ISCTE Business School
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CRYPTOCURRENCIES: THE FUTURE OF MONEY OR JUST A SPECULATIVE INVESTMENT?

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Abstract

Cryptocurrencies have been in vogue ever since Bitcoin first appeared in 2008. From that moment on, a new potential market started evolving and is nowadays a daily topic for everyone involved in the financial and monetary markets. Cryptocurrencies presented themselves as a viable alternative to traditional currencies, with a lot of new interesting features, but also several aspects that split the opinions between those who understand it as a great alternative for the future and the more skeptical ones who still question its legality and use. Nowadays, cryptocurrency is one of the most interesting topics in the financial markets due to all the controversy associated, as well as the public acceptance, responsible for the huge prices that these coins have been reaching.

In this dissertation, we aim to analyze every aspect concerning cryptocurrencies. With the intention to clarify the most important details about this new market, all these details have been scrutinized, from the several different types of cryptocurrencies and its behavior, to the factors that have an impact in cryptocurrencies prices.

Cryptocurrency is still a trendy and unknown subject to many people, and that was the motivation and the main objective of this dissertation, to clarify everyone about this topic before thinking of investing in any of these new cryptocurrencies.

JEL Classification: E42; E52.

Keywords: Cryptocurrency; Virtual Currencies; Bitcoin; Ethereum.

Resumo

As cripto moedas tem estado em moda desde que a Bitcoin apareceu em 2008. A partir desse momento, começou-se a verificar o aparecimento de um novo mercado, que é, atualmente, um assunto diário para todos os envolvidos nos mercados financeiros e monetários. As cripto moedas têm-se apresentado como uma alternativa viável às moedas tradicionais, com várias características interessantes, mas também alguns aspetos que têm dividido as opiniões entre aqueles que as consideram como uma excelente alternativa de futuro e os mais céticos, que ainda questionam a sua legalidade e utilização. Atualmente, as cripto moedas são um dos tópicos mais interessantes dos mercados financeiros devido a toda a controvérsia associada, bem como a aceitação por parte do público, responsável pelos preços elevados que estas moedas têm atingido.

Nesta dissertação, a intenção foi analisar todos os aspetos relacionados com as cripto moedas. Com a intenção de clarificar os detalhes mais importantes deste novo mercado, todos estes detalhes foram examinados, desde os diversos tipos de cripto moedas e o seu comportamento, aos fatores que podem ter impacto nos preços das cripto moedas.

As cripto moedas continuam a ser um tópico atual e desconhecido para muitas pessoas, e essa foi a motivação e o objetivo principal desta dissertação, clarificar todas as pessoas sobre este tópico antes de pensarem em investir em qualquer uma destas cripto moedas.

Classificação JEL: E42; E52.

Palavras Chave: Cripto moedas; Moedas virtuais; Bitcoin; Ethereum.

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"Bitcoin is the most important invention in the history of the world since the Internet." – **Roger Ver**

"Every informed person needs to know about Bitcoin because it might be one of the world's most important developments." – **Leon Luow**

"The future of money is digital currency." – **Bill Gates**

Section 1: Introduction

It is extremely difficult to establish the origin of monetary societies. Payments using different kinds of money have been made as early as 2200 BC. However, the format of money has changed considerably throughout the years. In its primordial, money was frequently commodity money, that is, an object which had intrinsic value, like seeds or vegetables that were traded between people. Some authors believe that the first form of money consisted of cowry shells (Sehra, Cohen, and Arulchandran, 2018: 13). As civilization progressed, different forms of money were developed, like gold and silver, becoming the way people were trading with each other. In the eighteenth century, "commodity-backed" money started to be used, and the most common example were gold certificates, which represented an underlying commodity. Even though these papers did not have intrinsic value, they could be exchanged for a fixed amount. This was a huge advance for that time, and allowed portability of the money, as well as the capability of transfer larger amounts of money.

