A Conceptual Extension of Speculative Bubbles

- The Case of Bitcoin

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En konceptuel udvidelse af spekulative bobler

- Et casestudie af Bitcoin

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Abstract

Formålet med denne afhandling er at undersøge det traditionelle adfærdsøkonomiske bobledannelsesbegreb i kontekst af en disruptiv innovation. Undersøgelsen bygger på et casestudie af kryptovalutaen Bitcoin, der defineres som et nutidigt eksempel på en teknologi, der har potentialet til fundamentalt at ændre en hel industri samt opfattelsen af de etablerede samfundsinstitutioner. Casestudiet er en eksplorativ undersøgelse gennemført som et kombinationsstudie af kvalitative og kvantitative metoder. Datagrundlaget består af syv semistrukturerede ekspertinterviews og en spørgeskemaundersøgelse samt udvalgte deskriptive markedsdata med det formål at kontekstualisere det øvrige datamateriale. Det teoretiske udgangspunkt er Robert Shillers teori om spekulative bobler, der anvendes som fundament for at analysere bobledannelsesbegrebet ud fra specialets empiriske grundlag. Begrebet analyseres i et markeds-, et aktør- og et aktivperspektiv. Studiet viser, at bobledannelsesbegrebet har nogen grad af forklaringskraft i forhold til de empiriske observationer, men at der også forekommer centrale afvigelser, som teorien ikke kan indfange. Analysens resultater viser, 1) at bitcoinkursen har oplevet flere ekstreme stigninger med efterfølgende drastiske fald, hvor prisen i alle tilfælde har stabiliseret sig på et højere niveau end indgangsniveauet, 2) at der findes to investortyper i markedet; dels den klassiske prisspekulant og dels en investortype, der motiveres af teknologiens fremtidige anvendelse, 3) at bitcoin endnu ikke endegyldigt har opnået en aktivklassedefinition, som er en basal forudsætning for validiteten af bobledannelsesbegrebets forklaringskraft. En alternativ forklaringsmodel, der tager højde for casens disruptive natur, er derfor introduceret og anvendt for at adressere bobledannelsesteoriens mangler. De yderligere teoretiske inddragelser er fundet inden for innovationsfeltet og bidrager ved at placere analysens fund i en bredere kontekst af teknologisk diffusion. Undersøgelsen sætter overordnet spørgsmålstegn ved, om det er muligt og meningsfuldt at benytte sig af et traditionelt begreb til at forstå et fænomen, der fundamentalt set repræsenterer et "paradigmeskifte".

Keywords

#bitcoin #speculative bubbles #disruptive innovation #behavioral economics

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1 Introduction

In today's society, new technologies keep emerging continuously intervening with our current perception of the world. Artificial intelligence, machine learning, robotics and Internet of Things are among the current technological trends that show the promise of irreversibly changing the business environment as well as our daily lives *(Gartner 2018)*. This places a general requirement for humans to constantly be able to adapt to embrace the unstoppable wave of technological evolution. Innovation is thus also seen as an essential driver for any company or industry that wants to remain competitive in these fast-paced markets.

A term evolving from the theme of innovation that has widely increased in popularity over the last years is *disruption*. The concept is mentioned in all sorts of contexts, everything from corporate business strategies to municipal workflows, though the actual definition and appropriate application of it is still unclear *(Østergaard 2017)*. However, it appears that the term disruption has become an everyday "buzzword" that insinuates a focus on development and willingness towards changes.

Harvard Business School professor, father of the renowned theory of disruptive innovation and author of *The Innovator's Dilemma* (1997), Clayton Christensen, argues that the term is used too loosely to invoke the concept of innovation in support of whatever people wish to do. He further states that the use of "disruptive innovation" to describe *any* situation in which an industry is shaken up, making previously successful incumbents stumble, is much too broad a usage *(Christensen et al. 2015)*. The question then still remains; what makes something a truly disruptive innovation?

The very same disruption guru has publicly defined the concept of disruption as follows:

> *"A disruption displaces an existing market, industry, or technology and produces something new and more efficient and worthwhile. It is at once destructive and creative. Disruption changes how we think, behave, do business, learn and go about our day-to-day."*
>
> *- Clayton Christensen in Forbes (Howard 2013)*

According to this definition, it can be discussed how many innovations and new technologies that essentially are truly disruptive, despite the many that are proclaimed to be so. Historically, it is difficult to define whether a given invention has been disruptive, as the definition itself is rather vague, but it is suggested that the last real disruptive technology actually was the invention of the Internet in the late 20th century, as it has fundamentally changed the way of, among much else, doing business, learn and communicate, let alone has it definitively broken down physical distances *(Giovannetti et al. 2003)*.

However, today a new phenomenon has occurred that fulfills the definition of a disruptive innovation. In technological terms, it holds the potential to disrupt an entire industry, but moreover, it represents a fundamental reconsideration of the established institutional landscape. That phenomenon is *Bitcoin*.

In short terms, Bitcoin is *"a purely peer-to-peer version of electronic cash that allows online payment to be sent directly from one party to another without the need of a financial institution" (Nakamoto 2008)*. Bitcoin is thus a global payments system, yet, after further considerations, also basically representing a paradigm shift in how we build our societies by proposing the idea of decentralized governance.

Unsurprisingly, the system was invented in the wake of the global financial crisis in 2008[1]. It was created by a person or a group that goes by the pseudonym, Satoshi Nakamoto. Bitcoin builds on the *blockchain technology*, which, along with the above mentioned, has grown into one of the technological trends that currently receives massive attention. Following the introduction of Bitcoin, a huge number of *cryptocurrencies* with all sorts of attributes have seen the light of day potentially constituting an entirely new asset class *(Simon Ousager, Appendix 5)*. In terms of readability, it should be noted that "bitcoin" refers to the cryptocurrency (the token), whereas "Bitcoin" refers to the network (the protocol).

Until 2017, the existence of Bitcoin remained relatively unnoticed by most. However, following a sudden extreme price increase, reaching an all-time high of almost $20,000 in December, bitcoin became one of the most heavily debated investment topics at the end of the year.

[1] The crisis emerged from chains of irresponsible subprime mortgages issued by the established banks that ultimately drove the economy into the most severe recession since The Great Depression in 1929-1930 *(Amadeo 2018)*.

Bitcoin, or at least blockchain, has well-anticipated also grown to be one of the biggest technology-related buzzwords, together with disruption, of modern times. The excessive hype among all sorts of investors, enthusiastically throwing themselves into the crypto arena, caused an emerging mentioning of bitcoin as a *bubble (Google Trends 2018)*. Prominent figures[2], both within academia and the corporate world, have in fact publicly denoted bitcoin as the best contemporary example of a speculative bubble *(Detrixhe 2017).*

This statement seems to be based on a conventional understanding that a fundamentally new phenomenon is well interpreted through an existing conceptual framework, a point of view that is considered quite paradoxical by the authors. This initially introduces a new field of interest; how is the explanatory power of the concept of speculative bubbles in the context of a truly disruptive innovation?

1.1 Research Gap

The term "bubble", considering investment purposes, was invented in Britain 300 years ago, thus the academic literature concerning speculative bubbles is quite mature *(Plesner 2018)*. In contrast, disruptive innovations were manifested as an autonomous field of research roughly two decades ago *(Christensen 1997)*. Despite the various articles and research studies in the field of speculative bubbles, we believe that the research considering the specific context of disruptive innovation is far from fully explored. Hence, this thesis sets out to test if the assumptions of the bubble concept can be extended to the context of a disruptive phenomenon.

At the time of writing, the literature combining speculative bubbles and disruptive innovations is scarce[3]. Speculative bubbles have been studied thoroughly in well-established financial markets of stocks, bonds and real estate, but the research considering the particular circumstances of disruptive markets is still poor *(Shiller 2015)*. It can be argued that the heavy investments made in Internet-based companies under the Dotcom bubble in the 1990s somehow relate bubble formation and disruptive phenomena. This crisis is widely studied, for example, Ofek &

[2] Including Robert Shiller, leading the academic research field within speculative bubbles.
[3] A CBS library search on speculative bubbles and disruptive innovation returned 145 peer-reviewed articles. Exploring the articles further, it was discovered that none of the articles have studied the link between speculative bubbles and disruptive innovation.

Richardson (2001) specifically studied the behavior of the Internet stock prices in the given period. However, there is a clear difference between bitcoin and tech-stocks in the sense that bitcoin is not a financial instrument connected to the innovation, but it is a token of the innovation itself.

A few studies have already made the connection between speculative bubbles and bitcoin. Bianchietti et al. (2018), for example, investigate indications of bubble formation in bitcoin and ether[4] through quantitative modeling. It was found that bitcoin periodically shows strong bubble signals through the lens of the statistical methodology built for the study. However, the underlying mechanisms for driving the prices are not particularly addressed. Corbet et al. (2017) reach similar conclusions in their attempt of date stamping bubbles in the bitcoin price. Also, Cheah & Fry (2015) investigate bubble formation in the bitcoin price using econometric modeling. The study finds that the fundamental value of bitcoin is zero and that the bitcoin price occasionally has exhibited speculative bubbles. As with Bianchetti et al. (2018) and Corbet et al. (2017), the purpose is to predict whether bitcoin is a bubble in quantitative terms. The study does not interpret the bubble concept but is conducted under the assumption that the phenomenon at stake is the same as the traditional bubble concept.

Thus, none of the above papers consider how the underlying assumptions of the concept of speculative bubbles are applicable in the case of Bitcoin essentially representing a disruptive phenomenon. Moreover, none of the studies distinguish between the token and the network. It is thereby believed that there is a gap in the literature when it comes to bubble formation in disruptive markets. This thesis seeks to close this gap by using the case of Bitcoin as the unit of analysis to test and expand the explanatory power of the traditional bubble concept. The aim is thus to nuance the discussion of how the concept can be used or should be understood in a disruptive context.

[4] Ether is the second largest cryptocurrency and is the token of the Ethereum network *(Ethereum 2018)*

1.2 Thesis Statement

Based on the above, the focus of this thesis is to investigate the concept of a speculative bubble in the context of a disruptive phenomenon by analyzing the case of Bitcoin. The aim of the dissertation is to expand the realm of understanding in relation to the application of traditional and practical concepts on phenomena that are defined as truly disruptive. To further unfold the concept of speculative bubbles, we will examine the underlying assumptions of the bubble theory and test the explanatory power on our empirical findings.

The following problem formulation constitutes the foundation for the research:

How can the traditional concept of a speculative bubble be extended to the context of a disruptive phenomenon?

In the research question, the term traditional refers to a term or concept that has not evolved to cover an innovative context[5]. It is considered that *traditional* and *disruptive* in fact are opposites, which illustrates the paradox.

The following sub-questions are constructed to further guide the research:

1. **What explanatory power does the bubble theory hold in the bitcoin market?**
2. **How can an alternative explanatory model expand the bubble concept to capture the nature of bitcoin?**

The intention is thus, first, to investigate the explanatory power of the bubble concept, at its current theoretical state, on a case that fulfills the definition of disruptive innovation. Second, we intend to introduce a theoretical contribution that specifically accounts for the essence of a disruptive phenomenon to nuance the existing bubble concept. To do so, relevant theories within the academic fields of behavioral economics and innovations will be applied to shed light on how the bubble theory extends to a disruptive market.

[5] Traditional is defined as *following or belonging to the customs or ways of behaving that have continued in a group of people or society for a long time without changing (Cambridge Dictionary 2018).*

1.3 Motivation

The motivation for the research is first and foremost grounded in a genuine interest in financial market behavior and current issues within the financial sector. The financial sector is experiencing major changes these years, among others initiated by the financial crisis in 2008. Large sections of the Western world population have still not forgiven the financial institutions and the damaged trust is not yet recovered *(Pedersen 2017)*.

Moreover, a keen interest in emerging trends and new phenomena with a potential future impact lies as the foundation of the research. Cryptocurrencies show the promise of such future impact, why it was found exciting to study the field. With our educational background, it was further considered interesting to comprehend the hype of the phenomena, Bitcoin, through a behavioral economics perspective.

The field of interest thus arises from the above-mentioned, but the final idea for the thesis emanated from an interview with Hans Henrik Hoffmeyer, SVP in Smart Payments[6]. He thoroughly believes that Bitcoin represents a paradigm shift in relation to the way people perceive financial systems today and further concludes that a mutual definition of what Bitcoin is, has yet to come:

"All people come to this conclusion that it is not one of the things [gold, currency, payment system, software], and that's also what makes it so annoying from a regulatory perspective."

- Hans Henrik Hoffmeyer (App. 7: 188)

The statement spiked our interest as it stresses the disruptive capability of Bitcoin as well as the struggles of a proper classification. At the same time, the media all over the world pronounced bitcoin the greatest bubble in history *(Monaghan 2018).* After having researched the existing theory on speculative bubbles, we found a paradox in the link between an undefined asset and bubble formation, which founded the ultimate motivation for the research.

[6] Smart Payments is a subsidiary company to the Danish payment company Nets A/S, www.nets.eu

Justification of relevance to MSc in Business Administration and Psychology

This thesis is a part of the Master of Science in Business Administration and Psychology program at Copenhagen Business School. The program particularly focuses on change and innovation processes from different perspectives including project management, change management and behavioral economics from a thematic framework within psychology, organization and business economics. It is required that one or more of the themes are the foundation for the master's thesis. Considering that the analysis includes elements of psychology, innovation and behavioral economics, we find that this thesis justifies its relevance to the program.

1.4 Contribution

It is acknowledged, that the purpose of the thesis is first and foremost academia. The academic contribution lies in the nuancing and elaboration of the concept of speculative bubbles, including a discussion of its application in the context of a disruptive phenomenon.

In addition to the academic contribution, it is believed that the dissertation manages to ensure a practical contribution. By exploring and investigating the case of Bitcoin, it is assumed that the research will contribute with a greater span of knowledge of the phenomenon, which hopefully supports the current discussion in the field of cryptocurrencies.

1.5 Research Scope

To investigate how the traditional concept of a speculative bubble extends to the context of a disruptive innovation, we will examine the application of the bubble theory on the case of Bitcoin. Considering the newness and topicality of the case, it was found appropriate to go forth with an exploratory approach. The explorative method is supported by a qualitative approach comprising semi-structured expert interviews. The complexity of the case further justifies this method, as the constant development of the phenomenon makes written material outdated relatively fast.

To increase the scope of the research and support the findings of the expert interviews, we integrated a quantitative survey to further investigate the general motives underlying the observed market behavior. Moreover, the findings are contextualized by including descriptive market statistics in the aggregate data basis. The use of a case study based on mixed methods thus enables a thorough exploration of a complex phenomenon as it embraces both a descriptive and a more in-depth understanding of the mechanisms at stake.

Other cryptocurrency cases could also have the potential of serving as the basis for our investigation as the overall crypto market has experienced major increases in price over a short period of time imitating bubble-like conditions *(CoinMarketCap 2018)*. However, bitcoin is the first of its kind and thus the first to represent the disruptive potential, whereas descendant cryptocurrencies are inspired by the original attributions of bitcoin. Furthermore, bitcoin is still the largest[7] and far most accessible cryptocurrency, which makes it an ideal case as means of investigating the problem at hand.

Finally, it must be noted that the scope of the research, due to availability, is limited to only include respondents from Denmark. However, given that the data collected embraces a broad spectrum of respondents, it is initially assumed that the findings can be applied to the general context of the case.

1.6 Delimitations

As the authors of the thesis are not experts in the field of cryptography, computer science or coding, the thesis will not go in depth with the exact technological processes within the Bitcoin network. It is therefore not possible to evaluate Bitcoin based on any technological applications.

Moreover, regarding the empirical data collection, primarily pro-Bitcoin experts were included in the group of interview participants. As the crypto-community is still relatively immature due to the emergent stage of the technology, knowledge of the phenomenon remains concentrated among proponents. The authors are aware that this potentially involves a positivity bias. Also, the research is delimited to study only the bitcoin market and the market participants. It was therefore found natural to exclude people who declare themselves against Bitcoin. It is,

[7] Bitcoin is the largest cryptocurrency measured by market capitalization and users *(CoinMarketCap 2018)*.

furthermore, recognized that the institutional perspective is highly relevant to the case. However, the thesis is delimited from considering governmental and political issues as these are considered outside the research scope.

Finally, another limitation arises from the thesis statement and the scope of the research. It is considered important to clarify that the thesis concentrates on investigating the application of the concept of speculative bubbles in the context of a disruptive innovation. We thereby refrain from further investigating and propose a conclusion to whether bitcoin is a bubble or not.

1.7 Thesis Structure

The thesis consists of 11 chapters. Chapter 1 contains the introduction, presenting the thesis statement and the scope of the study providing a direction of the research. Chapter 2 presents a review of the existing literature containing an overview of the previous research within speculative bubbles. In Chapter 3 the research design is presented, including the scientific inference method and overall methodology covering data sources, data collection and data processing. Chapter 4 consists of the theoretical framework within bubble formation applied to analyze the research question. The chapter further places the theoretical framework within the broader landscape of economic thinking. Chapter 5 introduces the fundamental attributes of Bitcoin to clarify the studied phenomena as a service to the reader. Chapter 6 presents the first part of the analysis. Part 1 examines the case of bitcoin based on the definition of a speculative bubble. In the following chapter, Chapter 7, the analysis of the case is continued by an elaboration of the findings in the first part, introducing contributions from the theoretical landscape of innovation to expand the existing explanatory model. Thereafter, Chapter 8 reflects on the complementation of the theories applied in the analysis. In Chapter 9 a discussion of the empirical findings and the overall thesis framework is presented. Chapter 10 concludes the research by answering the thesis statement. Finally, Chapter 11 provides recommendations for future research.

2 Literature Review

Throughout history, there have been various market bubbles that have had different implications for economies, industries and communities around the world *(Kindleberger & Aliber 2005).* The first known example of a bubble is the famous Tulip Mania in the Netherlands. The story is almost a classic, yet very illustrative:

> *Tulips were brought to Europe from the East midst 1500's and at the beginning of the 1600's, tulips evolved into a thriving industry in Holland (Rapp 2005). However, tulips could only be sold two months a year, but due to the excess demand, caused by a general rise in wages, an important change in the sales procedure was made that enabled contracting on the bulbs for a small percentage of the total price prior to the harvest season. This became the first step in the direction of the speculative mania as buyers began to see an earnings opportunity in reselling the bulbs at a higher price. Investments in the tulip market started emerging solely with the purpose of resale, never the intention of use. Prices thus escalated as contracts were merrily traded at the local exchanges. In reality, few possessed the wealth to realize the amount due at the completion of the deal, so the tulip prices were, in fact, a castle in the sky. At the peak of the price inflation, a tulip auction netted about 250 times the yearly salary of an average artisan (Rapp 2005). When the following auction yielded no bids, a panic started to spread among buyers that ultimately resulted in the burst of the tulip bubble.*

At other occasions, a similar phenomenon has appeared. The table below displays an overview of the biggest speculative bubbles through history and their points of origin. In relation to the investment market, the term "bubble" was officially introduced by the British parliament in 1720 *(Plesner 2018).*

YEAR	BUBBLE
1636 – 1637	The Tulip Bulb Bubble: Tulip bulb mania in Holland
1720	South Sea Bubble: South Sea Company in England
1720's	Mississippi Bubble: Mississippi Company in France
1840's	Railway Bubble: Railway mania in Great Britain
1980's	Japanese Asset Price Bubble: Real estate and stock market in Japan
1990's – 2002	The Dotcom Bubble: Silicon Valley in the USA (for the most part)
2007-2008	The US Housing Bubble: Real estate and credit crisis around the world

Table 1 – Overview of the biggest bubbles through history[8]

One of the first studies of the formation of speculative bubbles was conducted by Scottish journalist Charles MacKay depicting crowd psychology. MacKay published his findings in 1841 in the book *Extraordinary Popular Delusions and the Madness of Crowds (MacKay 1841)*. Years later, in the 1980's, the post-Keynesian American economist, Hyman Minsky, developed the theory of the *financial instability hypothesis* that models the instability of a credit system and the market encouragement of speculative investments *(Minsky 1986)*. Economic historian, Charles Kindleberger followed Minsky's work and further explored the anatomy of a typical crisis, which resulted in a framework considering the impact of the powerful human dynamics of fear and greed. Kindleberger later outlined five phases of a speculative bubble *(Kindleberger & Aliber 2005)*. In recent time, it is the American economist and Nobel Prize laureate, Robert Shiller, who leads the field of study within market bubbles based on in-depth analyses of previous market dramas *(Shiller 2000)*.

However, the theoretical concept of bubbles is not well anticipated by every economic scholar. The bubble theory is considered controversial among those who agree on the *efficient market hypothesis* and the *perfect rationality model (Investopedia 2018b)*. Both argue that bubbles cannot exist due to an underlying assumption that market prices always reflect the true economic value. That because information is shared among market participants and rapidly incorporated in the price and all market actors are anticipated to be rational *(Investopedia 2018b)*.

[8] Compiled from Rapp (2009): *Bubbles, Booms, and Bursts – The Rise and Fall of Financial Assets*

The concept of bubble formation thus exists under certain theoretical prerequisites, which will be further elucidated in relation to the theoretical framework of the thesis. Initially, the literature review focuses on the academic work developed under the assumption that speculative bubbles indeed exist.

2.1 The Scope of the Literature Review

The literature within bubble formation is reviewed with the purpose of writing a master's thesis to complete the Master of Science in Business Administration and Psychology program at Copenhagen Business School. Therefore, the focus of the literature review is on the work that contains behavioral and psychological contributions to the theoretical field of bubbles.

It is recognized that the subject of speculative bubbles implies comprehensive macroeconomic and societal consequences, which however is considered outside the scope of the current research as this thesis studies how the concept specifically unfolds in relation to disruptive technologies. The aim is thus to test if the assumptions underlying classic bubble theory is applicable in the context of a fundamentally innovative phenomenon.

The literature review is moreover limited to only consider academic articles or books written in Danish or English. In consideration of the submission deadline, the review includes research published no later than January 2018. The search for academic material is done with a starting point in the database offered by Copenhagen Business School, Libsearch, corresponding to the guidelines on literature search from the Royal Literary Fund (2018). Libsearch comprises 120 global academic databases and moreover contains all the printed material available at the CBS Library, e-books, articles from international journals and dissertations from CBS alumni *(CBS Library 2018)*.

2.2 Conducting the Literature Search

The structuring of the literature search is inspired by the systematic approach to conducting a literature review by Webster & Watson (2002). Initially, an identification of the prior relevant academic research within bubble formation was approached by using the keywords "bubble" and "behavioral economics" or "behavioral finance" to search the material that contained either of the word constellations. The result was 4,066 hits.

To narrow down the initial search result, only articles and books were selected as relevant, as conference proceedings, dissertations, texts and reviews were anticipated to be more of reflections of the existing bubble theory than theoretical contributions to the field. Still, this only reduced the body of literature to 3,702 results, which demanded further focusing in order for us to be able to screen the search results and obtain an overview.

When conducting a literature search, a concept-centric approach is recommended *(Webster & Watson 2002)*. Libsearch contains a function that enables the researcher to filter by pre-defined topics. The following topics were considered respectively potentially relevant and irrelevant to this thesis:

POTENTIALLY RELEVANT TOPICS	IRRELEVANT TOPICS
Economics	Experiment/Theoretical Treatment
Bubbles	Political Science
Economic Theory	Education
Financial Crises	Econometrics
Business	Economic Policy
Consumer Behavior	Monetary Policy
Finance	Corporate Governance
Economic History	Risk Management
Behavioral Economics	Law
Social Sciences	Macroeconomics
Economic Psychology	Physics
Investments	Engineering

Table 2 – Overview of Libsearch topics

The exclusion of the irrelevant topics listed above left 362 potentially relevant results, which were considered a manageable amount for manual screening. The material was screened and organized in terms of relevance, publishing entity and year of release based on a preference for more recent research. Moreover, potentially interesting references were further investigated using Google Scholar and Google Search.

2.3 Theoretical Overview

From the search process, 13 books and articles were selected as the main material for the literature review. The overview of the research (Table 3) is indented to cover some of the most prominent academic contributions in relation to shaping and expanding the concept of bubble formation from a behavioral perspective. The screening process revealed that much research within the field refer to the same theories, which were thus, among others, selected as representative for the overview.

Temporally, the starting point of the overview is taken in the contribution of Minsky (1986) who almost anticipated the backlash of the efficient market hypothesis within economic research that evolved with the diffusion of behavioral economics through the 1980's *(Engsted 2010)*. Earlier studies were thus discarded due to a criterion of contemporaneity. Moreover, the research on the concept of bubbles distinguishes between rational and irrational speculative bubbles *(Engsted 2010)*. Rational bubbles are grounded in rational expectations theory and are thus not included in the current review. Additionally, studies like Odean (1998) on investor overconfidence were delimited, as speculative bubbles are not specifically mentioned though the behavioral contribution is considered relevant. Also, studies like Wright et al. (2012) were sorted out, as it is perceived that food prices are influenced by significantly other circumstances than a disruptive technology. Articles such as Jones (2014) are furthermore considered irrelevant since price and quantity were used as the only measures for the identification of a bubble.

The academic research selected for the review is presented in Table 3. The overview is structured by author and year of publishing, title, publishing entity and a short summary.

AUTHOR AND YEAR	Minsky (1986)	Smith, Suchanek & Williams (1988)	Stiglitz et al. (1990)*	Shiller (2000a)	Shiller (2000b)	Abreu & Brunner-meier (2003)	Porter & Smith (2003)	Shiller (2003)	Kindlberger & Aliber (2005)	Deck, Porter & Smith (2014)	Garcia et al. (2014)	Shu & Chang (2015)	Hageback (2017)
TITLE	*Stabilizing an Unstable Economy*	*Bubbles, Crashes, and Endogenous Expectations in Experimental Spot Asset Markets*	*Symposium on Bubbles*	*Irrational Exuberance (2nd ed. 2005, 3rd ed. 2015)*	*Measuring Bubble Expectations and Investor Confidence*	*Bubbles and Crashes*	*Stock Market Bubbles in the Laboratory*	*From Efficient Markets Theory to Behavioral Finance*	*Manias, Panics and Crashes: A History of Financial Crises*	*Double Bubbles in Asset Markets With Multiple Generations*	*The Digital Traces of Bubbles: Feedback Cycles Between Socio-Economic Signals in the Bitcoin Economy*	*Investor Sentiment and Financial Market Volatility*	*Archetypes as Triggers of Financial Bubbles*
PUBLISHING ENTITY	Yale University Press	Econometrica	Journal of Economic Perspectives	Princeton University Press	Journal of Psychology and Financial Markets	Econometrica	Journal of Behavioral Finance	Journal of Economic Perspectives	Palgrave Macmillan	Journal of Behavioral Finance	Journal of the Royal Society Interface	Journal of Behavioral Finance	Journal of Behavioral Finance
SUMMARY	Explains the development of financial instability and its interaction with economy. The economy does not always conform to the classical view of an equilibrium-seeking entity. Minsky is known for the identification of five steps of a standard credit cycle; displacement, boom, euphoria, profit-taking and panic.	Studies spot asset trading in an experimental environment where all investors receive the same dividend. 14 out of 22 experiments displayed price bubbles relative to the intrinsic dividend value. It was found that the bubble tendency was reduced when traders were experience but not eliminated.	The symposium contains six papers reflecting different economist' perspectives on the extent to which asset prices depict fundamental values. If the reason the asset price is high today is solely because investors believe that the selling price will be high tomorrow, no concern for fundamentals, then a bubble exists.	The initial edition analyzes the broader stock market boom from 1982 and onwards and presents 12 factors that are part of creating a bubble as well as suggested policy changes. The theory especially considers investor behavior and the underlying psychological factors driving market prices.	The paper explores changes in the bubble expectations and investor confidence among both institutional and private investors over time. Three investor attitudes are identified; speculative bubble, negative speculative bubble and investor confidence.	The study presents a model in which bubbles initially occur as a result of irrational investors' excessive optimism. However, the model also anticipates the presence of fully rational investors who can identify overrated prices. Asymmetric information is though still an obstacle.	Trading of assets at prices above the fundamental value concludes the existence of a bubble. This has been replicated in several laboratory studies over the recent years. Rational expectations models are found not to predict the bubble and crash phenomena observed in the experimental asset markets.	The general theory of efficient market is replaced by finance from a broader perspective incorporating the social sciences, i.e. psychology and sociology, pointing how time trends tend to impact research until better explanations take over.	The theoretical work builds on Minsky (1986) and further explicit the various phases of a bubble. The model illustrates the anatomy of a bubble. Manias are identified to typically occur in the markets following unexpected good news.	Price bubbles are observed to form when new generations enter the market with extra liquidity and burst as old generations exit the market. The entry and exit create an M-shaped price path over the life of the traded asset. Trading experience seemingly leads to price expectations that incorporate fundamental value.	The study investigates role of social interactions in the creation of price bubbles. Two positive feedback loops spurring price bubbles in the absence of exogenous stimuli are identified. Also, spikes in information search is observed to precede drastic price declines.	The study attempts to link psychological research, empirical evidence, and asset-pricing theory to examine how investor sentiment affects financial market volatility. It was found that fluctuations in investor sentiment have rich implications in economic and financial analyses.	The study conducts a juxtaposition of financial bubbles and the psychological concept of archetypes originating from Carl Jung. It is thus explicated how the understanding of irritational investor behavior can be further informed by psychology.

* The symposium further comprises Flood & Hodrick (1990), Garber (1990), Shiller (1990), Shleifer & Summers (1990), White (1990)

Table 3 – Overview of theoretical contributions

2.4 Key Findings

An analysis of the academic contributions in Table 3 shows that the research within speculative bubbles has considerably evolved over the last four decades. The concept has clearly manifested itself as a distinct research field, which it was not at the time *Stabilizing an Unstable Economy* was published. Thus, the work of Minsky suggests a well-founded idea that markets do fail and fall into crisis as a consequence of extended periods of highly inflated market speculation and unsustainable bullish tendencies *(Minsky 1986)*.

Though certainly defined as an autonomous area of academic work, the literature does not seem to agree on a mutual definition of speculative bubbles and why the phenomenon occurs. However, the basic intuition is to some extent similar, as the definitions of Stiglitz (1990) and Kindleberger & Aliber (2005) demonstrate:

"If the reason that the price is high today is only because investors believe that the selling price will be high tomorrow – when "fundamental" factors do not seem to justify such a price – then a bubble exists." (Stiglitz 1990: 13)

"The bubble involves the purchase of an asset, usually real estate or a security, not because of the rate of return on the investment but in anticipation that the asset or security can be sold to someone else at an even higher price; the term 'the greater fool' has been used to suggest the last buyer was always counting on finding someone else to whom the stock or the condo apartment or the baseball cards could be sold." (Kindleberger & Aliber 2005: 11)

Both describe a situation in which the single cause of price increases is a solid belief that the price will be even higher the next day. Shiller (2015) extends the definition to further incorporate the distinct investor behavior forming speculative bubbles:

"I define a speculative bubble as a situation in which news of price increases spurs investor enthusiasm, which spreads by psychological contagion from person to person, and, in the process, amplifies stories that might justify the price increase and brings in a larger and larger class of investors, who, despite doubts about the real value of the investment, are drawn to it partly through envy of others' successes and partly through a gambler's excitement." (Shiller 2015: 2)

Despite the slight variations and definitive level of detail, all theories in the literature survey encompass that *expectations* play a central role in the formation of a bubble. This seems to stress a future-oriented component that naturally also implies a high degree of uncertainty and risk, though it might not be anticipated so until the bubble eventually bursts. Common to the various definitions is that they place humans in a social context, as there must be a social enactment of these expectations for the prices to continuously build up.

Additionally, the concept is believed to fundamentally relate to an intrinsic value, which must then somehow be determined. Otherwise, it is considered meaningless to discuss justification of price increases. Stiglitz et al. (1990), however, demonstrate the difficulty in addressing fundamental value in relation to the extent the value generally is reflected in prices. This is considered a further complication of the application of the bubble theory in practice.

Smith et al. (1988, 2003 & 2014) have empirically shown the occurrence of speculative bubbles through extensive series of "laboratory" experiments. However, critical voices point to the difficulty of identifying bubbles in the real world, both *ex-ante*, yet also *ex-post*. So far, the research field has not succeeded in presenting a theory that explains exactly when a bubble implodes, only it is found that it eventually does *(Engsted 2010)*. In principle, this market condition can reach infinite heights. Nevertheless, the term is still widely used and remains an active topic of research, which is why it is considered interesting and plausible to attempt a contribution to the field with this thesis. The idea is neither to assess to which extent a speculative bubble is, in fact, identifiable but rather to test the explanatory power of the concept when extended to a certain context. Thus, this approach is considered to imply an underlying assumption that it is possible to identify speculative bubbles.

In terms of methodology, most bubble studies intend to come up with mathematical models interpreting a variety of variables of the existence and persistence of a bubble, e.g. Abreu and Brunnermeier (2003). On the other hand, relatively few seem to incorporate qualitative elements in the methodological approach. Shiller (2000b), however, differs considerably in the sense that the theory of *irrational exuberance*, among others, builds on comprehensive questionnaire surveys targeting the attitudes of ordinary citizens towards different economic matters, e.g. the current valuation of the real estate market, and investors and traders about their motivation for conducting trades in the financial markets.

In terms of developing the bubble theory, especially the contributions of Shiller seem to lead the overall research picture offering a comprehensive theoretical framework for understanding the mechanisms driving speculative bubbles. *Irrational Exuberance* distinguishes itself by approaching bubble formation from a holistic perspective that highlights a broad range of structural and behavioral factors contributing to the formation of bubbles *(Shiller 2000b)*. Based on the wide coverage and general acknowledgment[9], the theory is considered sufficient to build the theoretical framework for this thesis around.

2.5 Concluding Reflections

Having extensively surveyed the academic research on speculative bubbles, the concept appears widely generalizable and thought to be applicable in all sorts of contexts. None of the theories include any mentioning on how the occurrence of the phenomenon is affected by the distinct contextual aspects or the particular characteristics of the investment object at stake. This is considered to only enforce the relevance in testing the explanatory power of the theoretical assumptions in a disruptive context.

While conducting the literature search and screening process, we came across several studies linking the concept of bubble formation and Bitcoin as in the current project[10]. However, it appeared that all those studies aimed to conclude whether bitcoin is a speculative bubble, which is why those were excluded from the review. This suggests a novelty in the research angle evolving around testing and nuancing the bubble concept by investigating how it extends to the context of Bitcoin. The conclusion of this thesis is thus targeting the theoretical concept and not the case in practice, which justifies the deselection of bitcoin bubble studies for the review. This moreover depicts an alternative research approach in our thesis which supports the relevance.

Considering the respective years of publication in the theoretical overview, it appears that the research clusters in the years after the major bubbles (see Table 3). This might indicate that the contemporaneity spurs the interest in resuming the research. The tendency might, in fact, include our own motivation as researchers, as the current discussion of the crypto theme has led us on track of the subject. As noted in the introduction to the thesis, the theoretical link between

[9] Robert Shiller received the Nobel Prize in 2013 for his empirical analysis of asset prices *(Nobel Prize 2018)*
[10] See Section 1.1, Research Gap, for mentioning of specific studies.

bubble formation and disruption has not previously been established which possibly could be due to the circumstance that the inspirational event spurring this research angle has not occurred until bitcoin recently showed bubble resemblances. It also appears a relevant reflection considering how the bubble research generally treats the Dotcom burst, disregarding the influential companies that arose from the investment mania surrounding the tech-based companies in 1990's *(Plesner 2018)*. In that sense, bubbly periods are not solely considered bad as a perceptible capital injection and a sufficient amount of public attention also potentially create momentum for rapid development. This moreover illustrates how the research of the topic is far from exhausted.

Reviewing the literature on speculative bubbles and further considering the criticism of it, we have become conscious of some complications in the testability of the occurrence of bubbles. However, the theory is still widely recognized within the academic field of research, which serves as a justification of its usage, though we are aware that several of its aspects are complicated to test empirically due to an excess complexity of explanatory elements. The outcome of our study is unavoidably also under influence of this factor.

3 Research Design

The research design comprises the scientific method through which the thesis statement is investigated. This includes the scientific view imprinting the study, the research methodology as well as the data collected.

3.1 Philosophy of Science

As researchers, our philosophical standpoint is essential to how we can study the world and thus describe, understand and explain phenomena *(Egholm 2014)*. The scientific perspective is determinant to the methods of data collection and the choices of inputs, but it is important to emphasize that various research methods are applicable across different perspectives and not bound to certain philosophical standpoints.

Based on our problem formulation, we intend to explore a traditional concept in the context of a new phenomenon that potentially requires a cognitive conversion to essentially understand the

phenomenon and its possible future impact. This immediately places us in a pragmatic position, as the overall interest of this thesis is to investigate the particulate and distinct characteristics of the context, which can only be recognized after experiencing and investigating the field (a posteriori). This approach characterizes the view of knowledge within the pragmatism. However, our philosophical standpoint also displays constructivist elements in the sense that it is recognized that the knowledge produced in this thesis is context-dependent and that we, as researchers, are an active part of the context.

The ontological standpoint of pragmatism is neither realistic nor constructionistic as the meaning is assumed to solely be a product of the phenomenon's consequence *(Egholm 2014)*. This fits our approach to exploring the case, as we do not engage in the discussion of the essence of money and institutions in general neither do we propose that the phenomenon necessarily exists outside our recognition of it. Moreover, we interpret the intentions of humans as being both individually and socially determined, though emphasizing the social determination, as this is a prerequisite for irrational speculative bubbles. Common to pragmatism and constructivism is that the purpose of knowledge production is to understand phenomena ideographically, which is central to the epistemology of both perspectives *(Egholm 2014)*. This thesis is considered to be based on a view that knowledge is a human construction that is produced in social interactions, which further favors the epistemology of the constructivist approach. However, the intention is to widen an existing theoretical concept by conducting a thorough exploration of the world surrounding the case phenomenon, which is characterized as an overall pragmatic purpose.

3.1.1 Inference Method

The concept of abduction is central to pragmatism and an essential characteristic of working within this scientific perception *(Egholm 2014)*. The term stems from Charles Sanders Peirce who introduced abduction as a third type of inference besides induction and deduction *(Stanford 2018)*. Abduction somewhat unites induction and deduction as it takes its starting point in facing reality to establish new theories but instead of conducting a single logic inference from a case to general theory, multiple hypotheses are generated based on the researcher's prior experiences and knowledge *(Egholm 2014)*. The hypotheses are afterward tested on the material that generated them. Abduction is sometimes referred to as *qualified guessing* though in Peirce's terms it is the only logical operation among the three types that actually introduce any new ideas *(Stanford 2018)*.

In this thesis, our approach as researchers is characterized as abductive though emphasizing the inductive elements of the abductive process. The purpose is to explore the concept of speculative bubbles in context of a disruptive innovation and thus move from a single case to more general knowledge of the phenomenon which overall appears inductive *(Egholm 2014)*. But as the intention is to explore a complex and emerging case, we rely heavily on our primary data collection to develop our knowledge and approach the importance of our research. Therefore, the exploration of the case is an iterative process where knowledge is accumulated during the process and used to ongoingly generate and test hypotheses with the interview participants. The abductive approach was also necessary to identify a relevant research angle and narrow it down to a thesis statement due to the novelty and emerging nature of the case. It is thus recognized that the research process undeniably is influenced by some subjectivity. However, the intention of the thesis is to contribute by nuancing a traditional concept, which is believed can be obtained in multiple ways if just new ideas are proposed.

Overall, the scientific approach in the thesis is thus characterized as interpretivism as opposed to positivism *(Research Methodology 2018)*. One should thus be aware of the specific characteristics related to the case of Bitcoin that refrains us from generalizing findings in a statistical perspective. Instead, the knowledge generated will concern meanings that are relative to the context and not absolute laws.

3.2 Methodology

The model below displays an overview of the methodology including the research strategy and the selected research methods. The intention is to provide the reader with a visualization of the interconnectedness between the different layers of the methodological approach applied in the thesis. In the following, the elements are presented and discussed separately.

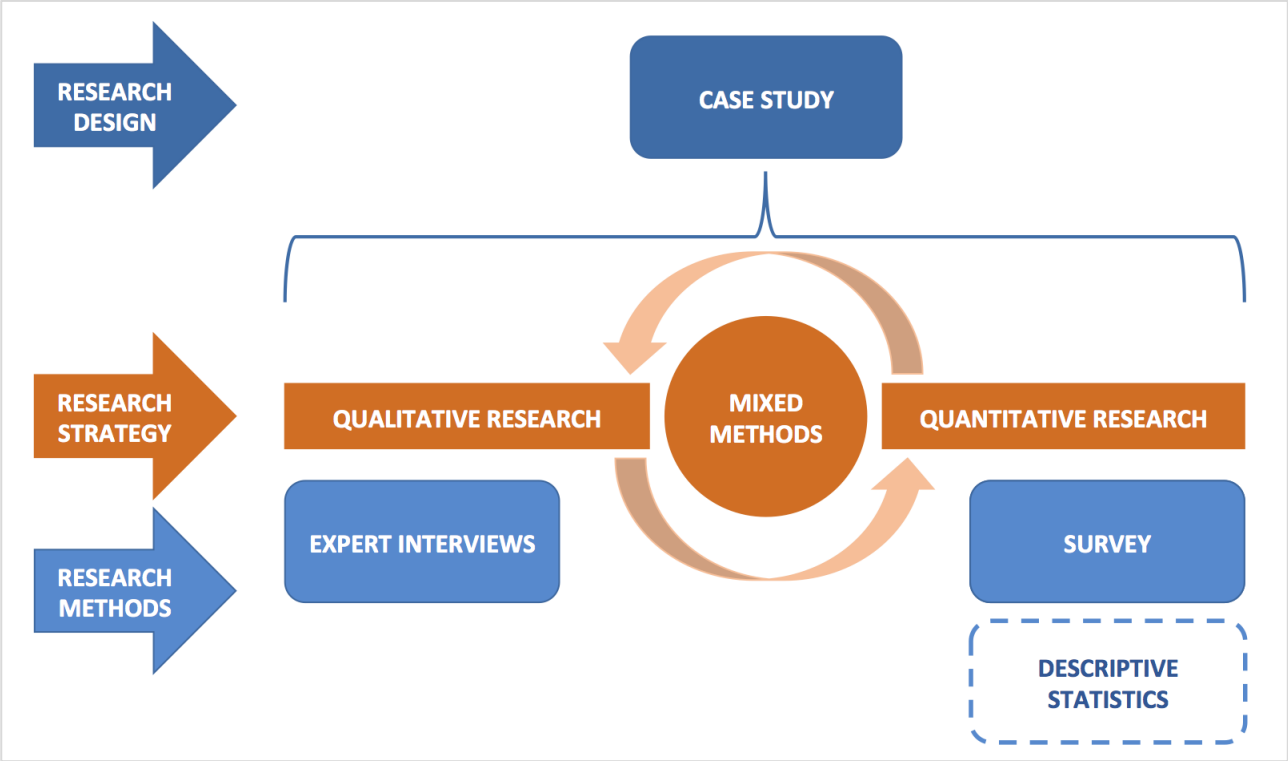

Figure 1 – Methodological overview

3.2.1 Case Study

Due to the novelty of the phenomenon, a case study approach is selected as the overall research design. The advantage of the case study method is that it enables a thorough exploration of a complex phenomenon, which we find quite suitable for our research purpose *(Bryman & Bell 2011)*. The thesis intends to explore the concept of speculative bubbles in the context of a disruptive phenomenon by elucidating the unique features connected to the case of Bitcoin and for that matter a case study approach is ideal. Furthermore, case studies enable an in-depth study, which is considered appropriate when investigating a case that is new to academia, and thus has a sparse research history for researchers to exploit.

