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**CRYPTOCURRENCIES AS SPECULATIVE BUBBLES:
THE CASE OF BITCOIN**

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Table of Contents

Introduction	2
Chapter 1 Cryptocurrencies and cryptocurrencies' industry	4
1.1 AN INTRODUCTION TO DIGITAL CURRENCIES.....	4
1.1.1 HISTORY OF CRYPTOCURRENCIES AND CRYPTOGRAPHIC PROOF-BASED TRANSACTIONS	6
1.1.2 VIRTUAL CURRENCY EVALUATION TOOLS AND MAJOR CRYPTOCURRENCIES DESCRIPTION.....	8
1.1.3 DIGITAL CURRENCIES INDUSTRY	13
1.1.3.1 EXCHANGES.....	13
1.1.3.2 WALLETS	15
1.1.3.3 PAYMENTS	16
1.1.3.4 MINING	18
1.2 MAJOR INSTITUTIONS' ATTITUDE TOWARDS CRYPTOCURRENCIES.....	19
1.2.1 A GENERAL RANKING OF POSSIBLE APPROACHES TO VIRTUAL CURRENCIES.....	19
1.2.2 UNITED STATES.....	21
1.2.3 EUROPEAN UNION.....	22
1.2.4 UNITED KINGDOM	26
1.2.5 JAPAN.....	28
1.2.6 CHINA.....	29
1.2.7 OTHER INSTITUTIONS' APPROACHES.....	30
Chapter 2 Speculative bubbles: the case of Bitcoin.....	33
2.1 AN INTRODUCTORY OVERVIEW OVER THE NOTION OF "BUBBLE"	33
2.2 A SURVEY ON THE BIGGEST BUBBLES IN HISTORY.....	37
2.2.1 TULIP MANIA	37
2.2.2 THE SOUTH SEA COMPANY	39
2.2.3 THE DOT-COM BUBBLE.....	41
2.2.4 THE UNITED STATES HOUSING BUBBLE	44
2.2.5 COMPARISON	45
2.3 IS BITCOIN A BUBBLE?	46
2.3.1 BITCOIN'S ADVANTAGES AND DISADVANTAGES	48
2.4 BITCOIN'S FUNDAMENTAL ANALYSIS.....	51
2.5 BITCOIN PRICE ANALYSIS	55
2.6 BITCOIN AS A MEANS OF PAYMENT.....	57
Conclusions	60
Bibliography	62
Sitography	64

Introduction

We are going through a period of great innovations that improved our life, starting from smartphones, which gave us the possibility to connect with people, settle transactions and to find any information instantly, using a single device, or the GPS system; thousands of revolutionary ideas were conceived over the last twenty years, including some related to alternative methods for finance; cryptocurrencies fall into this category. Indeed, this new kind of money was conceived with the aim of changing forever the way we conduct transactions, starting from everyday purchases to worldwide money transfers; cryptocurrencies offer us the possibility to spare a third-party supervision in our transactions, without the need to worry about the possibility of fraud and counterfeiting.

In this thesis, we are going to describe in detail cryptocurrencies, starting from highlighting their main characteristics, examining the process that brought to the creation of this digital asset through the literature and describing the environment surrounding cryptocurrencies, for instance the digital industry that developed in order to facilitate digital monies' users. Afterwards, we will focus on the concept of speculative bubbles, since during the past few years several economists associated this concept to that of cryptocurrencies, suggesting digital monies are an example of financial bubble, proposing a review of the biggest crashes in financial history and a clarification on the reasons that led to the development of such financial event, concluding with an illustration of the meaning of intrinsic value and an investigation over the different theories attempting to assess Bitcoin's fundamental value.

The thesis consists of two chapters: The first one contains a description of cryptocurrencies' features, compared with those of fiat money, a review of the main papers in which digital monies' leading figures formalized the concept of anonymous payment system and cryptographic proof-based transactions. Then, we described the major cryptocurrencies, underlining their characteristics, namely the market capitalizations, the price per unit or the number of markets in which the digital currency is available; after that, we outlined cryptocurrencies' industry and examined the different positions major countries took towards such innovative money.

The second chapter concentrates on the notion of speculative bubble, depicting the main financial bubbles in history and describing the conditions leading to it, such as investors biases or government deregulations. Afterward, we studied the concept of fundamental value and fundamental analysis, briefly describing the main evaluation tools used to assess the value of an asset or a company. Finally, the paper focuses on Bitcoin, examining the major experts' theories, some of them supporting the cryptocurrency and believing it has an intrinsic value, while others taking a more skeptical stands and claiming the digital currency is just a bubble and has no value at all.

The main conclusions emerging from this research may be summarized as follows: What is the connection between Bitcoin and past speculative bubbles? Is there a speculative component in Bitcoin's market value? And if there is, how much does it contribute to the digital currency's price? As we will examine in the conclusive part of the thesis, data concerning Bitcoin market price and its use as a payment method confirm experts' theories, asserting Bitcoin is not ready to serve as a currency yet, as well as the fact that Bitcoin value is greatly influenced by speculative investments, which account for more than 60% of total Bitcoin transactions. Moreover, we will see that Bitcoin can easily be compared to past financial crises, since it seems to follow the same pattern.

Chapter 1

Cryptocurrencies and cryptocurrencies' industry

1.1 AN INTRODUCTION TO DIGITAL CURRENCIES

In the last decade, the world of finance changed irreversibly. As a result of several innovations' establishment that brought to light uncharted and innovative technologies, our vision of money was suddenly overturned, and our beliefs with respect to the best way to carry out safe and sound transactions, without the need to worry about any kind of fraud and counterfeiting were undermined from the foundations. Alternative methods for finance emerged, new types of assets and interfaces to transfer money, above all, new types of money were conceived.: cryptocurrencies.

Cryptocurrencies were created by the combination of accomplishment in several aspects of computer science, such as peer-to-peer network, and cryptography; they are, indeed, a type of digital money, which rely on cryptographic proofs to confirm transactions. They do not require the regulation of a central authority, that is the reason why they are defined as decentralized currencies. The enforcement of the network guidelines is pursued by all its participants, also called *nodes*. All transactions are broadcasted and recorded into the ledger, which is kept updated by the process of mining, through which new digital coins are minted. Moreover, the system allows users to maintain a certain degree of anonymity and to enter and exit the network whenever desired.

The main properties for a cryptocurrency are the following: first of all, the token offered by the cryptocurrency network has to be a digital bearer asset, in the sense that the user controlling the keys can speculate on the currency as if it was a speculative asset and use it as a medium of exchange as well; the second property is that of integrated payment system, giving the possibility to participants to make global payments, at a convenient cost and with a greater speed with respect to traditional currencies. Furthermore, the payment has to be irreversible, in order to prevent the possibility of fraud. Finally, a digital coin system should allow to use the currency in ways going beyond that of money and/or asset.

Another characteristic shared by several cryptocurrencies is that of fixed money supply, in the sense that their maximum supply is capped to a certain value, which is fixed. For example, Bitcoin maximum supply is fixed at 21 million BTC. Other digital currencies have instead a flexible supply, such as Dogecoin, which has no limits on it.

When introducing cryptocurrencies, it is often necessary to make a clear distinction between the former and electronic money, in terms of their acceptance and limitations associated with them, since they present very different schemes, but a little bit of confusion is made between the two.

As summarized in table 1, although they are both characterized by a digital format, meaning they are not physical money, such as coins or banknotes, one of the main differences between the two can be observed from their unit of account: in fact, while electronic money is expressed in euro, dollars or others, and has a legal tender status, virtual currencies are not backed by any fiat money, and their values need to be converted into a traditional currency through their own exchange rate based on the specific virtual currency supply and demand, which means their value may experience wide fluctuations.

Furthermore, being virtual currency decentralized, which implies that it is not regulated by any authority, its acceptance is guaranteed only within specific online communities, whereas electronic money is accepted by a wider range of merchants or retailers, which makes it easier to use in everyday life.

This last feature implies virtual currencies entail different risks with respect to those of electronic money; as a matter of fact, electronic money may be subject primarily to operational risk, arising when the system in which the funds are stored experience a failure in its internal processes, while virtual currency, in addition to the risk described above, may encounter credit risk, which is the risk of loss deriving from the impossibility of the borrower to repay the lender, and liquidity risk, meaning that, according to the European Central Bank, virtual coins' users may encounter some difficulties when it comes to exchange this kind of asset for money. Moreover, virtual currencies may be subject to all the risks coming from the lack of regulation, such as that of fraud and uncertainty.

Table 1: Differences between electronic money and digital currencies

Differences between electronic money schemes and virtual currency schemes		
	Electronic money schemes	Virtual currency schemes
Money format	Digital	Digital
Unit of account	Traditional currency (euro, US dollars, pounds, etc.) with legal tender status	Invented currency (Linden Dollars, Bitcoins, etc.) without legal tender status
Acceptance	By undertakings other than the issuer	Usually within a specific virtual community
Legal status	Regulated	Unregulated
Issuer	Legally established electronic money institution	Non-financial private company
Supply of money	Fixed	Not fixed (depends on issuer's decisions)
Possibility of redeeming funds	Guaranteed (and at par value)	Not guaranteed
Supervision	Yes	No
Type(s) of risk	Mainly operational	Legal, credit, liquidity and operational

Source: European Central Bank (October 2012), 'Virtual currency schemes'

1.1.1 HISTORY OF CRYPTOCURRENCIES AND CRYPTOGRAPHIC PROOF-BASED TRANSACTIONS

The first paper trying to formalize the system underlying cryptography and anonymous payment system was made by David Lee Chaum, an American computer scientist who, in an essay published in 1983, proposed a new type of cryptography based on blind signature concept.

In his paper, Chaum developed a system by which a payer could create a note $c(x)$ and send it to the bank, which in turn signs it and sends back the signed note to the payer. At that point, the payer checks the signed note and subsequently makes its payment, providing the note to the payee.

When the payee receives the payment, it checks the note and sends it to the bank, who checks again the payment and finally accepts it.

Following this scheme, the bank that receives the note from the payee does not know who is the payer that originally issued the note, because of the blind signature properties, and according to Chaum, this system ensures anonymity and counterfeiting protection.¹

Later on, Chaum suggested to implement a system able to guarantee total anonymity in personal online transactions, to the point that even banks and the government were prevented from tracing those payments²; he tried to introduce this technology through his company, DigiCash, In 1989, but it did not succeed, and the company declared bankruptcy in 2002.

In the early 90s, cryptography and privacy-enhancing technologies started to be seen as strong tools in order to bring social and political changes.

In 1992, Eric Hughes, Timothy C. May and John Gilmore, who were respectively a mathematician and computer programmer, an electronic engineer, and the co-founder of “Cygnus Support”, founded a group of people, named *cypherpunks*, communicating through a mailing list, whose roots are dated back to David Chaum paper of 1985.²

Cypherpunks were particularly concerned about privacy, which they considered essential for society in the electronic age, in order to guarantee the freedom of speech and entitle every individual to reveal its identity only when desired. Furthermore, they believed the government and other organizations could not grant people privacy, since it was not in their own interests. Because of that, they developed anonymous transaction systems, to defend privacy with cryptography.³

¹ Chaum D. (1983) Blind Signatures for Untraceable Payments. In: Chaum D., Rivest R.L., Sherman A.T. (eds) *Advances in Cryptology*. Springer, Boston, MA

² Chaum, D. (1985) Security without Identification: Transaction Systems to Make Big Brother Obsolete. *Communications of the ACM*, 28, 1030-1044.

³ Hughes, Eric (1993), ‘A Cypherpunk’s Manifesto’

One of the first papers dealing with cryptocurrencies themselves was published by Wei Dai, a computer engineer, as well as one of the cypherpunks we described above, in 1998. He developed two different protocols: in both of them the creation of money, called *b-money*, is computed by broadcasting the solution of an unsolved computational problem, and the transfer of money is regulated by a contract, in which it is stated the maximum amount due in case of default, namely in case one of the user involved in the transaction is not able to fulfill his/her duty of payment to the other parties, for each participant to the transaction. Moreover, both protocols require the presence of an arbitrator. The only difference between the two protocols arises from the account where all the participants put the amount of their maximum reparation in case of default, specially created for the purpose of the contract; in fact, in the first protocol, which Wei Dai defines as the impractical one, the account is kept by every participant, while in the second protocol, the account is kept by only a subset of them, who must deposit a certain amount of money used as fines in case of proof of misconduct.⁴

Only after ten years, a new proposal for a cryptocurrency was conceived: in 2008, an individual or a group of people named after the pseudonym of “Satoshi Nakamoto”, published a paper, in which they described the characteristics and functioning of *Bitcoin*, a new digital currency⁵.

Satoshi Nakamoto’s work took inspiration from previous publications concerning digital currencies and anonymous online payment systems, such as Wei Dai’s⁶ and Adam Back’s, the inventor of *hashcash*, a proof-of-work system⁷.

The starting point of Satoshi’s paper is the usual definition of electronic coin as a chain of digital signatures, as defined also in previous works, needed to guarantee a strong control of ownership and privacy (maintained keeping public keys anonymous); he then developed a network making use of proof-of-work. The reasons that brought to the creation of such network presented in the paper mainly concern the weakness of the trust model, the increase in transactions and mediation costs, reducing the volume of transactions, especially small ones.

According to Satoshi’s model, all transactions made are publicly broadcasted and subsequently recorded in a ledger book, known as the *blockchain*, which is managed by miners, that are encouraged to remain honest through rewards for their computational work (i.e. transaction fees and new minted bitcoin); the miners serve as a substitute for the traditional third party, whose key task is to check for

⁴ Dai, Wei (1998), ‘b-money’, <http://www.weidai.com/bmoney.txt>.

⁵ Nakamoto, Satoshi, (2008), ‘Bitcoin: A Peer-to-Peer Electronic Cash System’.

⁶ Despite Satoshi references to his paper, Wei Dai commented that, in his opinion, bitcoin’s creator did not even read his article before developing his work, but that he probably just came to knowledge of it afterwards and credited it.

⁷ Back, Adam (1997), ‘A partial hash collision based postage scheme’

transaction's double spending. According to this incentive-based system, the majority of miners will stay honest, since it is more profitable for them: indeed, as explained in the paper "If a greedy attacker is able to assemble more CPU power than all the honest nodes, he would have to choose between using it to defraud people by stealing back his payments, or using it to generate new coins. He ought to find it more profitable to play by the rules, such rules that favour him with more new coins than everyone else combined, than to undermine the system and the validity of his own wealth". This should lead to an increase in the speed with which reliable blocks of transaction are recorded into the ledger, making it more difficult for an attacker to keep pace with the recording, and, therefore, to fraud participants; moreover, the creations of blocks by miners constitutes a way to initially distribute Bitcoin.

This proof-of-work scheme allows two willing parties to make a transaction without relying on a central authority and moreover, solved the double-spending problem affecting preceding works related to the topic.

On January 2009, Satoshi Nakamoto mined the *genesis block of bitcoin*, namely the block number 0 of the blockchain, giving birth to the bitcoin network.

1.1.2 VIRTUAL CURRENCY EVALUATION TOOLS AND MAJOR CRYPTOCURRENCIES DESCRIPTION

After Satoshi Nakamoto's publication, there has been an exponentially increasing interest⁸ about cryptocurrencies from the public, that in turn caused the rise of many new digital currencies with a structure that is very similar to that of Bitcoin, that are being traded nowadays. In fact, to this day, there are 1586 different cryptocurrencies available, with different characteristics and purposes, making them more or less attractive to investors.

The main features used to evaluate cryptocurrencies are the following:

- ❖ The **Market Cap** (short for market capitalization): it refers to the total value of the currency. It is considered as the most important metric in order to assess the value of a digital currency and it is calculated by multiplying the currency's price per unit times its circulating supply;
- ❖ The **Price per Unit**;

⁸ According to www.blockchain.com, Bitcoin's transaction per day skyrocketed from less than a hundred transaction to approximately 50.000, a number that continued to rise until the peak of more than 420.000 transactions per day in 2017.

- ❖ The **Volume of Trading**: it is usually taken into account the volume monitored in the last 24 hours, or in the last month;
- ❖ The number of **Markets** in which the currency is traded;

According to a survey mentioned by the website *www.cryptominando.it*, cryptocurrencies' investors claimed that there are several more characteristics to be considered when evaluating a digital currency, such as the degree of decentralization, the number of active participants in the markets, the rate of growth of the latter and the activities carried out by the developers.

All the Cryptocurrencies in existence are coupled with a public ledger, whose functioning is of primary importance in order to preserve the feature of decentralization, but there are mainly two ways to develop it: there are the so-called **Altcoins**, which are very similar to bitcoin, meaning they are built on the same framework of a peer-to-peer network, and can differ from it by some features such as the proof-of-work algorithm or currency supply; or there are types of cryptocurrencies that are more innovative, and come up with significant differences with respect to Bitcoin.

