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The New Breaking Virus: Presence of Correlative Driving Factors in Cryptocurrency and
Tulipomania

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ABSTRACT

The minority of investors who have been able to avoid succumbing to speculative bubbles have based their decision to abstain from the market by comparing current market qualitative and quantitative characteristics with those of market bubbles. By doing so, they have been able to notice trends among bubbles, and thus, decide not to participate in the market. This paper aims to determine if there are qualitative and quantitative similarities between Tulipomania and the current cryptocurrency market. The goal is to determine whether there are sufficient similarities to conclude that the latter is a market bubble. The paper explores the historical significance of both Tulipomania and the developments in the cryptocurrency market. Thereafter, discussion on qualitative and quantitative characteristics of both markets draws attention to similarities between Tulipomania and cryptocurrency. The qualitative similarities explored include changes in participant attitudes, lack of intrinsic value, and that both were/are new, unregulated markets. Quantitative similarities discussed are volatility, trading as a medium of exchange, collateralization, and illiquidity of wealth in the markets. Notable differences are also explored to make sure that consideration is given to the advancements in technology and the effects of modernity on the prospects of the cryptocurrency markets.

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Chapter 1

Introduction

When studying the history of market speculation, one can often see similarities between one bubble and the next. According to American Economist Charles Kindleberger, this is nothing out of the ordinary. Kindleberger (2005) wrote a renowned book on his study of market bubbles titled *Manias, Panics, and Crashes*, and in this work, Kindleberger argues that there are five distinct stages in all significant market bubbles. These stages are displacement, expansion, euphoria, crisis, and contagion, and Kindleberger (2005) notes that the reason these stages are prominent in all market bubbles is because of human nature. However, if all market bubbles present the same characteristics, why do so many people get involved in them to their detriment? Twentieth Century journalist, Sydney Harris (n.d.), was once quoted as saying, “History repeats itself, but in such cunning disguise that we never detect the resemblance until the damage is done.” This is why Kindleberger’s (2005) assertion that human nature plays an integral role in the continuation of market bubbles is important to understand as it relates to Harris’s opinion on the cyclical nature of history.

A speculative frenzy starts when some type of product or event displaces the status quo (Kindelberger, 2005). For instance, the dot com bubble started because of the disruption of the World Wide Web to the status quo of communication and electronics. The disruptor and its potential are shared around the market during Kindleberger’s (2005) expansion stage, and during this period people are becoming more aware of the “changes” occurring in the market. The

newfound popularity of the disruptor pushes prices higher and higher, and it appears as though the related asset class(es) cannot go down. It is this belief that transitions the market into the euphoric stage, which is the stage in which investors are more focused on getting rich quickly and easily. The price of the asset(s) is more driven by the market's greed and by the underlying value of the asset (Kindelberger, 2005). In the late 1900s during the dot com bubble, this would have been when people were more interested in getting rich quickly off tech company IPOs or selling website domains for unfathomable amounts. However, as is the case in market bubbles, the crash is bound to occur. This stage is what Kindelberger (2005) calls the crisis, and it is when people realize the errors in market pricing, and the market makes necessary corrections. The dot com bubble coincided with the economic boom in the United States; however, after years of economic success, tech companies started to experience cash flow concerns. This brought public concerns about the companies' operations, which led to drastic changes in market prices (Goldman Sachs, n.d.). The last stage of Kindelberger's (2005) model is that of contagion, or when the crisis in the speculative asset class(es) starts affecting other asset classes and the overall market. The effects of the dot com bubble's collapse were not only felt in the technology sector and not only in the United States markets, but the effects also spread to other international markets and other industrial sectors, which is what happens during the contagion phase.

It is in the beginning stages that human nature fails investors. Because a speculative bubble starts when a market is disrupted by a new product, technology, or event, people assume that "this time is different." While the recognition of the changes is minute during the displacement stage, it grows throughout the expansion stage. The mantra is that we are in a new phase of markets that transcends conventional wisdom about how markets work. However, the laws of

human nature remain constant, and this is why Kindelberger's research proves to be so predictive. Harris's assertion that history is only able to repeat itself because it is disguised as something different than it is, relates to this reason. Once people notice the shared characteristic between their bubble and past bubbles, they are quick to make the necessary corrections to save themselves (Chancellor, 1999).

Although many participate in the market bubble only to find out too late that they are participating in a speculative frenzy, there typically is a minority group of investors who notice that a bubble is taking place, and they come to find this out through several ways. First, these investors review economic and quantitative data. For example, investors who shorted subprime mortgages before the market crash of 2008 made that decision by evaluating data surrounding mortgages (Lewis, 2010). Since subprime mortgages were tied to mortgages, these investors looked at default rates and approval rates on mortgages. What they came to notice was that people traditionally unqualified were being approved (Lewis, 2010). Furthermore, they noticed that a slight increase in default rates had the potential to significantly affect the worthiness of the subprime investments, which based on the fact that unqualified borrowers were being approved for loans beyond their means, was bound to occur (Lewis, 2010). Examining the quantitative factors behind a market bubble allows one to see people's economic relationship with the affected asset class. Moreover, comparing economic data from one market bubble to the next helps show trends and reveal areas of concern. For example, if the risk metrics for subprime mortgages were similar to those of tech stock during the dot com bubble, then there is reason to believe that the former could suffer the same vicissitudes as the latter.

The other way that these investors can evaluate a market for speculative leanings is by looking at qualitative characteristics. These investors can compare characteristics with past

speculative markets. If there are similar societal sentiments or instances of herd mentality between a current market and a past bubble, then these similarities should be considered as part of an underlying trend in market speculation. Those who shorted the subprime mortgage market came to notice that the pre-2008 market was a bubble by examining qualitative factors. The minority investors reviewed the general public's attitude toward wealth, debt, and other characteristics. Michael Lewis (2010) in his book *The Big Short* provides poignant examples of how people's viewpoints were a conduit for speculation. Lewis (2010) notes that lenders were more motivated financially to approve unqualified people and that people were ignorant of the loans they took out (many of which had a lower "teaser" rate and then a higher rate after the introductory period). Furthermore, the idea of getting rich quickly as well as that of the market being immune to decline were similar between the subprime and dot com markets. Again, this is because, as Kindelberger (2005) and Harris (n.d.) note, due to the similarities in human nature and how they operate in markets. While it is easy to draw examples from the dot com bubble and 2008 since they are recent examples of speculative markets, the truth is that examining qualitative and quantitative data for other markets throughout history was how some crude investors protected themselves from falling prey to herd mentality.

By examining both quantitative and qualitative data about the financial markets, past investors have been able to identify speculative markets before the majority of investors, who find out all too late (Chancellor, 1999). While it is unfortunate for those actively involved in the bubble, it is helpful to researchers because there is a hyper-focus on understanding what took place after the dust settled. Ergo, the government and its regulators as well as academics begin to analyze the quantitative and qualitative knowledge that allowed the market bubble to take place. The difference between these researchers and the minority investors who noticed the

bubble earlier is that the former group has the added benefit of hindsight. Through this additional knowledge that comes from having completed the bubble, more characteristics are noticeable.

When studying many infamous market bubbles, one may eerily feel as though many of the characteristics and traits inherent in those speculative crazes can be felt and seen in our current economy. The most obvious area in which such concerns are likely noticeable is in the cryptocurrency asset class. Understanding whether cryptocurrency is, or has the potential to be, a speculative bubble would be invaluable information for investors, governing bodies, and society overall. As discussed above, in the past, minority investors have been able to successfully identify a market bubble based on examining the quantitative and qualitative characteristics of that market and comparing them to those of known speculative markets. This thesis aims to compare the current cryptocurrency market to the oldest known speculative market—Tulipomania—to prove that the form fits that category of a market bubble.

To provide a holistic picture, the structures of this paper will be as follows. First, a summary of the history of each respective market will be discussed. For Tulipomania, this will be a retrospective on the market through all five of Kindelberger's (2005) phases of a mania. For cryptocurrency, a history of its origins and developments in the market will be discussed. Moreover, a portion of the cryptocurrency discussion will be devoted to discussing how the technology behind the asset class works. It is important to understand the history of both as the topics discussed within these sections will then be later applied throughout the paper. Thereafter, the paper will discuss the qualitative and quantitative similarities between Tulipomania and cryptocurrency in several different areas. The paper will examine the qualitative similarities of new, unregulated markets; amateur participation; herd behavior; market manipulation and fraud;

the intrinsic value similarities between the investments; and the social purpose of these investments. The quantitative-specific similarities that will be explored revolve around volatility, pricing, asset lending rates, and the liquidity of investment wealth. Finally, there will be a discussion on the important difference between Tulipomania and the current cryptocurrency market.

Chapter 2

History of Tulipomania

People's fascination with the tulip started long before the market frenzy that swept the Dutch Republic in the 17th century. The tulip originated in Central Asia around modern-day Iran, and it is believed to have been first cultivated around 1000 A.D. by the Turks (Dash, 2010). In fact, the term “tulip” derives its meaning from the Turkish word for turban, *tülbent*, and it was assigned to the flower because its petals resemble the folds of turbans (Fourtané, 2020). Interest in the tulip among the Ottoman ruling class started in the 16th century under Sultan Mehmand II (Tüfekçi, 2021), who demanded the cultivation of different tulip varieties to beautify the empire. Subsequent Sultans also held Mehmand's regard for the flower, and in the early 18th century, the Tulip Period occurred in Turkey (Zarinebaf, 2011), which was a period of relative peace for the Ottoman Empire. The peace brought about leisure, and the wealthy and ruling classes of the Ottoman Empire used tulips as one of their ways of displaying pleasure and wealth (Zarinebaf, 2011). Because of its cultural focus on tulips during the period of the Dutch Tulipomania, the Ottoman Empire was in a place to export bulbs to the Netherlands, thus contributing to the market speculation (Zarinebaf, 2011). However, about a century after the conclusion of the Dutch Tulipomania, the Tulip Period saw many similar frenzies around the tulip bubble which caused problems within the Ottoman Empire (Zarinebaf, 2011).