In support of the above argued, Yin (1994) has established a simple overview of the characteristics of a given research situation that calls for different research strategies within the field of social sciences. The case study approach is relevant when the research question is in the form of "how" or "why", when the research does not require control over behavioral events and when the research focuses on contemporary events *(Yin 1994)*. These are all characteristics of our project which speaks in favor of selecting the case study as the research strategy.

A case is often associated with a certain geographical location *(Bryman & Bell 2011)*. That definition is naturally not applicable to the case of Bitcoin as the phenomenon exactly represents a breakdown of physical and institutional borders. Instead, the case boundaries are defined as the surrounding cryptocurrency system which constitutes the Bitcoin network *(Hileman & Rauchs 2017)*. A systemic view is thus brought to the definition of the research entity *(Bryman & Bell 2011)*.

The case is primarily seen as an instrumental case in the sense that broader conclusions are intended to be made from studying the case though it is recognized that some of the topics discussed are particularities to the case of Bitcoin *(Bryman & Bell 2011)*. To further distinguish between case types, the classification of Yin (1994) is used. This encompasses five different types of cases denoted as *the critical case, the unique case, the revelatory case, the representative* or *typical case* and *the longitudinal case (Bryman & Bell 2011).* As this thesis attempts to create clarity of a contemporary phenomenon, the case is mainly thought of as a revelatory case, which has its basis *"(…) when an investigator has an opportunity to observe and analyze a phenomenon previously inaccessible to scientific investigation" (Bryman & Bell 2011: 62)*. Though somehow applicable in this context, the condition of studying a phenomenon not previously studied has later been relaxed as it is recognized that the revelatory case, in general, appears when the study has an inductive character.

3.2.2 Mixed Methods Research

A case study is often misinterpreted as being qualitative by nature *(Bryman & Bell 2011)*. However, the case study method might as well solely build on quantitative research or, as in this thesis, a mixed methods framework. Mixed methods research covers the integration of both qualitative and quantitative methods within a single project and is thus also referred to as *multi-strategy research* as it combines the two research strategies *(Bryman & Bell 2011)*. This approach is selected as we intend to explore the case both broadly in terms of describing the market and in-depth in terms of understanding the mechanisms at stake. Using a mixed methods framework enables us to exploit the strengths of both research strategies especially in relation to understand the observed market behavior.

Also, the lack of reliable literature[11] calls for applying different research angles to obtain a holistic understanding of the phenomenon. In this case, a combination of methods is helpful just to reach a sufficient level of knowledge to be able to work with the theme. We thus put equal weight on the qualitative and quantitative aspects of our research and work with the methods parallelly to allow the generated data to inform and inspire the research.

In relation to the above, it is noticeable that not all researchers agree upon the idea of combining qualitative and quantitative research. The main arguments presented against a combined research strategy are that the two strategies carry incompatible epistemological commitments and in fact are separate paradigms which naturally prevent an integration *(Bryman & Bell 2011)*. The idea of scientific paradigms stems from American philosopher and historian Thomas Kuhn who indeed stated that paradigms are incommensurable and therefore could never coexist within one project *(Egholm 2014)*. However, the theory does not necessarily justify a separation of quantitative and qualitative research as different paradigms. Moreover, it is proved rather difficult to sustain the idea that research methods imply fixed epistemological implications *(Bryman & Bell 2011)*.

3.2.3 Qualitative Methods

The general purpose of qualitative research methods is to investigate phenomena as they occur in their distinctive context and thereby gain an increased understanding of the phenomenon itself *(Justesen & Mik-Meyer 2010)*. The emphasis is on the particularities and uniqueness of entities that cannot (or should not) be quantified or experimentally uncovered. The advantage of qualitative research methods is that they enable the discovery of new aspects of the phenomenon as the research process evolves which fits our explorative approach to the case of Bitcoin. On the other hand, it is recognized that qualitative research generally is costly in terms of time, both regarding data collection and processing, which also contribute to the rationale in combining the strategies, as the research period is relatively short. The possibility of investigating a phenomenon in-depth generally tends to decrease the generalizability of a study though this is highly dependent on the research purpose *(Bryman & Bell 2011)*.

[11] Much written information relies on personal attitudes towards Bitcoin such as what is expressed on social media forums, e.g. Twitter and Reddit.

From the qualitative toolbox, we have selected the expert interview, which as a method is specifically designed to explore expert knowledge *(Bogner et al. 2009)*.

3.2.3.1 Expert Interviews

Expert interviews have relatively recently been acknowledged as an autonomous discipline in research practice *(Bogner et al. 2009)*. What ultimately separate expert interviews from other research methods are the distinct methodological considerations linked to the definition of experts and expert knowledge, including how this positions the researcher when interviewing experts.

When well-conducted, expert interviews are especially suited for the explorative phase of a project and an efficient way to gain extensive insights within a topic or an issue in a far less resource-consuming manner than learning the same things through other research methods *(Bogner et al. 2009)*. On the other hand, the method poses great demands on the preparation of the interviewer when entering the interview situation. The interviewer will otherwise be unable to properly address and access the expert's knowledge spectrum.

However, considering the newness and topicality of Bitcoin, the expert interview is an ideal method to approach an understanding of the case. It is also a central consideration that the phenomenon is in constant development, which makes written material outdated relatively fast. Furthermore, interviewing experts involves an interaction that is of great value when studying a highly complex theme.

Bogner & Menz in Bogner et al. (2009) distinguish between three types of expert interviews; *exploratory*, *systematizing* and *theory-generating* expert interviews. When used as an *exploratory* tool, expert interviews help the researcher establish an initial orientation of a field or get a clearer idea of the problem at stake, thus the expert interview functions as a method to structure the investigated topic and help generate hypotheses. On the other hand, the mere purpose of the *systematizing* expert interview is to exploit expert knowledge to fill information gaps in a systematic way. In this sense, the expert is perceived as a source of "objective" knowledge. Essentially, the *theory-generating* expert interviews diverge quite from the other typologies, as the goal is to extend the theoretical foundation of expert knowledge by opening up and analyzing the subjective dimension. In this thesis, expert interviews serve as a combination of the exploratory and the systematizing kind as we, on the one hand, rely on

experts in terms of extracting knowledge of the field, but on the other hand incorporate experts as important means of exploring the phenomenon from various angles and challenge our own perceptions.

A common issue associated with expert interviews is how to define an expert. An obvious pitfall is to confuse the particular information that a human possesses with expert knowledge *(Bogner et al. 2009)*. In broad terms, a distinguishing is made between the "expert", the "well-informed citizen" and the "man on the street". What differentiates the expert from the well-informed citizen is that *"she or he possesses an institutionalized authority to construct reality" (Bogner et al. 2009: 19)*. In practice, this means that an expert is recognized as an expert constituted by a profession or field of action that implies special knowledge and insight to a phenomenon.

In this thesis, the expert interviews are conducted as semi-structured interviews. What defines a semi-structured interview is that it is based on a loose interview guide that primarily states what topics the researcher wishes to cover during the interview as well as some broad questions for each topic *(Justesen & Mik-Meyer 2010)*. Thus, this type of interview leaves room for deviations from the guide that allow the conversation to develop during the interview.

The semi-structured interview is considered ideal for combining the exploratory and systematizing elements of our approach to expert interviews. It is also relevant that the experts were selected based on their different backgrounds and approaches to Bitcoin. In that sense, it was important to proceed with a method that allowed us to explore each expert's specific angle on the subject and adjust our questions during the interview. On the contrary, it still proved beneficial to have some guidance and pre-formulated questions to hold on to as this enables some degree of control over the situation without compromising the conversational flexibility.

For the further data processing, all the interviews were recorded with consent from the interviewees *(Justesen & Mik-Meyer 2010)*. All participants were given the opportunity to act in confidence which was declined by everyone. Moreover, all participants were informed of the purpose of the interview and were made familiar with the outline of the thesis.

3.2.4 Quantitative Methods

Quantitative methods are characterized as generating broad, representative (if well-conducted) data that can be measured, i.e. expressed as numbers *(Andersen et al. 2011)*. Quantitative data

is often descriptive, and the methods are used for the purpose of creating an overview of the scope of a problem. With quantitative research methods, it is possible to gather data from a large sample relatively uncostly, though on the other hand the option of exploring a phenomenon in-depth is sacrificed. This is sought to be made up for by a mixed methods framework that allows us to benefit from the strengths of each of the research strategies. In its pure form, quantitative research represents an objective conception of social reality which is generally associated with the positivistic approach *(Bryman & Bell 2011)*.

The data foundation of this thesis incorporates secondary survey data, which as a method, will be examined in the following section. Additionally, the quantitative data collection comprises descriptive market statistics.

3.2.4.1 Surveys

To investigate the general motives of the observed market behavior and increase the scope of the thesis, a survey is integrated into the research. Though not self-conducted, we were granted the raw data file which enables us to process the data as if we had collected it. Methodological reflections are therefore still considered appropriate.

The main advantage of conducting multiple interviews in the form of a digitally distributed survey is that it is possible to reach a high number of respondents and thereby collect a large data material with relatively few costs *(Olsen 2006)*. Moreover, digital surveys eliminate physical distances which increase the access to respondents and thereby potentially strengthens the representativeness of the research *(Andersen et al. 2011)*. Surveys are considered a strong method for descriptive purposes as they are ideal for creating a structured overview of the attitudes of a certain population.

On the other hand, a disadvantage of digitally distributed surveys is that the interview is self-administered which eliminates the possibility for the researcher to interact with the respondent, further elaborate on answers or ask follow-up questions. Additionally, there is also the opportunity for the respondent to disconnect from the interview process leaving an unfinished reply which is also the case for some respondents in the survey data used for this thesis. It is a naturally embedded part of the concept of surveys that the questionnaire is fixed and identical for all respondents which after all refrain the researcher from adjusting the questions depending on the respondent. This leads to a risk of receiving some irrelevant or forced answers and losing

valuable information that is not captured by the questionnaire. To some degree, that issue can be met by constructing the survey with open elements that provide the respondent with the opportunity to comment on questions and express personal views *(Andersen et al. 2011)*. As such qualitative elements are harder to quantify, it surely depends on the purpose of the survey whether to incorporate such elements or not.

Nevertheless, the methodological advantages of a survey are considered superior to the disadvantages in the present context because of the reach of the method.

As mentioned, the actual construction of the survey has been beyond our influence, though the authors trust the professional ability of the responsible organization, *Økonomisk Ugebrev*, to properly construct a survey. The survey consists of 10 questions (Appendix 8) where only the first question generates demographic knowledge of the sample in terms of the respondent's age *(Andersen et al. 2011)*. As the survey is only distributed to the recipients of a specific news media, demographic data already exists and is thus not necessary to gather through the survey.

The length of the survey is considered to be appropriate in order to maintain the respondent's attention throughout the completion of the questions *(Olsen 2006)*. The questions are of various types, but the majority is designed as multiple-choice questions and scale questions where the optional answers are predefined. This makes most of the answers easily quantifiable but restricts the possibility for the respondents to bring in new perspectives that were not thought of when the questionnaire was constructed *(Andersen et al. 2011)*. Open elements are introduced in Questions 8 and 10 where the respondent has the opportunity to select "Other" and is encouraged to add a comment. Questions 3-7 are recognized as primarily relevant to people who have invested in cryptocurrencies, which is also reflected in the response rate for these particular questions compared to the remaining part. As our field of interest is the investment behavior, this is not considered an issue for our research purpose as these questions exactly capture the respondents who are relevant to our research.

3.2.4.2 Descriptive Statistics

Within the quantitative field, our research also comprises the collection of descriptive market statistics, i.e. factual data on price, number of bitcoins mined, etc. This entails data extracted from online data sources characterized as semi-official *(Andersen et al. 2011)*. In general, one should always be cautious about the reliability of an un-official data source, but due to the

essence of a distributed ledger bitcoin market statistics are easily cross-checked *(Tvede & Hoffmeyer 2018)*.

The descriptive statistics are contributing to an objective characterization of the investment behavior and to contextualize the rest of the data collection. The intention is to generate an overview of the case by incorporating numerical facts *(Andersen et al. 2011)*. Besides describing market characteristics, this type of data collection also contributes as inspiration for the questions discussed in the expert interviews. As it also applies in this thesis, such descriptive data often catalyze the identification of an issue where after other research methods are used for further exploration.

As this part of the research methodology does not entail interaction with respondents or any respondents as such, the methodological considerations are significantly limited. In the following section, the output of the data collection is described and evaluated.

3.3 Data

3.3.1 Primary Data

Primary data is original data that is collected firsthand by the researcher for a specific research purpose or project *(Andersen et al. 2011)*. Primary data sources are most often created using survey research. The data is collected via different survey techniques such as interviews or self-administered questionnaires but other techniques, for example, field observation and experiments, are also used *(Salkind 2010)*.

Further, primary data provide unmediated information that is closest to the object of study. However, that does not guarantee that the sources are always accurate *(Salkind 2010)*. In addition, primary data collection is quite expensive and time-consuming. However, due to the scarcity of reliable information about the case phenomenon, we found it necessary to collect primary data from field experts. By conducting the interviews ourselves, it was made sure that we were in complete control over the data collection process, which minimizes the concern about the data quality. As the data is firsthand and unfiltered, the credibility of our data is increased, and it is thus secured that it is purposeful for investigating the thesis statement *(Salkind 2010)*.

3.3.2 Qualitative Interviews

During the initial phase of the thesis, the interview participants were identified and selected based on their different backgrounds and approaches to Bitcoin. An important parameter for the investigation of the phenomenon was to include experts with specific knowledge and insights to the phenomenon to accomplish a 360-degree understanding of the case. Seven expert interviews have been conducted throughout the research process. An overview of the interviewees is found in the following table.

NAME	ORGANIZATION	TITLE	TYPE OF INTERVIEW	DATE	PRIMARY AREA*
Jacob Skaaning	Baldr Capital	Crypto Trader and Portfolio Manager	Face-to-face	8/2-2018	Trading
Ulrik K. Lykke	Baldr Capital	Blockchain- & Crypto Assets Investment Advisor	Face-to-face	8/2-2018	Investment
Sarid Harper	Pipnotic	CTO	Face-to-face	8/2-2018	Currency trading, technology
Camilla Frost Jensen	Chainalysis	Product Manager	Face-to-face	19/2-2018	Regulation, fraud detecting
Simon Ousager	Chainalysis	Head of Customer Success	Face-to-face	22/2-2018	Fraud detecting, blockchain consultant
Lars Holdgaard	Represented by self	Founder of Dansk Bitcoinforening & Entrepreneur	Skype	28/2-2018	Bitcoin pioneer
Hans Henrik Hoffmeyer	Smart Payments, NETS	Senior Vice President	Face-to-face	1/3-2018	Institutions, payments

** The interviewees' primary knowledge and contribution to the research*

Table 4 - List of interviewees

The first interview was conducted with Jacob Skaaning from Baldr Capital holding the position as professional crypto trader and Portfolio Manager. The interview provided an understanding of the bitcoin market from a professional perspective as well as the behavioral mechanism of the actors in the market. Jacob Skaaning further introduced us to Ulrik K. Lykke, whom we conducted the second interview with. The aim of the interview with Ulrik K. Lykke was to further

elaborate on the investment behavior. He moreover contributed with his own insights on how to act in such a volatile market.

To acquire more specific knowledge on the technology, an interview with Sarid Harper, CTO of Pipnotic, was conducted. Pipnotic is a startup that provides trading software to currency traders. Sarid Harper elaborated on the advantages and pitfalls of the blockchain technology underlying Bitcoin, and he shared the most distinctive differences between fiat currencies [12] and cryptocurrencies. As part of our explorative approach we were introduced to Camilla Frost Jensen, Product Manager at Chainalysis[13]. Camilla Frost Jensen provided us with a general knowledge of the regulatory work and how data from the underlying blockchain is helpful in detecting fraud based on her own professional experience. To further elaborate on our understanding of Bitcoin, we interviewed Simon Ousager, also employed in Chainalysis, on the regulatory aspects and the professional use of data from the underlying blockchain as well as a general perspective on the innovation.

Having obtained specific knowledge on Bitcoin from different viewpoints, we wished to reflect on our knowledge and gain more information on the usefulness and capabilities of Bitcoin. First, an interview with Lars Holdgaard, Bitcoin pioneer, entrepreneur and initial founder of Dansk Bitcoin Forening, was conducted. Lars Holdgaard has also worked academically with Bitcoin as part of his master's thesis and has followed the development of the Bitcoin environment since the early stages. Finally, we interviewed Hans Henrik Hoffmeyer, Senior Vice President in Smart Payments. Hans Henrik Hoffmeyer also participates in the Blockchain and Virtual Currency Working Group supporting the EU Commission. He contributed with profound knowledge about Bitcoin's implications for national and global institutions and their regulation of cryptocurrencies, the political challenges for our monetary system and the future of payment solutions.

[12] Fiat money is non-commodity backed currency declared legal tender by a government.
[13] Chainalysis is a fintech company specialized building compliance software for blockchains.

The figure below illustrates the areas of knowledge covered in the interviews, which are believed to constitute sufficient knowledge of the phenomenon to fulfill the intention of the thesis.

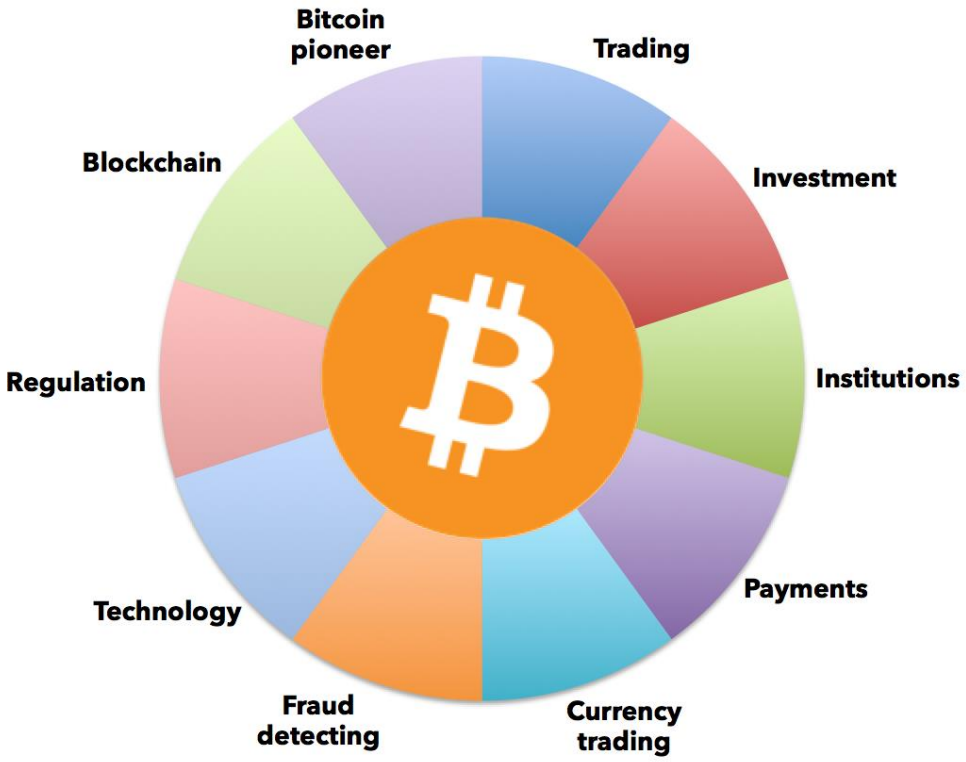

Figure 2 – Knowledge areas covered in the interviews

3.3.2.1 Data Processing

All the interviews have been transcribed and translated into English. The transcriptions are presented in Appendices 1-7. As the research is not concerned with the use of language or with the details of expressions, but in the factual content of what is said, it is academically acceptable to "tidy up" the interviews according to Boyatizis (1998). Irrelevant parts and interjections are therefore left out of the transcriptions. Further, the benefit of transcribing lies in the fact that the transcriptions, and the corresponding data recordings, can be repeatedly analyzed *(Jencks & Ebrary 2011)*. In the current study, the transcriptions are used to assist the analysis and verify the validity of the claims and opinions *(Jencks & Ebrary 2011)*.

To structure the comprehensive material generated from the transcription process, qualitative coding was used as a mean of further processing the data for the analytical purpose. The

intention of coding is to break the data material into smaller, hence easier manageable, parts that can be reunited again in more meaningful entities *(VIA 2018)*. Qualitative coding can be approached both inductively and deductively. We demonstrate a mixed approach as we, on the one hand, use the interview material as a starting point for identifying interesting themes. On the other hand, analytical perspectives were derived from the theoretical framework and used for coding the transcriptions and thus sort the material in terms of the analytical topics. The coding is conducted using different colors to highlight the relevant passages in the interviews.

Market: RED
Actor: GREEN
Asset: BLUE

The colored passages appear in the appendices.

3.3.3 Secondary Data

Compared to primary data, secondary data refers to data that already exists and is thus used for a purpose for which it was not originally intended, and/or by someone other than the researcher who collected the original data *(Salkind 2010)*. Although secondary data is quick and quite inexpensive to gather, it is important to address the challenges inherited by using such data, because of the possibility of misleading and inaccurate results. One of the greatest challenges associated with secondary data is the uncertainty about the data collection process *(Salkind 2010)*. As mentioned above, the data foundation for this thesis incorporates a survey produced by the Danish media *Økonomisk Ugebrev*. However, as we were granted the raw data file, some level of transparency in the data process is still obtained.

Another concern associated with secondary data is the age of the data *(Salkind 2010)*. This is, however, not a concern to this research, as the secondary data used is contemporary. The survey from Økomomisk Ugebrev was conducted in January 2018 and the market data is updated daily.

Finally, it is important to consider the suitability of the secondary data for the current research purpose *(Andersen et al. 2011)*. Considering that the survey provides a broader picture of the opinions towards Bitcoin and the underlying investment motives, the data was found suitable and relevant for our research. Accompanied by the market statistics, the accumulated secondary

data basis contributes to a broad characterization of the market conditions and the underlying investment behavior.

3.3.4 Market Data

3.3.4.1 Quandl

In order to contextualize the various kinds of data collected, it was considered necessary to extract descriptive market statistics from an online data source. To do so, Qaundl.com was chosen as data source, which is an online platform that delivers financial, economic and alternative data to over 250,000 investment professionals worldwide *(Quandl 2018)*. All the datasets from Quandl's database include daily historical data, which can be downloaded in the formats of JSON, CSV or XML. All bitcoin datasets contain data from January 3, 2009. The following datasets were extracted with March 31, 2018, being the last day of the data collection:

1. Total number of bitcoins mined to date
2. USD price of one bitcoin
3. Total market capitalization (USD)
4. Number of unique addresses

1	Date	Total no. of bitcoins	Price USD	Market cap	No. of unique adress
1958	13/05/14	12.764.450,00	438,95	5.602.955.327,500	125.036,0
1959	14/05/14	12.768.200,00	447,49	5.713.641.818,000	131.116,0
1960	15/05/14	12.772.350,00	448,99	5.734.657.426,500	151.809,0
1961	16/05/14	12.776.900,00	449,51	5.743.344.319,000	127.748,0
1962	17/05/14	12.781.475,00	449,08	5.739.904.793,000	115.383,0
1963	18/05/14	12.785.325,00	447,14	5.716.830.220,500	151.855,0
1964	19/05/14	12.789.750,00	446,42	5.709.600.195,000	127.935,0
1965	20/05/14	12.794.225,00	485,01	6.205.327.067,250	153.007,0
1966	21/05/14	12.798.675,00	494,87	6.333.680.297,250	145.579,0
1967	22/05/14	12.802.850,00	523,84	6.706.644.944,000	129.318,0
1968	23/05/14	12.806.800,00	527,47	6.755.202.796,000	155.129,0
1969	24/05/14	12.811.000,00	521,52	6.681.192.720,000	113.362,0
1970	25/05/14	12.814.775,00	575,00	7.368.495.625,000	159.903,0

Table 5 – Example of extracted market data from Quandl

3.3.4.2 Google Trends Data

Google Trends is a public web facility based on Google Search that shows how often a specific search term is entered relative to the total search volume across the world and across different languages *(Google Trends 2018)*. In Figure 3 below, the horizontal axis of the graph generated represents time (2004 the earliest), and the vertical axis shows how often a term is searched for

relative to the total number of searches, globally. The trend score is an exponential value between 0 and 100 *(Google Trends 2018).*

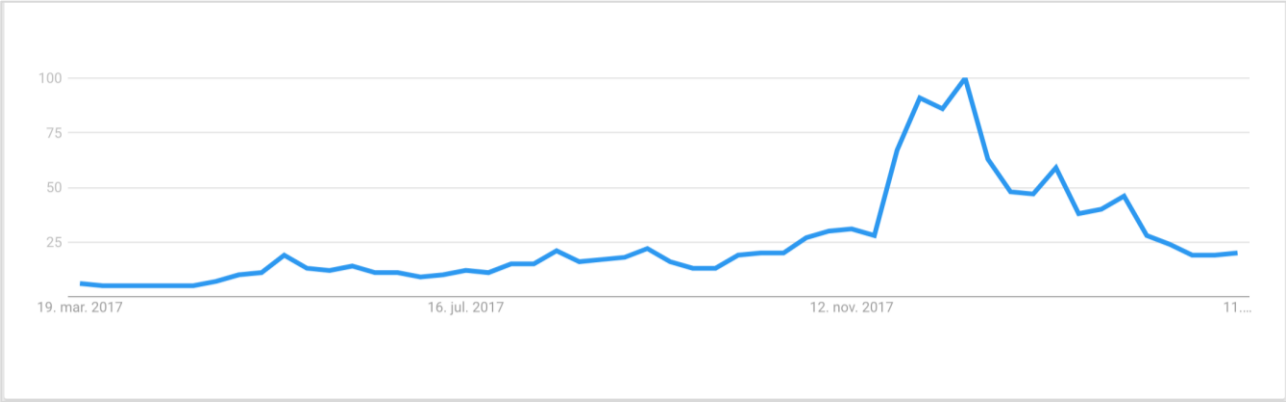

Figure 3 – Example of Google Trends data for bitcoin

The data collected from Google Trends shows the distribution of how many times and where in the world the search term "bitcoin" was entered since 2009. The dataset expresses how popular the term was every week, with 100 being the most popular search term and 0 meaning that there was not enough data for the term to be scored *(Google 2018).*

3.3.4.3 Data Processing

The data from Quandl and Google Trends was downloaded in CSV format. As the data was imported into the Microsoft Excel workbook as text, with commas or semi-colons separating the date and value, an extraction of the data was necessary. The "Text To Columns" function in Excel was applied to each dataset to separate the data. The data from Quandl was compiled in a single Excel workbook to make visualization possible. Since all the data sets from Quandl are collected for the same days, a compilation into one Excel worksheet was possible. For the current purpose, Excel was considered a sufficient data visualization tool to make the quantitative data comprehensible for the researchers as well as the reader.

3.3.5 Survey from Økonomisk Ugebrev

Økonomisk Ugebrev is a universe of several specialized newsletters aimed at the top of the Danish business community and financial sector, as well as private and semi-professional investors *(Økonomisk Ugebrev 2018)*. It is among the most cited business media in Denmark. Økonomisk Ugebrev publishes five different weekly newsletters; *Finans, CFO, Ledelse, Formue*

and Nordic Biotech & Pharma. Økonomisk Ugebrev has 25,000 subscribers of whom 85% are men and 15% women. The average subscriber is between 45 and 65 years old and has a private wealth of over 2,000,000 DKK *(Nichehuset 2018)*.

The questionnaire survey was conducted from January 22, 2018, to February 1, 2018, and distributed to the subscribers via email. The survey was conducted in Danish language. The original purpose of the survey was to *"conduct a questionnaire survey on Danish investors' views on investment in cryptocurrencies"* (E-mail invitation from Økonomisk Ugebrev), which is considered compatible with the purpose of using the survey in our research. The importance of reflecting over the sender of the results lies in the fact that some surveys are sent out to show either a positive or negative result in certain industries *(Andersen et al. 2011)*. As Økonomisk Ugebrev is a media and not a representative of an industry or business, the authors trust that Økonomisk Ugebrev has collected the data in the most objective way possible, which contribute to the overall credibility of the results.

A total number of 818 respondents participated in the survey (Appendix 8). In terms of age, the respondents are distributed as follows:

1. What is your age?

Answer Choices	Responses	
Under 30	8,54%	66
31-40	9,18%	71
41-50	11,77%	91
51-60	19,40%	150
61-70	25,74%	199
Over 70	25,36%	196
	Answered	**773**
	Skipped	**45**

Figure 4 – Age distribution in Økonomisk Ugebrev survey

As observed in the dataset, the majority of the respondents are found in the age group above 51 years. When further analyzing the data set, it was found that the younger group of respondents is more positive towards cryptocurrencies. As the younger segment is underrepresented in the sample, a potential bias in relation to the usefulness of the results of the survey arises. However, the advantage of using the data collected by Økonomisk Ugebrev is

that it has been relatively easy to gain access to a large amount of sample data, which would have been difficult to obtain otherwise. What is thus important to reflect upon is the representativeness of the respondents and the derived consequences for the results.

As mentioned above, the subscribers of Økonomisk Ugebrev belong to a group with specific characteristics. The data sample is therefore assumed not to represent the overall investment behavior within the bitcoin market. However, due to the anonymity component in the Bitcoin network, it is generally difficult to construct a representative sample, as investor demographics are unknown. Thus, although the survey sample is considered not to be representative, it is a quite large sample that after all provides information about opinions and characteristics that otherwise would have been concealed.

Finally, it should be noted that the original intention of the survey was to cover investor attitudes towards cryptocurrencies in general. However, since bitcoin at the time of the survey distribution was the largest of its kind and the fact that bitcoin represents the idea of cryptocurrencies, the authors take the liberty of assuming that the motivation for investing in bitcoin is the same as for investing in cryptocurrencies. That way, it is possible to include an even larger sample in the data basis.

3.3.5.1 Data Processing of Survey Data

The survey data was sent to us via email from Økonomisk Ugebrev immediately after the completion of the survey. The raw data file contained all answers per respondent. As the file contained all the information needed, the function "Pivot Table" in Excel was applied to show the relationship between the different factors, e.g. the age of the respondent and investment attitudes towards cryptocurrencies. As with the data from Quandl and Google Trends, the visualizations of the survey data were created in Excel using pivot tables, bar charts and line charts.

3.4 Validity and Reliability

To address the relevance and accuracy of the research, the authors find it relevant to reflect upon the validity and reliability obtained in the thesis. In practice, it is quite difficult to measure validity and reliability, and if possible, it is usually costly *(Andersen et al. 2011)*. This section is thus a discussion of the scientific and methodological implications for the study overall.

First of all, the scientific standpoint is considered to affect the reliability of the research, as the researchers are an interactive part of the data collection and therefore not entirely objective. However, we seek to partially meet this challenge by not performing or analyzing data alone, as this reduces the risk of individual misinterpretations and misunderstandings *(Andersen 2013)*. Thus, it is recognized that the research unquestionably is influenced by some subjectivity and that this further, due to the data being generated context-dependent, affects the reproduction of the very same research design.

On the other hand, the reliability of the study is addressed through the choice of research design, as several research methods are applied to ensure greater consistency in the data foundation *(Andersen et al. 2011)*. The use of quantitative methods is moreover considered to have a positive influence on the reliability, partly because the descriptive statistics are objective measures and partly due to the nature of the survey, which is easy to redistribute. However, the survey was only distributed to a specific investment profile, which limits the representativeness and thus the validity of the results. Furthermore, the validity might be affected, if the respondents either underpin or overplay their behaviors and attitudes when responding to the survey *(Andersen et al. 2011)*. However, we address this challenge through the expert interviews by continuously interpreting and elaborating on the issues that need further explanation *(Viden til handling 2018)*.

By involving experts with different aptitudes, approaches and knowledge about the case, diversity in the exploration and a comprehensive understanding are obtained. However, an issue arises from the fact that the experts included primarily are positive towards the future opportunities of Bitcoin. This might invoke an overly optimistic view influencing the empirical findings. It is considered to have strengthened the validity of the research if experts from outside the community, i.e. experts with a more critical view on Bitcoin, were included. Moreover, an unavoidable limitation in terms of validity is that the case is still in its early stage of development. This means that the interview data is subjectively biased in relation to expectations for the future, which are not confirmable in a retro perspective.

In relation to the expert interviews, it must also be emphasized that the use of qualitative methods always leads to an uncertainty in the results obtained, as it is difficult to repeat the interviews with a similar possibility of generating the exact same results, even with the same participants *(Andersen et al. 2011)*.

Overall, the authors believe that the research has achieved a relatively high degree of validity, as there is a strong agreement between the empirical and theoretical framework in the thesis. However, as the data sample collected does not fully account for the globality of the phenomenon, the research does not simply convey to generalizable conclusions. This is, nevertheless, often a natural consequence and implication of exploratory research studies. The thesis is, thus, contributing to validate the conceptual plan and theoretical discussion.

4 Theoretical Framework

Based on the review of the literature on speculative bubbles in combination with the results of the data collection, this chapter comprises the theoretical framework selected for the investigation of the bubble concept's explanatory power in the case of Bitcoin. The framework consists of a central bubble theory, which is used for analyzing the problem at hand and two supporting theoretical contributions intended to unfold certain aspects of the main theory. The choice of theory is based on relevance to the case and the perceived explanatory power. First, the following section intends to place the overall theoretical approach of the thesis within the broader theoretical context of economic thinking. Second, the selected theories are presented.

4.1 Behavioral Economics

The concept of speculative bubbles stems from the field of behavioral economics, which is defined as *"a method of economic analysis that applies psychological insights into human behavior to explain economic decision-making" (Oxford Dictionary 2018)*. Behavioral economics is thus a distinct school within economic thinking that differentiates by incorporating insights from human psychology to inform the economic models and theories.

4.1.1 The Theoretical Landscape of Economics

In a rough overview, economists can be divided into three approaches to economy, each with its own basic assumptions on the nature of decision-making; Mainline (Classical) Economics, Neoclassical Economics and Behavioral Economics *(Boettke & Candela 2015)*[14]. Mainline Economics originates from the philosophic tradition of Adam Smith and comprises the core

[14] In reality, the lines are blurred but this rough categorization brings an understanding of the main differences

tenets of economic thinking *(Mitchell & Boettke 2017)*. Neoclassical Economics and Behavioral Economics are both categorized as Mainstream Economics but represent two fundamentally different theoretical approaches. Behavioral Economics is often seen as a critique of the neoclassical line as it builds on insights from psychology, which the neoclassical economists effectively seek to shut out to maintain the borders between the social sciences *(Camerer 1999)*. The intent of Mainstream Economics is to quantify decision-making using statistics and mathematical models to validate theories *(Investopedia 2018i)*.

A brief overview of the theoretical positions based on the perception of humans, assumptions of decision-making and the societal view is constructed below *(Boettke & Candela 2015; Knudsen 2011)*:

SCHOOL OF THOUGHT	MAINLINE ECONOMICS	NEOCLASSICAL ECONOMICS	BEHAVIORAL ECONOMICS
View of human nature	The humankind is driven by self-interest but is also perceived basically moral as it builds institutions to create welfare and secure social order.	The idea of *homo economicus* belongs to this school of thought, thus humans are perceived as perfectly rational with unlimited access to information and unlimited cognitive capabilities.	Humans are irrational and have limited cognition. Access to information is limited.
Assumptions of decision-making	Decision-making is characterized as natural within the boundaries of institutions. The process is neither deliberate nor logical. Instead, it builds on emotions that are learned, e.g. "right" or "wrong".	Humans logically calculate the consequences of every alternative choice in order to optimize the outcome of a decision, i.e. the principle of utility maximization. Preferences are transitive and consistent over time.	Humans logically calculate the consequences of alternative choices in order to optimize the outcome but are not good at it due to mental biases and heuristics. Humans are generally perceived as bad decision-makers.
Societal view	Usually proponents of free markets and laissez-faire, i.e. a liberal view with no institutional interventions.	Predominantly liberal, though originally Keynesian.	Pro comprehensive governmental/ institutional intervention.

Table 6 – Overview of economic lines

Besides the different schools of thought, economic studies can be classified as either microeconomics or macroeconomics *(Investopedia 2018f)*. Microeconomics is concerned with the decision-making of individual users and producers, e.g. how the functions of supply and demand affect price in a single economy. Macroeconomics, on the other hand, focuses on the overall economy at a societal level.

4.1.2 The Diffusion of Behavioral Economics

The behavioral line of thought was initially introduced in the first half of the 20th century by British economist John Maynard Keynes *(Knudsen 2011)*, who used the term *animal spirits* to describe how human emotions irrationally drive consumer confidence in markets subject to high levels of uncertainty *(Investopedia 2018a)*.

An essential contribution to the field came from Herbert Simon in the 1940s where he challenged the concept of the perfectly rational *homo economicus* by proposing his theory of bounded rationality *(Behavioraleconomics.com 2018a)*. The theory of bounded rationality implies that the human rationality is limited or "bounded" because our cognitive capacity is limited in terms of thinking, information processing and memory *(Knudsen 2011)*. Instead of *maximizing*, as proposed by neoclassical models, humans tend to *satisfice*, i.e. choose the first option that meets some basic criteria. Unfortunately, at that time, the ruling paradigm within economic thinking was not in favor of theories like bounded rationality. It was not until several decades later that psychology really found a foothold in informing the mainstream economic thinking *(Camerer 1999)*.

That radical change came in the shape of cognitive psychologists Amos Tversky and Daniel Kahneman *(Knudsen 2011)*. In 1979, their work on the *Prospect Theory*, falsifying the principle of maximization in decision-making, was published in the highly esteemed economic journal, *Econometrica*, which finally constituted the point of no return for the recognition of human psychology underlying economic behavior. The prospect theory explains how people tend to value gains and losses differently and thus have inconsistent risk profiles and preferences depending on how decision scenarios are framed as either gains or losses *(Kahneman & Tversky 1979)*. Moreover, Kahneman and Tversky are authors of the heuristics and biases program that states how humans, given our limited cognition, use "rules of thumb" (heuristics) to make decisions and the inherited flaws (biases) that are associated with these *(Knudsen 2011)*. Kahneman and Tversky did not solely defy the standard model of rationality. They constructed a theoretical framework of two parallel cognitive systems that allowed *homo economicus* to coexist with the irrational economic agent as a reflective system against an intuitive one. This theoretical integration might, in fact, have been the crux of the breakthrough for psychology in economics *(Knudsen 2011)*.

4.1.3 Behavioral Replacements for Principles of the Standard Rationality Model

Just as Kahneman & Tversky's prospect theory stands as the behavioral "correction" of the principle of expected utility, Camerer (1999) has further identified three parsimonious behavioral replacements for rational model principles; equilibrium replaced by learning/evolution, discounted utility replaced by hyperbolic discounting and individual payoff maximization replaced by social utility. The foundations of behavioral economics can thus be described as offering mathematical alternatives with solid psychological foundations to make a theoretical movement from how humans should behave to how they do behave. It is thereby sought to improve the underlying assumptions of economic theory and the theoretical ability to predict economic behavior *(Camerer 1999)*.

Besides the mathematically modeled counterparts to the rationality model, behavioral economics encompasses the ongoing identification of a wide range of mental biases resulting from how we think and feel. Common to these are that they all share the underlying assumptions that humans are social, irrational, inconsistent over time and with a limited willpower *(Samson et al. 2014)*.

Following an elucidation of the theoretical origin, the forthcoming sections present the specific theories applied to the analytical purpose of the thesis. The theoretical framework includes the work of Shiller (2015), Shiller & Akerlof (2009) and Kahneman & Tversky (1974).

4.2 Robert Shiller: Irrational Exuberance (2015)

American economist Robert Shiller stands as one of the most prominent and influential contributors to the academic and practical field of bubble research, currently associated with Yale University and Yale School of Management *(Yale Department of Economics 2018)*. His written work covers widely within the fields of financial markets, financial innovation, behavioral economics, macroeconomics, real estate and statistical methods as well as public attitudes, opinions and moral judgments regarding markets. Shiller started challenging the efficient market hypothesis and the rationality paradigm in the early 1980's where the neoclassical view was still dominant *(Knudsen 2011)*. As with many neoclassical economists, Shiller is inspired by

the ideas of Keynes whom he naturally recognizes as behavioral economist[15]. In 2013, Shiller received the Nobel Prize in Economic Sciences for his work on asset pricing, paradoxically alongside Eugene Fama who is further mentioned in relation to the critical reflections later in this section *(Yale Department of Economics 2018)*.

Shiller's work on speculative bubbles is considered highly relevant to apply in this thesis as he emphasizes the interaction between psychology and economics and thus rejects the standard rationality model, which corresponds with our research approach. His book *Irrational Exuberance (2015)* provides a comprehensive theory on the aspects of speculative bubbles that is suitable as the theoretical foundation for testing how the concept extends to the context of a disruptive phenomenon.

4.2.1 Theory of Irrational Exuberance

The term *irrational exuberance* is generally said to originate from former Chairman of the Federal Reserve, Alan Greenspan's speech on "The Challenge of Central Banking in a Democratic Society" held in December 1996 *(The Federal Reserve Board 2018)*. Irrational exuberance refers to rapidly increasing investor enthusiasm or mania that drives the price of an asset up to a level that no longer can be justified by the asset's fundamental value *(Investopedia 2018h)*. The problem, as Greenspan continues his speech, is how we can know *"(…) when irrational exuberance has unduly escalated asset values, which then become subject to unexpected and prolonged contractions as they have in Japan over the past decade*[16]*? And how do we factor the assessment into monetary policy?" (The Federal Reserve Board 2018)*.

Ultimately, irrational exuberance causes the rise of an asset bubble, which, as mentioned in the literature review (Chapter 2), can be difficult to predict both in terms of scope and consequences, all further problematizing the development of monetary policy addressing irrational exuberance. Shiller takes up this problem initially analyzing the stock market boom from the early 1980's resulting in the publishing of the first edition of *Irrational Exuberance* in 2000. This initial edition covers the identification of 12 factors that created the stock market boom as well as suggested policy changes for better management of these *(Investopedia*

[15] Keynesian economists comprise both neoclassical as well as behavioral economists who continuously disagree on the nature of his work *(Boettke & Candela 2015)*.
[16] Reference to the speculative boom in the Japanese economy in the late 1980's, which ultimately led to a crash of the stock market and real estate market and that caused a severe economic recession.