According to market cap rankings, the largest cryptocurrencies in circulation are the following⁹:

- ❖ **Bitcoin(BTC)**: it is the largest cryptocurrency available, with a market cap of \$106.511.062.866 and a monthly volume of trade of \$130.879.166.464. Its supply is fixed, as well as other digital cash's supply, at 21 million BTC. The consensus is based on the proof-of-work mechanism and is distributed among several individuals. Up to now, the circulating supply of Bitcoin amounts at around 17 million BTC, meaning more than 80% of total Bitcoin supply has been mined, moreover, in 2017, the Bitcoin network reached a number of nodes equal to 11.128;

- ❖ **Ethereum(ETH)**: this digital currency was defined by one of his founders, Vitalik Buterin, in 2013, inside the "Ethereum white paper", and formally announced in January 2014.

In order to set up a network, founders decided to conduct a presale of ether tokens, in order to raise funds; through this presale, 60 million ethers were created.

Up to now, the supply of ether is fixed at 18 million every year, part of them created to reward miners (3 ethers per block).

According to developers, "Ethereum is a decentralized platform that runs smart contracts: applications that run exactly as programmed without any possibility of downtime, censorship, fraud or third-party interference"¹⁰, with smart contracts being self-executing

⁹ Data for June 26, 2018; data from <https://coinmarketcap.com/>

¹⁰ <https://ethereum.org/>

contracts, whose terms of agreement are directly found into their codes, and whose enforcement is facilitated by some computer protocols, and it is therefore categorized as an innovative cryptocurrency. In fact, its currency, Ether, is mainly intended as a “fuel”, a form of payment used within the platform and an incentive for miners, rather than as a proper currency or an asset; furthermore, developers are working on a new algorithm to be implemented in the future, that will switch Ethereum from a proof-of-work to a consensus system. By analyzing Ethereum features, it is easy to determine the latter is quite different from Bitcoin, meaning it does not fall into the definition of Altcoins; also, the fact that ether is not to be intended as an asset or currency empowers it with a greater stability with respect to Bitcoin.

Developers of Ethereum state they do not see Ethereum as a competitor of Bitcoin, but as “complementary ecosystem”⁹; it is in fact possible to use Bitcoin inside Ethereum’s platform. In 2017, Ethereum carried out more than 21.000 transactions, and can boast the participation of approximately 15.900 nodes.

With a market cap of \$45.325.492.612, Ethereum is ranked as the second most influent cryptocurrency;

❖ **Ripple (XRP)**: market cap \$18.839.597.126.

Established in 2012, Ripple technology can be used as both a cryptocurrency and a network to perform global financial transactions using the blockchain technology, “By joining Ripple’s growing, global network, financial institutions can process their customers’ payments anywhere in the world instantly, reliably and cost-effectively. Banks and payment providers can use the digital asset XRP to further reduce their costs and access new markets”.¹¹

The main benefits associated with Ripple are: its stability, the speed of payment settlements (about 4 seconds) and its growing sets of users.

The main difference between Ripple and the two cryptocurrencies described above, is that the former is not-mineable, meaning it is only bought and not mined;

❖ **Bitcoin Cash (BCH)**: market cap \$12.888.374.641.

On August 1st, some Bitcoin’s developers and miners set up a hard fork, namely a radical change in the protocol of the blockchain technology, a divergence from its previous version, and created Bitcoin Cash. The main reason that led to the development of a new cryptocurrency was the gradual slow down of the speed of transaction process of the Bitcoin

¹¹ <https://ripple.com/company/>

network, worsening as its user base grew. In fact, the key difference between Bitcoin and Bitcoin Cash was exactly the speed with which a transaction can be accomplished;

❖ **EOS**: market cap \$7.261.131.914.

“EOSIO is software that introduces a blockchain architecture designed to enable vertical and horizontal scaling of decentralized applications (the “EOSIO Software”). [...] The resulting technology is a blockchain architecture that has the potential to scale to millions of transactions per second, eliminates user fees and allows for quick and easy deployment of decentralized applications”.¹²

The EOS.io software was built by Block.one, a Cayman Islands company and, as Ripple, it is not minable. Moreover, the EOS token distribution was stopped in June 1, 2018 and, subsequently, tokens became non-transferrable on the Ethereum blockchain.

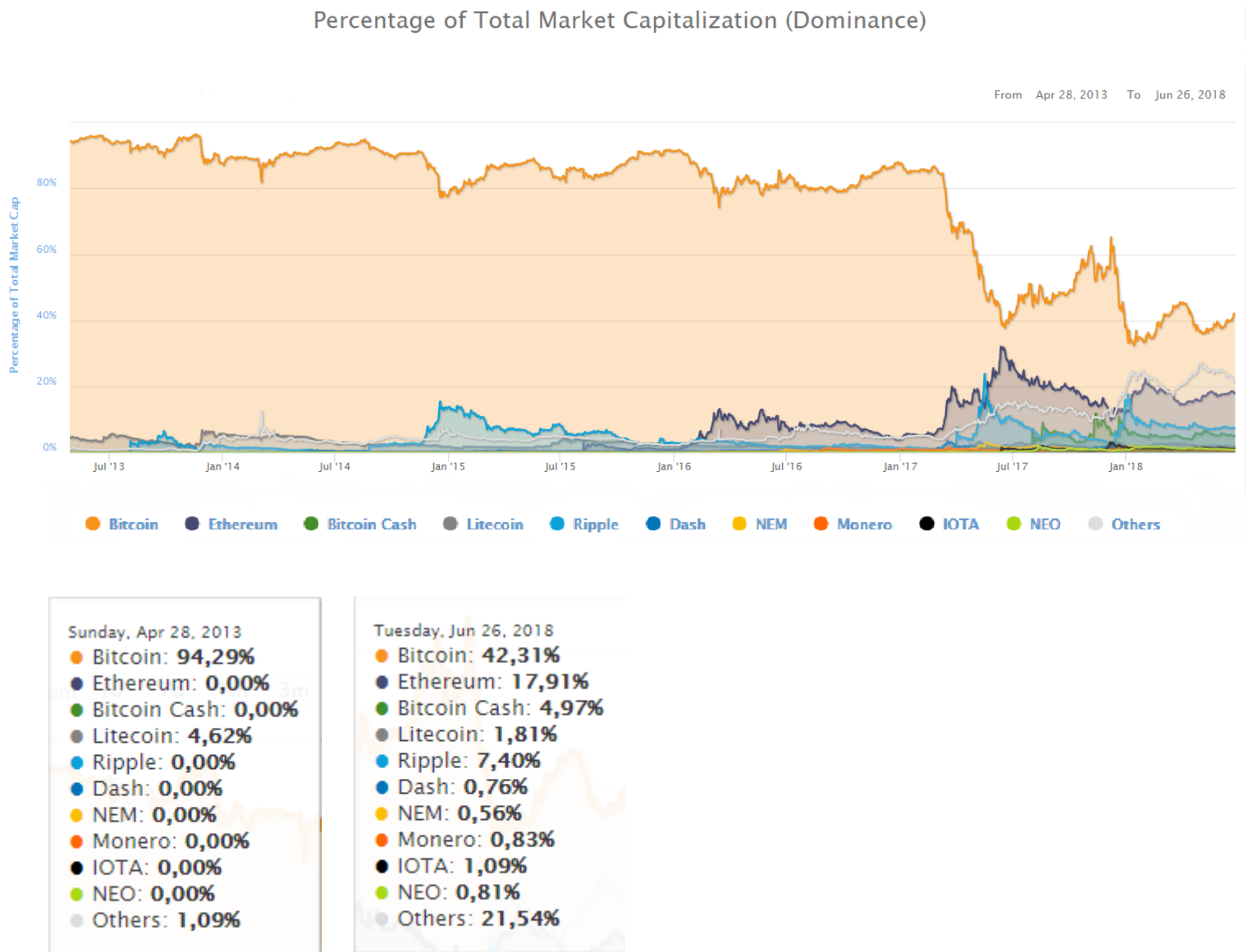
❖ **Litecoin (LTC)**: market cap \$4.663.048.048; It was distributed in 2011, and it is a currency very similar to Bitcoin, except for some characteristics, such as a larger total supply (84 million LTC). It is based on an open source software, and it can boast a very fast transaction confirmation time.

As indicated above, 1586 different cryptocurrencies are right now available, with a total market capitalization of \$253.866.195.094, 11238 markets and a total monthly volume of \$434.516.416.080. Nevertheless, Bitcoin still has a dominance in the cryptocurrency market, as shown in Figure 1. By looking at this chart, it is clear that, until February 2017, Bitcoin remained strongly dominant, with a percentage of total market cap exceeding 80%, with the rest of cryptocurrencies accounting for less than 15%. Afterwards, Bitcoin gradually lost about half of the shares held, and, after some fluctuations, it stabilized at around 40% share of total market capitalization. This occurred because of the rise of new digital currency; in fact, in 2013, the only relevant cryptocurrency competing with Bitcoin was Litecoin. It took some time for other digital currencies to be developed and gain a significant total market cap share, thanks to their different characteristics with respect to Bitcoin (i.e. platforms to run contracts, or mainly targeted to financial institutions), improved performances (i.e. greater speed of transactions settlements, more stable market price).

In any case, Bitcoin still is the currency that inspired the creation of many others, the first one to gain public attention and the more widely known, which gives it a considerable advantage, with respect to other type of cash traded online.

¹² <https://eos.io/faq>

Figure 1: Dominance of Bitcoin Market capitalization



Source: coinmarketcap.com

1.1.3 DIGITAL CURRENCIES INDUSTRY

With the development of a considerable number of digital currencies and the associated blockchain technologies, a massive amount of companies and projects emerged, with the aim of exploiting the potential embodied in this unexplored industry, by providing services designed to facilitate the use of cryptocurrencies, especially for beginners. Some examples of those services made available for users can be data web sites, keeping track of fundamental values of different cryptocurrencies, storing previous data and building charts showing the fluctuations of the main digital currencies, or forums and consulting blogs, where the cryptocurrency community can interact, sharing advice, information and news regarding digital cash. The increasing number of actors within the industry and the existence of services creating a connection between blockchains network and other sectors of the traditional economy has contributed to add value to cryptocurrencies themselves.

In particular, to facilitate the analysis of the various components of the digital cash industry, it is useful to divide it into four main sectors: *exchanges*, primarily used to buy and sell cryptocurrencies for other cryptocurrencies or in exchange for national fiat currencies; *wallets*, the purpose of which is to store cryptocurrencies; *payments* sector, facilitating payments through the use of cryptocurrencies; and *mining*, which is the sector responsible of the recording of the transactions inside the public ledger (the blockchain).

1.1.3.1 EXCHANGES

The exchanges sector plays a crucial role in the cryptocurrencies industry, since it enables market participants to trade, offering a marketplace, also important for liquidity and price determination of digital cash. It was the first sector to evolve in the industry: in fact, the first exchange was founded in 2010, to facilitate the trade of Bitcoin and in order to assess its market price. It is the bigger sector in terms of active users. For what concerns the trading by fiat currencies, the five more traded are respectively the U.S. dollar (USD), the Euro (EUR), the British Pound (GBP), The Yen (JPY) and, finally, the Chinese Renminbi (CNY).

It is possible to identify three different categories of exchange activities performed in the sector:

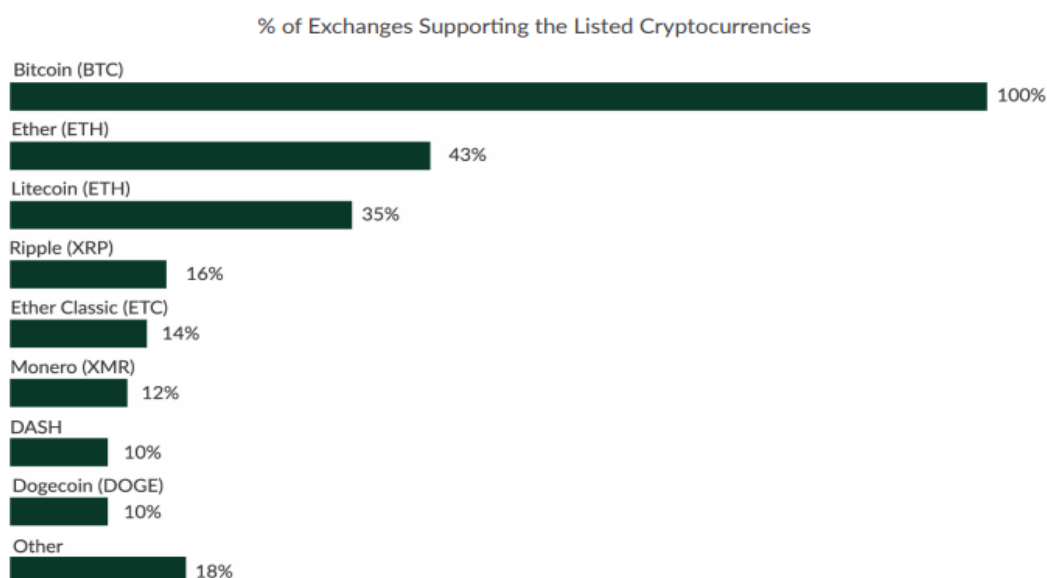
- ❖ *Order-book exchange*, which is a platform using trading engine to match requests from users to buy and sell;
- ❖ *Brokerage service*, whose function is to let users acquire or sell digital currency at a given price in a convenient manner;

- ❖ **Trading platform**, providing a single interface enabling users to connect to other exchanges and provides leveraged trading and cryptocurrency derivative.

It is also useful to distinguish exchanges based on their size, since large and small exchanges are proven to specialize in different types of activities and, consequently, to provide different services: indeed, small exchanges tend to specialize in delivering one specific service, especially brokerage services (42%), accounting for 72% of total small exchanges analyzed. A small share of exchanges considered supply a combination of services (28%). Conversely, a big share of large exchanges, precisely 72%, provide a combination of services, rather than concentrate on just one of them.¹³

Because of this particular concentration, Small exchanges seem to have significant difficulties with obtaining and maintaining relationships with banks, while large exchanges seem to have this risk factor under control. Furthermore, small exchanges tend to be also substantially more concerned about fraud than large exchanges, a factor suggesting that they are either targeted more often or simply that fraud has a more severe financial ripercution on them, caused by the limited scale of their operations and their budget. Another factor affecting the ability of exchanges to withstand fraud and theft of sensitive informations is the degree of security measures adopted by the former: according to studies, large exchanges use them more often with respect to small ones.

Figure 2: Percentage of exchanges supporting existing cryptocurrencies



Source: Hileman, Garrick & Rauchs, Michel, (2017), 'Global Cryptocurrency Benchmarking Study'.

¹³ Data from: Hileman, Garrick & Rauchs, Michel, (2017), 'Global Cryptocurrency Benchmarking Study'.

As shown in figure 2, all exchanges support Bitcoin, and this is probably due to the cryptocurrency fame, while it is possible to find Ether and Litecoin listed only in, respectively, 43% and 35% of exchanges. Ripple, Ether classic, Monero, Dash and Dogecoin are listed by a share of exchanges between 16% and 10%, while, altogether, other digital currencies are supported by 18% of total exchanges analyzed.

According to the survey carried out by Garrick Hileman & Michel Rauchs in 2013¹⁴, the exchanges network include a total of around 1150 employees, accounting for the largest share of employees in the digital currencies industry.

1.1.3.2 WALLETS

Wallets are generally defined as software programs used to store, send and receive cryptocurrencies securely, by using public and private keys. They also allow the user to keep track of its cryptocurrencies holdings and estimate the fees for a certain transaction with a desired confirmation speed. Even though all digital currencies have a reference implementation performing all these operations, users find it impractical for several reasons, and therefore prefer using wallets not related to reference implementations. The number of wallets is increasing over time, it is in fact estimated that its total number grew from 8.2 million (2013) to approximately 35 million(2016); in this sector there are more than 400 full-time employees, with an average of around 19 employees per wallet.¹⁵

Wallets can be categorized in two main classes: *open-source* wallets, representing the majority of wallet available nowadays, whose providers do not keep custody of user funds but let the user control private keys, and *closed-source* wallets, meaning the wallet source code is not open for outside developers.

The majority of wallet providers add to their offer supplementary features, beyond the basic storage functions of the wallet; one of them is the integrated currency exchange service, allowing users an customers to exchange digital cash within the same wallet interface. There are three different models used by wallet providers in order to deliver currency exchange services: the *centralized exchange/brokerage service*, the traditional model according to which the wallet provider, acting as a central authority, behaves like a counterparty to the user who wishes to sell or buy a digital currency. According to this model, the wallet provider directly handles the exchange of cryptocurrencies; the

¹⁴ They collected data from 51 exchanges based in 27 countries.

