The adoption process of cryptocurrencies

Identifying factors that influence the adoption of cryptocurrencies from a multiple stakeholder perspective.

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Identifying factors that influence the adoption of cryptocurrencies from a multiple stakeholder perspective

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Management Summary

Cryptocurrencies[1] are rapidly gaining more and more interest as a technology that is potentially groundbreaking and disruptive for the whole payments industry on a global scale. However the future of cryptocurrencies is very unclear as there are many different usage scenarios and different stakeholders have different needs. In order to be able to give a better future perspective and to determine possibilities for improvement of cryptocurrencies factors that influence adoption will have to be determined. To achieve this the following main research question was formulated:

What are factors influencing the adoption of cryptocurrencies in different usage scenarios for different stakeholders?

The way current payment systems work throughout the world varies widely. The added value of cryptocurrencies therefore also hugely differs per geographical area. In order to be able to give clear and concise conclusions this research is scoped towards looking at the European market and the Dutch market in particular.

Based on the Diffusion of Innovations Theory, which defines characteristics necessary for an innovation in order to be successfully adopted, a conceptual model to describe the adoption of cryptocurrencies was formulated. This model was based on academic literature resulting from a literature review. The model was then validated by means of qualitative semi-structured interviews with subject experts.

To make sure that a balanced view was obtained stakeholders from a wide range of industries were interviewed: employees from the four biggest Dutch banks, the Dutch Central Bank, the three largest Dutch cryptocurrency exchanges, senior payments consultants, Payment Service Providers, a cryptography expert and the largest Dutch company that accepts cryptocurrency, Thuisbezorgd.nl.

During the interviews barriers were identified that have to be overcome in order for cryptocurrencies to be adopted on a large scale. The three main pillars which are important for future mass adoption are:

1. Ease of use: at the moment there is a lack of user-friendliness when using bitcoins. Sending and receiving bitcoin is still cumbersome and holding bitcoins is prone to many risks. Users need to be able to have more confidence in the safety of their funds.
2. Price stability: the current price volatility driven by speculation and a lack of liquidity makes that it is very risky for a user to keep his funds in cryptocurrency as the value varies wildly. This undermines the function of cryptocurrency as a store of value.
3. Governance: the current bitcoin foundation undermines ideological aspects of cryptocurrencies by being very centralized and intransparent. There is increasingly less democracy in the bitcoin ecosystem with large mining companies entering the system and big investors holding large amounts of bitcoin. Solutions to future problems as scalability and the height of transaction fees are not being dealt with efficiently and no clear roadmap to solving these problems is available.

The security risks associated with stealing cryptocurrency of users by a direct attack or by hacking of exchanges turned out to not be a real problem according to the interviewees. This was mostly seen as a minor problem, something that also can happen with other payment methods. The expectation is that in the future the security of exchanges and private wallets will increase when higher adoption levels are reached.

Cryptocurrencies also have benefits over existing payment methods. The low transaction costs and low barriers to entry of the system make that it is very easy for newcomers to enter the cryptocurrency ecosystem and start using it; either as a payer or payee. The fast worldwide, cross-border transactions and partial anonymity can also be an advantage depending on the stakeholder and the usage scenario. In the paradigm of globalization and online shopping a global currency fits very well; cryptocurrencies can play this role.
Removing the aforementioned barriers is necessary but not sufficient to guarantee success. Whether the adoption of cryptocurrencies will take off and reach mass adoption is something that remains to be seen.

[1] A cryptocurrency is a digital medium of exchange that relies on a decentralized network, that facilitates a peer-to-peer exchange of transactions secured by public-key cryptography.

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Writing this thesis is my final task as a master student at the University of Twente. It signifies the end of the life as a student and the beginning of starting with the first fulltime job. When thinking of graduating I immediately thought of graduating on a topic which intersects between IT and Finance. These two worlds have always interested me and are a good fit with the master-track IT & Management as part of my study Industrial Engineering and Management at the University of Twente.

After careful deliberation I came to the topic of cryptocurrencies. This topic had already caught my interest in the spring of 2013, when I first got involved with cryptocurrencies by mining and buying them. What better way to graduate than on your favorite topic?

At that time I had already decided to ask Prof. Dr. Jos van Hillegersberg to be my first supervisor, the choice to ask Dr. Berend Roorda as second supervisor was a logical one as he has affinity with Finance whereas the affinity of Van Hillegersberg with IT. This proved to be a good combination and during the process of graduating they both had very useful and to the point feedback. Therefore I am very grateful for their help and supervision during the past months.

I did not conduct the research at the university; during the period I was an intern at KPMG - Risk Consulting - IT Advisory, department Financial Services. I am very thankful for KPMG to provide me with the chance to do this internship at the Financial Services department. It proved to be a very good fit between the department and the topic of my research. I would like to thank all my colleagues for their feedback and help during the process. In specific I want to thank Dennis Voges. As my external supervisor at KPMG he was involved in the whole process from start to finish and helped me find a direction for my research.

The quality of the research is for a large part dependent on the interviewees that contributed to this thesis. I was positively surprised by the cooperation of all the interviewees and the fact that they allocated a part of their time to me during their busy schedules. I had the fortune to be able to speak to many very interesting stakeholders during the research and for this I want to thank all of them (alphabetically):

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1 Project Description

1.1 Core problem and its background

In this section we describe the evolution of payments and how we arrived at the situation we are at today, which leads to the core research problem.

Barter trade was the first form of trading, people were trading their goods with the goods of others (e.g. trading an apple for a loaf of bread). From this a reference commodity system was created. The "price" of all goods was expressed in one single good, which makes it easier to see the relative price of commodities. For example 10 bushels of grain is one horse, 200 eggs equals one horse and 150 apples also equals one horse. The next step is moving to gold as a reference commodity. Since using perishable goods as a reference commodity has many disadvantages (you cannot keep the reference commodity stored for a long time), gold was used to replace these goods. For more than two millennia gold has been the reference commodity. (Martin, 2013)

In the 13th century the concept of banknotes was introduced. Banknotes are in principle a certificate that gives the bearer of the note the right to exchange it for the equal value of the note in gold at the bank. Since 1971, the direct convertibility of U.S. dollars to gold ended and since then the U.S. dollar (and the Euro) have been fiat currencies. Meaning that the value of the money is based on trust, since the money has no intrinsic value.

The last step in the development of currency is the transition from banknotes to digital currencies. Looking at a banknote, the thing that determines the banknote as an individual banknote is the serial number printed on the note. All else is just to make counterfeiting the money difficult, but it does not contribute to the value of the note. The key idea of digital currencies is to create only the unique serial number, in such a way that it cannot be copied or counterfeited.

Cryptocurrencies

A cryptocurrency is "a digital medium of exchange that relies on a decentralized network, that facilitates a peer-to-peer exchange of transactions secured by public-key cryptography" (see Chapter 3 for more information into what constitutes a cryptocurrency). The best known cryptocurrency is the Bitcoin, but many other cryptocurrencies currently exist. In this thesis we will take Bitcoin as an example; however the basic principles are the same for all cryptocurrencies. More on this can be found in section 3.3.

Bitcoin is a digital, decentralized and pseudo-anonymous currency as all transactions are visible, however the sender and receiver are anonymous (more on this in section 8.1.7). It is not backed by a government and is not redeemable for gold or other commodities. The currency relies on peer-to-peer networking and cryptography. The main idea behind the currency is to provide a fast way to transfer funds globally, with minimal transaction costs and with a certain amount of privacy. Transactions made with Bitcoin are irreversible, this way the recipient of the funds is sure that he or she owns the funds for good and therefore less trust is needed to make sure the other party is reliable. If the recipient receives the funds, the funds cannot be charged back.

1.2 Problem statement

Cryptocurrencies are rapidly gaining more and more interest of the media, however widespread use of this type of currency is still scarce (De Nederlandsche Bank, 2014). The future of cryptocurrencies is very unclear, there are many different usage scenarios and different stakeholders have different needs. Factors that influence adoption have to be determined in order to be able to give a better future perspective and determine possibilities for improvement of cryptocurrencies. A well-built model explaining the adoption of cryptocurrencies enables a more informed debate about the merits of cryptocurrencies and the possible applications of its technology. The main focus of this research will be on one specific kind of cryptocurrency: the Bitcoin, however as justified in Chapter 3, the findings are applicable to cryptocurrencies as a whole.

The way current payment systems work throughout the world varies widely. The added value of cryptocurrencies therefore also hugely differs per geographical area. If this research would look at cryptocurrencies from a global perspective this would result in research outcomes that are highly generalized and would not be very useful. In order to be able to give clear and concise conclusions this research is scoped towards looking at the European market and the Dutch market in specific.

1.3 Possible causes of the problem

The fact that there is no clear future perspective of cryptocurrencies yet has several causes. An initial exploratory search resulted in the finding of certain possible causes to this problem:

- The advancements in the cryptocurrency landscape are going at an exponential rate. Academic research has yet to catch up with this new form of payment.
- Due to the highly fragmented landscape with regards to the acceptance of cryptocurrencies by governments the legal implications for businesses are unclear.
- The first implementations of cryptocurrencies (e.g. Bitcoin) are complicated to use and implement in business processes.
- There are many different and possibly conflicting interests among stakeholders (e.g. regulatory pressure from the government versus the decentralized nature of the protocol)

1.4 Objective

The objective of this research is to identify the factors that influence the adoption of cryptocurrencies by consumers and businesses in different usage scenarios from a multiple stakeholder perspective including government and regulators.

1.5 Research Questions

The main research question is:
What are factors influencing the adoption of cryptocurrencies in different usage scenarios for different stakeholders?

To answer the main research question the following sub research questions are defined:

1. What are cryptocurrencies?
2. How can the different stakeholders in cryptocurrencies be defined?
3. How can different usage scenarios of cryptocurrencies be defined?

In order to be able to design a conceptual framework determining factors that influence the adoption of cryptocurrencies, first literature concerning the adoption of IT innovations in general will be studied.

4. What are factors influencing the adoption of IT?

Based on the identified factors an adoption model for cryptocurrencies will be formulated.

5. What are the most important factors influencing adoption of different usage scenarios of cryptocurrencies?

The model will be validated by interviewing different stakeholders.

6. How do current implementations fulfill these requirements of different stakeholders?

Finally, since the real world adoption of cryptocurrencies is very complex and factors may influence each other over time we will attempt to take in to account the dynamics of the cryptocurrency adoption model by creating a system dynamics model.

7. How does the modeling of the adoption of cryptocurrencies benefit from using a system dynamics approach?

1.6 Scientific motivation

Since the beginning of cryptocurrencies the scientific community has displayed its interest in them. After the appearance of the original paper describing Bitcoin in 2008 by Satoshi Nakamoto, many papers have been written about the workings of the Bitcoin protocol, safety, privacy, and other cryptocurrencies have been described with different workings. However to our knowledge, at the time of writing, April 2014, no papers exist that comprehensively describe factors that influence the adoption of cryptocurrencies (Glaser & Zimmermann, 2014; Kristoufek, 2014). With this thesis the author hopes to contribute to the scientific community by giving a clear and structured overview of factors that influence the adoption of cryptocurrencies for different usage scenarios from a multiple stakeholder perspective.

2 Literature review

In order to give an overview of the state of the field of academic research into cryptocurrencies a structured literature review is undertaken. Based on this literature review important topics for further research will be defined.

2.1 Approach

For our structured literature review we will use the guidelines set by Webster & Watson (2002). We start with defining the selection criteria. Then we define the keywords used in the literature search. We state the used queries per academic search engine. A concept matrix is created stating the most important concepts and which will be used to analyze the literature. Finally we will present the results of the literature review. (Webster & Watson, 2002)

2.2 Selection Criteria

The papers that the selected search engines return based on the keywords and filters that are applied will all be scanned for their applicability in the research. If the papers turn out to be unrelated or not applicable to the current research they will be discarded. All the papers that are discarded will be listed during the review process.

For the literature review, two widely used academic search engines are used: Scopus and Web of Science. Since these are covering virtually all relevant journals (more than 20.000 peer-reviewed journals in Scopus and 12.000 journals in Web of Science), no additional search engines are included. In Table 2-1 Search engine selection criteria an overview of the used settings, scope and databases are listed.

Table 2-1 Search engine selection criteria

Search Engine	Settings	Scope	Databases
Scopus	article title, abstract, keywords	all years to present	physical sciences, social sciences & humanities
Web of Science (WOS)	Topic, title	all years to present	all databases

2.3 Keywords

Since this thesis is about cryptocurrencies, the main interesting keyword is of course, “cryptocurrencies”. However since this is still a developing field, there are different writing styles of the word: “cryptocurrencies” versus “crypto currencies”. Of course also the non-plural form “cryptocurrency” or “crypto currency” is an option (we use the asterix “*” operator to account for this). Besides this, since Bitcoin is the most prominent and well known example of a cryptocurrency, this is also a search term that is used.

Table 2-2 Keywords

Keywords
Cryptocurren*
Crypto currenc*
Bitcoin*

2.4 Query

Based on the keywords as defined in section 2.3, a search query was defined. For both Scopus and Web of Science the same search query is used:

(crypto currenc) OR cryptocurrenc* OR bitcoin**

To filter the results of the query, the following filters were used:

Table 2-3 Applied filters

Engine	Filtering for
WOS	Article or proceedings paper
Scopus	Conference paper, article, conference review & review + language=english

2.5 Literature search results

Using the query as defined in section 2.4 with predefined selection criteria and keywords we found 46 articles on Scopus and 24 articles on Web Of Science. After applying the filters from Table 2-3 we were left with 38 and 15 articles respectively. These results were then combined and duplicates were filtered. This resulted in 42 articles. Of these 42 articles, 2 results were not relevant and 2 results were conference proceedings containing already selected articles. Therefore we arrived at a definite list of 38 articles to review. The process is shown in Table 2-4 below.

Table 2-4 Number of found articles

#of found articles	Scopus	Web Of Science	Combined
Initial results	46	24	
Applying filters	38	15	
Combining both lists			42
Filter for relevance			38

2.6 Concept matrix

The cryptocurrency field is relatively new, which is reflected in the small amount of articles (38) that resulted from the literature search. In order to give an overview of the current state of academic research a concept matrix is devised. All papers found in the literature research are read and plotted in the concept matrix. Following the approach of Webster & Watson (2002) while reading each article the concept matrix is compiled and key concepts are added. This serves as a guiding tool to assess what the most researched concepts are and to see whether there are concepts that are still largely uncovered by academic studies. The full concept matrix can be found in Table 2-5. Each column represents a different concept and each row represents a specific paper. The full reference for each paper can be found in the Appendix in Table 12-1.

Table 2-5 Full concept matrix

Papers	*Explaining*	*Use in Crime*	*Other uses of blockchain*	*Anonymity*	*Security*	*Blockchain statistics*	*Scalability*	*Economic aspects*	*Alt-coins*	*Regulation*
1			x							
2				x						
3	x		x							
4			x		x					
5	x			x	x		x			
6		x								
7	x				x					
8	x	x								
9		x								
10			x							
11			x	x						
12	x				x		x			
13	x	x						x		x
14	x	x		x						
15	x		x						x	
16	x									
17	x									
18										x
19	x				x					
20						x		x		
21								x		
22	x									
23		x		x		x				
24	x		x	x						
25					x					
26	x									
27		x								
28		x		x						
29						x				
30	x				x					
31		x								
32	x									
33			x							
34	x									
35	x								x	
36	x						x			
37		x								
38			x							
Total	19	10	9	7	7	3	3	3	2	2

2.7 Analysis of concept matrix

The first thing to note is the fact that the sum of the article count column is more than the amount of researched articles (38 articles and a sum of article count of 65). This is because most of the articles mention more than one topic.

As you can see, most articles start by explaining cryptocurrencies, or more specifically the Bitcoin protocol. Interestingly, while Bitcoin is only a specific implementation of a cryptocurrency, almost all papers are about Bitcoin in particular and not on the more general topic of cryptocurrencies (25 out of 38 have the keyword Bitcoin in the title). Due to the fact that Bitcoin is a very recent phenomenon and the workings of cryptocurrencies are complicated, this high number of articles "explaining" cryptocurrencies can be explained.

The second most popular topic is that of the use of cryptocurrencies in crime. This has most likely to do with the fact that the use of cryptocurrencies in crime has been widely covered in the media. The complex nature of the workings of cryptocurrencies, combined with the pseudo anonymity it provides it gives many the idea that cryptocurrencies enable criminals to transact unseen and shielded from the authorities. However as many academics prove, this is purely *pseudo* anonymity as all transactions are publicly visible and (statistic) analysis of the blockchain leaves little anonymity (e.g. Karame, Androulaki, & Čapkun, 2012; Meiklejohn et al., 2013; Reid et al., 2013; Reid, F., 2012). Note the relatively large amount of papers that discuss the anonymity of cryptocurrencies. See section 8.1.7 for more details about this topic.

The main conclusion that can be drawn is that most topics discussed in literature are very technical. Most of the articles approach cryptocurrencies from a technical perspective: by analyzing the blockchain, looking at technical features of cryptocurrencies that provide anonymity and security and by looking at scalability of the protocol. Only three articles were found that mention economic aspects and two mention regulation. Therefore there seems to be a lack of scientific knowledge in the field of cryptocurrencies besides the technical aspects.

In order for cryptocurrencies to be successful, they have to be adopted first. However the important aspect of cryptocurrency adoption is never discussed in academic literature as of yet. The author recognizes the importance of this topic and therefore the focus of this thesis is to contribute to the field by studying the adoption of cryptocurrencies.

3 What are cryptocurrencies?

To answer the first research question "What are cryptocurrencies", we will give the definition of a cryptocurrency, the workings of a cryptocurrency and its most prominent features.

3.1 Introduction to cryptocurrencies

It is only since the last couple of years that there has been (academic) interest in the field of cryptocurrencies; the earliest articles included in the literature review are from 2011. Due to this there still is no author that provides a well cited definition of what constitutes a cryptocurrency. Many authors simply seem to avoid defining the word cryptocurrencies. However in order to be concise the author will compile a working definition of cryptocurrency that will be used throughout this thesis.

Though the few definitions that are given by various authors vary, there is a general line be seen in all these definitions:

> *"Crypto Currencies is a type of digital currency which relies on cryptography, usually alongside a proof-of-work scheme, in order to create and manage the currency. A decentralized network of peer-to-peer computer nodes working in sync creates and verifies transactions of transfer of said currency within the network" (Ahamad, Nair, & Varghese, 2013).*
>
> *"…that can be transferred instantly and securely between any two parties, using the Internet infrastructure and cryptographic security with no need for a trusted third party. Its value is not backed by any single government or organization" (Ametrano, 2014)*
>
> *"A Cryptocurrency is a modern digital medium of exchange. It is a new decentralized, limited and peer–to–peer payment system. Most cryptocurrencies are created to introduce new units of currency, whose total amount is limited. All cryptocurrencies use cryptography to control the creation and transfer of money….All cryptocurrencies use public–key cryptography; a pair of public and a private cryptographic key make Bitcoins safe." (Wiatr, 2014)*
>
> *"… relies on public/private key cryptography to facilitate electronic trading in a completely anonymous, secure, peer-to-peer fashion" ("Open source innovation on the cutting edge," 2010).*

The aspects that are recurring in all these definitions is that fact that a cryptocurrency:

- Is a decentralized network
- Peer-to-peer
- Uses the internet network
- Uses public-key cryptography

Therefore we define a cryptocurrency as follows:

> *A cryptocurrency is a digital medium of exchange that relies on a decentralized network, that facilitates a peer-to-peer exchange of transactions secured by public-key cryptography*

3.2 Cryptocurrency nomenclature

There are many different cryptocurrencies, which all differ in certain aspects (more on this in section 3.5). The best known cryptocurrency is the Bitcoin, other alternative cryptocurrencies are called alt-coins. Since the workings of cryptocurrencies in essence are all very much alike and Bitcoin being the most prominent example, when references in this thesis are made to Bitcoin this can be seen as also referring to the larger category of cryptocurrencies. More on this can be found in the next section, section 3.3.

It is very important to realize that there is a difference between a cryptocurrency network and the currency itself. For example, the Bitcoin network is the technological infrastructure, the protocol, that allows the transaction of the bitcoin currency. However the Bitcoin network can also be used for other purposes. Chapter 5 will give an overview of these alternate uses as an answer to the second research question.

In this thesis we will follow the convention as set by several authors that the protocol is written with an uppercase B and is used in a singular form, while the currency name of bitcoin is written in lowercase and can be plural. There is only one Bitcoin network, while there are millions of bitcoins. (Ametrano, 2014; Bitcoin Wiki, 2014a)

3.3 Cryptocurrency similarity

An interesting graphic which shows the similarity of cryptocurrencies is the price of both Bitcoin and Litecoin plotted on the same graph. Litecoin is the next biggest cryptocurrency after Bitcoin. It is clearly visible that the price development of Litecoin is almost identical to that of Bitcoin.

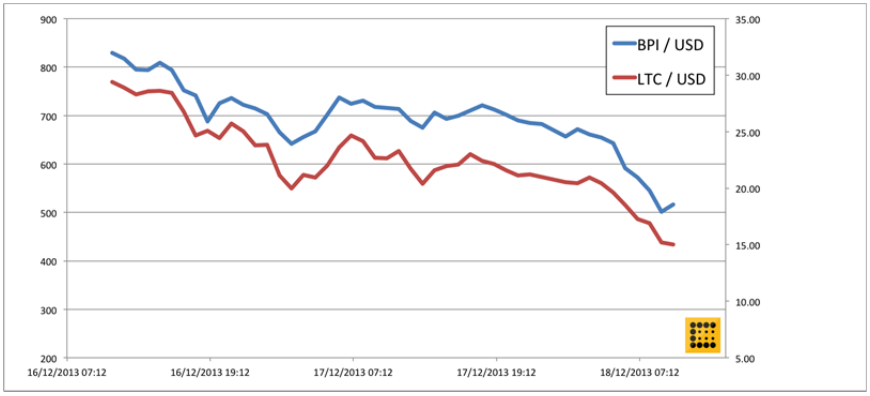


Figure 3-1 Bitcoin vs Litcoin price (source: Coindesk)

Besides the price development of alternative cryptocurrencies being similar to Bitcoin, another reason why the terms cryptocurrency and Bitcoin are almost similar at the moment is the fact that 93,9% of all the funds that are invested in cryptocurrencies are in Bitcoin. Bitcoin has a market capitalization of $7,7 billion USD versus a total combined market capitalization of $8,2 billion USD as of August 2014. In Table 3-1 below, the five biggest alt-coins in terms of market capitalization are listed. One can clearly see that Bitcoin is the cryptocurrency with virtually all the market share and with each next biggest cryptocurrency the market capitalization of the alternative drops significantly. (CoinMarketCap, 2014)

Table 3-1 Top 5 cryptocurrency market capitalization

Currency (Top 5)	Market Capitalization	% Market share
Bitcoin	$ 7.736.903.762	93,9%
Litecoin	$ 214.884.256	2,6%
Ripple	$ 43.280.764	0,5%
Nxt	$ 37.224.992	0,5%
DarkCoin	$ 25.769.200	0,3%
Total (of 462 alt-coins)	$ 8.238.034.710	100%

3.4 The workings of a cryptocurrency

The main idea behind cryptocurrencies is to provide a fast way to transfer funds globally, with minimal transaction costs and with a certain amount of privacy (the sender and receiver of transactions are anonymous) while being independent from a third party to handle the transactions. Transactions made with Bitcoin are irreversible, this way the recipient of the funds is sure that he or she owns the funds for good and therefore less trust is needed to make sure the other party is reliable. If the recipient receives the funds, the funds cannot be charged back. [2]

Since the system is decentralized and the money exists only virtually, a system is needed to keep track of who is the legitimate owner of the virtual currency and to prevent one from spending the same money twice (a so called "double spending attack") (Nakamoto, 2008). In 2008 Satoshi Nakamoto came up with the idea of using a chain of digital signatures to sign every transaction and allow users to verify the transactions by verifying the signatures. However due to the fact that there is no central authority in the system, the only way to verify that a coin has been spent only once is to be aware of all transactions. To accomplish this all transactions are publicly announced and chained together in a "block chain". Therefore if one is certain that a block chain is correct, due to the chaining of the transactions all the transactions are thought to be correct.

So called "miners" are users that are using their computer power to encrypt all transactions into the block chain and broadcast this across the Bitcoin network. By solving a computationally hard problem, they "prove" that they processed the transaction and that it is legitimate (Babaioff, Dobzinski, Oren, & Zohar, 2012). This problem is called a "proof of work" and it is constructed in such a way that it is difficult to solve, meaning costly or time-consuming, however trivial to check by others to see if the miner actually put in the required effort.

This concept of "proof of work" is essential to cryptocurrencies because it guarantees the integrity of the block chain. An attacker cannot simply change one transaction in a block, he would have to change the entire blockchain from the point this transaction occurred and thus do all the work again. If the processing power of the network increases, so does the difficulty of finding a block. This is to make sure that if more computers join the mining network the amount of found blocks per unit of time stays the same. Therefore the more processing power the network has, the higher the difficulty and the higher the safety. Because of this reliance on "miners" they are rewarded for their computational efforts. Every time a miner is first in "creating" a block in the block chain, a predetermined amount of Bitcoins are created which he owns. Since no Bitcoins are issued by a central authority this is the only way in which Bitcoins enter circulation. This does not mean that there is an infinite number of Bitcoins to be mined. Due to the specification of the Bitcoin protocol there is an exponentially decreasing number of Bitcoins to be earned per mined block, leading to a maximum of 21 million bitcoins in circulation. Each of these 21 million bitcoins is however divisible into 100 million units leading to a nearly infinite amount of pieces of bitcoin.

3.5 Characteristics of cryptocurrencies

There are many different types of cryptocurrencies and there are a few main areas on which these can be identified from each other. In this section we will shortly discuss the most important characteristics of cryptocurrencies. These are all coins that have Bitcoin as the basis for their design, hence the name *"alt-coins"* is given to them.

3.5.1 Total amount of coins

One of the most important details characterizing a cryptocurrency is the total amount of coins that will be generated. For bitcoin this amount is 21 million coins while for *litecoin* this is 84 million. For many coins this amount is fixed, however there are also coins in which the total amount of released coins is not fixed. For example *dogecoin* has a coin supply of 99 billion coins with 5 billion coins added every year. So even though there is no finite amount of coins, the supply of coins is predictable.

The total coin supply of a cryptocurrency is of course a large determinant of its price, there are relatively few bitcoins which leads to a high price of several hundred US dollars at the moment of writing (May 2014). On the

[2] Parts of this section are under review for a book about Information Systems in the Financial Service Industry.

total opposite is the dogecoin, with its huge available coin supply the price is only less than one thousandth of a US dollar.(Bitcoin Wiki, 2014b; “List of cryptocurrencies,” 2013)

3.5.2 Block generation times and award per block

Another characteristic of cryptocurrencies is the block generation time and the award per block. For example, bitcoin has a block generation time of 10 minutes, which means that every 10 minutes a block is found. When a block is found the *block award* is handed out, which is 25 bitcoins at the moment. So this means that the combination of the block generation times and the award per block determines how fast the supply of coins grows. If the block generation time is very low or the award per block is very high, the supply will grow faster. (Bitcoin Wiki, 2014b)

The block generation time also is of impact to the confirming of transactions. Only after a transaction is included in a generated block it is called “confirmed”. This means that shorter block generation times will lead to a shorter time to confirmation of a transaction. However short block generation times implicate that the chance of mining an orphaned block increases. An orphaned block is when two miners find a new block simultaneously independent from each other. Only one of these two blocks will end up in the block chain and the other block will not be used. This increases overhead and wastes mining resources.

3.5.3 Used algorithm

Cryptocurrencies all use a specific algorithm for the so called “proof-of-work” function to secure the blockchain. The first generation of cryptocurrencies all used the SHA-256 algorithm, however many newly released cryptocurrencies now have switched to different algorithms such as Scrypt or SHA-3. They have done this to keep the mining for the coins fair. In 2013 specialized mining equipment called ASICs has hit the market, these specialized machines are very efficient at mining SHA-256 coins such as bitcoin. Because they are so massively efficient this has completely pushed “amateur” miners out of the market. By introducing new algorithms the cryptocurrencies are not mineable by these specialized ASIC miners. This is however a constant battle between the developers of cryptocurrencies and the manufacturers of specialized mining equipment; new Scrypt mining ASIC miners have already been released on the market. (Bitcoin Wiki, 2014b; M B Taylor, 2013)

4 How can the different stakeholders in cryptocurrencies be defined?

There are many different stakeholders for cryptocurrencies to be recognized. Every party that is normally concerned with money and financial transactions is also a stakeholder in cryptocurrencies. So this means that consumers, businesses, banks, regulators and government are all stakeholders.

4.1 Consumers

Consumers are an obvious stakeholder for cryptocurrencies. This is because consumers are usually the party initiating the payment in a business to consumer setting. Consumers decide using which payment method they want to pay and (if the business offers it of course) use their preferred method of payment. For consumers the most important benefits are the low transaction costs (saving them money) and the fast worldwide transactions. Another interesting feature to consumers could be the fact that payments are semi-anonymous, making payments online less traceable, see section 8.1.7 for more details about this.