2018h). Since then, two more versions have been released; the second edition in 2005 and the latest (third edition) in 2015, which will be the version used for the present analytical purpose *(Shiller 2015)*.

In a broad view, Shiller seeks to explain the emergence of speculative bubbles and how this market condition sustains itself relying on psychological factors as the underpinning mechanisms of the less rational aspects of financial markets *(Shiller 2015)*. *Irrational Exuberance (2015)* is an explication of the concept of speculative bubbles with special reference to the stock market, the real estate market and the bond market *(Yale Department of Economics 2018)*. Though depth-analyzing these three major markets, the theory is intended to generally cover bubble formation in any financial market and thus provide a better understanding of the forces that shape markets *(Shiller 2000a)*.

The previous editions of *Irrational Exuberance* are famous for identifying respectively the Dotcom bubble in the 1990's (first edition) and the US housing bubble at the beginning of the 2000's (second edition) and furthermore forecasting the subsequent market crashes as consequences of these unsustainably overpriced and vulnerable conditions. The analysis of the US bond market is a new addition to the third edition as a response to, at the time of publishing, an increasing concern about a possible bond market bubble *(Shiller 2015)*. Though pointing out some bubble-like characteristics, the bond market is concluded to be driven more by fear and general anxiety about the future, which is not categorized as traditional drivers for a speculative bubble *(Rotblut 2015)*.

4.2.2 Definition of Speculative Bubbles

In line with the choice of theoretical framework, this thesis naturally takes on Shiller's definition of speculative bubbles as a starting point for the analysis of the concept in the context of disruptive innovation.

In Shiller's definition, irrational exuberance is the psychological basis of any speculative bubble *(Shiller 2015)*. That further highlights the use of human psychology as a mean of understanding and explain economic phenomena. Shiller explicitly defines a speculative bubble as follows:

"I define a speculative bubble as ***a situation in which news of price increases spurs investor enthusiasm, which spreads by psychological contagion from person to person, and, in the process, amplifies stories that might justify the price increase and brings in a larger and larger class of investors, who, despite doubts about the real value of the investment, are drawn to it partly through envy of others' successes and partly through a gambler's excitement."*** *(Shiller 2015: 2)*

This definition of the concept draws associations to a sort of psychological epidemic, spreading among investors, that solely stems from news of price increases. Moreover, the definition clearly implies that bubbles are sparked by news or stories with strong enough narratives to create collective investor thinking, no mentioning of the actual validity of the story.

4.2.3 Central Concepts

Shiller poses several subjects central to speculative bubbles around which he organizes the theoretical exposition *(Shiller 2015)*. The introductory part of the book, which covers empirical findings in the stock market, the bond market and the real estate market, has a historical orientation of the ups and downs within the three major investment markets. These chapters provide the reader with the basis for understanding the market fluctuations, especially the remarkable ones, experienced over the years and thus obtain an overall perspective on market trends. Then, the main part of the book identifies and discusses respectively the structural factors, the cultural factors and the psychological factors that drive speculative bubbles. However, for this analytical purpose, the structural and cultural factors are perceived more as external factors that constitute favorable terms for speculative bubbles to develop and less as core elements of the concept. A greater emphasis is thus put on the psychological factors at stake as it is recognized that the central actors in a bubbly economy (and any other economy) are humans.

The final chapters of *Irrational Exuberance* seek to place the theory in a broader context by, on the one hand, addressing some of the influential arguments against the eligibility of the theory and, on the other hand, discuss the implications for policies on various levels. Though perceived very interesting discussions, this is immediately considered outside the analytical scope of this study.

4.2.4 Assumptions

With reference to the definition of the concept of speculative bubbles, as stated above, it is a noteworthy underlying assumption for the application of Shiller's theoretical work that bubbles are social phenomena with no central impresarios *(Shiller 2015)*. This expresses a distancing to Oxford English Dictionary's definition of a bubble as *"anything fragile, unsubstantial, empty, or worthless; a deceptive show. From 17th c. onwards often applied to delusive commercial or financial schemes"* which by involving words as "show" or "scheme" is perceived to suggest a deliberate central point of origin *(Shiller 2015)*.

Essentially being social-psychological make speculative bubbles even more difficult to control, let alone also difficult for the smart money[17] to speculate against, as the rising collective mindset unconsciously seeks justification for the price increases which almost rationalizes participation in the bubble *(Shiller 2015)*. Thereby not said that investors under bubbly market conditions do not believe that prices can never recede. The tendency is rather a social ignorance of the fact that it could happen in the near future. This exactly demonstrates how investor irrationality on all levels is a central assumption to the theory.

4.2.5 Critical Reflections

As mentioned in the introduction to Shiller, Eugene Fama and, for that matter, Lars Peter Hansen were co-recipients of the Nobel Prize when it was granted Shiller in 2013 *(Yale Department of Economics 2018)*. This is interesting as Fama's academic work denies the existence of such phenomena as bubbles. Instead, he stands as a firm advocate for the efficient markets model *(Fama 1970)*. Thus, no such thing as irrational psychological epidemics spurring price increases unjustified by fundamentals can exist. The problem, as Fama states it in his 2013 Nobel Prize lecture, is the absence of evidence that stock market price declines, in fact, are predictable *(Fama 2013)*. Without such evidence, regulatory policies for managing "bubble economies" are perceived to be nonsense. This counterpart to Shiller's work clearly demonstrates how the different lines within economic thinking act in practice. Obviously, Fama belongs to the neoclassical school where other assumptions apply than within behavioral

[17] Within financial markets the term "smart money" is used to describe the capital controlled by professional investors who are perceived to have a better understanding of market mechanisms and/or access to information that is inaccessible to other investors *(Investopedia 2018j)*.

economics (see Table 6). The different theoretical positions thus define how phenomena are recognized which implies important reflections for researchers.

Regarding the application of Shiller's bubble framework in this thesis, it is appropriate to note that Shiller is among those who have publicly expressed that bitcoin is the best contemporary example of a bubble; in Shiller's view, primarily due to the motivational strength in the narrative of Bitcoin *(Detrixhe 2017)*. Nevertheless, we intend to present other arguments to nuance this statement.

4.2.6 Analytical Tools

From the theory of irrational exuberance and the corresponding definition of speculative bubbles, three analytical perspectives are derived which are found operational for examining the case with the aim of testing the applicability of the theoretical assumptions. Thus, these perspectives structure the first part of the analysis. The three perspectives involve the market, the actors and the asset. The table below illustrates what part of the bubble definition the analytical perspectives respectively refer to.

PERSPECTIVE	RERENCE TO DEFINITION
Market	*"a situation in which news of price increases spurs investor enthusiasm"*
Actor	*"(…) which spreads by psychological contagion from person to person, and, in the process, amplifies stories that might justify the price increase and brings in a larger and larger class of investors, who, (…) are drawn to it partly through envy of others' successes and partly through a gambler's excitement."*
Asset	*"(…) despite doubts about the real value of the investment"*

Table 7 – Analytical perspectives with reference to the bubble definition

The market perspective covers the price development of an asset or an asset class over time. To assess the stock market, Shiller has developed *the cyclically adjusted price-earnings ratio*, commonly known as the CAPE ratio, which is a metric used to evaluate the current valuation of a market *(Lyn Alden 2018)*. Within the real-estate market, the S&P/Case-Shiller home-price index is likewise a mean to monitor price developments *(Investopedia 2018k)*. Similarly, we intend to conduct an analysis of the bitcoin price development with parallels drawn to Shiller's findings.

The actor perspective examines the investor behavior and the motives for participating in a given market, which are defining elements for the occurrence of speculative bubbles. The behavioral characteristics are considered essential to Shiller's definition of bubbles, which stresses the eligibility of applying this analytical angle.

The asset perspective revolves around defining the real value of an investment, which is considered a basic component for the assessment of whether price increases are products of irrational investor behavior. This perspective requires an analysis of the fundamental value of bitcoin, let alone a classification of bitcoin as an investment object.

In unity, these perspectives are believed to capture an adequate analysis of how the concept of speculative bubbles occurs in the context of disruptive technology. Other relevant theoretical contributions will be drawn upon as supplements to further elaborate the three perspectives.

4.3 Akerlof & Shiller: Animal Spirits (2009)

American economist George Akerlof is currently an associated professor at the University of California, Berkeley with primary research fields of macroeconomics, monetary theory and behavioral economics *(Berkeley Department of Economics 2018)*. Akerlof is a 2001 Nobel Laureate, honored for his work on asymmetric information and its effect on economic behavior *(Nobel Prize 2018)*. He was granted the prize for his paper "*The Market for "Lemons": Quality Uncertainty and the Market Mechanism"* in which he relates quality and uncertainty in markets characterized by asymmetric information using the market for automobiles as an example *(Akerlof 1970)*. The theory states that in markets where sellers have more information about product quality than buyers, products of low quality tend to dominate the market as prices of high-quality products suffer from the problem of asymmetric information. Consequently, high-quality products are withdrawn from the market *(Nobel Prize 2018)*.

Akerlof is as well as Shiller inspired by Keynes which is explicitly expressed by the choice of title for their joint work *Animal Spirits – How Human Psychology Drives the Economy, and Why It Matters for Global Capitalism (2009)*.

4.3.1 Theory of Animal Spirits

As mentioned in the introduction to the theoretical line of behavioral economics, the term *animal spirits* was originally used to describe the idea that in markets with a high level of uncertainty, humans tend to experience confidence anyway, though based on emotions, which is not rational *(Knudsen 2011)*. In more modern economic theory and practice, the term describes the psychological factors that drive investors' decisions when faced with highly volatile capital markets *(Investopedia 2018a)*. Animal spirits represent confidence and optimism, on the one hand, but also anxiety, fear and pessimism, on the other, which thus either spur or inhibit economic growth. The spirits are not necessarily corresponding with market fundamentals but nevertheless, they demonstrate strong effects on price developments.

With *Animal Spirits (2009)*, Akerlof and Shiller provide a behavioral explanation of how an economy works based on Keynes' belief that much economic activity is governed by emotions and that humans also have noneconomic motives that influence their economic decisions. The theory most importantly accounts for how an economy works when the participants (humans) are driven by human instincts and cognitively function as humans. Moreover, the theory explains how ignoring the human aspects in the functioning of an economy has led to, at the time of publishing, the state of the world economy in the wake of the breakdown of the credit markets *(Akerlof & Shiller 2009)*.

The theory of the animal spirits is viewed as a natural complement to our choice of proceeding with the bubble framework of Shiller. Though demonstrating some theoretical overlaps, *Animal Spirits* is perceived to enrichen our theoretical framework by contributing with concepts to help understand what drives the bitcoin market.

4.3.2 Central Concepts

The first part of the book examines different aspects of animal spirits and their influence on economic decisions. The theoretical concepts covered are *confidence*, *fairness*, *corruption and antisocial behavior*, *money illusion* and *stories (Akerlof & Shiller 2009)*.

- The concept of *confidence* is denoted as the cornerstone of the entire theory with special emphasis on the feedback mechanisms between confidence and the economy. The state of confidence has implications for both practice and policy as lack of

confidence has the potential to undermine economic policies that otherwise could have been effective *(The Economist 2018)*.

- Other economic lines tend to ignore *fairness* as an important driver for economic decision-making. In practice, the concept plays a significant role in the sense that fairness functions as an anchor that guides our willingness to pay *(Akerlof & Shiller 2009)*. Furthermore, humans tend to cast away their self-interest just to punish others perceived as unfair which in theory is irrational. The sense of fairness also stresses that human mindsets are social.
- *Corrupt and antisocial behavior* should not be left out of the theoretical field as crises exactly ensue when confidence is undermined by enough examples of moral hazard *(The Economist 2009)*.
- The concept of *money illusion* is, along with confidence, a theoretical cornerstone. It covers the general, public confusion with the effects of inflation and deflation *(Akerlof & Shiller 2009)*. An extreme, yet real, example is a tendency for workers to resist pay cuts when prices decrease even if their employment is at stake *(The Economist 2018)*. After all, that is not considered very rational.
- Also, in this theory, *stories* are highlighted as fueling economic decisions *(Akerlof & Shiller 2009)*. As mentioned in the section on *Irrational Exuberance (2015)*, strong narratives are in themselves enough to spark the formation of a speculative bubble.

With the five animal spirits established, the second part of the book contextualizes the identified concepts analyzing and answering eight macroeconomic questions. Similarly, we intend to apply these core concepts to help explain how the bitcoin market unfolds as a bubble.

4.3.3 Assumptions and Analytical Tools

As part of the behavioral tradition, the theory naturally builds on a central assumption that economic decision-makers tend to be both intuitive, emotional and irrational. Mere "gut feelings" often drive decisions which stresses the importance of understanding the mechanisms that influence the economy if not products of rational calculations.

Inspired by the ideas of Keynes, governmental interference is positively looked upon by Akerlof and Shiller who consider it necessary to prevent severe crises given the irrationalities argued to impact economic decisions. The proper role of the government is thus perceived to be as setting the stage and thereby provide the foundation for the economy to grow in a healthy way

(Akerlof & Shiller 2009). To explain this point of view, an analogy is made to parenting; limits should be set so a child does not overindulge its animal spirits but on the other hand, it should still experience independence to learn and to explore its creativity. Thus, the role of the government is to secure a total freedom of movement for creativity though at the same time restricts the excesses that occur because of the animal spirits. Though considered outside the scope of this thesis, the attitude towards governmental interference with market forces is a central aspect of the theory that should be at least kept in mind when using it for analytical purposes.

In relation to the three analytical perspectives derived from Shiller (2015) – market, actor and asset – the theory of animal spirits is mainly considered relevant for the actor perspective where it is applicable to elaborate the analysis of the investor behavior characterizing the bitcoin market. However, this is also closely connected to the market perspective, as the theoretical core is to understand and elucidate what drives market fluctuations.

4.4 Kahneman & Tversky: Biases and Heuristics (1974)

As we live in a busy and complex world, humans do not have time to compare alternatives and to analyze the consequences they result in before making an actual decision *(Knudsen 2011)*. Therefore, decisions are based on a set of simple rules. These rules are theoretically known as heuristics. The disadvantage of using these rules of thumb is that they sometimes lead to systematic, cognitive biases. The US-Israeli psychologists Daniel Kahneman and Amos Tversky first pointed this out in 1974. Kahneman and Tversky's research on heuristics and biases has fundamentally changed the way in which psychologists and economists describe human decision-making *(Knudsen 2011)*. In 2002, Kahneman was awarded the Nobel Prize in Economic Sciences[18], which cements the relevance of the theory and the ideas in modern society.

4.4.1 Assumptions and Central Concepts

The theory is based on the underlying *Dual Process Theory*, which intends to explain how our brain works during decision-making and especially what part of the brain that is active in relation to distinct types of decisions *(Evans & Frankish 2009)*. According to the dual process theory, humans use at least two systems that interact with each other *(Knudsen 2011)*. The first

[18] Amos Tversky passed away in 1996.

system is denoted *System 1* and is characterized by being intuitive, automatic and parallel. On the contrary, the second system, *System 2*, is analytical, controlled and serial *(Evans & Frankish 2009).* The theory assumes scarcity in decision makers' cognitive resources, which aligns with the behavioral economic assumption that humans are not rational and therefore do not obey to the neoclassical utility theory *(Kahneman & Tversky 1974).*

As the overall fundamental starting point for our theoretical analysis is behavioral economics, the theory fits well into the theoretical framework. In addition, the theory provides an in-depth understanding of some of Shiller's conceptual elements as well as how people tend to assess new phenomena.

4.4.2 Analytical Tools

In the original theory, Kahneman & Tversky (1974) define a limited number of heuristic principles that people rely on, which reduces the complex tasks of assessing probabilities and predicting values to simpler judgmental operations. Kahneman & Tversky (1974) define three heuristics:

Representativeness Heuristic: A heuristic we use when we need to find the answers to questions of the type "What is the probability that object A belongs to class B?" or "What is the probability that event A originates from process B?". Probabilities are evaluated by the degree, to which A is representative of B, that is, by the degree in which A resembles B.

Availability Heuristic: We assess the risk that a given event occurs based on how easy or difficult it is to induce in our memory.

Anchoring and Adjustment Heuristic: This heuristic assumes that one first selects an output estimate, a so-called anchor or reference point, and try to revise this estimate based on what further information is considered relevant.

Kahneman & Tversky turned their research into a field of study, and subsequent work has later identified many more heuristics and biases which complement the original work *(Knudsen 2011)*. However, this study only includes the three above-mentioned heuristics as they embrace the theoretical framework and are considered sufficiently explanatory in terms of Shiller's concepts as well as for the scope of the study.

5 Case Description

Prior to the analysis and the application of the theories deliberated in the previous chapter, this chapter presents a conceptual outlay of Bitcoin. As the phenomenon and associated technological landscape constantly evolve, it is important to bear in mind that a unanimous definition of Bitcoin is not yet determined, why this conceptual depiction may change in the future. The aim of this section is not to provide an in-depth technical description of how Bitcoin and blockchain work, but instead to outline the overall landscape and explain the key concepts regarding the phenomenon.

5.1 Bitcoin

Bitcoin was first introduced in the white paper from 2008 *"Bitcoin: A Peer-to-Peer Electronic Cash System"* by an anonymous person or group that goes by the pseudonym Satoshi Nakamoto *(Nakamoto 2008)*.

Nakamoto (2008) stated that financial institutions were almost exclusively serving as trusted third parties with regard to electronic payment processing. As an alternative, Nakamoto proposed Bitcoin; "*a purely peer-to-peer version of electronic cash that allows online payment to be sent directly from one party to another without the need of a financial institution" (Nakamoto 2008)*. The system is based on mathematical and cryptographic proof, as a replacement of trust, obsoleting the need for a trusted third party. Transactions are hereby practically irreversible *(Bjerg 2016)*. Bitcoin is decentralized meaning that no single institution or state controls or owns the network. Today, central banks can, in principle, issue an unlimited supply of fiat currencies, but an underlying algorithm in Bitcoin controls the supply of bitcoins, which is mathematically determined to be 21 million in the year of 2140 *(Coindesk 2018c)*.

In practice, Bitcoin is separated into two components; the network and the token. The network comprises the protocol while the token is a piece of code, popularly understood as "the coin itself" *(Coindesk 2018c)*. A linguistic distinction is made by referring to the network as *Bitcoin* and the token as *bitcoin*. The abbreviation of bitcoin is BTC.

At the time of finishing the data collection for the thesis, the scope of the Bitcoin network was as shown below in Table 8. However, to put Bitcoin in perspective, it is still a relatively small economy, equal to less than 1% of the global money supply *(Tvede & Hoffmeyer 2018)*. The

bitcoin market is, in fact, minuscule compared with other socio-economies *(The Money Project 2017)*.

BITCOIN FACTS (31.03.2018)	
Number of bitcoins	16,948,887.50
Number of unique addresses	449,629
Market cap USD	$116,651,254,934.00
Market price USD	$6,882.53
Total number of bitcoins in the year 2140	21,000,000 BTC

Table 8 – Bitcoin facts

The smallest unit of a bitcoin is called a *satoshi*. It is a one hundred millionth of a bitcoin (0.00000001), which enables micro-transactions that traditional electronic money is currently not capable of handling *(Coindesk 2018c)*. Each bitcoin in the network consists of a unique chain of digital signatures and is stored in a digital wallet installed on the user's computer, smartphone or external hard drive. The wallet generates keys used for sending and receiving coins *(Bjerg 2016)*. The ownership of a bitcoin is ensured by possession of its code consisting of 26-35 characters. However, if the code is lost, so is the coin *(Tvede & Hoffmeyer 2018)*.

A bitcoin transfer is recorded with a time stamp by the network and bundled together with other transactions to form a block. These time-stamped blocks form a database structure of a chain, also known as a blockchain *(Mougayar 2016)*.

5.2 Blockchain Technology

The blockchain technology underlying bitcoin is used as the network's public transaction ledger. At the most basic, a blockchain is a continuously growing database with a list of records that are linked and secured using cryptography *(Blockchain.info 2018).* Each block contains a cryptographic hash[19] of the previous block, a time-stamp and the transaction data, which means

[19] A hash is a unique fingerprint that helps to verify that a certain piece of information has not been altered, without the need to actually see it *(Mougayar 2016)*.

that the blockchain, by the basic design, is inherently resistant to modification of data *(Mougayar 2016).*

The real novelty of the blockchain technology is that it is a public record of all transactions, an open distributed ledger, which makes it eternally possible to track the development and change in a blockchain *(Blockchain.info 2018).* The technology further solves the problem of double-spending[20] as the protocol verifies and publicly announces all approved transactions in the blocks, preventing fraudulent activity *(Nakamoto 2008).*

Although Satoshi Nakamoto (2008) invented the idea of the blockchain technology with the introduction of Bitcoin, the nature of the technology is found suitable for other purposes. The technology can be leveraged out to perform several important tasks such as executing contracts, ensuring incorruptible voting in elections and safely buying and selling intellectual property *(Coindesk 2018b)*

5.3 Bitcoin Mining

The validity of the transactions within the blockchain is checked and confirmed by the computing power of the *miners* within the network *(Lifewire 2018).* Anyone with access to the Internet and suitable hardware can participate in the mining. The mining process involves compiling transactions into blocks and solving a computationally difficult problem. When transactions are verified and added to the public ledger, new bitcoins are released to the network as a reward for the miners *(Investopedia 2018a)*.

The number of new bitcoins added to the network depends on each mined block. In 2018, an average of 12.5 bitcoins are added to the network every time a miner confirms a transaction to the rest of the network, and a new block is solved every 10 minutes *(Bjerg 2016).* The steady addition of a constant number of bitcoins is considered analogous to gold miners expending resources to add gold to circulation. In the case of bitcoin, it is CPU time and electricity that is expended *(Nakamoto 2008)*. The mining process thus serves the purpose of both disseminating

[20] Double-spending is a potential flaw in a digital cash scheme in which the same single digital token can be spent more than once *(Investopedia 2018e)*

new coins in a decentralized manner as well as an incentive for people to maintain and provide security for the network *(Bitcoinmining 2018).*

5.4 Cryptocurrencies

Bitcoin is the first example of a cryptocurrency, which shares some characteristics of traditional currencies, but with verification based on cryptography *(Coindesk 2018c)*. Other cryptocurrencies have later been issued, collectively referred to as *altcoins* as they represent an alternative to bitcoin. Of these, the largest, in terms of market capitalization, are Ethereum (ETH) and Ripple (XRP) *(CoinMarketCap 2018).* Although bitcoin and the different altcoins are categorized under the same category of cryptocurrencies, the various coins are intentionally issued to meet dissimilar needs.

Users of cryptocurrencies operate in semi-anonymity since no central entity imposes the users to identify themselves when participating in the networks. In practice, each user is identified by the address of his or her wallet *(Coindesk 2018c)*. The lack of regulation has initiated many discussions regarding the use of cryptocurrencies within the established financial systems. However, regulation is to some extent present both internally in the network and externally when entering the markets. As Simon Ousager points out, Bitcoin has regulation integrated into the protocol:

SO: *"Bitcoin is a protocol, a set of rules. If you do not follow the rules you are not in the cave. It is a form of de facto regulation at the protocol level. If you try to make multiple bitcoins or send bitcoins that you do not have, you're not in it anymore. The rules are regulated and enforced by 70.000 computers worldwide." (App. 5: 160)*

The various cryptocurrency exchanges are further obliged to follow regulation such as "Know-Your-Costumer" (KYC), which makes it possible for law enforcement to identify users, if necessary *(Coindesk 2018c).*

Thus, based on the concepts laid out above, the case description is believed to provide the reader with a sufficient knowledge base to proceed with the analysis of the case. The analysis considers the token, *bitcoin*, due to the assumption that it is the tradeable entity that can be subject to speculation and bubble formation as opposed to the protocol, *Bitcoin*.

6 Analysis Part 1: Investigation of the Bubble Concept

To assess the explanatory power of the concept of speculative bubbles, the first part of the analysis will be an in-depth investigation of bitcoin based on the theoretical definition of a speculative bubble. With reference to the theoretical framework, this part of the analysis consists of three sections that respectively focus on the market, the actors and the asset.

6.1 The Market Perspective

The market perspective covers the development in the price of an asset or asset class over time. This is considered appropriate as a starting point in an investigation of the bubble concept, as a speculative bubble unfolds from *"a situation in which news of price increases spurs investor enthusiasm" (Shiller 2015: 2)*. Below, Figure 5 shows the development of the bitcoin price over time.

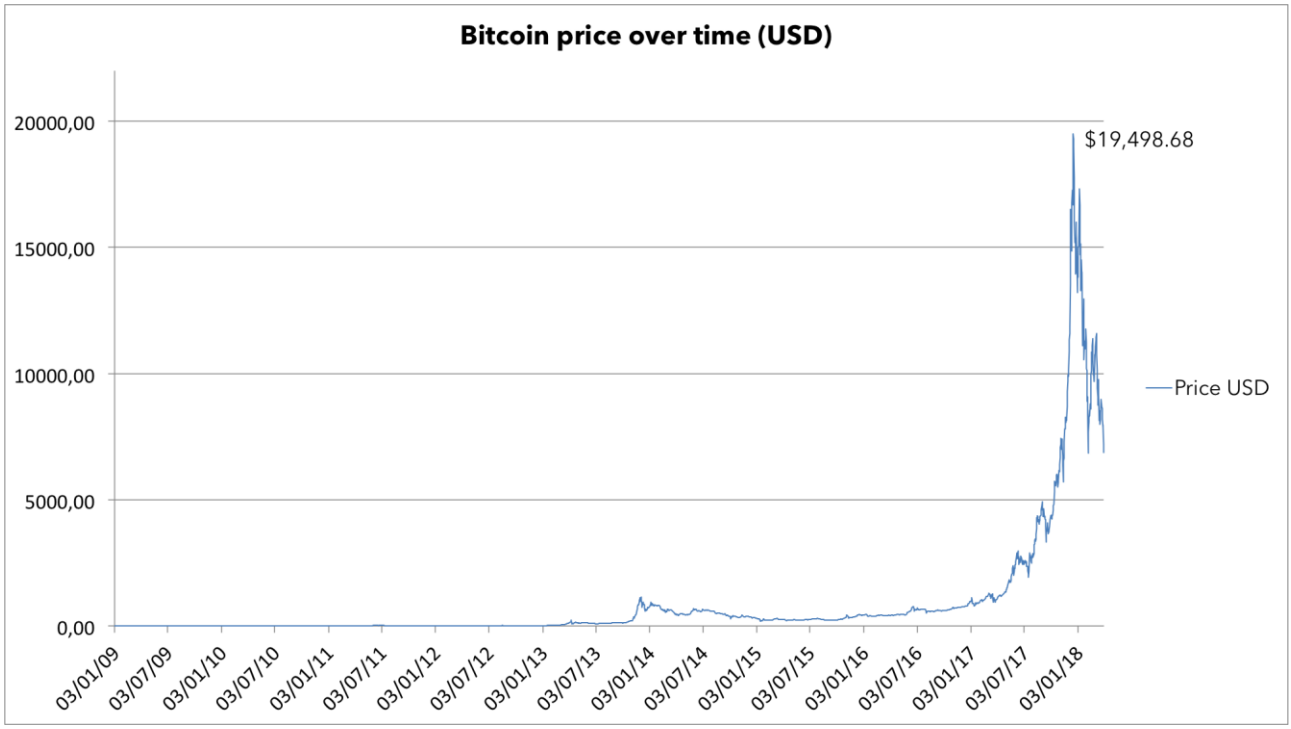

Figure 5 – Bitcoin price development 2009-2018

The figure clearly displays that the price has risen explosively since the introduction of bitcoin. Especially 2017, seems to dominate the full picture as the price of one bitcoin hit an all-time high of $19,498.68 in December after a steep price increase. Crypto trader Jacob Skaaning also

compares the bitcoin market to earlier market bubbles: *"(…) that is what all markets do. The Housing Bubble was the same. It just happened within a larger timeframe" (App. 1: 133)*. From a first view on the chart, it is thus considered reasonable to jump to the conclusion that bitcoin must be a bubble as both the visual expression of the price curve along with experts' views suggest that bitcoin very well could be a speculative bubble.

What is further interesting when looking into the bitcoin price development is the coinciding increase in the Internet search for "bitcoin" and "bubble" shown in Figure 6 below. The figure shows how the search-term "bitcoin bubble" was entered relative to the total search-volume across the world and across different languages *(Google Trends 2018)*.

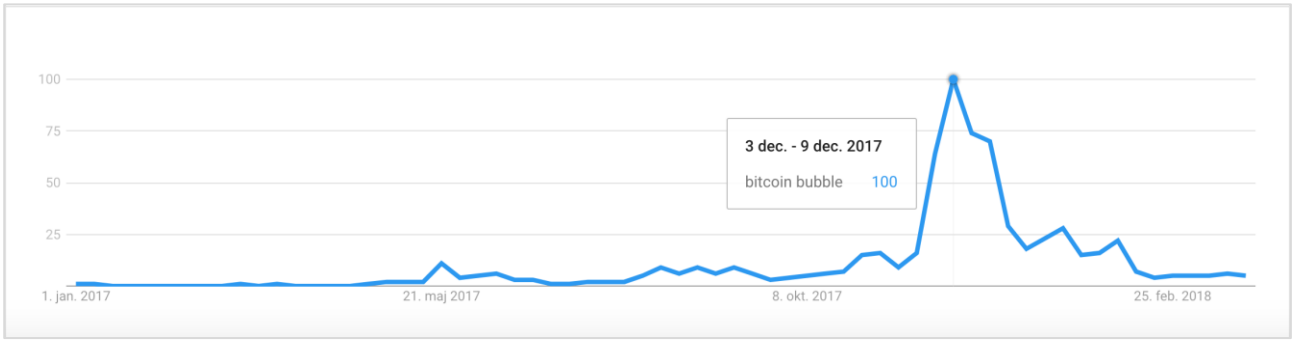

Figure 6 – Google Trends for "bitcoin bubble" 2017

As the bubble theory also mentions, "*the history of speculative bubbles begins roughly with the advent of newspapers" (Shiller 2015: 101)*. Similarly, many news media around the world increased the media coverage on bitcoin and other cryptocurrencies in 2017 *(Bovaird 2017)*. The theory further states that the news media "*are fundamental propagators of speculative price movements through their efforts to make news interesting to their audiences" (Shiller 2015: 121).* The rapid price increases in 2017 might then be connected to the increased media publications and search score on Google Trends.

Thus, in a brief view, the market curve resembles that of a classic bubble and there seems to be a suggestion canalized by the media that bitcoin is a bubble. However, what is considered interesting when further exploring the price curve, is that there have been several price peaks during the lifespan of bitcoin that immediately "disappear" because the peak in 2017 is that relatively high (see Figure 7 below).

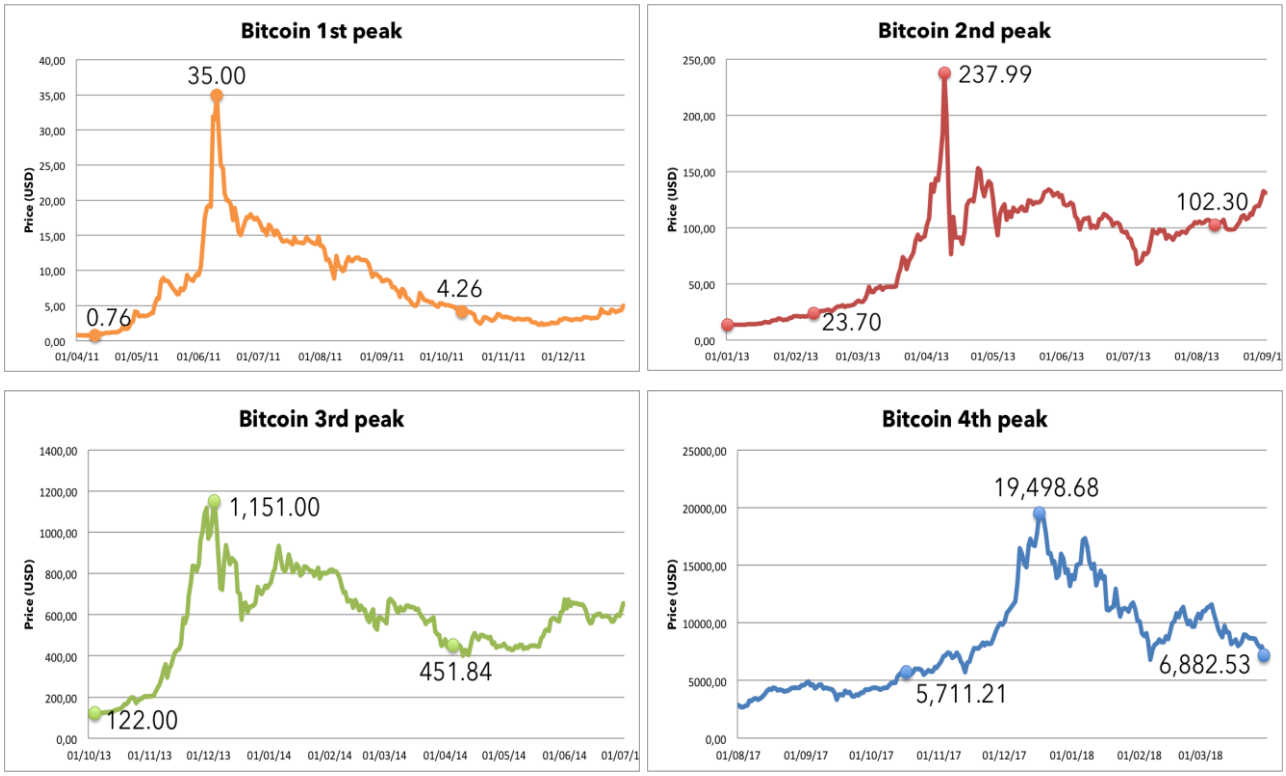

Figure 7 – Peaks in bitcoin price over time

By analyzing the price curve in-depth, four peaks were identified which are depicted above. The first peak was during 2011 and the next two peaks are identified in 2013 and 2014. The last peak was in 2017 and is probably the most heard-of spike *(Google Trends 2018)*. In Figure 7, different points are highlighted on the charts. The first point on each graph depicts the price of one bitcoin two months before the curve hits its peak. A two months interval has been chosen to show the relatively steep increase in price over a short period.

In Table 9 below, the percentage increase in price is calculated based on the price two months before the peak. The table shows that the first three peaks exhibit a remarkably larger percentage increase than the peak of 2017. This may indicate that there have been more periods of bubbly conditions over the years. However, it is assumed that the other peaks have not received noteworthy media attention and therefore have not been as publicly discussed as the peak of 2017 due to the microscopic market capitalization and immature technology at the time.

PEAK	PERCENTAGE IN PRICE INCREASE
1st peak	$\frac{35 - 0.76}{0.76} x\ 100\% = 4{,}505.26\%$
2nd peak	$\frac{237.99 - 23.70}{23.70} x\ 100\% = 904.18\%$
3rd peak	$\frac{1151 - 122}{122} x\ 100\% = 843.44\%$
4th peak	$\frac{19498.68 - 5711.21}{5711.21} x\ 100\% = 241.41\%$

Table 9 – Calculated percentage increase in bitcoin price

The 1st peak occurred in June 2011 about 2.5 years after bitcoin was invented. The price increased from $0.76 to $35 over the period of two months, which corresponds to a percentage increase of 4.505,26%. During the next two peaks in 2013 and 2014, the price respectively increased 904.18% in 2013 and 843.44% in 2014. At the 2017 peak, the price increased by 241.41% over the period of two months.

It is prominent to all peaks that the price has stabilized at a higher level than the input level after each peak (newfound price level marked by a point four month after the peak price). This is considered an interesting and quite surprising finding. Although the price drops rather fast after the peaks, the market does not seem to crash in the sense that the price level increases quite fast again compared to the analyses conducted by Shiller *(Shiller 2015: 7)*.

As noted in relation to Figure 8, the Google Trends score consistently increases coinciding with all the price peaks, which is also marked in the figure below. However, the 2017 peak clearly received extensive media coverage compared to any of the other spikes *(Bovaird 2017)*. Thus, one could imagine that the whole bubble discussion has become more interesting because of the relatively higher price level.

Figure 8 – Google Trends for "bitcoin" from 2009-2018

6.1.1 Reflections

The findings above spur a reflection on whether the bitcoin market can be defined as a speculative bubble or just subject to ongoing market corrections. Based on a common definition of a crash, *"a crash is a significant drop in total value of a market, almost undoubtedly attributable to the popping of a bubble" (Investopedia 2018d)*, bitcoin has seemingly experienced several bubbles when solely focusing on the price development. In the 1st peak of 2011, the total value of the bitcoin market fell with 42.86% in a matter of five days after the peak. And following the 2017 peak, the price dropped 17.81% in five days. These price drops are thus significantly larger than what generally defines a simple correction *(Investopedia 2018d)*.

Hence, the numbers and the shape of the curve speak in favor of a bubble, but expert Jacob Skaaning proposes another point of view. Although he argues that the bitcoin price is a bubble, he describes the bitcoin market as a *"five-phase market cycle, which all markets go through" (App. 1: 133)*. He explains the five-phase market cycle as follows:

JS: *"So the market starts like this: it's flat, it goes into bull trend, it goes into a bubble, parabolic, then the first washout, then makes a dead cat, next is bear trend, it accumulates and goes into bull trend, parabolic, washout and so on and so on. That is what all markets do." (App. 1: 133)*

It is thus suggested that bitcoin is following a dynamic market cycle where the bubble condition is a natural component. This contradicts the theoretical definition, which argues that speculative bubbles are a result of irrational exuberance *(Shiller 2015)*.

Moreover, what is interesting to observe is the price development relative to the number of bitcoins mined. The figure below shows that the general price level has demonstrated an upward trend simultaneously with a steady increase in the number of bitcoins mined.

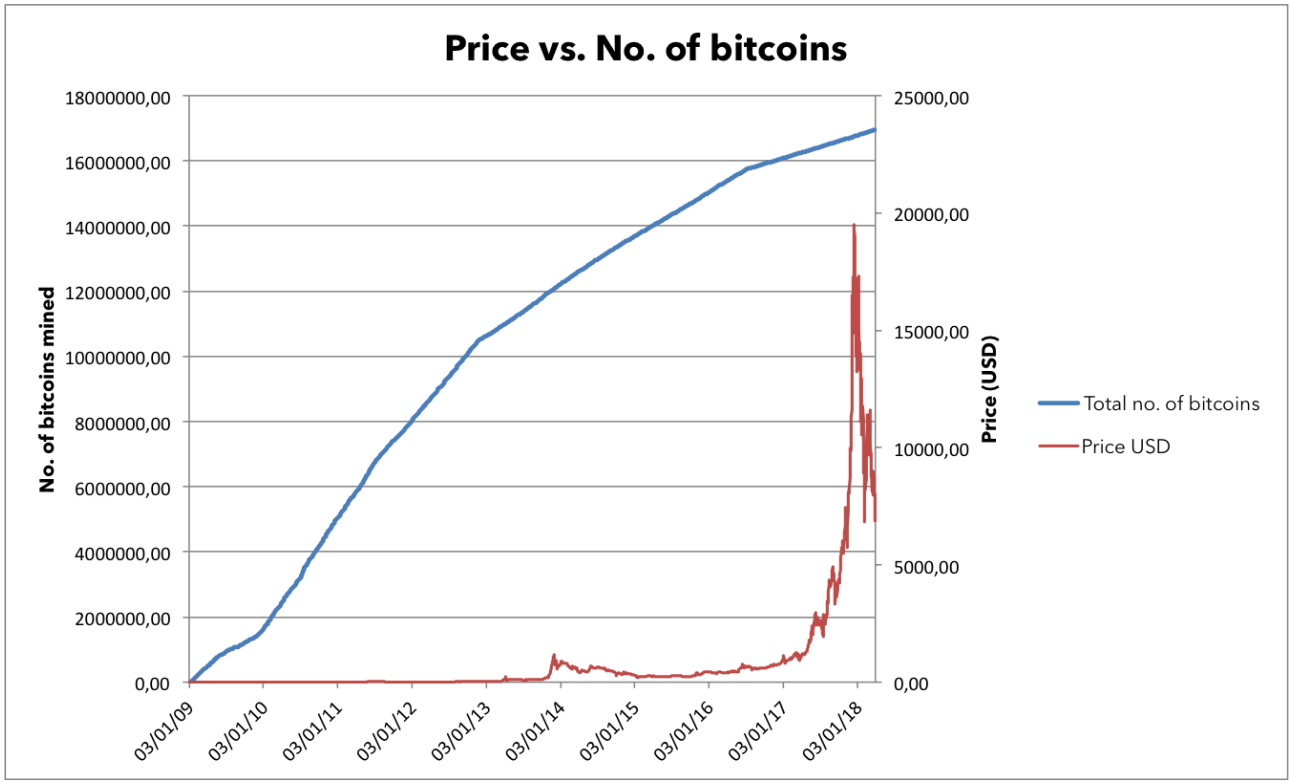

Figure 9 – Price vs. No. of bitcoins

Intuitively, this upward price trend does not make a lot of sense. In economic theory, the price of a good normally decreases when the good becomes less exclusive *(Perloff 2012)*. This potentially suggests that the bigger the network gets, i.e. the more bitcoins that are mined and thus made available, the higher the demand. Hence, an expansion of the network makes bitcoins more valuable.

In addition to the above, Figure 10 below displays that the number of unique addresses increases as more bitcoins are mined. Unique addresses are defined as the total number of unique addresses used on the blockchain *(Blockchain.info 2018)*. Camilla Frost Jensen further explains that the *"addresses are like bank accounts, which means that people can have more than one address" (App. 4: 153)*. Although one cannot know the exact number of users of bitcoin, the number of unique addresses is seen as a fair measure of the active users in the

network. The increasing number of unique addresses supports the above idea that the perceived value of the network increases as the number of bitcoins increases.

