be saved. If a user uses Bitcoin for transaction purposes then this has no impact on the value of Bitcoin, while the value of Bitcoin raises a given Bitcoin is more likely to be saved rather than transacted.
- Two events that caused Bitcoin prices to increase: 1. Cyprus banking crisis in April 2013 and 2. The rise of Mainland Chinese Bitcoin exchanges in October 2013. (Both increased the likelihood that a given Bitcoin would be saved rather than transacted, which increased the price of Bitcoin)

Some economists, notably P. Krugman are pessimistic about the viability of Bitcoin as medium of exchange, because they will fall into a liquidity trap caused by the fixed supply of Bitcoin.<sup>17</sup>

Krugman claims that as the price of Bitcoin rises, the amount of Bitcoin in circulation will decrease thereby increasing the price, ultimately creating a situation in which Bitcoin is completely hoarded. This effect has been observed in scrip economies such as the Capital Hill Babysitting Co-op, Krugman 1997.

BRL claim is instead that as the price of Bitcoin rises, people will be more likely to spend their Bitcoin rather than fiat currency, which will decrease saved bitcoins thereby cause Bitcoin prices to fall. Conversely a fall in the price of Bitcoin will increase the likelihood that people will save Bitcoin as they will be more interested to spend fiat, and this will cause Bitcoin prices to rise (once again). BRLs model insists on that long-run increases or decreases in the prices of Bitcoin will not be influenced by the transactional use of Bitcoin but rather the external factors, which change the likelihood that a given Bitcoin will be saved.<sup>18</sup>

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<sup>17</sup> Krugman, 2013

<sup>18</sup> A simple macroeconomic model of Bitcoin, Wang, February 2014

*“Krugman’s belief that Bitcoin is destined for a liquidity trap ignores the fact that Bitcoin exists within an fiat-based economy, and that the ease of convertibility to and from fiat prevents a liquidity trap that exists when convertibility is difficult.”*- Concludes the working paper on a macroeconomic model on Bitcoin.

## 6. Empirical evidence

*This chapter will consist on the first part with a lecture that I participated in at the company Safello and on the second part with interviews that took place in order to get a profound understanding on the topic.*

### 6.1 Lecture about Bitcoin at Safello

*Ludvig Öberg, VP of Business Development at Safello*

Centralised monetary system, means that they can print or confiscate money, which has posed different problems such as inflation rates and also usually slow because you have to wait for someone to verify it for you which mean that you cannot do transactions on holidays or weekends when banks are usually closed.

The solution to this is something called *block chain*. This is a decentralised ledger. It is basically a massive data book of who owns what and how many bitcoins and on what addresses they are, and that is spread out to everyone, everyone can hold it, and everyone can see it. It is transparent.

The way it is validated is that instead of having a central party, you have a group of people, a network that can verify the transaction for you. And the way this works is something called *proof of work*. This is a solution to a problem that has previously not been solved, which is how to validate data on a network that is not safe. So, if I do not trust anyone on the Internet how do I know that the data that they sent to me is correct?

So, this currently works with something called *mining*. They solve a very complex mathematical algorithm with their computer.

If you can show that you can put it at a value than it is less likely that someone is faking a transaction, as in to sacrifice something to prove something else.

Then basically the way that Bitcoin validates transactions in reality, works like this.

You send the transaction, usually with an average of about 10 minutes network, then the transaction returns and say 'we have validated it and you can see that it has now gone through'.

There have been some concerns previously that nobody knows who created Bitcoin.

2009 someone called Satoshi Nakamoto, might be a person or a group of people we do not know, it is an alias, released the *Bitcoin code*, but this does not really matter as it is an open source. Anyone who knows programming can read the code and check what it does. It is completely decentralised, so there is no central point that you have to trust, instead you have mathematics. This is some of the strengths of Bitcoin system.

Some other strengths of Bitcoin is that it is very hard to shut down because there is no central place, and it basically works the same way as torrents do.

*Tristan Edwards, UI/UX designer at Safello*

Safello was born in summer 2013 with one simple goal and that is to make it easy and simple for everyone to use Bitcoins. It was a very small team at first that launched the very first version of the website about a month after the company was created.

The reason I joined was because this was a once in a lifetime opportunity to fundamentally change how the world works.

So, as an example, the Internet today has completely changed the way we interact with each other, how the media works and has started to change education as well. But in spite of all this innovations there is one sector that has remained pretty much unchanged and that is the banking and financial sector. We still use these same old companies, which have pretty much used the same old services for hundreds of years.

