

A BEHAVIOURAL FINANCE EXPLANATION OF SPECULATIVE BUBBLES: EVIDENCE FROM THE BITCOIN PRICE DEVELOPMENT

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Abstract. In 2008 a group of programmers, alias Satoshi Nakamoto, introduced bitcoin. Bitcoin is a cryptocurrency or virtual money derived from mathematical cryptography and is conceived as an alternative to government authorised currency. The founder anticipated, through bitcoin's construction and his digital mining processes, that bitcoin prices would be relatively stable. However, the recent bitcoin price decline proves that bitcoin is extraordinarily volatile and is not that stable as hoped. Although some scientists have already shown that the fundamental value of bitcoin is zero, the price of bitcoin has reached over 19.000\$ in December 2018. Since then, bitcoin prices dropped nearly 70% from their peak value and showed in addition to that the typical trends of a speculative bubble.

Hyman Minsky and Charles Kindleberger discussed three different patterns of speculative bubbles. One is when price rises in an accelerating way and then crashes very sharply after reaching its peak. Another is when the price rises and is followed by a more similar decline after reaching its peak. The third is when the price rises to a peak, which is then followed by a period of gradual decline known as the period of financial distress, to be followed by a much sharper crash at some later time. One of the key findings of this study is that all these three patterns occurred during 2017-18 for the bitcoin price.

Therefore, the purpose of this paper is to analyse the historical bitcoin prices in context with the typical five-step characteristics of a speculative bubble. Furthermore, each phase of a speculative bubble is explained by a behavioural finance approach and answer the price development of this cryptocurrency. The result is frightening, bitcoin can be seen as a perfect textbook example of a speculative bubble.

Key words: *Bitcoin, Cryptocurrencies, Bubbles, Behavioural Finance, Volatility*

JEL code: G41, E31, G12

Introduction

The history of finance is filled with asset bubbles, from the Dutch tulip mania in the 1630s, the Dot-Com bubble of the early 2000s to the US housing bubble which led to the 2007/08 global financial crisis (see Abreu and Brunnermeier, 2003). The most recent example, however, can be found in the overheated Bitcoin market. Initially introduced in 2008 by a group of programmers, under the pseudonym Satoshi Nakamoto, Bitcoin is a cryptocurrency or virtual money derived from mathematical cryptography. It was initially envisaged that its construction and digital mining processes would mean, that Bitcoin prices should be relatively stable. However, the fact that Bitcoin prices have recently fallen about 80 per cent from their peak value shows that Bitcoin is anything but not stable. Furthermore, academic literature on analysing digital currencies such as Bitcoin argues that the fundamental value of Bitcoin is zero (Cheah and Fry, 2015); Baur et al., 2017). This raises two critical questions of interest. Firstly, does the Bitcoin price show a typical development of a speculative bubble? Secondly, how can a behavioural finance approach explain the Bitcoin bubble?

The academic literature on digital currencies, such as Bitcoin, has only recently begun to emerge (see e.g. Grinberg 2012; Maurer et al., 2013; Bauer et al., 2017) and is even more dwarfed by a multitude of popular articles and unpublished working papers. Much of the academic literature concentrates upon legal aspects and one the analysis related to the fundamental value of these cryptocurrencies. This paper differs from previous work on Bitcoin and digital currencies in trying to understand the typical characteristics of the Bitcoin bubble based on Aschinger (1991), Kindleberger and Aliber (2005). Papers on Bitcoin pricing tend to investigate the pricing efficiency of Bitcoin (e.g. Hong, 2016; Urquhart, 2016) or pricing determinants using past information (e.g. Kristoufek, 2013; Li and Wang, 2017). This study contributes to the rising debate on the cryptocurrency market investment from a behavioural finance perspective. Therefore, a more theoretical framework of the Bitcoin price development is established with some of the current academic empirical literature. For instance, one aspect, which was analysed by Yao et al. (2014) and Bouri et al. (2017), is herding behaviour. It can offer a behavioural explanation for the extreme volatility and trends observed in many cryptocurrencies. Some rolling analysis (Stavroyiannis and Babalos, 2017) provides evidence in favour of such herding.

The remainder of the paper is organised as follows. Section 2 provides some background into speculative bubbles (section 2.1) and describes the typical steps of those phenomena (section 2.2). Part 3 presents the analysis of the Bitcoin bubble in the context of the classical development steps. Chapter 4 explains the excess volatility clusters with the help of behaviour finance approaches. Finally, section 5 summarises the main findings of the paper and provides concluding remarks.