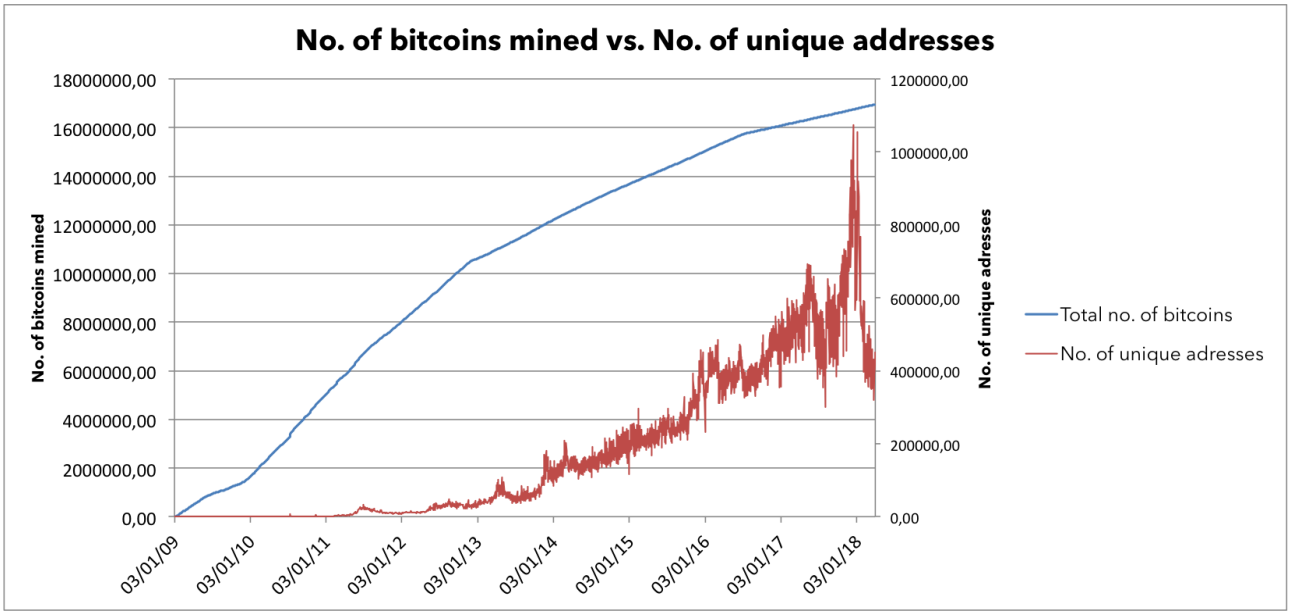

Figure 10 – No. of bitcoins mined vs. No. of unique addresses

6.1.2 Market Endnote

The shape of the curve, as well as the percentage increase in prices over a short period of time, immediately support the idea that the bitcoin market is well described by the concept of a speculative bubble. However, by further analyzing the price trend, it was found that there have been more peaks over time that are not accessible to the naked eye because of the relatively higher level of the price peak in 2017. In addition, it was found that the price has never decreased to a value below the input level before a peak. This might indicate that the bitcoin market does not crash after a peak but simply survives the "bubble" and continuously retains a slightly higher price level.

6.2 The Actor Perspective

In this section, the analysis concentrates on the behavior of the market participants initiated by the definitory part which states that a speculative bubble *"(…) spreads by psychological contagion from person to person, and, in the process, amplifies stories that might justify the price increase and brings a larger and larger class of investors, who, (…) are drawn to it partly*

through envy of others' successes and partly through a gambler's excitement" (Shiller 2015: 2). Preliminary to this analytical part, it is considered appropriate to clarify the use of concepts.

Throughout the analysis, the term "investors" is used to denote the market participants. In practice, not everyone agrees that bitcoin should be interpreted as an investment, which for this purpose complicates the definition of the market actors. As Hans Henrik Hoffmeyer puts it, bitcoin is something one buys while other experts view it as an investment.

HHH: *"No, I have not invested in bitcoin, but I have bought bitcoin." (App. 7: 179)*

JS: *"I have bought bitcoins as an investment." (App. 1: 129)*

CFJ: *"I had a well-paid job and wanted to learn how to invest. Via my network, I went to a Christmas lunch and ended up being placed between two guys who knew a lot about bitcoin. After we talked, I invested in bitcoin." (App. 4: 152)*

Although there is some disagreement regarding whether bitcoin is, in fact, an investment, a common definition of an investor is *"any person who commits capital with the expectation of financial returns" (Investopedia 2018g)*. Since the definition is not limited to any particular investment opportunities, the term "investors" is used to denote the actors in the bitcoin market. For further clarification, the term "actor" is delimited to cover the investors in the market and not the surrounding institutions, etc.

6.2.1 Actor Characteristics

When analyzing the results from the Økonomisk Ugebrev survey, it appears to be the younger segments that are most involved in cryptocurrencies. The respondents within the age interval of "under 30" and "31-40 years" are relatively more positive towards cryptocurrencies and are also the segments where most respondents have invested in cryptocurrencies before 2017 (see Figure 11). Within the segments of "51-60 years", "61-70 years" and "over 70" the tendency is reversed, showing a more skeptical attitude towards cryptocurrencies. This indicates that the age distribution in the market is characterized by an overweight of young actors.

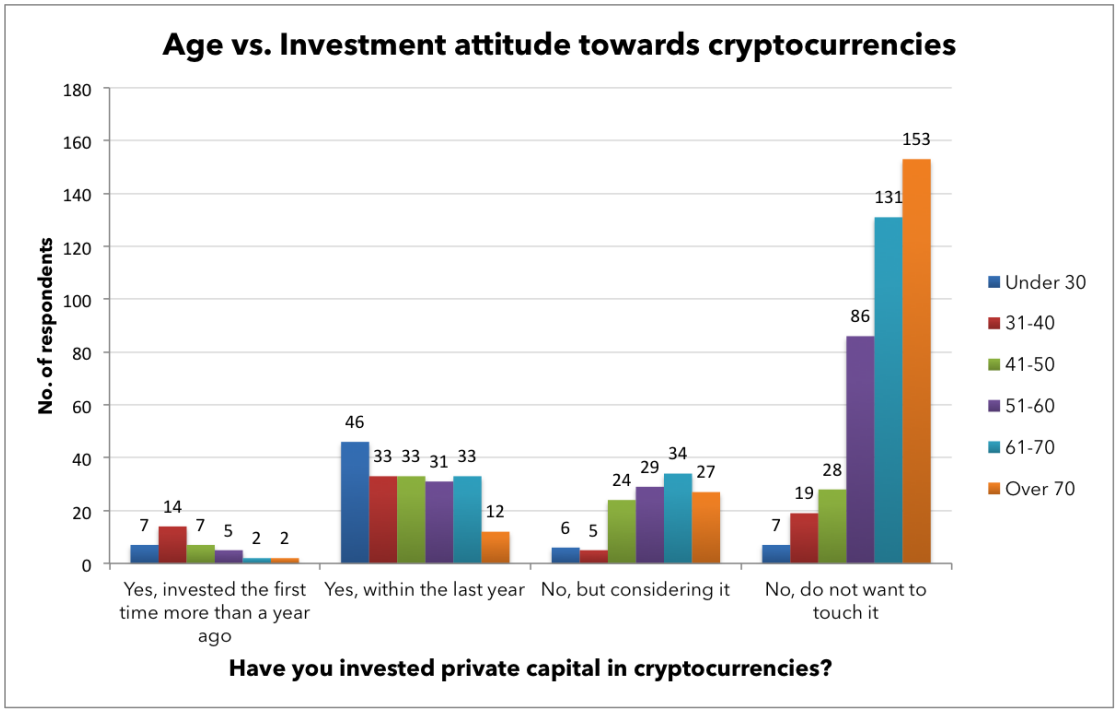

Figure 11 – Age vs. Investment attitude

The market actors can also be characterized for other than age. It is profound in several of the interviews that the bitcoin market primarily consists of private investors and traders, many of which have little or no knowledge of investing. Crypto trader Jacob Skaaning says that *"we see a lot of private traders and that is also why the market acts so crazy" (App. 1: 132)* while Simon Ousager mentions that *"all sorts of investors joined, some with knowledge of investing and others with no knowledge" (App. 5: 163)*.

Further, as Jacob Skaaning and Ulrik K. Lykke experience it, it is the amateur investors who cause the heavy market fluctuations because they lack experience and mental practice.

JS: *"The problem with new money is that they buy at the wrong time and then they lack on the mental part if they go in minus." (App. 1: 130)*

As Ulrik K. Lykke further states, experience as a professional trader has taught him how to recognize emotional states and remain in control.

UKL: *"You're not immune to fear, you're just smart enough to know that you're not going to succumb to your feelings. You can put them at a distance." (App. 2: 139)*

It is especially the emotional experience that Jacob Skaaning and Ulrik K. Lykke perceive as the essential difference between amateur investors and professionals, which also explains why the bitcoin market, qua the many amateurs, is a *"wild, wild west"* as Sarid Harper denotes it *(App. 3: 145)*.

The bitcoin market can thus be characterized as not yet very professionalized, because of the dominance by private investors, which suggests that the animal spirits affect the market more freely than markets with a higher ratio of professional investors and traders. This is thus a particular condition of the bitcoin market.

Moreover, it is considered interesting to further approach a characterization of the investors by looking into their motivation to participate in the market. The figure below shows how much money each respondent has invested in cryptocurrencies and when.

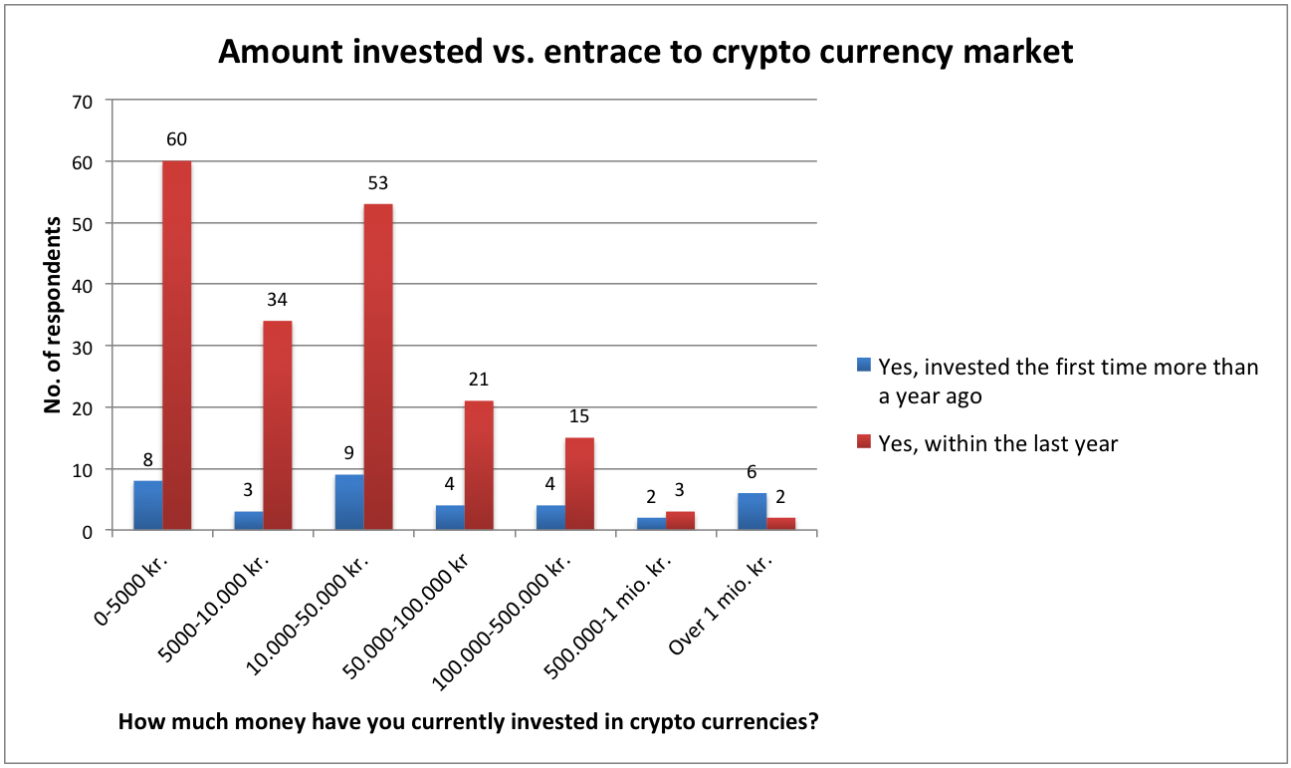

Figure 12 – Amount invested vs. Market entrance

First, it is notable that the vast majority has invested within 2017 and mainly below 50,000 DKK. This might indicate that more people want in when the price increases as it did in 2017. Second, the amount invested is more equally distributed for the investors who made their initial

investment before 2017, whereas the investors who joined within 2017 display a tendency towards the lower end. This suggests that the newer entrants, to a greater extent, invest just to get at least a little share of the cake though still being cautious about exposure to the bitcoin market.

In addition, when considering the respondents' motivation to join the market, there is a clear difference between the short-term investors and the long-term investors.

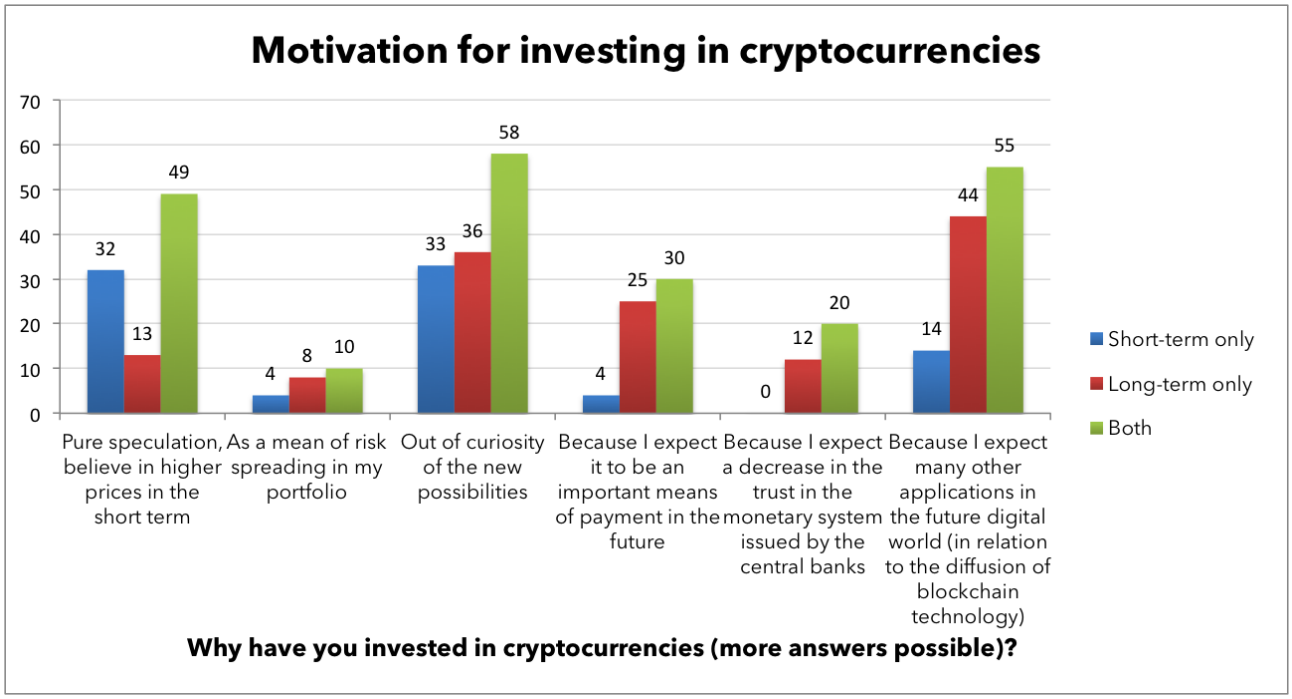

Figure 13 – Motivation for investing in cryptocurrencies

The figure above shows that short-term investors are primarily motivated by "pure speculation" and "curiosity of the new possibilities", whereas most long-term investors are motivated by "curiosity of the new possibilities", "an expectation for it to be a future means of payment" and "an expectation of many other applications in the future digital world". However, the investors who are both long-term and short-term are more difficult to categorize, as it is not explicit how the total amount of capital invested is percentage distributed at respectively long-term and short-term purposes.

These findings are supported by Hans Henrik Hoffmeyer, who believes that the overall motivation for investing in cryptocurrencies is pure speculation. On the contrary, Sarid Harper is,

as an investor, genuinely interested in the technology, which resembles the motives among the long-term investors in Figure 13.

HHH: *"It's speculation and we know. (…) People buy in because they see other people become rich." (App. 7: 183)*

SH: *"It is not the speculative part. I speculate in fiat currencies, but in crypto, I find the technology very interesting." (App. 3: 144)*

The current section thus intended to extend the knowledge of the market actors. The following sections proceed with an investigation of the observed behavior.

6.2.2 Market Feedback

In the analysis of the market perspective, it was found that the number of unique addresses increases as the number of bitcoins mined increases (Figure 10). When comparing the number of unique addresses with the price of bitcoin, it appears that the number of unique addresses increases excessively when the price also increases, especially in the last months of 2017. This connection can be seen in relation to what Shiller (2015) mentions as feedback loops which is a key factor for the creation of speculative bubbles.

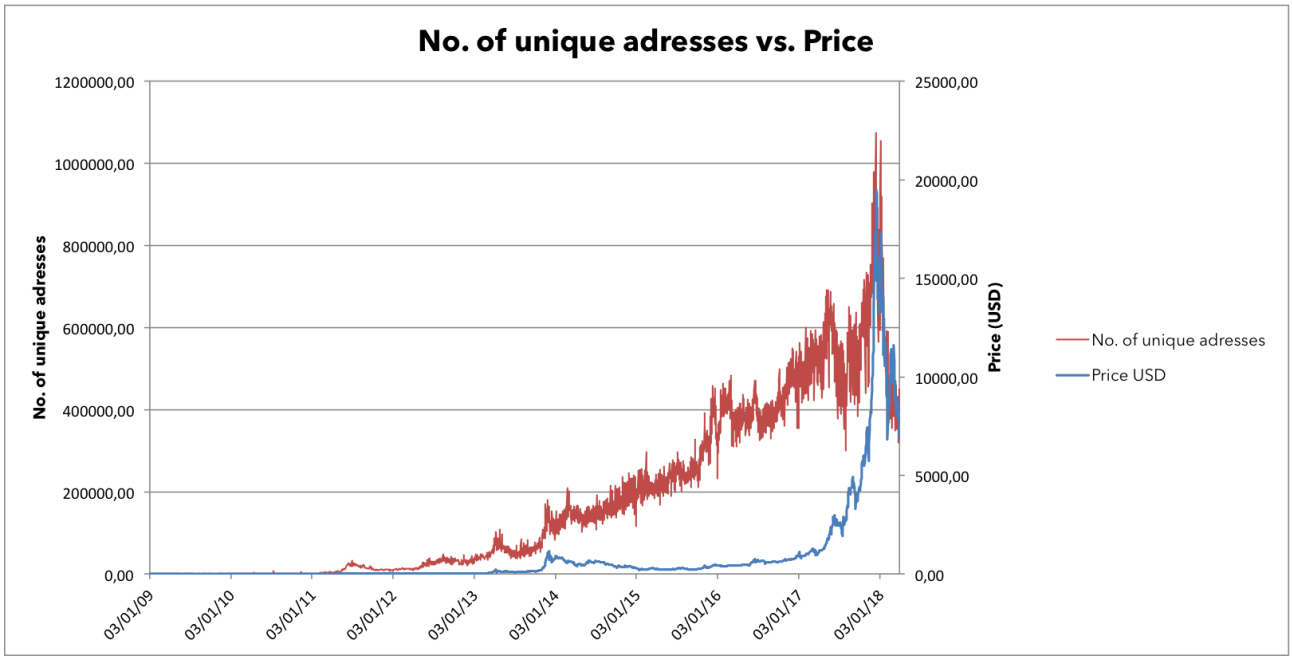

Figure 14 – No. of unique addresses vs. Price

In theory of feedback loops, initial price increases lead to further price increases as the effects of the initial price increases feedback into yet higher prices through increased investor demand *(Shiller 2015)*. The figure above illustrates that when the bitcoin price increases, it also appears that more investors enter the market, hence the increasing number of unique addresses, potentially resulting in further price increases, which again encourages more people to enter the market.

Feedback loops cover the vicious circle of self-fulfilling prophecy and bandwagon effect that drives the price up *(Shiller 2015)*. The feedback loop relies partly on the *adaptive expectations*, where feedback takes place because past price increases generate expectations of further price increases, and partly on *investor confidence* where feedback takes place because of increased investor confidence in response to past price increases *(Shiller 2015)*.

In the survey conducted by Økonomisk Ugebrev, it appears that most respondents, who have made a private investment in cryptocurrencies, have invested within 2017:

Answer Choices	Responses	
Yes, invested the first time more than a year ago	4.57%	37
Yes, within the last year	22.99%	186
No, but considering it	15.70%	127
No, do not want to touch it	56.74%	459

Figure 15 - Answers to question 2 in Økonomisk Ugebrev survey (Appendix 8)

This could indicate that the majority of investors in the bitcoin market have joined as a result of the feedback mechanisms described above. In addition, the interviewed experts state the following in relation to the behavior observed in the market:

> JS: *"The problem is that they buy because they see that the price has increased." (App. 1: 130)*

> SH: *"People will stay a little bit from it until it starts to rise again and then people will think: okay, it is rising, now I buy." (App. 3: 145)*

Among others, Lars Holdgaard and Hans Henrik Hoffmeyer further elaborates on the investment behavior comparing it to previous market bubbles and implicitly describe the term "FoMO" (Fear of Missing Out) to explain the actor psychology in the bitcoin market:

LH: *"I think there is a large group of people who have seen a lot of others become rich or say they have become rich, and now they want to enter the market. We saw the same thing during the IT bubble in the 90s." (App. 6: 171)*

HHH: *"People buy in because they see other people become rich, and so it's that fear of missing out." (App. 7: 183)*

The term "FoMO" refers to "*a pervasive apprehension that others might be having rewarding experiences from which one is absent" (Przybylski et al. 2013: 1841)* and has later been used to describe the fear of regret which might lead to a compulsive concern that one might miss an opportunity, for example, a profitable investment or a social interaction *(Shea 2015).*

Jacob Skaaning further elaborates and states that the mass psychology of the market reflects the emotion FoMO, which could be one of the factors that drive the market up as seen in Figure 5.

JS: *"When the market goes up by 150% in 28 days, then the mass psychology is FoMO – we need to put money in this market." (App. 1: 133)*

The indicators found in this section suggest that feedback mechanisms are present in the bitcoin market and hold a certain influence on the price development. The following further considers the psychological factors underlying investor behavior.

6.2.3 Behavioral Explanations

Considering the psychological factors, Shiller (2015) divides his theory into two parts. The first part concentrates on the psychological anchors of the market that stems from a difficulty for the general public to assess true market value. The second part focuses on herd behavior with reference to classic experimental results from social psychology that provide an explanation of how a large group of investors changes their opinion simultaneously *(Shiller 2015)*.

Psychological anchors further split into two categories; quantitative anchors and moral anchors in the market. The theory of quantitative anchors is heavily inspired by Kahneman and Tversky's (1974) work, especially related to the *anchor and adjustment heuristic*, and thus covers how humans tend to estimate the numerical market value.

The moral anchors merely arise from the comparison between arguments for holding an investment on the one side against the perceived need to realize the wealth that the investment represents on the other side (*Shiller 2015*). Once the perceived discrepancy between the two becomes sufficiently large, investors will start selling, which causes the market price to decrease.

This might very well work as an explanation for the peaks in the price diagram illustrated in Figure 7. When the graph hits a sufficiently high price level, some investors want to realize their gain in the market, which immediately results in a price decrease that stabilizes when the reasons for holding bitcoins once again are perceived superior to the alternative wealth consumption. This might be further amplified by the speculative short-term investors who participate in the market exclusively to withdraw a profit as shown in Figure 13. These are assumed to be even more sensible when the price drops due to their shorter time horizon.

As mentioned in relation to the theoretical framework of bubbles, the theory builds on an assumption that people are social and socially influence each other. This is foundational for the psychological concept of herd behavior *(Banerjee 1992)*. Herd behavior is characterized by humans imitating other humans instead of making individual decisions based on the available information *(Behavioraleconomics.com 2018)*. Irrational herd behavior is, by definition, vital to the emergence of a speculative bubble. The phenomenon of herd behavior is also described by Sarid Harper as occurring within the bitcoin market:

SH: *"You have the smart money and the dumb money. The smart money buys early and cheap whereas the dumb money buys when the price is already on its way up. Psychologically you can see that people think: "are you doing this? What about you? Yes? Then I'll also do it. You want to confirm that the action you are taking is the right one." (App. 3: 145)*

Herd behavior in markets is immensely dependent on the diffusion of information described by the term *information cascades (Shiller 2015)*. Especially face-to-face communication is denoted as a strong influencer for behavioral changes.

An informal chat in the very early explorative phase of the project, with a young woman on why she bought bitcoin, illustrates this theoretical underpinning; she reported how she had never invested in anything before but nevertheless recently had decided to place most of her savings in bitcoin because her father and brother told her about this amazing opportunity. A similar pattern of face-to-face influence appears in the interviews:

CFJ: *"I had a well-paid job and wanted to learn how to invest. Via my network, I went to a Christmas lunch and ended up being placed between two guys who knew a lot about bitcoin. After we talked I invested in bitcoin." (App. 4: 152)*

HHH: *"It was my business partner Mark, who told me I had to look at it back in 2012. I did not, but after 3-4 months I looked into it. It was a bit random." (App. 7: 178)*

LH: *"Later I went to Singapore where I met some friends, and I ended up talking to a guy who wouldn't stop talking about bitcoin. He just kept talking about bitcoin and that he was starting a business called Bitcoin Nordic. It took a year and then I meet one of my friends back in Denmark who cannot stop talking about bitcoin. He kept saying, "Just buy a few bitcoins". In January 2013, I wanted to see what it was all about. I bought some bitcoins and was really inspired about how easy it really worked." (App. 6: 169)*

Moreover, it is considerable, as expressed in the interview with Jacob Skaaning, that discussions on the topic are constantly flowing on social media platforms, primarily Twitter and Reddit:

JS: *"I use Twitter, Reddit and Bitcointalk Danmark. I am looking at what the new investors say. What the new say I use as a benchmark for my strategy in the market. I do the opposite of what the mass thinks." (App. 1: 137)*

Nowadays, such online platforms, to a large extent, fill the role of traditional word-of-mouth communication why it is considered appropriate to deduct that the way information is spread in the bitcoin market resembles the bubble theory a lot. The tendency of overconfidence in one's own knowledge and skills is furthermore a notable pitfall as it is hard for layman to assess the validity of the information made available by social media channels *(Shiller 2015)*.

Bringing into play the theoretical concept of *stories*, it is explained why people after all irrationally act on relatively questionable informative inputs *(Akerlof & Shiller 2009)*. The human mind is simply thought to be built to think in narratives, which constitute a framework for motivation relying on emotions superior to rationality. With reference to the motives to enter the market (see Figure 13), it is suggested that there are two dominant stories impacting the investor behavior. One evolves around quickly obtaining extraordinary wealth while the other is attached to what bitcoin conceptually represents. Both are considered to provide strong reasons for entering the market though speaking to different types of investors. Naturally, the story of getting rich is more vulnerable to price fluctuations.

Stories are also important aspects of generating confidence in the market *(Akerlof & Shiller 2009)*. As long as investors are confident, prices will stay up or continue even higher as explained in relation to the market feedback mechanisms in the previous section *(Shiller 2015)*. The following situation referred in the interview with Ulrik K. Lykke shows how investor confidence can be irrationally connected to price:

UKL: *"I spoke with a guy in December, whom would like to invest a couple of 100,000 DKK in bitcoin and it could not go fast enough. I have just written him again to hear if he got started. He never did. He could not get his stock account verified, which means he couldn't get the money. So, I'm asking him whether it is a good time for him to invest now [February]? Now, I cannot remember exactly what he wrote, but it was something like "I've lost a little confidence in the entire crypto market, and I think it is somewhat more uncertain than what I imagined." (App. 2: 141-142)*

Essentially, the man in the episode was more than willing to buy bitcoins in December 2017, when the price was all-time high, whereas he was not so sure about buying the exact same thing (if not better due to meanwhile improvements in the code) when the price was less than the half (see Figure 5). This demonstrates that this type of investor does not want in because he, based on personal reflections, believes in bitcoin. Investors who have decided to go in because they are confident about the potential of the technology should, in principle, be happy about buying bitcoin at a discounted rate.

6.2.4 Reflections

The above analysis of the bitcoin market actors seems to lead to a dual-categorization of investor types. The typifying originates from the two overall investor time horizons identified, respectively short-term and long-term. Figure 13, displaying the motives compared to time horizon, indicates that the pure speculators primarily are found within the short-term investors whereas the long-term investors are motivated by a belief in the future potential of the technology.

The figure below illustrates the attitude among investors related to whether bitcoin is perceived to be a bubble.

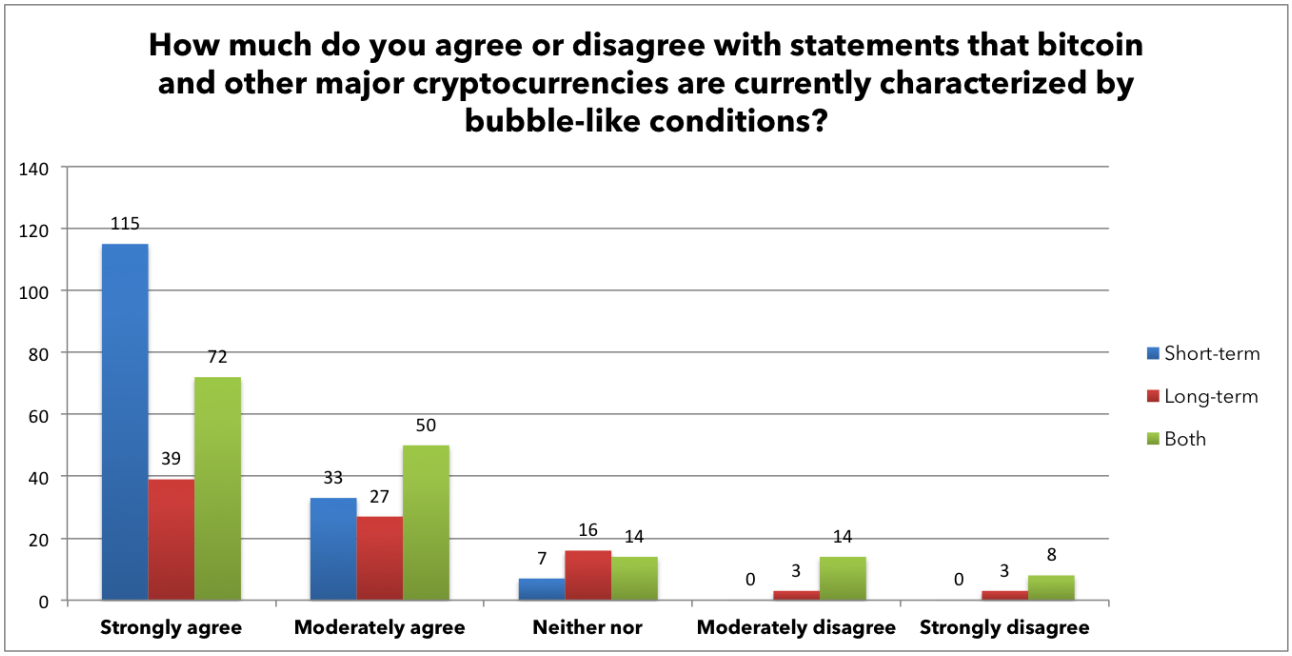

Figure 16 – Investor time horizon vs. Perception of a bubble

The figure displays that all the short-term investors to some extend view bitcoin as a bubble except for a few that state themselves neutral. This further supports the hypothesis that the short-term investors are dominantly price speculators disregarding the potential future applications of bitcoin.

This distinction between the two investor types initiates a reflection of how the chart showing the different bitcoin price peaks over time could be understood (see Figure 7). As mentioned in

the analysis of the market perspective, it appears that the price stabilizes at a higher level than before the peak. Based on the two types of investors identified, this could be explained as that for every peak some of the short-term speculators, who are more sensitive to price decreases, are being "washed out" of the market leaving long-term investors as a relatively larger proportion than before.

These reflections are considered very relevant to the application of the bubble concept as they suggest that there are two parallel investor behavior patterns present.

6.2.5 Actor Endnote

From the actor perspective, it appears that the bubble theory provides a range of explanatory concepts for the overall observed market behavior. However, the class of investors attracted seems to split into two main types; on the one hand, the classical speculators that resemble the bubble theory, but on the other hand, also a grouping who are in because they believe in the potential of the technology. The theoretical frame does not capture the latter type of investor. For this reason, it is not proper to conclude that the actors in the bitcoin market are comprehensively explained by the theory of speculative bubbles.

6.3 The Asset Perspective

The final component in our investigation of how the concept of speculative bubbles unfolds in the context of a disruptive technology is the asset itself and how it corresponds to the given bubble definition. This is based on the underlying assumption that in order to assess whether *"(…) doubts about the real value of the investment" (Shiller 2015: 2)* are, in fact, justifiable one needs to be able to determine the real value or fundamental value of the investment object. The designation of overly investor enthusiasm, described by irrational exuberance, driving prices away from fundamental value is thus believed to require a determination of the actual worth of the investment.

6.3.1 Approaches to Classification

To assess the real value of bitcoin, a starting point is taken in the asset classification of bitcoin as this is seen as conclusive to how the true value of the investment should be calculated.

In his article, Damodaran (2017) presents a reasonable review of the generic explanatory models that are widely used for understanding bitcoin in terms of classification. This encompasses the following four major classes:

- Cash generating assets; generate or are expected to generate cash flows in the future, which can be valued.
- Commodities; value is derived from use of raw material to cover a fundamental need.
- Currencies; medium of exchange with no cash flow but can be priced against other currencies.
- Collectibles; hold an aesthetic or emotional value that can be priced depending on the perceived desirability by others and the scarcity of the collectible.

It is subsequently argued that bitcoin, based on these fixed categories, is best understood as a currency facing the potential of developing into either the global digital currency, gold for Millennials or the 21st century tulip bulb[21] *(Damodaran 2017)*. It is also suggested that bitcoin could take on the role of a commodity in the instance that it becomes a necessary component of smart contracts [22] *(Damodaran 2017)*. However, the article, after all, received many disagreements despite the otherwise well-structured reasoning. This suggests a general disagreement on, or at least a diverse perception of, what bitcoin is and how it should be understood as an asset.

The discussion of how bitcoin is defined was also a generic subject to the expert interviews. Below is a compilation of how the interview participants respectively define and classify bitcoin. The table demonstrates exactly how different bitcoin is perceived, also among experts within the field.

[21] Referring to the "tulip mania" in Holland in the 1600's.
[22] Smart contracts are self-executing contracts, enabled by the blockchain technology. Smart contracts define the rules and penalties around an agreement and automatically enforce the obligations *(Blockgeeks 2018)*.

EXPERT	BITCOIN DEFINITION
Jacob Skaaning	– *"Bitcoin is an opportunity to give freedom back to the people" (App. 1: 128)* – *"It is a currency located on blockchain" (App. 1: 135)*
Sarid Harper	– *"Bitcoin is virtual money" (App. 3: 145)* – *"It can be used to transfer money without any third party" (App. 3: 144)*
Camilla Frost Jensen	– *"It's very good at transaction history" (App. 4: 155)* – *"But I think that bitcoin will be used as a mean of payment" (App. 4: 156)*
Simon Ousager	– *"Bitcoin is a protocol, a set of rules" (App. 5: 160)* – *"Bitcoin is the very first time that there has been an alternative [to the present monetary system]" (App. 5: 163)* – *"I actually think that digital gold is a very good way to look at it. Gold, which you can send to each other" (App. 5: 164)* – *"So, I think it is a new asset class" (App. 5: 164)*
Lars Holdgaard	– *"It reminds you of a share, in that you have… it's more like a liquid asset than a share. Yes, I see it as a currency. I do that" (App. 6: 173)*
Hans Henrik Hoffmeyer	– *"Bitcoin is not exactly a political system. It is a mathematical system" (App. 7: 182)* – *"Bitcoin can be a store of value like gold" (App. 7: 186)* – *"It is still not quite gold, because it looks more like a currency. It is easier to divide" (App. 7: 187)* – *"Bitcoin is not only a currency but also a payment system" (App. 7: 187)* – *"Then there is the software comparison, which is very common. It's just software, it's just someone who has programmed something" (App. 7: 187)*

Table 10 – Expert definitions of bitcoin

Though certainly not agreeing on a mutual definition, there are some commonalities to the different explanations. Jacob Skaaning, Sarid Harper, Camilla Frost Jensen and Lars Holdgaard all somehow agree on the currency-approach though emphasizing different elements of the blockchain technology and the new possibilities it enables. However, Simon Ousager and Hans

Henrik Hoffmeyer both see bitcoin as a system that reaches beyond the definition as a currency. Simon Ousager further favors the comparison to gold in a digitalized version from the analogy between the bitcoin mining process and physical mining of gold, yet ultimately stating that bitcoin, after all, represents an entirely new asset class. Likewise, Hans Henrik Hoffmeyer points out that bitcoin does not make it easy to mutually reach a categorization:

HHH: *"All people come to this conclusion that it is not one of the things [gold, currency, payment system, software], and that's also what makes it so annoying from a regulatory perspective." (App. 7: 188)*

From the above, it is thus likely that there exist as many perceptions and explanations of the phenomenon as the number of people engaged in the network and the discussions hereof. This circumstance is considered, in relation to the application of the bubble concept, to make it difficult, if not impossible, to conclude whether the price development is justifiable by the real value of the investment. Moreover, we observe a tendency to draw on known phenomena as means of understanding something that represents a fundamentally new way of thinking which essentially is seen as quite paradoxical.

6.3.2 Explaining the Confusion

With the formulation of heuristics as the underlying mechanisms for human thinking under uncertainty, Kahneman & Tversky (1974) offer a theoretical framework that enables an explanation of the confusion with how bitcoin should be understood.

As explained in the theoretical framework (section 4.4), when confronted with complex phenomena, humans do not possess the cognitive capacity to evaluate all possible alternatives *(Knudsen 2011)*. This implies the use of a set of mental models that reduce the complexity and thus provide shortcuts for decision-making. Similarly, the struggle to mentally cope with a truly disruptive innovation is anticipated to lead to the use of heuristic principles to simplify the operation of reaching a sensible understanding of something that is otherwise, de facto, beyond the scope of our cognition. Naturally, this manifests itself in analogies and references to known phenomena that somehow serve as means of breaking down the complexity.

Especially the theoretical concept of representativeness seems to hold explanatory power of the different definitions stated in the previous section. With reference to the theoretical framework,

the *representativeness heuristic* entails that the probability that an object, A, belongs to a class, B, is evaluated by the degree to which A resembles B *(Kahneman & Tversky 1974)*. In the same way, it is observed that how bitcoin should be categorized is evaluated in terms of how the phenomenon resembles existing groupings of assets, which then function as ways of making sense of the phenomenon. Moreover, common to the three originally identified heuristics is that they all build on information or impressions that are easier retrieved in our mind than others *(Kahneman & Tversky 1974)*. This further suggests that when trying to mentally process a complex phenomenon, one typically relies on existing concepts that are easily retrievable to provide an adequate explanation of something otherwise incomprehensible.

Inspired by our conversation with Hans Henrik Hoffmeyer (Appendix 7), take for example the concept of a "mobile phone", or for that matter "digital money". The constellation "mobile phone" indicates that the concept in focus is like a phone, but it is not stationary as the known concept, it is mobile. As with digital money; it is like money, but it is not tangible as the traditional sense of money, it is digital. When physical coins and notes no longer exist in our society, digital money is in fact just "money". Thus, this way of naming and understanding an object or phenomenon encompasses a reference to a known object that is relatable, together with a description of what differs the new object from the object of reference. This is intended to illustrate how humans generally make use of mentally existing categories when assessing a new phenomenon. The question is whether that approach is also adequate for assessing a phenomenon that represents a fundamentally new way of thinking.

Despite the usefulness, heuristics occasionally also result in systematic biases. In the current context, it might be relevant to consider the potential presence of a *confirmation bias*. The term covers the tendency to solely pay attention to the things that confirm or support one's initial hypothesis, yet not take into account the things that could prove the hypothesis wrong *(Knudsen 2011)*. This type of bias is seen as a derived consequence from the explanation that one finds plausible to understand the concept of bitcoin. This thereby constitutes a cognitive frame, which defines how one interprets the phenomenon in a way that makes sense within the individual realm of understanding.

6.3.3 Reflections

The initially referred work of Damodaran (2017) furthermore contains a rather interesting distinction between value and price and also between investment and trading. In the article, it is

stated that currencies cannot be valued, only priced. And objects that cannot be valued can only be subject to trading, not investment. In simple terms, trading is only a matter of assessing the current price level and make a judgment of whether the price will go up or down *(Damodaran 2017)*. Provided that bitcoin, in a classical sense, is a currency, thus poses the question whether it is even possible to define a real value. If so, the foundation for applying the bubble concept in this context might be questionable.

On the other hand, Cheah & Fry (2015) claim to have empirically found that the fundamental value of bitcoin is zero. If so, the bubble theory is supported as the basis for applying the concept exists. However, it all depends on how bitcoin is understood which certainly complicates the use of the traditional bubble concept.

From a crypto trader's perspective, Jacob Skaaning also stresses a clear distinction between investment and trading, yet he does not dismiss that bitcoin can be subject to both.

JS: *"The reason I find the market so interesting, from a trader's perspective, is that the market is very volatile. That is the worst condition for an investor, but the best condition for a trader. It is very important to distinguish between an investor and a trader. (…) From a more fundamental perspective, bitcoin is an opportunity to give freedom back to the people. (…) I have different "hats". You have to separate it. I have bought bitcoins as an investment. When you invest it doesn't matter whether the market just took a deep fall, but that is easy to say when you bought the bitcoins at price $400. But as a trader, which is my main work, I look for the volatility. Then I do not look so much at the ideological and technological aspects." (App. 1: 128-129)*

The conflicting views on the value of bitcoin incite a reflection on how the value of bitcoin could be described based on our data collection. The above quote from Jacob Skaaning indicates that the opportunities in bitcoin could be equal to the fundamental value. From the interview with Hans Henrik Hoffmeyer, it is further derived that the value of bitcoin is best described as being the first real alternative to the central bank system that actually works.

HHH: *"There are two things in that dialogue. One is what people think. There are plenty of people who think some things. You can see a lot of warnings in the market and the institutions that need to distance themselves from it. That is one part of the case. Of course, people should be warned when they do not know what they are doing. Then there's another side of the case, and it's that this is a real alternative. It's something that works." (App. 7: 185)*

The value of bitcoin is thus said to essentially be the alternative it represents. It is though considered complicated, if not impossible, to calculate the real value based on this abstraction and hence conclude whether the price can be justified but it at least suggests that a fundamental value exists and is bigger than zero. In that perspective, bitcoin is also suitable as an object of investment besides from trading.

This naturally leads to another reflection over the concept of *stories* that is quite central to the theories of both Shiller (2015) and Shiller & Akerlof (2009), as mentioned in relation to the actor perspective (section 6.2). Stories might in themselves be powerful enough to drive the speculative behavior of a bubble *(Shiller 2015)*. On the one hand, the story of "the alternative" could be seen as a mean of justifying price increases, which is consistent with the theory of speculative bubbles. On the other hand, as long as it is undecided how the fundamental value of bitcoin should be defined and calculated, it is inappropriate to jump to the conclusion that the story of "the alternative" simply just is an aspect of keeping a speculative bubble alive.