We do have Pay Pal, which is still built on top of an old traditional system, it has not really been this revolution from the bottom up that fundamentally changes the rules of a game that when it comes to a democratic system.

Bitcoin is an amazing invention. It is not just a new transaction protocol, but it is a new currency. So even though there might be some problems and speculations about volatility, I think the positive sides of it far outweighs the negative sides.

*It is probably the first time in history that we actually have the opportunity to start from scratch and reinvent a new financial system. We can tailor it to the new information age. Credit cards and bank transfers were not really designed for the global economy of the Internet.*

The fact that it is an open source means that we can keep changing it as our civilisation goes further. It kind of triggers an evolutionary process that always stays relevant. All this exciting potential is one of the reasons why we decided that Safello should not just be a Bitcoin exchange. I see exchange as the first step for Bitcoin companies. It is a sort of a transition period where people will go from fiat to cryptocurrency. But what the interesting stuff is what will come later. Just like no one could anticipate Twitter or Facebook and the Internet when it first started in the 90s, it is equally impossible for us to predict what will be built on top of this protocol later. So that is one reason why Safello wants to be a general Bitcoin company and offer a lot of these different services on top of the Bitcoin network and the one that will be build in the future.

Another reason why we are not just a regular garnering exchange is because of security. If you are an exchange, people have to first deposit money on their site. And they have to store it there until they think it is time to trade. When they decide to trade they set a price and hope that someone will accept it and then have to wait to withdraw their money to their own bank account or to their Bitcoin wallet.

As we have seen the Mt Gox scandal, storing money on an exchange is not always a good idea because than you have to have a hundred percent faith on this company, and have to trust that they do not mess around with your Bitcoin private keys or with your fiat money for that matter.

So, not being a Bitcoin exchange but rather a Bitcoin retailer has actually many advantages. On Safello you do not have to trust your funds with us if you do not want to. You can purchase bitcoins with your normal bank account and we then send your bitcoins directly to your wallet on your computer instead of going through some kind of middle wallet in between. So we can offer a lot of things that other exchanges cannot. For example we can make fast payment methods so that any European customer can buy bitcoins directly from us through their bank.

Every time you buy bitcoins you get a receipt that allows you to keep track of your purchases. If you decide you want to sell bitcoins, we can lock the price for 15 minutes so you won't have to worry about price fluctuations, which is very common in bitcoins. We basically want to show the people who are sceptical about getting into the Bitcoin world that it does not have to be hard and this is a natural evolution for any new technology. At first we are slowly moving away from this 'geeky' phase to a more mainstream audience. That is also why we are spending more time getting solutions that people might feel more comfortable with, like the Bitcoin ATM. It is easy for people to understand that when you put money in, you can get bitcoins out. And the key right now is to ease the transition from the old system to this new one and usually when you have made the transition to Bitcoin you do not want to go back because you realise how easy it is to make transactions and send people money. Safello offers its services not only in Sweden but in some other European countries as well, for buying and selling bitcoins.

This is just the beginning. What we are truly excited about is the upcoming financial services that really turn the old school banking upside down and make everything easier, faster and overall better for average people. So without revealing too much of our upcoming products we have some very cool stuff coming up and one of them is that we want to give you a nice way to easily store and send Bitcoin to one another. Because for average people, using wallet software and keeping track of other people's public key addresses, is really far too complicated today. It might be easy for us because we are probably all tech geeks.

It is not a pleasant experience logging in to a bank account. It is actually rather boring. And this is a shame because every transaction is interesting, it does tell a story of who you are. You can transform banking to something that is more personal, more social and something you actually can enjoy using.

We have some very exciting times ahead of us and what is most exciting is that most people do not know what is happening yet. Just like the Internet in the early 90s, right now it is kind of confusing, and no one really knows what Bitcoin is used for or why it is any good. So right now we are that tiny minority in the beginning of the 90s who were using computers and internet when no one else did.

## 6.2 Interviews

Questions after the lecture at Safello

*Tristan Edwards, UI designer at Safello*

*Ludvig Öberg, VP of Business Development at Safello*

1. Do you have any moral aspect of this whole project? Is there a stand that you think its good to go outside the financial infrastructure?

Bitcoin is a tool, it itself has no moral implications. It can be used for both good and bad. It has also been used for charity and other things, not only buying drugs and such. Bitcoin by it self is just a technology.