An old legend states that the tulip first made its way to the Netherlands around 1562 as a “thank you” gift from a Turkish merchant (Dash, 2010). The merchant included a few tulip bulbs in a shipment to a buyer in the Dutch Republic; however, the merchant mistook the tulip bulbs for onions (Dash, 2010). He ate half the bulbs and planted the remainder in hopes of

having more onions when they sprouted (Dash, 2010). Much to the amazement of the Dutch merchant, those bulbs flower one year later not as onions but as beautiful tulips (Dash, 2010). While this may be how the tulip started its long presence in the Netherlands, the validity of this story is still widely unknown. Most historians credit Carolus Clusius, a French physician and botanist, for bringing the tulip to the forefront of Dutch culture (Chancellor, 1999). Clusius was the gardener for Emperor Maximilian of the Holy Roman Empire from 1573 until the death of the emperor three years later (Dash, 2010). This position put Clusius in Vienna, which was only a few miles away from the edge of the Ottoman Empire and the influence of the tulip (Dash, 2010). After the end of his commission as gardener, Clusius remained in Vienna tending to his own garden, which included the many varieties of tulips (Dash, 2010). During this time, Clusius studied the tulip intensively for its horticultural and medicinal purposes, and he would send bulbs to his horticulturally interested friends throughout Europe (Chancellor, 1999). In 1592, Clusius accepted a professorship at the University of Leiden located in the Dutch Republic. Thus, according to historian Michael Dash (2010), "...the man who had done more than anyone to popularize the tulip made his way to the Dutch Republic, where the flower would become truly famous".

During his time at the University of Leiden, Clusius was charged with forming a *hortus academicus*, and Clusius worked quickly to develop that school and a garden of about a third of an acre and over 350 individual beds (Dash, 2010). What distinguished Clusius from the other horticulturalists of his day was not the number of bulbs he planted but the rigor of study he devoted to the plants, and as a result of his astute research, Clusius became known as the greatest botanist of his era (Dash, 2010). In much of his research, Clusius studied the tulip, and it is because of his work that there is a plethora of information on the early history of the flower in

Europe (Dash, 2010). Two main contributions to the tulip provided by Clusius were the work on developing offshoot plans and exploring the breaking virus. Clusius noted in his research that tulips could be grown either from seeds or from the bulb (Dash, 2010). When a tulip was mature, the mother bulb produced offshoots that could be removed from the mother and planted on their own (Dash, 2010). It was easier to cultivate tulips from the bulbs, and the flowers that were cultivated through this process could mature in as little as two to three years (Dash, 2010). Dutch horticulturalists and gardeners valued the tulip more than other flowers because of its vibrant colors. Moreover, the collectors were excited by tulips that displayed flame-like qualities where the tulip's original vibrant unicolor was fragmented by stripes of white (Dash, 2010). Which tulips would bloom with these unique variations was random, further increasing their desirability over the unicolored, breeder bulbs (Dash, 2010). Clusius worked on discovering an explanation for the breaking bulbs, but he came to find that breaking tulips only came from offshoots, not seed-grown flowers. What is known now in the 21st century is that these breaking bulbs were the result of a virus that infects tulips, resulting in the white streaks (Chancellor, 1999). Nevertheless, in his pursuit of an explanation, Clusius developed a garden with a number of breaking tulips, and his collection garnished the attention of other connoisseurs and other members of the Dutch Republic (Dash, 2010)

During Clusius's time, the Dutch Republic was going through its "Golden Age." The 17th century for the Dutch was a period known for advances in their economy and culture (De Jong, 2011). The Dutch Golden Age started after the seven northern provinces of the Netherlands won independence from Habsburg-ruled Spain and formed a confederation-type government. The period was dominated by an active business class, and the government was ruled by a rich merchant class. The economy was focused on trade, and over time the Dutch

became the largest trading power in Europe (De Jong, 2011). By the midpoint of the century, the Dutch controlled 50% of European shipping (De Jong, 2011), and this control came largely from the government-backed shipping monopolies of the Dutch East India Company (VOC) and the Dutch West India Company (WIC) (De Jong, 2011). The Dutch also developed the unique idea of joint-stock companies, which are pooled investments that spread the risk of business ownership. The joint-stock structure was popular among maritime businesses because of the increased risk associated with shipping; thus, the VOC and WIC were both joint-stock ventures. The increased commerce brought about commercial wealth, and the owners of the joint stock companies saw an increase in their personal wealth. Moreover, the Golden Age was characterized by a period of increased immigration to the country, and this helped develop a more diverse population within the confederation (De Jong, 2011). The economic prosperity of the Dutch Golden Age helped create a robust middle class that was relatively well-off to the middle classes of other European countries.

With the growth of wealth in the Netherlands, there was an increase in culture. The Dutch wanted a means to display their increased wealth; however, their Calvinist background frowned heavily on the outward display of wealth (Chancellor, 1999). One socially acceptable means for displaying wealth was through art, and well-off merchants began collecting art as a means of showing their success (Brenner et al., 2007). As a person's wealth grew, so did their collection, both in number of paintings and size of paintings (Brenner et al., 2007). It was through the subtle nuances of the paintings that the Dutch displayed their wealth. For example, expensive white lace and furs adorned both male and female portraits. Furthermore, we see in still-life paintings the display of commodities that came from faraway places via the Dutch trade

routes (Brenner et al., 2007). The works of Rembrandt, Vermeer, Hals, and other great Dutch Painters are emblematic of their time's increased wealth.

It was in this society that Carolus Clusius started sharing his tulips. At first, Clusius brought the tulip to the center of European botanical gardens through the sharing of bulbs with his like-minded friends. The tulip was a hearty plant whose bulbs could be easily mailed across Europe and only needed to be stored in a dry place to remain viable (Dash, 2010). In the Dutch Republic, the tulip also began to take on a symbolic purpose similar to the art of that same period. The vibrant broken tulips were hard to come by, which created a scarcity value for the plant. As a result, among horticulturalists, these tulips were already trading at prices higher than other flowers long before the market frenzy. The high prices for these tulips drew the attention of wealthy merchants. These merchants had large gardens that they wished to fill with valuables and hard-to-get flowers. Thus, wealthy merchants also began to desire the tulip, but more so as a way to show their financial success rather than out of admiration for the plant itself. There began a trade among the more elite classes of the Dutch Republic for the coveted broken bulbs. The horticultural and gardener "tulipophiles" went so far as to develop a grading system for the bulbs, which helped determine their value (Dash, 2010).

According to Edward Chancellor (1999), the tulip lent itself well to speculation mainly due to the uncertainty around whether the flower would bloom broken or not. Again, it was this fascination around variety that initially made the tulip valued among the Republic elite. Another reason that the trade of tulips was susceptible to speculation was because of the market's lack of regulations and barriers to entry. The tulip was relatively easy to cultivate, especially if offshoots were used (Chancellor, 1999). The bulbs were easy to transport and resilient. Moreover, over time the offshoot would themselves become mother bulbs that created

new offshoots. This allowed for the continued expansion of a garden without the need to purchase more flowers (Dash, 2010). The trade of tulips was also not controlled by a guild, which would have increased the difficulty for entry and would have resulted in self-regulation (*i.e.*, guilds would regulate themselves and their members to make sure that they were upholding certain trade practices and produce quality) (Chancellor, 1999).

In 1634, other merchants and middle-class individuals started to take note of the tulip trade after hearing about the high prices certain varieties were going for among wealthier collectors. These individuals started getting involved in the tulip markets for woefully different purposes than the two social classes already involved in the trade. While the connoisseurs collected the tulip for its horticultural significance and wealthy merchants collected the tulip as a means to display wealth, this new trading class was getting involved in the tulip market as a means to acquire wealth (Chancellor, 1999). This new class of amateurs made up of middle and working-class weavers, bakers, cobblers, *etc.* was attracted to the market after hearing about rising prices for the flower in France (Chancellor, 1999). In other words, they were interested in using the tulip as an investment asset. It was easier for these middle-class investors to get involved in the tulip trade because the entry-level price was much lower than participating in a joint-stock company (this is similar to penny versus blue-chip stocks today), and with the entry of these lower classes, the speculator entered the market. It is important to note that throughout the latter parts of the tulip bubble, there was a noticeable lack of wealthy merchant and connoisseur investors (Chancellor, 1999). For them, the purpose of the tulip was to display wealth; however, they were not willing to pay substantially more than usual when bulb prices reached remarkable highs (Chancellor, 1999).

The fundamentals for trading tulips had long been established by the connoisseurs of earlier years, but with the new social classes and speculative interest came notable changes to the trade (Dash, 2010). The tulip, for instance, was not traded on the exchange in Amsterdam. At first, sales took place as a form of private negotiation between two parties, but with the increased traffic, the market became more sophisticated (Chancellor, 1999). At the height of the bubble, trades were done in taverns called “colleges” (Dash, 2010). The primary method for trading bulbs was called *met de Borden*, which is Dutch for “with the boards,” and it was when the seller and potential buyer would each write their desired sale and purchase price respectively on their boards (Dash, 2010). The boards would be passed to an intermediary who produced a “fair” price, and the buyer and seller had a choice as to whether they accepted the figure produced by the intermediary. If they both agreed, then the sale would take place, be recorded in the ledger, and both parties expected to pay a fee to the college (Dash, 2010). The fee was called the *wijnkoopsgeld* (i.e., wine money), and it was used to purchase drinks for the entire group of traders (Dash, 2010). While mutually unwanted trades were cancelled, interestingly, in cases where only one party refused to complete the trade, that individual was fined (Dash, 2010). This trading style created an incentive for buyers and sellers to make trades. Moreover, as a result of the wine money, there was a mingling of profit and pleasure. Traders would spend money on food, tobacco, and alcohol oftentimes to the point of excess (Chancellor, 1999).