Thus, this analytical perspective does not intend to provide a definitive answer to how bitcoin should be classified and what the real value is. The intention is merely to illustrate the diversity in how the phenomenon is understood which after all has not yet resulted in a mutually agreed-upon definition. From this point of view, it is clear that the nature of bitcoin as an emerging technology that has not yet gained real foothold complicates the use of the bubble concept. Though many resemblances are found considering the market and actor perspectives, fundamental characteristics suggest an alternative explanation of the phenomenon.

6.3.4 Asset Endnote

In fundamental terms, the above examination poses the question whether the traditional concept of bubble formation holds comprehensive explanatory power in the context of bitcoin defined as a disruptive innovation. Bitcoin has not yet achieved a definitive asset class, which makes it difficult to assess whether the price is justifiable by the real value of the investment.

6.4 Preliminary Conclusion Part 1

The intention with the first part of the analysis was to explore the bubble concept and thus investigate the explanatory power in the case of bitcoin. The analysis was systematically organized around the three analytical perspectives derived from the theoretical framework regarding the market, the actors and the asset.

The analysis of the market showed that the price curve of bitcoin resembles the theoretical foundation of speculative bubbles. What the analysis further showed was that there have been several peaks on the price curve during the lifespan of bitcoin that immediately demonstrate characteristics of a bubble. Despite that, the price has never decreased to a value below the input level but always managed to stabilize at a higher output level after a peak.

From the analysis of the actor perspective, it was derived that two main types of investors characterize the market. On the one hand, the dominant type is well captured by the bubble theory as this type is described as a classical speculator that drives the market into the bubble-like conditions observed in the analysis of the market perspective. On the other hand, a considerable number of investors have a long-term strategy and are motivated to participate in the market because of a belief in the future potential of the technology. The bubble theory does not account for the latter investor type though many explanatory concepts were otherwise found to describe the observed market behavior.

Based on the definition of a speculative bubble, it was considered necessary to assess whether an asset classification of bitcoin is even possible as this is interpreted as foundational for identifying a bubble. It was found that no such classification is yet possible due to the multiple perceptions of what bitcoin is. This leaves an unanswered question of how the value of bitcoin should be calculated and whether it is even appropriate to anticipate the existence of a fundamental value. Moreover, it is questionable whether it is a durable strategy to approach an understanding of a truly disruptive phenomenon through a predefined set of categories.

The traditional bubble concept thus appears to hold some explanatory power in the case of bitcoin. However, due to the nature of the phenomenon, deviations from the classical framework are derived from the analysis, which suggest that some of the observations are better explained by introducing an analytical angle that accounts for the disruptive aspect of the bitcoin technology.

7 Analysis Part 2: Explanations from the Field of Innovation

The second part of the analysis is a continuation of the first part and seeks to nuance and elaborate the theoretical conceptual framework, which we have studied in the sections above. This part of the analysis is intended to specifically address the identified deviations from the bubble theory and thus consists of new theories, which will be introduced and analytically applied to tackle the theoretical shortcomings in Analysis Part 1.

As outlined in the introduction to the thesis (Chapter 1), it is perceived that bitcoin is a contemporary example of a disruptive innovation that has the potential to revolutionize the financial system, as we know it today. Although the founder of the theory of disruptive innovation, Clayton Christensen, argues that many researchers, writers and consultants use the term "disruptive innovation" too loosely and misunderstands the basic core concepts, we argue that bitcoin is indeed a disruptive innovation *(Christensen et al. 2015)*. This is further elaborated by Hans Henrik Hoffmeyer, who argues that bitcoin in many ways is a paradigm shift and something that is able to disrupt an industry that has never had competitors before:

HHH: *"The paradigm shift takes place in relation to several things. In relation to the political: to move from a politically based currency to a mathematically based currency. (…) In the very old days, we had commodity-based currency and it was a question about how many horses you sold etc. It is a paradigm shift. Another paradigm shift is that traditional currencies have zero competitors. They have never had that before. It's the first time they've got it. That's it." (App. 7: 191-192)*

As bitcoin is a new technology that represents a fundamentally new way of thinking, we find it appropriate to incorporate contributions from the theoretical landscape of innovation to explain some of the deviations from the bubble theory, which are observed in the bitcoin market.

7.1 Theoretical Frame

Initially, it is considered important to clarify the link between disruption and innovation to support the choice of the theoretical landscape of innovation. As Clayton Christensen claims, *"a disruption displaces an existing market, industry or technology and produces something new and more efficient and worthwhile. It is at once destructive and creative" (Howard 2013)*.

Meanwhile, an innovation is defined as a new idea, device or method and as the application of better solutions that meet new requirements, unarticulated needs or existing market needs *(Maranville 1992)*. In practice, it can be difficult to set the two apart, but one can think of it this way: A disruption is per definition an innovation but not all innovations are disruptive. Thus, this supports that the theoretical field of innovation is applicable in this case.

Furthermore, as bitcoin is digitally, hence technologically, founded, it can be defined as a technological innovation cf. Schilling (2013): *"the act of introducing a new device, method, or material for application to commercial or practical objectives" (Schilling 2013: 1).*

As the nature of bitcoin promises a new digital payment system that can fundamentally change how financial systems are perceived, an even more precise definition might be that suggested by Hans Henrik Hoffmeyer, who defines bitcoin as a digital disruption according to the following conditions:

HHH: *"It requires three things to be speaking of a disruption, a digital disruption. Three things define what you've seen in these industries. 1) That you have made a digital version of a physical product, 2) you have been able to distribute it to zero in cost, 3) everyone can consume it anywhere." (App. 7: 183)*

Moreover, leading research and advisory company Gartner, Inc. more officially defines a digital disruption as *"an effect that changes the fundamental expectations and behaviors in a culture, market, industry or process that is caused by, or expressed through, digital capabilities, channels or assets" (Gartner 2018)*. This is believed to adequately comprise the nature of bitcoin and thus manifest its theoretical field of belonging. The bubble theory, on the other hand, is not specific to market characteristics of innovative technologies or products but has a more general take on bubble formations across different markets and industries *(Shiller 2015)*.

From the field of innovation theory, we specifically focus on theories that address diffusion of new technologies as these logically complement the first part of the analysis. However, one should notice that the chosen innovation theories are developed to illustrate products and services. It can be discussed whether bitcoin should be interpreted as a mere product as it also comprises a systemic revolution. Nevertheless, bitcoin is a technological innovation, as argued

above, intended for use, which justifies a presumption that the theories are applicable in this context.

7.2 Innovation Patterns

As a starting point to this analytical perspective, the theoretical work of Everett Rogers (1983) on the diffusion of innovations and adopter types is considered relevant to further elucidate the long-term type of investor identified in the first part of the analysis.

When looking at almost every new technology's performance improvement and the rate at which the technology is adopted, it has been shown repeatedly to conform to an S-shaped curve *(Schilling 2013)*.

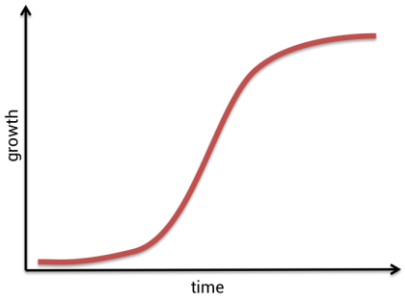

Figure 17 – S-curve

Two types of S-curves are found in the innovation literature. The S-curve for technology performance improvement and the S-curve for technology diffusion. Although the two S-curves are related, they are fundamentally different processes *(Schilling 2013)*. This analysis focuses on the S-curve for diffusion of technology as we continue to focus on the behavior of the actors observed in the bitcoin market. It should thus be made clear that the S-curve of diffusion is in part a function of the S-curve for technology performance improvement; as the technology is better developed, it becomes more certain and useful, facilitating the adoption by the mass *(Schilling 2013)*.

The S-curve for technological diffusion, i.e. the spread of a technology among a population, is obtained by plotting the cumulative number of adopters of the technology against time *(Rogers 1983)*. This yields an S-shaped curve because the adoption is initially slow when an unfamiliar

technology is introduced to the market; it then accelerates as the technology becomes better understood and utilized by the mass market. Eventually, the market is saturated which causes the rate of new adoption to decline *(Schilling 2013).*

7.2.1 Adopter Categories

The S-curve of technology diffusion can further be explained as a process of various categories of people adopting the technology with different speed levels. Rogers (1983) identifies five types of adopter categories each with their distinct characteristics. The criterion for the adopter categorization is based on innovativeness, the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a social system *(Rogers 1983)*:

- Innovators (2.5%): The innovators are the first individuals to adopt an innovation. They are characterized as comfortable with a high degree of complexity and uncertainty. The innovators typically have access to substantial financial resources and though they are not always well integrated into a particular social system, they play an extremely important role in the diffusion of an innovation, as they are the individuals who bring new ideas into the social system.
- Early Adopters (13.5%): The early adopters are well integrated into their social system and have the greatest potential for opinion leadership. Other potential adopters look to the early adopters for information and advice. This thus makes the early adopters excellent missionaries for new products or processes.
- Early Majority (34%): The early majority adopts innovations just before the average member of a social system. They are typically not opinion leaders, but they interact frequently with their peers. Their innovation-decision period is relatively longer than that of the innovator and the early adopter.
- Late Majority (34%): The late majority approach innovation with skeptical air and may not adopt an innovation until they feel pressured by their peers or it becomes an economic necessity. The late majority may have scarce resources, thus making them reluctant to invest in any adoption until most of the uncertainty about the innovation has been resolved.
- Laggards (16%): The laggards are the last in a social system to adopt an innovation. They are highly skeptical of innovations and innovators and must feel certain that an

innovation will not fail before adopting it. They may base their decisions primarily upon past experiences rather than influence from the social network, and they possess almost no opinion leadership.

Rogers (1983) emphasizes that the five adopter categories are ideal types, which are conceptualizations based on observations of reality and designed to make comparisons possible. This means that there are no pronounced breaks in the innovativeness continuum between each of the five categories and exceptions to the ideal types are possible *(Rogers 1983)*.

Figure 18 below illustrates the adoption of an innovation over time by the members of a social system. Both curves build on the same data: The blue bell-shaped curve represents the number of individuals from the five identified groups of consumers adopting a new technology, whereas the yellow S-curve shows these data on a cumulative basis, where a 100% market share represents complete adoption *(Rogers 1983)*.

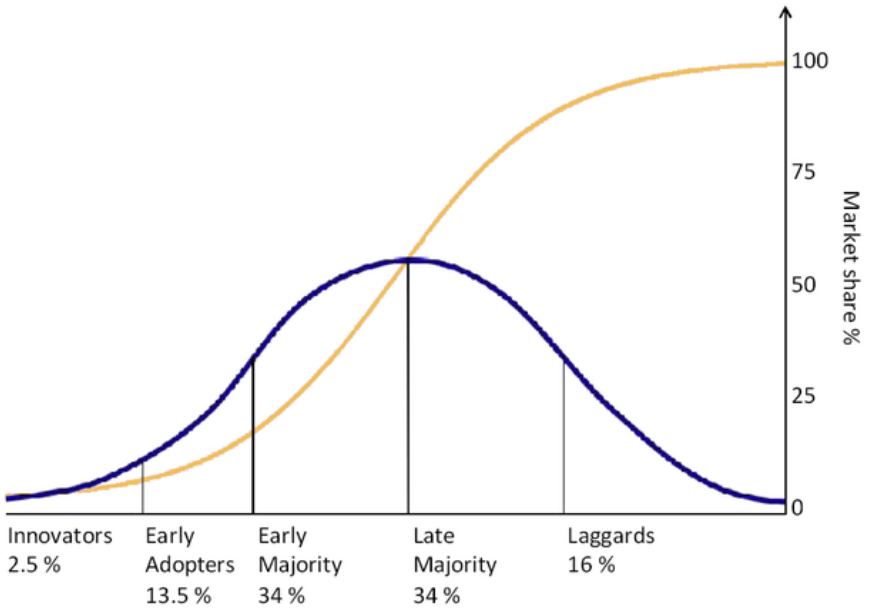

Figure 18 – S-curve and adopter categories

In practice, the bell-shaped curve may be skewed sideways, and neither is the shape of the S-curve set in stone as unexpected changes in the market, component technologies, or complementary technologies can shorten or extend the life cycle *(Schilling 2013)*.

7.2.2 Adopter Categories Applied

In the first part of the analysis, two types of investors were identified in bitcoin market. The bubble theory only takes account for one of the types; the short-term speculative investor. On the other hand, an explanation for the long-term technology believer, also present in the bitcoin market, is found within the innovation perspective.

In his theory, Rogers (1983) describes the first adopters of a new technology as *innovators*, with the characteristics of being the first individuals to adopt an innovation and comfortable with a high degree of complexity and uncertainty. In the interviews and the survey from Økonomisk Ugebrev, it appears that the long-term investors are motivated by the future potential of the technology and of bitcoin as a mean of payment, which indicate that these investors already to some extent have adopted the innovation (Figure 13). Further, the high volatility in the bitcoin market suggests that the investors are comfortable with the high degree of uncertainty and complexity.

It can though be discussed if the long-term investors only are *innovators* or if part of them belongs to the category of *early adopters*. Numerous opinions about bitcoin are expressed in the news media and online forums constituting a kind of opinion leaders, which is one of the characteristics of the early adopters *(Rogers 1983)*.

It was further observed in the survey from Økonomisk Ugebrev that more investors belonging to the younger generations (under 40 years) have either invested in cryptocurrencies before 2017 or within 2017, whereas the investors belonging to the older generations (above 51 years) are more skeptical and do not want to touch cryptocurrencies (see Figure 11).

Although Rogers in his original theory did not find a relationship between age and adopter category, he did emphasize that there are greater differences in age between the adopter categories when looking at the age at the time of the actual adoption, rather than the age at the time of the data collection *(Rogers 1983)*.

The relationship between age and innovativeness has though been examined in two separate studies, where it was found that the relationship between age and innovativeness does indicate that younger people predominantly belong to *innovators* and *early adopters* whereas older people to a larger extent are represented in the *late majority* category *(Green et al. 1985;*

Bohlen & Beal 1957). This thus fits well with the results of the survey, which further substantiates the categorization of the more long-term investors whom can be characterized as a mix of *innovators* and *early adopters.*

This categorization is further elaborated by Simon Ousager who points out the value of digital assets for the younger generations:

SO: *"I actually think that Digital Gold is a very good way to look at it. Gold, which you can send to each other. There is a limited amount and you can send it over the Internet. And it works. Digital gold may be a bit silly but look at people under the age of 30. They have no relation to gold. Super stereotypical, but they relate to Snapchat, Facebook, digital platforms and Instagram likes. They see a great value in things that are already 100% digital. For them, the concept of digital gold is more tangible than the concept of gold, and I think that some of the old economists forget that. So, I think it is a new asset class. How big it is going be, I cannot predict." (App. 5: 164)*

Following the elaboration on the adopter types, it is considered relevant to return to the actual adoption rate. Rogers (1983) points out that a curious feature of technology diffusion is that it often takes far longer than the diffusion of the information about the technology. This is an observation we have come across throughout the thesis. Both through our interviews and during general searches on the Internet, it appears that information about bitcoin is widely distributed though the actual usage of bitcoin is still quite limited *(Google Trends 2018).* As Lars Holdgaard also explains:

LH: *"If you really understand what bitcoin can… can you mention some places where bitcoin and blockchain are used for something? Because I can't. I cannot list any real thing it's being used on. There are newspaper articles that Mærsk uses it with their blockchain. These are only research projects. There is not anyone who uses it yet." (App. 6: 171)*

This is further consistent with the categorization of the long-term investors as *innovators* and *early adopters*. As observable in Figure 18 above, the categorization of adopters and number of adopters correlate. Our characterization of the more long-term investors thus implies that bitcoin is located very early on the S-curve, which suggests that bitcoin is far from being

adopted by the mass. As the theory further states, it can take years or even decades to move further on the curve *(Rogers 1983)*.

Crypto trader Jacob Skaaning agrees on this finding, saying that bitcoin is far from being an everyday use case:

JS: *"It depends on where we are and what we are talking about. Are we talking price or actual usefulness of the product? I was thinking about the price, but you can also think about the mass adoption, the S-curve. But you have to think about how difficult it is to buy crypto. If we're seeing an S-curve it means that my mom is able to trade or buy bitcoin on her own. I think we are very far from that. You have to understand the market but also the security in bitcoin. If she writes one letter wrong when sending her bitcoin, no bank or institution is going to help her. The money is lost." (App. 1: 134)*

The answer to why the information diffusion is far more ahead of the actual technology diffusion might lie in the complexity of the underlying technology and in the development of the complementary resources that make the technology useful *(Schilling 2013)*.

Given the identification of bitcoin as being at an early stage of adoption, it is important to be aware that the market development continually is subject to a high degree of uncertainty. Whether bitcoin represents the new Internet, a paradigm shift or modern society's best example of a speculative bubble is yet unknown though the technology certainly holds a potential. As Jacob Skaaning argues, bitcoin is still very young:

JS: *"Bitcoin is only nine years old and I'm sure all the problems will get solved. The best brains in the world are working on this every day. Just look at Visa credit cards or Facebook. When they first started, the technology didn't have the capacity of so many new users every day because of small servers etc. I think it is the same with bitcoin." (App. 1: 134)*

7.3 Hype Cycles

The common innovation patterns applied above are part of the basis for the *hype cycle* framework which in this section is introduced and applied to further explore the observations of the market behavior in the first part of the analysis. The hype cycle is an analytical tool

specifically developed to understand how technological innovations evolve over time *(Gartner 2018)*. The hype cycle provides a graphic representation of the various stages of an emerging technology from the early break-through of a potential technological innovation to the mainstream adoption of the technology.

The illustrated model shows how expectations to a new technology tend to over-inflate in the early stages of the cycle and then proceed to a minimum when it is experienced that the technology yet fails to deliver on the overly hyped expectations. As more and more instances of the use and benefits of the technology contradict the low level of expectations, confidence in the relevance and potential applicability of the technology starts to recover and increase, though not re-reaching the hyped level of the early inflated expectations *(Gartner 2018)*.

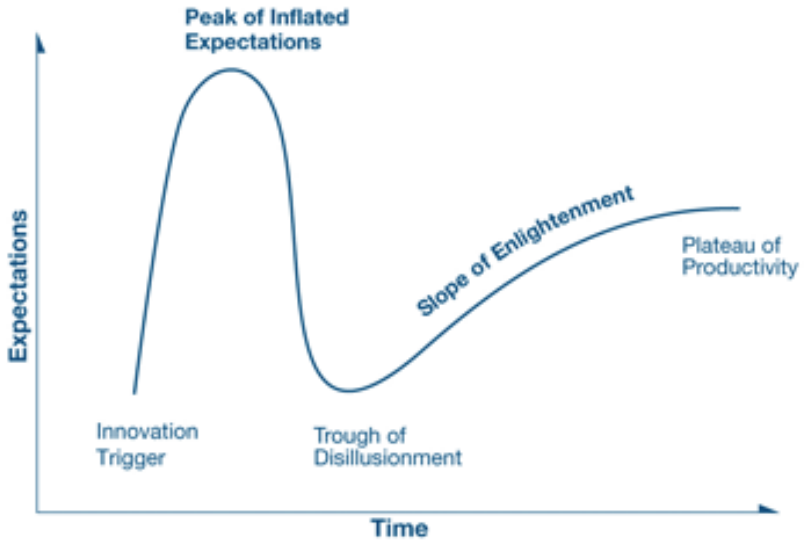

Figure 19 – Gartner's Hype Cycle (Gartner 2018)

Though, before further exploring the hype cycle, we shall briefly investigate its theoretical foundations in the work of Amara (1988) that after all supports the relevance of including the hype cycle framework for this analytical purpose.

7.3.1 Amara's Law

The illustration of the hype cycle builds on the work of American futurist Roy Charles Amara who in broader terms dedicated his research to expand the existing understanding and interpretation of the long-term consequences of technological, societal and environmental

changes *(Institute for the Future 2018)*. The specific underpinning of the hype cycle framework is Amara's formulation of people's erroneous forecasting abilities regarding new technologies, popularly referred to as *Amara's Law*, which states that:

> *We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run.*
>
> *- (Oxford Reference 2018)*

This deduction stems from extensive research and practice within the field of forecasting and planning of the future. Among others, this has resulted in a list of ten rules of thumb recognized from common pitfalls in long-range forecasting including a theoretical contribution of how technological diffusion curves are mistakenly perceived by humans *(Amara 1988)*. The figure below illustrates the perception of the diffusion of a technological innovation that resembles the S-curve, as referred above, against the actual diffusion curve.

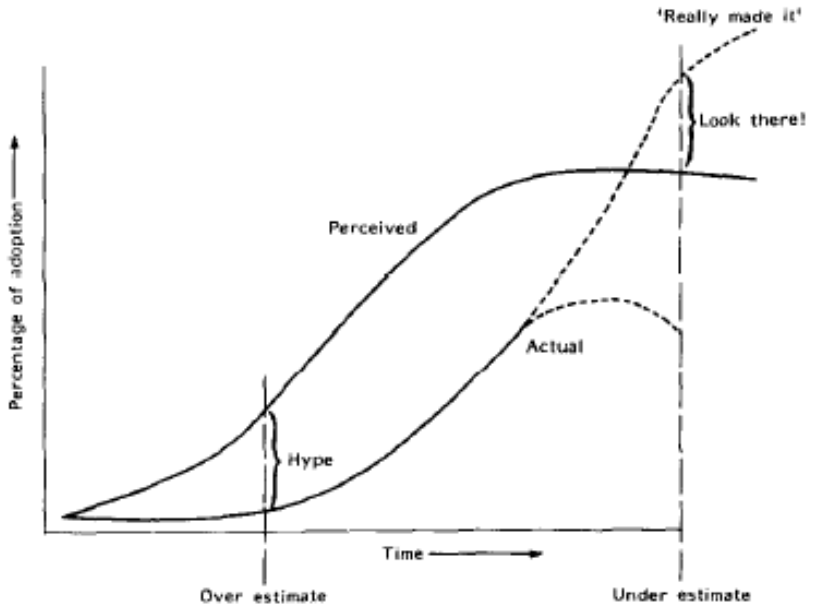

Figure 20 – Diffusion curve, underestimates and overestimates (Amara 1988: 399)

The illustration shows how the perceived diffusion curve clearly exceeds the actual diffusion in the short run but also clearly is below the actual curve in the long run, provided that the technology fulfills its early promises. The perceived diffusion curve fails by ignoring that no matter how attractive a technology appears at an early stage, new technological capabilities do

not immediately translate into adoption due to high initial costs in terms of, among others, cost/benefit ratios and necessary *in situ* adjustments *(Amara 1988)*.

This ignorance results in a "hype gap", as appearing in Figure 20. Despite that the first version of a new technology rarely is successful but requires many adjustments over time to be publicly adopted, the early-stage hype tends to accompany almost every technological innovation *(Amara 1990)*. At the same time, the long-run successful integration and sense-of-naturalness of a technology in our daily lives are often difficult to rightfully imagine in advance resulting in the reverse gap between the long-term curves *(Amara 1988)*. These findings are considered highly relevant when analyzing a disruptive technology.

Amara's Law quite resembles the concept of cognitive *biases* as introduced in section 4.4. It is therefore thought of as the identification of a specific bias that evolves from our limited forecasting abilities regarding emerging technologies. In any case of emerging technologies, the estimate of the future impact must be characterized as subject to a high degree of uncertainty, i.e. similar conditions as in Kahneman & Tversky's theory *(Kahneman & Tversky 1974)*.

Besides the general difficulties in forecasting the impact of technological innovation, Amara (1990) moreover distinguishes between *ladder innovation* and *incremental innovation*. Ladder innovation covers revolutionary technological breakthroughs, whereas incremental innovation most often occurs progressively around an existing technology. Being a truly disruptive phenomenon, bitcoin is anticipated to fall within the category of ladder innovations. Obviously, ladder innovations in the shape of radically new technologies are almost impossible to forecast both in terms of characteristics and capabilities but also in terms of their future social and economic impact *(Amara 1990)*. This humbleness towards fundamentally new innovations is perceived to be a valuable reflection to this project posed by the work of Amara.

7.3.2 Gartner's Hype Cycle

Based on the theoretical layout above, Gartner, Inc. (Gartner) has developed the hype cycle practice methodology. As a company, Gartner is dedicated to deliver impartial and actionable technology-related insights *(Gartner 2018)*. Gartner's hype cycle was first introduced in 1995 and has since developed into a widely used and recognized tool to understand the progression of emerging technologies *(Gartner 2003)*.

As mentioned in the preface to this section, the hype cycle is illustrated in Figure 18. Overall, the curve is divided into two parts. The first part is driven by unsubstantial hype, mainly spurred by the media, whereas the second part is driven by performance gains and a growing adoption rate *(Gartner 2003)*. In detail, the shape of the curve is determined by five phases:

1. Technology Trigger: The cycle is initiated by the public breakthrough of a new technology.
2. Peak of Inflated Expectations: On the rise to the peak, the potential of the technology receives heavy media attention. As problems with the early version of the technology become publicly known, the hype curve starts to slope downwards.
3. Trough of Disillusionment: The public interest wanes as the technology has not lived up to the overinflated expectations and it is thus widely discredited. However, the technology still continues to be improved and early adopters find their way.
4. Slope of Enlightenment: At this stage, the technology has managed to spread a more general understanding of its applicability.
5. Plateau of Productivity: The mainstream adoption begins as the real-world benefits of the technology are successfully demonstrated and publicly accepted.

Thus, the hype cycle reflects a specific section of the total life cycle of a technology that typically occurs at an early technological stage *(Gartner 2003)*. The length of the time period for an innovation to pass through the various phases is highly dependent on the specific features and requirements of the technology. Moreover, the scale of the hype might vary depending on how revolutionary the technology is perceived to the broader society.

In line with the rest of the theories applied in this thesis, the hype cycle is built around the human factor in the sense that it incorporates human attitudes towards technology and innovation *(Gartner 2003)*. Therefore, it is considered ideal to expand the existing theoretical frame along with the diffusion theory.

7.3.3 Hype Cycles Applied

In the analysis of the market perspective, it was noticed that the bitcoin price curve has experienced several peaks over the lifespan of the technology (see figure below). The hype cycle approach seems to provide an adequate explanation for this observation if the various peaks are interpreted as periodically hype.

Figure 21 – Bitcoin price with highlighted peaks

According to the hype cycle framework, *"some technologies experience multiple rounds of vacuous hype before beginning a more-serious growth path" (Gartner 2003: 6)*. This encompasses that the hype cycle should not necessarily be viewed as strictly sequential when initiated by the technology trigger but leave open the opportunity that a technology simply might experience multiple rounds of hype before it really catches a grip and grows into mainstream.

However, the identified rounds of hype as pointed out in Figure 21 does not appear to be entirely unsubstantial since the price curve in all instances has managed to stabilize at a higher output level than the input level as the figure also illustrates. Instead of being empty periods of hype, the peaks are interpreted as periodical hype being part of an overall upward trend where adoption is slowly yet consistently increasing. Nonetheless, price increases also attract speculators who clearly contribute in driving the periods of hype as derived from the first part of the analysis. This, however, makes sense when the bitcoin network is still relatively small and primarily relying on future potentials, while the main application, for now, continues to be investment or trading.

The hype cycle explanation is moreover supported by the data from Google Trends in relation to the role of the media in fueling the hype of a new technology.

Figure 22 – Google Trends hype

As the figure shows, the search activity on bitcoin increases in the same periods as the price peaks are identified. This is assumed to also be a fair measure of the online media activity in the given periods, which suggests that the excessive media attention is part of boosting the price development presumably amplified by the feedback mechanisms in the market.

Regarding the role of the media in creating hype, Shiller and Gartner disagree. Shiller anticipates that the effect of word-of-mouth far exceeds the effect of the news media during the formation of a speculative bubble *(Shiller 2015)*. In the first part of the analysis, it was also found that social relationships had a certain influence on the decision to participate in the bitcoin market. At the same time, the Google Trends data shows that online activity peaks simultaneously with the peaks on the price curve which all in all suggests that both word-of-mouth and media effects are present. Again, social media somehow blurs the lines as a Google search might direct the user to an online social forum where reading about bitcoin online suddenly transforms into something resembling modern word-of-mouth influence.

For some technologies, it might take significantly longer than others to traverse the hype cycle, depending on the extent of factors inhibiting the adoption process. Therefore, the hype cycle framework distinguishes between three adoption speeds; "fast track" technologies, "long-fuse" technologies and "normal" technologies *(Gartner 2003)*. With reference to the case description (Chapter 5), bitcoin is considered a *long-fuse* technology. Long-fuse technologies are

characterized by several particularly high barriers that complicate and/or slow down the maturity process. Bitcoin, especially, fits the following long-fuse indicators:

- *Adoption/regulation issues*
- *Reliance on a new infrastructure (ecosystem) that needs time to evolve*
- *Major changes to business processes or the creation of a new business model*

- (Gartner 2003: 10)

The adoption speed of a long-fuse technology may be one or two decades, which further explains why bitcoin still experiences some of the early hype though the technology was introduced in 2008 *(Nakamoto 2008)*.

Long-fuse technologies also often appear as "phoenix" technologies, which covers one of the special hype cycle circumstances *(Gartner 2003)*. Phoenix technologies are exposed to a repeating cycle between enthusiasm and disillusionment. These are often technologies that encompass principal methodological challenges which hinder them in "crossing the chasm" to gain foothold within the majority of users *(Moore 1999)*. Phoenix technologies, however, tend to be re-hyped by the media just before obtaining a solid user interest *(Gartner 2003)*.

The concept of phoenix technologies appears interesting in light of the findings from our interviews where more experts doubt that the world is yet ready for bitcoin or if layman ever will be able to understand the technological capabilities.

EXPERT	Is the world ready for bitcoin?
Jacob Skaaning	*"No, but I don't think that bitcoin is ready for the world either. There have been a lot of scaling problems with bitcoin. Transaction time has been long and fees have been too high. It is bitcoin's challenge but not its fault. The development of the technology is steadily increasing, but when a lot of people enter the market at the same time, the technology is not yet stable enough." (App. 1: 134)*
Camilla Frost Jensen	*"No, I actually don't think so. If you think of it in terms of maturity I believe we will see progression within the next five to ten years. I think we are very early on the hype cycle[23]." (App. 4: 156)*
Simon Ousager	*"I think that bitcoin does not care if the world is ready for bitcoin. I'm hopeful, especially in a country like Denmark. We are digital, we are adaptable. All in all, we have some relatively gifted politicians and skilled officials. And some talented entrepreneurs." (App. 5: 166)*
Lars Holdgaard	*"Yes, but I never believe that "Mr and Mrs Denmark" will understand it. If I ask you how the Internet works, I think 99% out of a 100 will be clueless. I come from DTU (Technical University of Denmark) and I can hardly understand it. The majority of people are not going to understand what it is. They don't have to. As consumers, we will just come to experience some other products. Developers understand it well and work with it." (App. 6: 174)*

Table 11 – Expert reflections on whether the world is ready for bitcoin

Even though the code is constantly improved, the systemic and mindset revolution that bitcoin requires might contribute to a temporary retention between the "Peak of Inflated Expectations" and "Trough of Disillusionment". But as previously suggested, the rounds of hype apparently win over slightly more of the long-term type of investors as the market generally depicts an upward trend despite the crash-like corrections. The complexity of bitcoin thus presumably makes it harder to place the technology within any framework though the hype cycle theory is considered to qualitatively add to the explanatory power of the overall theoretical framework.

This analytical angle contributes by situating our observations from the first part of the analysis in a broader context. What immediately resembled a bubble from the analysis of the market perspective (section 6.1) is thus interpreted as a temporary hype that is a specific stage in the process of introducing a new technology. On the other hand, the speculative element that is

[23] Camilla Frost Jensen is a former employee at Gartner, Inc. and is thus familiar with the hype cycle methodology.

clearly present in the bitcoin market is not considered the very same as "vacuous hype". However, the speculative element might be amplified through the feedback mechanisms with a starting point in a classic media-facilitated hype.

7.3.4 Alternative Interpretation of the Hype Cycle Framework

The two original functions of the hype cycle are, on the one hand, to illustrate the progress of a single technology as has been done in the section above, but also to compare the maturity of several emerging technologies by placing them relative to each other on the same curve *(Gartner 2018)*. On an annual basis, Gartner evaluates the technological landscape and publishes a report that places emerging technologies along the hype cycle, which also illustrates the relative evolution from the previous years *(Panetta 2017)*. Yet, from our data collection, it is suggested that the hype cycle could be thought of in a third way.

Instead of depicting the technology's maturity journey towards mainstream adoption, the hype curve may as well be an individual journey that we all travel in our minds towards an understanding of a new technological phenomenon. In this view, the horizontal axis in the illustrated hype cycle (Figure 19) then represents the maturation of our individual understanding over time as a substitute for technological maturity. Portrayed like that, it is not only the new emerging technology which must prove useful in our existence but likewise a matter of a mental development towards the ability to imagine the world different than it is today. However, research within the behavioral aspects of decision-making shows how humans tend to demonstrate an irrational yet strong preference for remaining in status quo because the disadvantages of leaving the current state by default are perceived larger than the advantages *(Kahneman, Knetsch & Thaler 1991)*.

This interpretation of Gartner's hype cycle is inspired by our interview with Hans Henrik Hoffmeyer (Appendix 7) who also generally uses the hype cycle framework as a mean of explaining the occurrences in the bitcoin market *(Andersen 2018)*.

HHH: *"You can go through it [the hype cycle] as a person, but it can also be an authority or something else. But it has something to do with being on a maturity journey, which takes time. If you are exceptionally skilled or very dedicated, you can complete the journey relatively quickly, but everyone needs to carry out roughly the same journey. Some may have gone back and forth, but these are basically the same topics you've gone through. (…) I arrived*

here relatively quickly [points to the curve]. (…) I'm beginning to see the consequences, which I think it will make. There are probably some others who think that it has some other consequences.

(…)

Everybody goes through the cycle. It's only a matter of time. (…) Everyone is heading in this direction. They come to the same conclusions at one point or another. State leaders will, nerds will, and children will. So that part of the journey is given. Then you can say: what do you believe? It depends on where you are on this journey. If someone says it's pure speculation when people buy bitcoin, then it's important to ask, "ok where are you?". You must be here [on the hype cycle] because you have not understood the fundamental change." (App. 7: 184)

The above suggests that individuals, as well as markets, pass through the phases on the hype curve when confronted with a new technological innovation. How far one has traveled the process of understanding the technology and its capabilities is then said to be expressed in how the technology is talked about. The hype cycle thereby also becomes a tool with which to detect the individual progress in understanding a new phenomenon.

From the interpretation of the hype cycle, the overall market behavior is thus described as an accumulation of all the individual maturity journeys. The observable behavior will then be characterized by where most have arrived in their understanding. The two main types of investors, as identified in the first part of the analysis, might in this explanation then represent two different stages on the hype cycle where the major part of the investors has not yet reached the same level of understanding as the minor part.

This alternative interpretation of the hype cycle framework is thus considered an interesting theoretical contribution, which is clearly relevant in explaining the bubbly tendencies experienced in relation to the diffusion of new technologies. But, on the other hand, we are aware that the data basis and analytical approach in this thesis basically does not support a further investigation of this research angle within the current scope. However, it is still considered a valuable learning in terms of assessing the available material and ongoing public opinions about bitcoin and moreover also a relevant reflection regarding the responses to the survey from Økonomisk Ugebrev (Appendix 8).

7.4 Preliminary Conclusion Part 2

The intention with the second part of the analysis was to further elaborate on how the concept of speculative bubbles unfolds in the context of disruptive innovations by building upon the theoretical deviations identified in the first part of the analysis. This part of the analysis was organized as an interaction between theory and application with the purpose of introducing a new analytical angle, which specifically accounts for the disruptive aspect of bitcoin.

It was found that the theoretical field of diffusion of innovations provided an adequate explanation for the group of long-term investors by characterizing them as *innovators* and potentially *early adopters*. This moreover suggested that bitcoin is in the early stages of technological maturity, which explains the modest adoption relative to the dominant grouping of speculative investors.

Following, the hype cycle framework was introduced as a mean of analyzing the early stage of the technological life cycle. The hype cycle provides a framework for understanding the several rounds of rapid price increases that bitcoin has been subject to. It was found that bitcoin, due to the high complexity, could be defined as a *long-fuse* technology, which explains why it is still subject to the early hype that precedes mainstream adoption. An alternative interpretation of the hype cycle framework was further introduced and discussed in relation to the individual maturity journey of understanding a fundamentally new phenomenon like bitcoin.

This analytical perspective provides an understanding of the high degree of uncertainty surrounding an early-stage technology. The theoretical field of innovation is found to contribute to a more holistic explanatory model as this perspective places the empirical findings in a greater market process grounded in the essential characteristics of bitcoin.

8 Theoretical Reflections

To round of the analysis, it is considered appropriate to present the authors' reflections on how the two theoretical perspectives, bubble formation and innovation diffusion, complement one another in the quest of a further understanding of how speculative bubbles unfold in the context of disruptive innovations. The intention of this section is thus to assess how contributions from

the field of innovation theory further enrich the bubble framework with reference to the analytical purpose of the thesis.

By introducing the selected theories of how new technologies diffuse into market adoption to support and further elucidate the findings from the first part of the analysis, it is believed that the aggregate explanatory model is strengthened. Overall, the perspectives are perceived to successfully combine as they certainly expand the basis for understanding the case. On the one hand, the theory on speculative bubbles is thought to provide a detailed framework for analyzing the behavioral patterns in markets by presenting an in-depth theory on the various aspects that drive price developments. On the other hand, the inclusion of theoretical knowledge from the field of innovation seems to further contextualize the findings from the bubble analysis by placing the observed behavior in a market cycle and thereby broaden the view on the case. This perspective contributes positively to the analysis by offering a toolbox that accounts for the specific characteristics of bitcoin that the bubble theory does not comprise. Essentially, the theories of adoption patterns and hype cycles are considered to capture the empirical deviations from the bubble theory and thus finish the explanatory loop.

When blending theoretical perspectives, a point to always pay attention to is what the theories respectively intend to address, i.e. the theoretical domain. Differing underlying assumptions might potentially constitute a pitfall for using separate theoretical perspectives to inform one another. However, it is not our perception that the chosen theoretical perspectives comprise decisive contradictions that conflict the joint usage.

The focal objects of the theories are different though. The bubble theory is centered on human decision-making and economic behavior patterns, in line with the rest of the field of behavioral economics, whereas the innovation perspective primarily centers the innovation itself, i.e. the product or technology. However, the work of Amara (1988) that underpins the hype cycle framework also points to an irrational tendency for humans to overestimate technological impacts in the short run and underestimate them in the long run. This resembles the view of human nature within the behavioral school, which implies that decision-making is biased due to limited cognitive capabilities. Besides that, the diffusion theories refrain from considering human nature as such, which at least does not conflict with the assumptions underlying the bubble theory. For example, the theory of adoption patterns does not explain what causes the

different adoption categories, only that they are there. The approach to human behavior is thus descriptive as opposed to explanatory.

Both theoretical perspectives include the effect of *expectations* as a central component, which for the bubble theory is also highlighted in the literature review (Chapter 2). However, the expectations are aimed at different objects. In terms of speculative bubbles, expectations refer to a belief in an ever-increasing price trend, whereas expectations in the hype cycle framework refer to the technology and an initial conception that it is capable of solving all the problems in the world *(Gartner 2003)*. The accumulated expectations cause respectively "speculative behavior" and "technological hype" depending on which explanatory model is selected, though it is assumed that the intentions are to describe similar situations. The difference is whether the underlying asset is interpreted as a speculative object solely intended for resale or an emerging technology. In the case of bitcoin, we argue that both views to some extent are present. This suggests that both types of expectations somehow affect the price level simultaneously.

Thus, when studying new technologies from a bubble perspective, a complex issue on how to separate the effects of price speculation and technological hype seems to arise. At the current state, it is moreover difficult to assess whether one, in fact, to some extent precedes the other, though in practice one could imagine that speculation arises from an early hype, also with reference to the role of the media as the catalyst.

These theoretical reflections thus round of the analytical part of the thesis. A discussion of the thesis components and the findings thereby obtained continues in the following chapter.

9 Discussion

The discussion is structured around the major parts of the thesis. The intention is to critically assess the methodological and theoretical pitfalls as well as to comment on the findings of the analysis. We attempt to embrace the main points, though it is recognized that every pitfall might not be grasped. Thus, the discussion is not exhaustive but will consist of key points found important to elaborate on.

9.1 Research Design

A mixed methods approach was applied to investigate the thesis statement, integrating both qualitative and quantitative methods. This approach was selected to explore the case both broadly in terms of describing the market and in-depth in terms of understanding the mechanisms at stake. However, it can be discussed if the selection of the methods becomes too extensive and if the study manages to fully exploit the methodological combination.

To further exploit the interaction of the methods, it might have served the results of the data collection to let the methods inform each other more, for example by using the findings in the survey in a structured way as the basis for the expert interviews. Additionally, another possibility could have been to construct a survey of our own based on the knowledge from the interviews and the survey provided by Økonomisk Ugebrev. These different methodological approaches might have produced other empirical findings. On the other hand, as the thesis is grounded in an explorative process, it is rather challenging to detail-plan the methodological approach prior to the confrontation with practice, as flexibility is preferable. The methodological approach chosen thus seems to fit the purpose, while it is acknowledged that other approaches could have been used.

Although the use of an interaction between the methodological approaches was initially reflected upon, the explorative nature of the research forced the authors to make certain choices. In the initial phase of the research, the use of sentiment analysis[24] to support the empirical data basis was discussed. The intention of incorporating a sentiment analysis was to investigate whether the collective mood of social media channels, such as Twitter and Reddit, correlate with the fluctuations in the bitcoin price. This methodological approach would most likely contribute with further information regarding the actors in the market than what was derived from the existing data foundation. Although this approach was initially discussed and further investigated, the analytical tool to proceed with was not available.

Further, as mentioned in relation to the data foundation of the thesis, it is worth considering the representativeness of the survey from Økonomisk Ugebrev as the respondents of the survey

[24] Opinion mining or sentiment analysis is the computational study of people's opinions, attitude, appraisals and emotions towards entities, individuals, events, topics, etc. *(Aggarwal & Zhai 2012).*

belong to a specific group of investors qua the media's audience[25]. Though the sample is not representative for the overall investment behavior, as noted in section 3.3.5, it is still a large sample, which contributes to our research in that it provides an indication of the current investment behavior within cryptocurrencies. Information, that would have been unknown if not for the survey.