4.2 Business

A widely cited benefit for business is supposed to be the irreversibility of payments with cryptocurrencies. However the scope of this research is Europe and in Europe payments made with SEPA (Single European Payments Area) are also irreversible. (Woutersen, 2013) Therefore the main benefit of using cryptocurrencies for businesses in Europe is the low costs associated with the usage cryptocurrencies. Payment Service Providers (PSP) which facilitate businesses to accept cryptocurrencies and convert these into fiat currency charge very low fees compared with PSPs for fiat currencies. The Dutch online fiat payment method iDEAL costs €0,39 on average per transaction according to a report of the “Authoriteit Consument en Markt”. This is a weighted average, meaning that certain internet shops with a high volume pay less, while more low volume internet shop will pay a higher fee than the €0,39. This is high compared to the costs of $30,00 US Dollars (approximately €23,00) monthly fee for accepting daily $10.000,00 US dollars equivalent in Bitcoin via bitcoin PSP BitPay (ACM, 2010; BitPay, 2014).

4.3 Banks

Banks are due to the nature of cryptocurrency as a possible replacement for fiat currency an important stakeholder. The cryptocurrency network undermines their position as the central party for sending and receiving money. However also for banks there are definitely possibilities to play an important part in the cryptocurrency network. Banks could for instance start a secure wallet hosting service, providing users the confidence that their cryptocurrency is stored safely. Also the technical background is possibly of interest to banks, which could use it to replace their own transaction network.

4.4 Government

The government and other regulating bodies are also stakeholders, since they want to keep track of payments made by consumers and businesses for taxing and other legal purposes. One of the key aspects of cryptocurrencies is the fact that they provide pseudo anonymity. This makes that the government has a definite stake in making sure that no unlawful business happens on the network and that taxes are paid wherever they are due. An advantage of cryptocurrencies from a government perspective is that fact that all transactions are visible in the blockchain, providing a good audit trail. (Decker & Wattenhofer, 2013)

4.5 Payment Process

In Figure 4-1 the stakeholders that are involved in a transaction are shown for a typical transaction. The customer orders an item at the merchant and wants to pay with cryptocurrency. The current price volatility (see section 8.1.5) and the fact that merchants cannot pay their suppliers with cryptocurrency makes that most merchants do not want to store cryptocurrency themselves. They use a Payment Service Provider (PSP) as a middleman to convert the cryptocurrency to fiat money which the PSP transfers to the bank account of the merchant. The merchant then sends the goods. Outside of this process is the government which regulates it (depending on the current regulation status in each country).

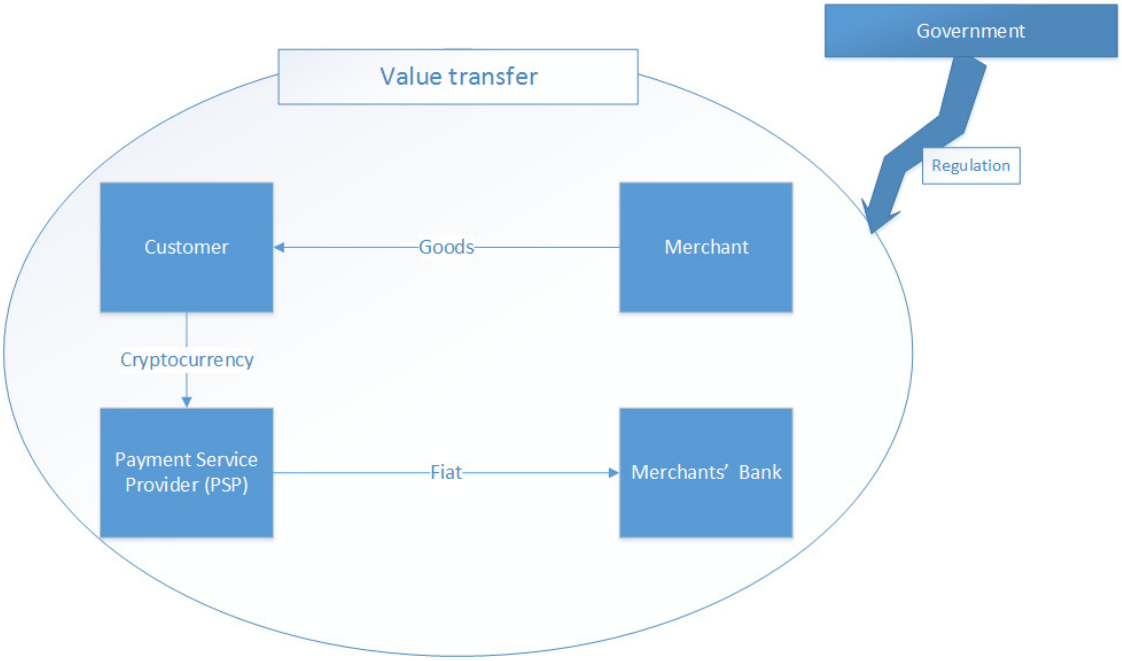


Figure 4-1 Stakeholder Overview

5 How can different usage scenarios of cryptocurrencies be defined?

In this chapter we will address the third research question "How can different usage scenarios of cryptocurrencies be defined?".

Since the main function of cryptocurrencies is its use as money (the term *currency* is already in the name), this is the primary usage scenario that this thesis will look at. In macroeconomic literature there are three functions of money defined: a store of value, a unit of account and a medium of exchange (Mankiw, 2009). In the following sections we will discuss each of these three functions and the role that cryptocurrencies can play.

Besides the usage scenario as money there are other uses for cryptocurrencies, such as a decentralized Domain Name System (DNS) register or a decentralized file storage (Aron, 2012; Hajdarbegovic, 2014). While the author recognizes the impact of these capabilities of cryptocurrencies, these are beyond the scope of this thesis and will not be looked at in detail.

5.1 Medium of exchange

In a barter system there is the problem of the 'double coincidence of wants'; both parties in the exchange must want the item that the other party is offering at the time and place the other party is offering it. If one party for example offers apples in the summer but the other party does not need or want apples at that time the offering party cannot trade his goods. (Jevons, 1876)

Money solves this problem by intermediating in the exchange of the goods and thereby makes the process of trading much more efficient. "We are confident that the shopkeepers will accept our money in exchange for the items they are selling" (Mankiw, 2009, p. 81).

In order to be a useful medium of exchange it should have the following characteristics (Wikipedia, 2014):

1. Value common assets
2. Constant utility
3. Low cost of preservation
4. Transportability
5. Divisibility
6. High market value in relation to volume and weight
7. Recognisability
8. Resistance to counterfeiting

Ametrano (2014) adds to this:

9. Fungibility

All these characteristics are pretty straightforward. *They all have to do with the fact that a good medium of exchange should facilitate the exchange of goods as best as possible.* Therefore the costs of preserving the currency has to be low, meaning that when the money changes hands it should not deteriorate (paper bills for example are not well qualified on this point, as when they are being used their physical quality deteriorates). It has to be easy to transport the currency in order to pay for goods wherever it is needed, meaning that the good should have a high market value in relation to its volume and weight. It has to be divisible in order to exchange the exact amount of value for the good.

The characteristic that is most important is that it has to be recognized or accepted by many merchants, else it is of no use. It should be very resistant to counterfeiting, else its value will plummet. And lastly, it should have fungibility, meaning that one unit of currency is able to be substituted by one other unit of the same currency (e.g. one ounce of gold can substitute for another ounce of gold). (Ametrano, 2014)

Note: of all the three functions of money the function of medium of exchange has always been the most difficult one to fulfill. This because over the course of history the counterfeiting of money has been a recurring theme which reduces the value of the currency as a means of exchange.

5.2 Unit of account

The second function of money is that it is a unit of account. Quoting Mankiw (2009) "money provides the terms in which prices are quoted and debts are recorded." (Mankiw, 2009, p. 80).
This means that money is the yardstick against which prices are measured. The prices of goods and economic transactions are noted in money, not in other goods. This allows entities to monitor their profits and losses and evaluate their performance.

In order for money to function as a good unit of account it is necessary that the prices are stable as otherwise it is not suitable for its yardstick function. (Hayek, 1978)

5.3 Store of value

The third function of money is that it is a store of value. Money has to be able to be stored and spent on a later period in time, while retaining its value. For it to retain its value it is important that the value does not fluctuate heavily. Barter items are not a good store of value, since they are mostly perishable goods and cannot be stored for longer periods of time. Of course there are also items other than money which can be a good store of value, such as precious metals, precious stones or real estate. (Ametrano, 2014; Mankiw, 2009)

5.4 Currencies compared

In this section we will compare three different forms of money: gold, fiat and cryptocurrencies. We will compare each of these kinds of money against the three functions mentioned in the sections above. A three point scale is used, ranging from low through medium to high.

5.4.1 Medium of exchange

Gold

As a medium of exchange gold scores medium. Gold has positive attributes that makes it much more attractive to using as a medium of exchange than barter goods. Gold is non-perishable, it is transportable, divisible, fungible, has a high value per volume/weight and is accepted as a commodity for centuries However relatively, compared to cryptocurrencies it is less easy to transport and store safely.

Fiat currency (cash)

Fiat cash money scores medium on the medium of exchange function. It possesses many of the same attributes as gold; it is non-perishable, transportable, fungible and has a high value per volume/weight. However cash money is not universally accepted, there are many different fiat currencies. Also is it lacking in divisibility compared to cryptocurrencies and gold (you cannot chop down a coin) and counterfeiting of fiat currencies is a serious problem. Besides this there is also a high cost associated with handling a cash currency. The estimated annual costs of handling central bank currency in the US alone are estimated at $60 Billion USD (Plassaras, 2013, p. 9).

Cryptocurrencies

Cryptocurrencies score high on the function medium of exchange. They exist in a purely digital form, therefore they are by definition non-perishable. Cryptocurrencies are highly divisible and fungible. There are no transport costs as opposed to gold and cash, since transactions happen on the internet. Finally are they unable to be counterfeited due to the technical architecture and use of cryptography. (Plassaras, 2013)

5.4.2 Unit of account

Gold

On the function unit of account gold scores medium. The price of gold has been relatively stable over the years. However prices are quoted in fiat currency and not in gold.

Fiat currency (cash)

Fiat currencies score high on the unit of account function since they are the de facto standard for quoting prices.

Cryptocurrencies

The value of cryptocurrencies is highly volatile at the moment making it unsuitable as a unit of account at the moment. (De Nederlandsche Bank, 2014)

5.4.3 Store of value

Gold

Since gold has been the most important store of value for centuries, gold scores high on the function of store of value.

Fiat currency (cash)

The value of fiat currencies has not always been stable and the value is ever decreasing due to inflation. However since they are the legal tender of a country, one can be sure that cash can still be spent for decades, leading to a score of medium.

Cryptocurrencies

Cryptocurrencies score medium on this topic because of price fluctuations. These price fluctuations make that it does not really count as a good store of value. However cryptocurrencies can be stored very well and do not perish due to their digital nature.

Table 5-1 Functions of money overview, based on Ametrano (2014)

	Medium of exchange	Unit of account	Store of value
Gold	Medium	Medium	High
Fiat currency (cash)	Medium	High	Medium
Cryptocurrencies	High	Low	Medium

6 Methodology

The purpose of this thesis is to develop a framework containing the factors that influence the adoption of cryptocurrencies by different stakeholders. This framework will help to give a better future perspective and to determine possibilities for improvement. Following Yin (2009) we first performed a literature research of cryptocurrencies in the previous chapter. After this a conceptual model will be created based on IT adoption literature and the findings from the literature research.

This research adopts a qualitative interpretive approach, meaning that the empirical evidence collected is qualitative. The conceptual model will be tested with qualitative semi-structured interviews with subject matter experts. This approach is chosen because of the nature of the subject. To the best of our knowledge there has been no research done yet into the adoption of cryptocurrencies and the adoption process involves a very wide range of actors. In order to be able to get a good overview of the situation and to be able to draw useful conclusions Rowe & Wright (2001) argue that expert opinions are necessary. (Miles & Huberman, 1994; Rowe & Wright, 2001)

The model can then be used as a starting point for creating a System Dynamics model. The real world adoption of cryptocurrencies is very complex we will attempt to take in to account the dynamics of the cryptocurrency adoption model such as changes over time by using this methodology. In this way the System Dynamics model complements the qualitative model by being able to take a wider view of the whole network surrounding the adoption process and modeling the two-directional interactions between factors identified in the conceptual model.

6.1 Interview participants selection

Rowe & Wright (2001) give several principles on how to come to a good expert judgment. They state that it is important to have experts with appropriate domain knowledge, to use heterogeneous experts and to use between five and twenty experts.

For the selection of the experts we take the principles of Rowe & Wright into account. All interview participants selected have specific knowledge of cryptocurrencies. However, because adoption processes are dependent on a wide range of factors (e.g. (Moore & Benbasat, 1991a; Venkatesh, Morris, Davis, & Davis, 2003)), it is important to view the adoption process from different aspects (see Chapter 7). Therefore the interview participants selected are from a variety of industries, each with their own view on the adoption process and therefore contributing helpful insights. In Table 6-1 an overview is presented of the different industries where the interview participants originate and the companies they worked at.

Table 6-1 Interview Participants overview

# of interviewees	Industry	Company
4	Banking	ABN AMRO, Rabobank, SNS Bank, ING
1	Central Bank	De Nederlandsche Bank
3	Bitcoin exchanges	Bitonic, Bitmymoney, Safello
1	Bitcoin PSP	PikaPay
2	Payments consultants	InnoPay, Lelieveldt consulting
1	Higher Education	Cryptography expert at University of Eindhoven
1	Payment Service Provider (PSP)	Mollie
1	Consultant	Implementation of digital currency at Deutsche Bank
1	Food & Beverage	Thuisbezorgd.nl

6.2 Data collection & analysis

Data collection will take place in the form of semi-structured interviews. The interviews are all centered around the conceptual model which is first created based on findings from the literature research and existing IT adoption models. First the steps toward getting to the conceptual model are explained in order for the interviewee to fully understand the process. Next the model is shortly explained and then the interview

focuses on the model and the thoughts of the person in question. This process is supported by showing the model in Microsoft PowerPoint to the interviewee. As Yin (2009) mentions: “the interview will be guided conversations rather than structured queries. In other words, although you will be pursuing a consistent line of inquiry, your actual stream of questions in a case study interview is likely to be fluid rather than rigid.” (Yin, 2009, p. 106)

6.2.1 Coding

During the interview notes are taken and the whole interview is recorded. After this the interview is coded in the qualitative data analysis package NVivo 10. Using NVivo, for all the relevant constructs in the model codings are created (called “Nodes” in NVivo). The audio file of each interview is imported into the program and then the interview is listened back. Next, relevant quotes of interviewees are noted down and mapped to the appropriate coding. This gives an overview of how many interviewees (called “sources” in NVivo) and how many references a particular construct gets. See Figure 6-1 for a screenshot of the program, showing an example of the nodes, an audio file below the nodes and below that the quotes are coded.

In order to analyze what the interviewees comments and views on the conceptual model were the interview audio files are analyzed in QSR NVivo 10. For each of the items in the conceptual model a node is created in NVivo 10. Then when analyzing the interviews, quotes can be written down and attached to a node. This way visualizing the amount of support a node gets and from how many different sources. Clicking on a node reveals all the statements made about that particular construct by the different interviewees. The audio file is tagged, so the specific audio part in the interview can easily be listened back.

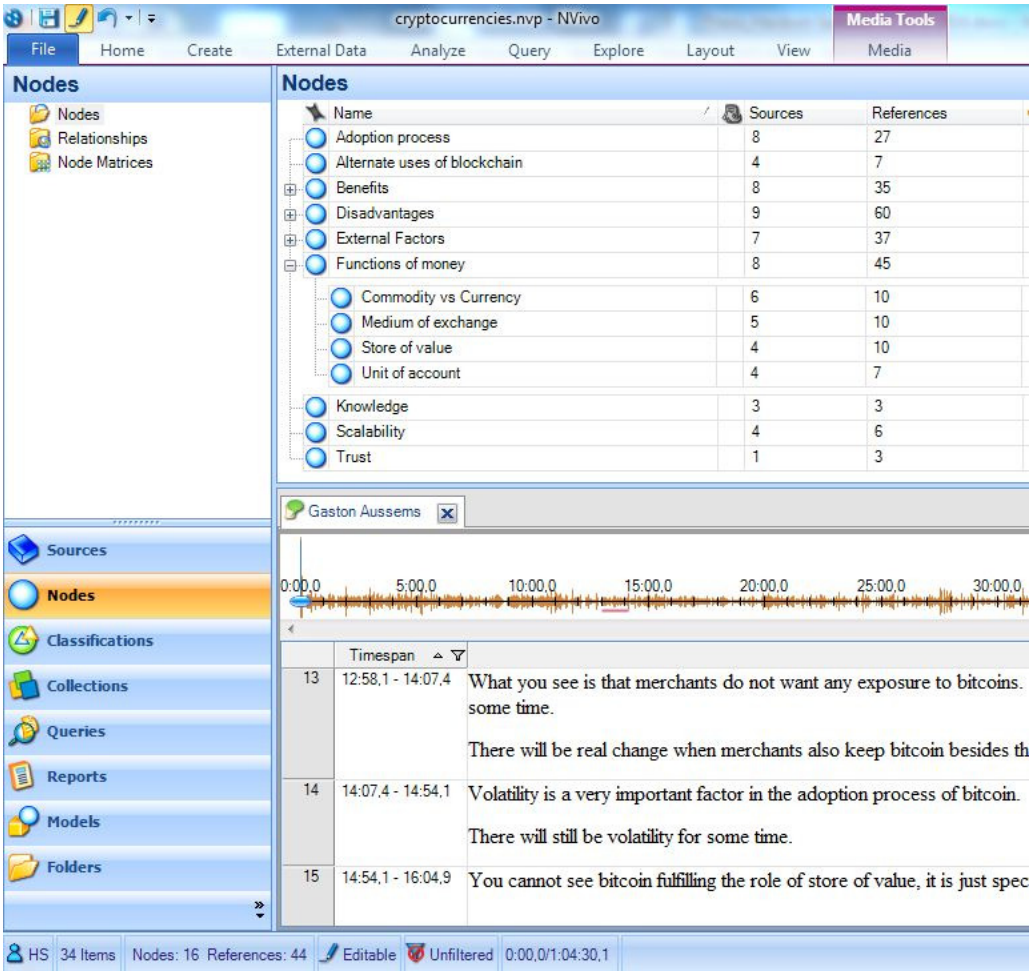


Figure 6-1 Interview analysis in NVivo 10

6.3 Empirical research quality

Four common measures to determine the quality of empirical research that are often used are construct validity, internal validity, external validity and reliability.

Construct validity examines how well a given measure is measuring the theoretical construct it is supposed to measure (Bhattacherjee, 2012). This research aims to identify the factors that influence the adoption of cryptocurrencies. However it falls out of the scope of this research to define quantitative measures for each of the constructs of the adoption model and test this. Therefore the research will focus on identifying the most important factors in the adoption process of cryptocurrencies and to give an overview of how these interacts.

Yin (2009) gives three principles of data collection which help to establish construct validity. The first principle is using multiple sources of evidence. This is done in this thesis by triangulating data from multiple data sources. This research gathers its data from two different sources, literature and interviews. Secondly, as already mentioned in previous sections, multiple persons from different industries were interviewed, thereby triangulating the interview results. And third, the interview participants all reviewed the draft notes from the interviews which gave them the opportunity to give feedback. The second principle is creating a case study database. This is done by keeping all interview recordings, notes and transcripts together allowing the raw data to be available for independent inspection. The third principle is to maintain a chain of evidence, that is to allow the reader to follow the derivation of any evidence from the initial research questions to the ultimate conclusions. This principle is adhered to by coding the interviews in a qualitative software analysis package, NVivo 10. This allows for the reader to see all the codings and therefore the logic that was used to draw conclusions for each topic and trace this back to the initial raw interview audio file.

Internal validity examines whether the change in the dependent variable (which is adoption in this case) is indeed caused by the hypothesized independent variables (Bhattacherjee, 2012). Since the independent variables cannot be manipulated this has the possibility of reducing the internal validity.

External validity “deals with the problem of knowing whether a study’s findings are generalizable beyond the immediate case study” (Yin, 2009, p. 43). Since the aim of this thesis is to find factors that influence the adoption of cryptocurrencies it is already a very broad subject. Most of the interest of the interviewee’s and the topic of almost all papers is one specific type of cryptocurrency: bitcoin. Therefore one could see generalizability as whether the found adoption model is not only applicable for bitcoin but also for other cryptocurrencies. As discussed in Chapter 3, all cryptocurrencies are very similar and differ only on relatively small technical details. As shown in section 3.3, the price development of alternative cryptocurrencies mimics that of bitcoin. The market capitalization of bitcoin is 93,9% of the total market capitalization of all cryptocurrencies, meaning that it is by far the biggest and most influential cryptocurrency. Therefore it is very likely that the adoption process for other cryptocurrencies will be the same as for the most prominent cryptocurrency.

Finally, reliability is to be sure that if another researcher follows the same procedures as described and conducted the same study all over again he would arrive at the same findings and conclusions (Yin, 2009). To ensure reliability of this research for every interview the audio was recorded and interview notes were saved together with the PowerPoint slide deck that was presented for each interviewee. Besides this were the interviews coded in NVivo 10. This is widely used software helping to systematically and consistently analyze the interviews.

7 What are factors influencing the adoption of IT?

In Chapter 8 a theoretical model of the factors that influence the adoption of cryptocurrencies will be created. Since cryptocurrencies are an IT driven innovation we will look at existing IT adoption models and use these as the basis for the theoretical model. By doing this we also scope the situation to look at the adoption process from a technical point of view. The technical aspects behind cryptocurrencies will be taken as a lens through which we will examine the adoption process. However with the goal of creating a System Dynamics model in mind we also do not forget external factors which do not only influence but are also influenced themselves by the adoption process. These will be taken into account, albeit in a less detailed fashion.

Five different IT adoption models will be discussed: Innovation Diffusion Theory (IDT), Technology Acceptance Model (TAM), Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB) and Unified Theory of Acceptance and Use of Technology (UTAUT).

We will explain why the choice has been made to use the IDT model as basis for the conceptual model. However one has to keep in mind that all adoption models suffer from certain weaknesses; there is no clear one single best model. While the IDT might be the most suitable fit, the adoption process of cryptocurrencies is a very complex process with a wide range of actors. Contrary to relatively 'simple' IT adoption processes of single organizations are there a great multitude of actors involved. Each actors has its own motivation and gains. Implications of adoption of cryptocurrencies will affect governments, banks, businesses and consumers everywhere.

7.1 Innovation Diffusion Theory (IDT)

The Innovation Diffusion Theory (IDT) described here is the adaptation by Moore & Benbasat (1991). The original IDT model was created by Rogers (1983). Rogers described five characteristics of innovations that influence the adoption of new technologies. Moore & Benbasat adapted the model for the adoption of IT innovations in particular. In comparison to the base IDT theory, Moore & Benbasat grouped the factors Result Demonstrability and Visibility under 'Observability' and added the constructs Image and Perceived voluntariness. This makes that the model is able to explain adoption in voluntary as well as involuntary environments. Being cited 4780 times of which 2690 times in the last five years (source: Google Scholar), it is a widely and actively used model nowadays. (Moore & Benbasat, 1991b; Rogers & Everett, 1983)

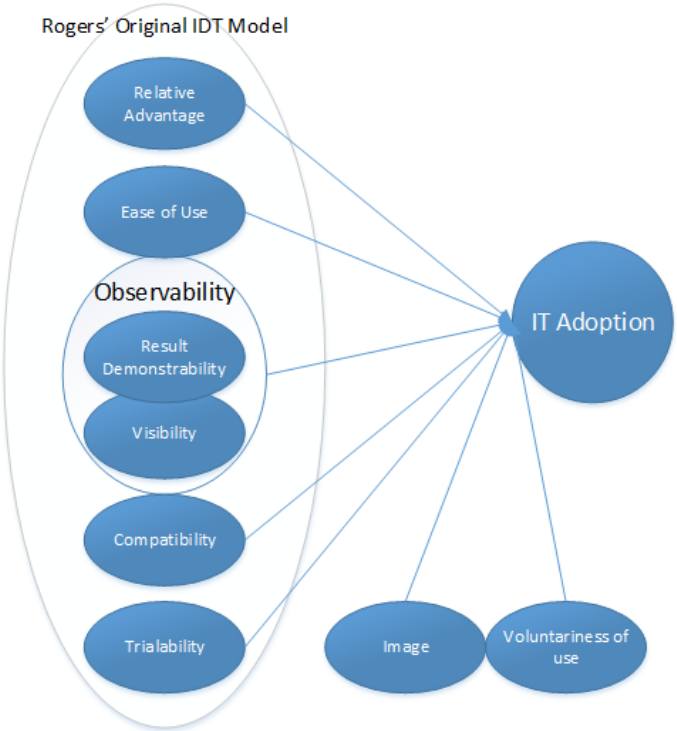


Figure 7-1 Innovation Diffusion Theory adaptation by Moore & Benbasat (1991)

7.2 Theory of Reasoned Action (TRA) & Theory of Planned Behavior (TPB)

A well known theory which tries to define behavior is the Theory of Reasoned Action (TRA) from Ajzen & Fishbein (1970). At the heart of this theory lies the model that behavioral intentions (which lead to behavior) are caused by two factors: attitude towards behavior (beliefs about a particular behavior) and subjective norm (the influence of others in the social environment).

Ajzen (1991) improved on TRA with a new model called the Theory of Planned Behavior (TPB) which was first proposed in 1985, see Figure 7-2. This model improved the predictive power of TRA by including perceived behavioral control. With this TPB is able to explain behavior when it is not entirely voluntary. However one has to keep in mind that it does not predict behavior per se as it predicts Behavioral Intention, which then leads to behavior. (Ajzen & Fishbein, 1970; Ajzen, 1991)

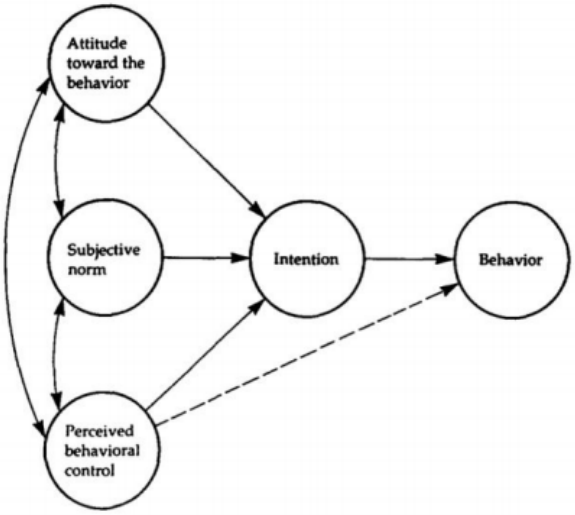


Figure 7-2 Theory of Planned Behavior

7.3 Technology Acceptance Model (TAM)

A widely known model (over 10.000 citations in Google Scholar) explaining how users come to accept technology is the Technology Acceptance Model from Davis (1989). The model is a very influential extension to TRA and TPB. There are two factors explaining user behavior, perceived ease of use and perceived usefulness. Perceived ease of use is “the degree to which a person believes that using a particular system would be free from effort” and perceived usefulness is defined as “the prospective user’s subjective probability that using a specific application system will increase his or her job performance within an organizational context” (Davis, 1989, p. 4).

Compared to TRA/TPB TAM is more specific for modeling user acceptance of information systems. TAM is also more restricted as normative beliefs are not included in TAM. Also is TAM just like TRA only useful to model situations where the subject is free to act and does not explain involuntary behavior. (Davis, 1989)

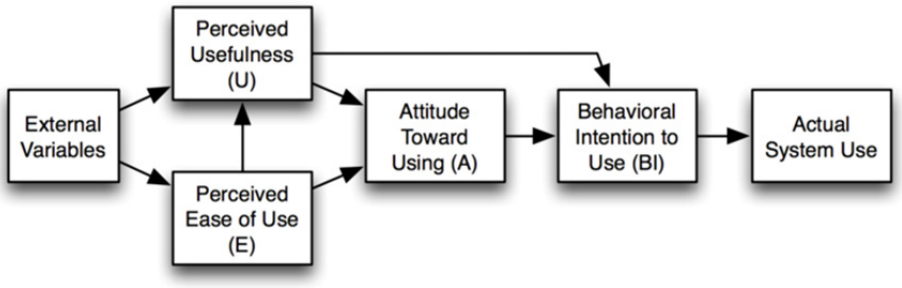


Figure 7-3 Technology Acceptance Model

7.4 Unified Theory of Acceptance and Use of Technology (UTAUT)

In Figure 7-4 the model of the Unified Theory of Acceptance and Use of Technology (UTAUT) is shown. UTAUT is built upon eight previous theories: Theory of Reasoned Action, Technology Acceptance Model, Motivational Model, Theory of Planned Behavior, combined TAM and TPB, Model of PC Utilization, Innovation Diffusion Theory and Social Cognitive Theory. These eight models are compared and subsequently a unified model is built and tested. The upper part of the model (Performance Expectancy and Effort Expectancy) clearly displays elements of the Technology Acceptance Model. Social Influence and Facilitating Conditions are from other theories. These four elements are thought to directly influence usage intention and behavior. UTAUT is known for its very high explanatory power, r^2 = 0.77. (Venkatesh et al., 2003)

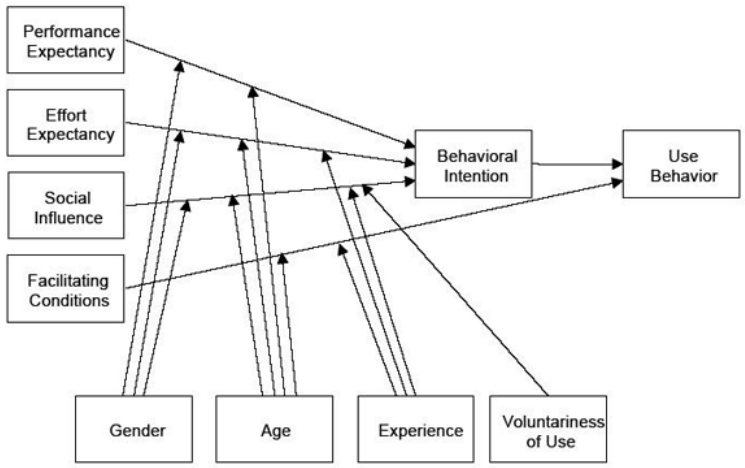


Figure 7-4 Unified Theory of Acceptance and Use of Technology

7.5 Choosing the best fitting model

The model that will be used needs to focus on the individual adoption decision as the focus of the research is the individual who decides to start using cryptocurrencies. The use of cryptocurrencies is (at least at the moment) not mandatory and the decision to choose to start using cryptocurrencies is therefore made on an individual and voluntary basis. Therefore the chosen model needs to be able to explain voluntary decisions.