What is a bubble?

Many papers focus on the explication, proof and analysis of market mispricing. Mainly, many well-known scientists - leading by Shiller (2000) and Fama (1965) - are engaged in the detection of bubbles. There are different opinions on how to define a price-bubble as there are two kinds of bubbles: The deterministic bubble, which will burst in a specific time or the stochastic, which will increase to infinite, as seen in figure 1. Trivially said and known from the efficient-market hypothesis of Fama (1970): An investor cannot score abnormal returns, because all relevant and available information are included in stock prices.

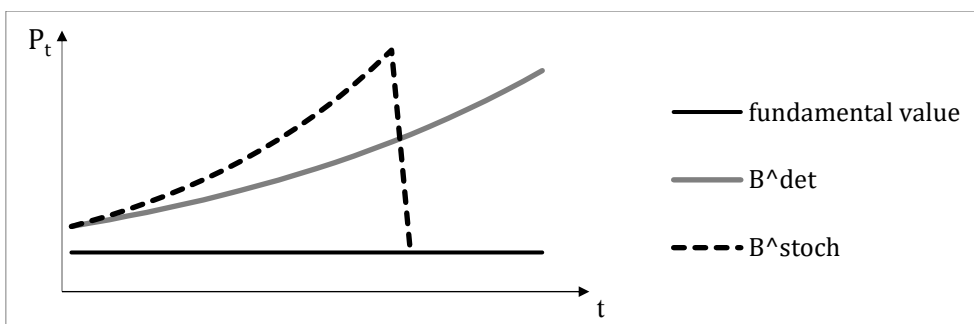
Nevertheless, at the beginning of every speculative price-bubble there is a belief of high probability of excess returns, see Garber (1990). In an efficient market, stock-market changes are only justified with new information. During the development of a speculative bubble, the investor knows that the prices are overvalued. Even normally no further information is published, which could explain those high stock prices.

Notwithstanding, one of the most-known definitions is following: A positive price-bubble is the deviation of market price from the expected discounted dividends (as known as the fundamental value) and is based on the dividend model of William (1938):

$$P_t > \sum_{t=1}^{\infty} \frac{E(D_t)}{(1 + \mu)^{t-1}}$$

P_0 defines market price, D_t dividends and μ returns. Speculative bubbles can arise from stock's price-expectation. As mentioned before, there are two types of bubbles. The main focus of this paper, as those of Scherbina (2013), Jarchow (1997), will be stochastic bubbles. These can burst with a specific probability during the time period. In contrast to stochastic bubbles, deterministic bubbles increase to infinite.

Figure 1, based on the theory of Aschinger (1991) and Jarchow (1997), shows two different scenarios: a deterministic (B^{det}) and a stochastic bubble (B^{stoch}) under the assumption that the fundamental value stays constant over time.



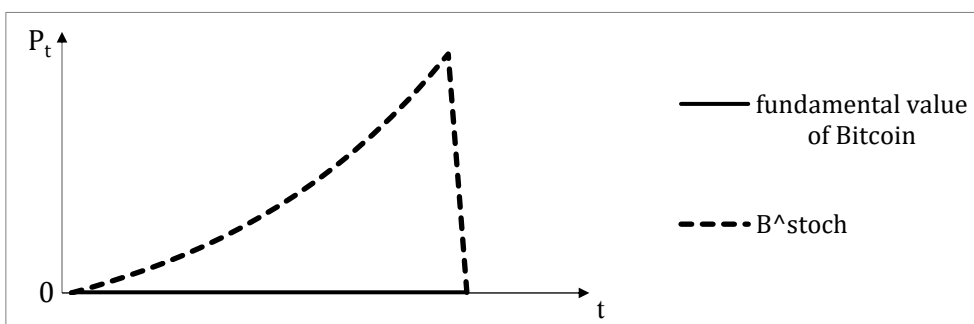
Source: author's construction based on Aschinger (1991) as well Koehn and Valls (2017)

Fig. 1. Stochastic and deterministic bubbles

Consequently, one key question arises: What is the fundamental value of Bitcoin? One answer to that specific question is presented in the paper of Cheah and Fry (2015). They analysed the fundamental value of Bitcoin and came to the conclusion, that the value of Bitcoin, P_F , should be zero in the long run:

$$\lim_{t \rightarrow \infty} P_F(t) = 0$$

Hence, the figure below shows the potential price trend of Bitcoin under the assumption that the fundamental value is zero and Bitcoin is a stochastic bubble.