With the change in market location and style also came two other notable changes to the tulip trade. It is these two changes that helped propel the speculative mania that would besiege the Dutch Republic, and they were the causation of its inevitable decline. The first was the introduction of credit and future trading, and the second was the introduction of lower-quality bulbs in the market. The original trading structure set forth by horticulturalists and garden

connoisseurs had a set period in which tulips were traded (Chancellor, 1999). Since tulips only bloomed for a few weeks out of the year, the connoisseurs structured their sales to take place when the flowers were in full bloom from May through September (Dash, 2010). The new amateurs, however, wanted to take advantage of the time when the flowers were not in bloom. As a result, the market began selling tulip bulbs while they were still in the ground (Dash, 2010). Some traders commissioned artists to produce paintings of the flower in the season prior, and these paintings were to serve as a reference for what the flower would look like in future blooms (Dash, 2010). However, the nature of the breaking virus is that it was unpredictable which plants it would infect and if the results of the infection (*i.e.*, the breaking white streaks) could be seen in subsequent years (Dash, 2010). When trading bulbs, the sale was done on credit and promised a particular bulb on a particular date for the agreed-upon price (Chancellor, 1999). No money changed hands at this point, and this new structure created a quasi-futures market that operated on investor credit (Chancellor, 1999).

The second evolution in the tulip trade was the introduction of lower-quality bulbs. Before the height of Tulipomania, traders mainly bought and sold higher quality flowers, particularly those of the broken varieties (Dash, 2010). However, over time the increased demand in the market as well as increased prices started to prevent some want-to-be traders from entering the market (Chancellor, 1999). These individuals started trading lower-quality breeder bulbs, and these are the bulbs that experienced the greatest increase in price relative to their general value (Dash, 2010). In order to take the most advantage of the market, a number of gardeners increased their production of breeder tulips, and new producers also came about (Dash, 2010). The increased quantity of lower-quality bulbs lowered the cost of entry to the market, which expanded the opportunity to a greater number of social classes (Dash, 2010). A

satirical period publication called *The Rise and Decline of Flora* criticized the mental follies occurring throughout the mania through a conversation between two friends. In this piece, Gaergoedt, the friend involved in the tulip trade, admits, “Yes, it had gone so far that the stuff which used to be weeded and thrown in the basketfuls on the dung heap has been sold for heavy money” (Chancellor, 1999).

It was the combination of credit, futures, and lower-quality bulbs that led to the hyper-speculative market that characterized the late stages of Tulipomania. This period lasted only a few short months from the winter of 1636 until the spring of 1637 (Chancellor, 1999). During this period there was no attempt made to justify the prices paid for tulip bulbs. Most traders entered into contracts with no intention of ever making the payment due in the spring (Chancellor, 1999). They intended to quickly sell the future rights to the bulb to another trader for a higher price (Chancellor, 1999). Edward Chancellor wrote a book on the history of financial mania called *Devil Take the Hindmost*, and the title of this book aptly applies in this situation. The concept of “devil take the hindmost” means that one is looking out for their own interests with the interests and fate of others being disregarded (Chancellor, 1999). Because there was little thought put into the actual price paid for the contract, the market became top-heavy, and the potential for fraud also entered the market. Since all tulip bulbs, be they breeders or broken, mothers or offshoots, looked similar before blooming, some traders misrepresented the flowers that they had (Dash, 2010). However, it is worth noting that the inherent variability and unpredictability of broken tulips also played a role in some traders being considered fraudsters (Chancellor, 1999). What was also problematic was that traders started to spend their earnings long before the contracts were due. Chancellor (1999) notes that all grandeurs were

imagined, and investors were spending money that they did not have. This strained an already fragile market.

Tulipomania went out not with a bang but a whisper. Many of the cities in the Dutch Republic had colleges that traded bulbs; however, due to the nature of information sharing during the 17th century, it took time for news about tulip prices from one city to reach the others. There were many people aware of the market's fragile state. In fact, one period pamphleteer cautioned against further investments in tulips by stating that "if ever there should be more sellers than buyers, which given the number of people involved could easily occur, then the collapse of this mania will be at hand" (Chancellor, 1999). This is exactly what happened in a Haarlem college one day in early February (Dash, 2010). A tulip went up for auction, and the buyer and seller could not agree on a price. No one wanted the bulbs that were being offered (Dash, 2010). This started a panic within that college, and very few bulbs were traded (Dash, 2010). The next day, the result was an entirely collapsed market where the number of sellers overwhelmed the few (if not completely extinct) buyers (Dash, 2010). The news spread to the other cities in the Dutch Republic, and as we can see from Figure 1, the market returned to pre-mania prices by May 1637 (Thompson, 2006). It is important to note that there are significant gaps in the day-to-day prices from February and May, which makes the graphical representation of the collapse appear somewhat steeper than what might have actually been the case.

All in all, the collapse of the tulip market in 1637 did not significantly impact the Dutch economy (Chancellor, 1999). As mentioned earlier, the market lacked involvement from the wealthier merchants of the republic, who were those who brought overall stability to the country's economy (Chancellor, 1999). Moreover, the collapse was predominantly limited to the tulip industry. While many traders lost the paper riches that they acquired, the other affected

group was the gardeners (Dash, 2010). Many of these gardeners had contracts to be paid when their flowers bloomed, but with the collapse, the holders of those contracts were ill-incentivized to make good on their commitment (Dash, 2010). As a result, many legal battles ensued, and the government had to step in with a compromise that amended contracts to have sacrifices from all sides (Dash, 2010). Furthermore, the tulip traders were ostracized for their speculative behavior. The idea of getting rich with little effort violated the Calvinist work ethic that defined Dutch culture (Chancellor, 1999). Publications such as *Rise and Decline of Flora* were produced to highlight the mental folly and moral qualms that resulted in the market. To the Dutch, the Tulipomania was a minor blimp on its overall economic progression during the Golden Age, but the bizarre notion that tulip bulbs once traded for as much as a home has fascinated people ever since.

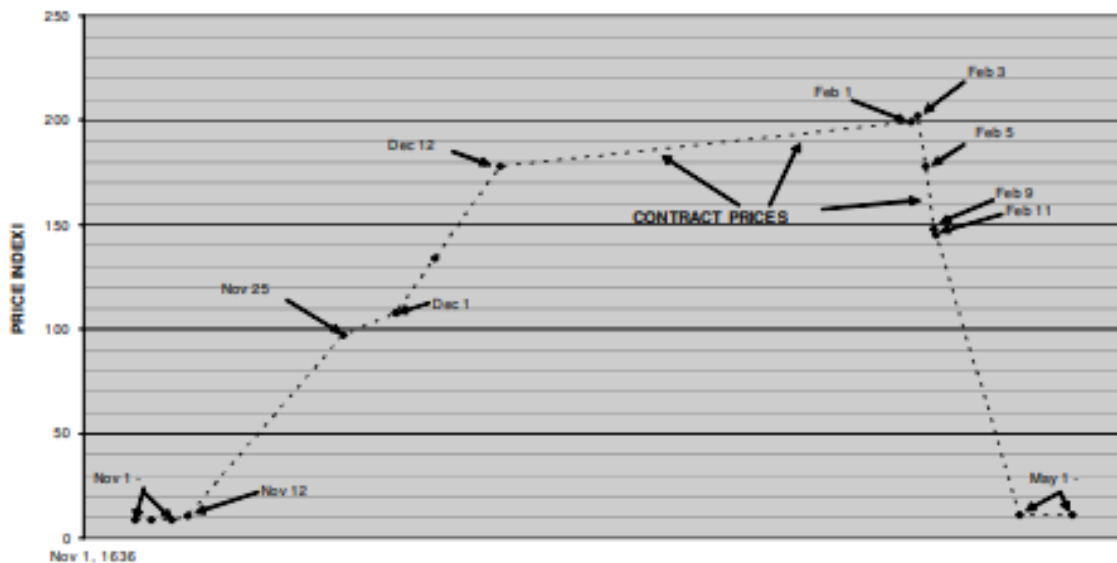


Figure 1: Index of tulip contract prices from November 1636 through May 1637 (Thompson, 2006)

Chapter 3

Developments in Cryptocurrency

Since the advent of the internet, there has been an interest in developing electronic currency. While today many different cryptocurrencies are becoming more mainstream, the evolution that the electronic currency market has gone through to get there has been rich. There were a number of different attempts to create a digital coin before Bitcoin, which ended up becoming the most popular cryptocurrency. Two important early coins to understand are DigiCash and B-Money. DigiCash was created in 1989 by David Chaum, and the primary emphasis of DigiCash was making electronic transactions more anonymous (VegaX Holdings, 2021). Chaum created the concept of “blind signatures,” which was an electronic process that created anonymous cash by placing the coins in a computerized envelope (VegaX Holdings, 2021). DigiCash came about before the invention of blockchain technology, so its operations were more rudimentary than later cryptocurrencies. In order to purchase DigiCash, the transaction had to be completed through a bank. DigiCash was purchased with real cash, and the bank verified the transaction before putting the DigiCash in its anonymous envelope, which applied the blind signature to those coins (VegaX Holdings, 2021). Whenever the owner of DigiCash wanted to complete a transaction with their coins, the receiving bank could tell from the signature on the coin’s envelope that the digital money was real, but they were not able to know the identity of the person that owned those coins (VegaX Holdings, 2021). The verification provided by the blind signature allowed individuals to safely transfer money to each other in an authentic but untraceable manner.

The overall purpose of DigiCash from David Chaum's perspective was to increase the security with which online transactions such as e-commerce, a relatively new phenomenon, could take place (VegaX Holdings, 2021). Ultimately, DigiCash failed because its target consumers did not recognize the need for the product. Many people thought that their credit cards could safely complete e-commerce transactions, so there was no need for the additional steps and costs associated with DigiCash (VegaX Holdings, 2021). While DigiCash was able to remain afloat for about a decade, this was predominately because of rumored takeover offers from Microsoft and Netscape, an American computer company that went out of business in 2003. When these potential deals fell through, the company ended up going bankrupt in 1999 (VegaX Holdings, 2021).