The IDT adaptation by Moore & Benbasat (1991) is very well applicable to model the adoption process of cryptocurrencies. The IDT model describes eight characteristics of IT innovations that influence the adoption of new technologies. One can see very clearly that this framework is ideal to be used with cryptocurrencies. This model can be used as a lens through which one can look at cryptocurrencies and see how it fulfils these eight characteristics and what the influence on the adoption process will be. The IDT model focuses on the individual adoption decision made on a voluntary basis.

As one can see IDT is well fitting and the eight characteristics of IT innovations are suited to map the characteristics of cryptocurrencies and see whether there are aspects missing or could be improved. Looking at the alternatives: TRA/TBP is too general and not specific for IS. TAM is more geared towards IS, however the two main constructs “Perceived usefulness” and “perceived ease of use” do not capture the essence of cryptocurrencies well. Perceived usefulness focuses on “...job performance within an organizational context”; the model is more focused toward IT innovations that are workplace related helping employees perform their job efficiently. While UTAUT has a high explanatory power, as Wu (2009) mentions it has gained this through introducing many constructs. With 49 independent variables for predicting intentions and behavior it has become a highly complex model and overcomplicated for analyzing cryptocurrencies. (Wu, 2009)

Moore & Benbasat addressed the research of Tornatzky and Klein (1982) which besides others also mentions the factor cost. Since the low costs of cryptocurrency transactions are one of the main features of this payment system, this is a very interesting factor to look at in this research. Unfortunately however, Moore & Benbasat decided not to look at this factor. The reason for this was that the costs were not made by the

individual who made the adoption decision but the company who introduced the new IT system. Since this research focuses on individuals adopting cryptocurrencies, whether this are consumers or the owners of a business considering accepting cryptocurrencies: costs are a very relevant topic for these stakeholders. Moore & Benbasat mention that one should not look at absolute costs, but at relative costs. Therefore relative costs compared to other payment alternatives will be taken into account in this thesis. (Moore & Benbasat, 1991b; Tornatzky & Klein, 1982)

8 What are the most important factors influencing adoption of cryptocurrencies?

In this chapter we will address to the research question: *"What are the most important factors influencing adoption of cryptocurrencies?"*

To do this we will look at relevant literature and give an overview for each of the eight factors of the IDT model how cryptocurrencies contribute to these. For each of the aspects of cryptocurrencies we will state whether this is a benefit for this specific IDT aspect or whether it is a disadvantage. The resulting overview will be the basis for the conceptual model. These factors together with the conceptual model will be discussed in interviews with relevant stakeholders. When defining the benefits and disadvantages of cryptocurrencies we scope the comparison to the European market with a specific focus on the situation in the Netherlands. The stakeholders that will be interviewed are all Dutch persons as well.

Stakeholders that are interviewed include employees from the four biggest Dutch banks, the three largest Dutch cryptocurrency exchanges, senior payments consultants, Payment Service Providers, a cryptography expert and the largest Dutch company that accepts cryptocurrency, Thuisbezorgd.nl.

8.1 Relative Advantage

Relative advantage is defined in the IDT model as *"the degree to which an innovation is perceived as being better than its precursor"* (Moore & Benbasat, 1991b, p. 195).

This means that when defining the relative advantage of cryptocurrencies the precursors are the current means of payment and therefore we will compare cryptocurrencies against these.

8.1.1 Costs

Cryptocurrencies offer the potential of sending money at very low costs. For example with Bitcoin the typical transaction costs are 0.0001 BTC which is $0,05 USD at an exchange rate of 500 USD/BTC. (Bitcoin Wiki, 2014d)

However at the time of writing many companies that accept bitcoin actually directly convert their bitcoin back to fiat currency as they do not want to incur the risk of price volatility in bitcoin. Besides this they will most likely have to pay their suppliers also in fiat money, just as the wages of their employees, et cetera. This means that there is still a need to convert the bitcoin payment back into fiat which incurs extra costs. However these costs are still less than most other payment methods in the Netherlands. To refer to the paragraph about converting into fiat of Chapter 4:

> PSPs which facilitate businesses to accept cryptocurrencies and convert these into fiat currency charge very low fees compared with PSPs for fiat currencies. The Dutch e-commerce payment system iDEAL costs €0,39 on average per transaction according to a report of the "Authoriteit Consument en Markt". This is a weighted average, meaning that certain internet shops with a high volume pay less, while more low volume internet shop will pay a higher fee than the €0,39. This is high compared to the costs of $30,00 US Dollars (approximately €23,00) monthly fee for accepting daily $10.000,00 US dollars equivalent in Bitcoin via bitcoin PSP BitPay (ACM, 2010; BitPay, 2014).

As one can see the actual transaction costs including the conversion back to fiat currency are relatively much lower than with fiat payments. The fact that the transaction fees of Bitcoin are a fixed amount of around $0.05 USD for sending bitcoin makes that the costs for sending large sums of money is much lower compared to alternatives as credit cards of PayPal which charge a percentage of the transaction value. However for micropayments is Bitcoin not very suitable as the fixed fee becomes a large percentage of the transaction when the transaction is small.

The scope of this thesis is western-Europe and the Netherlands in specific, costs are already low compared to other countries such as the United States where bitcoin transactions are commonly compared to the very costly credit card transactions. In that case the relative advantage of lower costs would be even higher.

Goldman Sachs give a very comprehensive overview in their "top of mind" report about bitcoin, comparing the costs of a credit card transaction versus a bitcoin transaction. The average credit card transaction is rated at 2,5% transaction costs.(Goldman et al., 2014)

Concluding: low costs are a relative advantage of cryptocurrencies.

8.1.2 Transaction speed

Another often mentioned benefit of cryptocurrencies is the fast transaction speed. It is however hard to specify the exact transaction speed of a cryptocurrency. This depends very much on how one would exactly define when a transaction is 'finished'. The actual transaction spreading through the network takes only seconds (Bamert, Decker, Elsen, Wattenhofer, & Welten, 2013; G. O. Karame, Androulaki, & Capkun, 2012). However due to the technical nature of the protocol, there is a possibility that transactions can be double spent by sending two different transactions with the same inputs to different hosts. For more details the reader is referred to (G. O. . Karame, Androulaki, & Čapkun, 2012b).

In order to mitigate a so called "double spending" attack, it is normally advised to wait for a transaction to be confirmed in a block. The more blocks are generated after and including the block where the transaction is in, the more "confirmations" the transaction has. More confirmations means more security, as it is increasingly difficult for an attacker to forge a larger chain. Generally most services require six confirmations (D. Bradbury, 2013; M.B. Taylor, 2013). It is however possible with several techniques to make double spending a zero confirmation transaction very unlikely, see: (Bamert et al., 2013).

So when comparing the transaction speed of bitcoin to other payment systems it is important to understand that one can either just take the time that a transaction needs to spread through the network, or the time that it takes to be confirmed (whether this be 1 or more confirmations).

In either way, the maximum time a bitcoin transaction takes to be safely accepted is an hour at maximum. Compared to a traditional bank transfer using the Single Euro Payments Area (SEPA) which takes one or two business days depending on whether the transaction is sent before 14:30 or after (ABN AMRO, 2014). PayPal and the Dutch iDEAL e-commerce payment system both facilitate instant payments, so the benefit of fast transactions only applies when compared to bank transfers.

Concluding: fast transactions are somewhat an advantage of cryptocurrencies.

8.1.3 Decentralized

One of the key characteristics of cryptocurrencies is that they are decentralized in nature. This means that there is no third party responsible for issuing the currency and therefore no third party that needs to be trusted.

The fact that it is decentralized has a few important consequences for cryptocurrencies that make them different from fiat currency:

- No backing of government. Cryptocurrencies are not backed by the government, the consequence of this is that they do not fall under the European deposit guarantee system. This system protects individuals from the collapse of a bank; if this happens a certain amount of funds is guaranteed to be paid back by the government. The disadvantage of bitcoin not having this guarantee was made very clear when in February 2014 bitcoin exchange Mt. Gox collapsed losing 650.000 BTC or roughly $300 Million USD from its clients (Rizzo, 2014).
- No governmental influence is possible at all. Therefore no monetary policy can be enforced on the network; so issuing of credit by banks is not possible as they can with fiat money. Whether this is an advantage or a disadvantage really depends on the stakeholders. For many cryptocurrency enthusiasts this is exactly why they like cryptocurrencies so much, however from a regulatory point of view this might not be desirable.

Concluding: the decentralized nature of cryptocurrencies leads to a lot of polarization in cryptocurrency debates; one is either totally in favor or completely against this. There are arguments for both sides, only the future will tell whether it is a blessing or a sin.

8.1.4 No Single Point of Failure

A 24/7 availability of the cryptocurrency network is an absolute must if one considers the network as a replacement for existing payment systems. There are two types of availability risks, the first one being most importantly the risk of downtime of the cryptocurrency network itself and the second being the availability of the exchanges where cryptocurrencies are traded.

Downtime of the network

Due to the distributed peer-to-peer nature of the system it is highly resilient against downtime, so the availability risk of the network is very low. A DDOS attack against the entire network would be almost impossible since one would have to target the ten thousands of nodes that run the network (Nakamoto, 2008). However bugs in the code of the protocol could enable malicious users to DDOS the network by exploiting them, this has happened before (Danny Bradbury, 2013).

Downtime of exchanges

Exchanges are not decentralized and there have been many incidents of exchanges being unavailable due to a DDOS attack.(Leyden, 2013; Sharwood, 2013)

Concluding: the network of cryptocurrencies does not have a single point of failure, however the exchanges where bitcoins are bought and sold are a single point of failure. Therefore depending on the use of the cryptocurrencies, whether sending them (via the network) or buying/selling them (via an exchange), there is an advantage over traditional banking which always is a single point of failure.

8.1.5 Price Stability

Taking Bitcoin as an example of a cryptocurrency we see that the value of the currency has endured enormous fluctuations. See Figure 8-1 for an overview of the bitcoin price at exchange Bitstamp, the huge price volatility is clearly visible. The most notable recent fluctuations were in April 2013, where the currency peaked at $266 dollars US from a high of $22 dollars US in February 2013. The other significant peak occurred in December 2013 when Bitcoin reached a record high of $1203 dollars US (on Bitcoin Exchange Mt. Gox.). All cryptocurrencies suffer from the same price volatility, see Figure 3-1 as discussed in section 3.3 for an example of the similarity between the Bitcoin and Litecoin price volatility.

Figure 8-1 Bitcoin price chart (source: bitcoinaverage.com)

The peaks are not all upward however, in the beginning of 2014 bitcoin Exchange Mt. Gox collapsed and the price dropped to as low as $400 dollars US on exchange Bitstamp (February 25th) and a flash crash occurred on exchange BTC-e on February 10th driving the price down to $104 dollars US before quickly recovering to $600 (Bitcoinwisdom, 2014; Bryans, 2014; Chowdhury, 2014; Dollars, 2014; Rogojanu & Badea, 2014). In Figure 8-2 is the volatility of bitcoin compared to gold, the Euro/USD rate and the Argentina Peso versus the US Dollar. One can see that also relatively the volatility is very high compared to other currencies and gold.

Related to this price volatility is the low liquidity of the bitcoin market. A lot of users are simply keeping their bitcoins in the expectation that they will rise in price, in order to make a profit. These speculators drive up the volatility and also do not provide any liquidity in the market. Recently Saxo Bank CEO Lars Seier Christensen

has said that these low levels of liquidity make that big investors and banks are not coming in to the market as it is very difficult to buy large quantities of bitcoin on an exchange (Higgins, 2014b).

Also the media plays a role in increasing the volatility of the market. A recent study by Kristoufek (2014) shows that interestingly media attention not only drives up the price when things are looking positive, but also drives the price down when a price bubble is burst. So this asymmetric correlation greatly enlarges the price fluctuations of cryptocurrencies. (Kristoufek, 2013, 2014)

Concluding: price stability is a real issue for cryptocurrencies and a disadvantage to potential adopters

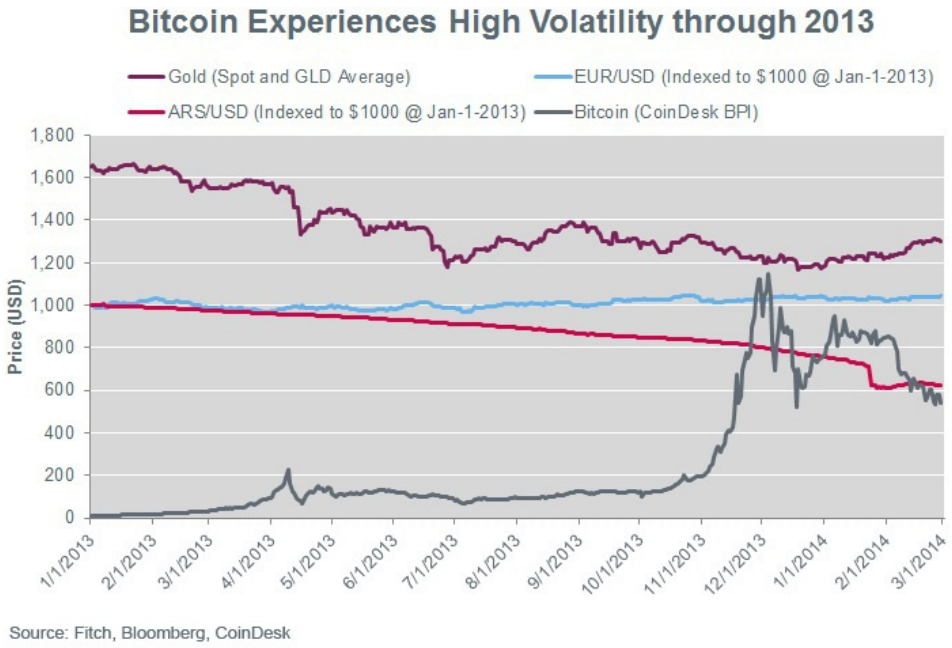


Figure 8-2 Bitcoin volatility compared to other currencies

8.1.6 Security

Security is a very important factor for cryptocurrencies to be adopted as a mainstream currency. Cryptocurrencies are designed to be used in a decentralized fashion using cryptographic proof instead of relying on trust. This design principle enhances the security of the protocol (Nakamoto, 2008). Of course the security of the protocol largely depends on the usage of encryption, and if this encryption were to be broken then the entire security of the protocol is breached. Bitcoin uses SHA-256 encryption which is deemed very safe, and there are other cryptocurrency implementations using other kinds of encryption standards, including MaxCoin which uses the successor of SHA-256, namely SHA-3 and has the interesting feature that it "cycles" between different encryption algorithms. This would make breaking the protocol significantly harder.
If the encryption algorithm used in a cryptocurrency were to be broken the architecture allows for it to be replaced with a new algorithm, therefore mitigating this risk.

Besides the encryption standards used by the protocol there are other possibilities for security breaches. What exactly will happen when a major security breach is identified is difficult to predict. Since cryptocurrencies are based on trust, if the trust gets broken all value of the protocol is lost.

However, in the past several issues with the protocol have arisen that did not have a major influence on the price of bitcoin as it is today. For example on the 11th of March 2013 a blockchain fork occurred due to a difference in two versions of the Bitcoin software. This error required manual intervention in order to solve it (Gervais, Karame, & Capkun, 2013). Due to the open source nature of most cryptocurrencies errors in its implementation are spotted by the community and swiftly dealt with. This does not mean that it is not a risk to take into account.

Concluding: the contribution of the security of the protocol to adoption is neutral as it has proven to be robust however there have been issues in the past.

8.1.7 Privacy

A lot of attention has been given to the fact that cryptocurrencies are deemed to be anonymous. However at most one can say that they are pseudo anonymous. While it is not visible in the blockchain who owns which address, all the transactions that happen on the network are visible for everyone in the network. Therefore it is impossible to make transactions invisibly. Statistical analysis and data mining can be used to indicate which party owns which address and as soon as the connection between an individual and a wallet address can be made all privacy is lost. Privacy can be enhanced by the usage of so called "mixing services" these services mix a high amount of bitcoins from many different wallets and then from the combined or mixed wallet they make the payments for the users of the services. This way it is difficult to see what the originating wallet for the transaction is. (Androulaki, Karame, Roeschlin, Scherer, & Capkun, 2012; Reid & Harrigan, 2013)

Concluding: it is not possible to draw a single conclusion on the topic of privacy. Depending on the implementation of the cryptocurrency there can be as many or as little privacy as required. However the question remains what is best for stimulating adoption: more or less privacy. Different stakeholders might have different needs regarding this topic.

8.1.8 Scalability of the protocol

Scalability of the protocol of cryptocurrencies is one of the most important factors for the acceptance of cryptocurrencies as a replacement for payment systems. By design the protocol of cryptocurrencies is highly scalable, however with an increasing amount of transactions comes an increased load on the Bitcoin nodes.
To get an idea of the amount of resources needed when cryptocurrencies become a mainstream platform for payments we take VISA as an example.
Visa processes an average of 2000 transactions per second. A transaction in Bitcoin typically ranges from 0.2Kb to 1Kb, averaging 0.5Kb per transaction. So the network bandwidth needed to processes these transactions would be (dividing by 1024 to get Megabytes and multiplying by 8 to get Megabit):

*2000 * 0,5Kb / 1024 * 8 = 7,8125 Mbit per second.*

Modern consumer grade broadband connections are already faster than this, so internet bandwidth is not a problem for hosting this level of transactions per second. According to the official Bitcoin wiki the CPU power needed to process these transactions is not a bottleneck, a high-end desktop could easily processes double this amount of transactions.

However the amount of disk space needed to store the full blockchain is enormous. 3,4 Gigabyte of data will be generated by the network every hour! This means that a 4TB hard disk will be filled with data in just 50 days. This level of data generation makes it infeasible for consumers to run a client that downloads the full blockchain.

While this might be a hindrance for consumers running a full client, for a commercial party the costs are negligible. So one could foresee that in the future consumers will not run a full client that downloads the entire blockchain, but will have to rely on third parties to host the entire blockchain. This seems paradoxical because we arrive at a somewhat centralized organization of the network, which goes against the entire idea of cryptocurrencies being decentralized. However what one has to take into consideration is the fact that even though there will be only certain parties hosting the full blockchain, they will not be the ones in control of the network. This remains a task for the miners in the network, so this averts some of the risks of the centralized situation. (Barber, Boyen, Shi, & Uzun, 2012; Dan Kaminsky, 2011; "Scalability - Bitcoin," 2013)

Concluding: there is no clear indication whether the scalability aspects of the cryptocurrency protocol will be negative or positive for adoption

8.1.9 Irreversible payments

As already stated in the stakeholders chapter: a widely cited benefit for business is supposed to be the irreversibility of payments with cryptocurrencies. However the scope of this research is Europe and in Europe payments made with SEPA (Single European Payments Area) are also irreversible. Looking at PayPal; these transactions are reversible contrary to SEPA and cryptocurrencies (Woutersen, 2013)

Concluding: this is not a relative advantage over certain other payment methods although it is something to keep in mind.

8.1.10 Economic and environmental costs of mining bitcoin

It is interesting to not only look at the costs for the end user of sending a transaction, which is described in detail in section 8.1.1, but also at the costs of hosting the entire bitcoin network as well as the CO2 emissions this causes. McCook (2014) compared the economic and environmental costs of the mining of bitcoin to the banking industry. He calculates under certain presuppositions the costs of the entire bitcoin mining network. There are two major parts to this calculation, one the one hand the costs of the equipment to mine the bitcoin and on the other hand the power usage to run this equipment.

Electricity costs

Given the energy usage of the current most efficient mining equipment about 1 Million MWh / year is necessary to run the network. This equates to 610.000 tonnes of CO2 per year.
At an electricity price of $0.10 per kWh the power costs are about $100 million. This is of course under the assumption that the power costs are indeed as low as 10 dollar cents per kWh, in Europe the power costs are usually higher. Also is the average bitcoin mining equipment likely less efficient, leading to more power consumption and thus even higher costs.

Equipment

The bitcoin mining equipment also costs a lot of money itself. The entire, lengthy calculation can be found in the paper of McCook (2014), however in short: the costs of the amount of equipment necessary to run the entire bitcoin network is about $685 million. Due to the exponentially increasing power of the network, new equipment is needed every year, therefore every year this investment is needed.

While one might expect the power costs to be the lion's share of the total costs, interestingly it can be seen that the power costs are less than one seventh of the total costs of running the bitcoin network of $100 million + $685 million = $785 million USD yearly.

Costs per transaction

The last two years there were on average 18.3 million transactions per year. This means that there is a CO2 emission of 0.61M tonnes CO2 / 18.3M = 32,39 KG of CO2 emission per transaction! However the power costs of the network are fixed costs, an increasing amount of transactions will not marginally increase the amount of power needed to run the network. Therefore when the amount transactions will increase, the electricity costs and associated CO2 emissions per transaction will go down.

McCook estimates the CO2 emission generated yearly during the production of cash money, bills and coins, at 6.7M tonnes of CO2. This does not include the distribution of cash, however one can see that this figure is only about 10 times the CO2 emission of the Bitcoin network whilst it comprises the entire global yearly cash creation. McCook notes that although the CO2 emission of making cash money will not go down, the CO2 emission of the Bitcoin network is generated by electricity usage alone; therefore if the electricity generation process will get greener or even emission free Bitcoin's emission levels will drop significantly.

8.2 Ease of Use

Ease of use is defined in IDT as *"the degree to which an innovation is perceived as being difficult to use"* (Moore & Benbasat, 1991b, p. 195).

At this time cryptocurrencies are difficult to use. Their complex nature makes that it is difficult for novice users to completely comprehend how they work. There are numerous cases of individuals losing their

cryptocurrency because of a technical failure of their pc or simply because they accidently lost their passphrase or wallet file. (Goldman et al., 2014)

Besides users losing or accidently destroying their wallet, also the current wallet software is often difficult and cumbersome to use. It is very easy for a user to enter the wrong amount of bitcoin or send them to the wrong address. The client does not warn the user and if a user completes the action, the bitcoins are gone forever. One user reported of accidentally sending over 100 BTC in transaction fees in just 24 hours. (Barber, S. & Shi, E., 2012; Southurst, 2013)

Especially compared to current forms of internet banking, mobile banking and payment systems as iDEAL, cryptocurrencies are much harder to use correctly. This lack of usability is further enlarged by the fact that mobile phone manufacturer Apple is consistently removing apps that have cryptocurrency related functionality from its appstore (Southurst, 2014). This lack of a proper mobile wallet application leads to users having to use mobile websites and degrades usability.

This current lack of ease of use is noticed by the bitcoin community and companies are trying to fill this gap. In May 2014 Circle launched its bitcoin related product, with the aim of bringing cryptocurrencies to the mainstream market. Circles aim is to make transferring bitcoin as easy as possible, by showing users their balance in their local currency, requiring 2-factor authentication for more safety and having free customer support. (Circle, 2014)

Another very important step in increasing the ease of use of bitcoin is the introduction of the new payment protocol BIP 70 in March 2014. This new protocol makes it possible for websites to have a direct connection with the wallet of the payee. Using a signed connection the user can then make sure that he pays to the correct address and never has to type in the long and complicated wallet address of the receiver. Also does the new protocol allow for the returning of payments, so that if something in the process goes wrong, the store can pay the user back without having to contact him for his personal wallet address.(Andresen, 2014; Bitonic, 2014)

Concluding: while there are ongoing efforts to increase the ease of use of cryptocurrencies, at the moment they are still difficult to use.

8.3 Result Demonstrability

The IDT defines result demonstrability as: “the tangibility of the results of using the innovation, including their observability and communicability” (Moore & Benbasat, 1991b, p. 195).

Looking at cryptocurrencies, one could say that they have a low result demonstrability. There are no tangible results of using bitcoin and its usage is not very observable in the way that you could literally see the transaction process. This low result demonstrability, combined with the technical nature of the innovation make that it is very hard for individuals new to cryptocurrencies to understand how they work and what is happening. While one could argue that the results of using cryptocurrencies can “demonstrated” by communicating about the benefits like low costs or fast transactions, these arguments are not a direct demonstration but a derivative of using cryptocurrencies.

Concluding: the result demonstrability of cryptocurrencies is low.

8.4 Visibility

Visibility is defined in IDT as: “The actual visibility of the PWS“ (Moore & Benbasat, 1991b, p. 203), where PWS is the studied IT system. Venkatesh et al. (2003) adapted it as follows*: “The degree to which one can see others using the system in the organization”* (Venkatesh et al., 2003, p. 7).

While the result demonstrability of cryptocurrencies is low, there are a lot of opportunities to see others *using* the system. Throughout the world there is a lot of media attention to cryptocurrencies and the opportunities it brings. This enormous amount of media attention gives a lot of visibility. Also are there more and more bitcoin ATMs being installed worldwide. This ATMs increase the visibility of cryptocurrencies, as they make the whole

process much more tangible. The ATM allows first time users to easily buy bitcoins just by submitting some banknotes.

PWC mention in their report titled "How Bitcoin is Driving Digital Innovation in Entertainment, Media and Communications (EMC)" that there are 3.400.000 social mentions about Bitcoin in 2013 (see Figure 8-3). Mentions include social networks, microblogs, forums, mainstream news, images, videos and blogs (PWC, 2014).

Concluding: This shows that there is a huge amount of media attention and also between consumers there is a lot of conversation about the topic leading to a high visibility.

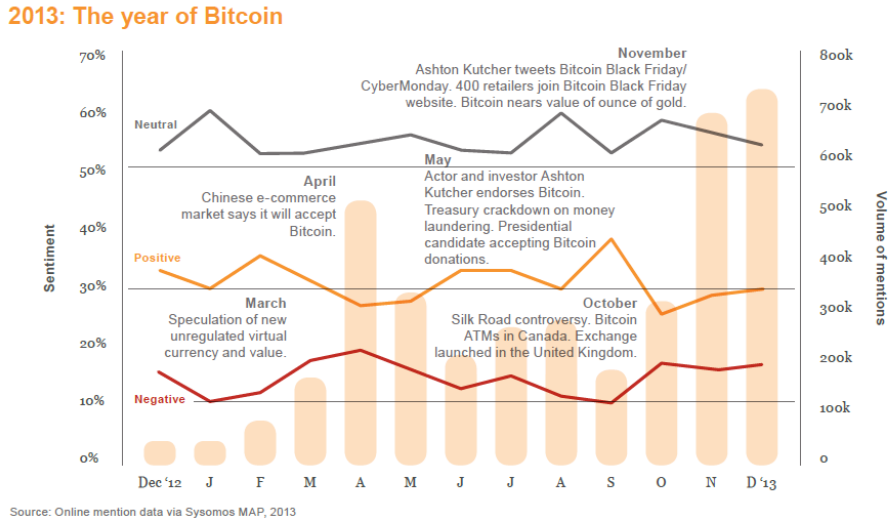


Figure 8-3 Social mentions of 'Bitcoin'(PWC, 2014)

8.5 Compatibility

Compatibility is defined as: "the degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters" (Moore & Benbasat, 1991b, p. 195).

Whether cryptocurrencies are compatible with the values and needs of potential adopters is difficult to say. This would depend on the potential adopter. When looking at early adopters of cryptocurrencies it becomes apparent that one very important aspect to many of them is the fact that cryptocurrencies are decentralized. Many early adopters are libertarians and followers of the Austrian school of economics. They like the fact that the government cannot influence the amount of currency in circulation.(Grinberg, 2011; Luther, 2013) To quote Eric Posner, professor of Law at the University of Chicago:

> *"One of the most appealing aspects of a decentralized currency for some people – and even perhaps a motivation for its creation - seems to be freedom from government or central bank control, as reflected in the libertarian mindset."* (Goldman et al., 2014, p. 4)

Understandably, to libertarian individuals, cryptocurrencies are very well compatible. However to argument of freedom from governmental influence might not interest the average user.

However one could also look at the theme of globalization. The internet and other inventions have made the world a small space, people from all over the world collaborate, work together, listen to music from around the globe and of course there is a lot of global trade, see Figure 8-4. In this paradigm a global currency fits very well; cryptocurrencies can play this role.

Concluding: cryptocurrencies fit excellently in the paradigm of digitalization and globalization and this way might be consistent with the values, needs and past experiences of potential adopters.