However, the importance of the national origin of the respondents is also an attention point regarding the data collected. As the survey merely captures the opinions from Danish investors, the views potentially reflect a national situation, where corruption in financial institutions and the government is very seldom. Thus, the survey does not capture the global opinions of the application and usefulness of bitcoin. The potential of bitcoin may be considered differently depending on geographical whereabouts. The usability, therefore, might weigh higher than the speculative incitement in some parts of the world, which the survey does not capture. This is thus a point of criticism in relation to the representativeness of the survey, which negatively affects the generalization of the findings.

9.2 Theoretical Framework

The thesis incorporates two different research fields to investigate the thesis statement; speculative bubbles and diffusion of innovations. It is considered relevant to reflect upon the choice of theories as the theoretical framework also determines part of the validity of the thesis.

Theoretical validity was first and foremost sought achieved by incorporating an extensive theoretical foundation from the academic field of speculative bubbles. The theoretical foundation was supplemented by complementary theories to underpin the relevance. The academic contributions stem from the renowned scholars Shiller, Akerlof, Kahneman, Tversky, Amara and Rogers, as well as the world-leading research company, Gartner, Inc. By applying theories from widely recognized and reviewed theorists, the validity is believed to increase, as other peers and researchers have validated the work.

[25] Økonomisk Ugebrev is aimed at the top of business and the financial sector, as well as private and semi-professional investors *(Økonomisk Ugebrev 2018)*.

The choice of theories naturally shapes the findings of the analysis. Choosing a theoretical direction implies the discretion of another. Other theories, for example, *The Psychology of Investing (Nofsinger 2005)*, could have been applied to address the decision-making behind investments. Something else interesting might, in fact, have been captured through a different theoretical lens, though at the same time, it is important to be aware of the connection between the choice of theory and validity of the research. Other theories may decrease the validity of the research, which is accommodated with the theories chosen.

Finally, the thesis incorporates several theories to elucidate the research question. The main bubble theory applied is supported by other theories to compliment and enrich the overall theoretical framework. Although the supporting theories are used to expand and explain the vague aspects of the main theory, it can be discussed whether the theoretical synergies are fully utilized. However, the degree of interaction between the theories is dependent on the empirical basis, which after all determines what the theories should provide explanation to. Therefore, it cannot be ruled out that the supporting theories would have come more into play, had the empirical basis been different. It is thus something to consider though it is perceived that the supporting theories compliment and enrich the findings of the research.

9.3 Findings

The analysis is divided into two major parts based on different analytical perspectives. Part 1 concentrates on the explanatory power of the bubble theory by applying three underlying perspectives derived from the theoretical definition; the market, the actors and the asset. Part 2 further introduces diffusion of innovations as a fourth angle. Applying four perspectives in one study might be a bit extensive initiating a discussion of whether the research is trying to embrace too broadly. As the three perspectives applied in Part 1 each contain several aspects of interest, it is considered advantageous to further conduct in-depth analyses of the perspectives in separate sub-studies as a recommendation for future work.

However, it was chosen to carry out the analysis with all three facets of the bubble concept as the analysis exactly aims to exploit the interaction between the perspectives. Because the theory underlying the concept of a speculative bubble is both complex and consists of a wide range of aspects, the use of all three perspectives enables a holistic understanding of the concept. Thus,

the analysis seeks to move away from a unit-based study, as the aim is to obtain a comprehensive representation of the bubble concept.

Although the application of all three perspectives contribute to a holistic understanding of the concept, it is still important to remain critical towards the scope of the analysis, as the thesis indeed comprises many aspects on relatively few pages. It is thus reasonable to criticize the scope of the research based on the formal scope of the thesis, as we find that this does not allow an exhaustive exploration of each theoretical perspective.

Furthermore, the findings of the research in relation to the assessment of the explanatory power of the bubble theory are considered appropriate to reflect upon. As mentioned in the literature review, the bubble theories have been criticized for their empirical relevance, as it has proved difficult to separate the factors constituting a speculative bubble from other surrounding factors. This also implies certain consequences for the validity of the findings in the analysis, as it might be difficult to determine the practical explanation of the observations made in the bitcoin market. In relation to the feedback mechanism, for example, it is thus challenging to conclude to which extent the observed market behavior is caused by feedback loops and what, on the other hand, is attributed to other factors. The findings in the thesis are thus based on the theoretical explanations provided by the bubble theory, although one should keep in mind that there is some uncertainty regarding the actual causality. However, the purpose of the thesis remains to test the explanatory power of the concept and not to conclude whether bitcoin, in fact, is a speculative bubble.

9.4 Limitations of the Study

As pointed out in the section on the scope of the research, the study is delimited regarding several aspects. Some of these will be discussed further in relation to the findings of the thesis.

The study of this global phenomenon was delimited to only capture the perception of bitcoin from a Danish perspective by building on a survey and seven expert interviews conducted in Denmark. Covering any subject or phenomenon always implies for the researcher to aim for representativeness, which however is considered difficult due to the nature of bitcoin. By constituting a global economy, the disruptive element is exactly that bitcoin breaks down the

political borders and institutions that exist today. This is thought to contradict a context-dependent investigation.

As societies around the world are different and face different challenges, it is important to emphasize that the perception of the usefulness and future impact of bitcoin might vary significantly. As Hans Henrik Hoffmeyer points out:

HHH: *"We don't experience that kind of world because we live in little protected community here in Denmark. But if you look at Argentina, Venezuela and any other countries, why do they introduce "petro coin" in Venezuela? This is because there is no trust in the financial system. They do not even trust themselves. This is an option that you have never had before." (App. 7: 185)*

Of course, this is a central consideration when evaluating the conclusions based on the empirical foundation produced in relation to this study, which ultimately leads to a constraint in the generalizability of the findings.

On a theoretical level, Shiller proposes three categories of factors affecting the formation of speculative bubbles, from which this study primarily considers the psychological factors. The two other groups of factors, the structural and cultural factors, are immediately perceived more as externalities that constitute favorable terms for speculative bubbles to develop than core elements of the concept as such. The research is thus delimited from considering structural and cultural factors, although we are aware that these factors, according to the theory, contribute to the formation of speculative bubbles. Though the analysis is delimited to only focus on the psychological factors, it was considered complex to evaluate the observed behavior. A further introduction of structural and cultural factors is thought to only add to the complexity, which follows the above-mentioned critique of the theory regarding what factors that, all in all, constitute speculative bubbles.

9.5 Meta Perspective

The discussion is finalized by proposing a higher perspective that essentially discusses the view put forth in this thesis[26]. This consideration is inspired by Hans Henrik Hoffmeyer denoting bitcoin a *paradigm shift (Andersen 2018)*. A paradigm implies a unified set of norms and beliefs that determine the prevailing theories and realms of understanding *(Den Danske Ordbog 2018)*. Considering a truly disruptive phenomenon, one could question whether it, in fact, is meaningful to understand something fundamentally innovative, potentially constituting a new financial and governmental paradigm, through the lens of an existing theoretical framework.

In principle, this thesis intends to do exactly that. What is basically done by the authors is to approach an understanding of the bitcoin phenomenon through a theoretical framework that is already known to us. However, being a truly disruptive innovation potentially implies that the phenomenon does not let itself characterize through predefined categories. As mentioned earlier, bitcoin is suggested to represent an entirely new asset class. Thus, the question is how that affects the application of currently prevailing theoretical concepts.

Moreover, an interesting consideration is the potentially occurring shift in how value is interpreted, which is quite relevant to the application of the bubble concept in the case of bitcoin. Bitcoin is often analogously compared to gold in terms of illustrating the bitcoin mining process. It is though frequently argued that the striking difference is that gold has a value because it is a physical element, whereas bitcoin has no value because it is a digital asset. However, in the digitized world that the younger generations are born into, digital assets are well understood and perceived as valuable, whereas the usefulness of gold is far more unrelatable. Simon Ousager also presents this idea in section 7.2.2 in relation to the early adoption of the technology being dominated by the younger segments *(Simon Ousager, Appendix 5)*.

After all, these reflections encourage humbleness towards truly disruptive innovations and their course of future development. This also draws upon the alternative application of the hype cycle framework (section 7.3.4) considering the individual maturity journey when confronted with a disruptive phenomenon.

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[26] *Meta* means "about the thing itself" *(Urban Dictionary 2018)*.

10 Conclusion

The intention of the thesis was to contribute to the academic research field with a nuance to the discussion of how the existing concept of speculative bubbles is applicable in the context of a truly disruptive innovation. It was initially argued that bitcoin is a contemporary example of such phenomenon and thus a case study was conducted to explore what implications that hold in relation to the original bubble theory. The analysis was carried out in two parts; the first part was dedicated to an investigation of the explanatory power of the bubble concept in the case of bitcoin. The second part introduced an alternative theoretical perspective to further elaborate on the findings from the initial analysis and provide a basis for expanding the explanatory frame to capture the specific circumstances surrounding emerging technologies.

The concept of a speculative bubble was operationalized for this analytical purpose through the identification of three perspectives underpinning the definition; the market, the actors and the asset. By investigating the explanatory power of the bubble concept, it was found that some deviations from the theoretical frame are present in the bitcoin case, which are not considered by the existing theoretical framework.

From the analysis, it was found that the bitcoin price has experienced several peaks during the lifespan of bitcoin, in fact, some relatively steeper than the peak in 2017 that spurred the public discussion on the presence of a bubble. What is interesting is that the price has never decreased to a value below the input level but always managed to stabilize at a higher output level after a peak. Furthermore, it was discovered that the market indeed seems to be dominated by speculative behavior, yet it was also realized that a second grouping of investors is present who are in for other reasons than earning a profit. Though outnumbered by short-term speculators, this other type of investor is characterized by a belief in the future potential of the technology and has thus bought bitcoin as a long-term investment. Additionally, it was found that multiple perceptions of what bitcoin is and how it should be classified in terms of fundamental value exist. An assessment of the intrinsic value is considered quite the crux of anticipating an adequate explanation by the concept of speculative bubbles.

These findings point to some limitation in the explanatory power of the bubble concept in the context of a disruptive phenomenon. Therefore, theories from the theoretical field of innovation were introduced and applied to expand the explanatory model offered by the bubble theory. It

was found that the theoretical field of diffusion of innovations provided an explanatory frame for the group of long-term investors by placing them as some of the earliest adopters of the technology. Moreover, it was found that the several rounds of price increases that bitcoin has been subject to could be explained as rounds of early-stage hype that are part of a maturity cycle that precedes mass adoption.

The findings suggest that some elements in the bitcoin case stem from the fact that it is an emerging technology and should theoretically be addressed so. The research field of innovation was found to provide a more holistic explanation by placing the empirical findings in a greater market process grounded in the essential characteristics of bitcoin. By joining the analytical perspectives, it is believed that the aggregate explanatory model is better extended to cover the context. However, when studying disruptive innovations from a bubble perspective, a complex issue on how to separate the effects of price speculation and technological hype is detected.

The generalizability of the study is, however, partly limited due to the representativeness and explorative character of the research. It is recognized that the empirical results are primarily obtained in a Danish context, which demands further exploration to capture the globality of the phenomenon. The theoretical reflections and the contributiveness of the initiated conceptual discussion are yet not considered to be invalidated for that reason.

Finally, it should be noted that this thesis continues an assumption that disruptive phenomena can be understood in terms of existing conventions. This potentially violates the essence of true disruption; that it fundamentally changes the way we think.

11 Future Research

This research stands as a first attempt at academically elucidating how the concept of speculative bubbles extends to the context of a disruptive phenomenon. This implies that the study is characterized as primarily explorative and thus lays the foundation for further expanding the research. With reference to the discussion of the study's methodological representativeness combined with the fact that the findings, to a large extent, are based on semi-structured interviews potentially with a positivity bias, additional empirical testing is first and foremost recommended.

As a further continuation of the research, following the discussion on the wide span of the thesis, the three analytical perspectives derived from the bubble theory to conduct the first part of the analysis could advantageously be split into separate sub-studies. The limited scope of the thesis is considered not to enable an exhaustive exploration of each theoretical component.

Additionally, the discourse-related aspects of the study remain unexplored for now, though it is suggested that the media and online social activity play a notable role in the case of bitcoin. This is moreover considered an entity that could carry its own research project focusing on how the hype surrounding the phenomenon is constructed through linguistic usage. *Stories* is theoretically recognized as a concept that is vital to bubble formation and an important behavioral driver, yet the theory does not cover how these strong narratives occur and how they fundamentally work. Such study naturally implies an even more constructionistic approach than the present one which once again emphasizes how the philosophical standpoint determines what we can realize as researchers.

In terms of today’s society, the bubble theory already appears slightly outdated regarding the role of online social forums in generating collective investor enthusiasm, whether that be regarding price movements or technological capabilities. We cautiously attempt to address the potential stake in bubble formation during the analysis, but it is certainly a theoretical shortage that, in addition to the above, motivates future research.

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Appendices

Appendix 1: Interview with Jacob Skaaning

Interviewers:	Emilie Lang Borup & Christine Mohr Balslev (EC)
Participant:	Jacob Skaaning (JS), crypto trader/ Portfolio Manager at Baldr Capital
Interview type:	Face-to-face, Copenhagen S, Denmark
Date of interview:	8/2-2018
Interview time:	54 min 25 seconds

EC: Can you start of by telling a little bit about yourself?

JS: I am a cryptotrader. I have traded cryptocurrencies and bitcoin for five years, since 2013. I now also have a learning platform, where I teach other people about cryptotrading. In addition, I am also Portfolio Manager in Baldr Capital, which trades cryptocurrencies. Previously I traded for private purposes but now I do it as my work.

EC: The focus of our Master's Thesis is bitcoin, so we will concentrate the questions around that.

JS: That is totally fine.

EC: Can you tell us why you believe in bitcoin and why you have decided to become part of the network?

JS: I actually started my career by trading futures contracts. I day traded, which means that my trades were 10 minutes long and then I made two trades every 10 minute. That is very, very tough and very boring, but I became better and better. My mentor told me about bitcoin and other cryptocurrencies and I quickly became really good at trading cryptocurrencies. Instead of being in top 10% of the world trading futures, I came in to top 2% trading crypto. The reason I find the market so interesting, from a traders perspective, is that the market is very volatile. That is the worst condition for an investor, but the best condition for a trader. It is very important to distinguish between an investor and a trader. From a more fundamental perspective is bitcoin an opportunity to give freedom back to the people. Instead of the banks; Western Union, Nationalbanken and the State who controls the money policy, it is the bitcoin code that controls

the bitcoin market. Many people say that bitcoin is not regulated, but that is one big lie. Bitcoin is extremely regulated, but it is not the State that decides on the rules. But there are quite specific rules with bitcoin that determine how it works. You cannot change the rules within bitcoin. Every ten-minute a new block occurs and that is how it is going to be forever. No Parliament can vote that it should be 12 minutes eg. It will always be ten minutes. That is a consensus that is within blockchain. If you want to change something in bitcoin you have to have at least 95% agreement. So bitcoin is super regulated, it is just not the State that regulates it.

EC: You work as a professional trader. Do you personally believe in the technology or do you think of bitcoin as a more volatile market, which is good for you because you are a trader?

JS: I have different "hats". You have to separate it. I have bought bitcoins as an investment. When you invest it doesn't matter whether the market just took a deep fall, but that is easy to say when you bought the bitcoins at price $400. But as a trader, which is my main work, I look for the volatility. Then I do not look so much at the ideological and technological aspects. I am a technical analytic. I look at the chart and try to forecast what is going to happen in the future based on what has happened in the past.

EC: So when you are wearing your private "hat" you are a more long-term investor?

JS: If you are a long-term investor you cannot just look at the chart. You have to figure out whether the asset or coin has a fundamental value. I can go out and buy a coin that I don't believe in, but by looking at the chart and the numbers I believe it will increase its value by a 100% in the next month. But that is not an investment. That is just me looking for profit. I make a very clear distinction between investments and trading.

EC: Is trading more of a professional profession or do you see a lot of private traders?

JS: There are a lot of private traders. We could see that yesterday, when I was so lucky to be in the news, as a person who has traded for long time. The other person had invested 50.000 DKK in bitcoin in December and now they were worth 35.000 DKK. "What should he do?" – He should go back in time and think about what he is doing. It's like jumping off a cliff and halfway down think about what he should do next. Crawl back, but you can't do that now. What you can hope for is that he has more money to trade for and didn't go all in. So you have to learn about the market. What is blockchain? What are market cycles? I can see the exact same setup at five

different charts, but it all depends on where we are in the market. My targets are smaller in the market we are in now in comparison with the market we saw just 6 months ago.

EC: But not all private traders or investors understand the market like you do?

JS: No, and that's the problem. If we look at the man from the news, we see that he has invested in bitcoin. He is wearing the investment "hat". He just invested when it was very, very expensive. Facts are, in January 2017 bitcoin was $1000 and when he invested it was in $18.000. No matter what the price has increased a lot. Could it increase to $30.000? Easily, but he has still bought at a very expensive price. I don't know whether you have looked at the price chart of bitcoin, but from $1000 to $8000 it was a relatively healthy market even if it was crazy increase, in comparison to the stock markets. The market went up and then a little bit down, up again and then a little bit back again. But the market went from $8000 to $20.000 in only 28 days. It was a 150% increase – what we call a parabolic move, which is often the end of a "bull-trend". The question is: the higher you get to the top of this "move", how many new money is entering the market? The problem with new money is that they buy at the wrong time and then they lack on the mental part if they go in minus. If they go in minus, we see a greater risk for them [the new money] to sell in minus.

EC: Why do you think people want to enter the market?

JS: The problem is that they buy because they see that the price has increased. And that is the only reason why I'm not buying. So I'm doing the opposite. If I see a red market, I think, "buy" and if I see a green market I think "sell". Of course is it not as black or white, but that is what I think.

EC: Is it about knowledge or how strong you are psychologically/mentally?

JS: When I trade and the way I trade is based on the thought "I have to be mentally able to trade like this". You talk about this phenomenon "FoMO" [Fear of Missing Out], which is probably something that this man was feeling. Bitcoin went from $1000 to $20.000 and if he thought it was going to $100.000 he could buy at $20.000 and earn the difference. The problem is that he buys bitcoin after it has already increased a lot. He doesn't wait until the market decreases. Nobody is buying right now when the price is $6000, which is so stupid. I am way more

interested in buying now. You have to remember that a 20% increase in price at $6000 means a smaller increase in dollars than a 20% increase in price at $20.000. And you have to remember that the price then has already increased over a 150%. The other problem is that people usually find out about it by reading the news. They want to become part of it like everyone else. The media tend to be some really bad traders. They easily get very motivated for things that have already increased and at the same time very negative on things that are decreasing. Just look at the media now: bitcoin took a fall and now the media is really negative. But you have to go back. Bitcoin is still the same. One bitcoin is still worth one bitcoin. The technology has actually increased. The product that one could buy in December for $20.000 was worse than the product one can buy for $6000 today. I also experience this FOMO-feeling. There isn't anyone that doesn't get the feeling. But when you have had that feeling 1000 times and you burnt your fingers the first 300 times then you learn that you shouldn't act upon your feelings. Either I wait until the price has decreased enough to buy again or if this market is the only market in the history that just keeps increasing, then that's just bad luck. There is always a new day tomorrow with a new good trade.

EC: So it is something about recognizing feelings inside yourself?

JS: It is really just a question about experience. In one day I could teach you technical analysis, the tool I use to trade with. The tough part is that I cannot give you my experience. There are so many unknowns. What do they say on Twitter? How are the fundamentals right now? What does the technical analysis say? What do you think to yourself? Are you in FoMO or should you be in FoMO? There are so many parameters. My colleague Ulrik uses himself a lot in the trading process. If he is in a trade and he is way too excited about "going to the moon", then he knows this feeling and he starts to sell. He does the exact opposite of what he feels.

EC: Has he taught himself that?

JS: Yes, because he knows from experience that he has to do the opposite. To do the opposite of what you feel is often the right thing to do. Trading is about taking risks, which is not very normal for humans. Being a trader is mostly about the mental part. Everything else is something that you can learn.

EC: You mentioned "FoMO", which is something that we have also come across. What does it mean for a market like bitcoin with a lot of small, private traders and investors?

JS: Yes, Fear Of Missing Out. Cold and cynical, that is the reason why I started trading crypto. When trading futures I traded against Goldman Sachs and computers and they do they job pretty damn good. In crypto I can trade against the man who buys for 50.000 DKK when bitcoin sells for $20.000. Goldman Sachs would never do that. My opponent is completely different. If I'm going to earn a 1000 DKK, someone is going to lose a 1000 DKK. So, it is clear that I prefer to trade against bad traders, because it automatically makes me a better trader. We see a lot of private traders and that is also why the market acts so crazy.

EC: Would you say that FoMO is something that drives the market to these big fluctuations?

JS: Yes indeed. And that is also why it is so interesting being a trader in this market. But it also means that your risk management has to be so much better compared to trading stocks e.g.

EC: How do you see the composition of players in the market?

JS: It is becoming more and more professional. There will also be institutional money in the market soon. But with the crazy year of 2017 we will see many new amateurs and the question is how many of them will stay in the market. The way to become a good trader is… you must be able to survive in the market as it is right now. You have to survive the market. There are a lot of amateurs in the market. Many of whom are being shaken out at the moment. They have bought very expensive and are now selling very cheap. You almost get scolded for saying, "remember to buy cheap and sell out expensively". People laugh and think, "of course, this is the stupidest advice". The problem is that people are doing the exact opposite.

EC: A lot of people think that bitcoin is a bubble. What do you think?

JS: For the last four months, I have said that bitcoin is a bubble. There is no doubt that it is. But it is the price of bitcoin that is a bubble. It doesn't shock me that we go from $20.000 to $8.000. I would be very shocked if we went from $20.000 to $50.000.

EJ: Do you think the price will go up again? Will we see more bubbles?

JS: Yes yes. Let's say it is the bottom now. Next time I think the bubble will burst at… let's say $100.000 and go down to $20.000. Bitcoin is going through a five-phase market cycle, which all markets go through. In reality is it very, very simple.

EC: How?

JS: When you are looking at these price charts it can only do two things. It can go up or it can go down. And the chart is only going right, moving forward in time. So the market starts like this: it's flat, it goes into bull trend, it goes into a bubble, parabolic, then first washout, then makes a deadcat, next is bear trend, it accumulates and goes into bull trend, parabolic, washout and so on and so on. That is what all markets do. The Housing Bubble was the same. It just happened within a larger timeframe. Of course do all charts not look like the same, but the way of thinking is the same. What you have to remember when looking at the charts is that they show the reactions of the mass. When its red and green it means that someone has bought or sold. That is the mass psychology. By using technical analysis I can put some frames around the mass psychology. When the market goes up by 150% in 28 days, then the mass psychology is FoMO – "we need to put money in this market". Some people have called me stupid by selling out at $8.000, but I see it more as a way of risk management. I'm not selling everything at once, but by selling a little at a time I can keep on selling out the more the market goes up, but I can still survive in market and get profit if it falls back.

EC: So your strategy is to always have something and sell something?

JS: I am never going to say that I have sold everything. What if it goes to a $1.000.000? But I like to sell a little when the market is in bull trend/parabolic. I am not right every time, but I'm also not never right, which means that I can earn money over a long period of time. The guy from above he needs to be right every time, in every situation. He will earn more money than me, but the moment he is not right, he is going to lose it all.

EC: Let us go back to talking about cycles. (*We show him the Gartners Hype Cycle*). Where on the Hype Cycle do you think bitcoin is located right now?

JS: So, curves like this one are super simplified. The market doesn't just go up or down. In theory, it is super tough to say anything at all. There is no doubt that we are at the back of our

trend. We are in negative hype, but that doesn't mean that the trend cannot turn around and the market goes up again. But I have a plan for everything happening.

EC: Do you think that bitcoin and other new technologies follow this curve?

JS: It depends on where we are and what we are talking about. Are we talking price or actual usefulness of the product? I was thinking about the price but you can also think about the mass adoption, the S-curve. But you have to think about how difficult it is to buy crypto. If we're seeing an S-curve it means that my mom is able to trade or buy bitcoin on her own. I think we are very far from that. You have to understand the market but also the security in bitcoin. If she writes one letter wrong when sending her bitcoin, no bank or institution is going to help her. The money is lost.

EC: Would you say that the world is ready for bitcoin right now?

JS: No, but I don't think that bitcoin is ready for the world either. There have been a lot of scaling problems with bitcoin. Transaction time has been long and fees have been too high. It is bitcoin's challenge but not its fault. The development of the technology is steadily increasing, but when a lot of people enter the market at the same time, the technology is not yet stable enough. Bitcoin is only nine years old and I'm sure all the problems will get solved. The best brains in the world are working on this everyday. Just look at Visa credit cards or Facebook. When they first started the technology didn't have the capacity of so many new users everyday because of small servers etc. I think it is the same with bitcoin.

EC: Do you expect that bitcoin can be used as a means of payment in the future?

JS: No, not for us. I don't see the point of using bitcoin in Denmark when buying a coffee. We are some of the 5% in the world with contactless creditcards etc. The cost of using it is minimal, if not free, and it is so easy. Bitcoin is not so applicable for us because we already have great technology. It's pointless for small transactions. But for big transactions I see potential. Especially when transferring money from one account in one country to another account in another country. It's fast, easy and you don't have to use your bank or Western Union. It can also be used for store of value, like gold. I think that bitcoin can and will be used as a currency some places in the world. 60 million people in the US and two billion people worldwide don't have a

bank account, so it might be more applicable for them, "Be-your-own-bank". Right now the market is too volatile, but that doesn't mean that it will not work as a currency in the future.

EC: What do you think is the fundamental value of bitcoin?

JS: That it is a currency located on blockchain, which is the safest, most tested technology in the world. That is the fundamental value. But we see an ideological fight for what people think is the fundamental value. What is the fundamental value of the Danish Krone? That Nationalbanken supports it. In bitcoin, blockchain supports it. If you don't trust the blockchain, bitcoin doesn't have any value. People who say that bitcoin has no value don't trust the blockchain technology. It's all about what we, the people, think something is worth.

EC: So when people compare bitcoin to tulip bulbs it is something that is possible if everybody agreed that tulip bulbs is worth a lot?

JS: Yes, you can say that. But I'm not a big fan of the comparison between tulip bulbs and bitcoin. There are quite few fundamentally differences between the two. You can for example just plant more tulip bulbs but there is a fixed number of bitcoins. But you can say that it is the same by looking at the asset. One tulip bulb was still worth one tulip bulb no matter what. The tulip bulb didn't change, but it was people's perception of the value of one tulip bulb that changed. The price. That is what we are seeing in the bitcoin market too. Bitcoin is still bitcoin, but people's perception of the value of bitcoin went up too fast. Again, that is not bitcoins fault. In my opinion, it does not hamper the development [of bitcoin] that we have had this big bubble. There is a difference between price, bitcoin and the technology in bitcoin. Three different boxes:

Blockchain (Technology)	Bitcoin	Price

The price is changing all the time. One bitcoin is still one bitcoin, 1:1. Then, there is the technological blockchain, which is the fundamental of bitcoin. So the price of bitcoin is the bubble. So lets go back to the tulip bulbs. It was the price of the tulip bulbs that was unrealistic. It was a bubble, just like the price of bitcoins. In that way you can compare the two. But in other aspects are the two not comparable. You can grow more tulip bulbs [grow more money] but

you can't do that with bitcoin. Bitcoin is very regulated and every 10 minutes or so 12.5 new bitcoins are being issued/mined, a total of 20,999,999.999997 bitcoins by the end.

EC: So when you separate bitcoin into three, and we hear that some major banks restrict their employees to own or trade with cryptocurrencies, they are focusing on the price of bitcoin?

JS: Yes, that is the price they are focusing on. Probably. They don't want you to own the asset, because the asset – in this case bitcoin – is related to something criminal. Or at least the banks think so. I personally think that it is a shitty reason to use to decide for your employees what own and what not to own. It's like saying to your employees that they cannot go out in the night because someone might sell coke. Not to you, but you cannot be involved at all. When you buy a bitcoin you cannot take responsibility for what happened 22 transactions ago, when it was used for something illegal. That has absolutely nothing to do with you. I think it's a very dangerous road to walk down, when you [as a employer] restrict people's personal freedom like that. Especially when Nordea, in this case, doesn't even have any kind of problem regarding ineligibility or other financial restrictions.

EC: We have both reviewed your podcast from this summer where you talk about when to invest in bitcoin. Back then you said that new investors should wait at least three months and then see how the market goes. How do you see the market now?

JS: I'm more interesting in buying now actually. If you have a 100.000 DKK to invest for I think you should do it. But I think that you should start off by investing 500 DKK because you are going to make a lot of mistakes. So do you want to lose 10 DKK for every mistake or 1000 DKK? You are going to make the same amount of mistakes, so start out small until you know the market, the technology etc. And most importantly, you get to know the feelings such as FoMO or fear.

EC: Can you please elaborate on the difference between a trader and an investor?

JS: An investor is investing in something, which means, "buy and forget". He might buy at $1000 and then it doesn't matter what happens up to $50.000. When he hits the $50.000 he sells. It is of course not as black and white, but you get the point. It's about buying something because you believe in the fundamental value. But this also means that you have to buy at a very cheap

price. If you buy bitcoin in $15.000 as an investment then your downside risk is extremely huge. Investing is especially about buying cheap. And if it is not cheap now, then I'll wait. We call it JoMO – Joy of Missing Out - the opposite of FoMO. Trading is about entry and exit. A lot of traders assess if a trade was good based on the profit at their exit. I don't do that at all. I do my trade and afterwards I assess whether the trade was good or bad. I have to know if the trade is good before I do my entry. It doesn't matter for my trade whether the market goes up or down. I can lose 20% and still think it's a good trade. And I can get a 100% profit and still think it's a bad trade. Its important to know when you decide if something is a good or a bad trade because you don't know where the market is going. Back to what I have been saying earlier; it's all about having a plan. Where do I want to entry and where do I want to exit depending on the life of the market. Where do I want the market to go before I take my profit? How am I feeling mentally? How is the mass psychology? Where are we in the market cycle? And so on.

EC: How do you consider the mass psychology?

JS: I use Twitter, Reddit and Bitcointalk Danmark. I am looking at what the new investors say. What the new say I use as a benchmark for my strategy in the market. I do the opposite of what the mass thinks.

EC: Thank you for your insights and time.

Appendix 2: Interview with Ulrik K. Lykke

Interviewers:	Emilie Lang Borup & Christine Mohr Balslev (EC)
Participant:	Ulrik K. Lykke (UKL), Blockchain- & Crypto Assets Investment Advisor at Baldr Capital
Interview type:	Face-to-face, Copenhagen V, Denmark
Date of interview:	8/2-2018
Interview time:	23 min 25 seconds

(This interview was conducted as a continuation of the interview with Jacob Skaaning, which explains why he is also present during the interview)

EC: When you trade, you are very good at doing the opposite of what your gut feeling is telling you to do. How do you use this a strategy when trading?

UKL: That's right. I try to use this methodology whenever I'm doing a technical analysis. Whenever I look at a chart I write down the emotions I have at a certain price level. No matter which chart I am looking at or what the price is, I have different feelings. I either feel happy or euphoric or another feeling. There is always a range of two emotions – one positive and one negative. So I'll write down my emotions on the chart, so that I'll know whenever my feelings are representative for the rest of the market (*Ulrik's own assumption*). So when I note my feelings on the chart I have an idea about the overall feelings of the other actors on the market. If people are showing depressive feelings and you see a lot of fear in the market, then I know that the market is emotionally down at a low point. Sometimes this means that the price level will not decrease more.

JS: That is exactly what I was talking about. When you see people writing stuff at bitcointalk-denmark and reddit, you know that what they are writing is their first emotion. I, and also Ulrik do exactly the opposite of what people are writing.

UKL: I also look at the emotions of others, but I mostly use my own emotions and thoughts. It gives me a really good indication of the market. I write down every feeling I have, whether that is kicking my neighbour because he is noisy or I want to throw my computer out the window. A

little sentence of what I want to do in this exact moment. It may sound terrible, but there is a meaning to it.

EC: So you assume that you think like the most?

JS: I think everybody thinks like most people. The first feeling you get is the same for everybody on the market. When you see a blood red market everybody thinks >>fuck<<, how much money have I lost? But you have to take a step further, which is something that new beginners often forget.

EC: So you have to see the market from a birds view and think about what this means for the market if everybody else is thinking the same as I am?

JS: Yes, exactly. If I have these feelings, then I know that a lot of other people have the same feelings. As a trader I am more immune towards fear than a totally new investor. Whenever I get the emotion fear…

ULK: You're not immune to fear, you're just smart enough to know that you're not going to succumb to your feelings. You can put them at a distance.

JS: It takes longer before I get the feelings. All I know is that when I have these emotions "full-blown" I know that I shouldn't act upon them.

ULK: I don't think that it takes longer with me before I get the feelings. I think I get them at the same time as everyone else, but that really helps me. Sometimes I even get the feelings before others. I may be "euphoric-in-profit" or I may be "scared-in-profit", which means that I have made a good deal, but now I'm really scared – how does that makes sense? That is because I'm afraid to lose the profit I have already made. I know that when I feel that, then there is a good opportunity for the market to continue, whereas if I had been more "euphoric-in-profit" or "excited-in-profit" there is a great chance that the market will go down.

EC: That is an interesting view on the behaviour on the markets.

JS: As we spoke about earlier, I think it's important to know that the bubble cycle chart you showed earlier and the more common ones you can find on the Internet are very simplistic. It goes up and it goes down. If it more technical, then it goes up, then it dives a little and then this "deadcat" appears, back-to-normal with a little bump upwards and then it falls again. But that is not how a market works. A market usually starts at the top and then it falls down, then this "deadcat" appears, but it doesn't go directly down. It goes down and you see a lot of fear, where everybody sells out. Suddenly there are no more sellers. Then the buyers begin to take over again, and then the market goes up again. When the market goes up more people will sell because they maybe reach break-even or they come in profit or their loss is smaller, and the sellers will yet again take over the market, and the market goes down again. This will keep going on. It is always a game about whether the market has more buyers or more sellers.

EC: That way, it may be too simple to apply such a model (bubble cycle model) to the market?

JS: I kind of like the models, because they show what is happening on the market; fear, euphoria, back-to-normal, deadcat. I think the deadcat is one of the most psychological interesting things. A "deadcat-bounce" means that you have had this bull-trend and then you get the first wash-out. That's what you saw at the bitcoin market when it went from $20.000 to $10.000. But then the market goes up to $16.000. On its way up again people start writing on bitcointalk Denmark "we need to reach all time high". So the people who bought bitcoins at $20.000 and sold again at $10.000 think that when the market goes up again that means that we're going through an all time high again and then they buy bitcoins again, but at the same time other people start selling and the market goes down again. So the people, who lost 50% the first time, buy again at $16.000 and lose again, because they are afraid of missing out.
So I think that it is one of the easiest things to see in a market…

EC: Because you know that the market goes through a cycle?

JS: Yes, because it is so normal when this "deadcat" appears, and the risk of shorting is very little because if we reach an all time high, then okay, it wasn't a "deadcat", but if it falls then I see a lot of downsize and upsize in the trade, where I can earn more money. You can mistake that trade many times, but the fifth time still make a lot of money. So I find the "deadcat" very interesting in a psychological perspective.

EC: Do you use the models yourself?

JS: No, I think they are too simple. But I use them to explain. This "deadcat" is extremely easy to explain using the cycle. I always say to people that they have to look at both sides. If they want to go to an all time high on a market, then I always ask them what they will do if we don't go though an all time high. You really need to have a plan for both scenarios.

EC: I guess you can say that it has something to do with not daring or wanting to see that something else can happen?

JS: Yes, I hear a lot of people saying that they want bitcoin to be in $30.000, and then they start to look at the chart and convince themselves with all kinds of technical tools, why it is going to $30.000. And then that's it. Whereas the best… now I'm going to tell you about a little discussion we have had. Women are better traders because they have a more objective vision of a market. They see the market as it is and plan for every step. Men want to be right, whereas women want to get right. And it's easier to get right if you think that everything can happen on a market. I think that it is an instant quality when you are patience and look at the dangers objectively, and when you are not intimidated by the dangers or "scared-in-profits". You have to objective all the time, and even though you have these feelings, you have to be able to put them aside and look at the chart and see what is really going on.

EC: So you have to get to a place where you acknowledge that you have these feelings?

JS: No one is without feelings, and no one is trading without feelings. The more professional you get, the more you know how to control and don't get intimidated by your feelings and use a more objective vision.

ULK: I have a more colourful view on it. Sometimes we get some feelings and we don't quite know why. I think it's our subconscious that is trying to tell us something. But we probably interpret the signals incorrectly. I spoke with a guy in December, whom would like to invest a couple of 100.000 DKK in bitcoin and it could not go fast enough. I have just written him again to hear if he got started. He never did. He could not get his stock account verified, which means he couldn't get the money. So I'm asking him whether it is a good time for him to invest now (*in January)*? Now, I cannot remember exactly what he wrote, but it was something like "I've lost a

little confidence in the entire crypto market, and I think it is somewhat more uncertain than what I imagined". This is very, very contradictory. His sub consciousness tell him "oh no, fear and horror, what if I had put all my money in bitcoin"? But you have to do the opposite of what the obvious signal is.

JS: You have to go against the fear. If he wanted to buy now he could get twice as many bitcoins, but he cannot see that at all.

EC: But maybe that is because he compares it with a fictional loss that he didn't even experience?

JS: Yes, yes. He takes the pain without even experiencing it.

UKL: It is such a typical thing for people to do.
(UKL talks about the man's investment in Genmab).

EC: I think we have all the answers we need. Thank you for your time.

UKL/JS: No problem. You can just write to us if you have more questions.

Appendix 3: Interview with Sarid Harper

Interviewers:	Emilie Lang Borup & Christine Mohr Balslev (EC)
Participant:	Sarid Harper (SH), CTO, Pipnotic
Interview type:	Face-to-face, Copenhagen V, Denmark
Date of interview:	8/2-2018
Interview time:	58 min 51 seconds

EC: Can you please start of by telling us a little bit about yourself? What you do and your relation to bitcoin and cryptocurrencies?

SH: I have a background in Computer Science. I have a technical entrance to trading and currencies. Currency trading has always been very interesting for me. I come from an IT background and have worked with hacking for many years. I have worked for several banks, where my job was to hack their systems and document how I did it, so that their systems could get more secure. I was also asked to do trading or risk software and about 10 years ago I started developing my own model for trading. My software is able to analyze the historical price and make prognoses, which you can use when trading with currencies. I now trade currencies based on my own model. Primary fiat currency: dollars, yen, Swiss franc and British pound. About half a year ago I gained interest for cryptocurrencies. The cryptocurrencies are a little weak in my model.

EC: What is the difference between cryptocurrencies and fiat currencies?

SH: The liquidity. The liquidity in the crypto market today is very limited. The amount of liquidity is spread over a lot of different cryptocurrencies. Bitcoin is the largest one and then ethereum and ripple. Together they may seem to be a lot, but compared to fiat currencies they are very small. Every day, several trillions are traded in the fiat currency markets. The crypto market is not as big yet, although it increases more every day. In the long term I believe that the volume will increase and we will see more trades in the crypto market, which will make it less volatile. The liquidity means all the orders in the market.

EC: What increased your interest in cryptocurrencies?

SH: Definitely the technology. I find the smart contracts very interesting. The technology is very sophisticated and relatively mature. I also looked at the possibilities for when you have to transfer money from one country to another. Is it possible to do it cheaper and faster? I believe that some of the new technologies can solve this problem.

EC: So it is primary the technology you find interesting?

SH: Yes. It is not the speculative part. I speculate in fiat currencies, but in crypto, I find the technology very interesting.

EC: Do you think that bitcoin will remain the biggest cryptocurrency?

SH: It is the biggest because it was the first. It can be used to transfer money without any third party, which is very attractive for a lot of people. There are a lot of people who want to hide their agenda and money, which is possible in bitcoin auspice. The first movers made bitcoin what it is today. Had any other coin been the first, I think that that one would be the biggest today. But bitcoin was fast with their technology and for ideologists it was like virtual gold, where you don't have to have any money in the bank anymore. I think the ideology behind bitcoin is great, but it also attracts some suspicious people who use bitcoin for money laundering and buying illegal services.

EC: But that happens in the FIAT market as well, don't you think? (*In regards to hiding your money, using them for criminal purposes etc.)*

SH: Definitely. You can also use cash for criminal purposes e.g.

EC: Do you believe in the future of bitcoin?

SH: When a market experiences so much success in quite a short period of time it expands quickly, but it has to contract at some point. So I think the market will go up and down, but I think the market will increase again as the price decreases to a fairer price.

EC: But how do you decide what the right price of a bitcoin is?

SH: You can access the price level in the market as with ordinary fiat currencies. There are some visual cues to see where the price will find its bottom. Remaining orders in the market leave some traces. What to look for in the crypto market is accumulation. The price might rise and some big buyers will go in a buy a large amount. Some will cash-out and it all leave traces. You can see this in all markets. You can also look at the volume in the market. How changes in the volume affects the price. You can draw parallels between the two and thereby conclude if the price continues up or down. Bitcoin has been up and has fallen down again, and it is now approaching a level where it is attractive to join again [*explains and draws on a graph*]. I think that within the crypto market there are quite a few people who have burned their fingers, which is why there has also been much negative publicity in the media. People will stay a little bit from it until it starts to rise again and then people will think: "okay, it's rising, now I buy". You have the smart money and the dumb money. The smart money buys early and cheap whereas the dumb money buys when the price is already on its way up. Psychologically you can see that people think: "are you doing this? What about you? Yes? Then I'll also do it." You want to confirm that the action you are taking is the right one.

EC: Bitcoin as a currency to buy goods for - do you see a future for that?

SH: So, it has already been used to buy things for. I have a friend who bought a car for bitcoins in Finland a couple of years ago. I definitely think it has its place in society but it will not replace fiat currencies like the Danish Krone. The regulation needs to be in place. Bitcoin is not regulated and there is no central control unit. I mean if the Danish Krone is too strong you can influence some parameters like the interest rates, to influence the value of the Danish Krone. You cannot do that with bitcoin. It is free floating supply and demand. Bitcoin is not tied up on gold or a commodity. It is decentralized and wild, wild west. So I think bitcoin will compliment the current currencies, but not replace them. In Denmark we almost already have cash less society with virtual money. Bitcoin is virtual money, so the difference is not that big. I think the implementation and use of bitcoin will vary depending on where in the world you are. What I like about bitcoin is the possibility for a farmer in Kenya to do business with someone in the Western world. They are on equal terms and the Kenyan doesn't have to bring a suitcase full of money just to buy a cup of coffee. People are equalized.

EC: Why do you think people invest in bitcoin?

SH: Why people do it? They want to earn money. Bitcoin doesn't have a purpose. It doesn't solve any problems. If you compare bitcoin to other technologies, they solve a defined problem. Ripple solves a very important problem, real-time international settlement. I can transfer money to a person in China or the other way and it happens instantaneously. You don't have to wait two to three days. So I think Ripple solves that problem. Bitcoin cannot do anything. I have a friend who speculates in bitcoin. Or at least he used to do that. He has made a lot of money, like a lot. He buys when it's low and sells when the price is high. Pure speculation. I think that is the only good way to use bitcoin.