2. Is this a good way to bypass the banking system? (Not giving banks so much influence and power and money)

I do not think that it is necessary to bypass the banks. It is more about upgrading the current technology. I think the financial system has been stagnant for a very long time and it is up to them to change.

### 3. Trust in Bitcoin

I think it is a lot about building user-friendly and serious services that have good security. I think because Bitcoin is digital and it has always been quite hard to secure just because the standard has not been there on how to actually operate an exchange out of an operational service and I think it is something that is going to happen as more serious actors get into the market and as the market develops, but I do not think we are really there yet. However I would not bring this to my mom or grandmother to use because first of all, I would not trust that she could keep her Bitcoins safe at the moment with the current services that are there and I do not think it is user-friendly enough at the moment. I think that is something that the community has got to improve on.

*Cecilia Hermansson, Senior Economist at Swedbank, PhD KTH*

C. Hermansson felt very sceptical about Bitcoin and its future development. She raised many concerns on this currency such as its lack of transparency, anonymity and money laundering, something that has been reported on the media as well<sup>19</sup>. In her opinion, all those who feel threatened by the performances of central bank and their role, do not understand anything about macroeconomics.

*Björn Segendorf, Riksbank*

“The Riksbank sees a lot of innovation, which is principally a good think. Depending on the technical solution there is to it varies the risk. We are anyhow starting to positively undergo a new development. There is no data on Bitcoin that shows how much it is

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<sup>19</sup> The Swedish wire, January 2014, Bitcoin used for money laundering; blocked by Swedish bank

used, I have checked exchange transactions Bitcoin-crown and I noticed a very minor usage on the Swedish market.”- Answers Segendorf to the first question about whether the risk on Bitcoin still lies on an individual level or more. “Bitcoin is extremely volatile and we have not yet noticed any difference from last years situation created around Bitcoin. And it is not that strange having to consider that is a very tiny market.

Approximately there are only 50 million dollars worth of Bitcoin transactions made on a daily basis. So, globally the value of the transactions is really small. Besides its volatility there’s also another concern regarding Bitcoin, that of the actual utilisation of this currency. Is it used for payments or for speculative investments? Is it a financial asset or mean of payment? These ambiguities on the usage do influence the exchange rate of Bitcoin.

Bitcoin has not had any effect on the real economy, yet. No spill over effects of any shape, yet. If the volume of usage would increase (it is considered possible) we could not tell what the result and effects would be.”

2. Besides the technology factor, what are the prerequisites today (time frame consists of 2009-today) that have made possible for Bitcoin to receive this much attention?

“It is indeed a very interesting technical solution as well as the anarchistic aspect of it. Media has played its important role on giving a lot of attention.

For Bitcoin to be worth something, you are going to have to possess Bitcoin. There has to be some regulation that would cover consumerism. There is no ‘own value’ on Bitcoin because Bitcoin is not a claim on anyone, as other currencies released from a central bank are. The value of a Bitcoin is rather defined by the confidence that with this Bitcoin I will be able to purchase something tomorrow. Instead central and other banks have the assets to back this claims as well as guarantee on deposits and payment technical rules. “This purchasing power exists on your account” and by this assurance is obvious that you are going to want to keep your money there where they are ‘safe’. So this aspect B.S thinks is going to play a major role on deciding whether Bitcoin is going to become a big phenomenon or not.

The Bitcoin protocol is not something one can commit to convincingly.



Virtual currencies are easy to generate. But you need to make it trustworthy. There is no guarantee on it. How does the pricing work for Bitcoin? Is not something that you can easily define. Buying a 15 SEK cup of coffee with a Bitcoin, which when worth at its highest was 8000 SEK, becomes suddenly very complicated as you have to divide it in multiple decimals. It is simply not regarded as a practical currency when it comes to the physical usage.”

### 3. What are your thoughts about Bitcoins sustainability?

Segendorf expresses his concern and worry on Bitcoin. The Bitcoin system is extremely reliable on computing power. Block chain is already a ‘big monster’ even though there are still few transactions/payments made. What happens when the payment on Bitcoin will increase? Will it explode, is it sustainable? There is no flexibility on this currency as there is a fixed set up for the amount of generating bitcoins. If the volume of transactions on Bitcoin would become the main one, then the flexibility would be an important issue, which would be necessary to improve on.