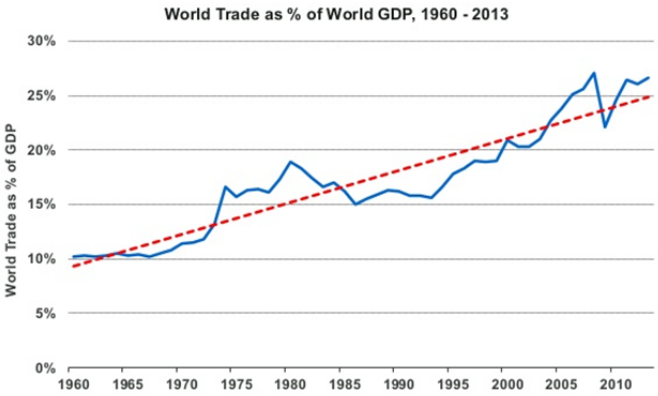


Figure 8-4 Historical World Trade (Meeker, 2014)

8.6 Trialability

Trialability is defined as: "The degree to which an innovation may be experimented with before adoption". (Moore & Benbasat, 1991b, p. 195).

Since the barriers to entry for using cryptocurrencies are very low, there is a high level of trialability. The software is open source and therefore freely downloadable for anyone with an internet connection. One does not have to pay money in order to experience cryptocurrencies either, there are so called "test nets" where users and developers can test the software and play around with it. (Bitcoin Wiki, 2014c)

Concluding: that due to the fact that there are very low barriers of entry for potential adopters the trialability is high.

8.7 Image

Image is defined as: "The degree to which use of an innovation is perceived to enhance one's image or status in one's social system" (Moore & Benbasat, 1991b, p. 195). Regarding cryptocurrencies there are two main topics influencing the image of the user: one is crime, which is of negative influence and the other, Public Relations, is positive.

8.7.1 Crime

Crime in cryptocurrencies is of course very bad for the image of the innovation. And in its infancy cryptocurrencies were known for its connection with organized crime. Silk Road, a major exchange where drugs could be bought anonymously online was busted in October 2013 (Ron & Shamir, 2013). However in reality there was very little involvement of the cryptocurrency community in the illegal online marketplace. Analysis showed that after the bust of Silk Road the volume of traded Bitcoins did not go down significantly at all. It was mostly just a media hype due to the interesting nature of the usage of cryptocurrencies. Quoting Fred Ehrsam, co-founder of Coinbase: "It was found that volume on Silk Road – the black market exchange that was shut down by the FBI in October 2013 – represented less than 1% of all activity, and that was by far the largest operation of its kind." (Goldman et al., 2014, p. 9).

However due to its pseudo anonymous nature there are unfortunately more aspects in which crime is involved in cryptocurrencies:

Stealing of wallets

One of the most prominent risks for end-users is the fact that wallets containing the cryptocurrencies of users get stolen by criminals. Special viruses exist specifically targeting Bitcoin wallets, sending them to the criminals who then quickly transfer the funds to their own. (Brezo & G. Bringas, 2012)

Illegal mining

Besides stealing cryptocurrency wallets, criminals have also been using botnets to mine cryptocurrencies illegally on the computer equipment of unsuspecting users. (Plohmann, 2012) Due to the large number of PC's

in a botnet hackers can obtain large amounts of cryptocurrency. Due to the introduction of specialized mining equipment it becomes less profitable to mine on a regular PC which seems to make this kind of crime irrelevant in the future. However at the moment there are even reports of hacking of integrated devices such as TV's in order to mine cryptocurrencies and Synology Network Attached Store devices (Higgins, 2014a; Pauli, 2013).

Money laundering
Cryptocurrencies also attract criminals and money launderers, due to its (largely) anonymous nature (Villasenor, Monk, & Bronk, 2011). However, Stokes (2012) states that although virtual currencies have a certain money laundering utility, they are not suitable for money laundering on a large scale at the moment (Stokes, 2012). Attention to the management of the risk of laundering should be given to these currencies though. The more popular the currencies become, the more they become suitable for large scale laundering.

Fighting crime involving cryptocurrencies
As Kerr (2008) noted, there are two problems dealing with criminals stealing virtual money or goods. Firstly, it is very hard to catch a smart criminal online. There exists plethora of techniques of hiding the identity of the thief making finding them very hard. Besides this are the "money trails" much harder to follow, due to the nature of the semi anonymous transactions with cryptocurrencies.

The second difficulty is the fact that while "regular" crimes usually take place in one country, crimes involving cryptocurrencies usually span the globe and cover multiple jurisdictions. This makes it very hard for a victim in one country to try to and get his possessions back from criminals in other countries and jurisdictions. (Kerr, 2008)

Concluding: the involvement of cryptocurrencies in crime is not good for its image.

8.7.2 Positive PR
There is a lot of positive PR to be had for companies accepting cryptocurrencies. For example when Dutch company Thuisbezorgd.nl/Takeaway.com announced that it would start accepting bitcoin it got media attention from all over the World. Jitse Groen, the CEO of the company stated that its decision to accept bitcoin was very good for the company image. (Lobosco, 2013)

Concluding: At the moment there is a lot of media attention for bitcoin and due to the novelty and technical nature of the innovation it really enhances the image of companies accepting cryptocurrencies. On an individual level are there still many people who do not yet know what cryptocurrencies are, therefore it would really depend on the social circles one is in whether or not having cryptocurrency contributes to ones social status.

8.8 Voluntariness of use
Voluntariness of use is defined as: "the degree to which use of the innovation is perceived as being voluntary, or of free will" (Moore & Benbasat, 1991b, p. 195).

The use of cryptocurrencies is (at least at the moment) not mandatory and the decision to choose to start using cryptocurrencies is therefore made on an individual and voluntary basis. In the future this might change, but at the moment there are no known stores that only accept bitcoin. Only accepting bitcoin would be illegal because euros are legal tender in Europe, and every store has to accept payment in euros. To quote the website of the European Commission department of Economic and Financial Affairs:

> *"Within the euro area, only the euro has the status of legal tender. This results from the fact that the money used in a monetary system does only have the status of legal tender if it is provided for under the respective monetary law. In the euro area, Article 128 (1) TFEU lays down the legal tender status of euro banknotes, and Article 11 of Regulation EC/974/98 on the introduction of the euro does accordingly with regard to euro coins. This mean that in the absence of an agreement of the means of payment, the creditor of a payment obligation is obliged to accept a payment made in euro which subsequently discharges the debtor from his payment obligation.*

Yet, contractual parties are free to agree to use in transactions other official foreign currencies with legal tender status in the state of issuance, e.g. the Pound Sterling or the US Dollar. The same applies to privately issued money like local exchange trading systems (e.g. voucher-based payment systems in certain communities) or virtual currency schemes (e.g. Bitcoin). Although these are not official currencies and have no legal tender status, parties can agree to use them as private money and without prejudice to the official currency (euro or national currency) being the sole legal tender." (European Commision, 2013)

Concluding: what this means is that the use of bitcoin in the Euro area will always be voluntary.

8.9 Overview table

In Figure 8-5 an overview is given of the mapping of cryptocurrencies on the IDT framework and the supposed contribution to adoption. This overview is based on the previous sections in this chapter which give more detail for each construct. The findings of this chapter are used as the basis for the conceptual model, which is presented in section 8.10.

Construct	Contribution to adoption
Relative Advantage	
• *Low costs*	Benefit
• *Fast transaction speed*	Benefit
• *Decentralized*	Neutral
• *No single point of failure*	Neutral
• *Price stability*	Disadvantage
• *Security*	Neutral
• *Privacy*	Neutral
• *Scalability*	Neutral
• *Irreversible payments*	Neutral
Ease of Use	Disadvantage
Result Demonstrability	Disadvantage
Visibility	Advantage
Compatibility	Advantage
Trialability	Benefit
Image	
• *Crime*	Disadvantage
• *Positive PR*	Advantage
Voluntariness of use	Advantage

Figure 8-5 Cryptocurrencies mapped on IDT

8.10 Conceptual model

Based on the aspects of cryptocurrencies a conceptual model is created, see Figure 8-6. This model contains on the one hand *intrinsic aspects of cryptocurrencies* and the benefits and disadvantages of using cryptocurrencies. Benefits will contribute positively to adoption, while disadvantages contribute negatively to adoption. These benefits and disadvantages are based on the previous sections in this chapter where they are discussed.

On the other side are the *external forces*. While these forces are not directly dependent on aspects of cryptocurrencies, they are very important in the adoption process and therefore cannot be left out of the model. Especially since the goal of the next chapter is to create a System Dynamics (SD) model.

Because adoption is not linear but rather depends on network effects such a SD model is highly suitable for the task. With the creation of the SD model in mind, already a feedback loop is created from adoption to external

forces. The meaning of this is that the more adoption there is, the more this will stimulate the use of cryptocurrencies by business, media attention et cetera. And also the other way around, the more businesses offer potential adopters the possibility of paying with cryptocurrencies, the more this will stimulate adoption. This initial model is verified in the interviews with important stakeholders as expert opinions.

External forces included in the model are: use by business, user base, media, government policy and role models.

- Use by business is the amount of businesses that offer adopters the option of paying with cryptocurrencies. This is of course a very important factor, because if potential adopters see that there is no place to spend their cryptocurrency they can then only pay other users and not make regular purchases.

- User base is the amount of users that have already adopted cryptocurrencies. The more users that have adopted cryptocurrencies, the more interesting it is for potential adopters as they can send cryptocurrencies to their friends and family.

- The construct media is the coverage of cryptocurrencies by the media. The amount of media attention cryptocurrencies attract is of high impact on the usage and therefore important. Also the other way around: the more adoption there is, the more the media will tend to cover cryptocurrencies.

- Government policy is included because it has an enormous influence on the adoption of cryptocurrencies. By putting in place strict regulations and barriers it can severely hinder the adoption process whilst on the other hand a push of the government in the direction of cryptocurrencies can speed up adoption. See for example China, where the ban on Bitcoin has led to a dramatic price drop of the currency on a global scale, versus the USA where the pro-active policies are stimulating many Bitcoin start-ups and increasing adoption rates.

- Role models are opinion leaders that influence potential adopters. The more role models start using cryptocurrencies and proclaiming their usefulness the more this will stimulate adoption.

Lastly are also the *three functions of money* included in the model, as discussed in chapter 4. The three functions are modeled as a moderating variable on adoption. Because cryptocurrencies do not yet fulfill all the three functions of money completely (see chapter 4 for an overview of this) this is hypothesized to impact the rate of adoption. However it is apparently not a requirement for cryptocurrencies to fulfill these three functions of money completely as there are already millions of cryptocurrency users.

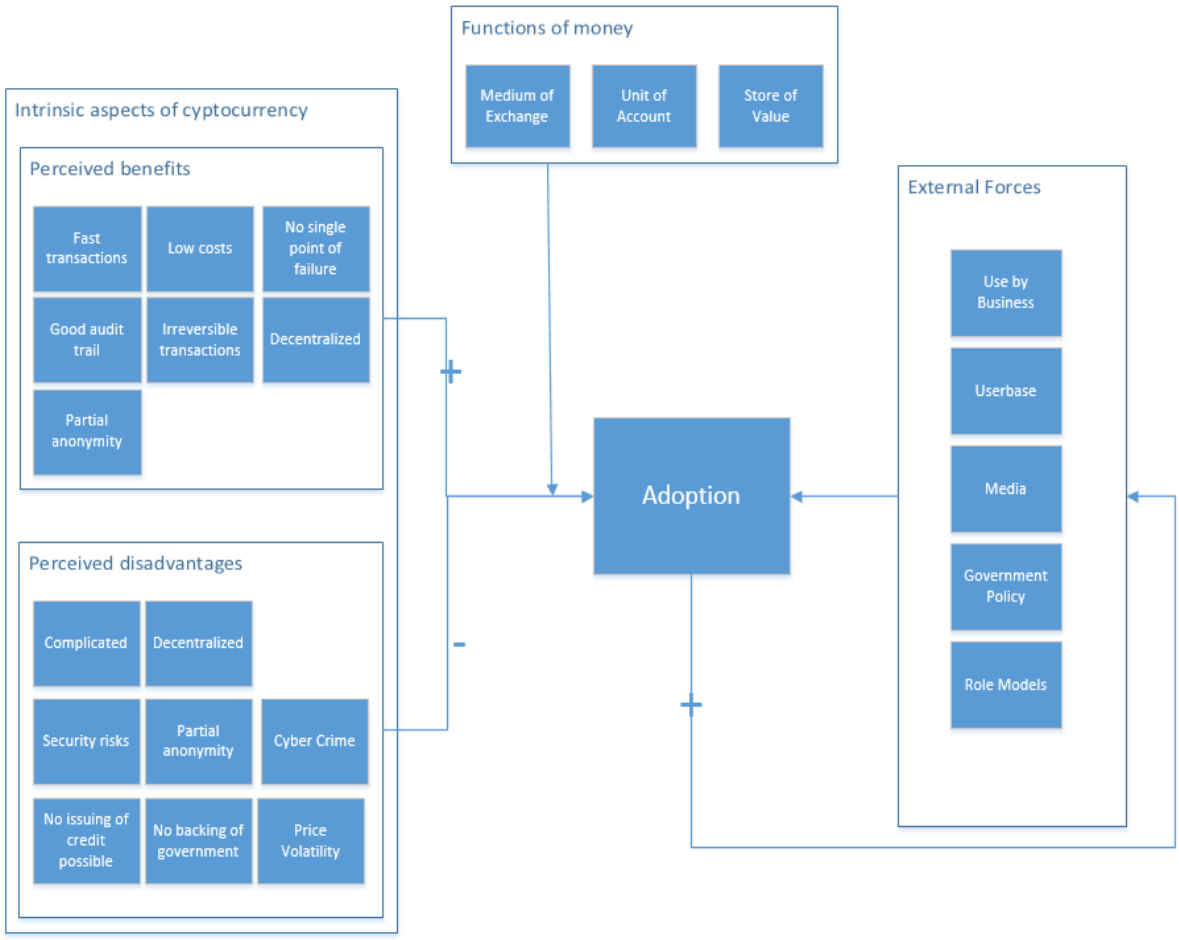


Figure 8-6 Conceptual Model

9 Interview Analysis - Validation

In this chapter we will address the sixth sub-research question: “How do current implementations fulfill these requirements of different stakeholders?”.

We will give an overview of the quotes of the interview participants for each of the factors that are discussed in the previous chapter. Also during the interviews and the coding process it became apparent that there were a few extra topics that were important according to the interviewees. These three additional topics of interest are: alternate uses of the blockchain, knowledge about cryptocurrencies and scalability. Also we coded an additional node called “adoption process” under which general remarks regarding the adoption process were filed.

In the next sections each factor will be discussed separately with the interview quotes as a basis. Out of the 15 interviews a total of 13 transcribed interviews with participants was used as a basis for this process. Two interviews were not transcribed as there was no audio recording available. Information from these interviews was used as input by means of recollection and notes that were taken. An overview of these participants can be found in Table 9-1. The opinions of each interviewee are taken into account and are used in order to be able to assess each topic. The most applicable and interesting quotes are given for each interviewee and are used to support the statements regarding the consensus of interviewees. A full overview of quotes of all participants about all topics can be found in the appendix.

Table 9-1 Interview Participants

Interview Participants	Company	Industry
Berry Schoenmakers	Technische Universiteit Eindhoven & Former DigiCash employee	Academic, Financial Services
Dennis de Vries	ING Bank	Banking
Mirjam Verhoeven	SNS Bank	Banking
Jochem Baars	Rabobank	Banking
Laurens Hamerlinck[3]	ABN AMRO	Banking
Richard Kohl	PikaPay	Bitcoin
Sander Regtuijt	Safello	Bitcoin Exchange
Robert-Reinder Nederhoed	BitMyMoney	Bitcoin Exchange
Jouke Hofman	Bitonic	Bitcoin Exchange
Kim Gunnink & Mirjam Plooij	De Nederlandsche Bank	Dutch Central Bank
Rob Voster	KPMG & former Deutsche Bank employee concerning E-Cash	Financial Services consultant, Banking
Imad Qutob[4]	Thuisbezorgd.nl	Food delivery
Gaston Aussems	Mollie	Payment Service Provider
Simon Lelieveldt	Lelieveldt Consulting	Payments consulting
Jacob Boersma	InnoPay	Payments consulting

9.1 Overview of coded concepts

An overview of all the different concepts that were coded in NVivo 10 is shown in Table 9-2. In this table in the first column the name of the node is given. The nodes are sorted alphabetically, with sub-nodes indented. The second column details the number of sources, so the number of different interview participants that said something regarding this concept. The third column details the exact number of references, so the amount of times interview participants mentioned a certain concept. There can be more references than sources, as an interview participant can mention the same topic multiple times.

[3] This interview was not recorded.
[4] Unfortunately due to a technical error, a large part of the audio recording of the interview is missing.

When an item gets more references from several different sources the conclusion can be drawn that this topic is of more importance to the interviewees than other topics. We can see for example that price volatility has 17 references by ten different sources (out of 14). This shows that in the opinion of the interviewees this is an important topic. Compare this to the concept of fast transactions which has only two references by two sources, making it apparently less important to the interviewees.

Table 9-2 Overview of coded concepts

Name	Sources	References
Adoption process	10	37
Alternate uses of blockchain	7	13
Benefits	11	49
Decentralized	6	8
Fast transactions	2	2
Good audit trail	4	5
Image	3	4
Irreversible payments	3	4
Low barrier to entry	2	2
Low Costs	5	8
No Single Point of Failure	4	6
Partial anonymity	2	2
Disadvantages	11	74
Decentralized negative	4	6
Ease of Use	7	19
No backing of government	4	7
Partial anonymity	3	7
Price Volatility	10	17
Security Risks	2	3
Use by criminals	5	8
External Factors	9	47
Media	6	10
Regulation	8	33
Role Models	1	2
Use by Business	1	1
Userbase	1	1
Functions of money	11	60
Commodity vs Currency	9	19
Medium of exchange	6	11
Store of value	4	10
Unit of account	5	10
Knowledge	3	3
Scalability	6	9
Trust	1	3

9.2 Adoption process

The adoption process in general is a topic almost every interviewee talked about. With ten out of 14 interviewees and 37 references the analysis of the interviews shows that this is an important topic of interest.

The main opinion of Berry Schoenmakers (Technical University Eindhoven) is that there are many different factors influencing the adoption of cryptocurrencies making it a complex process and there are many ways

where cryptocurrencies can go. He sees that bitcoin has gotten very big however he thinks that there will be a better alternative that will come along.

> *"Why would the first cryptocurrency on this earth directly be the one to succeed, why not a bitcoin 2.0, 3.0?"* –Berry Schoenmakers

Gaston Aussems (Mollie) also sees the playing field of payments changing with more parties entering. His opinion is that consumers change their payment behavior only very slowly. Still a large percentage (about 50%) of the transactions is done with cash.

> *"A merchant wants to offer the options that his customers have or ask for".* –Gaston Aussems

From his 20+ years of experience in the payments industry he states that adoption starts with first banks offering a new payment method, then consumers adopting it and finally consumers demanding their preferred payment method at the retailers.

The Bitcoin Foundation has as its mission to standardize and promote the use of Bitcoin. However Gaston mentions that:

> *"The bitcoin foundation undermines the ideological aspects of bitcoin. There is criticism from the bitcoin community that it is very centralized and untransparent. It can become a big threat to bitcoin as you can see that there is a lot of resistance in the community against it."* –Gaston Aussems

He states that the governance of the foundation needs to have a better match with what bitcoin is. And it needs to be open-source, transparent and democratic. Gaston is not the only one to see this, recently Olivier Janssens, an early adopter of Bitcoin has created a $100,000.- US Dollar bounty for software that will replace the need for the Bitcoin Foundation (Cordell, 2014).

Jacob Boersma (InnoPay) also sees the adoption of cryptocurrencies as still in its infancy phase. While Gaston Aussems sees the consumers as the factor that slows adoptions down, Jacob sees banks as the prime cause for this.

> *"There are many incentives to keep current systems. Banks maintain these systems and change slowly."* –Jacob Boersma

He sees scalability of the network as an essential factor to adoption just as Gaston Aussems.

> *"Scalability is essential for the network to survive, if all the regular fiat payments will be made on the blockchain this is threatened. Something will have to change."* –Jacob Boersma

Richard Kohl (PikaPay) sees the fact that important players in the Bitcoin industry start to look more like the traditional players such as banks as a factor that can limit Bitcoin's influence.

Robert-Reinder Nederhoed (BitMyMoney) sees the value of bitcoin to continue to increase however he states that it is important that users do not see bitcoin as an asset but rather as an innovation.

Sander Regtuijt (Safello) sees three things as most important to adoption: education, security and ease of use. Like other interviewees he also believes it will take at least several years before having a stable currency climate.

Simon Lelieveldt (Lelieveldt Consulting) never sees cryptocurrencies as replacing fiat currencies or fiat being issued on the blockchain. Although he definitely sees the opportunity for a great product to emerge.

> *"You never know what the next development in this space will be. A lot of e-money businesses have taken a leap forward compared to more traditional banks (see Paypal)."* –Simon Lelieveldt

A roadblock to adoption might be a possible lack of liquidity according to Simon, this due to the fact that large investors entered the market but stopped moving.

Dennis de Vries (ING) gives a good summary of the general opinion:

> *"It is very difficult to predict what will happen, however it is nearly unthinkable that cryptocurrencies will not have any influence at all."* –Dennis de Vries

Concluding: From this we can conclude that the general opinion is that the future of cryptocurrencies is still very unclear. There is still a lot that can happen and there are many ways in which cryptocurrencies can have a possible use case. The financial industry is seen as an industry that does not move very quickly. Cryptocurrencies can take a huge leap forward however precautions have to be taken to make sure that the core aspects, decentralization and transparency, do not get pushed away.

9.3 Benefits

9.3.1 Decentralized

The decentralized nature of cryptocurrencies is seen as an advantage by most interviewees. They state that this way:

> *"Bitcoin gives power to the people. This is a way to go back to the basics of money without fractional reserve banking, but with the advantages of digital payments."* –Jouke Hofman

Also Berry Schoenmakers and Gaston Aussems recognize this and state that the internet community is anarchistic to a certain extent and that they therefore like the anarchistic approach of cryptocurrencies. Especially the interviewees involved in the bitcoin ecosystem seem to have lost faith in the government and like the fact that it cannot influence bitcoin.

Jochem Baars (Rabobank) sees as benefit of the decentralized ledger the fact that it never closes and runs 24/7, this compared to a bank which does not process any transactions after it closes for the night.

> "Due to legacy architecture it is very difficult for banks to adapt their systems to be able to make faster transactions." –Jochem Baars

The Dutch Central Bank (DNB), as one might expect, does not like the fact that cryptocurrencies are decentralized. They specifically do not like it because there is no single party which can be held accountable.

Concluding: except for the DNB does every interviewee see the fact that cryptocurrencies are decentralized as an advantage.

9.3.2 Fast transactions

The topic of fast transactions has only got two references, which might imply that the interviewees do not really see it as much of a benefit. The reference from Jacob Boersma underlines this:

> *"Fast transactions is also not really a benefit in the Netherlands because popular Dutch payment methods provide an instant payment guarantee to the merchant."*
> –Jacob Boersma

Concluding: fast transactions are not really seen as a benefit of cryptocurrencies.

9.3.3 Good audit trail

Berry Schoenmakers thinks that the fact that all transactions are visible in the block chain is something the government will like. However Gaston Aussems remarks that it is only a good audit trail if you actually know which address is from which person. The DNB agrees:

> *"There is not necessarily a good audit trail, because it is easy for consumers to hide their payments with TOR.[5]"* –Kim Gunnink & Mirjam Plooij (DNB)

[5] TOR stands for The Onion Router and is a free piece of software that hides the online identity of its users. See https://www.torproject.org/ for more information.

Jouke Hofman (Bitonic) sees the benefits not for the government who can then track all the transactions of users, but as a way to make it possible for bitcoin exchanges to prove their trustworthiness and show that they do not engage in fractional reserve banking.

Concluding: the audit trail can have benefits by showing all transactions, however linking these transactions to identities is difficult.

9.3.4 Image

For merchants accepting payments in bitcoin can enhance their image. Imad Qutob from Thuisbezorgd.nl, the Netherlands biggest food delivery network, tells that they got a lot of media attention when they started accepting bitcoin as one of the first companies in the Netherlands. From all around the world they got phone calls from reporters jumping on the story.

Also Gaston Aussems from PSP Mollie acknowledged that their recent decision to start accepting bitcoin was purely a promotional stunt. They saw what had happened to Thuisbezorgd.nl and they wanted in on the action.

Simon Lelieveldt and Jochem Baars view this from another perspective and look at the image of the cryptocurrency itself. They see that bitcoin is a currency that has a clear ideological value, it is anti-government. They state that this has been very important in the adoption process and that this will remain key for adoption.

> *"Currencies with a moral value will develop, compared to the moralless currencies of this time. Look at the current trends toward fair-trade and organic products."* –Simon Lelieveldt

Concluding: accepting cryptocurrencies as payment option can enhance the image of the merchant. Cryptocurrencies themselves have a clear ideological value.

9.3.5 Irreversible payments

Irreversible payments are not really of importance in the Netherlands. Jacob Boersma mentions that irreversibility is already standard with SEPA. Simon Lelieveldt compares it to the United States where they have an outdated payment system and payment irreversibility is an advantage.

Irreversible payments are sometimes stated to be a disadvantage because in the case of fraud it is not possible to reverse the payment. However Jouke Hofman states that this is not really a problem in the Netherlands:

> *"Because we have a government in NL that makes sure that businesses are legitimate, the fact that payments are irreversible is not a real disadvantage to customers because they are pretty sure to get their goods."* –Jouke Hofman

Concluding: irreversible payments is not advantage because in the Netherlands there are already payment systems that offer irreversible payments.

9.3.6 Low barrier to entry

A benefit of cryptocurrencies that is mentioned by several interviewees is the fact that there are low barriers to entry. Jacob Boersma, Robert-Reinder Nederhoed and Jouke Hofman all see this as an advantage. They argue that these barriers are so low because the currency is digital. The only thing that a user needs is an internet connection in order to receive and send bitcoins. In the traditional system this is different, banks have a lot of power. They are the one to decide who get a bank account or who gets a credit card.

> *"Banks have a lot of power. They alone decide who gets a bank account. Bitcoin changes this."*
> –Jouke Hofman

Concluding: cryptocurrencies have a low barrier to entry which is an advantage.

9.3.7 Low costs

An often cited benefit of cryptocurrencies is the low costs associated with its use. Jacob Boersma does not see this as an advantage for Dutch citizen since a bank transaction in the Netherlands is free. Gaston Aussems compares it to cash payments and argues that reducing the amount of cash payments increases efficiency. Simon Lelieveldt sees a lot of additional costs:

> *"This advantage is not as big as it seems, because there will be a lot of added costs when cryptocurrencies will have to comply with regulations."* –Simon Lelieveldt

An interesting point that was mentioned by both the Dutch Central Bank (DNB) and Berry Schoenmakers is the fact that the miners that process the bitcoin payments might start to charge higher fees in the future. This leaves the door open for much higher costs per transaction in the future. While this seems as something to keep in mind, this topic is not mentioned in the academic literature that was found.

> *"Nobody charges any money for it and contributes for free to the bitcoin network (all the persons that host the blockchain). It is possible though that miners will charge higher fees in the future and gain a monopoly position this way."* –Berry Schoenmakers

Besides the uncertainty of transaction fees, the low costs are also debatable according to the DNB and Simon Lelieveldt. With regular payment methods you also pay for security they argue.

> *"Low costs is debatable. When looking at the costs of bitcoin, many people tend to forget the additional costs one incurs, such are the costs of converting into bitcoin etc."*
> –Kim Gunnink & Mirjam Plooij

Concluding: there are already other payment options which are low costs and the costs of cryptocurrency transactions might rise in the future.

9.3.8 No single point of failure

The interviewees did not agree on whether or not cryptocurrencies had a single point of failure and to what extent this is a disadvantage or an advantage. Jouke Hofman sees it as a huge advantage. While Berry Schoenmakers argues that also the regular payment method of doing a debit card transaction has triple redundancy and therefore also has no single point of failure.

Simon Lelieveldt argues that cryptocurrencies do have a single point of failure:

> *"If the network itself is vulnerable (look at transaction malleability bug) there is a point of failure."*
> –Simon Lelieveldt

Besides bugs that might occur in the network leading to a single point of failure, also the exchanges where users buy and sell bitcoins form to a certain extent a point of failure. If this exchange goes down, so do the funds that are on it, take the recent breakdown of Mt. Gox as an example.

The DNB argues that also the miners can form a single point of failure. Recently (June 2014) one mining pool, GHash.IO, reached 51% of the mining capacity of the whole network. Theoretically this does enable them to have control over the bitcoin network. They could have misused their power, or even in the case of no malicious intent if their mining pools created incorrect blocks they could have disrupted the network. Also do they argue that this makes you dependent on an unknown single centralized party which contrary to a bank is not under supervision.

Concluding: there is no agreement between interviewees whether or not there is a single point of failure.

9.3.9 Partial anonymity

The partial anonymity that bitcoin provides is not seen as a benefit by many interviewees. Only Jouke Hofman and Sander Regtuijt saw this as an advantage. Sander Regtuijt sees this as useful for a company in order to pay their employees' salary anonymized. Berry Schoenmakers argued that bitcoin has no partial anonymity to begin with:

> *"The pseudo anonymity in bitcoin is very weak. There will be new solutions that will make it more anonymous, however there is chance that this will make it even more complicated for end-users."*
> –Berry Schoenmakers

Concluding: only Jouke Hofman and Sander Regtuijt saw the anonymity of cryptocurrencies as an advantage, the other interviewees did not.