Another precursor to mainstream cryptocurrency was B-Money. While DigiCash emphasized a desire for anonymity, B-Money had a strong decentralization sentiment. As discussed, to purchase DigiCash, the transaction had to be facilitated by a bank. The inventor of B-Money, Wei Dai, wanted to create a system of online currency that did not need a central server to function (Franco, 2015). Dai believed in "crypto-anarchy," the belief that cryptography and the internet could provide a freer society, both economically and politically, than the government could (Saylor Academy, n.d.). In 1998, Dai proposed a system of electronic currency that was based on solving computational problems (Franco, 2015). Overall, the proposal for B-Money is similar to how Bitcoin actually works (discussed subsequently). Individuals could generate money by solving computationally difficult problems, and the value placed on solving that problem (*i.e.*, the monetary value given in B-Money) was based on the difficulty level assigned to that computation by a voting network (Franco, 2015). The solved problems also utilized a proof of work component that would be important to authenticating the

result (Franco, 2015). Balances were then stored on a distributed database (Franco, 2015).

Unfortunately, Dai's vision never came to fruition. B-Money was only ever a proposal, and Dai was unable to garnish enough popularity to develop the technological infrastructure for B-Money (VegaX Holdings, 2021).

Developments led by DigiCash, B-Money, and other digital currencies resulted in the emergence of Bitcoin in late 2008. The earlier renditions of cryptocurrency had one significant flaw: the currency could be duplicated and thereby double spent (Hayes, 2023). The double-spending concern caused earlier coins to use third-party intermediaries to ensure trust in the transaction; however, with the use of third parties came significantly increased costs and limited fraud protection (Hayes, 2023). Moreover, using third-party intermediaries to drive transactions went against the decentralization sentiment developed by Wei Dai and B-Money. On October 31st, 2008, a whitepaper describing a new cryptocurrency and process was published. The paper was called "Bitcoin: A Peer-to-Peer Electronic Cash System," and the paper was written by Satoshi Nakamoto (2008). It is important to highlight that Satoshi Nakamoto does not actually exist. Instead, the name is a pseudonym, and the actual writer(s) and developer(s) remain unknown (Hayes, 2023). Nevertheless, Nakamoto's (2008) paper addressed the centralization problem of earlier cryptocurrencies, which resulted in significantly changing the trajectory of cryptocurrency's development. Nakamoto (2008) was influenced by Dai and other early cryptographers, but his paper took aim at the current centralized system that was built on third-party trust. The transactions, as mentioned above, carried higher costs and the risk of being reversed (if another individual had a claim to the double-spent count). Nakamoto (2008) proposed an electronic payment system that was based on cryptographic proof instead of trust; this system would later become known as the blockchain. Blockchain utilized digital signatures

to validate the coin, which allowed any two willing parties to transact directly with each other without the need for a third party (Nakamoto, 2008).

According to Nakamoto's (2008) whitepaper, Bitcoin would work by housing all transactions on a large, distributed network that is self-governed. This means that anyone has access to the Bitcoin ledger and can validate transactions that are added to the Blockchain (Franco, 2015). Participating computers on the network are referred to as nodes (Nakamoto, 2008). Whenever a Bitcoin transaction occurs, it is transmitted to all nodes on the network for validation. The ledger would record the senders' and receivers' signature keys and create a transaction (Nakamoto, 2008). Most blockchains, including that of Bitcoin, utilize a proof-of-work concept to ensure the transaction's legitimacy. Proof-of-work is a consensus mechanism in which all nodes on the network solve computational puzzles to create a block (Franco, 2015). The item being solved for is the block's hash, which is essentially a new key for the block. There is no way to know the key except through a trial-and-error guess. The process of solving the computational mathematical problem is a time race between all the nodes in the system, and the quickest one to solve the problem receives a reward. In the case of Bitcoin, that reward is a coin (Franco, 2015). Once the miner finds a valid hash, it transmits the hash and the data block to the rest of the nodes for validation. If all the other nodes agree with the work and transaction information, the block is added to the blockchain (Franco, 2015). The effort needed by the computers to solve this problem is significant, and this is why Bitcoin mining demands high levels of energy. All said, it takes about ten minutes for a computer to solve for a hash.

A block of data is made up of three critical elements: the data, the hash, and the hash of the previous block (Franco, 2015). The data pertains to those particular transactions, which includes the sender's signature key, the receiver's signature key, and the amount of Bitcoin

transferring ownership (Franco, 2015). The hash is a unique identification number assigned to that particular block. Hashes are important because they serve as a digital fingerprint. No two hash numbers are the same; ergo, a transaction can accurately be identified by its hash number (Franco, 2015). Whenever a block is altered or tampered with, its hash changes. This identifies the block as being different from the original, approved block (Franco, 2015). The third element of the block is the hash of the preceding transaction. The inclusion of the preceding transaction's hash is what develops the blocks into the blockchain and allows the blockchain to be further validated (Franco, 2015). Since hashes change if the data inside its block is altered, the blockchain provides validation to the blocks because a changed hash would not be included in the subsequent block (Franco, 2015). In other words, it would not be pointing to the corresponding hash in the other block on the chain. While the implementation of a hash added significantly to the security of cryptocurrency transactions, there was still the possibility that the original hash and all subsequent hashes could be altered. The intricacies of how cryptocurrency works are far more complex than this brief overview, however, further explanation is beyond the scope of this paper.

What is important is that Bitcoin emerged as a response to some of the limitations and concerns surrounding earlier attempts at digital currencies. By utilizing the peer-to-peer network and blockchain technology, users of Bitcoin could be certain that their transactions were protected and anonymous. From its release in 2009 until 2011, Bitcoin remained relatively under the radar. It found initial popularity amongst the tech community and criminal community, and its value was primarily driven by the difficulty of generating a new Bitcoin through mining and whether a merchant (be that a legal or illegal one) would accept the cryptocurrency as tender (Greenberg, 2011). Bitcoin became more mainstream after Forbes published an article in 2011

calling attention to the “new currency” (Greenberg, 2011). The article highlighted that crypto-enthusiasts were looking to make the currency more readily available to normal individuals through the development of an app for purchasing Bitcoin on Android and point-of-sale software (Greenberg, 2011). After the release of the Forbes article, Bitcoin prices rose by 900% from \$1 per BTC to \$9 per BTC (WorldCoin, n.d.). Bitcoin’s popularity and adoption increased throughout the 2010s; however, the platform suffered a setback in 2014. A large Bitcoin exchange called Mt. Gox (similar to Coinbase today) was hacked, and users lost an aggregate of 850,000 BTC (WorldCoin, n.d). The exchanges were relatively new and immature at this time, and the platforms lacked basic security measures such as two-factor authentication that are now commonplace (WorldCoin, n.d).

Like with many other popular products, Bitcoin’s rise in fame brought about interest in developing new coins. Many of the earlier alternatives to Bitcoin (alt-coins) had minor adjustments to the former’s blockchain technology (WorldCoin, n.d). However, in 2015, a new crypto project was developed called Ethereum. Ethereum had a currency component to its blockchain, but the real inspiration for its developers was to decentralize the internet (Frankenfield, 2022). Ethereum was meant to be more than just a digital currency. Its founders wanted the blockchain to be used for creating any secured digital technology such as smart contracts (Frankenfield, 2022). Ethereum has become the go-to program for many decentralized finance (DeFi) applications such as non-fungible tokens (WorldCoin, n.d). Oftentimes Ethereum and Bitcoin are compared as though they are the same thing, but they are different in many regards. First and foremost is that Ethereum serves a wider purpose than Bitcoin because the latter only uses its blockchain program for currency whereas the former uses it for many different secure transactions. Moreover, Ethereum uses a slightly different valuation process

called proof-of-stake instead of proof-of work (Frankenfield, 2022). Essentially, proof-of-stake involves sharing the nodes staking ETH (the cryptocurrency behind Ethereum) on the validity of a transaction, and if the validity is found to be invalid, then those ETH are destroyed (Frankenfield, 2022). A benefit to using the proof-of-stake method over a proof-of-work method is that it requires less computer power and thereby less electricity to keep the system running (Frankenfield, 2022). Overall, Ethereum represented a new development in public view towards blockchain. There were newer possibilities for the technology that transcended decentralized currency, and many people realized the potential power of this newfound technology.

Cryptocurrencies suffered a significant setback from late 2017 through 2018. Bitcoin prices drew back over 84% from the end of 2017 until December 2018 (Greifeld & Harris, 2022). This period of prolonged downturn in cryptocurrency prices is referred to as a “Crypto Winter,” and it is often driven by consumer interest shifts away from cryptocurrency thus affecting demand for the digital assets (England, 2023). Several contributing factors led to the sharp decline in Bitcoin and other cryptocurrencies during 2017. Most notable is the preceding incline, which many have deemed to be a bubble in retrospect (Weissman, 2021). Novice investors were starting to get involved in cryptocurrency primarily because of the upward mobility of cryptocurrency prices, which begets a fear of missing out (FOMO) mentality among individual investors (Weissman, 2021). Moreover, access to cryptocurrencies increased through the advent of initial coin offerings (ICOs), which are like initial public offerings (IPOs) of company stocks but for new cryptocurrencies (Lee, 2017). While some ICOs were for more serious cryptocurrencies that were developed to solve the hard technical problems experienced by Bitcoin or ETH, many were merely attempts to take advantage of the ever-increasing prices for coins (Lee, 2017). Moreover, celebrities such as Paris Hilton started promoting these less-

worthy coins, and the promotions drove prices further upward (Lee, 2017). Ultimately, cryptocurrency was a speculative bubble in 2017, and it was only a matter of time before the market corrected itself. One of the main drivers for cryptocurrency declines in 2018 was a lack of institutional support (Weissman, 2021). Many of the big names in the financial milieu, such as JP Morgan CEO Jamie Dimon or Berkshire Hathaway President Warren Buffet, said that cryptocurrency was worthless, and more likely, fraudulent (Weissman, 2021). These types of criticism curtailed novice demand for cryptocurrencies, which resulted in steep market declines in 2017 and 2018 (Weissman, 2021).