Source: author's construction based on Aschinger (1991) as well as Koehn and Valls (2017)

Fig. 2. Bitcoin as stochastic bubble with its fundamental value

Development of a speculative bubble

There is no standard definition of a typical bubble, but all bubbles look alike because they all go through similar phases. The majority opinion about the typical development of a bubble is based on Kindleberger and Aliber (2005) and Aschinger (1991). The characteristics and phases of a speculative bubble are described as follows:

Phase 1: Displacement. The beginning of each bubble is initiated with an exogenous shock, which implicates pervasive economical changes. In this phase, a full branch of an industry can be changed. A displacement could be the end of a war, a significant political change, a technological or a financial innovation or a shift in monetary policy. Structural changes raise the optimism of investors, banks and companies. The optimism and the expectation of new welfare and new expected profit of the companies encourages investments into risky stocks, which results in a confident expectation of the stock market. Therefore, investors hope for higher returns than in a status quo ante.

Phase 2: Boom. The next step of a speculative bubble is reached by the expectation of continuing raising returns and a potential new market. Meaning, that the optimism begins to grow. The result is a positive feedback loop as the price of stocks, commodities, or real estate increase, which lead to greater consumption and investment, which will finally lead to higher economic growth. Credit fuels the boom. Borrowers become more willing to take on debt and lenders are increasingly willing to make riskier loans as economic prospects improve. In contrast to William (1938), the market price is now a multiple of its proper fundamental value.

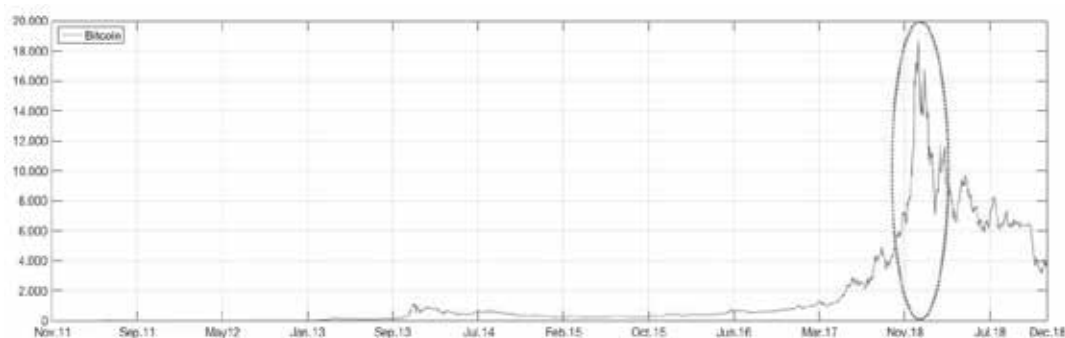
Phase 3: Euphoria. More and more euphoric outsiders begin to enter the market as media attention grows and individuals see others getting high returns. As Kindleberger and Aliber (2005) mentioned, “there is nothing as disturbing to one’s well-being and judgment as to see a friend get rich.” In this phase, behavioural and irrational factors determine the investors’ buying behaviour. For instance, bandwagon effects are incorporated into behavioural effects: Following the devise, if others are buying, I will also buy. These herd instincts happen avalanche-like and increase the capital inflow of each bubble, as Weil (2010) showed. The abnormal increase of the stocks allures speculators. Individuals invest with the hope of short-term capital gains, and debt compounds as people borrow or trade on margin to further speculate. The credit activities are expanded for instance by lower interest rates. A perpetual growing spectrum of participants from wealthy investors, debt-financed investors, and in the end, speculators characterise the climax of each bubble.

Phase 4: Distress. At some point, an event hits that causes a decline in confidence and stops the explosive prices. This event could be bankruptcy, a change in government policy or any news flow. The response to these events differs in bubbles because of the debt build-up. People who financed their purchases with borrowed money become distressed sellers as the income on their assets drops below their interest payments. In this – also called - crisis phase, the insiders originally involved start to sell their assets. The selling begins to gain momentum, as speculators realise that they need to sell, too. However, once prices start to fall, the asset prices start to crash. The only way to sell is to offer prices at a much lower level as someone else. The bubble bursts and euphoric buying is replaced by panic selling.