### 4. Thought on the crowns sustainability.

“Cannot see how something like Bitcoin could possibly substitute a national currency. National currency is some kind of a claim/instrument of debt on the bank and banks on one another... And there you have the fundamental difference between national and cryptocurrency. The government will never accept for its citizens to their taxes on Bitcoin. This is how it is and it will never change. The Swedish government will want payments on Swedish crown because is its own currency, as simple as that. There is at the same time an issuer (Riksbank) that everyone could demand answers and information from. Is reachable and not anonymous.

I cannot see how cryptocurrencies can become anything but a complementary payment mean, which would work out fine only on niched sectors of the market.

The timing of each transaction makes it less good and compatible with a national currency.”

5. Do you see any new trend of “new thinkers” regarding currencies?

“There are many signs that point on that direction. Innovation on the last 5-6 years has focused a lot on mobile payments. There is a whole different way of thinking today when it comes to new types of currencies. The banks are trying to protect their own market shares. But they certainly do not think of Bitcoin as a possible way to pay with, because they want to build their business models around something they own themselves. And the whole thing with Bitcoin is to get away from these business models.

Different countries have reacted in different ways. Money laundry...Russia and China are against it. EBA same. The Swedish Riksbank has not yet come out with an official statement on Bitcoin. As the ‘china’ banning Bitcoin resulted on a rather crafty price fluctuation, means that Bitcoin will be very sensitive on how different countries react to it and what position they take. However Bitcoin is not anonymous!”

## 7. Analysis

*This chapter will consist on the analysis based on the empirical evidence and theory presented on the previous chapters.*

### 7.1 Exploring both sides of Bitcoin

Before getting into the positive and negative aspects of Bitcoin, it is important to ponder on the reasons why this invention was made in the first place. Why did it happen? What were the factors that triggered the creation of Bitcoin?

Satoshi Nakamoto started the Bitcoin project in 2008 and it was then finalized ready to be launched in 2009. It was right after the financial crisis of 2007 hit many countries and their financial markets. Many people lost their jobs, which consequently made them loose faith on the governments, banks, central banks and financial system. The creators of Bitcoin saw a possible solutions or maybe an alternative way to keep off from being affected from the irresponsible actions of actors within the financial system.

Bitcoin is not the first cryptocurrency. It is however the first *decentralised* digital currency that uses cryptography for security, therefore also called cryptocurrency. This characteristic makes it clear that the inventors and supporters manifest a considerable mistrust on the central banks and their actions.

In order to get tidy view on both “sides” of Bitcoin, I will go through all of the main features of this electronic currency, based on the information gathered in chapter three, four and six.

Positive aspects:

- **Decentralised** – A currency is said to be decentralised when no centralised authority is involved in issuing the currency. By having a fixed creation rate of bitcoins, the inventors aim to avoid speculations on the system, which can occur by corrupted actors within banks or central banks. A fixed creation rate in theory makes it impossible for the currency to inflate, however it would theoretically start to deflate when the issuing will stop.

- **Open source** – As Ludvig and Tristan from Safello said, everyone who knows programming can review the code of Bitcoin and check what it does. This gives a sort of transparency to everyone who wants to learn more about how these virtual coins are generated.
- **Low transaction fees** – With Bitcoin you can make worldwide transactions, from person to person for less than a cent per transaction. These low fees make it interesting for businesses as well as individuals to minimize their transaction fees, consequently saving money that can be spent or invested elsewhere.
- **Accounts cannot be frozen** – Making it impossible to freeze someone's account, eliminates any subjective judgement regarding an individual's actions and activity. It is free of political influences.
- **No prerequisites, no arbitrary limits**
- **Does not cost to start accepting Bitcoin** – Makes it attractive for businesses to try it out as a way of payment and draw in customers that prefer using bitcoins.
- **Easy to set up** – The scale of difficulty is very subjective. It is determined by the level of skills and information an individual who wants to start using bitcoins has. However, there are accessible guidelines that make it easy to get started.
- **Anonymous online transactions** – Anonymity does not necessarily mean something negative. Not everyone who wants to be anonymous has bad intentions. Being anonymous gives some kind of privacy and “minding its own business” kind of behaviour.

#### Negative aspects:

- **Anonymity** – Makes it easier for those who want to use bitcoins to, for example, buy drugs and other illegal things, or finance illegal businesses.
- **Volatility** – Bitcoin is sensible to other potential new cryptocurrencies. Who knows what can happen if within some months there is another new cryptocurrency in circulation that has better protocol and security solutions than Bitcoin and therefore attracts more users? This could bring to those who have

invested and bought bitcoin make great losses. In other words, it depends on its popularity.