EC: On your own website Pipnotic you write about bitcoin. How do you use bitcoin?

SH: You can pay with bitcoin for my software. It's just a method of payment. But you can use my software to invest in bitcoin, ethereum etc.

EC: So you can use your software for technical analysis of different securities?

SH: Yes, technical analysis. I have my graph on my trading platform. It shows the price of different securities. My trading platform is connected to the bank I use, so I can see my money, all my orders etc. I usually do a limit order when the price goes down, and I get filled up. If the price increases I earn money and if it decreases I lose my money.

EC: Bubble is the most used word in connection with bitcoin and other cryptocurrencies. Do you think it's a bubble?

SH: No, I don't think it's a bubble. Right now all the cryptocurrencies are becoming mainstream. It is going to be some kind of everyday ownership. As more people become aware of bitcoin and the other cryptos there will be more focus on it. People have seen how the market has been historically and want to be part of it. It is not a bubble it is just the start. The "plane" (market) has taken off and it will go more upward from now on, with some small bumps on the way.

EC: So you think the price can get even higher than what we have seen?

SH: I most certainly think that it can. The challenge is the many and big stakeholders, who are all strong opponents of decentralized value creation. They are going to block cryptocurrencies.

China e.g. has banned cryptocurrencies a couple of times. Cryptocurrencies are going to threaten the monetary stability in the world, and the stakeholders are going to shut it down. That is also why you see a lot of notches on the bitcoin curve, because bitcoin is being banned in many countries. Of course you cannot shut it down completely but each country can make restrictions, which makes it hard to use bitcoins. But some legitimate exchanges might have to forbid trading with cryptocurrencies, which means that the volume decreases and the price thereby also decreases.

EC: You have a very technical background. You know how to use market data for trading purposes. How do you think the normal investor/mainstream investors influence the fluctuations in the market we see?

SH: You can draw parallels between bitcoin and the telephones. This phone [holds up an iPhone] might be worth 5.000 DKK. Are you going to wait until it is worth 10.000 DKK to buy it or wait until you can buy it for maybe 2-3.000 DKK?

EC: Rationally, I would wait until it hit 2.000 DKK, but maybe I'm afraid to miss out.

SH: Yes, it is exactly that. It is the same with bicycles, phones, whatever. If the prices are high, why should you buy? The most obvious thing is to wait for the price to drop. You can buy more of what you want. But within speculation, it is like people get a stroke and forget everything. I don't understand the mentality, but that's how mainstream investing works. You buy at a high price and sell at a low price, instead of the opposite. It is very counterintuitive. There are feelings at stake and people seek confirmation in their inner circle and in the mainstream media. But when, for example Politiken or Berlingske writes about it, it is too late. Then it is time to get out of the market.

EC: How do you know where on the cycle the asset is?

SH: You have to study the market by using different graphs. If you want to you can study different countries' economy, e.g. Bank of England and see how the economy is going. Jobs, GDP… Is it a healthy economy? If yes, then buy the currency. I trade a lot of British Pound and American Dollars. You can compare Bank of England with the Federal Reserve, and either you buy or you short one of the currencies.

EC: Don't you think that many people hear about a new asset in the media, when it's too late?

SH: Definitely. I don't even want to read the economic reports and key figures. I focus on the liquidity and the fundamental key figures in a given economy.

EC: As you say, when the major newspapers start to write about something then it's too late. The price is already too high so you should sell. But isn't it at this moment when people become aware of the market?

SH: Yes, indeed. In less liquid markets such as bitcoin, you have to have a buyer if you want to sell something and the other way around. You know, when mainstream media is telling people to buy a lot of people is going to buy. So the market thereby receives a lot of liquidity and it is easier for me to sell my bitcoins. The big banks usually have a "price window" in which they are willing to buy an asset. They want to buy in the lower part of window. So when the price goes down they buy. They want to buy in secret, because if they buy too much, they have shown their card. And then the opponents know that they should buy now because Goldman Sachs is buying. This is a patient accumulation where the big players buy a little at a time but they still leave some tracks. The bottoms are going to be a little bigger for each time the market goes down. Signature accumulation tracks which you can spot in the price rate.

EC: Do you see other differences between cryptocurrencies and Fiat money? Other than the liquidity?

SH: Interests play a big role. If you have a currency with a big yield I want to buy that. If I for example hold New Zealand Dollars I will be granted interest. Conversely, I have to pay to have Japanese yen: negative interest rate. You are not granted any interest by holding bitcoins. There is no central governing body to counteract inflation and stimulate deflation. It does not exist, it's a free-floating animal that goes up and down without anyone entering and controlling it. The fluctuations happen because there are many people who buy and sell and buy and sell etc. As you can influence the market so much, some central governing bodies like the Chinese Central Bank are trying to affect people to think badly about the bitcoin market. To stop people from using bitcoin. So the Central Bank buys a lot of bitcoins, which makes the market go up and more people buy more bitcoins. Then they sell and crash the market. They manipulate the

market and make people think badly about bitcoin. Pump and Dump or market manipulation is what they call it.

EC: Is it possible to see who pumps the market up? Via the wallet code?

SH: I don't know the methods. You can have several wallets spread across hundreds of exchanges, hardware wallets and software wallets. It is almost impossible to find all these wallets and see if they all point at one body. Some people have been successful finding criminals. If a wallet has been use for both some illegal stuff and also to by groceries you can compare the transactions and find the person. It's tough but it is possible.

EC: Speaking of the difference between cryptocurrencies and fiat currency. Do you see bitcoin as an asset or more like a currency?

SH: Bitcoin is considered virtual gold. So it is like gold, but there is no underlying gold accountable for the value of bitcoin. It might be considered an asset, but it is tough to conclude.

EC: What is the fundamental value of bitcoin? If you think that is has a fundamental value?

SH: The value is based in the interest that some people will give the price you ask for. Bitcoin is pure supply and demand. If it rises in value it's because people want to have bitcoin. Right now the value is X amount of dollars. And people are willing to accept these big price fluctuations.

EC: So its worth what people will sell and buy it for and that is what determines what its worth?

SH: Yes.

EC: A lot of people say that bitcoin doesn't have any underlying value, it doesn't do anything and the price has just taken off. But you think that the value is grounded in supply and demand?

SH: Yes. It is going to fluctuate all the time. It doesn't have a solid value. This table *[points at the table we are sitting at]* will always have a value of approximately 2.000 DKK in the next couple of months and years.

EC: We have one last question. It is fairly easy to make your own cryptocurrency and the last time we looked there were about 1500 different cryptocurrencies. Does it affect the market that it is so easy to join with your own currency?

SH: It gets tougher for the investor or speculator. Instead of having to deal with two or a handful it's now 1500 different cryptocurrencies. Which one should you choose? […]

EC: So maybe it's the opposite? To stick with what you know because you otherwise have to get to know the overwhelming big market?

SH: People are lazy and want the quick profit. So we choose the well known and established.

EC: I think we have what we need now. Thank you for your time, Sarid.

Appendix 4: Interview with Camilla Frost Jensen

Interviewers:	Emilie Lang Borup & Christine Mohr Balslev (EC)
Participant:	Camilla Frost Jensen (CFJ), Product Manager, Chainalysis
Interview type:	Face-to-face, Copenhagen K, Denmark
Date of interview:	19/2-2018
Interview time:	28 min 56 seconds

EC: Can you start off by telling a little bit about yourself and what you work with in Chainalysis?

CFJ: I have a cand.it from IT-Universitetet. Back then it was called E-business. Afterwards I worked as a consultant for four years for Gartner before joining Chainalysis seven months ago. Chainalysis is a start-up from 2014 and was started by three men. One of them is a former COO for Kraken, which is this big bitcoin exchange in the US. The other one made the first bitcoin wallet for Android mobiles, and the third one has an economic background with focus on the effects of decentralised economies. These three men, Michael, Jan and Jonathan figured out that there is a need for product where you can see what happens in bitcoin to create transparency between the financial world and the crypto world. Chainalysis made a product called "reactor" which is a visualisation tool that can be used to follow the money/follow the transactions within the cryptocurrency market. They made the tool at the same time of the hacking of Mt. Gox, a Japanese crypto exchange, to see if it was possible to get information about where the money went. Chainalysis knew for quite some time what happened to the money but it was not until this past summer when the FBI published a rapport on the incident, that BTCE was closed down. It looked like the BTCE exchange was made to launder the money from the hacking of Mt. Gox. The target group for our product is intelligence services. If they suspect anything or anyone they use our tool to look up an address or several transactions with bitcoins and our tool can then show them when the user or bitcoins was used in a service that needs to comply with the KYC law (Know Your Customer). That way, the intelligence services can figure out who owns which addresses and get in contact with that person. Whenever the information we gather is out of the financial world and has something to do with personal data, it is out of our system.

EC: So the point of Chainalysis is to make bitcoin and cryptocurrencies more legitimate?

CFJ: No, I would say more transparent. Our product is like the yellow pages in crypto. You can see what the address is connected to. Is it a shop, a dark net market or a personal wallet? Without crossing the personal data border.

EC: Yes, because you cannot identify the exact owner of the address, can you?

CFJ: No, then you have to cross the KYC (Know-Your-Customer) law.

EC: What is your own experience with bitcoin? Do you only work with bitcoin in Chainalysis or do you own some yourself?

CFJ: I have some bitcoins, but I bought them a long time ago. In 2013, so before Chainalysis was founded. When working at Gartner I could see that blockchain was on their hype cycle and I found it very interesting. Via networks and Kvindeøkonomien I met a guy who works at Chainalysis and he invited me in for a coffee and the rest is history.

EC: How come you bought bitcoin back in 2013?

CFJ: I had a well-paid job and wanted to learn how to invest. Via my network, I went to a Christmas lunch and ended up being placed between two guys who knew a lot about bitcoin. After we talked I invested in bitcoin.

EC: Did you think it was an interesting technology or something you could make money on?

CFJ: I remember I thought that it sounded like something that could become very big. And something that there is a limited amount of.

EC: OK. What is your perception of why people enter this market?

CFJ: Investment.

EC: So pure speculative?

CFJ: Yes. That is the short answer. The HQ is placed in New York and the market for our services is generally biggest over there. Our new market is the financial sector with a lot of interest coming from hedge funds and investment funds. We have a lot of data on bitcoin and what's going on in the market, but there is a myth that it is only drug dealers and criminals using bitcoin.

EC: What kind of data do you look at?

CFJ: We look at the age of a certain bitcoin – coinage. We look at the coin from it was mined and how it moves around and how its used. That number is quite high which means that a lot of people are day trading. We also look at the numbers of forgotten addresses and how many who holds the bitcoin (doesn't trade or use them). And we estimate how many bitcoins are lost and how many which are used for illegal stuff.

EC: Is it possible to identify how many users of bitcoin there are? How do you define that?

CFJ: You can't really do that. We can see that some or more addresses belong to the same exchange, but addresses are like bank accounts, which mean that people can have more than one address. You can see different patterns in regards to big sums or many trades, which could mean that the address belongs to an exchange.

EC: So when you have the term "unique addresses" it is the same as a bank account?

CFJ: Yes.

EC: What about wallets?

CFJ: You can have multiple addresses in your wallet. A wallet is software that helps to organize your addresses. And you can have more than one wallet. If you want to spread your risk you can have a software wallet and a hardware wallet. That way you can avoid hacks like that on Mt. Gox. You can also look at coinbase.com for more numbers on new addresses and new wallets. If you want more numbers I guess you can also take a look at the many new exchanges we see coming up. One of our other products is our risk profile. Especially in the US the market is more regulated, so if you are on an exchange and see something suspicious you have to report it to

their FSA. We don't see the same rules in Europe yet. We have a lot of contact to new exchanges in the US. They have a Chief Compliance Officer role on all the exchanges. If you have an exchange where you can buy or sell bitcoin with your credit card or tool can give the CCO a risk profile on person asking to buy or sell on their exchange. The risk profile will be red, yellow or green depending on their history in the blockchain. It is up to the CCO to decide whether they want that person on their exchange etc. This might be out of the area of your master's thesis, but I wanted to get back to the fact that you can see how many people enter a specific exchange.

EC: A lot of people say that bitcoin isn't regulated, but you mention regulation on the exchanges especially. So is there a kind of regulation on the exchanges?

CFJ: There are legal requirements in the US. If you have customers in the US you have to report any suspicious actions to the FSA. You can also report in England and Germany but it is not a legal requirement. So some places you have some kind of regulation and other places it is just wild west.

EC: Can you say something about the bitcoin market in general? What kind of actors do we see and how are the patterns of these actors?

CFJ: We see a lot of transactions going from one country to another. Each exchange can pick their own transaction fees, so we see indicators of people buying in one country and selling in another, the so-called arbitrage. You can also see the effect of restriction or banning of bitcoin in for example China. Whenever bitcoin is restricted in China, the price falls. The news comes every 14 days or once a month and every time it affects the market price. We can also see patterns by looking at the many new investors who join the market. They don't know the market history and the market is quickly hyped.

EC: Where do you get information about how people see the market right now?

CFJ: We use reddit a lot. But we also give a lot of information to journalists from Forbes, Fortune, and Bloomberg etc. From our own perspective we are of course interested in marketing our product but we are also interested in more real data on the Internet and not so much fake news.

EC: You mentioned knowledge of historical events on the market and how new investors don't know the market. Do you think that is because we see a lot of small amateur investors?

CFJ: Yes, that is one thing. The other thing is the safety. People don't know what they are buying or where they keep it safe. That can be a fake page or transferring bitcoins to the wrong address etc. Just look at the ICO's.

EC: A lot of people say that bitcoin is a bubble. What is your opinion on that?

CFJ: I don't know. If you look at the news I can see that bitcoin is over hyped and it's hard to see what the value of bitcoin is. And when all the economists use their knowledge and theory it's not hard to see that it is a bubble. On the other hand we have people calling it the new Internet. Someone wrote that bitcoin right now could be compared to the Internet in the 1990's.

EC: What do you think is the fundamental value of bitcoin? What do you think it's able to do in our world?

CFJ: It can do a lot but it also has its boundaries. It's very good at transaction history. Who owns what and when? The challenge lies in the scalability. But some people are working on that. If you look at bitcoin from a more economic perspective, the advantage is that it is a global decentralised possibility. Everybody can get access to it.

EC: What do you think it means for bitcoin when the big financial institutions go out and say that they won't touch it?

CFJ: I think it is… I mean our work is to make the gap between bitcoin and the traditional financial sector smaller. The financial institutions create this gap or make it bigger, which I think is very unfortunate. It makes the development go slower. Do you mean in terms of price or?

EC: Yes, but also what you think bitcoin is able to accomplish in the future? What are your expectations to bitcoin?

CFJ: The expectation is that bitcoin will become more mainstream. But at the same time are we not sure that bitcoin will stay as the biggest cryptocurrency. There are a lot of different cryptos

but they are somewhat technological build the same way. It depends on what people are going to use it for.

EC: From a Chainalysis perspective, do you then think that bitcoin and other cryptocurrencies can coexist with the financial systems we have today?

CFJ: It is going to be some kind of compromise. I don't think it is going to be either or. But we also need to see some more regulation. I think regulation is going to fill a lot this year. Bitcoin was more hyped last year. A lot of people were saying that bitcoin was used as a tax havens last year, so I think that the regulative institutions are waking up this year.

EC: So the regulation might be what is going to make it more mainstream?

CFJ: Yes, or at least create this compromise.

EC: Is the world ready for bitcoin right now?

CFJ: No, I actually don't think so. If you think of it in terms of maturity I believe we will see progression within the next five to ten years. I think we are very early on the hype cycle.

EC: It is very fun that you have worked at Gartner because we have looked at their hype cycle to get a more nuanced picture of the bitcoin market. Blockchain is placed on the hype cycle, but where do you see bitcoin on the hype cycle?

CFJ: I think that Bitcoin is more mature than blockchain. I think that blockchain has become a buzzword, like disruption. You can always discuss what blockchain is. Simon Ousager [another employee at Chainalysis] usually says that we have the bitcoin blockchain and then there is everything else.

EC: Do you think that bitcoin will be used as a method of payment or as store of value like gold?

CFJ: I don't know yet. I think bitcoin is going to lose some market share in the crypto world. But I think that bitcoin will be used as a mean of payment.

EC: I think we got all that we need. Thank you for your time.

CFJ: You're welcome. Please just write me if you need more information or have any questions.

Appendix 5: Interview with Simon Ousager

Interviewers:	Emilie Lang Borup & Christine Mohr Balslev (EC)
Participant:	Simon Ousager (SO), Head of Customer Success at Chainalysis
Interview type:	Face-to-face, Copenhagen K, Denmark
Date of interview:	22/2-2018
Interview time:	53 min 56 seconds

SO: For the record, everything I say is on behalf of myself and not Chainalysis.

EC: Yes. If you can start off with some background information about yourself, then the rest of the interview is going to be about the bitcoin market, bitcoin itself, its value and what it is, and a look into the future of bitcoin. Can you tell us a little bit about who you are, and what you do?

SO: I have a background in molecular biology and genetics, but have never work with it as I dropped out before my master's thesis. I have coded a little bit but it is limited what I have of IT-related experience. I read about bitcoin and blockchain about four years ago but wasn't convinced about it at first sight. But then I thought: "if I'm not convinced about it, then I better figure out how this doesn't work". As you can see I am still here, so I never found the explanation for why this cannot make systematically change. I started out by doing some consultant work and doing some lectures on bitcoin and blockchain. After some time of doing it part-time I went on to do lectures and talks on full time and that's when Chainalysis contacted me. I still do some talks now and then and I speak about different things to the Danish media and Danish politicians. In Chainalysis I work with support and training, which is education in our systems, the law enforcement, authorities, regulators, financial institutions, compliance, cyber crime etc.

EC: So all the knowledge you've obtained about bitcoin and blockchain to start with was that something you found yourself or?

SO: There were no other ways to do gain knowledge at that time. I was on Reddit trying to find out what this was about.

EC: What was it with bitcoin that kept your interest?

SO: It's that you can keep learning more. The more I learned about it, the more interesting it became. If you look at the debates, blog page wars and how bitcoin has been under attack for two years with lobbyism, propaganda etc. and the network still works better today than ever before. The bitcoin network is extremely stable. The transaction fees are completely low. You have technologies like lightning networks that are placed on top. Pure technical speaking is bitcoin kicking ass right now.

EC: Does bitcoin just get better and better?

SO: It looks like it at least. Many of the attacks that have been on the network have been averted quietly. The worst thing that happened was some high transaction fees at one point.

EC: What about the slowness of the transactions?

SO: They are as slow as they have always been. On average there will be a new block every 10 minutes. It has always been like that and so it will probably always be. You have a system such as the lightning network that allows instant transaction without counterparty risk. It will take some time before it is ready for mainstream use, but it works now.

EC: Do you think that bitcoin continues to be the biggest cryptocurrency?

SO: It is hard to say. It looks like it now. Compared to usage, it is for sure. Also in relation to value transfer. Of course you also have Ethereum that supports the ICO's and tokens on top. Bitcoin cannot do that. It's on purpose that bitcoin cannot. Much of the ICO activity takes place on other networks simply because they support it. Basically is bitcoin better "screwed together" than the other systems. It is more conservative but much more stable, decentralised and very resilient.

EC: Today people may also have a tendency to cut the cryptocurrencies into one. They are different and are put into the world for something different.

SO: Yes, first of all, they do something different. But the many differences are also trade-offs. It is compromises in the protocol itself. Ethereum can do a lot of different things, but there is also

much that can go wrong. It is notoriously difficult to write things to Ethereum. It is a clear trade-off made against bitcoin, but there are also significant drawbacks.

EC: You have followed this market since it was relatively sparse. How would you describe the bitcoin market? What kind of actors do we see? What kind of patterns do we see and how has the development been?

SO: Bitcoin is an open platform, where you can see everything. That may be legal things, it may be illegal things, market manipulation etc. There is so much scam in these markets right now. That is because there are so many people who do not understand IT and security. In all fairness, not many people do in general. To get back to the question: it's an open platform so if you want to cheat you can. If you want to build really interesting companies or systems you can. And if you want to do illegal things you can do it to some extent. We see a bit of everything at the moment.

EC: Some people say its not regulated. Is it not?

SO: It depends on what level you are looking at. Bitcoin is a protocol, a set of rules. If you do not follow the rules you are not in the cave. It is a form of de facto regulation at the protocol level. If you try to make multiple bitcoins or send bitcoins that you do not have, you're not in it anymore. The rules are regulated and enforced by 70.000 computers worldwide. Then you also have what goes on at the top. The monetary policy has been certain from the start in 2008 and has not changed since. There will be 21 million bitcoins and they come at a predefined rate. At that level, bitcoin is regulated in one-way or another. Then you have ordinary regulation when it hits our banking system, our financial institutions and then everything starts to get a bit muddy. Bitcoin is digital and moves very fast. Regulation is very analogous and moves very slowly. Everyone who has been in IT knows about this. And then it doesn't matter whether it's Uber or bitcoin. The United States are some of the ones who have been the fastest and actually said that you should be registered as "money service business" if you were to trade bitcoins for others in the United States. It is reasonably easy to get such a license. On the other hand, you can report suspicious behaviour to their authorities. It gives them a big advantage as they get hundreds of reports a day and when they have criminal cases, they have some data to go on with. So in this way they are far ahead, but at the same time you have to remember that the US consists of 52 states with different regulation. Some states are anarchists and some are something else. In

addition, you have local regulations like in New York, who has issued a so-called "bit-license" through the Department of Financial Services. They risk activity with bitcoins for banks, which in return provide bank accounts for bitcoin companies. One of the biggest problems for bitcoin companies is that banks will not touch them, as they are too high risk. But, because there is an actual regulatory framework, the bitcoin companies over there can go to a bank and show that they are compliant. Obviously, it creates a big barrier of entry for new players who may not have 1 million dollars to buy a license. On the other hand, the banks know that those who have a license are able to control things because they have a lot of things to live up to. It all depends on how open you want the market to be versus how big players you want. That is another discussion, which we can have at another time. In any case, it is how it works in the US, which means that big companies like Circle and Coinbase can operate out of New York and they move billions of dollars a for their customers. It creates for efficiency in the market. In Europe, it is more "up in the air" right now, but there will be more regulation through the Fifth Anti-Money Laundering Directive. This means that bitcoin companies, virtual currency exchanges etc. will be regulated. New rules demand them to take an ID when dealing with people. They are going to do anti-money laundering checks. The regulation will come at the end of the year or beginning of next year. Europe is somewhat behind the US but the new regulations means that you can now send reports on suspicious behaviour.

EC: Will it be primarily when you trade or exchange fiat currencies for bitcoins? When you are already in the market?

SO: No, it is when you enter the market. They will be these gatekeepers.

EC: So when you are in the network and you avoid getting in touch with a broker, you may well exist outside these regulations?

SO: Yes, yes, when you are inside the market. It is the same if I take out cash from the bank. Then I can run around with them without it being anyone's responsibility. The new will be that the companies can send reports, they can be de-risked, and they can build business models without having to shop for bank accounts. At the same time, we will get the PSD2 Payment Directive. Here it begins to become really interesting. Under the PSD2, banks have to open up for their platforms etc. and at the same time the banks cannot deny access to regulated companies. So the banks cannot equally reject companies that want to open a bitcoin account, if

the company follows the regulation. With the Payment Directive you cannot send them away. So there will be great opportunities for bitcoin start-ups. The banks need to get their fingers out because they are going to be more exposed to bitcoin and virtual currencies. To a greater extent than they are right now.

EC: What if the banks cannot deny people or companies to have an account. Would it help to break down the gap between the two systems?

SO: Yes, it is definitely about a greater integration between the systems. Personally, I want to see that we internalize these markets in one way or another rather than externalize them so that we do not have people going to Christiania to buy bitcoins. Then there will be no reporting, no one wins anything and the criminals do whatever the criminals have always done. I see a big advantage in enabling the banks to work with these companies. We cannot be too tough on the banks. It is tough for them right now. Ironically enough. It's not easy for them to operate here because there is no regulation. If they open up for more it will be bad, but if they hit hard at bitcoin it will be even worse. They are caught a little in limbo, where hopefully regulation will help.

EC: You said before that there are many who do not even know how to make a secure password online. What does it mean for the market that there are many amateur investors?

SO: That's part of it. Bitcoin does not have any customer service so when people lose their money they are just lost. There is no bank with responsibility, no NETS and no Nem-ID. When the money is gone, the money is gone. There are thousands of ways to cheat in the market. That is something of what financial regulation has tried to… they have introduced some customer protection. An ordinary Dane cannot go out and invest in all kinds of rattle. Whether it is the authorities' task to play parents for us is again another discussion.

EC: We were thinking more about the volatility you see in the price. Some of those people who enter the market simply do not understand what's going on. How does that affect the market?

SO: Yes, they may not. But maybe it is like that with many of the other products that people invest in. The dot-com bubble e.g. There is money to invest and people want to invest. If they do not invest, they will play poker online and then we can discuss where the boundary goes.

Primarily, I think that there is a lot of education in it. We have stickers on the cigarette packages so maybe we should also have it on bitcoin. It's a super complicated issue and I do not have answers necessarily.

EC: Now you mentioned the dot-com bubble. Bitcoin is, on a daily basis, compared to a bubble. What do you think about that?

SO: That is a very good question. I think, and I think I also mentioned that at the presentation in Rainmaking, that it is a new asset class that does not necessarily follow the rules we are used to. And there are not very many bitcoins. If people want bitcoins there are really not many of them that you can buy. And only fewer will come. If this trend continues, it's "to the moon". If there are more people who want to buy than sell, then the price goes up. Whether it is a bubble? I really have no idea. It's really hard to predict. But I do not necessarily think that common theories will work. We may call it a bubble but bitcoin doesn't care what it's called. We are also hiring economists now to make analyses. Nor are they completely sure what is happening. Many of them are not entirely sure where this is going.

EC: What do you think the potential is in bitcoin? What is bitcoin able to do?

SO: Bitcoin is the very first time that there has been an alternative. If we go back to start, you see that many people have tried to make magical Internet money before. And everything went wrong. No one had invented the right technology or a protocol that was stable enough, which could create the right game theoretic incentives for it to actually run. It was done so in 2008-2009. There were many hackers and cyberpunks who discussed it a lot on different forums and then you had all the libertarians, who didn't need much conviction other than "money without the state = yes". You saw a fairly large influx of politically motivated libertarians early in the history of bitcoin. Then there were the many technical interested that came into the market and built their companies. Bitinstant and Mt. Gox might not be the ones you would have liked to be built, but after them we see a fairly high level of professionalism and today we have big exchanges like Coinbase, BitStamp etc. If you go further ahead, these companies have gained more and more people and at some point in the course of last year, the third wave comes in where it is just sand bars and scrub [*revl og krat*] coming in. All sorts of investors joined, some with knowledge of investing and others with no knowledge. A lot of consultants came in trying

to build blockchain solutions. And we saw many scams that started making ICO whitepapers and making money that way. Everything was driven into a completely different gear last year.

EC: You mention that bitcoin may represent its own asset class. It is also something that we have discussed a lot. What do you think bitcoin is? How can you describe this?

SO: I actually think that Digital Gold is a very good way to look at it. Gold, which you can send to each other. There is a limited amount and you can send it over the Internet. And it works. Digital gold may be a bit silly, but look at people under the age of 30. They have no relation to gold. Super stereotypical, but they relate to Snapchat, Facebook, digital platforms and Instagram likes. They see a great value in things that are already 100% digital. For them, the concept of digital gold is more tangible than the concept of gold, and I think that some of the old economists forget that. So, I think it is a new asset class. How big it is going be, I cannot predict.

EC: These gold arguments are many trying to shoot down because they argue that gold can do something. You can have it in your hand and you can make jewellery out of it. Of course, bitcoin cannot. Is it a matter of understanding that the world looks different today?

SO: Yes, but you can say that gold is worth nothing just because you can make jewellery out of it. It's also not worth anything just because we put it in our consumer electronics. Gold is used as an investment object. Denmark's gold is located on large pallets in England's basements. Exactly because there is not much of it. That way, there are also some things that make more sense to have digital.

EC: Camilla talked about blockchain on Monday. She said that there is bitcoin blockchain and there is everything else. What exactly is there?

SO: Now, Camilla is also working at Chainalysis and we can see that bitcoin is doing a lot. This is where the money is moved around. And then ICO's at Ethereum. If you have these two, then it's the majority of the market. You also have all those other blockchains and all sorts of different coins that can do some other things. Then you have all the projects that come from the IT sector and consultants. There is not really anyone who knows what a blockchain is, when we keep mixing it all together. It has been one of the things that I have found problematically in the 4-5 years. I have held presentations about bitcoin and blockchain. I would spend two hours talking

about bitcoin and 10 minutes talking about blockchain. I think that the big change is going to happen on bitcoins blockchain. Blockchain was first called "Timechain" or "proof of work chain". That is why it's called blocks, as there's this proof of work mechanism behind. It is Satoshi himself who said that. Fortunately, the authorities are starting to split it up so that it becomes cryptocurrency and then blockchain. Some have gone so far as to say that you cannot take the currency element out of blockchain. If you do, things do not make sense anymore.

EC: So it might have become a buzzword and now everyone is calling the new technology blockchain?

SO: Yes, and that's why I like Deeana and her presentation. She is very open about it, saying that there are actually interesting technological possibilities in creating these open shared platforms. But it's not yet available. If we want the platforms we will have to build them, and here we can seek inspiration from bitcoin. None of the ICO's are delivering it yet.

EC: What do you think should be bitcoins place in our society?

SO: Bitcoin does some different things. Bitcoin will probably find its own place to live. The more we limit people in their financial activities, the more space bitcoin will be able to work on. We saw this in the dark net market, and we saw it with WikiLeaks. When WikiLeaks could not accept Mastercard or Visa anymore, they then accepted bitcoins. You see bitcoin in these grey zone economies where things are not necessarily illegal but its too high risk for traditional payment infrastructure to service it. That may be online sex service or gambling. Sex, drugs and Rock n' Roll. As soon as one of these systems is not serviced by traditional payment services, bitcoin will take over. We also start seeing it at a larger scale in, for example, Venezuela. Now they have fooled themselves so much, so now they are trying to launch their own crypto. But there are people in Venezuela who live by mining bitcoins. That is how they survive. Again, it is an alternative, for when the more traditional systems fail or doesn't meet the human needs. We have not had anything like this before. Certainly not something that has been digital and global.

EC: If it came to it, would you be able to pull bitcoin back at all?

SO: I think that will be difficult. Then you need a reasonable totalitarian approach if it is going to be closed down. It also doesn't look like there is anyone trying to close it. When looking at the

EU regulations, regulations from the US and from Switzerland, and South Korea who is also included now. China is a bit more restrictive, but still open, so nobody is closing it down. Of course there should be anti-money laundering check ups and knowing what it going on.

EC: Do you think the world is ready for bitcoin?

SO: I think that bitcoin does not care if the world is ready for bitcoin. I'm hopeful, especially in a country like Denmark. We are digital, we are adaptable. All in all we have some relatively gifted politician and skilled officials. And some talented entrepreneurs. I think we're going be all right, but I have no idea.

EC: I think we are about to have enough, but we have some last questions. What kind of data do you use in Chainalysis?

SO: We do some different things, so we have both the blockchain itself with the transactions, but we also have a team doing more in-depth analysis. That may be reports on cybercrime. It can be the case of *forken* with bitcoin and bitcoin cash. How did the miners mine the different blockchains, how did the game theory and economy coinside behind it? It can be data for different markets and traders. We have a lot of different data.

EC: Where do you actually get the data?

SO: Well, it's a public blockchain. You can take that data and then try to find some data yourself. Then you combine the two and if you do it right you get some very interesting data.

EC: How does a public blockchain work? How would I be able to see the data?

SO: I don't know if you have visited a blockexplorer like www.blockchain.info? It is a visualization of the blocks. [Simon shows us the webpage] Here you can see what the block is. It's about 500.000, which means that 500.000 times 10 minutes have passed on average. You can see how much time since this block was found and how much data the block holds. Before the update of "forken" there could only be 1 MB in a block but now you can get more. You can see that the blocks are not full, which means that the network can handle all the transactions that come in. If we click on a block we can see a summary. This block has about 2000 transactions, and it has

moved approx. 10 bitcoins in total and there was 0,2 bitcoins in transaction fees. You can see who mined the block and you can see all the transactions. So a blockchain is a spreadsheet of all transactions. If you have all transactions you can deduce the balance of all addresses. It's super trivial to do for a computer.

EC: If something needs to be changed, the network must approve it. Or the network must agree on it. How does that work?

SO: No one has tried it before. That has been the whole problem with this blocksize war, segregated witness update and bitcoin cash forken. In Denmark we can go down and vote and one person has one vote. On blockchain you do not have any identities. So how do you agree which updates to be made? If we take segregated witness as an example it was something that was suggested 2,5 years ago. It was in many was an uncontroversial update from a technical perspective. However, there were many people with conflicting interests or lack of cognitive ability to understand how good this update was. They became enemies on the Internet, without identities. How do you figure out what people actually think? At the same time you have all the stakeholder, miners bitcoin exchanges, users, developers etc. There were tweeted, made memes and written long articles. There was no opportunity to vote. Some might vote on exchanges where they had their identities verified. Some spammed the network with transactions to get the fees up. So you had a huge clash of technical skills, ideology and propaganda. The network had to agree, as the network is stronger as one than as two. Now bitcoin cash is out and that is very good indeed. It was hugely exiting to follow along from the sideline. How do you achieve consensus in a decentralized system without identities, for the first time? It was really going wrong. As a starting point, it was the miners against the users. It ended with the users threatening to throw the network beyond a slope. What you call a User activated soft fork. If the miners did not follow the rules that the users wanted, then the users would not accept the miners' bitcoin blocks. That would have been a huge problem. It forced the miners to signal that they would implement segregated witness, but it was in a period of time that they had to signal it. 80% of the blocks should signal, within a certain block, that the miners would update to segregated witness on this date. It was 81,5% on the cut-off date. Had it been under, and then everything had ceased. The update came and it has meant decreased fees and enabled the lightning network. I think many people try to write off bitcoin as being temporary. But it is the best case study for a decentralized system at the moment. I don't think you can write it off because it gives a picture of how decision can be made in the future.

EC: How did the users come to term? Was it on the web or?

SO: You have these core developers, which are the original bitcoin developers. It's the brains. If you find yourself on the other side of them, you should "check your premises". They have not been particularly good at communicating and transactions fees went up, so some said that the network should have bigger blocks. Many did not think about the trade-off that would be in relation to integrity and the power the miners would receive. The developers have always believed in a decentralized network, open source and the best ideas are going to win. They then had to speak with a single voice. They had to be a central point of authority because a lot of people needed convincing. It suddenly became clear that there is a development team behind bitcoin, and that some people have authority, which is good for the network. The developers needed to agree and then get everything communicated. It culminated in this User activated soft fork.

EC: How do you sense what the atmosphere/mood is in the community?

SO: It was really hard. Coinbase had some API's where, if you had your identity verified, you could build a voting system. Somebody did that, but it only represents the users on Coinbase. What did you do with the users in the rest of the world?
There was also BitGo, the biggest wallet vendor supplier, where the engineers were out on Twitter and called the Director of BitGo an idiot. There were many open twitter fights.

EC: So it's typical on Twitter, Reddit and other social networks that you read about the sentiment?

SO: Yes, I will say that. It depends on whom you follow on twitter. Bitcoin on Reddit has always been major supporters of the core developers. There are also some news sites, but it is difficult for Coindesk, for example, because they have investors from all over the industry.

EC: Thank you for your time. It was very exiting.

Appendix 6: Interview with Lars Holdgaard

Interviewers:	Emilie Lang Borup & Christine Mohr Balslev (EC)
Participant:	Lars Holdgaard (LH), entrepreneur, founder of Dansk Bitcoinforening
Interview type:	Skype connection, Denmark
Date of interview:	28/2-2018
Interview time:	37 min 36 seconds

EC: Can you start by telling who you are, what you do and your approach to bitcoin?

LH: I have studied software technology at DTU and after my bachelor I wanted to get away. I went to Asia and lived in Hong Kong. Later I went to Singapore where I met some friends, and I ended up talking to a guy who wouldn't stop talking about bitcoin. He just kept talking about bitcoin and that he was starting a business called Bitcoin Nordic. It took a year and then I meet one of my friends back in Denmark who cannot stop talking about bitcoin. He kept saying, "Just buy a few bitcoins". In January 2013, I wanted to see what it was all about. I bought some bitcoins and was really inspired about how easy it really worked. I ended up founding Dansk Bitcoinforening. I was then programming a lot and made some YouTube videos about it, I have blogged a lot about it and been asked about it in the media. I go out of it to make some startsups. In the meantime, I also got my master's degree. I finished in 11 months while I was working. On the sideline I have followed bitcoin because I have an economic interest combined with an interest through my friends' big investments and interests in bitcoin.

EC: Are you still active in Dansk Bitcoinforening?

LH: No, I left in the end of 2013/beginning of 2014. All the work was on me. I would rather do startups instead. I was starting a consultancy business at the time and I chose to focus on that.

EC: What did you do in Dansk Bitcoinforening?

LH: At the time, the purpose was to create value for Denmark through bitcoin, which was a bit of a bad title. The idea was… We were a group of right ideological people who believe that bitcoin and blockchain are part of the future. I think so even more now than then. We wanted to make people interested and spread it, so we informed, we made videos, we held conferences and

presentations at various companies and we were in the media constantly. Dansk Bitcoinforening still has that role, but basically no one is managing it today.

EC: What is it that makes you think more of it now than then?

LH: At that time, bitcoin was just a technological "ha ha, we're walking around with some kind of money". There were some cool technological things, but it was lacking so much. It was just an idea, and you could transfer something from A to B with low fees. It was really nerdy what the illusion really was. The last two years… especially with what has happened to Ethereum, which is a huge development of what can be done technically, I have had a change in attitude towards cryptocurrencies. I think that bitcoin is goin to die, but blockchain will change the whole foundation on which the financial institutions are based. I have been at the Fintec Lab at Christianshavn where there are many blockchain startups. I have been to Berlin and worked in an office with a lot of blockchain startups. And in Asia I have also met a lot of blockchain startups. There are more opportunities now.

EC: Why do you think bitcoin is going to die?

LH: Because it's rare that… the first Internet business is not the biggest either. Bitcoin was the first and if you look into bitcoin you find many serious issues. It has huge fees. Throughout the month of December it cost over $50 in transaction fees, which is completely crazy. This is because they have a very bad programming team. There are many who disagree with this. The point is that they have not really developed. It's expensive and I think there are many other cryptocurrencies that will go further. Do you look at anything other than what I claim; bitcoin had 70-80% of the total value of crypto last summer. Today, bitcoin's value is only 30-35% so bitcoin has fallen sharply in their power.

EC: If we say it's not dead yet, because it's not, why do you think people want to invest in it? Why do they want to go into this market?

LH: I think it's hard to talk about without talking about what kind of people you see.

EC: Yes, how can you divide people into types?

LH: Specifically… I was at a children's birthday party on Sunday, where the woman next to me talks about seeing a Facebook ad about bitcoin. She has heard that you get rich. Such people like her are people that do not understand what is going on. It's people who play Lotto. It's people who think they can get rich just by putting some money in. it's also the people who are going to lose all their money because they don't understand what's going on. I think there is a large group of people who have seen a lot of others become rich or say they have become rich, and now they want to enter the market. We saw the same thing during the IT bubble in the 90s. That is one group. There is also a large group of people who know something about it. They buy a little broader. I have a lot of friends who are here, but they go away from bitcoin and go with other cryptocurrencies, such as Ethereum, Dash. That is also a group. Then you have the money people who come from the financial world. It is quite clear that there a quite a lot from Wall Street and foundations. Wealth Management companies are also asked to get something with crypto. I think there are many subcategories.

EC: What do you think is the biggest of the categories? Is it the ones who don't know anything about it?

LH: Yes I think so, if you look at the volatility. You go from $20.000 to $8.000 in a few days. So that's because there are people who go into it and have no idea what it means. Otherwise it would not have fallen so much. It fell over 1/3. People from Wall Street are used to holding something for a longer time, unless it's traders. But I don't think that the majority of people are traders. The other thing is… now I was in Hong Kong and the government had commercials in the subway and elsewhere, where they basically said you should not invest in things you don't understand. Then there was a picture of bitcoin and ICO's. In Japan, you often heard something on the news. I think it's the width and right now many people are soldiers of fortune.

EC: Is it a problem, when we consider a technological difficult to understand market that a lot of ordinary people want to join?

LH: I'm actually sorry that so many people come in right now. If you really understand what bitcoin can… can you mention some places where bitcoin and blockchain are used for something? Because I can't. I cannot list any real thing it's being used on. There are newspaper articles that Mærsk uses it with their blockchain. These are only research projects. There is not anyone who uses it yet. The potential is greater than the Internet, maybe a bit on the tip, but the

potential is great. But it corresponds to the fact that we are in the 70s before the browser or the Internet was invented. Now, people are betting very big sums. It is very serious money that is in it. They bet on something that is not being used for anything yet. If you look at the valuation for many cryptocurrencies and compare that with many startups, the valuations are a 100 times bigger. The startups are even on the market. They have sales and customers. Of course, you cannot quite compare the two, but it's pretty crazy right now.

EC: What do you think the potential is when you say that it could potentially be bigger than the Internet?

LH: Looking back historically, back in the 90's when the Internet appeared. There, the companies built on HCB, browser, we had emails. Understand me right, when we send emails to each other, if you send from Gmail to Hotmail we can still send mail to each other. This is because the Internet was built on open protocols. There is no company who owns the Internet. There is no company who owns emails. The last 10-15 years, something else has happened. When I write to people I go to Facebook. I love Facebook. But it's a business. When I buy things, I trust Amazon. If I would like to buy a used bike, I go to Den Blå Avis. So for the past 15 years, there has been a wave of companies that have gone against the initial launch of the Internet. What we are going to see with blockchain now is this third thing, where many will do a lot of thing on protocols again. An example is Filecoin. Today I use Dropbox and I'm happy about that. But it would be nicer if there were an underlying protocol, which said, how to share files. Then Dropbox would still exist, but instead of building their own email platform they can use a protocol that already exists. I think we will see that protocols come back.

EC: Now you're talking more blockchain. Is that what the value in bitcoin is? Or is bitcoin something in itself?

LH: What bitcoin say they are is a way to transfer amounts between others. With the fees they have, it's not suitable for that. The fees have fallen now, as they have made some software updates. But bitcoin is not useable for buying groceries in Netto. It's not very nice spending $50 every time you buy milk. It's a pretty bad trade. Then there are others who think bitcoin should be used as new digital gold. I do not buy that hypothesis. It may be that I'm wrong; I just do not see what bitcoin has. Neither technological, commercial nor societal value. I do not see that.