Phase 5: Panic. Not everyone realises that a crisis is unfolding at the same time. Professional investors, like an insider or institutional, usually sell first. Once other market participants realise the gravity of the situation, run-of-the-mill selling turns into outright panic as everyone tries to get out at the same time. Prices plummet, and levered companies increasingly go bankrupt as they can’t meet their interest payments. The sell-off typically spreads to other sectors and other countries. This will lead to a massive increase in the demand for liquids funds in fear of illiquidity. The masses get into a kind of a panic state and sell their stocks at any price. As bankruptcies mount, banks begin to fail, further drying up credit when it’s needed the most. The panic continues until a lender of last resort convinces investors that cash will be made available to meet the demand, or prices fall so low that value investors start to buy back in. The speculative bubble has burned, and the prices should go back to their fundamental value.

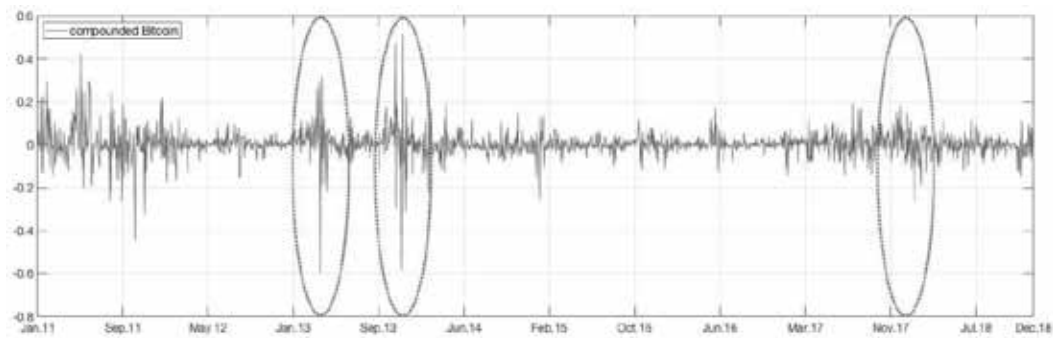
Bitcoin-Bubble and its Development

The majority opinion about the typical development of a bubble is based on Kindleberger and Aliber (2005), Rosser et al. (2012) and Aschinger (1991). In the following, the Bitcoin price development is analysed with the help of the previously shown development of a typical bubble. In advance, the volatility of Bitcoin is quite noticeable. The next figures show the historical Bitcoin price development as well the compounded return of Bitcoin between 2011 and 2018. These figures illustrate exemplary the typical trend of a speculative bubble with their high excess volatility clusters around the peak.



Source: author’s construction based on data from coinmarketcap.com

Fig. 3. Bitcoin Price 2011-2018



Source: author's construction based on data from coinmarketcap.com

Fig. 4. **Compounded Bitcoin Returns 2011-2018**

In 2008, a “whitepaper” was published called "Bitcoin: A Peer-to-Peer Electronic Cash System" by Satoshi Nakamoto (Nakamoto, 2008). The whitepaper's idea had ambitions to secure digital signatures, not requiring the use of a third party, proof-of-work, and hashing the transactions together to form a chain. Satoshi Nakamoto, an unknown person or group of people, wrote the Bitcoin paper. This can be seen as the exogenous shock from phase 1 of the typical development of a speculative bubble.

The first-ever block of Bitcoins, known as the Genesis Block, was mined in early 2009. By the 9th of January, the first iteration of Bitcoin software was released, and on the 12th of January, the first ever Bitcoin transaction occurred as Nakamoto sent 10 Bitcoins (BTC) to noted computer programmer and developer Hal Finney. Toward the end of the year, the New Liberty Standard publishes the first Bitcoin exchange rate in the young cryptocurrency's history, deeming \$1 to be worth around 1,309 BTC.

In May 2010, the first purchase with Bitcoin was made. Florida-based programmer Laszlo Hanyecz sent 10,000 BTC to a man in London in exchange for two pizzas, valued \$25 in that time. By November, the market cap for Bitcoin surpassed \$1 million for the first time. This still valued a single Bitcoin as a fraction of a penny, exactly \$0.0025.