9.4 Disadvantages

9.4.1 Decentralized

The decentralized nature of cryptocurrencies is not seen as a disadvantage by many interviewees. Richard Kohl states that you always have to trust someone, even with the decentralized nature that cryptocurrencies provide.

Sander Regtuijt sees that the core development team of the bitcoin software still has a certain amount of power because they develop the main software. Simon Lelieveldt sees the decentralized nature of cryptocurrencies as a disadvantage because you cannot influence anything.

> *"We also have influence on the ECB through voting. With cryptocurrencies you cannot influence anything. The power is very unevenly divided. There are large powers in the cryptocurrency space."*
> –Simon Lelieveldt

The DNB agrees with this and sees the fact that there is no single party to be held responsible as a big problem for the bitcoin system.

> *"The most important objections of the DNB against virtual currencies are the anonymous nature and the decentralized working. However these two characteristics are essential to bitcoin."*
> –Kim Gunnink & Mirjam Plooij

Concluding: the DNB and Simon Lelieveldt see the decentralized nature of cryptocurrencies as a disadvantage while Richard Kohl and Sander Regtuijt do not.

9.4.2 Ease of use

Ease of use is a very often talked about topic. The interviewees were unanimous in their opinion that the ease of use of cryptocurrencies is still very low. They all agreed that that it is very important that this changes and that it will become easier for the novice user to engage with cryptocurrencies.

> *"For the average joe all the complexity has to be abstracted. It needs to like just like a normal transaction with a bank."* –Berry Schoenmakers

Kim Gunnink and Mirjam Plooij of the DNB refer to the book of Geoffery Moore: crossing the chasm. They say that bitcoin is a technology that needs to cross this chasm between the early adopters and the early majority. This "chasm" can be crossed by offering more ease of use.

Besides this, also many interviewees talked about how to arrive at the situation when cryptocurrencies are easier to use. Jouke Hofman clearly saw a relationship between adoption and ease of use. His opinion was that there is a feedback loop there, with more adoption leading to a higher ease of use. Jacob Boersma sees potential competition on this aspect:

"Competition between different wallet manufacturers might emerge, to resolve complexity."
–Jacob Boersma

The different interviewees of bitcoin exchanges all reported that their exchanges were working on improving the ease of use.

"Usability has to improve, and we are busy with that. Users do not want to see the bitcoin addresses at all. This is all a matter of time." –Robert-Reinder Nederhoed

Concluding: all interviewees agree that more ease of use is necessary, the interviewed bitcoin exchanges are working to achieve this on their side.

9.4.3 No backing of government

The interviewees do not all agree on whether the lack of government backing cryptocurrencies is of a positive or negative influence on adoption. It appears that the interviewees not directly involved in the bitcoin ecosystem would prefer government backing and regulation while the interviewees of bitcoin exchanges see this more as a tradeoff that is necessary for the system to work.

"For the current adopting community regulation is not important but for the general public, they will want government backings." –Gaston Aussems

"Governments will never back this" –Simon Lelieveldt

However Simon Lelieveldt says that it is also possible that cryptocurrencies will be created which governments can have influence over. If such a cryptocurrency would be created this might mean that these types of cryptocurrency will be backed. Robert-Reinder Nederhoed sees the lack of a central counterparty as both an advantage as well as a disadvantage.

"There is no government to give trust to cryptocurrencies by backing them"
–Robert-Reinder Nederhoed

Jouke Hofman does not see it as a tradeoff, but as a direct advantage:

"Why don't you have no backing of government as an advantage? 2008 showed us that there are huge errors in the financial system. 6 years later there are still no fundamental changes. Bitcoin can play a role here." –Jouke Hofman

Concluding: there is no agreement on whether the lack of government backing is a disadvantage (Gaston Aussems, Simon Lelieveldt) or an advantage (Jouke Hofman).

9.4.4 Partial anonymity

The anonymity of cryptocurrencies is seen as disadvantage by Berry Schoenmakers. He refers to E-Cash, a product he previously worked on at DigiCash. One of the main reasons this product failed to achieve mass adoption was due to the anonymity it provided.

"Looking at E-Cash which had a lot of anonymity, even more than bitcoins, this was something that governments and banks were totally not happy with." –Berry Schoenmakers

Simon Lelieveldt sees the problem more in the fact that all the transactions in the block chain might be semi-anonymous but it is still a public ledger.

The DNB sees the anonymity of cryptocurrencies as a disadvantage:

"In comparison to cash it is less anonymous, although you can track the flow of bitcoins if someone is using TOR it is untraceable. Compared to cash, transfers are much quicker, there is no physical moment of money exchange and you can seamlessly convert to all kinds of different digital money

formats. Forensic teams are not very familiar with all these payment methods." –Kim Gunnink & Mirjam Plooij

Concluding: the partial anonymity is seen as a disadvantage by Berry Schoenmakers and the DNB.

9.4.5 Price volatility

Price volatility is a topic nearly every interviewee talked about and specifically the most talked about disadvantage, signaling its importance as a negative influence on adoption.

"Volatility is a very important factor in the adoption process of bitcoin." –Gaston Aussems

The interviewees were unanimous in their opinion that the price volatility is a negative aspect and that more stability is necessary for large scale adoption.

"Price volatility is definitely a disadvantage of cryptocurrencies that has to be addressed"
–Jacob Boersma

Gaston Aussems sees this price volatility remaining for some time:

"What you see is that merchants do not want any exposure to bitcoins. This shows that the market sees this volatility and want to shield itself from this, this will stay for some time." –Gaston Aussems

Richard Kohl, Rob Voster (KPMG & former Deutsche Bank employee concerning E-Cash) and Robert-Reinder Nederhoed see that the current volatility comes from market manipulation, which is possible because the Bitcoin economy is still small with a low market capitalization.

"Because there are very few players there is more possibility to manipulate the market." –Rob Voster

However Jouke Hofman and Sander Regtuijt believe that the adoption process will drive price volatility down. Jouke states that if there are more orders at the order book of an exchange the volatility will go down. Similarly Rob Voster sees this extra liquidity lowering volatility.

"I believe that if more people will adopt cryptocurrencies there will be less price volatility."
–Sander Regtuijt

Jochem Baars thinks that there might be a tipping point, when the price volatility gets low enough to get people started spending their hoarded bitcoins. This will further stabilize the price and increase liquidity in the market.

Concluding: all the interviewees agreed on the fact that the current price volatility has a negative influence on adoption which needs to be addressed.

9.4.6 Security risks

Jouke Hofman thinks that security will improve with more adoption and time. This is overlapping with ease of use; as time will go by new companies with innovative products will emerge that will enhance the security of cryptocurrencies. Jouke gives an example of one of such innovations: a USB hardware wallet by LaMaisonDuBitcoin.fr. This USB key is simply plugged into the computer of a user and enables one to send and receive bitcoins without being vulnerable to viruses stealing the bitcoins.

The DNB states that there is a consumer risk, if you lose your bitcoins due to fraud, you will never be able to get them back.

Concluding: the DNB sees security risks for the consumer. Jouke Hofman thinks that this will improve with more adoption and time as new innovative products will emerge.

9.4.7 Use by criminals

"Use by criminals is a disadvantage. The partial anonymity facilitates this." –Jacob Boersma

Jochem Baars states that the Rabobank prefers not to deal with companies that are involved in cryptocurrencies due to the possibility of facilitating crime with bitcoin. However does not necessarily see the preventing of crime as a task of a bank:

> *"There is a lot of pressure on banks prevent crime. Why not make all the data open and let everybody check the transactions. The role of the bank is not to catch criminals and terrorists, however we are being employed in this way currently."* –Jochem Baars

While the media extensively has covered the use of cryptocurrencies to facilitate crime, not many interviewees covered this topic. Perhaps because the position they are in requires them to look ahead and focus more on the opportunities cryptocurrencies provide.

Sander Regtuijt states that crime is something inevitable and an often stated counter argument is the fact that cash money also is anonymous and therefore can be used by criminals just as well as cryptocurrencies.

The DNB argues that cross border transactions which are possible with bitcoin make it very difficult to arrest online criminals.

Concluding: Jacob Boersma, Jochem Baars and the DNB see the use by criminals as a disadvantage. Sander Regtuijt states that this is something inevitable.

9.5 Alternate uses of the block chain

There are many alternative uses of the block chain, the central technology that underlies cryptocurrencies. This decentralized ledger can be used for decentralized file storage, voting processes and time stamping to name but a few.

The views of the interviewees regarding alternate uses of the blockchain varies a bit, there was acknowledgement that there could be many possible uses.

> *"The whole idea of the blockchain is very nice and this has a lot of uses. In the future more uses will come for it."* –Berry Schoenmakers

Richard Kohl argues that it is important that users understand this to speed up the adoption process. Some examples he gives are using a micro transaction for voting, smart contracts or as the modern equivalent of a +1 or a FB like. However it is so early in the process that besides using cryptocurrencies as a form of payment or currency there are no examples completely worked out yet. Berry Schoenmakers cites Timestamping as a possible use. Timestamping helps to date information so that, for example, a patent can be timestamped and this way it can be proven to have been submitted at a certain time in history.

Mirjam Verhoeven (SNS) also underlines the importance of looking at cryptocurrencies as much more than just a currency, she sees that they don't necessarily replace current payment systems but rather complements them. Jochem Baars sees the possibility to use the cryptocurrency network to make it possible that all kinds of value that is stored digitally can be traded and used for payments.

> *"I think the whole discussion about bitcoin as a currency is not so interesting. The protocol also functions when the value of bitcoin is near zero."* –Dennis de Vries

Simon Lelieveldt argues that the cryptocurrency community is trying too hard to find new uses of the block chain. The block chain is not a solution to everything.

Concluding: there is acknowledgement of most interviewees that there are many alternate possible uses of the block chain, however Simon Lelieveldt states that the community is trying too hard to find new uses.

9.6 Knowledge

A topic that three interview participants cited was the importance of users understanding the workings of cryptocurrencies and the fact that it is very hard to explain to novice users how cryptocurrencies exactly work. Also there are many alt-coins in the market which all have slightly different properties, enhancing the confusion of users.

> *"A disadvantage is the fact that cryptocurrencies are difficult to explain to potential adopters. When people are deciding whether to use cryptocurrencies they first want to know the basic workings of the system."* –Sander Regtuijt

Simon Lelieveldt sees this knowledge gap as a barrier to entry for the adoption of cryptocurrencies.

> *"Individuals that do not interact in the digital domain are left out in the model. It is technically complex to use."* –Simon Lelieveldt

Berry Schoenmakers also agrees with this and he states that the knowledge gap will become even more of importance when adoption is increasing:

> *"Bitcoin is popular, however you have to keep in mind that it is very popular under a certain crowd. For the average Joe it is a No Go. They don' t even know how internet works for example."*
> –Berry Schoenmakers

Jouke Hofman states that it is not necessarily a problem that new adopters do not know the details of the workings of cryptocurrencies:

"Bitcoin is complicated and this makes it difficult for new users, however users should also not try to understand. Just like you don't have to know the exact workings of your debit card." –Jouke Hofman

Concluding: Simon Lelieveldt and Berry Schoenmakers see the complicated workings of cryptocurrencies as a disadvantage while Jouke Hofman argues that users do not need to know the exact workings anyway.

9.7 Scalability

> "Scalability is an issue for the future. With a larger blockchain consumers will not be able to run their own node and become dependent on third parties." –Jouke Hofman

Six out of the 14 interview participants recognized scalability as important. As Jouke Hofman mentions, when the system keeps working in the way it is designed currently it will not scale. When the transactions per second increase to Visa levels as mentioned in Chapter 8, it will simply be unfeasible for a regular consumer to keep a copy of the block chain on his pc.

> *"Multiple possible (future) outcomes: 1. never will be more than a niche. 2. banks will take this up and will host it, will tend more toward regular currencies. 3. the protocol will be changed so that it will scale (off chain transactions)"* –Jacob Boersma

There are three scenarios how the scalability issue will possibly evolve as stated by the interviewees:

The first scenario is that cryptocurrencies will never be more than a niche product and that the amount of transactions will simply not increase a lot, therefore not leading to scalability issues.

The second scenario will be that cryptocurrencies do see a lot more adoption and the amount of transactions per second increases heavily. There will be no significant changes to the technical design of the block chain and therefore consumers will not be able to host the full block chain anymore. Since having the full block chain on your pc guarantees that all the transactions are legitimate, a trust issue arises. What most likely will happen is that commercial companies, will start to host full block chains and consumers will connect to the hosts they trust. Therefore as a trusted third party, there might be a role for banks in the ecosystem of cryptocurrencies.

The third scenario is that there will be a technical solution for the scalability of cryptocurrencies. There are many proposed solutions for solving this challenge, however they have yet to be proven to work correctly. This seems as the most likely scenario by the interviewees. Interestingly, many interviewees have a lot of faith that the core development team will come up with a solution.

> *"Scalability is dependent on how the bitcoin core development team will tackle this challenge."*
> –Sander Regtuijt

However this still stays a very important issue if cryptocurrencies really undergo mainstream adoption. Of importance is also that this technical solution does not damage the original idea behind Bitcoin being a decentralized network which is not dependent on trusting third parties.

Concluding: the interviewees all agree that scalability of the cryptocurrency network is an important issue that needs to be solved.

9.8 Functions of money

With 11 interviewees and 60 unique quotes the topic functions of money is a heavily discussed one. A subject that is the cause of a lot of discussion is whether bitcoin can be seen as a commodity or as a currency. The legal status of bitcoin is different between many countries and there is no clear opinion by regulators whether bitcoin is seen as a currency or as a commodity. In the Netherlands recently a judge has declared bitcoin as a commodity, in Germany bitcoin is seen as "private money" (Bitlegal, 2014; Rechtspraak.nl, 2014).

9.8.1 Commodity versus Currency

The interviewees are not agreeing on the point of whether cryptocurrencies are money or a commodity. Jouke Hofman of the Dutch bitcoin exchange sees it as very strange that bitcoins are not seen as money by the regulators in the Netherlands. He argues that it makes taxation very difficult if you do not see bitcoins as money, since this means that every transaction will have to be taxed. The DNB agrees that the question of whether bitcoins is money is most important to tax authorities. Because bitcoins are not seen as money in the Netherlands this leads to issues with reporting criminal transactions:

> "In the Netherlands there is the Financial Intelligence Unit were you have to report unusual transactions. However the FIU does not acknowledge reports from us since it is about bitcoin. This is very strange." -Jouke Hofman

On the other side of the spectrum is Simon Lelieveldt who sees the commodity approach as the most fitting one for cryptocurrencies. Berry Schoenmakers mentions that most activity in the bitcoin ecosystem is speculation, leading to the conclusion that bitcoin is more of a commodity than a currency. Rob Voster argues that although you could see cryptocurrencies as a commodity, contrary to other commodities as oil or gold there is no actual intrinsic value in cryptocurrencies.

> *"Al the dangers of HFT (High Frequency Trading) and other issues we have with other metrics are also playing a role here. And this is only one commodity, and one that has no other use. You can always burn oil and make jewelry from gold."* –Rob Voster

The Dutch Central Bank (DNB) has not decided yet on how to classify bitcoin, however they argue that for bitcoin to be called money it should fulfill all three functions of money properly.

> *"The question of whether bitcoin is money is a very difficult question. We think it is not money, but what it is exactly is difficult. We think more in the direction of a "digital representation of value"."*
> –Kim Gunnink & Mirjam Plooij

The DNB states that it is very important that a good definition of cryptocurrencies is developed and that there is consensus about this definition for the whole European Union.

> *"We as DNB are of the opinion that it is necessary to look at virtual currencies from a European perspective at least, a worldwide view would be even better. The ECB is busy with another report, due*

for this year however you never know how fast it will go with the decision making. As you can see in the news we are definitely not close to having a consensus." –Kim Gunnink & Mirjam Plooij

Gaston Aussems looks at it from a practical perspective:

> *"In practice bitcoin is money: people use it as money. Formally and legally it is not money, confirmed by a court ruling stating that is was not money."* –Gaston Aussems

Jacob Boersma agrees with this and says that although bitcoin is a token, the whole idea behind it is that it will be used as a currency: "look at the word coin in bitcoin".

Concluding: we can say that there is still a lot of debate left for this topic. There is no clear indication in which direction regulation will go and this will also be dependent on the actual usage scenarios of cryptocurrencies. Jouke Hofman and to some extent Gaston Aussems and Jacob Boersma see cryptocurrencies as a currency. Simon Lelieveldt and Berry Schoenmakers see it as a commodity. The DNB does not have a clear definition yet.

9.8.2 Medium of exchange

> *"Fiat currencies are generally a better store of value but a worse medium of exchange than cryptocurrencies."*
> –Jacob Boersma

The interviewees all agree that cryptocurrencies are a good medium of exchange. As stated above, Jacob Boersma thinks that they are even better in this aspect than fiat currencies in many ways. Robert-Reinder Nederhoed notes that this is the success of the protocol and not the currency itself that runs on top of it. He remarks that there is a certain liquidity needed; the value of the currency is not important.

While theoretically a good medium of exchange, Berry Schoenmakers thinks that in practice it is not such a good medium of exchange. There are several early adopters with large amounts of bitcoin (including Satoshi Nakamoto himself) which is strange. Another possible reason that the network is not used heavily for transactions is the fact that everything in the network is traceable.

Sander Regtuijt and Gaston Aussems both argue that there is too much focus of adopters on speculating with bitcoin and that there should be more focus on paying with cryptocurrency. Gaston refers to his observations as a Payment Service Provider processing payments in bitcoin and payments of consumers buying bitcoin:

> *"if you look at the amount of transactions that happen with our merchants this is very low however if you look at the amount of transactions of buying bitcoins this is much much higher. This is all speculative."* –Gaston Aussems

The DNB argue that due to the low level of acceptance of bitcoin by merchants and the low ease of use and security of the system bitcoin is only moderately suited as a medium of exchange.

Concluding: all interviewees agree that cryptocurrencies are a good medium of exchange. The DNB notes that low acceptance and ease of use weakens this a bit.

9.8.3 Store of value

The interviewees were all consistent in their opinion that bitcoin is not a good store of value at the moment. The reason for this is the price volatility.

> *"Price stability is very important to Store of Value, or at least a predictable price."* –Jacob Boersma

Both Jacob Boersma and Robert-Reinder Nederhoed argue that also fiat currencies have a certain level of volatility which also impacts these currencies' store of value. Besides this Robert-Reinder argues that the inflation of fiat currencies is bad for their store of value as they will depreciate in value.

The DNB does not see bitcoin as a good store of value due to the price volatility and warns users that they can lose a lot of money due to this.

Concluding: the interviewees did not see cryptocurrencies as a good store of value. Jacob Boersma and Robert-Reinder Nederhoed mention that also fiat currencies have a certain level of price volatility.

9.8.4 Unit of account

The interviewees all do not see the bitcoin as a unit of account at the moment. Jacob Boersma argues that this is also not of real importance as most merchants accepting bitcoins use a PSP that just converts their stated price in fiat currency to the real time bitcoin price.

> *"The fact that bitcoin is expressed in other currencies (i.e. not a unit of account), shows the weakness of the currency."* –Rob Voster

While Robert-Reinder Nederhoed never sees bitcoin becoming a unit of account, Jouke Hofman thinks that bitcoin might become a unit of account for international payments where normally multiple currencies are involved. Jochem Baars thinks the function of unit of account is very important for bitcoin in order to become a success:

> *"The fact that bitcoin is not a unit of account means that there will always have to be a conversion and this leads to exchange risks."* –Jochem Baars

The Dutch Central Bank (DNB) does not see bitcoin as a unit of account due to the high price volatility. (De Nederlandsche Bank, 2014)

Concluding: all interviewees do not see any cryptocurrency being a unit of account at the moment.

9.9 External Factors

9.9.1 Media

Media attention plays a role in the adoption of cryptocurrencies. Imad Qutob mentioned that when Thuisbezorgd.nl started to accept bitcoins as payment they got a lot of media attention. While there are many different alt-coins, most media attention goes toward Bitcoin as the first and most popular cryptocurrency. Jacob Boersma remarks that the feedback loop of volatility is sensitive to media attention, however this feedback loop seems to have become weaker in the past few months. Gaston Aussems sees from his position as a PSP that there are a lot of new bitcoin companies starting and he thinks that not all of them will survive, leading to negative publicity.

Jouke Hofman states that media also can have a negative influence. This is also the opinion of Rob Voster:

> *"Media will mostly focus on the negative aspects of cryptocurrencies."* –Rob Voster

Robert-Reinder Nederhoed also mentions that he thinks it is strange that there is so much focus on the bad things that happen. This focus on the negative side of cryptocurrency might be because it is not tangible and comes in the media as something that people do not really understand is Rob Vosters' argumentation. This lack of understanding is also cited by Dennis de Vries:

> *"The media have an interesting role, there is nearly no article regarding cryptocurrencies that is factually correct."* –Dennis de Vries

Concluding: the interviewees see media as being capable of having both a negative and positive influence on adoption. Dennis de Vries states that articles in the media are often incorrect.

9.9.2 Regulation

All interviewees agree on the fact that regulation has its impact on adoption. However the way in which regulation impacts adoption is unclear.

> *"It really depends on the type of governmental policy what the influence is on adoption and this can go both ways, negative and positive."* –Kim Gunnink & Mirjam Plooij

The DNB states that regulation on a European level is necessary and preferably on a worldwide scale. However the DNB also states that at the moment cryptocurrencies are too small to fall under regulation, although there is no hard boundary on when it is big enough to require this.

In the current state there is no regulation and there is a lot of uncertainty about what will happen in the future. The opinion of most interviewees is that this is not a good situation as many companies are holding back and waiting for regulation in order to act and possibly start a business. However Jouke Hofman sees this differently:

> *"Due to the lack of regulation it is very easy for startups in the bitcoin space to start their own business."* –Jouke Hofman

Although this lack of regulation makes that there are low barriers of entry for a startup, Jouke does argue that there needs to be more regulation in order to protect the customer/end-user. The current lack of rules facilitates fraud in the bitcoin system. Sander Regtuijt thinks that more adoption will lead to more regulation as the market grows. Dennis de Vries argues that worldwide regulation of cryptocurrencies is necessary but difficult:

> *"The question is whether it (bitcoin) will evolve in to a more regulated accepted version or will it go underground?*
> *As a regulator the only real instrument you have to influence the ecosystem are the exchanges."*
> –Dennis de Vries

Finally Simon Lelieveldt and Rob Voster specifically argue that there needs to be more regulation for the bitcoin exchanges where bitcoin is traded for fiat currency.

Concluding: all interviewees agree that regulation is necessary. Jouke Hofman also sees an advantage of the current lack of regulation: this makes it easy for entrepreneurs to start their own business.

9.9.3 Role models

The influence of role models on adoption is only discussed by one interviewee, Jouke Hofman. He states that role models are important and refers to the case of Thuisbezorgd.nl who started accepting bitcoin payments. When he tells this to people when speaking about bitcoin it inspires confidence because everybody knows Thuisbezorgd.nl as a website you can trust. However role models can also have a negative influence he states and refers to Charlie Shrem. Shrem was the CEO and founder of bitcoin exchange BitInstant and was accused of enabling money laundering through his website.

Concluding: the influence of role models seems to be limited as there is only one interviewee talking about the subject.

9.9.4 User base & use by business

These two topics both only had one quote. Interviewees suggested that it might be more logical to place these two topics inside the "adoption" process. This because of course: the amount of users that uses cryptocurrencies and the amount of businesses that offers the possibility to pay with cryptocurrencies is exactly what adoption is! The initial reasoning behind placing these two factors in the external factors section was that adoption fuels adoption, both adoption by users and adoption by business. It is a chicken and egg problem. For businesses to offer cryptocurrency payments it is only interesting if there are a lot of users and for potential adopters it is only interesting to adopt if there are places where one can pay with cryptocurrencies.

In order to make the model more logical and incorporate the feedback during the interview process these two factors were removed from the external factors. The adoption process has got a feedback loop to itself, signaling the fact that adoption leads to more adoption.

Concluding: this factor does not seem applicable here and needs to be moved inside the adoption process.

9.10 Summarizing the interview results

In this section we will give a short overview of the most important interview results as found in this chapter. For more detail the reader is pointed to each respective section concerning his or her interest.

9.10.1 Benefits

Overall consensus

What is interesting is that one of the most often mentioned benefits of cryptocurrencies, fast transactions, is a topic that does not seem of much interest to the interviewees. Since the scoping of the research is to focus specifically on the Netherlands and the EU in general, transactions are already (near) instant.

The other most mentioned benefit is the low transaction costs of cryptocurrencies. Comparing this again to regular payments in the EU there is not that much of a difference with regular bank transfers to be seen. However compared to parties such as PayPal and credit card schemes there are cost savings. An important thing mentioned by the interviewees is the fact that the transaction fees for the bitcoin network are subject to change and there is no certainty that these fees will stay low.

There is an image boost for companies accepting cryptocurrencies and this also seems to be one of the key reasons that companies start accepting cryptocurrencies. Not necessarily because they have so many customers that want to pay in cryptocurrencies, but because of the media attention it generates.

Another benefit is that there are low barriers to entry, both for the consumer and the merchant who wants to accept cryptocurrencies. The only thing needed is an internet connection. Related to this is the fact that the system is decentralized; there are no parties controlling the access of the bitcoin network and ecosystem. All interviewees except the Dutch Central Bank thought that this was an advantage.

General consensus

There was a general consensus on the topic of low costs. The DNB and Simon Lelieveldt argue that there are additional costs that many people tend to forget. Berry Schoenmakers notes that it is possible that in the future miners will start to charge higher fees to process transactions and that this benefit of low costs will disappear.

Little consensus

There is no agreement on whether it is good or bad that all transactions are publicly visible in the block chain. The DNB does not see this as an advantage as individuals will still be able to hide their identity online. Jouke Hofman sees this as an advantage not for the government but for exchanges to prove that they do not engage in fractional reserve banking.

The anonymity that cryptocurrencies supposedly provide is not something that is seen as a specific advantage or disadvantage by the majority of the interviewees. The DNB is very clear in stating that for them this is a major disadvantage; the anonymity combined with fast global transactions enables criminals to make cross border transactions easy and untraceable.

9.10.2 Disadvantages

Overall consensus

All interviewees agreed on the fact that the ease of use of cryptocurrencies has to drastically improve. Cryptocurrencies are complicated to use and there are a lot of risks leading to the consumer losing its cryptocurrency. They also saw that there was a lot of effort going on to improve this and that more adoption will lead to better products with a higher ease of use.

The other most important disadvantage according to the interviewees was the current price volatility. This volatility is fueled by the relatively large amount of speculators in the bitcoin ecosystem. More adoption will lead to more price stability and the other way around.

General consensus
The DNB and Simon Lelieveldt see the fact that there is no single party to be held responsible as a disadvantage. Richard Kohl and Sander Regtuijt do not see the decentralized nature of cryptocurrencies as a disadvantage.

Little consensus
There is no agreement on whether the lack of a government backing cryptocurrencies is a disadvantage. Gaston Aussems and Simon Lelieveldt think so while Jouke Hofman sees this as a clear advantage. It appears that the interviewees not directly involved in the bitcoin ecosystem would prefer government backing and regulation while the interviewees of bitcoin exchanges see this more as a tradeoff that is necessary for the system to work.

9.10.3 Extra identified factors
While outside the scope of this research, the interviewees recognized that there were many possibilities for the cryptocurrency network besides using it as a currency. However at the moment there is no telling in which way this will evolve.

A specific topic that was not part of the original conceptual model emerged during the interviews: knowledge. Several interview participants pointed to the fact that the exact working of cryptocurrencies is difficult to explain to potential adopters, while they might want to know the workings of the system before they adopt it. On the other hand: users should not have to know the exact workings of the system, just like you don't have to know how your debit card works in detail.

A second topic that arose was the concern of several interview participants of the scalability of the protocol and the inability of the bitcoin foundation to handle this in the future. Scalability is absolutely necessary for large scale adoption, however at the moment there is no clear solution to this.

9.10.4 Functions of money
There was no agreement between the interviewees on the point of whether cryptocurrencies are a currency or a commodity. Some interviewees argued that in practice it is being used as money and it therefore must be money (Gaston Aussems and Jacob Boersma), while the DNB argued that it does not fulfill the three functions of money correctly and therefore is not money. Jouke Hofman argues that it should be considered money for taxation purposes. Also do some question the value of cryptocurrency as a commodity, because of the lack of intrinsic value (Rob Voster).

Besides the heavy disagreement on the topic of whether cryptocurrencies are a commodity or a currency was there was a lot of consensus on the three functions of money. There is no doubt as to the fact that cryptocurrencies are a good medium of exchange, with the only the DNB seeing the value of cryptocurrencies as a medium of exchange reduced due to price volatility and lack of acceptance by merchants at the moment. The interviewees are also unanimous in their opinion that cryptocurrencies are a poor store of value, due to the current price volatility, at the moment and that it is not a unit of account. Certain interviewees see cryptocurrencies better fulfilling these functions of money in the future (Jouke Hofman, Jochem Baars).

9.10.5 External factors
The opinion of Jouke Hofman and Rob Voster is that the media seems to focus on the negative aspects of cryptocurrencies. Dennis de Vries states that articles in the media are often incorrect. The interviewees also see a feedback loop from media attention to price volatility. There seems to be a connection between the price and the media attention, however this connection seems to have become weaker in the last few months.