While the cryptocurrency market lolled from 2018 through 2020, the COVID-19 pandemic helped stimulate further market growth. Prior to the pandemic, Bitcoin was trading at about \$7,300 per coin, but by one year into the pandemic (*i.e.*, March 2021), the same Bitcoin was trading at \$46,800 (Jabotinsky & Roee, 2022). In other words, the value increased by 640% in one year. Early on, the influx of capital into the crypto market was driven by its lack of centralization and its ability to transcend global borders in trade (Jabotinsky & Roee, 2022). Moreover, access to cryptocurrencies has become more readily available through the development of centralized cryptocurrency exchanges (Reiff, 2023). Centralized exchanges allow for the conversion of conventional money into cryptocurrency, and it makes use of third-party intermediaries to facilitate escrow transfers (Reiff, 2023). While the use of centralized exchanges is the antithesis of cryptocurrency's initial purpose, it helped make the market more accessible to mainstream investors (Reiff, 2023). Platforms such as Coinbase and FTX were utilized by average investors to partake in the expanding market, and once again FOMO drove consumer demand. Additionally, the excess funds available to Americans and other investors through stimulus packages provided extra funds for "investing." Despite strong markets

throughout 2020 and 2021, Cryptocurrencies experienced market vicissitudes in 2022 mainly driven by the collapse of Terra Luna (a cryptocurrency) and the unraveling of Sam Friedman-Banks's FTX fraud, which subsequently led to the downfall of the trading platform (McGimpsey, 2023). Favors further reversed in 2023, and Bitcoin went from trading at \$16,000 in January to ending the year at \$45,000 (McGimpsey, 2023). An increase in mainstream attention on cryptocurrencies in 2023 was due to several reasons. In particular, due to the collapse of Silicon Valley Bank (SVB), U.S. Securities and Exchange Commission actions brought against the two largest cryptocurrency exchanges—Coinbase and Binance, and the introduction of crypto-ETFs caused the market increases seen in 2023 (McGimpsey, 2023). All in all, cryptocurrency from a market perspective has been characterized by heightened volatility throughout its two decades of history.

Chapter 4

Qualitative Similarities Between Tulipomania and Cryptocurrency

As past investors were able to deduce bubble markets by drawing qualitative connections to past speculative markets, the same can be done between Tulipomania and the current cryptocurrency environment. Several shared qualitative characteristics warrant discussion. Mainly, Tulipomania and cryptocurrency appear to share similarities in participant behaviors, a lack of intrinsic value, and the fact that both were new, unregulated markets before speculative participation. It is by examining these shared qualitative characteristics along with similarities in quantitative characteristics (discussed in a subsequent section) that one can determine whether cryptocurrency deserves to be considered a market bubble.

When comparing speculative markets, the most obvious correlation tends to be participant attitudes toward investments. In particular, in a majority of bubbles, there is often the presence of herd behavior and irrational exuberance. Because of seemingly endless increases in prices, the public develops a fear of missing out (FOMO) mentality that causes them to negate prudent investment due diligence in the pursuit of “getting rich quick.” When FOMO takes hold of the general public, a market draws in amateur participants whose intentions greatly differ from those of the initial investors. This leads to a shift in rationale, and at that particular point, the rationale is driven by the desire to make the most amount of money possible before the market collapses. For instance, investors suffering from FOMO do not take into consideration the price that they are paying for their “investment.” They believe that they will be able to sell the investment to a greater fool before suffering any adverse effects, which is the “Devil Take the Hindmost” mentality discussed by Chancellor (1999). This warped participant attitude drives

prices into a speculative mania that is not driven by normal efficient economic theories because of the presence of herd mentality and manipulative investor behaviors (Lambertini et al, 2010). When comparing Tulipomania and the current cryptocurrency market, we see the presence of these participant attitudes that hint at a bubble being present in the latter.

First and foremost, we see the introduction of amateur participants and a shift in the rationale behind the desire to invest. As noted earlier, tulips were initially desired by horticulturalists and nobles because of their beauty. These early investors paid healthy prices for bulbs that would make their gardens the envy of the Providence, and thus, display their wealth. However, these high prices drew the attention of amateur investors looking to get rich quickly with little effort. These investors lacked the financial maturity to participate in the expensive joint-stock ventures of the day, and as such, they were drawn to the tulip market. When these new investors became involved, bulbs became about getting rich instead of about displaying wealth. Ergo, these new investors were willing to trade lower-quality bulbs and trade on contracts (*i.e.*, futures). In the same vein, cryptocurrency has seen a shift in its investor participation, which has fueled a significant change in the purpose of the asset class. Initially, Bitcoin and earlier renditions of digital currency were designed to protect consumers with e-commerce and provide an anonymous and decentralized currency. The early adopters were people interested in the technology as well as some nefarious actors (*e.g.*, criminals using Bitcoin on the Silk Road). These individuals were also interested in Bitcoin's message of decentralization and anonymity. Moreover, early cryptocurrency was a place for rich tech entrepreneurs to invest their money. For example, the Winklevoss twins, who are famous in the general markets for their fight over Facebook with Mark Zuckerberg, helped develop the cryptocurrency market into what it is today (GoBanklessNow, 2023). For instance, they helped

fund an early trading platform for cryptocurrency called Gemini (GoBanklessNow, 2023). Several other tech entrepreneurs were early adaptors of cryptocurrency. These wealthy individuals saw cryptocurrency as a hedge against greater economic concerns such as inflation and government interference, which is why they resonated with Bitcoin's declared ethos.

For a while, Bitcoin was predominately known by this small group of enthusiasts and wealthy tech entrepreneurs. However, Greenberg's (2011) article in Forbes helped bring Bitcoin and the cryptocurrency market to the mainstream. The article discussed volatility in the price, which drew a comparison between risk and reward. As a result, Bitcoin surged in value by 900% after the release of the article (WorldCoin, n.d.). New investors were attracted to the volatility of Bitcoin rather than the initially stated purposes of decentralization and anonymity. These new investors do not believe in cryptocurrency's great purpose, but like the new traders during Tulipomania, they view Bitcoin as a means for getting rich quickly. For early investors, this was very easy to do as a slight fluctuation in price had a huge impact on an asset that was valued at \$9 per coin (WorldCoin, n.d.). An interesting study produced by Harvard Business School notes that generally large cryptocurrency gains have been reinvested into more traditional, conservative investments such as stocks or mutual funds (Aiello et al., 2023). While there is still a majority that truly believes that cryptocurrency represents the financial market's future, this study highlights that in its current state, the market is only being used to get rich (Aiello et al., 2023). For those who want to maintain wealth, other investments are being used. Thus, the first qualitative similarity between Tulipomania and cryptocurrency is that through the introduction of amateur participants, the sentiment of the market has changed. The "asset" class is no longer serving its higher purpose, but it is almost exclusively being used to get rich.

Moreover, like the tulip market largely saw the absence of wealthy investors and large-scale institutions when amateur investors started getting involved in the market, the same is true for cryptocurrency. Big talking heads of the Finance industry, such as Jamie Dimon and Warren Buffet have cautioned the public against cryptocurrencies. As recently as January 2024, Jamie Dimon, who is the CEO of J.P. Morgan said that cryptocurrency is an unfounded investment (Sigalos, 2024). At the World Economic Forum at Davos, Dimon compared cryptocurrency to a pet rock, and he said that the class is a “hyped-up fraud” (Sigalos, 2024). Outside of tech entrepreneurs, higher net-worth Americans appear to have a lower overall exposure of their wealth invested in cryptocurrency assets. Not only are wealthier individual investors taking a step back, but banks and other large companies are as well. Government regulators have made several statements over the last couple of years that make their position on cryptocurrency investments clear. These regulators believe that those types of investments are unsound and threaten the safety of the banking industry (Bennett, 2023). While no official policies have been rendered on the involvement of cryptocurrencies in banks, a unified message has been declared among banking regulators (*i.e.*, the Federal Reserve, FDIC, SEC, etc.) that it is best to stay clear of investing in cryptocurrencies. As a result, banks have become cautious of cryptocurrency investments. Some have decided to entirely exit the digital currency market while others are trying to work with regulators to involve cryptocurrency in their business in a manner that is safe for investors and depositors (Bennett, 2023). However, the regulatory bar has been set high, and many experts doubt that banks will get meaningfully involved in the cryptocurrency market for the foreseeable future (Bennett, 2023). Through the absence of these large investors, should the cryptocurrency market ever experience a collapse, the economy might not feel as negative the

effects as had these investors been involved. This is why the Dutch Republic did not experience a full-blown collapse after the tulip market crashed (Dash, 2010).

Not only did the desire to become wealthy perverse the original purpose of cryptocurrency, but market developments also played a key role in this shift. As noted, modern platforms such as Coinbase prioritize transparency in their operations, which limits investor privacy. Many platforms collect detailed personal identifiable information (PII) from their users, which compromises privacy (Bates, 2024). Moreover, regulations by governments and the traceability of platform blockchains have also reduced privacy (Bates, 2024). These developments in the market alter the purpose of cryptocurrencies further away from their decentralized roots.