- **Money laundering, speculative investments** – This was one of the concerns risen by Hermansson during the interview. What has turned out to be bad with the anonymity of the bitcoin transaction addresses is that it had become prone of illegal activity. Very difficult to keep track of criminals in this network, compare to the traditional one where banks and criminal investigative authorities often collaborate with each other.
- **Price instability** – Price instability is a very problematic aspect of Bitcoin, which frightens many potential users that still hesitate on buying bitcoins. As showed on Figure 1, the price fluctuations within the last two years have been quite drastic, giving no certainty for the days to come.
- **No guarantee** – One of the disadvantages of not having a central authority that regulates the system and imposes rules on other banks, is that you cannot enable guarantees in case of bankruptcy.
- **Legal frame**
- **Pricing** – As Segendorf mentioned during the interview, the pricing for Bitcoin is not something easily definable. For example, buying cheap goods and services becomes suddenly very complicated, as you have to divide a bitcoin in multiple decimals. Neither is regarded to be a practical currency when it come to the physical usage.
- **Exposed Digital wallets** – Something frightening with digital wallets is that they can be hacked. Or in case of loosing either private or public key, which are to different passwords needed in order to gain access of your digital wallet, will make it impossible to log into your digital wallet, therefore lose the bitcoins in it. There are no central agencies or units that keep track of these keys or issue replacement ones.<sup>20</sup>
- **Relying on an exchange platform** – Having to trust something you do not completely comprehend, like very complicated algorithms, makes many be

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<sup>20</sup> EBA, (Dec 2013) Warning to consumers on virtual currencies

sceptical and holds them back from trading with bitcoins. Relying on exchange platform means that one has to accept their exchange rate as best at the moment

## 7.2 Traditionalists Vs new thinkers

“More than 100,000 people use Bitcoin. All over the world people are trading hundreds of thousands of dollars worth of bitcoin every day with no middle man and no credit card companies. It's a startup currency, which has never happened before.”-

Weusecoins.com

Clearly, very few individuals who have most likely engaged in this network to experiment, bypass the financial system or undergo illegal activity are using Bitcoin. Hermansson sees no future for this cryptocurrency as its negative aspects outweigh the positive ones. On the other hand the Swedish central bank, has not made any public statement yet, other than stating that Bitcoin is no threat to the financial stability of the Swedish financial market. The risks lie on an individual level because of the unstable exchange platforms.

Another issue of Bitcoin is the pricing and value of this currency. What are the factors that make 1 bitcoin worth several hundreds of USD? Following macroeconomics, where demand meets supply there is the setting price. So, because there are fewer bitcoins in circulation than fiat currency, makes each bitcoin potentially worth millions. On the other hand, an experimental model on the value of Bitcoin from Dr. Joseph Wang, claims that the value of bitcoins lies on how many are saved and not how many bitcoin transactions there are taking place. This is still a complicated question, and hardly answered even by people who make of Bitcoin their everyday job. That is why many are hesitating to enter this market, yet.

According to Riksbank studies published work on the Swedish retail-payment market made in June 2013, there are indicators showing a possible future fragmentation of the payment market. As stated in the work these promoter forces are: existing and new challenging players are starting to launch new payment services; younger generations are

more prone to adopting to new payment services quicker; and lastly, payees may have different needs that could also contribute to the fragmentation of their demands on payment services.<sup>21</sup>

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<sup>21</sup> Riksbank studies, June 2012, The Swedish retail-payment market

## **8. Discussion & Conclusion**

The main purpose of this thesis was to explore the good and bad aspects of Bitcoin. The other one was to discuss whether or not this digital currency could continue to coexist with other currencies within the financial system.

This study indicates that there is a lot to be improved in order for Bitcoin to be trustworthy and competitive towards the fiat currencies or other types of cryptocurrencies.

As long as the government does not support these new currencies, such as Bitcoin, it will be very difficult if not impossible for them to reach to a greater number of users. Bitcoin will certainly be able to coexist along with other currencies, as it does since 2009. However, the way the situation looks like today, the Bitcoin market involves a minority group of users, compared to the market volume of the crowns usage in Sweden. Users and supporters of Bitcoin have the common interest on new and technology, innovation and above all, maybe, mistrust on the current financial system.