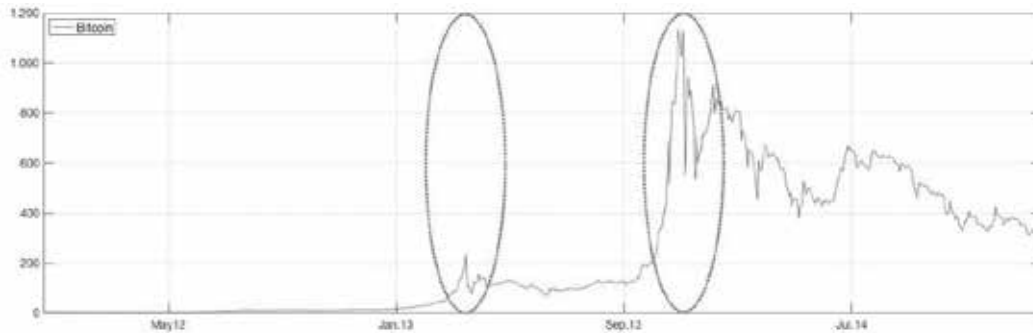
In 2011, for the first time, 1 Bitcoin was worth \$1. Bitcoin began receiving press - both good and bad. TIME Magazine published an article on Bitcoin for the first time, and in the same year, there was an article on Gawker (Gawker, 2011) detailing Silk Road, the dark web drug market where Bitcoin was frequently used as a payment option. The publicity got people talking, and by June, Bitcoin was worth over nearly \$30. Soon after, it crashed back down to about \$10. The most significant catalyst for this crash was the hacking of Mt.Gox, by far the biggest Bitcoin exchange at that time. The transaction was compromised by a hacker, who gained access to customer accounts and artificially pushed the price of Bitcoin on the exchange to \$0.01. Even though the crash to 1 cent was artificial, the hack resulted in a substantial hit to the confidence in Bitcoin and played a significant part in an over 93% price decline.

Among notable moments for Bitcoin on its way to becoming the world's top digital coin was its crossing of the \$100 threshold in 2012. But also, 2012, no year without any scandal. In August of 2012, Bitcoin dropped nearly 50% in just three days after Bitcoin Savings & Trust, a Ponzi scheme that promised substantial weekly payouts to its investors, had halted its promised payouts. The scheme’s operator, Trendon Shavers, claimed that more than 500,000 BTC in total was deposited into the scheme. Later in 2016, Shavers was sentenced to 18 months in prison. According to New York prosecutors, Shavers had obtained a total of about 146,000 BTC through his fraudulent activities.

2013, Bitcoin's price saw its share of ups and down, but it passed a value of \$1,000 for the first time and was becoming the most recognisable and successful wallet and exchange available. Bitcoin had started gaining significant traction in mainstream media, and new investors were flocking onto the market. Bitcoin was on a tear and rallied for four months before topping out at around \$260 on the 10th of April. The price then crashed, and the previously mentioned Mt.Gox struggled to handle the sheer volume of trading, causing even more uncertainty in the process. Cyber attackers took the opportunity to create even more chaos and started targeting Mt.Gox with specific hacking attacks. While it’s likely that

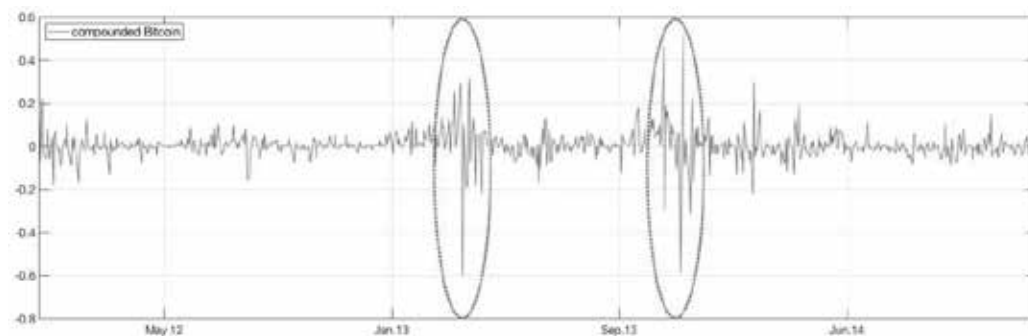
Bitcoin was due for a correction anyway, the confusion surrounding Mt.Gox contributed additional selling pressure and exposed the many risks of relying on a single entity as the nexus of the Bitcoin ecosystem.

In 2014 and 2015, Bitcoin stalled for a while. Quickly in January 2014 it fell below \$1,000 and struggled below crucial level for a few years. A few things of note happened, Crypto exchange Mt. Gox went bankrupt and shut down, but this period mostly saw Bitcoin rising and falling somewhat while failing to reach its high. Although there was a rally that started in May of 2014, which saw Bitcoin grow from about \$440 to around \$650, the second half of 2015 was decisively negative as BTC bottomed out at approximately \$177 in January 2015.