¹⁵ Data from: Hileman, Garrick & Rauchs, Michel, (2017), 'Global Cryptocurrency Benchmarking Study'.

integrated third-party exchange, where users can sell and purchase the cryptocurrencies through a partnered third-party, integrated within the interface of the wallet; finally, the *peer-to-peer exchange/marketplace*, a model that enables the user to exchange digital currencies with another user, avoiding the presence of a centralized third party. This means that, according to this model, the provider only makes the infrastructure available to users, without interfering with transactions. It is estimated that nearly half of the wallet providers deliver integrated third-party exchanges, while centralized exchanges and P2P exchanges account respectively for 31% and 23%.¹⁶

For what concerns different cryptocurrencies acceptance within the wallets sector, almost every wallet provider (96%) accepts Bitcoins, while other relevant digital coins (i.e. Litecoin, Ether, Ripple) are supported by a range of wallets going from 23% to 4%.¹⁷

1.1.3.3 PAYMENTS

In payments sector, as well as in wallets sector, the digital currency systems are supported by an integrated payment network to process transactions denominated in the currency of interest, but users prefer to adopt payment systems detached from the currency network.

Payment system providers can make use of cryptocurrencies in two ways:

- ❖ **Payment rail**, where digital cash is used as a channel for transferring national fiat currencies in a fast and cost-effective manner. As it can be inferred from the description above, cryptocurrencies are not the main focus of transactions, but rather a means for the transfer, that's why these transactions are defined as *national-currency-focused*. This category can be further divided into two activities carried out within the payment sector: *money transfer service*, which allow individuals to conduct international money transfers denominated in physical currencies (i.e. bill payment services); and *B2B payments*, where the providers allows businesses to make payments, usually cross-borders, through a platform;
- ❖ **Cryptocurrency payment**: through this channel, payment providers deliver services with the aim of facilitating the use of cryptocurrencies for its users; for this reason, this segment is defined as *cryptocurrency-focused*. Currency payments can also be split into two different activities, namely *merchant services*, whose function is to process payments for merchants that accepted cryptocurrencies as a means of payments; and *general-purpose cryptocurrency*

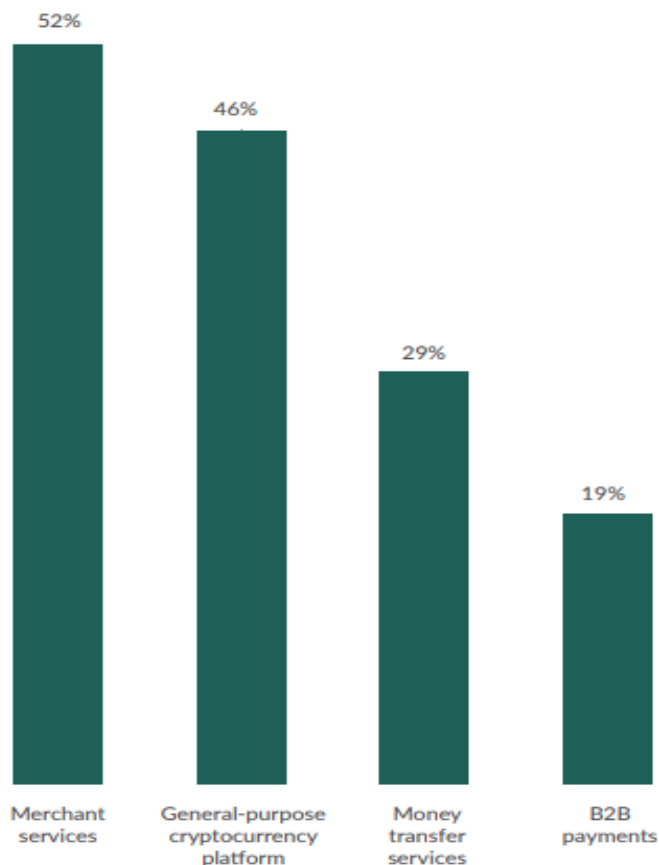
¹⁶ Data from: Hileman, Garrick & Rauchs, Michel, (2017), 'Global Cryptocurrency Benchmarking Study'.

¹⁷ Data from: Hileman, Garrick & Rauchs, Michel, (2017), 'Global Cryptocurrency Benchmarking Study'.

platform, performing several digital currencies transfer services, such as instant payments between two parties within the same platform, using both national currencies and/or digital cash.

It is therefore quite clear that B2B payments and merchant services are focused on businesses,

Figure 3: Payments activity distribution



Source: Hileman, Garrick & Rauchs, Michel, (2017), 'Global Cryptocurrency Benchmarking Study'.

while money transfer services and general-purpose cryptocurrency platforms are services created to facilitate payments and transfer of money between individual users. According to data summarized in figure 3, more than 50% of payment providers analyzed delivers merchant services, making it the major service offered, followed by services enabling individuals to transfer currencies within a platform (general-purpose cryptocurrency services), available for 46% of payments networks. These data highlights that the majority of payment providers are more

concerned about cryptocurrency-focused segment, accounting for more than half of the activities carried out in the sector.

In the payments sector, the total number of active employees amount to 1057, with an average of 22 full-time employees for each payment company, which is more than the average employees in the wallets sector, but less than the average in the exchanges sector.

As seen in the other sectors, Bitcoin is the most widely used digital currency payment rail, it is indeed adopted by more than 80% of payment participants.¹⁸

1.1.3.4 MINING

Miners are responsible for the recording of transaction inside the blockchain and provide to the ledger system the computational power necessary to keep the digital coins network safe from attackers, work for which they are rewarded, in order to give them incentives to remain honest. For all those reasons, mining sector plays a deeply important role in every cryptocurrency network. Five basic types of activities are recognized within this sector:

- ❖ **Mining**, which is basically the network of individual and organizations processing transactions to earn rewards through the digital currency's scheme.
- ❖ **Mining pools**, where computational power of several miners is combined in order to increase the probabilities to find a new block to mine. The rewards coming from the blocks mined are then redistributed among all mining pool's participants, based on the proportion of computational power they shared. Miners frequently "jump" from a mining pool to another, based on the profitability of the former; to determine which pool is more successful at finding blocks, it is useful to compute the so-called market share of mining pool, done by dividing the number blocks found for the total number of blocks found during a given time period. Even if it seems mining became more distributed across the years, the great majority of mining pools are located in China and in United States. This is because the location of the mining pools does not have to coincide with the location of miners;
- ❖ **Mining hardware manufacturing**, composed of organizations specialized at designing and building equipment for the mining activity. There is only a small number of teams in this segment;

¹⁸ Data from: Hileman, Garrick & Rauchs, Michel, (2017), 'Global Cryptocurrency Benchmarking Study'.

- ❖ *Cloud mining services*, mainly composed of organizations that rent hashing power
- ❖ *Remote hosting services*, where teams host and take care of mining equipment owned by their customers; it was mainly created to offer users the possibility to take part of the mining process without running the equipment themselves.

1.2 MAJOR INSTITUTIONS' ATTITUDE TOWARDS CRYPTOCURRENCIES

1.2.1 A GENERAL RANKING OF POSSIBLE APPROACHES TO VIRTUAL CURRENCIES

The rise of so many different virtual currency, and the interest they gained over time, brought central banks all over the world to pay attention to the development of this new “micro-universe” emerged within the alternative finance surroundings, mainly because they were worried whether they could jeopardize financial stability or because they were concerned about the opportunities this kind of monies could generate for illegal activities, thanks to the degree of anonymity they offer. Almost every banking authority expressed his own opinion concerning the virtual currency network and stated which approach to embrace. According to Jan Lansky (2018)¹⁹, these approaches can be classified in several level, going from level zero to five; the particular characteristics of different states are described in the following list:

- ❖ Ignoring (level 0): authorities in this state do not deal with digital currencies; because of the growing relevance reached by virtual coins, many country's authorities left this stage. Up to now, approximately 150 countries can be considered at level zero;
- ❖ Monitoring (level 1): at this state, the authority is aware of the existence of cryptocurrencies and, indeed, monitors the development of their networks, but takes no action, such as recommending for a possible approach;
- ❖ Recommendation (level 2): in this case, the authority makes public a recommendation, giving advice on how to use, or not use, cryptocurrencies. The recommendation can stem from a particularly negative analysis conducted by the central authority in question, that will therefore warn the public against the risks of these new type of money, including the possibility of an unexpected and rapid decline of the value the former; this position on the issue is actually the most widely adopted by authorities. Up to now, Belgium, Brazil, Cyprus, Denmark, France, Greece, Hungary, India, Indonesia, Israel, Italy, Lebanon, Lithuania, Malaysia, Mexico, Netherlands, New Zealand, Philippines, Portugal, Serbia, South Africa,

¹⁹ Lansky, Jan (2018), 'Possible State Approaches to Cryptocurrencies'.

South Korea, Taiwan, Turkey and Vietnam are included in this level. Otherwise, the recommendation can highlight the potential of cryptocurrencies and of the technology embodied in them;

- ❖ Guidance (level 3): in such a case, the authority issues a guide for people, in order to communicate what, according to whom, is the best method to handle virtual coins. This category can be further divided into several subsets, based on the type of guidance issued: First of all, the digital currency could be subject to restrictions, similar to the ones with the scope of fighting against money-laundering; another position the authority could take, is to state that cryptocurrencies cannot be viewed as goods and, as a consequence, they cannot be subject to value added taxes or they can be considered as a sort of asset, but taxed according to existing legislations; on the other hand, virtual money can be regarded as goods and therefore subject to value added taxes. In the last two categories, the authority declares, respectively, that cryptocurrency mining has to be subject to income taxes, and that cryptocurrencies themselves should be subject to gambling taxes;
- ❖ Regulation (level 4): at this specific state, the central authority impose that every digital coin-related activity must be granted under its explicit approval and some pre-determined conditions has to be met in order to obtain the authorization. This group includes the state of New York and Luxembourg²⁰;
- ❖ Ban or integration (level 5): finally, the national authority can fully adopt and approve the cryptocurrency or refuse it. The first level of this state requires a ban for banks, which are are restricted from delivering services related with digital money; a stricter position associated with this approach is the complete prohibition to use digital currencies, both for banking institutions and for people. This ban can be enforced by threatening to impose stringent sanctions and even with imprisonment (this stage includes countries such as Bangladesh, Bolivia, Kyrgyzstan, Russia and Thailand); conversely, the central institution can actually integrate digital currency, for example by creating a state one, adopt virtual currencies technology within its administration, or it can decide to invest its central bank's money in exchange for digital coins.

Hereafter, an analysis of the most relevant countries' approaches to digital currencies and blockchain technology throughout the years.

²⁰ Data for 2016.

1.2.2 UNITED STATES

In United States, so far, there is not a coherent view of virtual currency by the various institutions. In 2013 the Financial Crimes Enforcement Network (FinCEN), a bureau of the US Department of Treasury, whose main objective is to collect and analyze information in order to fight money laundering, issued a guidance²¹, in which it deals with the feature a currency needs to meet, an illustration of various type of virtual currencies, both centralized and decentralized and a depiction of the various actors in the digital money market; the FinCEN concluded the analysis declaring that “Virtual currency does not meet the criteria to be considered “currency” under the BSA [Bank Secrecy Act], because it is not legal tender. Therefore, a person who accepts real currency in exchange for virtual currency, or vice versa, is not a dealer in foreign exchange under FinCEN’s regulations”. Also, the Internal Revenue Service (IRS) published a guidance²² to clarify how existing tax regulations apply to digital monies-related transactions; According to the institution, virtual currencies are treated as an asset and not as a proper currency, especially for what concern the feature of generating foreign currency gain or loss. Based on this categorization, digital money services, such as mining, trading or holding them is subject to taxes, according to general tax principles.

On December 2017, the US Securities and Exchange Commission (SEC) released a post on his official website²³, in which the carried out an analysis of virtual currencies and Initial Coin Offerings (ICO). Its main concern came from the fact that people investing in digital monies are less protected than they would be in the traditional securities market, with a substantial growth of chances for fraud; for that reason, the SEC warns the public, making it clear that no ICO is registered with the institution, and suggesting to everyone willing to invest in cryptocurrencies to ask questions and require clear answers, together with the risk of losing money. Throughout the statement, it is not clear how the SEC categorizes cryptocurrencies, but it recognizes that the technology behind them and ICOs could be a disruptive innovation, able to increase efficiency of transactions. On March 3, 2017, Jerome Hayden Powell, the chairman of the Federal Reserve (Fed), delivered a speech²⁴ during which he gave an overview of the traditional payment system and its objectives, introduced alternative system, including the distributed ledger technology and finally listed potential drawbacks associated with a central bank’s digital currency, such as that associated with money laundering, drawing attention to the fact that banks would probably face a trade-off between users’ privacy and the risk of hidden

²¹ Financial Crimes Enforcement Network, (March 2013), ‘Application of FinCEN’s Regulations to Persons Administering, Exchanging, or Using Virtual Currencies’

²² <https://www.irs.gov/pub/irs-drop/n-14-21.pdf>

²³ <https://www.sec.gov/news/public-statement/statement-clayton-2017-12-11>

²⁴ Board of Governors of the Federal Reserve System, (March 2017), ‘Innovation, technology and payments system’

activities associated with cryptography. At the end of the speech, Powell concluded: “We should be open to the new ideas and innovations that will drive economic growth and improvements in our financial system. At the same time, the public rightfully expects that authorities will do whatever it takes to keep their money safe. Those of us in the public sector will insist on safety and security, while also working to assure that our citizens benefit from payments system innovation”.

In the early 2018, the SEC issued a statement²⁵ in connection with a message to investors about ICOs released by the North American Securities Administrators Association (NASAA)²⁶, praising the association for highlighting the main concerns with cryptocurrency, stressing the fact that digital monies lack several features characterizing traditional currencies and adding that, so far, they were intended as an investment, rather than a means of payment. At a later date, the SEC published a further declaration asserting that a relevant number of online platforms in which users can sell and buy digital currencies do actually provide a transaction mechanism meeting the federal laws’ definition of security and, therefore, they should register with the SEC, in order to protect investors against the risks of fraud and other illicit practices. During the year, also the US Treasury Secretary Steven Mnuchin expressed its view on cryptocurrencies²⁷: at the World Economy Forum in Switzerland, he declared: "My No. 1 focus on cryptocurrencies, whether that be digital currencies or bitcoin or other things, is that we want to make sure that they're not used for illicit activities". He also added that, according to him, virtual money needs a stricter regulations, since the illegal activities carried out through its network is unacceptable.

1.2.3 EUROPEAN UNION

The first signs of interest from the European Union with respect to the cryptocurrencies’ framework date back to October 2012, when the European Central Bank (ECB) issued a report concerning virtual currencies scheme²⁸. In this paper, the ECB tries to shed light on digital monies, whose use had spread over online communities during the previous two years, availing itself of its duty to enhance payment system and its overseeing role. It starts by classifying digital coins pattern in three main types, namely: the *closed virtual currency scheme*, whose primary characteristic is that of being restricted to the virtual world only, meaning this kind of virtual money cannot be exchanged for physical money and

²⁵ U.S. securities and exchange commission, (2018), ‘Statement on NASAA’s Message to Investors about ICOs’

²⁶ The NASAA is the oldest international organization devoted to investor protection.

²⁷ CNBC, (January 2018), ‘Treasury Secretary Mnuchin explains why he's really looking closely at bitcoin’

²⁸ European Central Bank, (2012), ‘Virtual Currency Scheme’

vice versa. An example of this first type can be games' monies, which can be used only in exchange for virtual goods and services; the *unidirectional virtual currency scheme*, in which there exists a rate of conversion, usually used to switch from physical to virtual currencies (it is in fact more common an inflows rather than an outflows pattern); and finally the *bidirectional virtual currency scheme*, the category including cryptocurrencies, whose rate of exchange is managed to convert both real money to virtual ones and vice versa and can therefore be used to buy virtual goods and services as well as physical ones. After that, the central bank made a distinction between electronic money and virtual one (table 1), proceeding with a description of payment arrangements in virtual currency schemes, and two case studies, dealing with Bitcoin and Second life, an online virtual world, with its own virtual currency, Linden Dollars. In the last section of the essay, ECB focused on the risks virtual currency scheme could pose to central banks and concluded that, so far, virtual currency schemes did not put at risk price stability, given that the creation of this type of money was still at a low level, furthermore, they could not endanger financial stability as well, since its connection with the real-world economy was still weak. Nevertheless, the central bank stated it could constitute a problem for authorities, especially for what concerns illegal activities that could be carried out through these schemes, and that they could have negative consequences on the banking system and its reputation, in case of an incident within the digital currency network, which could be seen as lack of diligence from central banks. Indeed, the ECB clearly underlined a good reputation constitutes a key feature for institutions like banks, whose deterioration could also have consequences on operational risk. The central bank stated that reputational risk can arise even if the authority questioned is not responsible for the trigger event. For that reason, ECB believes that if virtual currencies keep growing, any incident originated from them could undermine central banks' reputation, since the public could have the perception its not doing its job properly.