Both Tulipomania and cryptocurrency are also perfect examples of herd behavior driven by FOMO. Early speculative investors in the tulip markets experienced significant paper gains, which drew other investors into the market (Chancellor, 1999). Likewise, cryptocurrency investors are drawn to the market because of potentially high returns (Haykir & Yagli, 2022). Furthermore, there is a similarity in the type of herding behavior exhibited by the investors in both periods. For starters, both were ignorant about what they were investing in. For the tulip traders, the very nature of the tulip bulb begets uncertainty. All tulip bulbs look the same before they bloom and additionally, past breaking was not always indicative of subsequent breaking (Dash, 2010). As such, a trader could not fully understand the bulb that they were purchasing. According to Haykir and Yagli (2022), cryptocurrency investors exhibit a lack of financial literacy that threatens their financial stability. As such, they are ill-equipped to understand investing overall and even more so in the extremely volatile asset class of digital assets (Haykir & Yagil, 2022). Secondly, investors appear to be susceptible to herd behavior during the normal

periods and not necessarily the bubble periods (Haykir & Yagil, 2022). In other words, the influx of investors is during a relatively short period, which drastically affects prices over that short period. Tulipomania is an excellent example of this. As shown in the earlier graph of tulip prices throughout the mania, the increase in prices only occurred over a short period, and rapid increases were common (Thompson, 2006). There was not a long, sustained bubble period. The same can be seen across earlier “bubble” periods in the cryptocurrency market according to Haykir and Yagil (2022).

Both Tulipomania and cryptocurrency also saw fraud connected to the market frenzy, which spurred prices higher. In Tulipomania, the most obvious frauds were in bubble representation and investor credit. The entire trading system for tulip bubbles in the latter part of the speculative mania relied primarily on trust between the buyer and the seller (Dash, 2010). The buyer had to trust that the tulip bulb being sold was accurately represented by the seller. For instance, many tulip traders commissioned drawings of the tulips when in bloom that would then be sold as bulbs. Unfortunately, many traders took advantage of this trust and would sell cheaper, lower-quality bulbs that did not represent the paintings shown to the buyer during the auction (Dash, 2010). Similarly, sellers had to be wary of the credit sales with buyers. There was a general lack of creditworthiness that was present, which beget unsubstantiated leverage for buyers (Dash, 2010). This meant that sellers needed to worry about defaults stemming from fraudulent representation on the part of the buyers. Just as fraud was persistent in the tulip market, so it has been in the cryptocurrency market. While, as previously mentioned, the underlying structure of cryptocurrencies’ blockchain with its peer-to-peer network and proof of work verifications protect against frauds related to transactions (*i.e.*, double spending), there are other ways the fraud has been exhibited in the cryptocurrency market. For starters, there have

been examples of fraud present in cryptocurrency exchanges. An excellent example is the multiple frauds perpetrated by Sam Freidman-Banks through his FTX exchange; however, this is only one example of the countless instances of fraud in the cryptocurrency industry (Cohen & Godoy, 2023). Another type of “fraud” has been the promotion of gimmick coins by celebrities, which draw investors in based on popularity (Kelley, 2023). These sponsors have been blamed for riding the initial price influx resulting from their promotion of the coins only to dump them thereafter (Kelley, 2023). These were deliberate attempts at defrauding the general investing public. In both Tulipomania and cryptocurrency, fraud has driven demand and has furthered the herd behavior of amateur participants.

Another qualitative similarity between cryptocurrency and Tulipomania involves the intrinsic value, or rather the lack thereof, behind these asset classes. Generally speaking, a bubble occurs when there is a divergence between an asset class’s market value and its intrinsic value (Haykir and Yagil, 2022). In Tulipomania, there is a clear divergence between the intrinsic value of the bulb and its market value throughout the speculative mania. At the height of the frenzy, a single bulb of rarer varieties (such as the *Sempre Augustus*) could be used to purchase land or even homes (Reichert, 2019). Despite this significant increase in market price, there was no change in the intrinsic value of the tulip bulbs. No innovation or change in market supply and demand curves justified a change in intrinsic value. Ergo, this divergence between intrinsic value and market value is a textbook case of a bubble. Many argue that cryptocurrencies have no intrinsic value (Prasad, 2021) (Cheah and Fry, 2015). Thus, the various cryptocurrency market values are unsubstantiated. For example, in March of 2024, Bitcoin reached its all-time high of over \$72,000 (Lang et al., 2024). Considering the market value was around \$1 in 2011, this significant change in market value must be driven by something. However, like the tulip bulb,

nothing is supporting this increased value. While the demand for coins has increased, the manner of cryptocurrency mining is such that the supply is unlimited. While it takes longer to mine coins the larger the blockchain grows, there is still an unlimited supply of Bitcoins. Therefore, there is no scarcity which means that there is no intrinsic value (Haykir and Yagil, 2022). This means that any market value over \$0.01 constitutes a divergence from cryptocurrency's value, which is indicative of a market bubble. However, more concerning is the fact that the divergence is as large as it is.

The lack of consideration for prices paid in the market and the lack of due diligence into the validity of offers highlights the irrational exuberance in both Tulipomania and the current cryptocurrency market. Interestingly, irrational exuberance would not have been a term used by people in the Dutch Republic (Shiller, n.d.). This is because aside from one exception, “irrational exuberance” was not a popular lexicon before Alan Greenspan used the word in a 1996 speech (Shiller, n.d.). Nevertheless, irrational exuberance would most certainly apply to the occurrences in 1637. Robert Shiller (n.d.) is the author of *Irrational Exuberance*, which is a book about market bubbles in the 1990s and early 2000s. He describes irrational exuberance as unfounded market enthusiasm that is not rooted in proper fundamental valuations but rather in illogical psychological factors (Shiller, n.d.). In essence, irrational exuberance is the culmination of purchasing beyond an asset's intrinsic value driven by FOMO (Taylor, 2024). Ultimately, the tulip bubble collapsed when investors came to their senses (Dash, 2010). They realized that a single tulip bulb was not worth over a year's wages or as much as a home (Dash, 2010). They realized that they had been irrational investors. When this happened, the market immediately dried up (Dash, 2010). In the same manner, cryptocurrency investors appear to suffer from irrational exuberance with periodic bouts of lucidity. Cryptocurrency is different from

Tulipomania in that the market has lasted much longer, and there have been several instances of small bubble bursts. For example, investors suffered from irrational exuberance through the early 2010s before the market corrected in 2018 (Weissman, 2021). The significant market decline was due to a lack of support from leading financial heads and economic vicissitudes (Weissman, 2021). This also happened in 2014 after Mt. Gox was hacked and again in 2022 (WorldCoin, n.d.). This shows that there are two types of bubbles present in the cryptocurrency market. The first are the small bubbles that occur over a few months or years. The larger, more concerning bubble is the one affecting the entire cryptocurrency asset class. The cryptocurrency market has experienced numerous small bubbles, but unlike the complete collapse of the 17th-century Dutch tulip mania, cryptocurrency prices, particularly Bitcoin and Ethereum, have exhibited a trend of overall growth despite occasional setbacks. This paper aims to evaluate the larger bubble. The overall irrational exuberance and unfounded belief in digital assets is a large concern for those involved in the market.

The final qualitative similarity discussed is the fact that both Tulipomania and cryptocurrency were new, unregulated markets. Oftentimes market bubbles are associated with developments and innovations in markets (Chancellor, 1999). However, many of the famous bubbles such as the South Sea bubble or later housing bubbles took place within the broadly established economy (Chancellor, 1999). Tulipomania and cryptocurrency differ because there were no established markets for these bubbles to occur. Those markets had to be developed. Tulip traders developed the colleges in the backrooms of taverns to facilitate their trading (Dash, 2010). Over time, these colleges became more complex. For example, eventually, traders were charged wine fees and other charges on trades to support the college (Dash, 2010). In the same manner, the trade of cryptocurrency has also advanced. Initially, there were limited ways for

investors to get ahold of cryptocurrencies, and the primary means was to mine your own coins (Gemini, 2022). The drawback to this early market was that it required a lot of work on the part of the investor, and it required them to be interested in the technology to the level that they were interested in mining their coins (Staff, 2022). As interest in cryptocurrencies such as Bitcoin increased, mining coins became more challenging (Gemini, 2022). As a result of these early problems, developers started to build trading platforms for cryptocurrency exchange (WorldCoin, n.d.). One of the earliest platforms was Gemini, which was the platform developed by the Winklevoss twins (GoBanklessNow, 2023). There were other platforms, but the early history of cryptocurrency trading platforms has been dubbed the “Wild West” (Gemini, 2022). There were significant risks with using these platforms, and it was entirely unregulated. For instance, the hacking of Mt. Gox destroyed many cryptocurrency investors and led to the 2014 drawback of the market (WorldCoin, n.d.). Eventually, more secure platforms were developed that prioritized transparency and privacy (Kulkarni, 2019). These platforms operate similarly to stock trading platforms and have made the accessibility to the market easier.

The early, unregulated markets of both tulips in the 1600s and cryptocurrencies in the 20th and 21st centuries were more accessible than other markets at the time. There was no guild restricting participation in the tulip trade (Dash, 2010). This meant that investors from all social classes were able to enter the market. Moreover, introducing lower-quality bulbs increased the pool of potential investors, and the lower entry barriers to joint stock investments also increased investment (Dash, 2010). Similarly, the developments in the cryptocurrency market increased accessibility. Exchange platforms made access to the market more accessible by providing a space for interested individuals to exchange dollars for cryptocurrency instead of having to do the work of mining their own coins (Kulkarni, 2019). Another recent development that has

increased access to the cryptocurrency market is the introduction of Bitcoin ETFs in January 2024 (Lumley, 2024). This development makes cryptocurrency investment exposure available to anyone with a traditional investment account, and it shifts cryptocurrency evermore into the role of investment over currency. In other words, it further proves that cryptocurrency is abandoning its initial higher purpose of an anonymous, decentralized currency. The increased accessibility begot by these unregulated markets is what allowed significant amateur participation, which—as explored above—is what has most contributed to the market bubbles.