There is agreement on the fact that regulation will have its impact on adoption, however it depends very much on the type of regulation whether this will be positive of negative. Jouke Hofman also sees an advantage of the current lack of regulation: this makes it easy for entrepreneurs to start their own business. Two external factors of the conceptual model, user base and use by business, were not in the right place. Interviewees suggested that it might be more logical to place these two topics inside the "adoption" process. This because

the amount of users that uses cryptocurrencies and the amount of businesses that offers the possibility to pay with cryptocurrencies is what adoption consists of.

9.11 Updating the conceptual model

In general the interviewees all thought that the model looked good and complete. Interestingly, certain items that were placed under both benefits and disadvantages of cryptocurrencies such as the decentralized nature of the system and the partial anonymity remained placed under both benefits and disadvantaged. This because it really depends on the point of view and the stakeholder which you would ask. The Dutch Central Bank saw both decentralization and anonymity as clear disadvantages while for example the bitcoin exchanges mostly saw this as an advantage. Certain stakeholders, Dennis de Vries from ING Bank for example, remarked that he thought of these items as both disadvantage and advantage, depending on the usage of the cryptocurrency.

Berry Schoenmakers and Sander Regtuijt remarked that also the weight of each factor is different. Certain advantages might be more advantageous than others and certain disadvantages might be more important than others. The current conceptual factor model does not take weights into account, the dynamic model in Chapter 10 will include these. In the System Dynamics model all the factors can get weightings and this will enable a more accurate representation of reality.

Before continuing to the System Dynamics model, the conceptual model was updated based on the feedback received during the interview sessions. See Figure 9-1 below for the updated model.

The main changes to the model:

- As mentioned in the section above, the two factors ‘user base’ and ‘use by business’ were removed from the external forces. This because these were already included in the main ‘adoption’ process in the center of the model.

- A feedback loop has been added from the adoption process to itself. This to represent that adoption is a dynamic process, increasing in strength when more adoption is happening due to network effects.

- The three functions of money have been moved from being a moderating variable on adoption to be the receiving factor of adoption. This because the functions of money are not fulfilled properly at the moment, however this does not seem to influence adoption in a negative way. The interviewees saw it more the other way around: when there will be more adoption cryptocurrencies will better fulfill the three functions of money. With more adoption the price volatility will go down, increasing the store of value function. The unit of account function is also more likely to be better fulfilled with more adoption: when there is large scale adoption, there is a higher chance that prices will be noted in cryptocurrency instead of fiat currency.

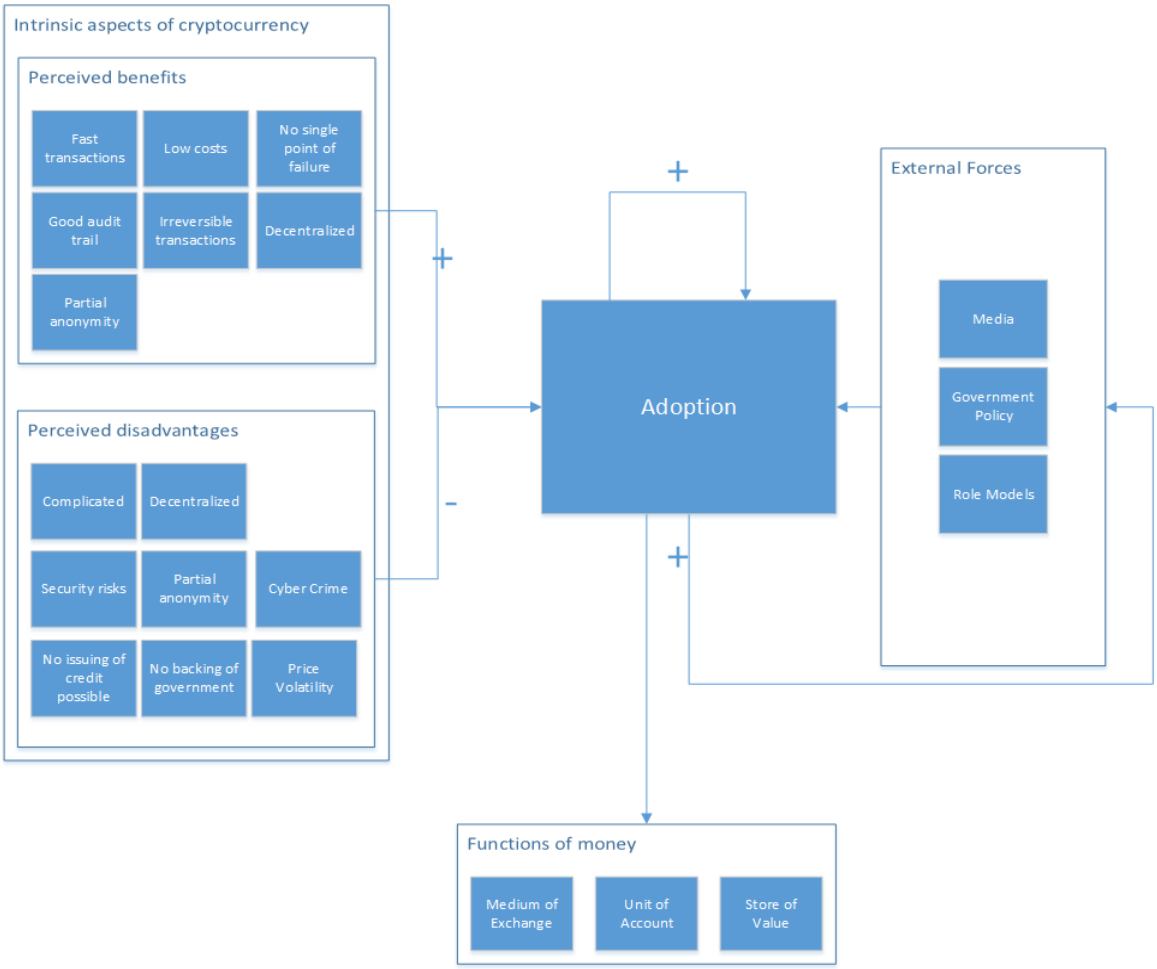


Figure 9-1 Adapted model

10 A dynamic approach

In this chapter we will address the final sub-research question: “How does the modeling of the adoption of cryptocurrencies benefit from using a System Dynamics approach?”.

We will look at the model for the adoption created in previous chapters and adapt it to a more dynamic approach. The reasoning behind this is the fact that the adoption process is not linear, it is rather exponential and can possibly benefit from modeling it using a dynamic approach such as System Dynamics which is often used to model adoption processes.

10.1 Extending the conceptual model

In order to accommodate these requirements a System Dynamics model is built based on the model for inter-organizational systems adoption by Kurnia & Johnston (2000), see Figure 10-1 (KJ Model). This model is composed of several dimensions based on different adoption theories. This model was built to understand the adoption of open standard-based Inter-Organizational Information Systems (IOIS), specifically Efficient Consumer Response systems (ECR) (Kreuzer, Krönung, & Bernius, 2014a). The goal of ECR is to improve the efficiency of a supply chain as a whole. Kreuzer et al. (2014) explain that IOIS have existed for several decades and have been used in many different industries, for example supply chain management systems.

IOIS are defined as: “information systems shared by two or more companies facilitating the creation, storage, transformation, and transmission of information across organizational boundaries.” (Kreuzer, Krönung, & Bernius, 2014b). One can clearly see the resemblance of cryptocurrencies and IOIS. Cryptocurrencies are also information systems that extend across organizational boundaries, and even national boundaries, they provide centralized storage of information and are open source and often use open standards. Because of this resemblance lessons that can be learned from the development of adoption models for IOIS can also be used when creating a model for cryptocurrency adoption.

In the KJ model, the Nature of Technology is based on the Innovation Diffusion Theory model which is used as the basis for the model developed in the previous chapters. This makes the model ideally suited to build on top of the previously constructed model of cryptocurrency adoption.

Kurnia & Johnston built their model based on the fact that an organization also has influence on its environment. To incorporate this in their model they split the external factors into two parts. Certain factors cannot be influenced and these will therefore remain external (e.g. unpredictable demand) however the other dimension is the industry which can be influenced (e.g. corporate relations). This is represented by the two-way arrows. (Kurnia & Johnston, 2000)

The developed model in Chapter 8 looks at the intrinsic aspects of cryptocurrencies, external factors and the impact that this has on the adoption decision of the individual users or business. However in practice are organizations and individuals not only influenced by external adoption factors and the properties of cryptocurrencies. There is a two-directional flow, they also have influence on the adoption process themselves. A wider view of the whole network around the adoption process is needed in order to more accurately be able to describe all the factors that influence the adoption process. As explained in the next section, System Dynamics is a well suited method to do so.

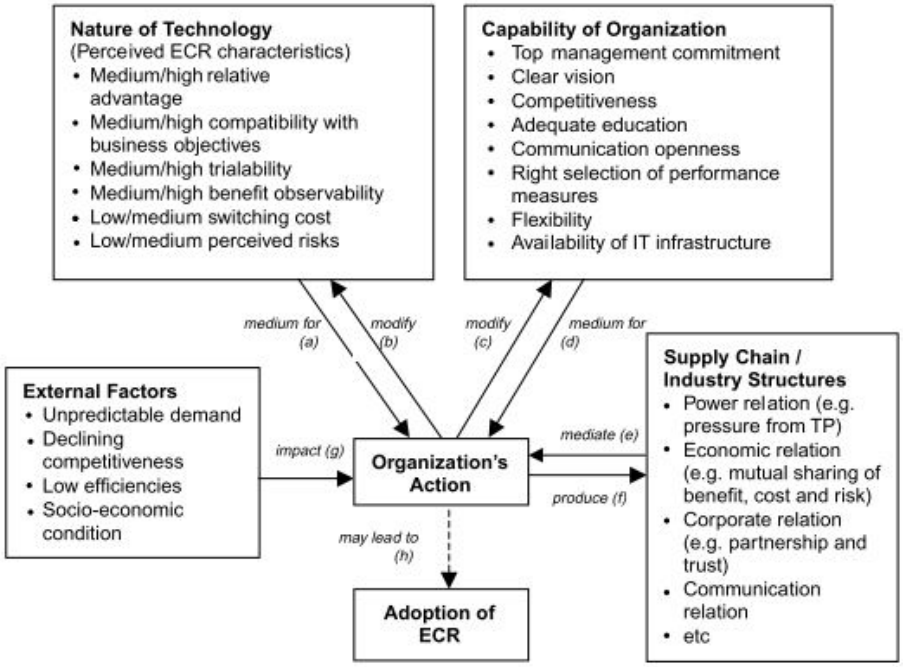


Figure 10-1 Kurnia & Johnston model of IOS adoption

10.2 Developing a System Dynamics model

10.2.1 System Dynamics

System Dynamics (SD) is an approach and methodology to understanding the behavior of complex systems over time. MIT's System Dynamics department gives a very comprehensive description:

> *"Unlike other scientists, who study the world by breaking it up into smaller and smaller pieces, system dynamicists look at things as a whole. The central concept to system dynamics is understanding how all the objects in a system interact with one another. A system can be anything from a steam engine, to a bank account, to a basketball team. The objects and people in a system interact through "feedback" loops, where a change in one variable affects other variables over time, which in turn affects the original variable, and so on."* (MIT, 1997)

As MIT explains, central to the system dynamics thinking is to look at the system at a whole and the interactions in the form of feedback loops between variables. During the process of creating the initial conceptual model and the interview sessions several feedback loops became apparent. These feedback loops and the match that System Dynamics has with the Kurnia & Johnston model is described in the next section. Adoption does not happen instantly, it happens over time. Therefore attention will be paid to the time horizon in which the adoption process will be simulated and the rate at which changes happen over time.

10.2.2 Feedback loops

Kurnia & Johnston recognized that it is not only the Technology that influences the adoption but that it is also the other way around: adoption can influence the technology. The same with certain external factors, they can influence adoption but will also be influenced by adoption. For example, more adoption will attract more government regulation but this is a two way street, regulation also influences the level of adoption.

In the development of the conceptual model already a two-directional flow between external factors and adoption was recognized, however no feedback loops were created which linked to the intrinsic aspects of cryptocurrencies. As Kurnia & Johnston mentioned, also multiple interviewees stated that they think there is a two-directional flow between the cryptocurrency technology itself and the level of adoption. These feedback loops are important to incorporate into the SD model, see Figure 10-2 for an overview.

Two specific aspects were most often mentioned: ease of use and price volatility. These two factors are thought to have an important impact on the level of adoption, but they also are subject to change when the level of adoption changes. With more adoption there will be more focus of developers on ease of use and products with a better user experience will emerge. Also do the experts state that more adoption will lead to less price volatility. While it is clear that the contribution of more ease of use is positive and price volatility is negative, the influence of the media and government policy can go either way. If there is a lot of negative media attention this can be negative to adoption, however positive media attention mentioning the benefits of using cryptocurrencies can give adoption a boost. Restrictive government policy might be negative, whilst positive government regulation might give potential adopters more certainty about the future of cryptocurrencies and persuade them to start adopting. Since these two factors can have either a negative of a positive influence, both situations will be modeled and the outcomes will be compared.

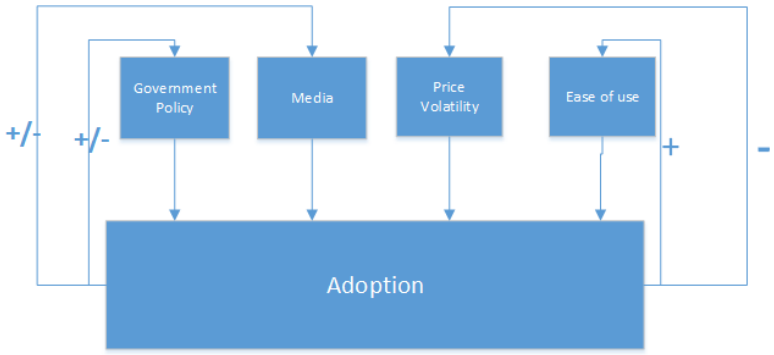


Figure 10-2 Feedback loops

10.2.3 Developing the SD model

System Dynamics models include three basic features:

- Reservoirs, also called levels, that accumulate over time (this can be any unit, in our case this will be the amount of adopters)
- Flows into and out of the reservoir (this being the adoption rate and the rate with which adopters stop using cryptocurrencies)
- Constants and other variables that influence the in- and outflows (this will be the factors influencing adoption)

For developing the System Dynamics model the modeling software Powersim Studio 10 was used. This is a widely used SD software package and the software receives regular updates. In Figure 10-3 the SD model as created in Powersim is shown. The most important feedback loops, flows and reservoirs are numbered for a clear reference when discussing them.

The SD model is based on the adapted conceptual model created in Chapter 9. During the literature review in Chapter 8 and the interviews in Chapter 9 the most important factors of influence on the adoption process were identified. Also the feedback loops that were already modeled in the conceptual model were built in the SD model.

Measuring Adoption

The purpose of the SD model is to model the adoption of cryptocurrencies. Therefore in this model the main measure of adoption is “adopters” which is the amount of persons that have started to use cryptocurrencies. The model does not look at the so called “bitcoin miners” or the merchants which start to accept cryptocurrency, but it is focused toward the adoption process of individual users.

The flow of adopters

The most important reservoir of the model is of course number 2, the users reservoir. This reservoir functions as the amount of users that have adopted cryptocurrencies. This level is increased, obviously, by number 1, the

adoption rate. This adoption rate is fueled by several factors and will be discussed in more detail in the next paragraph. The Users reservoir is drained by users who quit, the quit rate (number 3). These users will go into reservoir number 4, entitled “Stopped using”. These persons are users that have used cryptocurrencies and due to circumstances have stopped using cryptocurrencies. Gradually a part of these users will become open to adoption again and they will flow to the reservoir number 5, potential adopters. This reservoir is filled with 7.000.000.000 people, which is roughly the world’s population.

Factors influencing the adoption rate

There are several factors that have been determined in this thesis as being of influence on the adoption rate. This is based on the conceptual model and the factors that were adapted by means of the interviews. The factors that are selected are the external factors media and government policy and the most important factors as identified during the interviews: user-friendliness, price volatility and governance of the bitcoin foundation.

Feedback loops

The most important feedback loop is number 6, the feedback loop from users to the adoption rate. This because of network effects: the more users adopt cryptocurrencies, the more beneficial it becomes for potential adopters to also adopt.

The second feedback loop is number 7; as the cryptocurrency ecosystem matures and there will be more adopters, more companies will start to develop more user-friendly products. Therefore this feedback loop increases the user-friendliness.

The third feedback loop is number 8, as there is more adoption, the price stability will increase. The fourth feedback loop is number 9, as there is more adoption there will be more innovation to create stable exchanges that do not collapse. This is linked to the quit rate as the number of exchanges that collapses is at the moment quite high and users almost always lose all their cryptocurrency stored at the collapsed exchanges. It is hypothesized that if a user loses all his cryptocurrency this might lead to him abandoning cryptocurrencies and flow to the stopped using state. The final feedback loop is number 10; as there are more users that have adopted cryptocurrencies, there will be more users that stop using it.

External factors

Media, government policy and governance of the bitcoin foundation are all factors that influence the adoption rate. These three factors can all contribute in both a positive and negative manner to adoption, as stated in 10.2.2. Positively: positive media attention will draw users to cryptocurrencies, positive government policy will give more certainty to potential adopters about using cryptocurrencies and finally a good governance will have a positive influence. On the other hand, negative media attention will scare potential users, negative government policy might involve banning companies in the cryptocurrency sphere and a poor governance will obstruct innovation in cryptocurrencies.

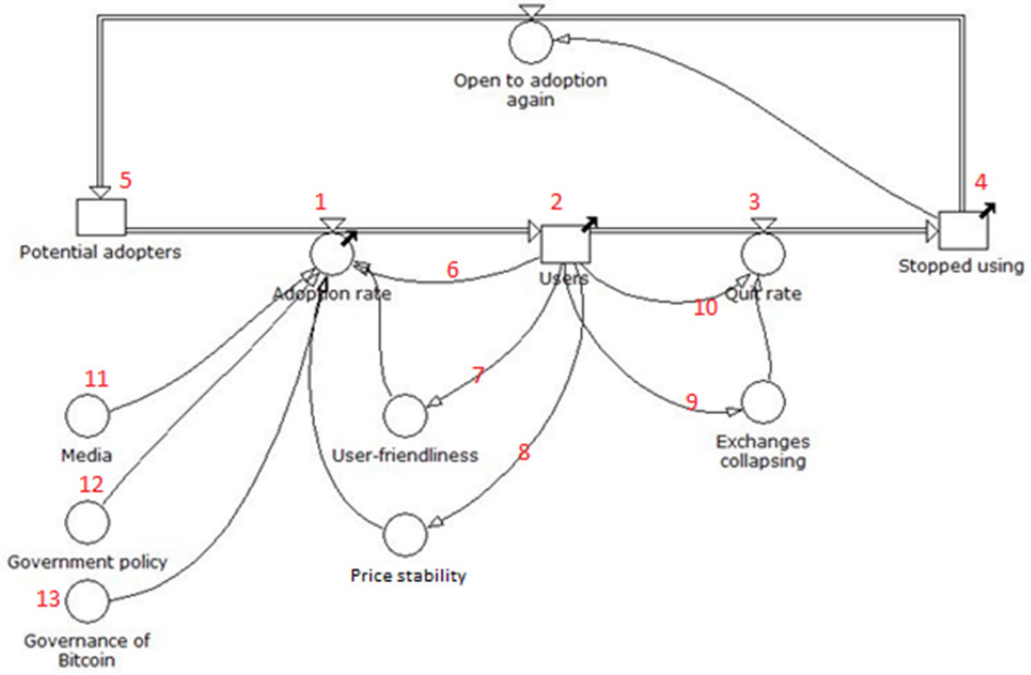


Figure 10-3 SD model

10.2.4 Model parameters

The model depends on several assumptions. Firstly, the model is not meant to be an accurate predictor of the exact amount of adopters at a certain point in time or to predict a price development curve. The idea of the model is to gain insight at the interplay of the different factors that were found to be of influence in the adoption process.

Therefore the five factors that influence the adoption rate directly are not measured in absolute quantities. A scale ranging from -1 to +1 was used to show the effect of the factor. This means that when the influence of a variable is highly positive, it is 1, when it is highly negative it is -1 and when its influence is deemed neutral it is 0.

Time range

The time range in which the model was simulated was taken as a 10 year period ranging from 1-1-2010 to 1-1-2020. The reason that this range is chosen is because in 2010 bitcoin started to catch on and serious adoption started at that point. Ten years seems as an appropriate time window as a shorter period would not be very realistic to show the adoption process; earlier in this thesis it is already discussed that consumers change their payment behavior slowly so time is needed. A longer period than 10 years also does not seem suitable as he uncertainty gets too big that far in the future.

Adoption rate

The calculation for the adoption rate is done as follows. A base adoption rate was taken with the five factors (media, government policy, governance, user-friendliness and price stability) as multiplication factor. As base adoption rate the year on year wallet growth of 2013 to 2014 is taken (which is 700% according to Coindesk (2013)) and is converted to a weekly growth factor as all the calculations happen on a weekly basis. (Coindesk, 2014)

User-friendliness

The factor user-friendliness has a feedback loop and is therefore dependent on the number of adopters. For every million adopters the user-friendliness increases by 0.1 up to the maximum of 1 which means complete user-friendliness.

Price stability
Price stability increases by 0.01 point for every million adopters. This because the price volatility is expected to go down with more adoption, but this will be only very slowly, as history has shown. The price stability is also capped at 1 such as the other factors.

Media, Government Policy and Governance
These three factors are not linked to the model with a feedback loop. They are directly connected to the adoption rate which allows them to be modified and to see what the impact of this is on the adoption, i.e. what happens if the government policy is negative -1 instead of a positive +1 impact? There is no feedback loop from adoption to these factors as more adoption might have multiple consequences: more adoption might mean that it just strengthens the factor. For example: if there is more adoption and there is negative media attention, this might lead the media to publish even more negative information. However if there is more adoption it could also be the case that the previously negative media attention will slowly turn to more positive news. This falls out of the scope of this research and therefore to keep the direct influence of these factors visible the feedback loop is not modeled. These observations will be discussed in the next section.

10.2.5 Model observations
In this section we will discuss the most interesting observations that become apparent after observing the workings of the model.
We started with a "most likely" scenario as shown in Table 10-1. This scenario is meant to represent the current situation. Media is 0.75 because at the moment there is a lot of media attention and hype around cryptocurrencies, however it is not all positive news therefore the value is 0.75. There is a clear lack of government policy making this a neutral 0. The Bitcoin foundation's level of current governance is not really good as stated by the interviewees, however the governance is better than having no governance in place; leading to a score of 0.5. User-friendliness is still very much in the begin phase and scores 0.1. The price stability is far from being very stable, leading to a score of -0.5.

Table 10-1 Startup variables model

Factor	Value
Media	0.75
Government policy	0
Governance of Bitcoin foundation	0.5
User-friendliness	0.1
Price stability	-0.50

Running the model leads to several interesting observations. In Figure 10-4, the total adoption as calculated by the model is shown. One can clearly see the exponential adoption curve with adoption growing rapidly in the later years.

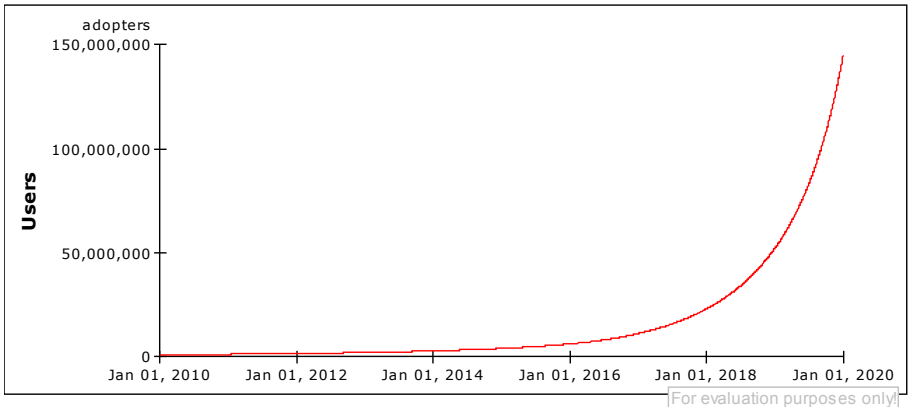


Figure 10-4 Total adoption

In Figure 10-5 the factors price stability and user-friendliness are plotted. This because they are dynamic factors and under influence of the positive feedback loop they increase in value. What can be seen is that first user-friendliness increases rapidly, followed several years later by the price stability. This is in line with the opinion of the interviewees who saw user-friendliness increasing already whilst price stability was nowhere to be seen.

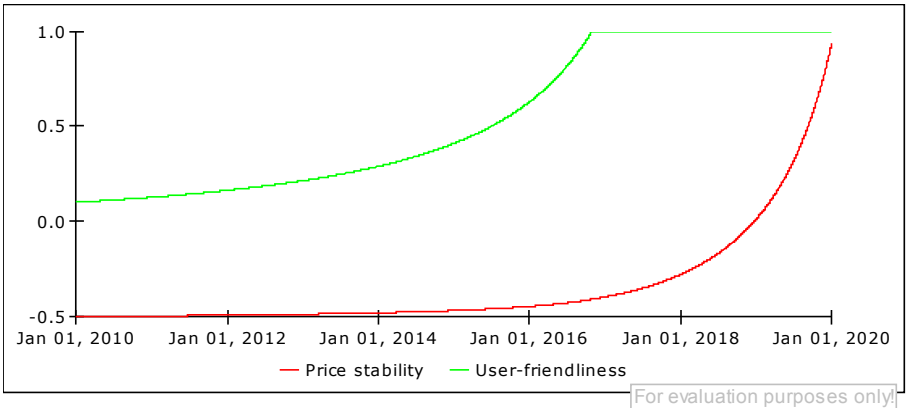


Figure 10-5 Price stability and user-friendliness factors

The dynamics of the model are very clearly displayed in Figure 10-7, which represents the quit rate, the rate with which people stop using cryptocurrencies. Interestingly this curve first climbs up and then declines rapidly after which it recovers. This is because of the feedback loops which are described in section 10.2.3. The quit rate is depending on the one hand on the amount of adopters, because there is always a percentage of adopters that quit. On the other hand is a large portion of the quit rate dependent on the collapsing of exchanges, see Figure 10-6. If an exchange collapses this drives away a lot of adopters. The rate at which exchanges collapse however is also dependent on the amount of adopters; because with more adoption the technology behind the bitcoin exchanges will evolve and more stable exchanges will develop. Therefore as the adoption increases the amount of exchanges collapsing decreases leading to the drop in the graph. From here the quit rate increases again as the adoption increases.

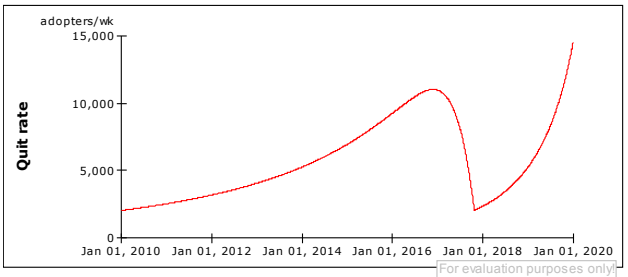


Figure 10-7 Quit Rate

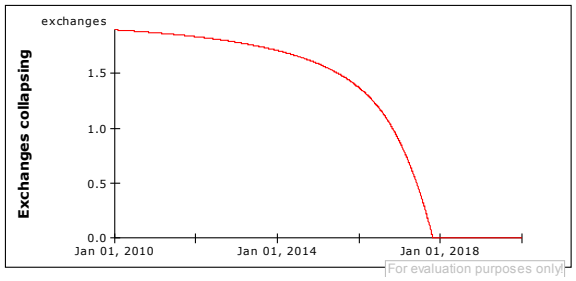


Figure 10-6 Exchanges collapsing

10.2.6 Scenario testing

In order to see what the influence is of changing the factors such as the impact of a negative government policy or the positive influence of an overhauled governance system we performed a sensitivity analysis on the model.

Negative government policy

When changing the government policy from a neutral to a negative influence (-0.5 on a scale of -1 to 1), adoption almost completely slows to a halt as one can see in the figure below.

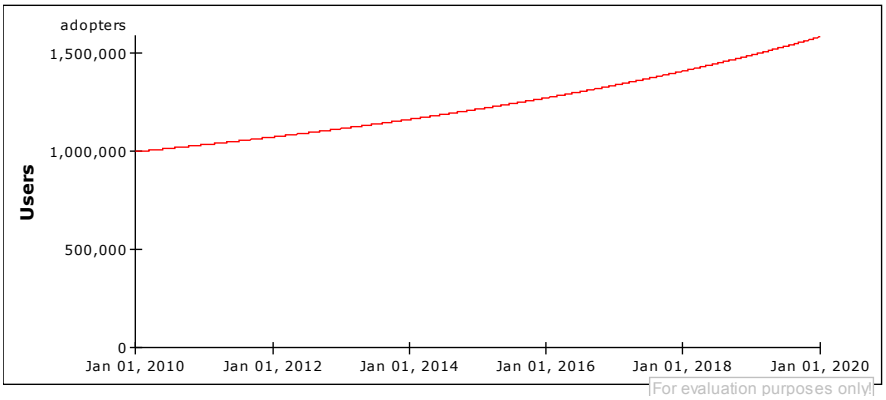
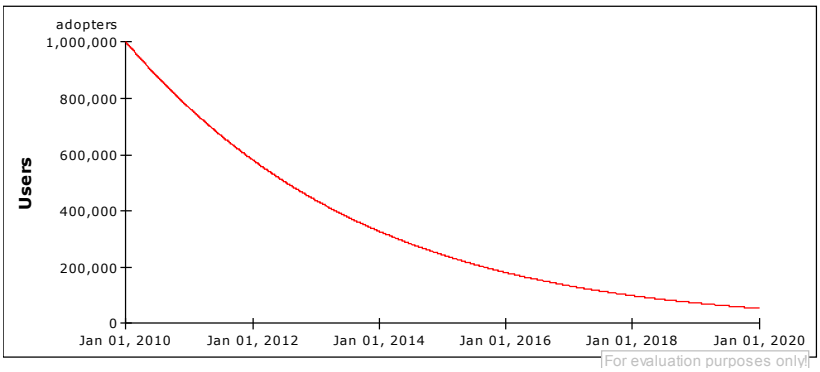


Figure 10-8 Adoption with negative government policies

Negative media attention

The same happens when media attention shifts to a mostly negative stance (-0.5), (potential) adopters are driven away and the entire ecosystem collapses.