One year after the report, the European Banking Authority (EBA) released a warning aimed at calling attention to the several risks entailed by the use of cryptocurrencies, while authorities try to figure out whether digital monies should be regulated and/or supervised. The major risks people are exposed to when buying or trading virtual currencies are the following, according to the EBA: The first one is that of losing money invested in cryptocurrencies, mainly because of the lack of regulation of trading platform which, in case of loss or failure, are not obliged to cover users, since there is no legal protection protecting them; in addition, money stored in digital wallets can easily be stolen by hackers. Besides, if the user loses its wallet's password, its funds could be unrecoverable; another risk associated with digital currencies is the absence of insurance when using it as a means of payment, because EU refunds do not apply for this kind of monies, and the irreversibility feature of

digital transactions could lead to a loss of money. Beyond this, the acceptance of virtual currency by retailers is not guaranteed and is at discretion of the merchant itself; EBA also warned the public about the great volatility of these currencies, whose value can experience huge fluctuations and even reach zero; moreover, holding cryptocurrencies may imply having augmented tax liabilities, depending on the country's regulation; finally, the principal problem concerning virtual monies is that of the use of the former to engage in illegal activities, such as money laundering, since transactions are almost untraceable. The misuse of this currencies could affect also other people, since it could cause exchange platforms to close, resulting in a loss of funds for all users.

In February 2015, the ECB published a second report²⁹, to extend the analysis begun in 2012, in response of the changes occurred during the past years. Even in this paper, the central bank states that digital currencies cannot be considered as full form of moneys, and highlighted the risk entailed with the use of such type of monies, such as the lack of transparency, and the possibility of fraud. On the other hand, it recognizes the technology embodied with cryptocurrencies can have positive aspects, with respect to financial innovation and as an alternative payment method for consumers, in addition, it can constitute an improve of the traditional payment methods used for cross-border transactions. ECB also declared to be worried about the financial and price stability, which could be endangered if the digital currencies framework became bigger and more tied to real economy, given that it proved to be very unstable. Finally, the institution claimed that a considerable incident within the virtual currency scheme could result in a loss of trust in electronic money and pose a threat to the smoothness of the payment system. For all these reasons, the Eurosystem intends to keep monitoring the development of such schemes. The main difference between this paper and the former one published in 2012, is the presence of a paragraph, inside which ECB analyses national responses to digital monies: it divided the different responses in four categories, namely warning, statements and clarifications on legal status, supervision and issuing bans. The central bank included the German Federal Financial Supervisory Authority, the Banque de France and the Dutch and Belgian central bank within the first category, together with other non-member countries such as China, India and Singapore, since these countries' financial institutions warned investors from the risks cryptocurrencies entail. Afterwards, it classified Finland and Sweden as second category countries, since their public authorities stated digital cash lacks legal tender status and therefore does not meet the criteria to be defines as a financial tool; Central bank placed Sweden, Germany and France in the third category, where virtual currencies sales and purchases have to be registered, or require an

²⁹ European Central Bank, (2015), 'Virtual currency scheme – a further analysis'

authorization; finally, the European Central Bank recognized Russia, Thailand and China as countries in which cryptocurrencies' activities are banned or illegal.

After the terrorist attacks on Paris, the EU minister met and decided to embrace stricter policies over digital currencies, tightening control on pre-paid cards and payment methods granted anonymity, and that could be used by terrorist organizations to finance their attacks; Furthermore, the European commission started conducting a risk assessment on money laundering, apart from terrorist financing.

In September 2017, the ECB president Mario Draghi rejected the Estonia's proposal to issue a national digital currency, the "Estcoin", declaring that "no member state can introduce its own currency. [...] The currency of the euro zone is the euro³⁰."

He stated that the rise in popularity of digital monies, which is mainly issued by private companies, concerned ECB, since there is (theoretically) a possibility they can erode the central bank control's over money supply.

Not too long after this declaration, in February 2018, Draghi defined bitcoin and other virtual monies as "very risky asset", and that people should consider buying them with great caution

After analyzing United States' and European Union's different approaches to this new crypto-assets, it seems quite clear that U.S. public authorities and financial institutions do not always share similar opinions, with some warning investors for the risk they could face, others staking a less strict stands, actually encouraging openness towards innovation, even if all of them agreed on the fact that cryptocurrencies could enhance illicit activities. On the other hand, European Union's institutions present a more coherent opinion, since most of them advised people that digital cash can be a very risky asset, but at the same time, they recognized the benefits the technology associated with them could bring to the current payment system.

³⁰ U.S. News, (2017), 'ECB's Draghi rejects Estonia's Virtual Currency Idea'

1.2.4 UNITED KINGDOM

An early comment regarding virtual coins by U.K institutions came from “Her Majesty Revenue and Customs” (HMRC)³¹, a non-ministerial department of U.K. government, with the primary function of collecting taxes, in June 2013, which affirmed it was monitoring the development of such currencies and their markets very closely, and added that U.K. tax system was already handling transactions with currencies different than sterling and, therefore, it was already aware of the treatment for activities involving the use of digital monies. Indeed, according to HMRC, if a cryptocurrency is used in exchange for goods and services, the profits arising from the transaction are taxable.

Approximately one year after this claim, the Bank of England (BoE) conducted an analysis within its quarterly bulletin in which it depicted the main features of virtual monies and its framework, comparing them to national currencies and assessing the risk they could pose to economy’s stability. At the end of the report, the BoE said that “In theory, digital currencies could serve as money for anybody with an internet-enabled computer or device. At present, however, digital currencies fulfil the roles of money only to some extent and only for a small number of people” and concluded that, so far, digital currencies cannot play a significant role as money in the society, but added that in the future, they might have the potential to improve; furthermore, the Bank of England affirmed it believe distributed ledger employed in virtual coins framework has some potential. Finally, as a result of the risks analysis, BoE stated that, for the moment, cryptocurrencies did not constitute a risk for monetary and financial stability, however, in the future, supposing cryptoassets experienced a relevant growth, monetary and, even more likely, financial stability could be compromised. Nevertheless, the bank did believe that this scenario was quite unlikely.

Succeeding an announcement by the U.K. HM treasury to regulate Bitcoin exchanges in order to prevent money-laundering, together with an in-depth research and study of its technology, in October 2015, the same ministry issued a money laundering and terrorist financing risk assessment³². Inside this paper, the Treasury emphasized several times the importance to assess the risk digital currency can pose to financial stability, given the fact that cryptocurrencies’ network increases the chances for criminals and terrorists to store funds and finance illegal activities, and that this work should be capable of helping governments and supervisors to better recognize these activities and, therefore,

³¹ CoinDesk.com, (2014), ‘IRS targets bitcoin’.

³² HM Treasury, (October 2015), ‘UK national risk assessment of money laundering and terrorist financing’.

improving their ability to prevent them. Throughout the essay, the Ministry recognizes that the knowledge about cash illegal activities is consistent, while law enforcement agencies still have a limited awareness about digital crimes and voiced its concern for the stability of UK financial system because, due to its complexity and size, is more likely to be exposed to this type of activities. The findings of the assessment are the following: the primary illicit transactions carried out using virtual monies take place in online market, and involve purchases of drugs and firearms; therefore, there is little evidence that virtual currency schemes have been adopted by criminals and terrorist organizations. One year later, the UK Treasury published an additional report³³, inside which it expressed its willingness to implement AML regulations, yet it stated it would not seek to enforce them to cryptocurrency's wallet providers.

The first move towards innovation is dated 2017, when the London Stock Exchange (LSE) announced a collaboration with IBM to adopt its Blockchain technology. Ed Clark, senior press officer at LSE, declared the idea came from the "Borsa Italiana" and that this technology introduction "has the potential to allow private SMEs [small- and medium-sized enterprises] to replace the paper-based system that currently exists that is both opaque and inefficient. Greater transparency could lend itself to trading opportunities in the future.". The blockchain is developed on an Hyperledger Fabric and hosted by Linux Foundation; the technology will enable sensitive data to be broadcasted with the permission of network participants, but, at the same time, are kept secure.

Following a warning³⁴ issued by the Financial Conduct Authority (FCA), a UK financial regulatory body, in which it alerted the public from the risks associate with an investment of cryptocurrencies, including that of price volatility, lack of transparency and leverage, the same institution announced³⁵ on April 2018 that all the UK companies offering cryptocurrency derivatives, even if digital currencies are not currently regulated by the FCA, must comply with all the rules enforceable for traditional derivatives both administered by FCA and the European Union. During 2018, many studies and publications were issued by the BoE; in one of them, the bank carried out an analysis to better understand the implications of the issuance of a central bank digital currency (CBDC). Throughout the paper³⁶, the BoE developed three models of CBDC, whose differences are based on the sectors

³³ HM Treasury, (April 2016), 'Action Plan for anti-money laundering and counter-terrorist finance'.

³⁴ Financial Conduct Authority, (November 2017), 'Consumer warning about the risks of investing in cryptocurrency CFDs'.

³⁵ Financial Conduct Authority, (2018), 'Cryptocurrency derivatives'

³⁶ Bank of England (May 2018), " Central bank digital currencies — design principles and balance sheet implications'

that can access to the virtual money: the *financial institutions access*, according to which the access to CBDC is allowed only to banks and other financial institutions (NBFI). In this way, the virtual currency can be seen as some kind of reserve asset, but with different purposes with respect to traditional ones; *the economy-wide access*, under which, apart from banks and NBFI, households and firms can use CBDC; finally, *the financial institutions plus CBDC-backed narrow bank access*, whose difference with the previous model is that one of the non-bank financial institution acts as a narrow bank, providing the currency to households and firms. Anyway, the BoE declares it is not palling to issue a CBDC and that this essay only has the aim of encouraging debates and comments, apart from the research purpose.

1.2.5 JAPAN

The first bill related to digital currencies was submitted to the national Diet, the national legislature of Japan, on March 2016; the bill includes a definition of virtual monies and of the exchanges carried out with them. According to the paper, if an individual wishes to engage in a virtual currency exchange service, he must obtain a registration with the prime minister, by submitting an application containing the details concerning the digital currencies he owns and all the information regarding the exchange services he wishes to carry out. In addition, the bill listed several reasons for the refusal of the registration, such as when the applicant is not a stock company established under Japan laws; also, the proposal recommended to establish regulations of the business of digital monies exchange services to protect users and ensure safe transactions, and provision for supervision of the former services. Finally, the draft law imposed some obligations (i.e. customer identification obligation and the obligation to maintain records of transactions)

As a result of several proposals, on April 2017, the Japan's Financial Service Agency, a government entity with the responsibility of supervising the banking system and exchanges, enacted a law that gave authorization to the use of digital currencies as a method of payment allowing them to have the same legal status as physical money. This choice has resulted in several debates that led to the enactment of anti-money laundering rules for Bitcoin exchanges, and finally with the categorization of Bitcoin as a type of pre-paid instrument. A few months later, the FSA conceded to eleven companies a license to perform digital currency exchanges; in order to obtain the license, companies have to comply with some pretty strict requirements, including the enhancement of their computer systems.

In spite of all these laws in favor of cryptocurrency exchange services, physical money still has dominance in Japan; indeed, in January 2018, Yuko Kawai, the head of the Bank of Japan (BOJ) division, said in an interview that Japan is not yet at the stage at which the BOJ could consider issuing a central bank digital currency, since there is no demand. Furthermore, Yuko Kawai declared in Japan “do we really need a digital currency in the nation where cashless living isn’t making much progress?”, which clarifies why BOJ is not planning to mint its own virtual currency. In addition, a cyber-attack to one of the cryptocurrency exchanges in Japan, Coincheck Inc., brought the FSA to changes its strategy towards virtual monies from enhancing their growth to monitoring them, with the aim of preventing similar attacks in the future. Indeed, on January 26, \$500 million were stolen from the Tokyo-based exchange Coincheck, event that undermined Japan’s reputation as a “blockchain-friendly” nation. As a result of this heist, the BOJ published a Q&A, which gives an overview of virtual currencies, highlighting the risks the public should be aware of when investing in virtual monies, including the risk of theft, explaining the differences between them and national currency and warning the public, who should do not assume it is a necessarily profitable investment. Furthermore, on April 018, the FSA suggested to abandon virtual currencies such as Monero, Dash and Zcash, since, according to the agency, they are the virtual monies favored by criminals and hackers, being them more difficult to track than other digital currencies. Nevertheless, Japan remains one of the less hostile Asian country for what concerns virtual coins.

1.2.6 CHINA

Already in 2013, Bitcoin had gained great popularity in China, thanks to several trading information sites, which reported the substantial amount of inflows generated through investments in BTC. For this reason, the People’s Bank of China (PBOC) announced that Bitcoin could not be considered as a proper currency since “it has no real meaning” and it lacks legal regulations; therefore, the PBOC banned banks and other financial institutions from carrying out transactions related with Bitcoin, while letting individuals and firms free to invest in virtual monies but warning them of the risks associated with such transactions. Moreover, the central bank required that all online exchanges submitted a registration with the appropriate supervisory institution and stated that it will monitor BTC users for potential illicit activities, including money laundering. Not too long after, the PBOC extended the ban to payment companies; as a consequence, BTC China, the nation’s largest Bitcoin exchange, announced it would no longer accept yuan deposits, due to action of a third-party payment provider, YeePay, directly involved in central bank’s provision; this caused Bitcoin to experience a

serious loss in value, since, although individuals and firms were still able to use Bitcoin, they were prevented from doing it without any provider.

Despite PBOC's measures described above, two banks, including China Merchants Bank, kept delivering services to BTC China; because of that, the PBOC reiterated the fact that there was a ban on banks, financial institutions and payment providers for providing services related with BTC. Since this announcement, many exchanges shut down any contact with the banking system.

During 2016, the PBOC conducted some studies on digital currency and in early November announced its willingness to hire blockchain experts in order to help it develop a central bank digital currency.

Later on, in 2017, the China's central bank declared its intention to improve regulation and supervision for what concerns online firms, since the development of digital finance improved the services delivered and their efficiency, this kind of finance does not only include P2P transactions, but also crowd funding and other services, a contributing factor to the growth of risks posed by cryptocurrencies' use. Afterwards, the PBOC published an announcement in which the bank ban households and firms from engaging the issuance of token financing activities, meaning they cannot raise funds through ICO (initial coin offerings), since the former are considered as illegal in China, confirmed the restriction for banks and payment providers to deliver crypto currency-related services and again warned the public to be aware of all the risks coming from handling virtual monies.

The latest information of digital coins coming from China dates back to March 2018, when the People's Bank of China announced its decision to launch a crackdown on all type of cryptocurrency, together with a promise to pursue its research aimed at minting its own virtual currency.

1.2.7 OTHER INSTITUTIONS' APPROACHES

- ❖ **G20:** it is a group of ministers of finance and central bank governors, created in 1999, in response to several financial crisis, with the purpose of enhancing financial stability and economic internationality. The country members of G20 are Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, the United Kingdom, the United States and the

European Union. During a meeting held in Buenos Aires (March 2018), the world's financial leaders debated, beyond other topics, about crypto-assets; in the “communiqué” released after the conference, the group recognized the potential behind innovations such as cryptocurrencies to improve the financial system. On the other hand, it also recognized the risks posed to the economy, including the lack of protection for investors, criminal activities or tax evasion. Since these issues could, at some point, affect financial stability, the G20 devoted to the future application of the Financial Action Task Force (FATF) standards to such digital assets; in addition, it encouraged all the supervision authorities to keep monitoring virtual currencies. Nonetheless, the members of the meeting did not agree on a common approach to regulate digital monies.

- ❖ ***The international Money Fund (IMF)***: it is a regulatory body established in 1945 with the aim of ensuring the stability of the international monetary system, obtained through monitoring of the exchange rates and helping countries to trade in a fair manner. The institution can count approximately 188 country members. One of the first statement concerning digital currencies was released in November 2013 by Gerry Rice, the director of IMF Communications Department, who declared that “It [Bitcoin] raises a number of topics and issues including issues of regulation, issues of consumer protection. For the time being, it's too limited a phenomenon to have any macroeconomic significance or financial stability implications, but again, something to watch.”

In 2014, Christine Lagarde, the managing director of IMF was seen on an Australian TV show, during which she defined Bitcoin as suspicious and stated that they were used for primarily for money laundering. Approximately two years after that, the International Monetary Fund issued a paper, in which the authority deeply depicted digital currencies' framework, starting from the description of such monies, a comparison with national currencies, a description of the distributed ledger technology until analyzing the problems they were and could probably continue to pose to both users and regulators. Following this introduction, the IMF carried out a study of the risks virtual currencies could create to financial and monetary stability and concluded that, up to that point, given the fact that virtual currencies were at their early stage, they did not pose relevant risks to neither monetary nor financial stability. At the end of the paper, the authority concluded that regulation of digital coins still needs to develop and that it should decrease risks “without stifling innovations”, since this new technology has several potential benefits.

The Fund proved to be very concerned about establishing a global coordination on digital

currencies, in order to reduce fraud, tax evasions and other illicit activities associated with the use of such monies, what's more, Lagarde asserted authorities should hurry up and enact some procedures in order to handle cryptocurrencies, pointing out that "Not so long ago, some experts argued that personal computers would never be adopted, and that tablets would only be used as expensive coffee trays. So I think it may not be wise to dismiss virtual currencies,". Christine Lagarde also called for an implementation of more severe measures in order to reduce illicit activities using the same technology enabling such actions; indeed, she proposed to use the same distributed ledger technology to increase the speed of information sharing between market participants and regulation institutions, to create "registries of standard, verified, customer information along with digital signatures.", also with the help of other technologies, to enhance the soundness of digital market for customers.