Chapter 5

Quantitative Similarities Between Tulipomania and Cryptocurrency

Quantitative similarities can also be seen between Tulipomania and the current cryptocurrency bubble. Quantitative similarities are those that have a numerical aspect to them. Quantitative similarities are as useful as qualitative similarities when considering the presence of a speculative bubble, and in many circles, quantitative similarities might be more impactful. This is because there is data specifically identifying these characteristics in both markets, which creates a more tangible correlation than qualitative characteristics. For example, in the introduction, there was a discussion on how qualitative and quantitative similarities led some investors to short the housing market. While the qualitative evidence of seeing people living beyond their means highlighted the presence of a bubble, it was looking at personal balance sheets and default statistics (both quantitative) that finally convinced those investors that a speculative frenzy was present. Despite the important role of quantitative data in realizing speculative bubbles, it is hard to obtain a lot of data pertaining to Tulipomania. This has to do with the fact that records were not kept as accurately as they are today as well as that some have been lost over time. Nevertheless, included in this discussion of quantitative similarities between cryptocurrency and Tulipomania are asset volatility, trading devoid of currency, collateral percentages, and the illiquidity of wealth invested in both tulip bulbs and cryptocurrencies.

The most obvious quantitative similarity between cryptocurrencies and Tulipomania is volatility. Of course, there is more volatility present in cryptocurrency because its market has lasted longer. In other words, Tulipomania only lasted for a few months, and as such its volatility is not as varied as that of cryptocurrencies (for analysis, Bitcoin will be the primary

cryptocurrency considered). Tulipomania saw a fairly consistent rise in prices since the beginning of its frenzy (Thompson, 2009). Bitcoin's history has seen a great deal of volatility. When examining the shape of the mini bubbles that have occurred throughout that history, there is a noticeable correlation to the graph produced by Thompson (2009) regarding volatility in tulip contracts. The increases and declines are not gradual, but rather, the slopes are quite steep (Edwards, 2024). However, a long-term price increase has persisted despite the short-term volatility in prices (Edwards, 2024). The long-term increase is comparable to the increase experienced in the tulip market from November 1636 through February 1637. The only reason that there has been greater short-term volatility in Bitcoin compared to tulip prices is because of its longer time in the market. Nevertheless, there is evident volatility in both cryptocurrencies and tulip prices. For both Bitcoin and tulips, this volatility was driven by issues surrounding supply and demand as well as public reaction to the market (Reiff, 2024).

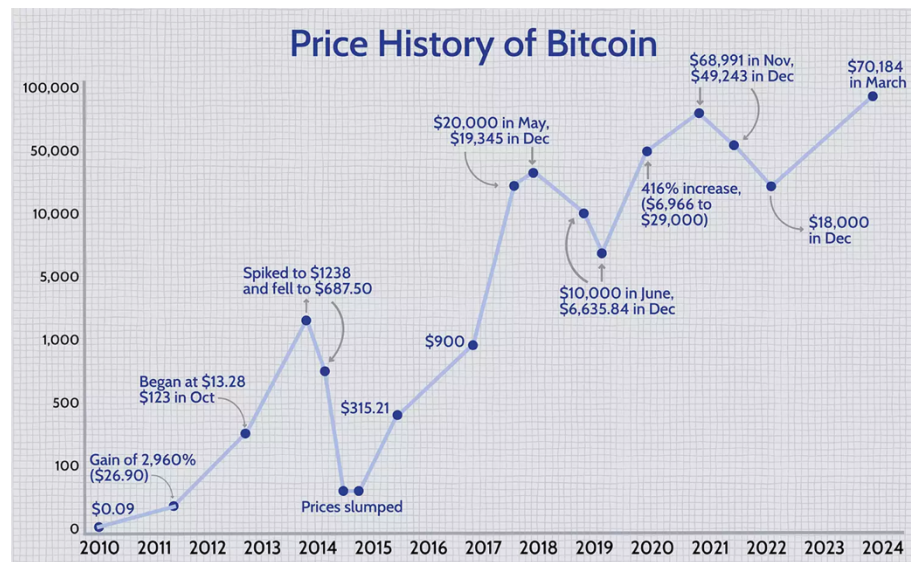


Figure 2: Historic Prices of Bitcoin (BTC) from 2010 to Present Day (Edwards, 2024)

Several contributing factors led to the volatility that attracted amateur participation. First and foremost was the trading nature of the tulip market. As previously discussed, traders developed a futures market that increased the period in which tulips could be traded (Dash, 2010). Instead of only being able to trade tulips when they were in bloom, the futures market allowed for bulbs to be traded over the winter while they were planted (Dash, 2010). This increased the uncertainty of tulip trades, which resulted in more compensation (*i.e.*, higher prices) required for bearing that uncertainty. Not only did increased uncertainty create price volatility, but there was also restricted supply. Increased demand for tulip bulbs occurred after the planting season, which meant that no more bulbs could be planted to meet the demand of the market (Garber, 1989). Ergo, existing bulbs, and their contracts became more valuable. When examining asset prices relative to other markets, there is evidence this asset has traded for overvalued amounts (Leath, 2019). Tulip prices outpaced other investment options during that time such as the Dutch Republic's joint-stock companies (Dash, 2010). According to the story of Gaergoedt and Waermondt, tulip trading was so attractive because it was difficult to make even ten percent from other business ventures (Chancellor, 2010). For instance, there was a 1,100% increase during the height of the market, which was far more than the steady returns brought by conventional investments (Al, 2020). In the same vein, Bitcoin's performance relative to popular markets is significantly varied. Before the 2018 collapse, Bitcoin's price fluctuated five times more than the NASDAQ and six times as much as the S&P 500 (Leath, 2019).

Volatility in market bubbles is not unique only to Tulipomania or the cryptocurrency market. However, there are two unique quantitative similarities that both tulip bulbs and cryptocurrency share. The first unique similarity has to do with the fact that tulip bulbs and

digital assets have both been used as currency. Tulips were used to trade directly for several items throughout the speculative frenzy including luxury goods (Chancellor, 1999). Direct trades of tulip bulbs for bails of wheat, oxen, pigs, cabinets, and other life necessities have been documented (Chancellor, 1999). As previously discussed, the prices for rarer bulbs throughout the height of Tulipomania were comparable to homes and salaries (Dash, 2010). Single bulbs could cost between 4,000 and 5,500 guilders, and the average workers' salaries were between 200 and 400 guilders (Chancellor, 1999). The Corporate Financial Institute (2023) notes that this means the best bulbs (such as the *Sempre Augusta*) were going for as much as \$750,000 in today's currency, and many of the lesser bulbs were trading for months if not years of basic labor salaries. Similarly, cryptocurrency prices are comparable to average wages today, and many of them are traded directly for goods and services. Interestingly, one of the first Bitcoin transactions was for pizza (Kaloudis, 2023). This transaction is widely celebrated by crypto-enthusiasts, and it took place on May 22nd, 2010 (Kaloudis, 2023). Laszlo Hanyecz transfer 10,000 BTC to Jeremy Sturdivant for two Papa John's pizzas (Kaloudis, 2023). Ever since this transaction, cryptocurrencies have been used to trade for other items as well. These transactions do not involve conversion into USD, which means that they are being directly traded. It is unique that items of speculation will operate outside the status quo economic methods as independent currencies. For example, mortgage-backed securities in the housing bubble or URLs in the dot-com bubble were not directly traded for goods and services. However, in both Tulipomania and cryptocurrency, this has been the case.

The other unique quantitative similarity between these two assets highlights the lack of wealth and institutional involvement in the market. The quantitative metric used to evaluate this is the ability to use these assets as collateral. As Chancellor (1999) has noted, the financial

institutions of 17th century Netherlands were not involved in the tulip trade, and they were very cautious of credit given. This was different from the general tulip traders who gave credit ignorantly and were largely involved in this particular asset (*i.e.*, as a percentage of their investments). While no collateral data exist from 17th-century loans, based on the fact that financial institutions were not involved in the tulip markets, it is reasonable to assume that they would not have accepted tulip contracts as collateral from loans. The data on lending rates for cryptocurrency assets is much clearer, and by examining the data, we see how banks and other financial institutions aim to be absent from the market. Other investment assets, such as stocks, bonds, mutual funds, and ETFs, can be collateralized through securities-based lines of credit (SBLOC). According to FINRA (2024), the average SBLOC allows for borrowing from 50% to 95% of an asset's fair market value. This is typically based on the value, type, and relative security of the underlying assets (FINRA, 2024). For cryptocurrencies, the lending rates are drastically less favorable. Typically, SBLOCs involving cryptocurrencies are only able to receive 3% to 8% of the asset's fair market value (Embriker, 2023). Stablecoins (such as Bitcoin) can secure slightly higher lending rates between 10% to 18% (Embriker, 2023). However, financial institutions are significantly less willing to accept cryptocurrency assets as collateral from loans.

The final quantitative similarity between Tulipomania and cryptocurrency explored is the illiquidity of wealth accumulated through the speculative mania. Tulipomania contracts were illiquid because of the nature of those contracts. As Gaergoedt and Waermondts note all grandeurs were all imagined (Chancellor, 1999). There was no real liquid wealth, and instead, wealth was represented in illiquid contracts. These contracts did not come due until the tulips bloomed in the spring, which was after the bubble popped in 1637 (Dash, 2010). Thus, investors

were spending money that they had yet to realize (and as hindsight has provided, would never realize) (Chancellor, 1999). There was no market for cashing out of the contracts (*i.e.*, going to florins) until the contracts came due, and this meant that wealth was illiquid. Cryptocurrencies can also be illiquid, which encourages debt trading. Generally speaking, the market size for cryptocurrencies is small (Loo, 2023). It is about \$1.3 trillion compared to US Equities at \$40 trillion, US Fixed Income at \$47 trillion, and Global Equities and Bonds at an aggregate \$230 trillion (Loo, 2023). This relatively small market size for cryptocurrencies makes it more susceptible to illiquidity, and this can restrict large sales of the currency (Club Swan, 2023). In other words, it is difficult to “go to cash” on large portfolios of cryptocurrencies. Because of this illiquidity, investors seek an additional premium for the inconvenience (Fitz, 2021). There is a noticeable mathematical premium derived from cryptocurrencies because of their illiquid nature (Fitz, 2021). More mainstream coins, such as Bitcoin or Ethereum, have larger market capitalizations and trading (Fitz, 2021). This means that they have less illiquidity. However, there are plenty of smaller coins that have irregular trading or small market capitalization (Fitz, 2021). It can be hard to trade in these markets, and thus they are deemed to be illiquid and demand a higher premium (Fitz, 2021). For example, if someone buys an unknown coin when the per coin amount is fractional pennies, and it rises by 200% (still being pennies), then that investor could have millions in cryptocurrency wealth. However, there is no market for millions in this coin without a significant effect on market price, and it can also be hard to fund buyers. Thus, this wealth could be considered illiquid.