Negative government, positive community, good governance

In this scenario the government shifts to being negative (-0.5) and imposing restrictive regulation, however the cryptocurrency community organizes a good governance system and the media continues to see cryptocurrencies in a positive way. Figure 10-9 shows that even if the government would take a negative stance, if there is a lot of belief of the community and the media continues its coverage of cryptocurrency news, this does not necessarily have to be the end of cryptocurrencies. Adoption is not slowed down because the good governance and positive media attention make sure that a well-developed ecosystem for cryptocurrencies is being created despite government efforts to restrict the use of cryptocurrencies.

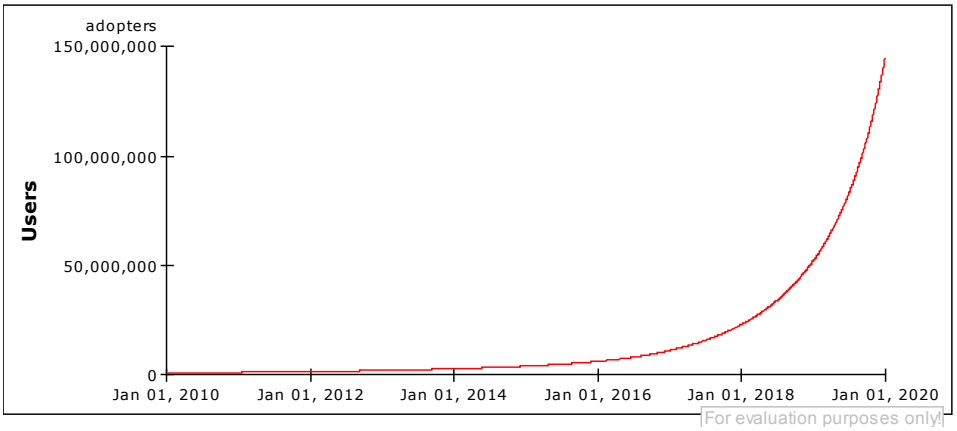


Figure 10-9 Negative government, positive community

Price volatility will worsen

In this scenario Bitcoin will be mostly used by speculators which drives up the price volatility even more than it currently is. When the price volatility is set to remain at a constant -0.75 this severely hinders adoption. The level of adoption is slightly lower than depicted in the figure above. Seeing as this is still an upwards trend, when extending the horizon of the simulation for 5 years until the year 2025 yields a graph that looks very similar to the initial graph (see Figure 10-10).

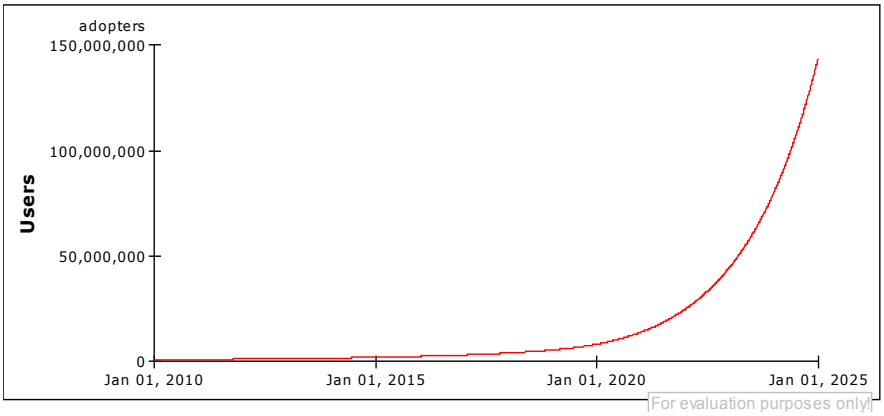


Figure 10-10 Worse price volatility

10.2.7 Conclusions

From the simulations we can draw several conclusions. When testing the model it became apparent that all single factors influencing the adoption of cryptocurrencies are important. If just one of them becomes very negative, such as in the scenario of “negative government policy” or in the scenario of “negative media attention” the adoption process fails. However when the government has a negative stance, but the community is strong, meaning that there is a lot of work put into creating a good governance structure and the media picks up on the positive attitude, there is a chance.

These mentioned scenarios are however all based on the assumption that the price stability will go up as there is more adoption. However when the price volatility stays the same or even worsens, adoption slows to a crawl. The simulation with extended horizon showed that with a longer simulation period, the adoption level will get rise even with a high price volatility. However one has to take into account that there is also a certain “momentum” for an innovation in order to become successful. The general public might not want to wait 10 years before the technology becomes a real success, it might be superseded by that time.

Concluding: while a basic model is built, it shows that there is a complex interdependency among the identified factors in this research. All the factors are needed for a successful adoption of cryptocurrencies and due to network effects if adoption will start happening on a large scale, it has to potential to grow to a global scale.

11 Conclusion & Discussion

> *"On this view, outcomes are difficult to predict and the adoption factors of the first-order model are seen as necessary but not sufficient to guarantee success" (Kurnia, 2000)*

The adoption process of cryptocurrencies is not progressing as fast as one might think. Payment behavior changes only very slowly, just look at the amount of transactions that is still done with cash (50%). The adoption process of cryptocurrencies is influenced by many different factors, making that there is a lot of uncertainty about the future for cryptocurrencies. The System Dynamics model created in Chapter 10 underlines this conclusion by showing that there is a complex interdependency among the identified factors.

As the above quote by Kurnia says: certain barriers have to be overcome in order for cryptocurrencies to be adopted on a large scale and even if these barriers are removed this is no guarantee for success. In this research three main pillars are identified which are important for future mass adoption by the general public.

1. Ease of use: at the moment there is a lack of user-friendliness when using bitcoins. Sending and receiving bitcoin is still cumbersome and holding bitcoins is prone to many risks. Users need to be able to have more confidence in the availability of their funds.

2. Price stability: the current price volatility driven by speculation and a lack of liquidity makes that it is very risky for a user to keep his funds in cryptocurrency as the value varies wildly. This undermines the function of cryptocurrency as a store of value.

3. Governance: the current bitcoin foundation undermines ideological aspects of cryptocurrencies by being very centralized and opaque. There is increasingly less democracy in the bitcoin ecosystem with large mining companies entering the system and big investors holding large amounts of bitcoin. Solutions to future problems as scalability and the height of transaction fees are not being dealt with efficiently and no clear roadmap to solving these problems is available.

The security risks associated with stealing cryptocurrency of users by a direct attack or by the hacking of exchanges was not ranked highly by the interviewees. This was mostly seen as a minor problem, something that also can happen with other payment methods. It is expected that in the future the security of exchanges and private wallets will increase when higher adoption levels are reached leading to more well-developed cryptocurrency products.

The anonymity that cryptocurrencies supposedly provide is not something that is seen as a specific advantage or disadvantage by the majority of the interviewees. Mostly cryptocurrency exchanges saw anonymity as an advantage. The Dutch Central Bank is very clear in stating that for them this is a major disadvantage; the anonymity combined with fast global transactions enables criminals to make cross border transactions easy and untraceable.

There is no agreement on whether the lack of a government backing cryptocurrencies is a disadvantage. It appears that the interviewees not directly involved in the bitcoin ecosystem would prefer government backing and regulation while the interviewees of bitcoin exchanges see this more as a tradeoff that is necessary for the system to work.

There is agreement on the fact that regulation will have its impact on adoption, however it depends very much on the type of regulation whether this will be positive of negative. The owner of a Bitcoin exchange also mentioned an advantage of the current lack of regulation: this makes it easy for entrepreneurs to start their own business.

One very interesting discrepancy between the academic literature and the interviews was found. Interviewees mentioned the fact that the miners that process the bitcoin transactions might start to charge higher fees in the future. This would diminish one of the key benefits of cryptocurrency payments: low costs. This caveat was not found in the academic literature resulting from the literature review.

Cryptocurrencies have benefits over existing payment methods. The low transaction costs and low barriers to entry of the system make that it is very easy for newcomers to enter the cryptocurrency ecosystem and start using it; either as a payer or payee. The fast worldwide, cross-border transactions and partial anonymity can also be an advantage depending on the stakeholder and the usage scenario. In the paradigm of globalization and online shopping a global currency fits very well; cryptocurrencies can play this role.

11.1 Limitations

There are many possibilities for future research on the topic adoption of cryptocurrencies. This thesis has made an attempt to give a first impression and rough sketch of the landscape of cryptocurrencies and identify the most important factors that are influencing adoption. The conceptual model is based on a very general IT adoption model and the opinion of multiple experts.

Care has been taken to select a broad sample of experts ranging from the Dutch central bank to bitcoin exchanges to payments consultants, however it is possible that their combined views are biased and differ from how the average potential adopter values cryptocurrencies. Besides the selection of interviewees are also the questions that are asked of importance. Semi-structured interviews have been used as method of data gathering, this way the interview is flexible allowing the interviewee to bring up relevant topics that otherwise might not have been in the question set. However this results in a qualitative dataset of a limited number of interviewees.

The model has been developed by means of a literature review and the input of expert opinions. It is a very qualitative model and the main goal was to identify the factors that are of influence in the adoption process of cryptocurrencies. However the model is not quantified in the sense that the factors have not gotten any weights and the model has not been quantitatively tested. Therefore a possibility for future research is to test the model with a larger sample size on a more quantitative basis.

This research is focused on bitcoin as the most prominent example of a cryptocurrency. It is possible that the factors that were found to influence the adoption might be different for other cryptocurrencies, therefore threatening the external validity of the findings. However as argued in Chapter 3, the price development of other cryptocurrencies is almost identical to that of bitcoin and the technical workings of other cryptocurrencies are mostly the same. Perhaps most importantly, bitcoin is by far the largest cryptocurrency with 93,9% of the market share in the cryptocurrency space.

11.2 Further Research

There are many interesting issues that have come to the light during the literature review and interview sessions that are in need of more research. Each of the three main pillars of adoption that are identified, ease of use, price stability and governance are in need for more in depth research.

The System Dynamics model developed in this thesis can be extended to include more factors that influence adoption. The current model uses dummy data for each of the factors, if future research uncovers more quantitative data about the adoption process this can be used as input for the model. This will help to create a more realistic output and might even be the basis for a model that can be used to predicts adoption figures or price ranges.

More research is needed on the topic of how to increase the security of the funds of users of cryptocurrencies. Funds need to be secure when storing, sending and receiving cryptocurrencies, there are many example of users losing cryptocurrency due to user error, crime and fraud. Scalability of the protocol is a very important issue that is not solved yet and that needs a good solution if large scale adoption is ever to happen. This is not an easy problem and in need of future research.

Economic analysis is needed on the topic of price stability; at the moment there is no clear consensus on how to reduce volatility. The general opinion is that this will reduce with more adoption, but this remains to be seen. Also would it be beneficial if more research effort is paid to the possible transaction fee increases in the future. There is no academic literature known to the author that discusses this topic, however when transaction fees would strongly rise this would diminish one of the most important benefits of the cryptocurrency.

To manage all these processes: that is to make sure that in the future adequate solutions to problems as scalability and transaction fees are implemented, a good governance is required. The radically different nature of the decentralized protocol makes that there is a need for governance in some form that can support this and is able to implement changes without losing the core values of transparency and democracy.

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Appendix 1. Concept matrix

Table 12-1 References used in concept matrix

Number	Reference
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Appendix 2. Interview quotes

Name: Berry Schoenmakers

	Timespan	**Content**
1	0:00.0 - 2:07.1	Introduction research
2	2:07.1 - 3:11.5	Image is the reputation of cryptocurrencies.
3	4:57.6 - 5:31.3	It is clear that many different factors are influencing the adoption process. It is also important to look at the weight of all the different factors.
4	5:31.3 - 6:50.8	The decentralized aspect is anarchistic to a certain extent.
5	6:50.8 - 8:17.2	In the current world these are important mechanisms to influence the economy (the printing of money). Also exchange rates compared to other currencies can be used to influence the economy. This will not be possible with cryptocurrencies.
6	8:17.2 - 9:01.7	It is strange that cryptocurrencies have become so popular, however what you can see that almost no bitcoins are used to buy stuff. Most activity is speculation only.
7	9:01.7 - 9:26.5	Bitcoin has become very big, there is a certain level of adoption; however it is not an alternative to a credit card.
8	9:26.5 - 10:16.0	The persons that got in early, Satoshi Nakamoto for example, they got a lot of these currencies.
9	10:16.0 - 11:28.1	On a day to day basis the medium of exchange function is not being fulfilled correctly. The reason might be that everything in the network is traceable.
10	11:28.1 - 12:11.9	Waiting for bitcoin transactions to be confirmed is something that you do not want. This takes time and is not ideal for certain situation. The 10 minutes for a confirmation is centuries in the land of the internet.
11	12:11.9 - 14:35.1	The lack of "finality of payment" in cryptocurrencies is a disadvantage.
12	14:35.1 - 15:49.3	No single point of failure: when doing a regular debit card "pin" transaction in the Netherlands there is also triple redundancy. So also regular payments with debit cards have a certain protection.
13	15:49.3 - 16:28.3	Also when buying/selling bitcoins there is a single point of failure: because you are dependent on the website of the exchange.
14	16:28.3 - 16:33.1	Keeping your cryptocurrency yourself is not something you would want, because you have to be very careful then. It is very nerdy and not easy to use.
15	16:33.1 - 17:26.1	Bitcoin is popular, however you have to keep in mind that it is very popular under a certain crowd. For the average joe it is a No Go. They don't even know how internet works for example.
16	17:26.1 - 17:52.7	For the average joe all the complexity has to be abstracted. It needs to like just like a normal transaction with a bank.

17	17:52.7 - 20:10.2	Looking at E-Cash which had a lot of anonymity, even more than bitcoins, this was something that governments and banks were totally not happy with.
18	20:10.2 - 21:39.6	The government will like the fact that all transactions are in the blockchain with bitcoins. And not only the government but everybody can see all the transactions.
19	21:39.6 - 22:39.5	The pseudo anonymity in bitcoin is very weak. There will be new solutions that will make it more anonymous, however there is chance that this will make it even more complicated for end-users.
20	25:04.8 - 25:58.5	It is still the wild-west, there are many ways where cryptocurrencies can go.
21	25:58.5 - 26:16.2	Personally I think that bitcoin will not live very long. Its usage is mainly based on speculation and we have no idea how long this will last. Why would the first cryptocurrency on this earth directly be the one to succeed, who not a bitcoin 2.0, 3.0?
22	26:16.2 - 29:10.0	Open source does not make things much better. This makes that bitcoin is extensible, however extending bitcoin too much will make it a software patchwork.
23	29:10.0 - 30:40.4	Current adoption is mostly based on the hype of bitcoin.
24	30:40.4 - 30:53.8	The current price volatility is unacceptable.
25	30:53.8 - 32:56.8	Fiat money is also based on nothing, however it is under control of governments. Cryptocurrencies are trust based. They have no intrinsic value such as gold. There was a real scarcity for it.
26	32:56.8 - 34:09.2	Time stamping is a real good use of the blockchain. Time stamping is already done since the 80's.
27	34:09.2 - 36:32.1	The whole idea of the blockchain is very nice and this has a lot of uses. In the future more uses will come for it.
28	36:32.1 - 40:05.2	Low cost: nobody charges any money for it and contributes for free to the bitcoin network (all the persons that host the blockchain). It is possible though that miners will charge higher fees in the future and gain a monopoly position this way.
29	40:05.2 - 42:35.3	It is not certain that things will remain as they are. Nobody contributes for fun; it is very well possible that in the future transaction fees might not get higher, but that miners want something else in return. Look at Facebook: it is free however you turn in your privacy.
30	42:35.3 - 43:26.6	You cannot see bitcoins as money, the three functions of money are the basis and these are not fulfilled yet.
31	43:26.6 - 50:05.3	David Chaum created blind signatures, which are the basis of E-Cash. In 1993 the first shop allowed paying with E-Cash.
32	1:02:25.7 - 1:04:20.0	The business model was to, together with banks, introduce the e-cash model. For banks it was more a thing of keeping up with others rather than being a frontrunner. It were just innovation departments of banks, this does not mean anything for real world usage. On the internet things go very fast however banks and payment systems are always slow with innovations. Very slow but robust development.

33	1:04:21.1 - 1:07:37.9	Internet banking had yet to be invented. There was girotel in the Netherlands, with which you had to use a special software application to make transactions. Digicash was one of the first with digital payments, but there was huge amount of different systems for internet payments. E-cash was just one option but it did not offer any other payments like credit card payments. It was no software suite.
34	1:10:18.8 - 1:10:59.3	Also the shopping cart technology had still to be invented. Payments was just a small piece of all of this.
35	1:10:59.3 - 1:11:51.6	SEMPER - Secure electronic market place for Europe, was a project that just started. E-Commerce was the new hype. (Also Latin for: 'always')
36	1:11:51.6 - 1:39:47.1	Banks and government didn't like the privacy of e-cash. There was no demand for such a product. There were certain risks to paying with credit cards but this posed not to be a problem. Credit cards had higher but certain risks, with e-cash the risks are maybe lower but very uncertain, the same with bitcoin.
37	1:44:57.8 - 1:46:35.0	There were only a few thousand users of e-cash at most and not many places to spend it.

Name: Gaston Aussems

	Timespan	**Content**
1	0:25,1 - 1:59,3	Introduction research
2	1:59,3 - 2:08,8	2-sided market of payments
3	2:08,7 - 2:40,7	There is not only the adoption at the consumer side (IT-adoption), but you also have the slowly changing payment behavior of consumers.
4	2:40,7 - 3:08,2	The payment behavior of consumers changes very slowly. Still a very large percentage of users pay with cash.
5	3:08,2 - 4:48,3	Reducing the amount of cash payments increases the efficiency. Both for merchants accepting cash and for banks.
6	4:48,3 - 5:44,9	A merchant wants to offer the payment options that his customers currently have or ask for. It is not that a merchant offers a payment method and that a user then wants to use this. Adoption of payment methods: Banks->Consumers->Retailers
7	5:44,9 - 6:47,9	Paypal is pretty successful but for the average Dutch consumer buying online iDEAL/other payment options are still preferred.
8	6:47,9 - 7:31,2	The countries that have introduced a payment product directly linked to the current account (e.g. iDEAL, BC/MC) have shown a rapid uptake. In countries where there is a more fragmented market and where every bank has its own payment product you see more PayPal and credit card usage.
9	7:31,2 - 8:00,0	It is our experience that merchants do not prefer PayPal because of its relatively high costs and their habit of blocking accounts for a relatively long time based on customer complaint without offering the merchant the option to provide his side of the story.

10	8:00,0 - 9:06,4	The playing field of payments will get bigger and there will be more different parties.
11	10:49,0 - 11:06,7	There should be a feedback loop also to the disadvantages (regarding the model) if there will be more adoption there will be better and easier solutions for crypto currencies.
12	12:23,4 - 12:58,1	Looking at the current bitcoin transactions handled by Mollie, they seem to suggest that it is all speculation that is happening. A large part of the bitcoins is still in the hands of a few people.
13	12:58,1 - 14:07,4	What you see is that merchants do not want any exposure to bitcoins. This shows that the market sees this volatility and want to shield itself from this, this will stay for some time. There will be real change when merchants also keep bitcoin besides their euro savings and they also can pay their suppliers in bitcoin.
14	14:07,4 - 14:54,1	Volatility is a very important factor in the adoption process of bitcoin. There will still be volatility for some time.
15	14:54,1 - 16:04,9	You cannot see bitcoin fulfilling the role of store of value, it is just speculation and taking arbitrage.
16	16:04,9 - 17:26,3	You see that bitcoin only acts as a store of value in countries where there is not other more stable store of value. Look at Cyprus, but then these bitcoins will be quickly converted to other more stable regular fiat currency.
17	17:26,3 - 17:57,4	I see the process as going from medium of exchange to store of value to unit of account.
18	17:57,4 - 19:38,2	People will keep some bitcoins aside, so it is more than just a medium of exchange. However just a small amount of money, like a checking account.
19	19:38,2 - 20:09,5	I do not see the remittance market as being replaced by bitcoin any time soon.
20	22:10,5 - 23:09,4	The internet community likes anarchistic approaches
21	23:09,4 - 23:48,5	For the current adopting community regulation is not important but for the general public, they will want government backings.
22	23:48,5 - 24:03,3	I wonder whether there will be a critical success factor. For regulation this will not have to be a national bank or even the European central bank, the global nature of the system warrants a global approach. If so it is also the question what this regulation will be.
23	24:03,3 - 25:44,6	No backing of government: this is a disadvantage for adoption by the general public but this is an unsolvable problem. It is too difficult to back this and guarantee the funds of users. There is an infinite amount of different alt-currencies. However the European deposit guarantee system is only applicable to savings accounts and many users will most likely not use bitcoin to store their savings in anyway.
24	25:59,5 - 27:54,1	About an issue of the Dutch Central Bank that said that there are risks for PSPs to dealing with cryptocurrencies: "the approach taken and medium used by the Dutch Central Bank makes me very unhappy"

25	31:09,4 - 32:45,3	In practice bitcoin is money: people use it as money. Formally and legally it is not money, confirmed by a court ruling stating that is was not money.
26	32:45,3 - 36:08,4	Remark on good audit trail: it is only a good audit trail if you know which address is from which person.
27	36:08,4 - 36:41,1	One of the problems for mass adoption of bitcoin is the size of the block chain which is not manageable. It will have to be stored centrally or be made manageable in some other way.
28	36:41,1 - 38:38,6	You say "perceived" but perceived by who? I would say that persons would rather adopt bitcoin because it does NOT have an audit trail. (Good audit trail might be more in the middle)
29	38:38,6 - 39:28,5	The bitcoin foundation undermines the ideological aspects of bitcoin. There is criticism from the bitcoin community that it is very centralized and untransparant. It can become a big threat to bitcoin as you can see that there is a lot of resistance in the community against it.
30	39:28,5 - 40:30,3	If there ever comes a blockchain fork due to ideological differences I expect the collapse of the bitcoin. If there will be two different kinds of bitcoin it will become even more complicated for users.
31	40:30,2 - 43:03,6	The organization behind bitcoin needs to intrinsically have all the aspects of bitcoin, decentralized, open-source, transparent, democratic. The governance has to match with what bitcoin is.
32	43:03,6 - 45:35,0	The decision for Mollie to start accepting bitcoin payments was that it was quite easy to implement bitcoin support and as a way to attract media attention we decided to do this.
33	45:35,0 - 46:28,7	About 400 merchants have enabled bitcoin support.
34	46:28,7 - 59:32,3	DNB did not discuss their concerns with the financial institutions that serve a lot of bitcoin customers. They are starting an investigation in the second half of 2014.
35	56:31,9 - 56:47,3	Looking at your model: I think it is correct.
36	59:32,3 - 1:00:30,4	Medium of exchange: if you look at the amount of transactions that happen with our merchants this is very low however if you look at the amount of transactions of buying bitcoins this is much much higher. This is all speculative.
37	1:02:15,9 - 1:02:56,3	I am amazed by the amount of bitcoin companies that comes to us. Is there a market for them? It will give negative publicity if one of them fails.

Name: Jacob Boersma

	Timespan	**Content**
1	0:00,0 - 2:02,1	Introduction research
2	3:37,1 - 5:04,5	The three functions of money:

3	5:04,5 - 6:25,1	Bitcoin is a very concrete implementation of a cryptocurrency. Make sure to keep in mind that most media attention is focused toward bitcoin.
4	6:25,1 - 6:29,3	Although government policy aims to be neutral towards which cryptocurrency is addressed, in practice it is mostly focused on the topic of Bitcoin.
5	6:29,3 - 6:52,3	Benefits and disadvantages are specific to bitcoin in some aspects. Alt-coins might remove some disadvantages of bitcoin.
6	6:52,3 - 7:39,6	Bitcoin technology vs network vs currency
7	7:39,6 - 8:32,4	Feedback loop from bitcoin network to itself. Because if a security issue is found to be very important this can be solved and the system improves itself.
8	8:32,4 - 9:16,3	Features of alt-coins that are successful will be implemented in bitcoin, so bitcoin disadvantages/benefits are not static.
9	9:20,2 - 9:56,7	Competition between different wallet manufacturers might emerge, to resolve complexity.
10	9:56,7 - 10:49,0	Can you see it as money? The network is clearly not money.
11	10:49,0 - 11:51,5	Look at ripple, these can be used to send fiat across the globe and cash in and out at gateways.
12	11:51,5 - 12:42,0	We are so early in the development of the cryptocurrency space that the entire ways of thinking have not completely evolved yet.
13	12:42,0 - 13:37,1	Even though bitcoin is a token, the whole idea behind it is that it will be used as a currency. (see the word coin in bitcoin)
14	13:37,1 - 14:10,6	As a medium of exchange cryptocurrencies are even better than real world currencies in many ways.
15	14:10,6 - 15:06,0	Unit of account: this is something that you agree on with each other, not so important in the current age and time. We can instantly convert fiat prices to bitcoin.
16	15:05,9 - 15:06,5	You could argue that bitcoin is an even better unit of account, because it is divisible into so many small units.
17	15:06,5 - 15:40,3	Price volatility is definitely a disadvantage of cryptocurrencies that had to be addressed
18	15:40,3 - 16:01,1	My top 2 of issues that needs to be tackled is price volatility and regulation, user friendliness could be called a third issue
19	16:01,1 - 17:35,9	The feedback loop of volatility is very sensitive to news. Just small news has a huge impact on the price.
20	17:35,9 - 18:33,5	Merchants can directly convert back to fiat, therefore is this volatility not very important to medium of exchange. It is for store of value.
21	18:33,5 - 19:25,9	Also fiat currencies have experienced quite heavy fluctuations.
22	19:25,9 - 20:32,1	For user-friendliness what is necessary is that not only on the merchant side, but also on the customer side there is instant conversion from fiat to bitcoin and back. This reduces the impact of price volatility.

23	20:33,1 - 21:12,6	Low costs transactions not really an advantage because a bank transaction in the Netherlands is free.
24	21:12,6 - 21:30,0	Fast transactions is also not really a benefit in the Netherlands because popular Dutch payment methods provide an instant payment guarantee to the merchant.
25	21:30,0 - 21:32,3	Irreversibility is already standard with SEPA in the Netherlands
26	21:32,3 - 22:19,6	In the Netherlands a lot of benefits are not really much of an advantage, while looking at foreign countries and cross-border payments, these are definitively an advantage.
27	22:19,6 - 25:48,9	There are many incentives to keep current systems. Banks maintain these systems and change slowly.
28	27:48,9 - 28:04,9	Banks do not earn a lot of money on consumer payments.
29	28:04,9 - 28:35,8	Bitcoin is not from a specific third party and therefore this can seem very threatening to other parties.
30	28:35,8 - 29:53,3	Regulation in order to restrict cryptocurrencies has impact on adoption
31	29:53,3 - 30:53,0	At perceived benefits I miss the aspect that cryptocurrencies are very extensible
32	32:07,2 - 32:32,0	Price stability is very important to Store of Value, or at least a predictable price.
33	35:44,6 - 36:36,7	Which services in cryptocurrencies contribute to which functions of money? Store of value = spaarbank medium of exchange is = payment system
34	36:36,7 - 37:05,3	Fiat currencies are generally a better store of value but a worse medium of exchange than cryptocurrencies.
35	37:05,3 - 37:34,7	More widespread adoption will lead to a better unit of account for cryptocurrencies.
36	37:34,7 - 39:36,2	Functions of money can be a measure of adoption. Adoption is high when a cryptocurrency has a good score on all three functions of money.
37	39:36,2 - 43:56,2	
38	43:56,2 - 44:29,5	An advantage of cryptocurrencies is the low barriers of entry. It is very easy for a person to get started and nobody can keep you from using bitcoin. While there are many parties that can keep you from getting a credit card.
39	44:29,5 - 46:34,3	Use by criminals is a disadvantage. The partial anonymity facilitates this.
40	46:34,3 - 48:29,1	It is nice that you try to be so complete when formulating the model. This makes it very complicated because you want to say everything about everything.
41	48:29,1 - 49:23,2	Take certain elements in the model as a given.
42	49:23,2 - 52:23,8	Low barriers to entry and no barriers to transactions.
43	52:23,8 - 52:40,1	Scalability is essential for the network to survive, if all the regular fiat payments will be made on the blockchain this is threatened. Something will have to change.