One of the last publications dealing with virtual monies was issued in June 2018, in the IMF f&d magazine, inside which Dong He, a deputy director of the International Monetary Fund's Monetary and Capital Markets Department, pursued a further analysis of cryptocurrencies, highlighting the lack of three principal functions that a reliable monetary system must be able to achieve, namely the ability to function as a lender of last resort, the protection against the risk of deflation and the capability to respond to a shock in a flexible manner. On the other hand, He also pointed out that if in the future virtual coins' framework got stronger, central bank monetary policy would not be able anymore to successfully affect the monetary system; to this end, he suggested Central Banks should struggle to improve national currencies stability, for what concern its unit of account function, together with maintaining public trust in fiat monies and actively monitoring the development of cryptocurrencies, taking into consideration the possibility to issue their own digital currency, to "stay in the game in a digital sharing, and decentralized service economy".

Chapter 2

Speculative bubbles: the case of Bitcoin

2.1 AN INTRODUCTORY OVERVIEW OVER THE NOTION OF “BUBBLE”

A formal definition of *speculative bubble*, also known as *asset bubble* or a *speculative mania*, was drafted by Robert Shiller, Yale professor and Nobel prize winner, who, in his book “Irrational Exuberance”, defined a bubble as “a situation in which news of price increases spurs investor enthusiasm, which spreads by psychological contagion from person to person”; he also added, in the third edition of the former book, that every bubble tend to differ from others depending on the “stories” circulating about it. If we try to develop a more in-depth description, an asset bubble can be defined as a trade of an asset for a price that exceeds its intrinsic value, determined through an analysis of the asset’s fundamentals and without taking into account its market value, due to speculation, unrealistic growth expectations or other factors that could lead to an increase in value of that asset. After this period of sharp escalation, prices suddenly experience a collapse, and it is when the bubble “burst”. This economic phenomenon was identified in many past economic distresses and contractions driven by people’s speculation over a specific commodity; the well-known Dutch Tulip mania, the dot.com bubble and the U.S. financial crisis are all examples of this financial events. The term bubble was coined in 1720, when the British Parliament released the *Bubble Act* with the aim to prevent the increase in several companies’ stock prices, mainly caused by fraudulent rumors about their operations and profits.

Many scholars³⁷ devoted to the study of this particular economic phenomenon, introducing new models to assess the causes of the inflation of prices, and tried to categorize bubbles into different varieties: *Standard rational speculative bubble*³⁸, a specific type of bubble that arises when the deviation from the fundamental value of an asset is caused by an increase in the asset’s demand, which is in turn driven by expectations of future price. In the context of rational bubbles, inflated prices have an extremely important influence on the valuation of the asset itself. In this case investors are willing to pay incredibly high prices for an asset, since they believe to have a compensation for

³⁷i.e. Blanchard and Watson (1982); Diba and Grossman (1988); Froot and Obstfeld (1991); Bjorklund and Soderberg (1999); Ma and Kanas (2004).

³⁸ O. Nneji, C. Brooks, C. Ward, (January 2011), ‘Intrinsic and Rational Speculative Bubbles in the U.S. Housing Market 1960-2009’

the risk of the bubble burst, namely the increasing returns of the asset; *Intrinsic bubble*³⁹, a class of bubbles introduced by Kenneth A. Froot and Maurice Obstfeld in 1989. It is defined as a particular variety of rational bubble, but unlike them, intrinsic bubbles are exclusively influenced by fundamentals (i.e. dividends), albeit in a non-linear way. Intrinsic bubbles tend to revert to their fundamental values periodically and that mainly rely on “self-fulfilling expectations” of investors. Froot and Obstfeld demonstrated that, for any given level of exogenous fundamentals, the price of the asset remains constant, one of the main characteristics of intrinsic bubbles, meaning that this bubble predicts stable overvaluation or undervaluation for steady fundamentals. Froot and Obstfeld also proved that an intrinsic bubble explains long-term fluctuations in the stock market and found strong evidences of the presence of an intrinsic bubble in the U.S. stock market; other researchers supported the former theory (Ma and Kanas, 2004), and demonstrated that this kind of rational bubble outperforms the standard model in predicting actual stock prices. The major difference between intrinsic bubbles and standard rational ones, is that, in the former type, deviations from intrinsic value are caused by a non-linear relationship between the price and; on the other hand, rational bubbles have roots in exogenous factor, that would not normally have any influence on the value of the asset. Finally, a third category of bubble can be defined: *Irrational bubbles*⁴⁰. In this case, movements in the asset price are mainly based on exaggerated belief regarding this asset’s potential to generate profits, for instance, because of the technology embodied in it.

Apart from studying different types of bubbles, academics also tried to assess the factors triggering such a phenomenon but, up to this date, no widely accepted theory exists to explain why bubbles occur; despite this, some possible economic conditions emerged, mainly through experimental markets, including excessive leverage, insider trading or excessive monetary liquidity in the financial system.

Speculative bubbles were examined not only by economists, but they were also examined within the framework of behavioral finance, in which there were studied additional determinants of bubbles, namely several psychological biases common to market participants, that extensively contributed to the occurrence of the phenomenon:

- ❖ The *greater fool theory*⁴¹, according to which investors purchase the overvalued commodity even though they are aware of such overvaluation, just because they attempt to benefit from

³⁹ O. Nneji, C. Brooks, C. Ward, (January 2011), ‘Intrinsic and Rational Speculative Bubbles in the U.S. Housing Market 1960-2009’

⁴⁰ A. H. Meltzer, ‘Rational and Irrational bubbles’

⁴¹ Despite the popularity of the greater fool theory, it has never been entirely validated through an empirical study.

selling it a naïve investor at a higher price. Hence, the investor described by this theory believes he/she has the ability to time the forthcoming bubble burst;

- ❖ **Extrapolation**, a speculative bias for which investors tend to build expectations based on past asset prices: if the value of the asset has risen in the past at a certain rate, an investor with extrapolation bias will think it will continue to rise, following the same pattern shown in the past. This behavior usually leads to overbidding, which will in turn cause deflation of prices, with investors no longer compensated for the high-risk asset. This kind of behavior is usually associated to the so-called chartist investors, namely individuals who forecasts future trends of an asset price by looking at historical prices of the latter. Indeed, a chartist usually believe value of securities follows a certain pattern, and therefore it tends to invest according to the abovementioned scheme. Also, there exists another class of investors, which is usually referred to as fundamentalists that, unlike chartists, select their investments on the basis of fundamental analysis. Chartists are said to unbalance a security market since they tend to buy when the price is high (because, according to their analysis, the price will follow a past pattern and rise even more) and sell when it is low, on the other hand, fundamentalists are said to rebalance the market, since they have an investment strategy opposite to that of chartists;
- ❖ **Cognitive dissonance**: bias for which market participants overlook bad news and only give importance to information in favor of their point of view;
- ❖ **Herd behavior**: an investor shows a herd behavior when it assumes that the majority cannot be wrong and, therefore, buys and sells assets in the direction of the market trends;
- ❖ **Fear of Missing Out (FOMO)**: it is a form of social anxiety. A person suffering from FOMO constantly has the feeling that others are experiencing things he/she is not, and that they are collecting rewards for the former experiences the person is missing, followed by the “desire to stay continually connected with what others are doing”⁴². In the context of a speculative bubble, all the stories circulating through world-of-mouth and medias concerning people investing in an asset and becoming wealthy, thanks to the purchase of the former, prompts a fear of missing out, so that people piles up into the market trying to make profits by investing in the asset;
- ❖ **Overconfidence**: a bias that typically affects people who are not able to understand ability and limits, as well as other’s; if one is subject to overconfidence, he/she will think that he/she is smarter and better than others, additionally he/she is not able to perceive the limitations of his/her knowledge;

⁴² Przybylski, Andrew K.; Murayama, Kou; DeHaan, Cody R.; Gladwell, Valerie, (2013), ‘Motivational, emotional, and behavioral correlates of fear of missing out’.

- ❖ **Excessive optimism:** it typically goes hand to hand with overconfidence, a person is subject to excessive optimism when he/she usually underestimates the possibility of experiencing adverse outcomes and, in contrast, he/she tends to overestimate the frequency with which he/she will experience favorable outcomes.

In order to better detect a bubble and to easily determine which stage the phenomenon has reached, Hyman Minsky, an American economist and a professor at the Washington University in St. Louis, identified a bubble cycle in his book “Stabilizing an unstable economy”. Inside his work, Minsky drafted an explanation for the great instability characterizing our economy, mainly by understanding how bankers and business men are able to turn an initially stable financial system into a fragile one⁴³. According to his studies, a bubble life-cycle is composed by 5 steps, namely: the **displacement**, during which investors start to grow an interest in a new paradigm (such as a new product or particularly low interest rates). A fitting example is the decline in federal funds rate, followed by a decrease in mortgages rates, events playing a key role in the U.S. housing bubble; the **boom**, where prices experience a slow rise after the displacement phase, but, as more and more investors enter the market, the growth of the asset value gets faster. One of the main characteristics of this step is the increasing attention the phenomenon gains by medias, together with the rise of the Fear of Missing Out that massively contributes to the increase in the number of speculators and market participants; following the boom, Minsky identified the **euphoria** phase, during which the greater fool theory applies, as a consequence of the soaring asset price. Furthermore, in the euphoria stage, new metrics and models are applied in order to justify the incessant rise in the asset’s value; shortly after that, we find the **profit-taking** phase, whereby institutional investors and financial professional detect the sign of an imminent crash and thus sell the asset for profits before the bubble burst, whose timing is quite difficult to estimate. Finally, there is the **panic** stage, when the price of asset starts to fall, more and more rapidly, and investors and speculators want to liquidate their asset as soon as possible; at this point the supply overcomes demand and asset value declines further.

Notwithstanding this, Minsky, together with several experts believe speculative bubbles are frequently unavoidable in a free-market economy; this cycle is still a useful guide in order to recognize them and to avoid involving in such assets’ market.

⁴³ Minsky’s work was later exploited by Charles Kindleberger in his “Manias, Panics and Crashes”, who carried on the study of bubbles life-cycles. When covering this subject, some studies refer to such cycle as the “Kindleberger-Minsky model.”

2.2 A SURVEY ON THE BIGGEST BUBBLES IN HISTORY

In order to better understand economic and behavioral factors leading to the creation of a speculative bubble, it is important to carry out an analysis of financial history, identifying the most famous past financial crashes and studying the differences and similarities between them, in order to detect a comparable pattern, which is shared by several bubbles, even though they are categorized as different types of financial bubbles. Moreover, we detected the life-cycle for each bubble, and highlighted the phases every of them went through, according to Hyman Minsky model. Notwithstanding the fact that some events described above look very distant from cryptocurrencies' environment, we believe it is crucial to revise them, in order to subsequently possess all the tools needed to deal with an analysis of cryptocurrencies themselves (Bitcoin in particular).

2.2.1 TULIP MANIA

One of the first event considered a bubble by several economists was the *Tulip mania*, which occurred in the Netherlands, at that time known as the Dutch Republic, during 1600.

It is believed that tulips were introduced in Europe by the Sultan of Turkey, who sent the first bulbs and seeds to Vienna in about 1550; after that, they spread over northern Europe, as the bulbs were delivered to various cities, including Amsterdam.

After the discovery of the flower's ability to withstand Netherlands' rough climatic conditions, which it is usually attributed to the botanist Carolus Clusius, tulips gained significant popularity among the population; furthermore, the flower had a characteristic differentiating it from every other plant in Europe, namely the intense color of its petals. According to Charles Mackay, who described all the events occurred in that period in his book "*Memoirs of Extraordinary Popular Delusions and the Madness of Crowds*", the Netherlands became the main country to cultivate several varieties of tulips, such as the *couleren*, whose main trait was its single-colored petals, some multicolor species, or the so called *bizarden*, characterized by a unique striped pattern⁴⁴. Thanks to the increasing success of tulips, that gradually turned to be luxury items, the Dutch republic seized the opportunity to develop a prosperous trade activity, initiating the *golden age* of the country; during this period we placed tulip mania's *displacement* phase.

In fact, the price of tulips rapidly exceeded all other flowers' market value, making it extremely profitable for growers to increase the production of tulips and to cultivate several types, since

⁴⁴ It has been subsequently discovered that the peculiar pattern of *Bizardens* was due to a virus that infected tulip bulbs, known as the *tulip breaking virus*, since it "broke" the petals into different colors, creating the striped pattern, or the mosaic, which amazed thousands of buyers. Nevertheless, this particular variety was the most precious, making it the most expensive one.

customers were willing to pay a higher price for limited varieties of the flower. Therefore, the different species of tulips quickly increased during the 1600 and, at the same time, the price of the flower were rising to unbelievable levels, as aristocrats and the middle-class became more and more interested in what it had already become symbol of wealth and prestige; the bubble *boom* phase started during this period and lasted for around two decades. Approximately in 1620, the value of the most expensive flower in Europe had reached an incredible amount. A record of this event is the story of a customer offering about 12.000 guilders⁴⁵, which was higher than the value of a house in Amsterdam, in exchange for 10 bulbs of the *Semper Augustus*, the most rare and expensive kind of tulip traded at that time; however, in spite of the large amount of money submitted, the offer was rejected. From this matter, it is possible to highlight one of the most interesting features defining the tulip market: the item traded was not the flower itself, but rather the bulbs. In fact, especially after the 1634, prior to which deals were settled only when the bulbs blossomed, transaction started to take place throughout the year, though what we nowadays call future contracts: this kind of deal enabled people to sell bulbs, and therefore to make profits, without being in possession of the bulbs themselves in the present. This kind of contract were traded several times a day, that is why they begun to be used as some sort of currency⁴⁶. At this stage, a large number of speculators entered the tulips' market, attracted by the profits generated by the trade of future contracts, and the price of the flower skyrocketed; for instance, the *Semper Augustus*, whose value in 1620 was around 1.000 guilders, reached the price of 5,500 guilder in 1637, which is considered to be the year in which tulips' value achieved its peak. In fact, some deals concluded during that year were worth approximately 20 times the value of a similar contract signed a few years before⁴⁷; approximately here, *euphoria* stage begun. According to different researchers, there are several reasons why speculators were induced to enter the market, such as the great potential the Dutch commerce showed during those years, creating profitable opportunities for middle class, apart from the aristocrats⁴⁸; as well as the low entry barriers on tulip trade⁴⁹; and a free coinage policy enacted by the Bank of Amsterdam, according to which "The State will mint coins out of any quantity of metal delivered to it, either making no charge to the person delivering the metal, or merely a very small charge to cover cost. The person delivering the metal receives in coin from the mint the quantity of the metal delivered up by him either without any

⁴⁵ Data from: Sooke, A. (2016, May 03). Culture - Tulip mania: The flowers that cost more than houses. Retrieved from <http://www.bbc.com/culture/story/20160419-tulip-mania-the-flowers-that-cost-more-than-houses>

⁴⁶ There is actually a discrepancy between various authors and researchers concerning the proper medium of exchange at that time: some of them believe future contracts were used as currency, while others assert the bulbs themselves acquired the function of money in the Dutch republic.

⁴⁷ Data from: Was tulipmania irrational? (n.d.). Retrieved from <https://www.economist.com/free-exchange/2013/10/04/was-tulipmania-irrational>

⁴⁸ Van Aiztema, Lieuwe, (1669), 'Saken van staet en oorlogh'

⁴⁹ Goldgar, Anne, (2007) 'Tulipmania: Money, honor, and knowledge in the Dutch golden age'

deduction or with a very small deduction for seigniorage”⁵⁰ which probably attracted further amount of capital to the Dutch republic.⁵¹

After reaching its peak, in February 1637, the tulip mania bubble reached the *panic* phase, with the price of contracts involving tulips trade crashed unexpectedly. This is a trend which is believed to have started in Haarlem, and rapidly spread all over the Netherlands, as a consequence of the refusal to show up at a bulb auction by a customer. An explanation for this behavior is given by the fact that bubonic plague had spread in Haarlem, an event that is believed to have encouraged the risk-taking attitude that enabled speculation.⁵²

Charles Mackay’s version of the *Tulip Mania*, according to whom the “crowds”, namely the people involved in the tulips’ trade or other similar schemes, were driven by an irrational behavior and that the magnitude of this mania was so great that the entire Dutch republic suffered a severe economic distress, remained unchallenged for roughly 140 years. Only after 1980, several researchers claimed that Mackay’s interpretation of the event was incomplete and not accurate, such as Anne Goldgar, who stated that the Tulip mania was actually limited to a little group of people, which included mainly wealthy craftsmen and merchants, and affirmed that most of the accounts dating back to that period were unreliable. Indeed, she claimed that around six or fewer buyers and sellers experienced financial distress throughout that period. To this day, the debate concerning the impact of Tulip mania is still open, and many researchers affirm that this event cannot be considered a proper speculative bubble or, at least, it should not be treated as an event of great influence, as a consequence of modern studies i.e. Garber (1990), Goldgar (2007). Anyway, this episode is still used to compare other contemporary manias and suspicious events resembling a bubble.