Chapter 6

Notable Differences Between Tulipomania and Cryptocurrency

While there are several similarities between Tulipomania and cryptocurrency, there are also notable differences between these two asset classes. First and foremost, the latter is a form of technology, and tulip bubbles were only a part of nature. Edward Chancellor (1999) notes that often time speculation in a new industry is the result of innovators looking to push the industry beyond its current capabilities too early. For example, there were several speculative bubbles in railroad stock during the early stages of the industry in the United States, and these were because of the enthusiasm of “early adopters” looking to forward this new technology (Chancellor, 1999). Tulipomania did not come as the result of a new advancement in the horticultural industry, which makes it atypical for speculative bubbles. However, cryptocurrency is a new industry, and part of the early market inclines was driven by “early adopters” who believed in the technology. As we have noted, we have seen a change in the general sentiment of the market away from believing in the technology and instead focusing on the money-making potential of the asset class; however, the initial market enthusiasm was driven by these “early adopters” (WorldCoin, n.d.). While tulip prices were high relative to other flowers directly before the speculative mania that gripped the Dutch Republic in the 17th century, this was because it was a flower collected by societies rich and powerful (Dash, 2010). Therefore, cryptocurrency displays a difference from Tulipomania that aligns it with other speculative bubbles.

Chancellor (1999) also notes that the speculative bubble does not diminish the underlying importance of the new technology or industry. The railroad bubbles did not destroy the need for rail transportation, and the dot com bubble did not make URLs obsolete (Chancellor, 1999).

While Tulipomania did not get rid of the cultivation of tulip bulbs, what the other bubbles did for their respective industry or technology is different. The railroad bubbles brought the innovations occurring in the industry to the attention of the general public (Chancellor, 1999). In this way, the current cryptocurrency mania has brought more mainstream awareness to blockchain technology. Prior to 2011, Bitcoin and its blockchain technology's awareness were limited to technologically savvy communities and more nefarious criminal minds (WorldCoin, n.d.). However, with Greenberg's (2011) *Forbes* article in October 2011, cryptocurrencies were made more public. Moreover, its subsequent volatility in the market and the speculative bubbles that have resulted in eye-watering high returns have also attracted public attention. The underlying technology of cryptocurrency—blockchain—has benefited from this increased mainstream exposure, and it has led to the technology being used in fields outside of digital assets. According to the United States Government Accountability Office (2022), there are numerous potential applications of the technology that the government is actively exploring. They are exploring the use of blockchain in the medical industry by examining its potential for preventing theft or alteration of medical records (Government Accountability Office, 2022). There is also the potential for blockchain to help store property records and other sensitive data, and it could also create a more efficient infrastructure for data sharing (Government Accountability Office, 2022). However, there are still a lot of improvements needed for blockchain to make significant strides that would increase its application outside of the financial applications of its technology with cryptocurrency (Government Accountability Office, 2022). Nevertheless, because of the increased spotlight on blockchain technology driven by the speculative manias in the cryptocurrency market, individuals are actively looking into how to apply the technology in non-financial areas. In this way, the bubble, like others in the past, has helped forward the

technology. This was different from the tulip market after the collapse of Tulipomania, which did not see much change in the innovation or application of tulips in the general markets.

The other notable difference is the change in information sharing that was brought about because of modernity. Technological advances and globalization since the 17th century have created a world that shares information quickly. For those in the Dutch Republic, it was challenging to send timely letters to friends or family in other towns because of the relatively slow pace of travel. This is why it took Tulipomania a few months to collapse after the initial panic in Haarlem, and moreover, it is why there are gaps in data during that decline (Thompson, 2009). When looking at the graphical representation of the market decline from Chapter 2, we see that it took almost 4 months for information to reach the other main Dutch towns where trading took place (Thompson, 2009). In modern days, bubbles pop much quicker because information is shared at “lightning” speeds, and cryptocurrency has been no exception to the vicissitudes of modern communication on market volatility. Cryptocurrency markets can falter drastically based on present news. For example, in June 2021, Bitcoin fluctuated 3.6% lower based on a tweet by Elon Musk (Browne, 2021). Musk shared a meme (an internet video or image that is meant to be shared for comical purposes) that implied he was “breaking up” with the coin (Browne, 2021). This is not the only example of cryptocurrency markets moving quickly due to news; however, it is an excellent illustration of the market’s volatility to de minimis news. The difference in speed of shared information means that when the overall cryptocurrency market bubble comes to an end, the speed at which that decline happens will be accelerated compared, not just to Tulipomania but also, to all other market bubbles. The caution issued by the concerned pamphleteer during Tulipomania of “if ever there should be more sellers than buyers, which given the number of people involved could easily occur, then the collapse of

this mania will be at hand” would be seen on a global stage in the case of cryptocurrency’s decline (Chancellor, 1999). Through social media sources and the internet, news of decreased demand will spread like wildfire, and the devil will take the hindmost, which will unfortunately be many investors.

Chapter 7

Concluding Remarks

In conclusion, by examining the histories of both Tulipomania and cryptocurrency, there were several shared qualitative and quantitative characteristics discovered. From a qualitative perspective, it was noted that both cryptocurrency and Tulipomania saw changes in participant attitudes. This was driven by FOMO and a “get-rich-quick” mentality that perverted the initial intentions of the object. For tulips this was the natural beauty of the plant (especially those suffering from breaking virus), and for cryptocurrency, the original purpose of an anonymous, safe, and decentralized means of currency. Moreover, the lack of intrinsic value in both tulips and cryptocurrencies was discussed. The market values of these assets were drastically high compared to this lack of intrinsic value, which showed the presence of irrational exuberance in both markets. This lack of irrational exuberance led investors to negate prudence due diligence, and this resulted in more bloated and riskier markets for both tulip bubbles and cryptocurrencies. For example, because of this irrational exuberance, it was easier for fraud to occur in these markets than in others. The final qualitative characteristic category explored was the development of each market from unregulated to structured. Tulip trading went from a close-knit community of nobles and wealthy Dutch to an advanced college in the backroom of taverns, equipped with elaborate trading techniques and fees from communal wine and snacks. Bitcoin saw the development of trading platforms, which is how a majority of the market accesses this investment option today. These developments further drew tulips and cryptocurrency away from their initial purpose.

From a quantitative standpoint, the volatility in both cryptocurrency and tulipomania was discussed. Similarities in patterns between the prices of tulip bubbles and Bitcoin in small bubbles showed similar steep increases followed by equally steep declines. It was also argued that from a long-term cryptocurrency bubble perspective the market is still in the inclining period of the bubble, which was compared to the mania in tulip prices and options from November 1636 to February 1637. Furthermore, the fact that both tulip bubble contracts and cryptocurrency are used as independent mediums of exchange was discussed. This is unique from other bubbles that needed to convert their asset to cash to realize economic value. Tulip contracts were traded for a variety of goods such as farm equipment and food, and cryptocurrencies now are accepted as currency in many stores and countries. The quantitative factor of collateralization was also explored, which showed the absence of institutional investors in both markets. In Tulipomania, the very parties that built the initial interest in tulips were the wealthy, but they were absent from the market. In the same manner, financial institutions were also absent, and this is also true in the current cryptocurrency space. This protects the general economy from any potential negative effects of market declines in cryptocurrencies like this group's absence did during Tulipomania. Finally, it was noted that wealth accrued during these bubbles was/is largely illiquid. There was no way to get cash from tulip contracts until the contracts for bulbs came due in the Spring. This resulted in unrealized wealth and spending on credit. Similarly, large sums of wealth in cryptocurrency markets are illiquid because of the lack of large demand and the smaller market capitalization of cryptocurrency compared to other markets.

Like past investors who concluded that a market was a bubble (*i.e.*, those who shorted the housing market in 2008) by weighing the qualitative and quantitative similarities of

the current market with past, known bubbles, the same can be done for cryptocurrency. The significant number of shared characteristics of both a qualitative and quantitative nature to the oldest known market bubble can lead to a justified conclusion that the current cryptocurrency market is a bubble. There are documented cases of irrational exuberance and altered investor behavior, which are key marks of a bubble. What one does with the information depends on their views of risk and reward. Unfortunately, many people are infected by the diseases of “get-rich quick” and FOMO like the tulips that drove the Dutch Republic mad throughout the 1630s were infected with the breaking virus. These diseases will lead them to continue to speculate in the cryptocurrency market with hopes that they can sell to a greater fool and exit the market before the crash. However, as noted, there is no telling when that day will come. The “Devil Take the Hindmost” mentality leads them to believe that they can skirt being tailed, but the speed at which the collapse will occur due to modern communication structures will leave many foolish investors holding the bag. For the minority of investors brave enough to neglect temporary wealth for long-term protection, they will follow the path of those before them by staying removed from the cryptocurrency market. However, unlike those in 2008, they should not short the cryptocurrency market. The tumultuous volatility of cryptocurrency has the potential to bankrupt any investor on the short side of a transaction. Abstinence in this particular case is the most advisable course of action; only through a total removal from the system can they protect themselves from the virus.

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