Source: author's construction based on data from coinmarketcap.com

Fig. 5. **Bitcoin Price 2012-2014**

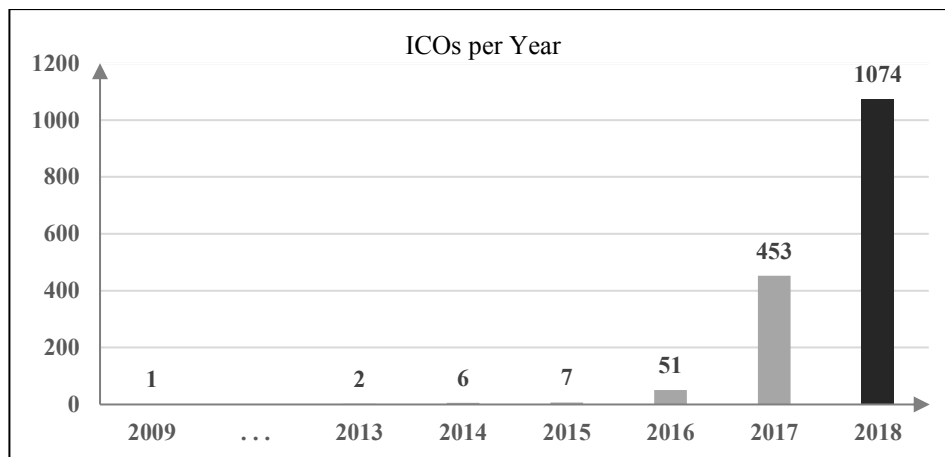


Source: author's construction based on data from coinmarketcap.com

Fig. 6. **Compounded Bitcoin Returns 2012-2014**

2017 was the most prominent and busiest year for Bitcoin. After spending 2016 desperately trying to claw its way back up, 2017 was when it finally reached and passed the \$1,000 mark. It kept ascending. By June, Bitcoin was worth over \$3,000. By October, it was topping \$6,000. It ended November at nearly \$10,000, and by the end of December, Bitcoin hit a peak of \$19,783, intraday. More and more people and companies began chasing the trend as the price just kept rising. Unsurprisingly, it wouldn't continue that strong growth.

2017 brought a fundamental transformation to the cryptocurrency landscape, and Bitcoin's iron grip on the cryptocurrency market began to slip. At the start of the year, BTC dominance was at roughly 85%. Meaning that the market capitalisation of Bitcoin was 85% of the full cryptocurrency market capitalisation. In March, however, BTC dominance started to decline drastically as Ethereum ETH, another cryptocurrency, began taking significant chunks out of Bitcoin's market share. By June, BTC dominance was sitting at around 38%, while ETH represented about 30% of the cryptocurrency market. Ethereum's smart contract capabilities, combined with the fact that the platform allows users to issue tokens that function on Ethereum's blockchain easily, provided the ideal infrastructure for initial coin offerings (ICOs). With more tokens issued by ICOs rewarding their backers with astronomical returns after hitting cryptocurrency exchanges, the ICO frenzy was in full effect as people rushed into the market in hopes of finding the next 10x, 100x or even 1000x ICO token. The positive momentum and extreme confidence did not affect just ICOs but was evident in the market as a whole. The next figure shows that the amount of ICOs increased significantly from the first ICO in 2009 with Bitcoin to over 1.000 ICOs in 2018