2.2.2 THE SOUTH SEA COMPANY

The Governor and Company of the merchants of Great Britain, trading to South Seas and other parts of America, and for the encouragement of fighting, also known as the *South Sea Company* was a joint-stock company founded in Great Britain in 1711, with the main aim of consolidating and reducing the national debt. Indeed, according to a scheme designed by Edward Harley, the chancellor of exchequer, and John Blunt, a director of a company, named the Hollow Sword Bate Company, which acted as an unofficial bank, all the holders of national debt should have handed it over to the South Sea Company, which would in turn issue shares of the same amount. Moreover, the company obtained the monopoly on all trades with South America and Islands nearby, which would have been

⁵⁰ Helfferich, Karl, (1927), ‘Money’

⁵¹ French, Doug, (2006), ‘The Dutch monetary environment during tulipmania’

⁵² Garber, Peter M., (2000), ‘Famous first bubbles: The fundamentals of early manias’

a potential source of advantage, leading the company to considerable profit; however, South America was owned by Spain, country with which England was at war and that blocked every attempt of trade between the South Sea and the colony.

In 1719, influenced by the success of John Law⁵³ in France, the British parliament gave the South Sea company the right to convert the annuities issued in 1710 into company's stocks, with a projected total amount of £2.5 million stocks, if all annuities were converted. In July 1719, the company submitted the offer to the public, with a result of two-thirds of existing annuities converted; we believe approximately here the *displacement* phase began to take hold, since, starting from here, investors shown interest in the company, an interest that was meant to be increasing. After the success of the previous scheme, a new strategy was planned, in order to gain control over most of the British capital left unconsolidated, in return for shares of the company. In fact, in 1719, the government debt, which amounted to £50 million, was divided as follows⁵⁴:

- ❖ £11.7m was held by the South Sea company;
- ❖ £3.4m was owned by the Bank of England;
- ❖ £3.2m belonged to the British East India company;
- ❖ £16.5m were privately held;
- ❖ £15m were mainly long-term and short-term annuities

When the South Sea company presented the plan to the parliament, the former suggested to the Bank of England to propose a better offer⁵⁵ and, after some bids submitted by both parties, the South Sea's offer was accepted by the parliament, causing the Bank stock value to fall substantially.

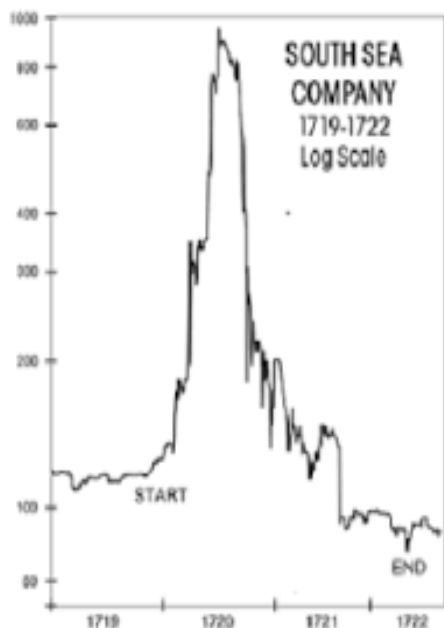
Subsequently the company spread all kind of rumors concerning the value its abovementioned monopoly over South America and of the potential profits resulting from it; this caused the price of South Sea company to rise as a result of a massive speculation. As shown in figure 4, the stock value of the company in at the beginning of 1720 was slightly above £100 and experienced a positive trend (where the *boom* phase started), with an increase in price to approximately £300, which persisted until the achievement of the peak of almost £1000 in the middle of the year. This event coincided with the issue of the *Bubble Act*, enacted by the parliament in 1720 in order to stop the action of

⁵³ John Law was a Scottish economist, whose refinancing theory was implemented in France from 1716, when he established the Banque Générale, to 1720. During this period, he tried to consolidate France debt by introducing paper bank-notes. His scheme turned out to be a failure.

⁵⁴ Data from: Garber, Peter M, (1990), 'Famous First Bubbles'

⁵⁵ According to the scheme proposed, the South Sea company should have made a payment to the government of £3 million a year after its implementation.

Figure 4:
Chart of company stock prices



Source: thebubblebubble.com

several joint stock companies that, following the example of the South Sea company, spread rumors about their operations abroad and the profits they made; this act did not undermine the British company, and, by contrast, it boosted its stock value.

Considering the stock price of the company's sharp rise, people developed a growing interest toward the South Sea, pushing price to even higher levels, until it reached £1000 in August 1720; this period coincides with the *euphoria* phase. At that point, after the peak was reached, the value of the South Sea stocks fell abruptly and went back to less than £200 at the end of the year (*panic* stage); researchers were not extremely specific about the causes of the speed and the size of this decline, although they agreed on attributing it to a shortage of liquidity. Afterwards, the parliament began an investigation on December that revealed fraud and corruption amongst the directors of the South Sea company.

“In retrospect, anyone projecting commercial returns high enough to justify the higher prices of South Sea shares was probably too optimistic. Nevertheless, the episode is readily understandable as a case of speculators working on the basis of the best economic analysis available and pushing prices along by their changing view of market fundamentals”⁵⁶.

2.2.3 THE DOT-COM BUBBLE

The *dot.com bubble*, or the *internet bubble*, one of the most well-known examples of speculative bubble, is an event occurred during the period going from the mid-90s to 2002, stage at which the usage of the internet for growing exponentially. Everything started with the release of the Mosaic web browser, developed by the NCSA, on January 1993, which is considered to be the browser that promoted the World Wide Web (WWW) to the crowd, making it easy for them to surf on the net; from that point, online connectivity increased, together with several services that changed people's attitude towards computers, that gradually went from a luxury item to a necessity, and the internet. In this chain of events, new online companies were founded, together with the enactment of the Tax

⁵⁶ Garber, Peter M., (1990), 'Famous First Bubbles'.

Relief Act⁵⁷, that encouraged people to take a more risk-taking attitude and to engage in speculative investments. Moreover, the Telecommunication Act of 1996, the first act in which the internet was treated as a means of communication, with the aim of fostering competition by removing regulations creating a barrier to entry, in order to improve the communication sector and to facilitate its development, gave to many entrepreneurs the hope to develop a profitable business online. This period, starting from 1993, is where we placed the *displacement* stage; in fact, thanks to online innovations and new regulations facilitating the development of companies operating through the world wide web, people became aware of a totally new way for doing business and investors proved to be more and more attracted to companies operating in this new sector. As a result of the abovementioned factors, many dot-com companies, namely companies operating through an online channel, were founded and there were hundreds of investors ready to put their capital in one of this brand-new companies, encouraged by the profits made by investment banks from IPOs that, in addition, fostered speculation (*boom* phase). Stock prices increased, together with the confidence in future profits generated by these online companies, and investors started to make valuations of the former businesses without employing the traditional metrics; Here we detected the *euphoria* stage, since both investors and the market present the same features described in Minsky's bubble life-cycle (i.e. the price of stocks rising more and more rapidly and investors applying new evaluation methods to assess the security's value). The events described above caused companies that had not made any profits or revenues yet to experience an overstated increase in their stock value, which tripled or even quadruple, during IPOs, allowing these businesses to raise a substantial amount of money. Throughout that period, the NASDAQ index, which indicated a value around 500 at the beginning of '90s, reached a peak of 5048 on March 2000.

this type of company relied on a theory, which was later entitled *Dot-com theory*, based on the motto "*get big fast*": according to it, dot-com businesses tended to concentrate their capital to advertising, in order to attract as many customers as possible, with the aim of enlarging their networks, even if it usually meant incurring in net operating losses. In addition to this, they offered their products for free or at a discount to increase brand awareness and change a higher price in the future.

The burst of the bubble started around the beginning of the new millennium, because of the volatility on technology spending increase, as a result of the foreseen *Year 2000 problem*, but despite that, stock prices continued to increase.

Several determinants of the dot-com crash were identified, but the following are considered as the crucial ones:

⁵⁷ The Tax Relief Act, enacted on August 1997, had the main objective of reducing several federal taxes in the U.S.

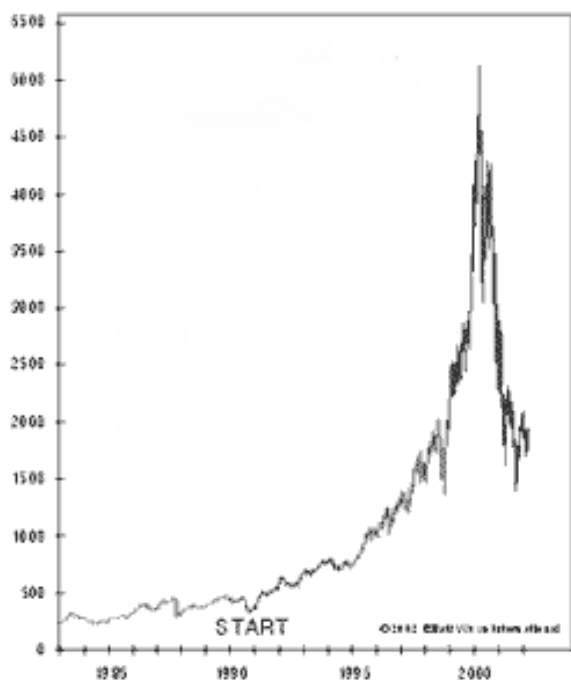
- ❖ The recession in which Japan entered in 2000, a few days after the achievement of the peak of the NASDAQ index, which affected technology stocks value and caused the start of the *panic* phase;
- ❖ An article released on March 2000 by the American newspaper Barron's, which predicted the bankruptcy of many online companies, prevented many people from making new investments and led investors to reconsider previous ones;
- ❖ On April of the same year, the court for the case against Microsoft Corporation declared the latter guilty of monopolization and violation of the Sherman Antitrust Act, causing Microsoft shares to fall by 15% (NASDAQ value dropped by 8%). At that point dot-com businesses were forced to modify their attitude towards the "get big fast" theory, revising their advertising campaign;
- ❖ Several accounting scandals came up, together with the bankruptcy of many companies, undermining investors' confidence.

At the end of 2002, the stocks had lost approximately \$5 trillion in market capitalization and NASDAQ index had dropped by 78% from the peak. Many dot-com companies ran out of capital and were not able to recover from this crash; on the other hand, some businesses survived and still exist today, such as Amazon, which managed to get over the crash of its stock from \$107 to merely \$7; Cisco, even though it lost nearly 90% of its market capitalization⁵⁸; or eBay, which actually did not suffer from great loss⁵⁹.

⁵⁸ Data from: 'Where are the kings of the '90s Dot com bubble?', (2016), Business Insider.

⁵⁹ T. J. Naylor, (2013), 'Internet Companies That Survived The 2000 Tech Bubble', Benzinga.

Figure 5: Nasdaq composite over the period 1983 - 2002



Source: *thebubblebubble.com*

2.2.4 THE UNITED STATES HOUSING BUBBLE

The U.S. Housing bubble was a real estate crash that affected half of the United States and took place during the years going from 2001 to 2007. It is commonly believed that this bubble was influenced by the dot-com crash, which led investors to enter into the real estate market, believing it was a safer asset with respect to online companies' stock; this corresponded to a global saving glut and with a deep decline in global interest rates. The combination of these factors led to the so-called U.S. housing boom; the value of houses skyrocketed, especially in coast cities, as the number of subprime lending, Alternative-A paper lending (both of them granting loans to people who usually encounters difficulties in repaying debts), mortgage-backed securities and mortgage frauds increased abruptly; "New "affordability" mortgage products [...] allowing the recent boom period to continue much longer than previous expansionary periods. Nontraditional loans were increasingly granted with fewer requirements for buyers to provide documentation to verify that their income could support the mortgage payment. Moreover, these loans were often granted with little or no down payment."⁶⁰,

⁶⁰ Byun, Kathryn J., (2012), 'The U.S. housing bubble and bust: impacts on employment'

indeed, experts believe that 56% of home purchases during the bubble were made by people that would have been considered unable to afford them under normal circumstances. The U.S. house price index doubled from 1996 to 2006 (In this decade we placed the *boom* stage), year in which prices peaked, event that fueled speculation: investors started to buy houses with the aim of quickly resell them for profits, rather than waiting from them to appreciate; this period may be labeled as a *profit-taking* one, since it is possible that several investors, aware of the imminent crash, sold their security in order to quickly get rid an asset whose value was about to fall abruptly. This practice massively contributed to the price inflation, it is in fact estimated that roughly 30% of valuation during the peak was supported by speculative investments. Once reached the top, the price levels had become unsustainable relative to incomes; when prices started to decline, house owners found themselves in a position where the value of houses they possessed was less than their mortgage debt. In 2009 the average U.S. house value was declined by one-third of its value and the subprime mortgage industry collapsed, because of the high foreclosure rates, with more than many subprime lenders declaring bankruptcy or trying to sell the business (*panic* stage). This crisis spilled over to the banking sector, mainly through the fall of Mortgage-backed securities, which resulted in large losses for financial institutions, with a following loss of confidence in banks.

Many economists and researchers predicted the upcoming crash, such as Robert J. Shiller, a Yale professor and Nobel prize winner, who wrote about it in his publication, *Irrational Exuberance*, in 2000, or Dean Baker, an American macroeconomist, who identified the housing bubble in 2002; despite this, many other did not agree and even refused the label *house bubble* in 2008.

The burst of the Housing bubble resulting in a global economic recession, the biggest since the great depression of 1930 is nowadays referred to as the *Great Recession*.

2.2.5 COMPARISON

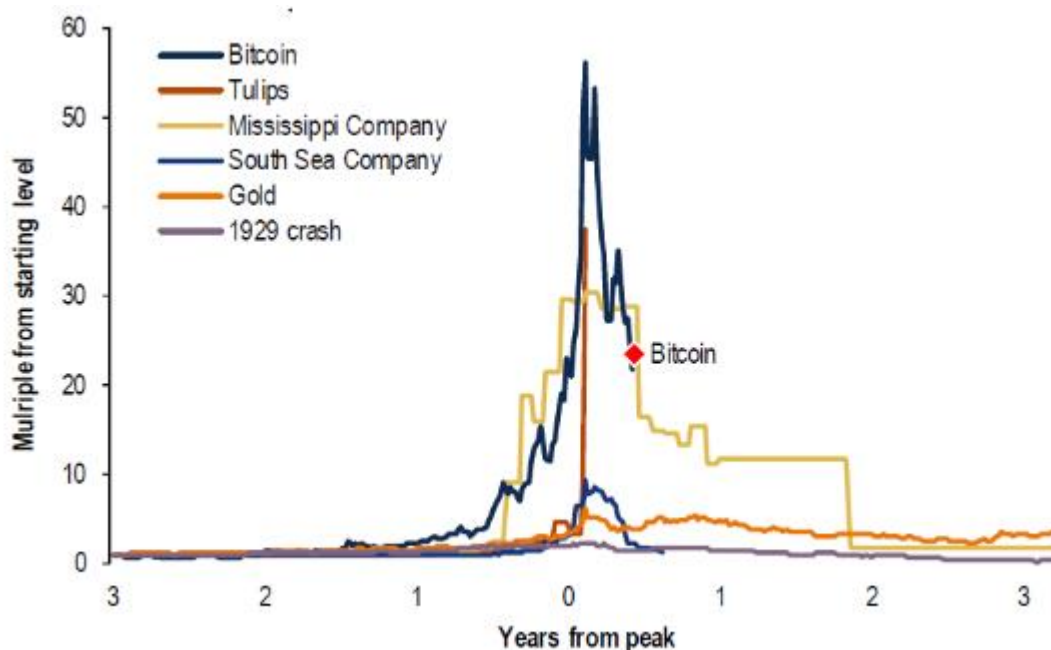
After analyzing these bubbles, it is quite clear that they are very heterogeneous, especially for the diverse roots leading to each crash; indeed, Tulip mania appear as the most different between all of them, issue probably due to the different financial system, which was obviously less complex and advanced with respect to that of '90s. The Dot.com bubble and U.S. housing crash are the more similar, since they both took place in the United States and both of them were enhanced by not really strict regulations, which allowed investors to engage in ventures that, maintaining the same conditions, would never be permitted or that they would normally not be able to afford (i.e. mortgages during the housing bubbles) and entrepreneurs to build business operating through uncharted channels (i.e. online companies). On the other hand, we can also spot similarities between the South Sea

company bubble and the Dot-com one, lying on the exaggerated beliefs of investors concerning the profits made by these new businesses; this believes were caused respectively by rumors spread about claimed-but-inexistent gains of the South Sea, and by an investors' overconfidence about the worthiness of new companies. Despite the difference that are easily recognized through a careful reading of each event, we see how all of them shares the same behavior, as we were able to place most of the stages described by Minsky's model; anyway, the profit-taking stage is actually the most difficult phases to identify, since it is difficult to determine the motives that led investors to sell their asset before the following panic stage, a crucial element in order to precisely locate it.