EC: What do you think bitcoin is?

LH: In the original white paper that was released, it was presented to be an electronic cash system, where the idea is that you can transfer money/value to all people in the world for free. I was quite interested in bitcoin as it was the first system in the world where you can transfer for free and you are not dependent on an intermediary. The development has gone in the wrong direction for bitcoin, and that's also why I'm not in it anymore.

EC: Do you think bitcoin is a currency?

LH: Yes… that's a hard question. In what context do you define currency? It reminds you of a share, in that you have… it's more like a liquid asset than a share. You can buy something for it, that you cannot do with shares. Yes, I see it as a currency. I do that.

EC: If we look at the development in price a lot of people think bitcoin is a bubble. What do you think about that?

LH: You can answer in many ways. It has just fallen 1/3 and then increased slightly. There was a kind of price bubble. I do not think anyone can answer that. If I could, I would be the richest man in the world. I more think that… it's a bubble because there's nothing underlying. Nothing that supports these values. Do you take the IT-bubble; in the first place it crashed because of excessive valuation. Today, Google, Amazon, and Facebook are the world's most valuable companies, but it's also those who earn the most money. So there is a connection. That connection is not in bitcoin and blockchain and all the others yet, as there is no one being used. It may rise. I don't want to rule that out. I have said that since $3.000 and been wrong ever since. I think it's more a bubble because none of them are being used yet. If we look 15-20 years ahead, it's very hard not to believe that the majority of our financial systems are not build on blockchain technologies.

EC: What do you think are the potential usecases for bitcoin?

LH: It's a little harder to answer what is it really not. Each time we have e central player it makes sense to have a protocol instead. That includes everything from banks, loans, mortgages or social media. If Facebook's Messenger was on an open protocol, I could make Messenger 2. I

could still talk with you. It may be that people would not use my software because it's nerdy and ugly. But Facebook still exists. I think it's the entrepreneurs who need to find the grasp. When that is said, the technology is not ready today. We cannot even create a decentralized file-Dropbox-copy yet. They have been researching for 2-3 years and have failed to do it. The point is, like the Internet in the 70's and 80's; they need to develop a browser first.

EC: How mature do you think the technology is, if you consider the application of it?

LH: I think we begin to see the first applications being used within 5 years. Blockchain works. It is not so much a concept that needs to be developed. It is a theoretical concept that you can describe. The conclusion is, the more simple the usecase, the shorter the time. Within 3-5 years we will see the most simple begin to do something good.

EC: Is the world in a place where it can understand what this technology can do?

LH: Yes, but I never believe that Mr and Mrs Denmark will understand it. If I ask you how the Internet works, I think 99% out of a 100 will be clueless. I come from DTU and I can hardly understand it. The majority of people are not going to understand what it is. They don't have to. As consumers, we will just come to experience some other products. Developers understand it well and work with it.

EC: So it's a bit up to the developers and entrepreneurs to figure out how this should be?

LH: Entrepreneurs always find some ideas and want to earn money. They get funding from people, at that will also happen here.

EC: Do you work with or use bitcoin and blockchain in your own startups?

LH: No, I do not. My initial argument was that I was so financially disposed. Let's just say that bitcoin will go well, so I'm going to earn enough money in the increase to make other things. Today, I have a debt collection bureau and it doesn't make any sense to make that blockchain based. The whole point is, that we will use blockchain daily in the future. Just as you don't think about using a website today, you're not going to think about using blockchain in the future.

EC: Just to make it clear. Do you think it's the technology that's going to find its place in society or do you think that cryptocurrencies are being used as a means of payment?

LH: One thing. I certainly think the technology is going to be very wide and we will se many things, but you cannot separate the two. All of these blockchain technologies have a token. Their own currency. I think we're going to see a lot of internal cryptocurrencies in the individual blockchains. One might imagine a Facebook coin or social media coin, if they made one. I think that the individual blockchains will have their own coin, but only relevant to their own application. But I also think we are going to see some crypto coins that get very global. For money transfers and storage of money. One might fear that Visa and Mastercard could get some beatings. But there are many ways in which they have seen what is going to happen. I think it will be quite normal to receive crypto in payments. Not many, but some will win it there.

EC: How much is ideological? That's what it all started with?

LH: Back in 2013, it was very ideological. It was some strange people to be around. There were anarchists and people who wanted the state gone. At that time, the majority were ideologists. Today… I'd like to say that all the wisest people I know work with blockchain: the wisest businessmen, the smartest developers and best entrepreneurs. It is the most exiting technology of the time besides artificial intelligence and other of that kind. Today, the ideology doesn't fill that much. I think it's much more the entrepreneurial, economic "how can we make money from this?"

EC: What about the people who invest in it?

LH: I think it's a 100% about earning money. There are two things in it. One, there are some people who buy a little and try to sell it again. Then there is the term "hodling", where people buy to be in it for a long time. These are the two different types depending on how far you look ahead.

EC: So the ideological can fill more or less depending on the type of person?

LH: Honestly, I don't think neither the Wall Street man, the guy who uses a wealth management fund or the lady next to me at the birthday party do it for ideological reasons. I think it's a lot

more about having money in your account. I don't hear anything saying they do it because they want a free society.

EC: What do you think is needed for bitcoin and other cryptocurrencies to be more accepted in society?

LH: The technology must work first. We need some serious startups and we have a lot and they have a lot of funding. I think that this year we will see Ethereum overtake bitcoin as the leading cryptocurrency. It's a better technology. When there are some real benefits, I think it will be used, even if it's not accepted by society.

EC: How many cryptocurrencies do you think there are room for? Do they compete against each other or can they do something different?

LH: The latter. There are these tokens, and I think there will be a 100 or a 1000 different. I think we are going to have one crypto coin that automatically turns into the others when we use them for payment. There will be different categories of cryptocurrencies, each of which gets a winner. There will be one that is good at anonymous transfers, there are going to be a winner among the very ideological people, there will be a winner for storing value and there is going to be a general winner, which is good for everything. One last thing: people that know about cryptocurrencies and understand it, not any of the people I know still think bitcoin is the most exciting technology. I do not know any wise people who work with bitcoin. I strongly believe that bitcoin is MySpace and that we have not seen Facebook yet, as it is still being developed.

Appendix 7: Interview with Hans Henrik Hoffmeyer

Interviewers:	Emilie Lang Borup & Christine Mohr Balslev (EC)
Participant:	Hans Henrik Hoffmeyer (HHH), SVP in Smart Payments, NETS
Interview type:	Face-to-face, Ballerup, Denmark
Date of interview:	1/3-2018
Interview time:	1 hour 28 minutes 49 seconds

EC: Let us start. Can you start off by telling us a little bit about yourself and what you do in Smart Payments?

HHH: NETS has made an initiative to look at the future of payments within the next five, seven and 10 years. We already now make preparations for that world. NETS, for example, have a great societal role in carrying out payments for over 250 different banks, 300.000 companies, and thousands of stores and online. In the North, NETS have a 50% market share in many areas. We run Dankort Danmark, which has a very essential structure. And then we do all this payment service, billing service and clearing of all transactions between banks. If there is someone who can do something in payments and the settlement of payments, then it's NETS. NETS has now also become number two in Europe and there is a very large consolidation wave, where a lot of acquisitions are taking place etc. We also look at an internalization of NETS. And we also just got new owners after being on the stock exchange. There is a desire, from the Executive Board, to address these new areas. First and foremost mobile payment, which I have been in for two years and have established a strategy for, on the Nordic level. The strategy has included helping banks get in the stores with their mobile payment products. Everything you see from Apple Pay to the banks' own initiatives such as Nordea Pay, Wallets etc. It's an infrastructure that I have built up with a large team. It is based on a new technology called "tokenization", which allows devices to pay. We provision a debit card down into a mobile phone in a secure way. It's the same technology you see in Apple Pay and all the NMC-based payment methods. Not like MobilePay, which is something completely different and a very old technology. The technology can also support other payments because it is tokenized. Machines can also pay. You can provision your fridge so it can buy items for you. So that part of the technology we have made and implemented. Everything here takes a long time to adopt in society. We can see that mobile payments are difficult to adopt because the credit cards with contactless technology are so easy, so why should you find your phone? However, there is a need to go further, and so we

have established Smart Payments, which is based on disruptive technologies. What can blockchain mean for the future? What can virtual reality mean? What can robotics and chatbots mean? In that context, we have made different payment method examples, as you saw below, but we have also made social media payments where we by Messenger can send money to each other. We have a lot of technologies that we are currently working with. It looks very promising. Right now, we also have a payment set based on the cryptocurrency mind-set, but where the idea is to be able to make payments, the principle is microscopic, in an efficient and cheap way. My role here is to help Susanne, who is the CEO of the company we're building. My background for being here is that I have built companies before. Among them some of the first mobile payment initiatives in Denmark. I have sold it to another company now, but I also built and co-founded Coinify, and merged two other companies back in 2012. One called Bitcoin Internet Payment System and the other called Bitcoin Nordic, which respectively made purchases and sales of bitcoins for consumers and remittance to the Philippines. And the other company made payments where stores could take bitcoins for their goods. I put together the two companies and built a team around it and got it funded. It has since gone very well. It is now a European leader in the field and has hundreds of thousands of customers today. I have been in the bitcoin theme since 2012, and in this regard I contacted the Financial Supervirsory Authority regarding regulation. Back in 2013 I helped discuss the dialogue about how this should be regulated. It is not being regulated by the FSA and it was my recommendation not to do so. It's too complex and fortunately they understood that. Then I joined the Blockchain Virtual Currency Working Group, and organization gathered by the foremost in the field, which discusses with the Commission and Parliament in the EU context. How should this be regulated? And if there is any regulation, how should it look? We have then contributed to preparing the new anti-money laundering legislation, AML5, which will include what is now called virtual currencies. Not cryptocurrencies, but virtual currencies, which is an umbrella term for all everything that is not central bank issued currency. All member states, inclusive Denmark, must implement it. It is already approved by the Parliament. The next step is a tax process in Denmark, where you discuss how this should be taxed. It is reasonable to realize that it is going to be taxed, but the question is how. So that's my background for talking to the theme.

EC: How did you get into bitcoin?

HHH: It was my business partner Mark, who told me I had to look at it back in 2012. I did not, but after 3-4 months I looked into it. It was a bit random.

EC: Have you invested in bitcoin?

HHH: No, I have not invested in bitcoin, but I have bought bitcoin. And I've lost them again too. And I bought them again. I've been through the same journey as everybody else in this area. However, I don't think of it as my business.

EC: What is it that makes you believe in this?

HHH: It's a really good question and I'm glad you asked. But then it will be an understanding of money. We separate the cryptocurrency from the blockchain. Cryptocurrency is an application on a blockchain. If you see the Internet as being blockchain, the virtual currency, bitcoin, is a website. So in principle there can be infinite many cryptocurrencies, but bitcoin is one of the really successful websites. Why are they so successful? Is it because they were first? There is something fundamentally about currency that people do not understand. People don't even know what the difference is between currency and money. I would even challenge Nationalbanken to explain it to an ordinary person. I can explain how blockchain works, but I cannot explain how money is being issued in society. And I don't think there's anyone who can. When we buy a cup of coffee, we know more about how this coffee is brewed, where the beans come from, how they have been roasted than the money we use to pay for that coffee. You have probably not asked yourself that question in life. That's a shame. Currency as it is, is not money. Currency is something that a central bank issues and they don't issue that much. They issue some cash, banknotes and coins. Today it's very digital. In fact, the banks account for 90% of the issue of ALL the money in the world. Only a few understand that. What people also don't understand is the difference between money. The central bank's issued currency is actually something else than what the banks are doing. Banks issue debt instruments. If the banks have to issue money, if you need a loan e.g., then they will issue some money for you. This is based on the fact that you have paid some money to the bank, but now they gear it up. If you pay 10 kr. in the bank, they can loan you 100 kr. Where are the 90 kr. coming from? They come like this [snaps] – out of the blu sky. So now a debt item of 90 kr. has been made and you owe them to the bank. Now we have some debt in society. Now, by the way, we put some interest on which you have to pay to the bank. Let's say that's 10%. Let's say you're paying the money back. What's that left? There is still some interest to be paid. Where does it come from? How do you ever pay that money back? It's new money, but its debt-based money. That is, there is no money to repay them. If our society here consists of exactly the transactions I have just mentioned, then there is

still interest. Where did it come from? It has never been issued. So all the debt there is in the world can never be removed. There is nobody who understands this correctly. But there is no one at the other side, who repays the debt. When we talk about the US debt ceiling now being raised from 20 trillion, where does that debt come from? It's not because there are anyone on the other side of that money. If anyone thinks there are some who have the 20 trillion they have borrowed and are going to repay, think again. The money does not exist. The whole world community is indebted. That's how our monetary system works. Then of course it is the supply and demand in the different countries. We can see it as a commodity, something that can be bought and sold and that has a price. We see the Danish Krone as very stable. Nationalbanken says that it's incredibly stable. But if you look at the international markets, I promise you that the Danish Krone is flying up and down. That is, if you take it relatively to many other things. If you are confident that the system will live forever, you must open some history books. There is never a currency that has survived. All currencies that have ever been in the world have all been worth zero at one point. It may be that it is not so likely, but there is a risk for everything. When we had the last financial crisis and we look at what was issued, you start to figure out how much money was issued. It's an amount that no people can understand. A project called "The Money Project" has made it visual. I love using it, its just not very positive to read about. I think it "hits the nail on the head" with respect to what I'm also telling you. [*HHH is showing us The Money Project on his computer screen, while telling us about the facts*] You will see that the market for silver has this size, which is very, very small. Cryptocurrencies may be that order of magnitude. Each of these boxes is 100 billion US dollars. Compared with large companies, the cryptocurrency is very small. It might be a fifth or half of a company like Amazon, which has a total capitalization of $800 billion. Compared to the richest in the world, that is also a small amount of money. If you take such a thing as the FED's balance sheet, you will see that the money that are dark is 3,5 trillions. That has been issued since 2008. And this is what has been issued throughout the history, i.e. 180 years. It may be OK that they have been issuing extra money; you may well live with that. If we look at how much currency there is in the world; this is the money and banknotes that the central banks have issued. Physical money. We can agree that they don't have a value. It's a piece of paper, but people value it. We also do that with a bitcoin today. It has no intrinsic value. Nationalbanken would say that regular currency has a value. What is the value? It has the value that Nationalbanken issue it and we can take tax from the citizens. That is the value that a currency has. That's true. It is a central bank that can decide what our monetary policy is. They can print a lot of banknotes and then the money is worth less because there are more of them in circulation. That is what the central banks can do. They can control the money. In fact, not much

money has been issued. This is this the total currency amount that has been issued globally. That's gold and it roughly matches how much currency there is in the world. It is 7.7 trillion. If we compare it to the stock market, you will see that the US is the largest stock market. Now you begin to feel a sense of size. If we look at the global money supply then you can see that this is what the central banks have issued. But this debt machine runs in relation to issuing the general currency. This is bank-issued. This is called broad money. It's about 8% of which is physical money and then there is the digital money. The central banks also issue money that is not coins and banknotes. Banks need the money to be in their database system. That is an impression of how much money is actually issued. All that is debt-owed. Let's say we should offset it in something, so let's look at the global debt. If you take all countries, it's an amount of just over 200 trillion. It's a relatively large amount. It's 325% of global gross domestic product (GDP). If we only pay debt back and everything continued, as it should, it would take us three years to repay the debt. Theoretically speaking. There are relatively high debts for both the established and the new markets. If we compare it to all real estate in the world, it's roughly the same size. Can you see that? So if you take all the debt and only finance the houses, that wouldn't even, be enough. That is not very good. What is really bad is the derivatives market. Derivate market was established… it is in fact a betting market for all that is above. Here you can make a contract of difference, i.e. I believe that gold is going up or down and I'm betting money on that. Derivative market is demonstrably influential for example. Derivative market can affect the price of gold. Derivative market is what many are really afraid of. These are some enormous amounts. You can continue to issue instruments. It is estimated to be twice the global growth. Just visually, if you look at this derivate market, then this is estimated, low end. The high end is the 1,2 quadrillion. If this market crashes, then there is nothing that can survive this. There is no who strives to save anything. So that's fine enough if you believe in this kind of currency and monetary system, but there are also an increasing number of people who think it will end. Look at our indebtedness and how it is exponentially rising. So one of the reason why I think this theme is important is that we have always had a commodity based currency. What was worth money was to have land. It was to have goods - what you bought and sold. Until gold came. But gold was also a commodity. Then someone found it smart to trade with. Then at one point you go the bank and put the gold here, because you're too afraid it will get stolen. The bank then gives you a receipt to show that you have gold in the bank. But when I needed to use it to pay you and needed to go get the gold so you could have it, and then you needed to go to the bank with the gold, the bank got a function. If you just got a proof of ownership of this gold, you could just go down and pick it up. That was the way currency began to be established. And as a landowner you needed

to protect your land. You then needed to pay some warriors. The way people paid warriors were to say that they were going to steal something from the peasants. It's my country, so I decide. That didn't work, so the landowner introduced a form of coin. "Now I give you some coins and with those coins you can go down and buy something. With those coins down there I can pay my peasants too." A small economic community was made. It was just a matter of time before ant poor government leader thought of putting copper into the gold coins. Suddenly you had more copper than gold in the coins and people saw a difference in colour. They wanted the gold coin and for the first you began to pay ten copper coins for a gold coin, and the gold got a price. The problem was that it turned into a political system. We went from gold as being weighed and which had a confinement to some political condition; "We have a monetary policy and I'm a politician so I'll decide how many banknotes we produce." There are so many stories of people who could not manage it. We have also seen that all, ALL currencies have only gone one way. None of them have risen. So, that just shows that at one point or another they are all worth nothing. Nationalbanken says that they won't mistreat our currency, but a package of liquorice does not cost what it did 20 years ago. So it's not a place where you can save your currency. Bitcoin is not exactly a political system. It is a mathematical system. If you trust the politicians and their monetary policy, you can go with the politicians and their currency. If you trust the math and what you see, you can go with bitcoin and others and say you think it has a value.So, people will argue; who are you trusting, who invented this? Then this whole story begins. So, I say, I don't know who invented the math either but I know that one plus one gives two. I trust that. The tendency was, that the first who entered the bitcoin market were libertarians and you know it was also invented during the 2008/2009 crisis. This was where it emerged, and it was an initiative to create a new monetary system. Then you can discuss whether it succeeded or not, but that was the background. So I'm in the box, where I look at bitcoin as a competitor and it's the first competitor we've ever seen in existing currencies. The basic theme here is that we have never had any competitors to a currency before. We have never been able to issue currency. You can make a currency tomorrow. When there is a situation ... we have seen it before with the music industry, the film industry, and the media industry. They have been disrupted. What have they been disrupted by? They have been disrupted by something new that has come. The Internet is of course the very basic thing. What is the Internet doing? In fact, it has not enabled you to produce news differently; it has allowed you to distribute news differently. The kind of disruption we are talking about does not have to be completely fundamental. The music industry was also not disrupted by putting music from a vinyl over to a CD. What disrupted the music industry was that you took a MP3 format with a large file that

could not be distributed, and put it on a tiny file that could be sent in an email. Suddenly, people sent music everywhere. It completely changed the music industry. Now we are having a disruption. We have an invention that cannot be uninvented, which means that the established fiat currency system is under pressure. It's not something that's going to happen in 5 years, as there will be so many forces associated with it. But trust me, it's going to be disruptive; you cannot get around it. So that's the basic thing for me.

EC: What do you think is the wide motive for buying into the market?

HHH: It's speculation and we know. But it doesn't matter much. The fact that people buy into it ... now I do not know if you have seen this presentation? These are the ones I base for disruption in these industries. It requires three things to be speaking of a disruption; a digital disruption. Three things define what you've seen in these industries. 1) That you have made a digital version of a physical product, 2) you have been able to distribute it to zero in cost, 3) everyone can consume it anywhere. Spotify, Internet distribution, a digital version of the physical product. That is, you have digitalized foresight. If you take currency, bitcoin is a digital version of what we know as cash. It can be distributed to zero in costs, and can be consumed by everyone. Everyone can have a wallet. Therefore, it is per definition a digital disruption that has happened to banknotes and coins. That has never happened before. What people should understand is, when that happens, we can all discuss what eventually happened. Did something happen to the banks? Who was affected and blah blah blah? If we stood in 1995, when the MP3 format was invented, we could also guess what would happen to the music industry. Would the artists go directly to the consumers? Then Spotify and some others came, but the music industry has never been the same again. It was fundamentally changed. This applies to all of these industries: telecom operators, photography, and books with Amazon and media with Berlingske, who are in a controlled demolition and have been so for the last 10 years. It will also happen in the foreign exchange market. For your question about why people buy in? People buy in because they see other people become rich, and so it's that fear of missing out. There have been studies regarding FOMO. That's the only reason. There is not anyone who buys bitcoins to use them to pay for something. Then there are the people who argue that people buy it for laundering purposes, although it's just about 0.6%. It doesn't matter at all. There is not much basis for money laundering in bitcoin. Then you switch to other currencies. It's too dangerous in bitcoin.

EC: Can you say a little bit more about the hype curve? We reheard your podcast the other day. Do you look at it from an individual point? That it is an individual who goes through the cycle?

HHH: You can say that. You can go through it as a person, but it can also be an authority or something else. But is has something to do with being on a maturity journey, which takes time. If you are exceptionally skilled or very dedicated, you can complete the journey relatively quickly, but everyone needs to carry out roughly the same journey. Some may have gone back and forth, but these are the same topics you have to go through. Some may have gone back and forth, but these are basically the same topics you've gone through. What I talked about before and where I came to, relatively fast, is here - "what is money"? I spent a lot of time studying the theme of what is money, how does money occur, what is currency, what is the difference between currency and money, and why it is essential to understand? I arrived here relatively quickly. I'm well ahead now I've seen how this game is going to be played. At least for myself. I'm beginning to see the consequences, which I think it will make. There are probably some others who think that it has some other consequences. When the world is going to look like this, then we will see these kinds of impacts.

EC: But can everyone experience this journey?

HHH: Everybody goes through the cycle. It's only a matter of time. You are already here, before you were here. My mother is there, I don't know. Everyone is heading in this direction. They come to the same conclusions at one point or another. State leaders will, nerds will and children will. So that part of the journey is given. Then you can say: what do you believe? It depends on where you are on this journey. If someone says it's pure speculation when people buy bitcoin, then it's important to ask, "ok where are you?" You must be here [*on the hype cycle*] because you have not understood the fundamental change. If there was a new financial crisis that happened tomorrow, as an example. You have some money in the bank, what are you going to do now? Your bank, with deposits from the Guarantee Fund, guarantees 100.000 euros. That's it, anything else is lost. If your bank goes down, you get 100.000 euros. It sounds like a lot of money, but there are a lot of people that has more than 750.000 DKK standing in a fucking bank. So what are you doing now? Because it's the bank's money. Good if you know that there is a financial crisis around the corner and you know there is an alternative. That there is a safe haven. It may be that it is volatile and everything possible, but you are in control. It is mathematically conditioned. You don't have to trust anyone. What I'm nervous about is when

the price rises a lot in bitcoin, and then the likelihood for a financial crisis is big. Because there is someone who knows something that we don't know. It was like that in 2008. Some people pulled out of the market because they knew that something was going to happen. The banks will start to face some challenges. Nationalbanken says calm down, calm down. The banks have always been solid and secure and blah blah blah. Fine, but we all know we are part of a global society. There is nothing happening in Japan, which does not affect Europe. If a Danish National Bank thinks they are in control of the Danish Krone, then give me a break. It is completely payed up against the euro. The euro is part of a global monetary system. If there is distrust and there is no liquidity in the markets and you cannot move money and people panic… It doesn't matter what you say. So, here you have an alternative. You did not have that before. If you have more than 750.000 thousand DKK. Just look at Cyprus, where they took money out of people's accounts and said, "We're just bailing out and taking you money". We don't experience that kind of world because we live in little protected community here in Denmark. But if you look at Argentina, Venezuela and any other countries, why do they introduce "petro coin" in Venezuela? This is because there is no trust in the financial system. They do not even trust themselves. This is an option that you have never had before.

EC: But can all go through this journey? Will anyone understand it, because it is complex to understand?

HHH: No, maybe not everyone. There will surely be a large amount of people who never join this wave before it's too late. There are already many who buy these cryptocurrencies without knowing what it's all about. They are incredibly easy... then they buy something and then they hear about something. They are easily influenced. There are lots of people trying to cheat and many people who get cheated. Many coins that cannot do shit, but people jump on it.

EC: What does it mean for the market, that it's like that?

HHH: I don't know what it means for the market. I know where you want to go. There are two things in that dialogue. One is what people think. There are plenty of people who think some things. You can see a lot of warnings in the market and the institutions that need to distance themselves from it. That is one part of the case. Of course, people should be warned when they do not know what they are doing. Then there's another side of the case, and it's that this is a real alternative. It's something that works. I could understand it, if it was a Ponzi scheme. If everyone

agreed that this was fraud. But when people now find out that it's not fraud, and find out that it's a real thing that has a function and a value, and people are warning against it, then I think it becomes a little pitched towards the people who know that they are doing. It stigmatizes. Those who understand this theme… there will be a change. Some people will join this cart, some will be in front and some will be completely behind. Those who are completely behind, which may be some of the older generations will never come along. I think that the younger generation will catch this relatively early and be influential. I think it's great that some people get cheated, because they learn, and find out why you have a bank. It's to be guaranteed of some things. When we remove the bank in this environment, you must control everything yourself; your own assurance, that you have some proper codes etc. The learning is also important to people

EC: Do you think bitcoin will remain the largest cryptocurrency?

HHH: No. I think there will be a time when ... bitcoin is the only real currency. All the others are there are altcoins, which is a copy. People do not fully understand how the value is built up. A large part of the value is built up by the assurance that this blockchain is the safest one. So the blockchain with the most computational power, where it's hardest to hack or cheat, that should be the best. And therefore is bitcoin the best. It is the one with the longest chain; it has the most computer power. But there are other purposes to be resolved. Bitcoin can be a store of value like gold. It's not easy, and it's expensive in bitcoin. But there are other currencies where it is easy and fast, but they may not have the same staying power, e.g. bitcoin cash and Ethereum that both have some other purposes. Different currencies will have different purposes. I still think that bitcoin will be an infrastructure that people will lean over since it is the safest there is. There have been 8-10 versions of bitcoin and it is constantly updated, but not at the same speed as some of the others. Unfortunately, I do not think that bitcoin will always be the biggest, but it should be the biggest. There is a group called bitcoin maximalists, who say that there is only one coin and that is bitcoin. I can follow that. Somebody asked how many currencies you could have and one responded that there could be as many currencies as there may be companies. As long as there is a need to solve a problem, there is the possibility of having a coin. It must have a demand as well. Why do we have 200 different currencies in the world? They all have a function in some different national states. And why is the dollar the biggest? If you compare bitcoin with the dollar: if I go to Vietnam, I do not take Danish Kroner. I can take dollars with. Why can I take dollars? That's because they understand it and that's something that can be redeemed for Vietnamese dong. Well, so the dollar has the function that it actually has some additional

attributes than just being a currency. It is actually also convertible. The Danish Krone and the US dollar thus have different attributes. In Vietnam, the Danish Krone is like an obscure dogecoin. It can only be used in some contexts. Where, if you have bitcoin it can be used everywhere. What we also see in the market for all other currencies is that there is only one way in and out. If you need dogecoins or monero, you come in with bitcoin and you come out with bitcoin. Bitcoin is like the one reserve currency, where all the others are some other types. You're going in and out of the dollar, and that is also what you se at the global currency markets. If you are going to buy Vietnamese dong it is cheaper with dollars than Danish Kroner. A Vietnamese would not be able to get rid of the Danish Kroner, and then the exchange will be high. The dollar is more competitive in the international markets.

EC: There are many people who discuss what bitcoin is. You speak a lot about it as a currency.

HHH: I can also talk about it as something else.

EC: yes, but can you?

HHH: Back to the mobile phone. The first immediate relationship we make is that we say it's like gold. Electronic gold, why? There is a mining process that sounds like gold. We make the relationship with the mobile phone and Satoshi has, in his white paper, also suggested that it is a digital form of gold. Originally, it should not be bitcoin, but bitgold. So he has obviously added the analogy to it. It is still not quite gold, because it looks more like a currency. It is easier to divide. If you have 100, you can split it into smaller units. If we say that it's currency, we can compare it, because it has a purchase price. It also has BTC like DKK and USD. Then you begin to make that comparison, until you find out that it can also be programmed and you can do anything with it. They also have serial numbers, which in turn is an analogy to your bitcoin address. So then we say that it does not have a damn thing to do with it. Then there is the software comparison, which is very common. It's just software, it's just someone who has programmed something. How can you call it something that it is not? That is relatively deadlocked, as people have found that it's very powerful programming. The last is the comparison with the payment card. Bitcoin is not only a currency but also a payment system. I.e. when you are traveling, you do not need an infrastructure like NETS in the Nordic region. Bitcoin comes with its own infrastructure. It is located on the Internet, but it comes with its own infrastructure, which is a payment system. So it's a currency and a payment system. That's why

you can stand on the streets of Vietnam and transfer bitcoins between two people without terminals or other equipment. It is a bitcoin code that is sent through the cloud. So that comparison might work. One reason why this comparison cannot work is that bitcoin has a number. A pan number, a reference to an account. We all know what happens if I give up all the numbers on the front and back of my card. Then there are some who have access to my account. It's like a private key. A Public key could be the 16 digits because with the 16 digits I can transfer money to you, but it does not mean that I have your expiration date and CVS number. However, there is a difference here as you can have many different currencies on a card. You can have dollars and Danish Kroner. So a payment card might also be a bad comparison. The reason banks have been so afraid of this area is that they make this analogy (payment card). That's my theory. When you issue a credit card as a bank, then ... if you start buying weapons and financing terror, the bank is responsible for what you do. If the bank had paid cash over the counter, you could do whatever you wanted and the bank is completely irresponsible. When the banks see something that's digital, they think about the mobile phone analogy. It is traceable, and thus the bank will have responsibility of how this is used, so the bank can vouch for it. The banks are not afraid because of disruption. They have not reached that place yet. They have too much confidence to believe that it can happen. They are afraid of "source of funds" and that they can be put in jail if they don't have control over it. Source of funds assumes that if you receive a million dollars as a bank, you have to ask yourself the question of where this money comes from. If you do not ask that question, you can be held liable for money laundering. The reason banks do not want bitcoin money is that they do not know where the money comes from. If they cannot justify where the money comes from then they are nervous. The problem is, that it is in fact a public / private key structure. There is not anyone who owns bitcoin. The key is a holder's certificate. The one, who has the key to something, can do something. All people come to this conclusion that it is not one of the things, and that's also what makes it so annoying from a regulatory perspective. We cannot say that everything is illegal in the world. At least we have chosen to say that it is not. There are some states that say everything is illegal unless we say it's legal. We have chosen in Denmark to say that everything is legal unless we regulatory say that it is illegal. When we get to bitcoin and we cannot put it into existing regulations, what the hell are we going to do? That's what's the headache is right now. The FSA says that they can properly regulate it in relation to money laundering. It's just a matter of how the money comes in and out, but you have not regulated the area. When people say that bitcoin is regulated or bitcoin must be regulated, then the question is "what do you mean"? What is it that should be regulated? "It is a completely unregulated

market". Yes, what is unregulated? Is it in relation to your concepts in relation to what this topic deals with? You have to find out where they are on this curve because if they are here, then we know what they are thinking. However, if they are over here or beyond, they begin to see the possibilities in it. This is typically what happens to people in the field of regulation. They start here, saying that we must get it regulated because it is anonymous, it is not traceable, it must be criminal and therefore it must be stopped. Gradually, people will see that it is something completely different. Finally, you may come over here, where you say, "maybe we should give room for this innovation before we begin to regulate". When you show them the picture of the size of this market, they become aware of how small it really is. On the international currency market, trillions of dollars are traded on a daily basis. It's a fraction of Amazon, and so we sit here and discuss it all day long. It's like order of magnitude. If all the money in the cryptocurrency is laundering, it's not close to what a respectful European bank can launder in one day, and which they do. It has also been part of the dialogue we have had in Bruxelles. When this pile of cash lies over here and is being used for money laundering, and you look at this cryptocurrency, where we need to pay a lot of attention. What about that cash that just lies over here and is being used for laundering all day long, that apparently doesn't matter? It is such a political agenda.

EC: What can we do, if we can't say it's this, or this, or this? It's a whole new phenomenon.

HHH: What the hell are we going to do?

EC: Yes?

HHH: I don't have the solution. But why are we going to do something? Back to being in control: it is obviously very good if we get in control of something that we cannot control. This is impossible to get in control of. I had this dialogue with the Danish Financial Supervisory Authority with these exchanges and this regulation we have now made. As I also think makes good sense. It covers two areas. It covers those who have wallets and those who have them exchanges. There are exchanges that help people in and out and where the money is stored. If they follow the KYC-restrictions, that is, know-your-customers, then we know who has what. Then we can manage it from a laundering perspective. Well, then we'll have to get in and control them here. How do we do it? We just find out where people buy and sell their bitcoin. There are some exchanges like Coinify, Kraken and some different others. Well, then, we say

you have to control your customers, and now we're in control. Until this industry does exactly the same as Napster. Can you remember when Napster was closed? Perhaps you are not old enough. Napster was the first to distribute MP3s. Then we came in with a hammer and closed Napster. However, one only made a new peer-to-peer distribution system. What are you doing now from a regulatory perspective? How do I arrest all the people who are part of the network? Guess what, now these exchanges are made into ... again some technology called atomic swaps. Then they make a market that is P-to-P, which has no location. People meet electronically and trade, without any location, without any central party, and clear that transaction. So what do you want to regulate now? Back to my point: we can sit and make all the regulations we dream about, but it's completely unstoppable. From a regulatory perspective, one cannot keep up with it. Then there is regulatory arbitration, which means that Denmark makes some rules. Fine, all the companies are just moving somewhere else. What we do then is not the right question to ask. It's more a matter of what does this mean? That's what I'm working with. When we have such a thing and accept the premises – and of course we need to go through this curve… Let's say that it actually has a staying power. And so far, it's also the only thing that has been proven. It has not disappeared it has only grown. If we just do not act as in the mobile phone analogue. Good, it's a new theme, we cannot relate to it. What happens then? Let's look up and see what it's going to mean. What does it mean when currencies get a competitor who has competitive unfair conditions? Bitcoin can be transferred 24/7 through weekends; banks do not need to be open. What does it mean for Western Union when this happens? Then we can start having that dialogue. Here I would like to say, that this is the interesting dialogue. The uninteresting dialogue is how can we control this? Because the answer has already been given - you cannot control it. They can jump and dance down in Brussels, and I'm also in the process of getting some control over it. At least in relation to money laundering, which I think is a bad idea that potential terrorists can use it. Now, we can only hope that terrorists use bitcoin, because it's a great tool to investigate where the money comes from. And we will be able to investigate it in all future too. You cannot only trace it in all the past but also in all future. If you suspect that this money is with a criminal, then you can sit and keep an eye on where the money are sent. That's amazing. You cannot do that with banknotes today. Anyways, that's another discussion. It was most just to come to this fact that there are some conclusions already, I think, and it is that you cannot stop this.

EC: How about the anonymity? How is this traceable?

HHH: It is. You can make a wallet and you can have some bitcoins in it. That way, it's anonymous. The problem is what do you want now? Now you have them standing there, hurray for that. What will you? Want to buy something? Fine, where do you want to go? A website, okay, so we know your IP address. Okay, where will you have it delivered? You have to take care for any digital footprint you deliver it will be saved forever. If, at any time, we can associate a digital footprint with just one of the transactions that you are making, then it will be possible to go back to you. The way you do it today is ... let's say that the police suspect you about something and some money that has arisen from some bank robbery. And now they find banknotes that are pink and they ask you how you have these pink banknotes. Either you can cooperate or go to jail. Exactly the same traceability lies in blockchain. By the way, we can also see that you have received bitcoins from two others too, and you used something on those who have nothing to do with it. Bum bum bum. You have extreme traceability and you have it forever. If, at any time, you get something delivered to your home address then it's simply too easy. In Coinify, we have been involved in capturing some criminals. Even though they are on a "tor network" they are on an email browser and we have traceability. But it can also be super hard. If people know what they are doing, then they can of course also hide. Then there are some ways you can save yourself. The problem is that you must be technically very, very skilled. It's just a lot easier to use cash. It just is. I want to say: the traceability comes from you doing something. “It’s anonymous if you never do anything”. In many of the heists that we have seen, the money (bitcoins) just lies out there. People must activate them in one way or another. There are thousands of people looking at certain blockchain addresses, and as soon as something happens, you'll see where the money goes. If one of those addresses is a known address at an exchange or a mergent, then you call the owner of the address. It's a bad idea. In the Commission, it was very funny to have the discussion, when they are from this anonymous world-thought, that we explained to them that it also has something to do with the fact that if I use the system to pay salaries, I can also see what you spend the money on. You can see the address and follow its future activity.

EC: Can you say a few words about this paradigm shift, which you talk about?

HHH: The paradigm shift takes place in relation to several things. In relation to the political: to move from a politically based currency to a mathematically based currency. If you search on Commodity Political Mathematical Currency: in the three themes, this is the first initiative we see, that goes from a politically defined currency to a mathematically defined currency. It's a paradigm shift. In the very old days, we had commodity-based currency and it was a question

about how many horses you sold etc. It is a paradigm shift. Another paradigm shift is that traditional currencies have zero competitors. They have never had that before. It's the first time they've got it. That's it.

EC: Thank you so much for all the information and views on this exciting new phenomenon.

Appendix 8: Survey Questionnaire from Økonomisk Ugebrev

Survey questionnaire with distribution of respondents

1. What is your age?

Answer Choices	Responses	
Under 30	8,54%	66
31-40	9,18%	71
41-50	11,77%	91
51-60	19,40%	150
61-70	25,74%	199
Over 70	25,36%	196
	Answered	773
	Skipped	45

2. Have you made a private investment in cryptocurrencies?

Answer Choices	Responses	
Yes, invested the first time more than a year ago	4,57%	37
Yes, within the last year	22,99%	186
No, but considering it	15,70%	127
No, do not want to touch it	56,74%	459
	Answered	809
	Skipped	9

3. How much money have you currently invested in cryptocurrencies?

Answer Choices	Responses	
0-5000 DKK	72,76%	454
5000-10.000 DKK	6,57%	41
10.000-50.000 DKK	10,58%	66
50.000-100.000 DKK	4,17%	26
100.000-500.000 DKK	3,37%	21
500.000-1.000.000 DKK	0,80%	5
Over 1.000.000 DKK	1,76%	11
	Answered	624
	Skipped	194

4. What are your two preferred cryptocurrencies out of the six major? (Choose one or two)

Answer Choices	Responses	
Bitcoin	59,22%	257
Ripple	29,03%	126
Ethereum	56,22%	244
Bitcoin Cash	5,30%	23
Cardano	6,68%	29
NEM	3,69%	16
Answered		434
Skipped		384

5. Are you short-term or long-term investor in cryptocurrencies?

Answer Choices	Responses	
Only short-term	38,42%	156
Only long-term	21,92%	89
Both	39,66%	161
Answered		406
Skipped		412

6. Why have you invested in cryptocurriences (option of several answers)?

Answer Choices	Responses	
Pure speculation, believe in higher prices in the short term	43,20%	162
As a mean of risk spreading in my portfolio	8,53%	32
Out of curiosity of the new possibilities	50,13%	188
Because I expect it to be an important mean of payment in the future	21,07%	79
Because I expect a decrease in the trust in the monetary system issued by the central banks	10,40%	39
Because I expect many other applications in the future digital world (in relation to the diffusion of blockchain technology)	40,27%	151
Answered		375
Skipped		443

7. Do you expect to invest more or less in cryptocurrencies within the coming 3-6 months?

Answer Choices	Responses	
Much more	3,18%	15
More	18,90%	89
The same	37,79%	178
Less	9,98%	47
Much less	30,15%	142
	Answered	471
	Skipped	347

8. What do you perceive as the two biggest threats against cryptocurrencies?

Answer Choices	Responses	
That the current price bubble bursts followed by a sufficient price drop	55,82%	350
That the exchanges will be subject to a hacker attack with investor losses	18,02%	113
That cryptocurrencies will be prohibited as in China and South Korea	33,97%	213
That more cases of insider trading and price manipulation within cryptocurrencies are revealed	22,33%	140
That the costs of trading will be too high because of expensive brokers	7,50%	47
That the use of cryptocurrencies among criminals will increase	21,69%	136
That regulations will make cryptocurrencies less interesting	28,87%	181
That the established financial system refuse to integrate cryptocurrencies in their transactions	21,69%	136
Other (please comment)	10,69%	67
	Answered	627
	Skipped	191

9. How much do you agree or disagree with the statement that bitcoin and the other big cryptocurrencies at the moment are characterized by bubble-like conditions?

Answer Choices	Responses	
Strongly agree	71,91%	512
Moderately agree	17,98%	128
Neutral	6,04%	43
Moderately disagree	2,39%	17
Strongly disagree	1,69%	12
Answered		712
Skipped		106

10. How do you perceive cryptocurrencies as investment objects in a year's term compared to other investment options? On a scale from 1 to 10 (10 is most attractive)

	1		2		3		4		5	
Bitcoin	43,99%	249	10,95%	62	8,13%	46	5,48%	31	10,95%	62
Ethereum	36,80%	191	7,51%	39	8,09%	42	5,39%	28	8,86%	46
Stocks	5,12%	28	2,01%	11	3,84%	21	5,85%	32	12,07%	66
Long-term bonds	18,79%	96	19,77%	101	15,66%	80	10,57%	54	13,70%	70
Corporate bonds	11,50%	59	10,33%	53	13,84%	71	13,84%	71	22,61%	116
Gold stocks	11,66%	59	7,11%	36	12,85%	65	13,24%	67	21,94%	111
Energy stocks	8,27%	42	4,92%	25	7,87%	40	11,42%	58	19,29%	98
Short stocks	20,68%	103	10,64%	53	11,45%	57	11,04%	55	16,27%	81
Other (please comment)										

6		7		8		9		10		Total
4,77%	27	6,54%	37	3,53%	20	1,77%	10	3,89%	22	566
4,43%	23	6,55%	34	9,44%	49	4,43%	23	8,48%	44	519
10,60%	58	15,72%	86	18,83%	103	8,78%	48	17,18%	94	547
6,65%	34	6,07%	31	4,11%	21	1,37%	7	3,33%	17	511
9,36%	48	8,38%	43	5,85%	30	1,56%	8	2,73%	14	513
10,28%	52	8,50%	43	7,71%	39	3,36%	17	3,36%	17	506
13,58%	69	11,81%	60	15,55%	79	3,94%	20	3,35%	17	508
8,03%	40	8,23%	41	7,83%	39	2,01%	10	3,82%	19	498
										33
									Answered	**580**
									Skipped	**238**