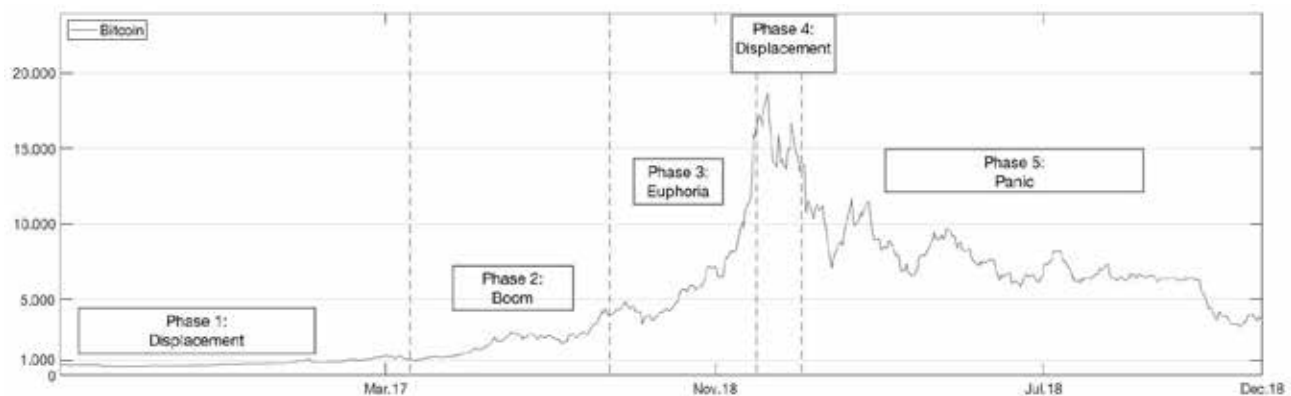


Source: author's construction based on data from coinschedule.com

Fig. 7. Amount of ICO's per year

2018 was a rough year for Bitcoin users, especially for those who held out their cryptocurrency on assuming the price would keep ascending. Many sold their Bitcoins while they could, and the price steadily dropped all year. At the end of 2018, Bitcoin's price had declined over 75% to \$3,674.

One could argue, that the development of the Bitcoin price shows more than one bubble in the last 10 years, one quite obviously in the price development between early 2017 to end of 2018, as shown in the figure below.



Source: author's construction based on data from coinmarketcap.com

Fig. 8. Bitcoin Price Bubble 2017-2018

Behavioural Finance Explanation

The main important part of the puzzle of a speculative bubble is the assumption of a Homo Oeconomicus, a fully rational individual. But especially individuals, like investors – both private as professionals - tend to overreact or make decisions regarding irrelevant information. This is in contrast to the assumption of an entirely rational investor, who will always make rational, utility-maximising decisions, like Sheffrin (1983) and as well Simon (1979) point out. This irrational behaviour tends to a result in excess volatility clusters. Therefore, to understand more in detail which physiological factors drive a bubble, the Bitcoin bubble is analysed. Behavioral finance is a new behavioural-scientific approach, which explains stock volatilities during speculative bubbles with the help of psychology and rational models.

One of the main discussed models of behavioural finance is the Feedback Trading model on the stock market or other tradable assets, like Bitcoin. This model produces a speculative bubble under the assumption that the stock demand of an investor's group is based only on historical trading information. The bubble will grow with more capital inflow until a particular time. At this moment when the capital inflow will rapidly decrease, the bubble will break down. The following example explains this theory:

Caused by positive news of a cryptocurrency their coin price increases. Cheah and Fry (2015) analysed the google trends for the search term “Bitcoin” and showed notable peaks before higher volatility and higher coin prices, reinforcing an important social dimension to bubbles (Kindelberger and Aliber, 2005). Some investor groups buy these coins with the expectation that the coin price will increase and therefore, getting high returns. The first step is to define the traded volume as the amount of trading coins of cryptocurrencies. The demand for these coins increases with the expectation of growing returns which involves that the coin price will be higher than the fundamental value of the coin. The trading volume also increases because of the amount of money inflow. These will also attract other Feedback Traders, who are expecting growing price. This schematic repeats as long as no capital is invested anymore. At this point, the price increases will stop. Investors would like to sell their assets profitably, and the necessary demand of capital threatens the bubble which would lead the bubble, see Scherbina (2013) for more details.

A bubble will burst when the supply of capital is exhausted. To keep a speculative bubble growing new invested capital is needed. Once the capital inflow decreases, the prices will fluctuate. The result of this will change the optimistic mood, which will deflate the bubble as well. In fact, there are some indicators that a bubble will burst as soon as a massive amount of unprofessional investors are speculating with those overpriced assets, as Scherbina (2013) showed.

Many behavioural models assume that competitive arbitragers limit the huge price volatilities. The following model by De Long et al. (1990) shows that rational arbitragers intensify more than dissolving the price volatilities under certain circumstances. The model implies three investor types:

- 1) Positive Feedback Trader: The base of the asset demand is based only on past price changes.
- 2) Passive Trader: The trading base is dependent on the asset value relative to their fundamental value.
- 3) Informed rational speculators: The foundations of their tradings are news about the fundamental value as a hypothesis for future price movements.

With the help of those models and the knowledge from section 2, that the fundamental value of Bitcoin is zero, passive traders as well as the informed, rational speculators should not invest in Bitcoins or cryptocurrency.