2.3 IS BITCOIN A BUBBLE?

Since the release of the paper *Bitcoin: A peer-to-Peer Electronic Cash System* in 2008, the cryptocurrencies environment developed with remarkable speed, new digital monies emerged, some of them with features and scope similar to that of Bitcoin, while other ones very different from the former, and countless investors and speculators, attracted by the possibility of making profits, entered in the crypto-assets market. Many experts and skeptics labeled bitcoin as a speculative bubble, some of them even stated it is about to burst. Several opinions circulate nowadays: according to Joost van der Burgt, a policy adviser at the Federal Reserve bank of San Francisco, Bitcoin bubble is likely at the profit-taking stage of the cycle developed by Hyman Minsky. In addition, van der Burgt identified the previous phases; in particular, he located the displacement stage in the years following the issuance of Nakamoto's paper. He finally predicted the imminent panic phase, where Bitcoin price would crash. In accordance with van der Burgt theory, the Bank of America published a note on April 2018, a few months after the abrupt decline in the cryptocurrency value, fell by more than 65%, where analysts claim Bitcoin would be the greatest bubble in history, since it is replicating the downfalls of previous bubbles, as shown in figure 5.

Figure 6: market price of the biggest asset bubbles in history



Source: Wolf, Janine, (2018), 'Bitcoin, the Biggest Bubble in History, Is Popping', Bloomberg.

Even the Nobel price-winning Robert Shiller, during an interview for CNBC⁶¹, expressed its opinion regarding Bitcoin, comparing it to the tulip mania and stating Bitcoins bubble has roots in biases of the crowd and added he sees crypto-assets as more of an experiment than a concrete investment: "To me, it's interesting as another example of faddish human behavior. It's glamorous," he stated.

He also claimed to not possess any Bitcoin and underlined that it is likely the cryptocurrency will not disappear out of nowhere in the near future, indeed he affirmed it will probably keep being around for some time.

Furthermore, he highlighted the political side of this situation, pointing out that many people nowadays do not trust the government anymore and are excited by this new kind of monies, not controlled by a central authority, but rather issued by a smart computer scientist.

A more catastrophic view was depicted by Nouriel Roubini, the American economist credited with predicting the U.S. housing bubble burst, defined⁶² Bitcoin as the "mother of all bubbles" and stated

⁶¹ CNBC, (2018), 'Bitcoin is a bubble and a perfect example of 'faddish human behavior,' says Robert Shiller'.

⁶² J. Ossinger, (2018), 'Roubini Says Bitcoin Is the 'Biggest Bubble in Human History', Bloomberg.

its crash should be near.

He also expressed his opinion about other cryptocurrencies, which was even more severe than the one concerning Bitcoin; indeed, he stated some of them are even worse than the afore-mentioned digital money and they altogether form “a bubble to the power of two or three”; finally, he highlighted the massive energy costs maintaining such a virtual currency requires, labeling Bitcoin as an environmental disaster.

Although there are some experts disagreeing with the bubble theory concerning Bitcoin, major economists, heads of bank and investors are skeptics about the cryptocurrency and are very concerned for future financial stability and criminal activities, fostered by the existence of such digital monies.

2.3.1 BITCOIN'S ADVANTAGES AND DISADVANTAGES

Bitcoin, together with all other cryptocurrencies, has its benefits and drawbacks; the Bank of America issued a report in 2013⁶³, inside which they analyzed all Bitcoin's advantages and disadvantages, with the aim of assess its value and to determine whether it had what it takes to be a worthy competitor to traditional money-transfer providers. Some of the characteristics they highlighted are described below:

- ❖ **ADVANTAGES:** First of all, the main advantage Bitcoin can boast is its potential as a *medium of exchange* indeed, it offers extremely low transaction costs, by using a peer-to-peer network, described in the previous chapter, which allows the system to avoid of the presence of a central authority (i.e. a bank or another financial institution). The blockchain technology, which is responsible for all these characteristics, is regarded as a useful innovation and many researchers and experts, even the more skeptics, identified its benefits. Moreover, it constitutes an alternative digital payment method for people that do not possess a credit card; the relative *degree of anonymity* the network guarantees can also be seen as an advantage, especially by users living in disadvantaged countries; another strength of Bitcoin lies in the proof-of-work, providing to the network with a protection from double spending and counterfeiting; this system make Bitcoin a *valid alternative* to fiat money in terms of *security and transparency of transaction* (this does not apply to exchange platforms, which have been many times subject to heists and frauds) mainly thanks to its ledger technology, where all transactions are recorded. Furthermore, Bitcoin are easier to carry than other type of money, thanks to their format, a characteristic that could constitute a great advantage, in particular it

⁶³ D. Woo, I. Gordon, V. Iaralov, (2013), 'Bitcoin: a first assessment'.

would be a benefit for countries whose economy is mainly based on cash. Another plus for Bitcoin is the increasing success this digital currency is gaining, creating higher and higher **barriers to entry** for competitors⁶⁴; in addition, the **limited supply** of Bitcoin was recognized as an advantage, since it protects the system and its value from the governments and central banks, by imitating gold. The last strength highlighted in the report is the **negative correlation** Bitcoin has **with risk sensitive assets**.

Anyway, other Bitcoin strengths can be outlined, such as the almost total freedom its network guarantees to each user, or the minimal quantity of risk merchants face when joining the network; indeed, due to the fact that Bitcoin transactions cannot be reversed, they are protected from frauds, furthermore, thanks to Bitcoin, merchants are now able to perform their business where crime rates is quite high, since they are protected by Bitcoin's blockchain, which makes it very difficult for people to steal from them⁶⁵.

- ❖ **DISADVANTAGES**: The major flaw associated to Bitcoin is its **poor performance as a store of value**: indeed, Bitcoin value is extremely volatile, factor that is associated with the massive speculation characterizing the market, whose results are very unstable returns. In addition, according to the Bank of America analysis, the great volatility associated with Bitcoin also undermines its role as a medium of exchange, since retailers are not likely to accept it as a form of payment, because of its price's deep fluctuations. Also, new government **regulation**⁶⁶ on Bitcoin, aimed at hindering illegal activities, could lead to an **increase in transaction costs**, weakening one of its most important advantages. Here again, Bitcoin's role as medium of exchange would be undermined. A further disadvantage of crypto-assets such as Bitcoin lies in the **unreliability of the exchange platforms**: a large number of exchanges were subject to heists and hackings⁶⁷ and users were not able to recover all the funds that were stolen. This factor increases risks for investors who are unable to mine and therefore cannot invest in Bitcoin except through exchange platform; in the context of Bitcoin as a future international currency, the fact that it is **not a legal tender** will likely undermine its use. Indeed, unlike Dollars or Euros, no retailer is under obligation to accept Bitcoin as payment; this could lead to a decline of the digital currency value due to changes in users' perception of its usefulness,

⁶⁴ According to the report, the market structure the digital currencies sector is the one of "winner takes it all", whereby users have less incentive to invest in a crypto-asset alternative to Bitcoin, as the latter become increasingly popular and easy to use.

⁶⁵ CoinReport, 'What are the advantages and disadvantages of Bitcoin?.'

⁶⁶ See paragraph 1.2, pp. 18-31.

⁶⁷ i.e. the Coincheck Inc. heist in Japan. (discussed at page 23)

as a consequence of weak Bitcoin potential as a means of payment, repeated hacks and fluctuation of prices. An additional weakness stressed in the report is the large amount of time needed to mine a block and add it to the chain to protect transactions from double spending, in other words, the *wait time* to have a confirmation of the payment, which stands at around 50 minutes. Hence, without a third parties verifying transaction, Bitcoin will probably remain a rather illiquid asset and prevented from becoming a national currency.

Also other weaknesses were identified, such as the lack of awareness of Bitcoin and the poor understanding of its network's functioning and dynamics; many people still have to discover this new payment method, symptom of a lack of education about the cryptocurrency to the crowd, which is not able to understand how they work. In addition, since Bitcoin is still at its early stage, many features that will characterize it in the future are still incomplete or under development, such as its security and accessibility⁶⁸.

2.3.2.1 INTRINSIC VALUE AND THE FUNDAMENTAL ANALYSIS

When evaluating an asset, a great number of investors look at the asset market price, to the expected utility they may derive from it, to their subjective perception of the asset value, they may even rely on others' opinion about it (i.e. medias) in order to decide whether to invest or not in a security. Anyway, the market price of an asset, together with any other measure of its value, usually differs from its *intrinsic value*. The intrinsic value, also known as fundamental value or true value, is calculated through the fundamental analysis, taking into account both tangible and intangible factors adding value to a company, stock, currency or product. It does not include the market price, in fact, is commonly compared to it, in order to determine if it is overvalued or the other way around. To conduct a fundamental analysis, investors need the so-called fundamentals, namely the basic qualitative and quantitative details allowing to evaluate the stability and financial performance of an asset or a business, and to estimate whether it is a profitable investment. To calculate the fundamental value of an asset, it is usually used the present value of its future cash flow while, in order to calculate it for a national currency, different fundamentals factors are taken in consideration, including the following:

- ❖ Trade surpluses or deficits;

⁶⁸ CoinReport, 'What are the advantages and disadvantages of Bitcoin?'

- ❖ The money supply of the nation issuing the currency;
- ❖ The currency's economic prospects for growth;
- ❖ The inflation/deflation rates;
- ❖ The security used to back the currency.

2.4 BITCOIN'S FUNDAMENTAL ANALYSIS

At this stage, it is perfectly natural to wonder what Bitcoin intrinsic value is and what factors are used to evaluate it. In practice, analysts assert the valuation is not straightforward, since Bitcoin does not have any cash flow, cost of production or any other fundamental employed in traditional assets evaluation techniques. One thing is for sure, that most of the current demand for Bitcoin is driven by speculation: people buy Bitcoins haunted by the Fear of Missing Out and with the aim of reselling them as quickly as possible in order to obtain a margin, rather than using them to settle payments. This causes the market price to rise and, consequently, to differ from the crypto-asset's intrinsic value, a fact that almost every expert agrees on, even though Bitcoin fundamental value is still not determined exactly. Because of the lack of the typical evaluation basis, very different results emerged from various scholars' examinations and beliefs: Henry Blodget, the founder and CEO of *Business Insider* claimed that, according to his point of view, Bitcoin has no intrinsic value at all and suggested to everyone who's being told that it was related to GDP or even gold to “put down the Kool-Aid and back away.”⁶⁹

Analogously, Alan Greenspan, the former chairman of the Federal Reserve, shared his opinion during an interview for Bloomberg Television; he explained that currencies need to be backed by something in order to work properly, bringing as example the gold standard period, during which monies had a precise and widely known intrinsic value. The economists also added that even paper currencies are backed by the trust of the issuer, claiming he does not understand if Bitcoin has some kind of backing and that “You have to really stretch your imagination to infer what the intrinsic value of bitcoin is. I haven't been able to do it. Maybe somebody else can. [...] you asked me is this a bubble in bitcoin. Yeah, it's a bubble.”

Following the statement of Adam Smith “money can serve no purpose other than purchasing goods”, Paul Krugman, an economist and professor at Princeton university, as well as Nobel-prize winner in 2008, tried to assess Bitcoin's role as store of value and medium of exchange and asserted that Bitcoin

⁶⁹ Ccn.com, ‘Bitcoin – A Speculative Asset with “No Intrinsic Value”, Says Business Insider Founder’, (June 2017)

does not prove to be a stable store of value. He also added that, when trying to raise the previous issue, Bitcoin's supporters constantly try to deflect, underlying the cryptocurrency's great potential as medium of exchange. Following the same strategy, Bank of America attempted to estimate Bitcoin intrinsic value, evaluating the two purposes of the digital money separately:

- ❖ First of all, they established the value of Bitcoin as a medium of exchange, in the event it gained dominance for e-commerce. To compute this, they made a few assumptions: they supposed that e-commerce accounted for around 10% of B2C transactions (and that Bitcoin would grow until it is used for paying 10% of online transactions), added its role as means of payment and presumed that Bitcoin network's characteristics of recording transaction that are publicly available would undermine the growth of its use for illicit transactions. Subsequently, they calculated the digital currency market capitalization as a medium of exchange that, according to their estimations, accounts for \$9.5bn.
- ❖ Secondly, they tried to assess the maximum Bitcoin's market capitalizations as a store of value; since the cryptocurrency does not pay any interest to investors and, besides, there is no equity or bond expressed in Bitcoin, they claimed its potential as store of value is actually quite restricted. As a consequence, Bank of America made a comparison between Bitcoin and gold (which appeared as the closest the store of value to the digital asset): during this analysis, they found that both gold and Bitcoin have a limited supply, that none of them pays any interest and that they both are difficult to trace with respect to other assets. On the other hand, they underlined the great volatility characterizing Bitcoin that makes it approximately five times riskier than gold. In addition, they also noted that it took time for gold to acquire its reputation and value; if Bitcoin achieved to acquire a good reputation⁷⁰, its maximum market capitalization as a store of value would equal \$5bn.

Adding the value of the two roles of Bitcoin as a currency, the maximum market capitalization according to the Bank of America accounts for \$15bn, meaning the intrinsic value of one Bitcoin should be roughly 1300 USD. Keeping in mind the assumption made, and the current Bitcoin market price, it is easy to determine whether Bank of America's experts think Bitcoin is a bubble or not.

Opposed to the former theories, the Wedbush Securities Inc.⁷¹ released a paper in 2013 in which they stated to see Bitcoin intrinsic value "as the conduit in a new global crowd-founded open source

⁷⁰ Bank of America assumed the "good reputation" corresponded to the silver's status, that back in the analysis' time (2013), was sixty times lower than that of gold.

⁷¹ The Wedbush Securities Inc. is a private investment firm based in Los Angeles and founded in 1955. It is one of the largest investment banks and securities firms in the United States.

payment network". They found three basic key sources of the cryptocurrency demand, such as the fact that Bitcoin is an alternative asset, or that it is a disruptive payment network technology, and claimed the all Bitcoin's potential as a currency lies in the Blockchain technology. Indeed, Wedbush researchers strongly believe it constitutes a disruptive innovation in the online micro transactions and cross-border payments industry, thanks to the decentralization of the platform, the fee structure, which they described as flexible, and to the speed of transactions settlement; moreover, they suppose Bitcoin will develop new sources of advantage, increasing its potential as an alternative to existing payment companies. They praised the incentive-based structure of Blockchain, since they recognized it was the main determinant of the spread of the currency and allowed the network to benefit from the computational power of miners and from the creation of dedicated infrastructures. According to Wedbush Securities, Satoshi Nakamoto developed the scheme of the first new global payment network, which is the major cause of the success the cryptocurrency acquired in the last decade; on the basis of some calculations, they additionally claimed that Bitcoin could be worth more⁷² than its market price back to 2013 and supposed the volatility of the digital currency value is due to a "price discovery process". Finally, the investment firm's experts think there are long-term opportunities for Bitcoin to be accepted as means of payment by existing online platform, such as PayPal. However, at the end of the report's preface, Wedbush declared the analysis could be biased, since the firm intends to engage in business with the companies mentioned.

CNBC also expressed its point of view on Bitcoin's intrinsic value, publishing an article on January 2018 in which they analyzed the digital currency's scarcity and utility in order to assess it. For the former characteristics, the report simply mentioned Bitcoin's finite supply; for what concerns crypto-asset utility, the article presents several reasons why Bitcoin should be considered a useful resource: the first thing CNBC highlighted is the thrill investors show for the digital money and the widespread belief that Bitcoin has the potential to become one of the most valuable and "efficient commodity". Additionally, the essay contains a list of features that make the cryptocurrency so popular among the crowd, including the fact that its network is open source and, therefore, constantly evolving, or the absence of third parties regulating it. The report goes on anticipating the skeptics reaction, who could argue that none of the former features describe Bitcoin's fundamental value, by demonstrating neither gold or paper money prove to have little intrinsic value.⁷³

⁷² Making a few assumptions, such as that Bitcoin acquired part of the demand for gold, Wedbush Securities estimated a potential aggregate demand of \$13,659,224 and a total supply for 2014 of 13 million BTC.

⁷³ For what concerns gold, CNBC based its analysis on the World Gold Council data, according to which only 15% of gold was employed in industries, while the rest of it was mainly used for jewelry or gold bars, showing that gold value as an asset only exists because people believe it is valuable. Afterwards, the paper demonstrates the little

Furthermore, CNBC proposed a solution to help people understand the value of such cryptocurrency: originally conceived by Tom Lee, co-founder of Fundstrat Global Advisors and former chief equity strategist at J.P. Morgan, the method suggested in the article consists in treating Bitcoin as a digital business (i.e. Netflix, Google or Amazon), since almost everyone is able to perceive the value of such companies. Finally, the report tries to assess the value of the digital currency through two main approaches designed by Tom Lee: the first system is based on the theory that Bitcoin will partially replace gold at some point in the future. CNBC's article contains Lee calculations for the digital currency to replace 5% of gold demand after five years, which would make one Bitcoin worth more than \$20.000; the second hypothesis relied on Metcalfe's law, which states the value of a network depends on the number of people using the network itself ⁷⁴. CNBC also include Fundstat's observation on the application of the law to the Bitcoin system, which reached the conclusion that roughly 90% of the digital money price fluctuations are explained by the number of users of the network.