There are many questions rising concerning the future of this decentralised digital currency as well as for the commonly used traditional currency system. Is there room for improvement? The systems are far from perfect. A perfect system would be flawless and at the same time stimulate economical growth.

In order for Bitcoin to gain greater trust from its existing users and potential one, the protocol must undergo some improvements; mainly regarding the security system for the purpose of diminishing the losses caused by for examples forgetting either private or public key or the hard drive used to backup all that information could crash.

Bitcoin is still in an early stage of development, but would these and other improvements on its system attract more enterprises and individual and have them willing to start frequently use it? We will most likely be able to answer this question within few years and then observe how the dynamics of the currency systems will change.



## 8.1 Further studies

It would be very interesting to undertake a broader survey on Bitcoin users in Sweden, in order to understand not only from the theoretical point of view all the flaws and benefits of such currencies, Bitcoin in particular. Another area of interest to this topic would be a thorough study on different macroeconomic models, based on different economic ideologies, such as The Austrian school of Economics, and decide which best is fitted to the Bitcoin and digital currencies systems.

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## Interviews

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## Appendix

*Interview questions to Björn Segendorf:*

1. The risk lies on an individual level. There is a high exchange risk for those who own bitcoins.

Do you think things have changed since a year ago? Do you see any future threats for the currency (the crown) or the financial stability?

2. Besides the technology factor, what are the prerequisites today (time frame consists of 2009-today) that have made possible for Bitcoin to receive this much attention?

3. What are your thoughts about Bitcoins sustainability?

4. Thought on the crowns sustainability.

5. Do you see any new trend of “new thinkers” regarding currencies?

## Definitions

**Address:** It is the only information you need to provide for someone to pay you with Bitcoin. Each address should only be used for a single transaction.

**Block:** Is a record in the block chain that contains and confirms many waiting transactions. Roughly every 10 minutes, on average, a new block including transactions is appended to the block chain through mining.

**Block Chain:** The block chain is a public record of Bitcoin transactions in chronological order. The block chain is shared between all Bitcoin users. It is used to verify the permanence of Bitcoin transactions and to prevent double spending.

**BTC:** Common unit of Bitcoin currency.

**Cryptography:** Cryptography is the branch of mathematics that lets us create mathematical proofs that provide high levels of security. Online commerce and banking already uses cryptography. In the case of Bitcoin, cryptography is used to make it impossible for anybody to spend funds from another user's wallet or to corrupt the block chain. It can also be used to encrypt a wallet, so that it cannot be used without a password.

**Double spend:** If a malicious user tries to spend their bitcoins to two different recipients at the same time, this is double spending. Bitcoin mining and the block chain are there to create a consensus on the network about which of the two transactions will confirm and be considered valid.

**Hash Rate:** The hash rate is the measuring unit of the processing power of the Bitcoin network. The Bitcoin network must make intensive mathematical operations for security purposes. When the network reached a hash rate of 10 Th/s, it meant it could make 10 trillion calculations per second.

**Mining:** Is the process of making computer hardware do mathematical calculations for the Bitcoin network to confirm transactions and increase security.

**P2P:** Peer-to-peer refers to systems that work like an organised collective by allowing each individual to interact directly with the others. In the case of Bitcoin, the network is built in such a way that each user is broadcasting the transactions of other users. And, crucially, no bank is required as a third party.

**Private Key:** A private key is a secret piece of data that proves your right to spend bitcoins from a specific wallet through a cryptographic signature. Your private key(s) are stored in your computer if you use a software wallet; they are stored on some remote servers if you use a web wallet. Private keys must never be revealed as they allow you to spend bitcoins for their respective Bitcoin wallet.

**Signature:** A cryptographic signature is a mathematical mechanism that allows someone to prove ownership. In the case of Bitcoin, a Bitcoin wallet and its private key(s) are

linked by some mathematical magic. When your Bitcoin software signs a transaction with the appropriate private key, the whole network can see that the signature matches the bitcoins being spent. However, there is no way for the world to guess your private key to steal your hard-earned bitcoins.

**Wallet:** A Bitcoin wallet is loosely the equivalent of a physical wallet on the Bitcoin network. The wallet actually contains your private key(s), which allow you to spend the bitcoins allocated to it in the block chain. Each Bitcoin wallet can show you the total balance of all bitcoins it controls and lets you pay a specific amount to a specific person.

\*Source of these definitions is [Bitcoin.org](https://bitcoin.org)