Overconfidence and overoptimism are essential for the evaluation of stock prices, as De Bondt (1998) found out, but as well for cryptocurrencies. Individuals tend to be overoptimistic if they have their own influence on stock prices. The phenomenon of overconfidence explains that every individual has higher confidence in his own expectation and evaluation. Both phenomena are documented by experiments: Cryptocurrencies, which are held in their own portfolios, are getting overvalued belong their returns and expected growth. Moreover, this self-reliance on personal judgments entails concepts such as miscalibration, over precision, which are at the same time associated with an overreaction to random events (Barber and Odean, 2013; Barberis and Thaler, 2003). A classic illustration of overconfidence bias is the “better than the average” beliefs, which is the perception of a more than proportional of a group’s composition that they perform better than the mean for the same group for certain activities.

Another effect is called the bandwagon effect or the herding behaviour, based on DeBondt and Forbes (1999). This phenomenon explains the buying behaviour, which is influenced by the buying behaviours of others. This means: A non-professional investor buys/ sells stocks analogue to the market/investors-majority in a speculative bubble. He makes his decision based on other market participants, which emblemizes the majority. This behaviour is relevant: On the right hand, he does not deviate from the majority opinion, because the majority cannot be wrong. On the other side, he is not willing to swim against the stream and bet against the majority. Nguyen and Schueßler (2011) analysed this specific behaviour in different speculative bubbles. Stratopoulos and Calderon (2018), Belhoula and Naoui, (2011) as well Bouri et al. (2017), analysed the cryptocurrency market and found out that investors frequently deviated from the rational asset pricing benchmark, and instead follow the consensus in market stress situations.

Another aspect that occurs during a bubble is Narrow Framing, researched and introduced by Barberis and Thaler (2003) and Barberis et al. (2005). Individuals judge differently over same stocks in the same decision situations if the stock or portfolio strategy is positive described. In the initial stage of the Bitcoin, one assumed a massive benefit of a new technology of this virtual currency. Potential users of those virtual currencies like Bitcoin as a medium of exchange may be attracted by its low transaction costs, its peer-to-peer, global and government free design and the possibility to purchase special goods which the seller may prefer virtual currency. In those times coins of those companies, which expected a huge excess profit regarding the new technologies, get an even higher rating than if they were objectively rated. Interestingly, this same phenomenon was also indicated during the Dot-Com bubble in the early 2000s, like Barberis et al. (2005) found out. Another behavioural aspect is loss-aversion. Non-professional investors tend to hold bad performed stocks too long, in order not to have to realise their losses. That loss-aversion affects the behaviourism of each investor and like shown by Tversky and Kahneman (1991).

To understand the formation phase of a speculative bubble you have to take these previous behaviours into consideration. Under the rational assumption, it does not make sense to invest in assets, which have a higher market value than their fundamental value. But this happens exactly during bubbles as shown by Weil (2010) and as well by Nguyen and Schueßler (2011). Non-rational investing means not only that stock prices are determined not always objectively by future expectations, but also biased by individual characters and their emotional factors, as respectively shown by the studies of Barberis et al. (2005), Kugler and Hanusch (1992).

Conclusions

Amid increasing levels of interest and popularisation (see, e.g. Frisby, 2014), Bitcoin and other cryptocurrency markets have been underexplored academically. This paper analyses the question of whether the most prominent virtual currency, Bitcoin, shows the typical development of speculative bubbles. One of the assumptions of this paper is, that the fundamental value of Bitcoin in zero (Cheah and Fry, 2016). Adopted with this, the bitcoin price was investigated. The paper found out that Bitcoin showed high volatility around their peak prices. This is a typical trend of a speculative bubble with its high excess volatility clusters around the peak. Nevertheless, academic literature mentions and talks about one Bitcoin price bubble. Using the compounded return of Bitcoin, three excess clusters were indicated. Therefore, one can say, Bitcoin had some price bubbles within their nearly ten-year history.

After describing some of the evidence, we can draw understandings about Bitcoin price formation, given cryptocurrency markets idiosyncrasy formation of pure beliefs and fuzzy expectations. Mainly, herding behaviour, overconfidence as well loss-aversion can be found as well. This was described by empirical herding analysis, which has been studying investors' behaviour during a momentum- following or positive feedback trading based on the decision on past price pattern. Therefore, behavioural finance can once again be used to explain those price bubbles. But as history shows, price bubbles will repeat themselves again and again. Clearly, overoptimism and overconfidence about the future of blockchain technology, Bitcoin or other cryptocurrencies should be avoided as irrational exacerbation often leads to financial disaster. Future work should undertake further empirical analyses of cryptocurrency markets, and the comparison with findings reported for other asset classes appears interesting.

Finally, in an ever-changing financial world with new technologies popping up, one should bear in mind the proverb: caution is the parent of safety.

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