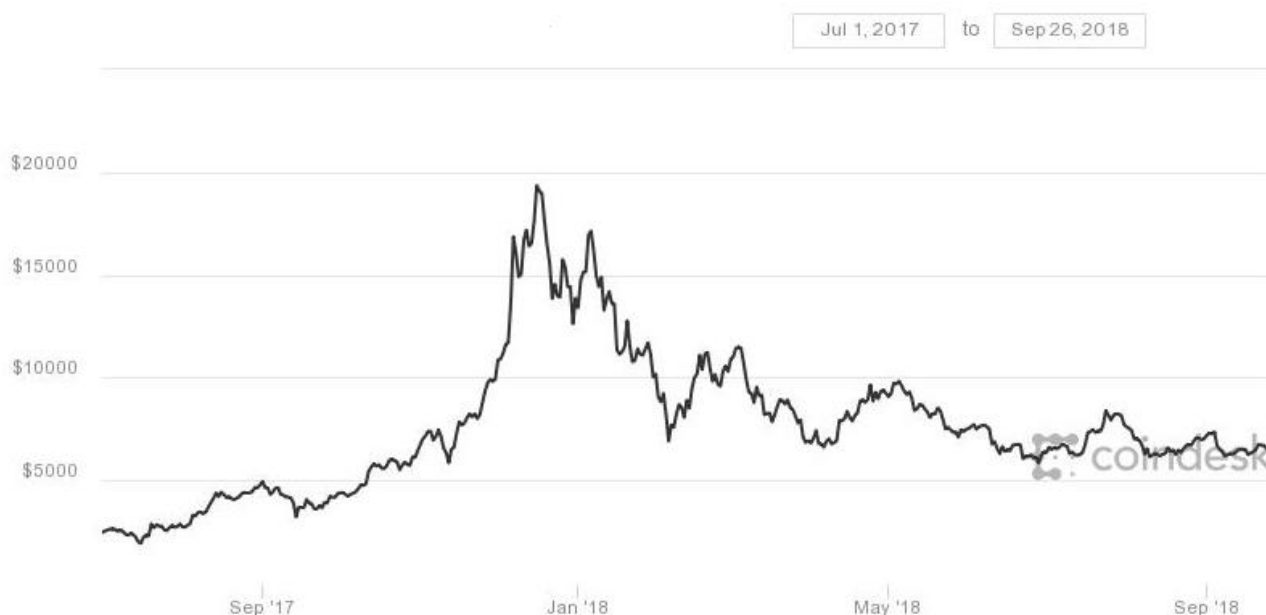
fundamental value of paper money by drawing attention to the fact that, to create a \$100 banknote, an expenditure of barely 16 cents is needed.

⁷⁴ In particular, the law affirms that the effect of a network is proportional to the square of the number of users connected to the network.

2.5 BITCOIN PRICE ANALYSIS

At this point, we still do not have a clear vision of whether Bitcoin is a speculative bubble or not. The best way to shed light over this issue, is to analyze Bitcoin market price, in order to understand whether it is possible to identify different steps of a bubble life-cycle and, in case, which phases Bitcoin is going through now.

Figure 7: Bitcoin (BTC) price



Source: coindesk.com

In figure 7, we can observe the pattern of Bitcoin price during the last year, starting from July 2017 to September 2018; anyway, it is more convenient to start our analysis from an earlier date⁷⁵, in order to see the overall picture. Starting from 2010, two years after the publication of Nakamoto's paper, the price of the cryptocurrency did not undergo any significant changes; indeed, its value showed a positive trend, but at a very slow rate. Until 2013, its price went from \$0.06 to approximately a hundred. However, the same cannot be said for Bitcoin daily transaction⁷⁶, which experienced a great rise during 2012, going from 6,000 transactions per day in April, to almost 57,000 in June. From that point, the volume of daily transactions kept rise in an almost strictly positive trend for the following 5 years. Heading back to the price, it remained nearly constant until the beginning of 2017, during which Bitcoin value reached \$1,000, and from there it kept rising at a faster and faster rate for almost

⁷⁵ Data from: Coindesk.com

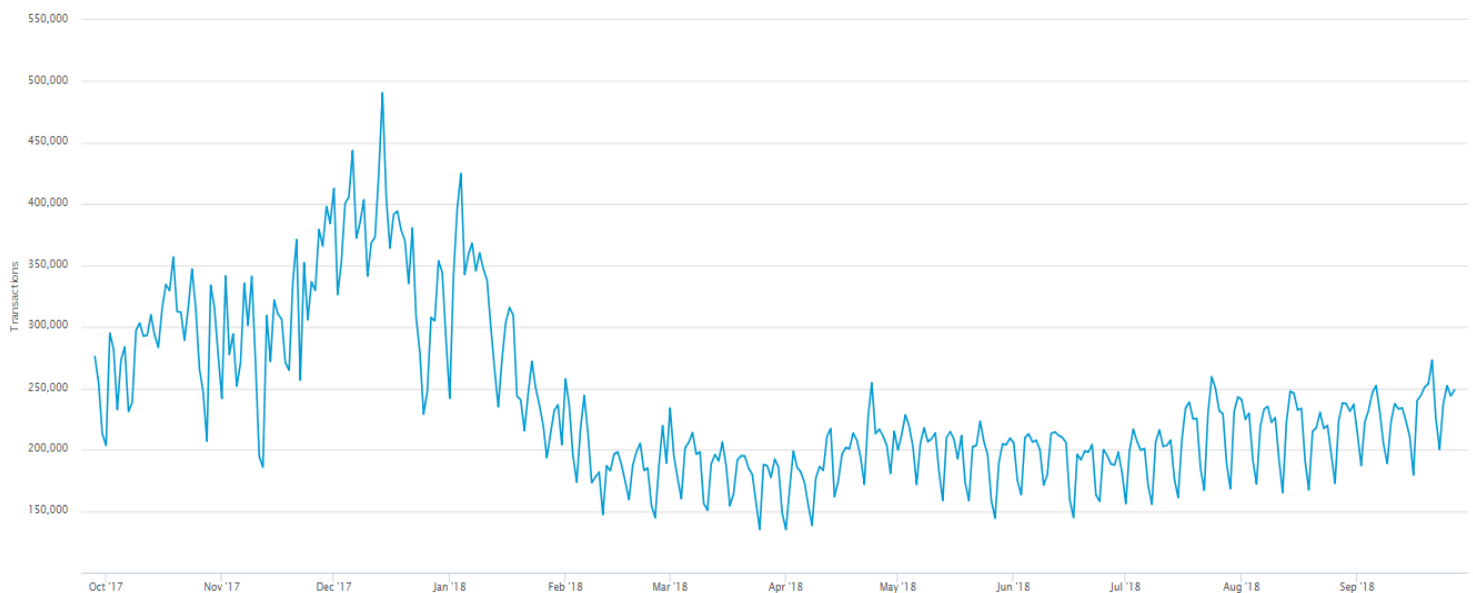
⁷⁶ Data from: Blockchain.com

a year, with a few contractions in July and September 2017. Together with price, transactions volume skyrocketed, reaching approximately 370,000 transactions per day in May 2017.

Bitcoin market value reached its peak the 11th of December 2017, with a price of \$17,549.67; afterwards, the digital currency's value fell sharply during 2018, year in which it experienced many fluctuations, but following a decreasing pattern. On September 2018, where data ends, Bitcoin market price was just above \$6,000.

For what concerns transactions volume, it was also affected by changes in Bitcoin price; after some deep fluctuations, it reached a peak of 424,579 during December 2017, then crashed to around 135,000 on March 2018 and finally rose a little bit, achieving approximately 252,000 daily transactions.

Figure 8: Confirmed transactions per day



Source: *Blockchain.com*

Comparing figure 7 and 8, respectively showing Bitcoin market price and its transactions volume, we observe similar patterns, with a peak during December 2017 and a sharp decrease afterwards; apart from that, figure 8 shows daily transactions volume tend to be more unstable, with great fluctuations all over the period of interest, which is probably due to the fact that the number of transaction settled in a day is very sensitive to any kind of shock Bitcoin is exposed to. Another difference observable from comparing the two charts is that, while BTC price maintained an almost constant level in the last months (with some exceptions), transactions volume is showing a slightly positive trend.

According to Minsky model, Bitcoin already went through the early phases of a bubble life-cycle: in particular, we can place the *boom* stage in 2016, period in which Bitcoin prices started to rise, while the *euphoria* phase can be located shortly after the former one, near to the peak reached at the end of 2017. Following this reasoning, right now Bitcoin should be going through its *profit-taking* stage, characterized by investors that, aware of the situation, try to sell their own Bitcoin before “it’s too late”.

This analysis supports the Bank of America analysis⁷⁷ summarized in figure 5⁷⁸, according to which Bitcoin is about to burst, and is following a pattern that is very similar to the ones of previous market crashes.

2.6 BITCOIN AS A MEANS OF PAYMENT

As we previously underlined, Bitcoin supporters, together with several experts, whose opinions were studied earlier during this paper, believe the major advantage of this virtual currency lies in its potential as means of payment. To prove whether these claims are justified or not, we collected data on Bitcoin’s actual use as a payment method.

According to CoinMetrics, a blockchain data provider, Bitcoin’s transactions are primarily attributed to mining and additional researches conducted by a different data provider suggest that only the 33% of Bitcoin payments are related to the purchase of goods and service.⁷⁹

Also CNBC published an article⁸⁰ on March 2018, in which it gathered several experts’ opinion concerning Bitcoin use as an actual currency. As a result of its survey, both experts and digital monies’ developers agree on the fact that, to this date, Bitcoin value is too volatile, characteristic undermining its use as a payment method, together with the fact that the technology associated to Bitcoin is still under development; for instance, Nick Saponaro, the co-founder of a project aimed at education people on crypto-currencies, affirmed “Right now there's no easy way to buy, send or spend cryptocurrencies”, even though it hopes his program will encourage a wider adoption of digital currencies. Moreover, CNBC added a few more reason why the use of Bitcoin for the purchase of goods and services right now is not a great idea, such as taxes applied on them, given that IRS treat

⁷⁷ Wolf, Janine, (2018), ‘Bitcoin, the Biggest Bubble in History, Is Popping’, Bloomberg.

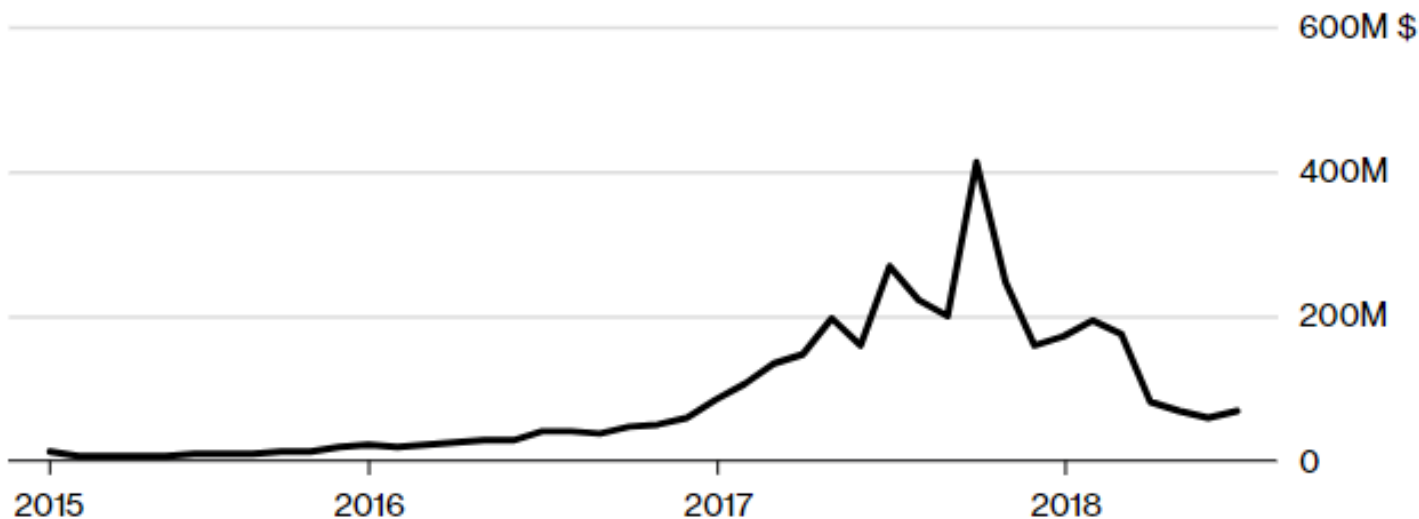
⁷⁸ See pg. 46.

⁷⁹ Data from: News BTC, (2018), ‘Only 33% of Bitcoin Payments Used to Purchase Goods, Economic Value in Question’.

⁸⁰ CNBC, (March 2018), ‘Bitcoin takes on cash, as more places accept the cryptocurrency’.

them as assets⁸¹, a fact that, together with transaction costs, would disproportionately raise the cost of the purchase.

Figure 9: Amount of Bitcoin received by merchant services



Source: O. Kharif, (August 2018), 'Bitcoin's use in commerce keeps falling even as volatility eases', Bloomberg.

According to an analysis carried out by the startup Chainalysis for Bloomberg, whose results are summarized in figure 9, Bitcoin's use as a means of payments experienced a fast rise during the period from June 2016 to April 2017, where it attained a total amount of \$197,523 million received by providers such as BitPay and Coinify⁸²; afterwards, the amount of the digital currency used for everyday purchases went through some fluctuations, until reaching a peak of \$411 million in September. Finally, it fell to less of \$60 million in May 2018. Moreover, according to Chainalysis survey, the fall in Bitcoin usage as method of payment coincide with the rise in price (which is also observable in figure 7), which was clearly caused by a peak in speculation.

In addition, at the beginning of 2018, the payment service provider Stripe.Inc decided to not support Bitcoin anymore, because of price fluctuations, together with the decline in usage, and several companies, such as Expedia.com, stopped accepting the digital currency as payment. However, there are still many companies allowing for payments in Bitcoin, such as Overstock, the American online

⁸¹ CNBC is addressing its article to an American reader.

⁸² BitPay and Coinify are Bitcoin global payment service providers, the former was founded in 2011, while the latter in 2014; they provide payment processing services for merchants.

retailer, which started accepting cryptocurrencies as a form of payment in August 2017, PayPal and Microsoft, which began accepting digital monies in 2014.⁸³ One of the main reasons why companies are increasingly accepting cryptocurrencies is due to the benefits they get, such as smaller transaction fees with respect to payment with credit cards, which makes it a cheaper way to conduct business for them; this gives to Bitcoin hopes to establish itself as a form of payment.

⁸³ Nasdaq.com, (2018), '7 major companies that accepts cryptocurrency'.

Conclusions

In this paper, we studied cryptocurrencies' environment, provided an overview of Central Banks' and major international institutions' opinions and examined several theories concerning Bitcoin's intrinsic value.

The results of this work clearly reveal cryptocurrencies have received massive attention in the last decade, both from investors, that proved to be immediately fascinated by this alternative currency, institutions and economists; while users' reaction to digital monies was enthusiastic, banks and other financial institutions shown concern over them. Some of them tried to warn people about the riskiness of this new class of asset and prohibited states to adopt it as currency (i.e. European Union), while others took a less strict position, trying to facilitate the use of cryptocurrencies through exchanges platforms (i.e. Japan, United Kingdom) and finally, some of them even considered the possibility to mint their own digital money (i.e. China). Nevertheless, many of them are worried about illegal activities associated with this kind of money, even if they recognized the benefits a digital architecture such as Blockchain could bring to the current digital payment system.

For what concerns the analysis of Bitcoin's fundamental value, it seems quite clear that economist did not found yet a precise metric to evaluate this type of financial asset, given that its value cannot be assessed through traditional fundamental analysis tools. This is the main reason why there is not a widely recognized theory on the digital currency's value, and why there is such disagreement among economists.

At the end of our survey, we can conclude that Bitcoin is likely to be a bubble, since it presents many of the features common to previous financial crashes, such as investors biases (i.e. the Fear of Missing Out, overconfidence, excessive optimism) and a massive speculation; furthermore, Bitcoin pattern perfectly fits Minsky's bubble life-cycle model. Anyway, we believe it is possible to find Bitcoin's intrinsic value, which can be similar to the one of different cryptocurrencies, mainly lying on its ledger technology, which is widely recognized as a great innovation and in the dimension of its network.

For what concern its potential as a medium of exchange, it needs to be improved by ensuring greater safety of exchange platform and by further developing Bitcoin's technology (even if this feature could be mined by the great volatility characterizing Bitcoin value), since right now, it is very inconvenient to use Bitcoin as payment method.

On the other hand, we are not sure Bitcoin's popularity will last forever, but, according to our study, it is possible that, in the case Bitcoin did not survive, another digital currency could take its place, acquiring its user base and its reputation.

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