44	52:40,1 - 54:32,7	There is already an enormous amount of mining power, this is increasing much faster than the amount of transactions. This is too much at the moment.
45	58:59,6 - 1:00:44,6	Multiple possible (future) outcomes: 1. never will be more than a niche. 2. banks will take this up and will host it, will tend more toward regular currencies. 3. the protocol will be changed so that it will scale (off chain transactions)

Name: Jochem Baars

	Timespan	**Content**
1	0:00.0 - 1:36.1	Ripple is an alternative for SWIFT. It offers benefits for cross-border payments and cross-currency payments
2	6:06.7 - 6:56.5	There is a challenge here with unit of account. Is it possible to do bookkeeping in bitcoin?
3	7:54.9 - 8:32.4	The model looks very practical. The question is what the balance is, you need weightings for the different factors
4	8:29.9 - 8:37.4	Bitcoin is definitely a medium of exchange. It is only a weak store of value.
5	8:32.4 - 8:32.5	I think that the importance of unit of account is very high.
6	8:37.4 - 9:20.3	The fact that bitcoin is not a unit of account means that there will always have to be a conversion and this leads to exchange risks.
7	10:40.7 - 10:53.8	The deflationary aspect makes it difficult to keep the price stable
8	10:53.8 - 11:42.8	The fact that individuals can make money from just buying and holding bitcoins is bad. Speculation does not help the currency.
9	11:42.8 - 12:18.5	Price stability is important for the success of bitcoin.
10	12:18.5 - 14:44.1	An advantage is the fact that the ledger never closes, contrary to the 9 to 5 mentality of banks.
11	14:44.1 - 16:57.2	Possibility for use as letter of credit.
12	16:57.2 - 18:21.3	Due to legacy architecture it is very difficult for banks to adapt their systems to be able to make faster transactions.
13	18:21.3 - 18:51.0	Fast Company notes bitcoin as the number 3 most innovative company.
14	18:51.0 - 20:10.3	What problem does the currency solve versus what does the network solve?
15	20:10.3 - 20:33.2	The currency is more anti-government
16	21:25.8 - 22:23.7	The way we trade has its effect on price volatility.
17	22:23.7 - 22:33.6	Look at the difference between the network and the currency.

18	28:18.3 - 28:53.9	There might be a tipping point where people start spending their hoarded bitcoins when the price gets stable enough.
19	30:16.3 - 30:16.4	The Rabobank prefers not to deal with companies involved in cryptocurrencies
20	33:01.7 - 33:25.8	Why can I carry cash in my pocket but not cash on a USB drive?
21	33:25.8 - 34:45.7	There is a lot of pressure on banks prevent crime. Why not opensource all the data and let everybody check the transactions. The role of the bank is not to catch criminals and terrorists, however we are being employed in this way currently.
22	36:19.0 - 36:41.4	I think that it is not about bitcoin but about stored value. This can be your loyalty points, your mobile phone credits, everything that is stored digitally and that represents a certain value.
23	36:41.4 - 38:20.9	I think that the cryptocurrency network will make it possible that all values that are digital can be traded for each other.
24	42:26.4 - 43:03.0	If you are the first bank to start doing something with bitcoin this might give an advantage.

Name: Jouke Hofman

	Timespan	**Content**
1	0:00.0 - 3:06.2	Introduction research
2	3:49.7 - 4:10.9	More adoption will lead to more ease of use - make a feedback loop here
3	4:10.9 - 4:24.6	More orders at the orderbook of an exchange will mean less price volatility
4	8:18.8 - 8:34.5	We want to comply with all the regulation as Bitonic.
5	8:34.5 - 8:36.0	Biggest problem is cooperating with the banks, they see a lot of risks.
6	8:36.0 - 9:31.8	Customers heard from their bank that the payment to Bitonic could not get fulfilled. Rabobank is the biggest problem in NL, 90 percent of the payments to Bitonic were blocked.
7	9:31.8 - 10:32.0	There are many examples of items that served as money in history.
8	10:31.9 - 11:37.2	Practice proves that even if bitcoin doesn't fulfill the functions of money, there is still a huge amount of adoption going on.
9	11:37.2 - 11:57.4	There is no unit of account for bitcoin yet.
10	11:57.4 - 12:51.0	The argumentation of the Dutch judge that bitcoin is not money is very strange.
11	12:51.0 - 13:44.1	In the bitcoin network, even though you might use the network for other properties, you still pay a miners fee where you pay for their services.

12	13:44.1 - 14:54.1	I am very convinced that bitcoin is money
13	14:54.1 - 16:45.6	If bitcoins would not be seen as money this would make things very complicated from a taxation perspective.
14	16:45.6 - 17:11.8	The government is slow with responding to bitcoin.
15	17:11.8 - 18:22.3	Our address is on our website, together with our pictures. This is to gain trust from our customers, because due to the anonymity and decentralized nature this is necessary.
16	18:22.3 - 18:32.8	Bitcoin is still the wild west. People need to do their own due diligence.
17	18:32.8 - 18:47.5	We consider ourselves as a financial institution as Bitonic.
18	20:02.6 - 20:54.0	In the Netherlands there is the Financial Intelligence Unit were you have to report unusual transactions. However the FIU does not acknowledge reports from us since it is about bitcoin. This is very strange.
19	22:44.1 - 23:18.1	Due to the lack of regulation it is very easy for startups in the bitcoin space to start their own business.
20	23:18.1 - 24:15.6	More regulation to protect the consumers is necessary
21	28:08.0 - 28:22.6	Because we have a government in NL that makes sure that businesses are legitimate, the fact that payments are irreversible is not a real disadvantage to customers because they are pretty sure to get their goods.
22	28:22.6 - 29:46.9	In the Netherlands irreversible payments might not be an advantage, but already in other European countries this is a real advantage; it is good that it is noted as both a benefit and a disadvantage
23	29:46.9 - 30:45.1	No single point of failure is a huge advantage
24	30:45.1 - 31:28.8	The decentralized aspect of cryptocurrencies is a huge advantage. Only a small disadvantage.
25	31:28.8 - 32:21.2	It is good that cryptocurrencies offer a level of anonymity.
26	32:21.2 - 33:42.5	It is very confronting to see silkroad and all the drugs that are offered there. Although it has the advantage that people can rate drugs dealers. I am not in the position to say something about this further.
27	33:42.5 - 35:21.8	Why don't you have no backing of government as an advantage? 2008 showed us that there are huge errors in the financial system. 6 years later there are still no fundamental changes. Bitcoin can play a role here.
28	35:21.8 - 37:05.0	Bitcoin gives power to the people. This is a way to go back to the basics of money without fractional reserve banking, but with the advantages of digital payments.
29	37:05.0 - 39:37.5	The deflationary aspect of bitcoin is not a disadvantage. It makes that people pay better attention to their money and spend it more wisely and save money for times when things are tough. But people will spend, just on better higher quality products.
30	41:41.5 - 42:36.5	Security will improve with more adoption/time

31	42:36.5 - 44:19.4	Jouke gives example of innovation to enhance bitcoin security by LaMaisonDuBitcoin.fr: a USB hardware wallet
32	49:29.8 - 51:39.3	Good audit trail because of the blockchain makes it possible for exchanges to prove their trustworthiness
33	51:39.3 - 53:34.1	In the future auditors can play an important role in certifying exchanges
34	53:34.1 - 55:34.9	Jouke discusses that he wants to make the bitonic website opensource
35	55:34.9 - 58:50.0	It is not only money that you need for a successful exchange. We coded a special made software. The default wallet software cannot handle more than an X amount of transactions per minute.
36	59:50.0 - 1:00:14.8	There is no protocol specification of Bitcoin. There is only just the reference client: bitcoin core.
37	1:02:01.7 - 1:02:25.7	A lot of power is attributed to miners: however if important parties like us and bitcoin say we will stay on the old fork then these miners cannot sell their coins anywhere. Acceptation of a coin is key.
38	1:05:07.1 - 1:07:00.3	Scalability is an issue for the future. With a larger blockchain consumers will not be able to run their own node and become dependent on third parties.
39	1:07:00.3 - 1:07:29.0	To combat scalability issues it is necessary to perform offchain transactions, you could do this in a separate public chain
40	1:13:40.2 - 1:13:51.7	It is important that bitcoin stays trustless
41	1:18:40.0 - 1:18:59.6	Decentralized and no single point of failure sounds a bit similar
42	1:18:59.6 - 1:19:44.1	Bitcoin is complicated and this makes it difficult for new users, however users should also not try to understand. Just like you don't have to know the exact workings of your debit card.
43	1:19:44.1 - 1:21:34.7	Bitcoin can become a unit of account for international payments.
44	1:21:34.7 - 1:21:48.5	Role models are important. Look at Thuisbezorgd.nl
45	1:21:48.5 - 1:24:04.7	Role models can also be of negative influence: look at charlie shrem
46	1:24:04.7 - 1:24:26.3	Media and government policy can also have negative influence
47	1:24:26.3 - 1:27:24.1	Banks have a lot of power. They alone decide who gets a bank account. Bitcoin changes this.

Name: Kim Gunnink & Mirjam Plooij

	Timespan	**Content**
1	0:01.6 - 5:22.3	Introduction research
2	5:22.3 -	Also look at the technology adoption life cycle and hype life cycle. Moore has made an

	6:31.2	adopted version with a chasm between the early adopters and the early majority.
3	8:22.9 - 8:40.7	Bitcoin has still not crossed the chasm. There is need for more ease of use.
4	9:38.3 - 10:34.8	The 15th of June there was a single mining pool (GHash, based in Ukraine)that had more than 51% of the hashing power and is therefore a single point of failure. See also this article: "Bitcoin security guarantee shattered by anonymous miner with 51% network power" http://arstechnica.com/security/2014/06/bitcoin-security-guarantee-shattered-by-anonymous-miner-with-51-network-power/
5	10:34.8 - 11:56.0	This 51% of hashing power makes that bitcoin no longer is decentralized and goes against the ideology of cryptocurrencies.
6	11:56.0 - 12:55.0	You become dependent on a unknown single centralized party and contrary to banks is this party not under supervision
7	12:55.0 - 14:24.3	Make sure to have clear what you are comparing cryptocurrencies with.
8	14:24.3 - 15:31.6	In comparison to cash it is less anonymous in the sense that you can track the flow of bitcoin transactions in the blockchain. In some cases, you might be able to discover the identity of the owner of a bitcoin address, but if someone is using TOR, it is easy to become untraceable. Compared to cash, transfers are much quicker, there is no physical moment of money exchange and you can seamlessly convert to all kinds of different digital money formats. Forensic teams are not very familiar with all these payment methods. These characteristics make virtual currencies a potentially interesting tool for transferring criminal proceeds and/or laundering money.
9	15:34.0 - 16:46.1	Cross border transactions make it very difficult to arrest online criminals using bitcoin.
10	16:46.1 - 17:13.4	Consumer risk, if you lose your bitcoins due to fraud you will never get them back.
11	19:16.2 - 19:46.9	Low costs is debatable. When looking at the costs of bitcoin, many people tend to forget the additional costs one incurs, such are the costs of converting into bitcoin and back again, etc.
12	19:46.9 - 20:23.4	The transaction costs of bitcoin payments are low at the moment, however when the blockreward is lower these might rise in order for miners to cover their costs.
13	21:46.4 - 22:11.0	With regular payment methods you also pay for security
14	22:11.0 - 24:07.3	The transaction costs of bitcoin will rise. The extent to which it will rise will (amongst others) be dependent on the amount of transactions though.
15	24:07.3 - 25:41.2	There is not necessarily a good audit trail, because it is easy for consumers to hide their identities with TOR and payments with services such as Dark Wallet en Dark Market.
16	25:41.2 - 27:13.3	Also cashing out your bitcoins you can do without leaving an electronic trail outside the blockchain by doing in person transactions. See https://localbitcoins.com/
17	27:13.3 - 28:57.4	Depending on the technical savvyness of criminals bitcoins might be an alternative to cash.
18	28:57.4 - 29:13.5	In my perception the link between bitcoin and crime is still strong in the minds of people.
19	29:13.5 - 29:47.1	Governance issues is something that we have identified as a big problem to the bitcoin system. There is no single party which can be held responsible.
20	30:01.7 - 30:51.7	There is no control mechanism which holds individuals accountable

21	30:51.7 - 31:23.6	It really depends on the type of governmental policy what the influence is on adoption and this can go both ways, negative and positive.
22	31:23.6 - 32:24.2	If you want to make bitcoin mainstream it is good if there is a central party which is responsible.
23	32:24.2 - 34:03.9	If nobody is responsible and something goes wrong, what happens?
24	34:03.9 - 34:38.6	The most important objections of the DNB against virtual currencies are the anonymous nature and the decentralized working. However these two characteristics are essential to bitcoin.
25	34:38.6 - 35:27.5	Fidor bank is using the Ripple system as a payments structure, see Fidor Becomes First Bank to Use Ripple Payment Protocol http://www.coindesk.com/fidor-becomes-first-bank-to-use-ripple-payment-protocol/
26	35:27.5 - 39:47.0	Discussion about news posts by DNB: we simply remind PSPs of their duties.
27	39:47.0 - 40:33.2	The question of whether bitcoin is money is a very difficult question. We think it is not money, but what it is exactly is difficult. We think more in the direction of a "digital representation of value".
28	40:33.2 - 41:41.9	In two separate groups research is being done on virtual currencies; one in the European Banking Authority (Mirjam) and within the ECB (Kim) where we mostly look at virtual currencies from a payment methods perspective and the EBA looks more broadly from a regulating perspective. See EBA Opinion, published on July 5th http://www.eba.europa.eu/documents/10180/657547/EBA-Op-2014-08+Opinion+on+Virtual+Currencies.pdf
29	41:41.9 - 42:14.5	We as DNB are of the opinion that it is necessary to look at virtual currencies from a European perspective at least, a worldwide view would be even better. The ECB is busy with another report, due for this year however you never know how fast it will go with the decision making. As you can see in the news there are different perspectives on virtual currencies within the EU member states.
30	43:59.5 - 44:28.5	The question of whether VC is a currency or an asset is most relevant to tax authorities.
31	44:28.5 - 45:33.7	In order to regulate it is important to define cryptocurrencies more accurately.
32	45:33.7 - 46:25.8	At the moment it is used more for speculation than for paying, therefore this would not seem money,
33	46:25.8 - 47:28.9	The uncertainty regarding taxation rules is bad for adoption.
34	47:28.9 - 48:24.2	Within a certain niche it operates as if it is money, however outside this niche it might not function as money
35	48:24.2 - 48:53.4	Real money fulfils all the three functions of money properly
36	50:49.2 - 51:29.5	Bitcoin payments offer more benefits to the merchant in the form of lower costs, however to the consumer there are no benefits compared to other alternatives.
37	52:12.4 - 58:24.8	At the moment it is too small to fall under oversight, however there is no hard boundary on when it is big enough to require this.
38	1:03:18.7 - 1:03:31.0	If there will be regulation this will have to happen on a EU level. The question of whether regulation is necessary is being discussed right now.

39	1:03:44.0 - 1:07:03.0	Scalability is not very relevant as bitcoin is not so big right now and we do not expect to see bitcoin becoming very big.

Name: Mirjam Verhoeven

	Timespan	Content
1	0:01.6 - 9:22.9	The most interesting of bitcoins is that there are many alternative uses for the blockchain. Also look at what role are payments systems going to play. Do not necessarily look at bitcoin replacing other systems.
2	9:22.9 - 14:18.7	Also look at societal benefits.
3	14:18.7 - 23:09.4	Look at actual usage scenarios of bitcoins
4	23:09.3 - 27:41.8	Look at societal trends

Name: Richard Kohl
Transcript available on request.

Name: Rob Voster

	Timespan	Content
1	0:00.0 - 4:59.6	Introduction research
2	4:59.6 - 6:32.3	Use of business and user base is a chicken and egg problem.
3	6:32.3 - 7:20.1	For media attention you could look at the Gartner models (hype cycle).
4	7:20.1 - 7:22.6	Bitcoin comes in the media as something that people do not really understand, because it is not tangible.
5	7:22.6 - 7:42.1	Media will mostly focus on the negative aspects of cryptocurrencies.
6	7:42.1 - 8:43.3	Bitcoin is not a closed system, this is an advantage on the one hand but you could also see it as a disadvantage. There are no secrets to the workings of the protocol.
7	8:43.2 - 11:59.0	If an attack on the bitcoin encryption is successful this could destroy the entire ecosystem within days.
8	12:00.1 - 14:31.8	The fact that cryptocurrencies are peer-to-peer makes things very different. DigiCash did not have to convince the politics, but on short term the central bank that had to make a decision about whether e-cash was allowed or not.
9	14:31.8 - 15:41.7	The economy as a whole needs to have a climate in which cryptocurrencies can grow. This will not happen in North-Korea for instance. Open versus Closed economy.

10	15:41.7 - 17:10.5	The fact that bitcoin is expressed in other currencies (i.e. not a unit of account), shows the weakness of the currency.
11	17:10.5 - 18:12.6	The internet infrastructure is also a prerequisite for cryptocurrencies.
12	18:12.6 - 20:08.5	The software (e-cash) only ran on a windows pc and not on an Apple Mac, this was a problem, because also at that time the early adopters used a Mac.
13	20:08.5 - 22:05.3	Paying with credit cards had security risks while e-cash was safer.
14	22:05.3 - 25:09.2	There were different kinds of e-cash, every currency had its own e-cash. This an advantage, because it allows you to reach the critical mass faster. You did not had the 80-20 problem that 80 percent of the coins were with 20 percent of the people.
15	25:09.2 - 27:57.5	It is important that you know that there is enough liquidity, which means that there are enough bid/offers. The market depth should be big enough.
16	27:57.5 - 31:02.1	Because there are so little players there is more possibility to manipulate the market.
17	31:02.1 - 40:04.3	There is no intrinsic value. This value can be undermined by the tactics of high frequency traders, this is a threat to the adoption of bitcoin
18	40:04.3 - 41:54.2	Al the dangers of HFT and other issues we have with other metrics are also playing a role here. And this is only one commodity, and one that has no other use. You can always burn oil and make jewelry from gold.
19	41:54.2 - 51:00.4	Regular exchanges allow you to place iceberg orders.
20	51:00.4 - 53:38.3	There has to be more regulation regarding the trading aspect of cryptocurrencies.
21	53:42.5 - 1:12:25.9	

Name: Robert-Reinder Nederhoed

	Timespan	**Content**
1	0:00,0 - 3:37,0	Introduction
2	6:18,7 - 6:42,3	It is not bad that shops convert their bitcoin to fiat currency because they cannot pay their suppliers in bitcoin
3	6:42,3 - 8:12,5	You could see buying bitcoins as buying stock in bitcoin
4	8:12,5 - 8:27,7	First cryptocurrencies are a store of value and then a medium of exchange
5	8:27,7 - 9:26,8	Fiat currencies are also not a good store of value due to inflation
6	9:26,8 - 9:38,8	Bitcoin is a logical next step after gold
7	10:06,0 - 10:38,3	There is a low barrier to entry for using cryptocurrencies

8	10:38,3 - 13:40,7	Decentralization of cryptocurrencies is an advantage
9	13:40,7 - 15:20,7	The disadvantage of anonymity is that it increases cybercrime because you cannot trace it.
10	15:20,7 - 16:15,6	There is no government to give trust to cryptocurrencies by backing them.
11	16:15,6 - 17:53,1	As a bitcoin exchange you shouldn't lend out the users' bitcoins.
12	17:53,1 - 19:00,3	Due to the deflationary aspect of bitcoin the value will have to keep rising
13	19:00,3 - 20:16,0	I think that the price volatility has to do with trust. There is a high percentage of day traders which make the price fluctuate.
14	20:16,0 - 22:56,4	It is possible that the peaks in price will get higher on an absolute scale, however on a logarithmic scale this is not the case
15	22:56,4 - 23:16,5	It would be best if the price rises steadily
16	23:16,5 - 24:49,8	It has to be clear that the focus of users should not be the increasing value of bitcoin, but that you participate in the innovation
17	24:51,7 - 25:20,8	Useability has to improve, and we are busy with that. Users do not want to see the bitcoin addresses at all. This is all a matter of time.
18	25:20,8 - 27:13,3	The value of the holdings in bitcoin should be denominated in fiat. Just like when you buy gold online, you see the value your grams of gold have at the moment.
19	27:13,3 - 28:28,1	It is very strange that people keep focusing on the bad things that happen with cryptocurrency.
20	28:28,1 - 29:14,7	For average consumers the biggest risk is that they lose their own coins.
21	29:14,7 - 30:38,0	If you buy bitcoin you buy from our own supply.
22	30:38,0 - 31:08,6	We are going to launch a service where we store the bitcoins of our users.
23	33:36,7 - 35:49,7	Scalability can mean that when adoption goes very fast it might be unfeasible for regular users to download the full chain. Off chain transactions might be the key to solving this problem.
24	35:49,7 - 37:01,9	I trust that the bitcoin community will come to a solution for the scalability issues.
25	39:07,7 - 40:27,1	I think that store of value can be a success almost separately from the other functions of money.
26	40:27,1 - 40:49,2	Cryptocurrencies will not be such a good unit of account, I don’t see this happening.
27	40:49,2 - 41:06,7	Medium of exchange: this is more the success of the protocol. It doesn’t really matter what the value of the currency is at the moment. There has to be a certain liquidity though.

Name: Sander Regtuijt

	Timespan	Content
1	0:00.0 - 3:40.1	Introduction research
2	5:17.4 - 7:27.3	A disadvantage is the fact that cryptocurrencies are difficult to explain to potential adopters. When people are deciding whether to use cryptocurrencies they first want to know the basic workings of the system.
3	7:27.3 - 9:59.3	Also look at the weight of each factor. Certain factors might be more important than others.
4	10:17.9 - 11:43.4	Interesting aspect of anonymous alt-coins is that this might be useful if you are a company and paying your employees in bitcoin. With these anonymized cryptocurrencies the employees cannot see what other employees get as salary.
5	11:43.4 - 11:53.5	Crime is something inevitable.
6	11:53.5 - 13:58.1	My personal statement is that the financial system becomes more and more instable. The funds that are supposedly backed by the government are not guaranteed to be backed: look at Cyprus. A cryptocurrency cannot be taken away from you.
7	13:58.1 - 14:15.8	There has to be a bigger focus on paying with cryptocurrency.
8	14:15.8 - 15:36.4	I believe that if more people will adopt cryptocurrencies there will be less price volatility.
9	15:36.4 - 16:48.7	Whether price volatility is bad for adoption depends on the use of cryptocurrencies. For example as a speculative asset it is not bad that there is a lot of volatility.
10	16:48.7 - 19:19.4	Bitcoin does not have a store of value as of yet, due to price fluctuations.
11	19:19.4 - 19:28.9	As a means of payment bitcoin is already very suitable.
12	19:28.9 - 20:00.5	You could see it as an investment though, however there is a lot of money to be lost.
13	20:04.9 - 21:10.2	I think there are three things that are most important to adoption: education, security and ease of use.
14	21:10.2 - 23:14.7	Scalability is dependent on how the bitcoin core development team will tackle this challenge.
15	23:14.7 - 23:31.7	It will take several years at least before we have a stable currency climate.
16	23:34.1 - 24:19.6	Off chain transactions have advantages that you can have instant payments.
17	24:19.6 - 24:54.2	The core development team has a certain amount of power because they develop the main software.
18	24:54.2 - 25:58.1	The government is able to influence the mining process, by making mining a criminal activity. Although this is not very realistic.
19	25:58.1 - 28:50.8	Maybe it is better to change complicated to ease of use/difficult to understand.
20	28:50.8 - 30:05.5	The overview table is useful and can become a kind of guidebook.

21	30:05.5 - 32:52.4	When bitcoin gets bigger, governments and central banks will see it as more of a threat. At the moment the entire market is very small. More adoption will lead to more government policy.
22	32:52.4 - 34:12.0	

Name: Simon Lelieveldt

	Timespan	**Content**
1	0:00.0 - 2:24.1	Introduction
2	2:24.1 - 8:37.7	Introduction Simon Lelieveldt
3	8:37.7 - 13:15.7	Introduction research
4	13:15.7 - 15:00.6	Simon references Jouke Hofman
5	15:05.7 - 17:58.4	Identification has a lot of importance on adoption If no identification is necessary you can look at EGold, the adoption went fast because of this lack of identification. Self-governance: many providers will add KYC AML but cryptocurrencies are already being seen as negative by the government.
6	18:01.8 - 19:36.7	Regulation is important.
7	20:26.4 - 24:23.4	Irreversible payments are no advantage. SEPA already does this. Besides the technical irreversibility there is also the legal side. The judge can still say that one has to reverse the payment. A system has both technical and legal norms.
8	25:04.1 - 26:02.0	In the US they have an outdated payment system which makes irreversible payments more of an advantage. Shows importance of relative advantage.
9	26:02.0 - 27:09.8	Low costs of payments. This advantage is not as big as it seems, because there will be a lot of added costs when cryptocurrencies will have to comply with regulations.
10	27:15.7 - 28:14.7	Privacy is an issue. Do not put everything in public ledgers.
11	28:14.7 - 28:26.5	Ease of use is getting better.
12	28:26.5 - 28:34.4	Price volatility is a structural disadvantage.
13	28:34.4 - 30:09.7	No backing of government: governments will never back this.
14	30:09.7 - 31:59.3	Make a very concise definition of cryptocurrency. This is complicated.
15	31:59.3 - 33:16.2	Bitcoin is just named coin to make it seem more like a currency. But it is just a token you trade.
16	33:16.2 - 33:34.4	It is the distributed nature that makes it a cryptocurrency.
17	33:34.4 -	The customer does not care about the underlying technology.

	34:27.5	
18	34:27.5 - 36:55.2	There will continue to be a wide landscape with different currencies. This is not strange, there is a different system and purpose for every currency. History shows this (see Amsterdam with hundreds of currencies)
19	36:55.2 - 38:43.1	Interesting that you make the difference between business and consumer. The definition of peer to peer is that everybody is its own business.
20	38:43.1 - 39:30.4	Lack of governmental influence: also cryptocurrencies can exist that the government can have influence over.
21	39:30.4 - 41:53.1	No single point of failure: this depends, also cryptocurrencies have vulnerabilities. If the network itself is vulnerable (look at transaction malleability bug) there is a point of failure.
22	41:53.1 - 42:17.1	There will remain only a few big players in the cryptocurrency world. Compare to visa and MasterCard.
23	42:17.1 - 44:21.9	You just take a picture of the passport and facial recognition confirms your identity. AML/KYC is not that difficult for cryptocurrencies. There are already good online solutions for this (online ID checker)
24	44:21.9 - 47:05.6	There is an interplay of three parties: politics vs government vs regulators. Too many discussions see the government as a single entity.
25	47:05.6 - 48:09.9	The first dust has settled in the bitcoin market. Market is reorganizing, price fluctuations have settled down a bit.
26	47:53.2 - 48:23.8	Now the focus lies on creating interesting uses for cryptocurrencies.
27	48:09.9 - 48:10.0	There is a possibility of lack of liquidity in the market due to the fact that large investors entered the market but stopped moving.
28	48:54.0 - 49:56.7	Bitcoin has yet to be seen as a real currency. It is important that his happens.
29	49:56.7 - 51:59.2	The fact that you always have to first convert your cryptocurrency to fiat means that there is no spinoff effect to the monetary policy.
30	53:07.4 - 53:31.7	Cryptocurrencies will never replace fiat currencies.
31	53:31.7 - 53:56.9	There is a lack of knowledge about financial systems and payment systems by cryptocurrency adopters.
32	55:44.1 - 56:18.5	A much more relevant threat for governments to worry about are digital currencies with private issuers. (see E-gold)
33	56:18.5 - 57:43.2	Regulations for exchanges where cryptocurrencies can be traded are most relevant.
34	57:43.2 - 58:00.8	The commodity approach is the most fitting one for cryptocurrencies.
35	58:00.8 - 59:36.5	In the Netherlands you have to pay taxes over your holdings in bitcoin.
36	59:39.2 - 1:00:33.2	When looking at adoption from an IT perspective, regulation might be more of a precondition.

37	1:00:33.2 - 1:04:04.4	You never know what the next development in this space will be. A lot of e-money businesses have taken a leap forward compared to more traditional banks (see PayPal).
38	1:04:04.4 - 1:06:59.3	Bitcoin is a currency with an ideological value: anti-government. This has been important in the adoption process. An ideological component will remain key for the adoption.
39	1:06:59.3 - 1:10:49.0	Currencies with a moral value will develop, compared to the moralless currencies of this time. Look at the current trends toward fair-trade and organic products.
40	1:10:49.0 - 1:12:05.9	It is possible that there will be a long time of muddling along in the cryptocurrency space. In this phase everything can happen and a great product might emerge.
41	1:13:56.1 - 1:14:34.8	The community is looking too hard for new ways to apply the blockchain to solve problems.
42	1:14:34.8 - 1:17:24.1	Fiat currency will most likely not be issued on the blockchain because it is not an efficient system for that purpose.
43	1:17:24.1 - 1:18:14.0	In your model you miss the non-digital stakeholders.
44	1:18:14.0 - 1:18:56.4	We also have influence on the ECB through voting. With cryptocurrencies you cannot influence anything. The power is very unevenly divided. There are large powers in the cryptocurrency space.
45	1:18:56.4 - 1:19:36.0	Individuals that do not interact in the digital domain are left out in the model. It is technically complex to use.
46	1:19:36.0 - 1:19:59.6	The barriers to entry are still very high due to the complex nature of cryptocurrencies.
47	1:19:59.6 - 1:21:53.8	The key question is the question of whether cryptocurrencies are a commodity vs payment system.
48	1:21:53.8 - 1:23:34.0	Look at a possible tipping point of the question of value of bitcoin vs its liquidity.