Over the years, when everything else was being impacted by the advances in technology, the way we see money started to change with the introduction of the world wide web, which led to credit cards, smartphones where you can control bank accounts, and so on.

The first digital currency date back to the early 1990's, and was called DigiCash, offering anonymity through cryptography protocols. However, it was in 2008 that the first cryptocurrency was presented to the world, when Satoshi Nakatomo[1] introduced Bitcoin, in a nine-page paper entitled as "Bitcoin: A Peer-To-Peer Electronic Cash System".

Cryptocurrencies[2] combine several distinct characteristics such as innovative technology, high security architecture, opportunity to invest in it as an asset and prosperity in functionalities, motivating not only investors but also computer scientists and venture capitalists to see cryptocurrencies as a good investment opportunity. Besides all these characteristics,

[1] Nowadays, there are still no evidence about the validation of Satoshi Nakatomo as an individual figure. Many authors believe it is a pseudonymous identity, representing a group of people responsible for the creation of Bitcoin.

[2] Cryptocurrencies is the most used term among all the authors. However, some authors prefer the term cybercurrencies. In this dissertation, the term cryptocurrencies is used to be more consistent with most of the references.

cryptocurrencies also face several concerning problems like decentralization and the lack of regulations by financial institutions.

In the most recent years, cryptocurrencies and its market capitalization have been increasing to levels never seen before, which has attracted more people to invest on Bitcoin, Ethereum, Ripple, Litecoin and so on. In 2013, the recognized Forbes Magazine, declared it to be the year of Bitcoin, due to its spectacular growth which "evolved from a subcultural phenomenon into a mainstream public debate" (Bjerg, 2016: 53).

Bitcoin was the first cryptocurrency to enter the market, but soon there were new competitors. Ethereum appeared in 2015 and has been conquering its space in the new cryptocurrency market with new and diversified characteristics, like the smart contracts. In 2012, Ripple was launched and has ever since been a top five cryptocurrency in terms of market capitalization. Another important cryptocurrency is Litecoin. Launched in 2011, has been associated and named "silver to Bitcoin's gold" due to its higher supply.

The main objective of this dissertation is to clarify the emerging cryptocurrency market to contribute to the better understanding of what is attached to it. Every cryptocurrency is different and has its own characteristics, advantages and disadvantages, as well as common aspects. Section 2 clarifies all these problems by giving a clear idea about what are cryptocurrencies, its characteristics and its pros and cons. Also, an analytical description of five of the most important cryptocurrencies has been created. Here, every cryptocurrency is analyzed into detail, allowing to understand how they have been evolving and its unique characteristics. Section 3 concerns the growing market for cryptocurrencies, analyzing not only the primary market, about Initial Coin Offerings, but also the secondary market, consisting on the exchanges, wallets, payments and mining. The secondary market for cryptocurrencies has been increasing throughout the years, with a lot of technological enthusiasts taking part on the mining processes. Section 4 focus on how can we classify cryptocurrencies according to the recognized assets classes, as well as on how investors are using cryptocurrencies, for both transactional means and trading means. There is also a sub section concerning cryptocurrencies as money, due to its characteristics, where they can be used in different ways: as a medium of exchange; as a unit of account; or as store of value. In the end of Section 4, cryptocurrency "bubbles" are analyzed. Section 5 presents the reasons that impact cryptocurrencies prices,

whether they are for economic, transaction or technical motives. The interest rates and the influence that some markets have on its global price is also analyzed. The volatility that concerns many investors is also analyzed into detail in this Section, as well as the correlations that cryptocurrencies have nowadays with different types of assets. Here, Bitcoin[3] is confronted against gold, emerging currencies and other traditional assets like Private Equity (PE), S&P 500, and so on. Section 6 concludes this dissertation.

[3] Bitcoin is used to compare with different traditional assets, gold and emerging currencies. It represents the global picture of cryptocurrencies, but it is used individually because there is a lot more information about Bitcoin than about all the other cryptocurrencies.

Section 2: A Global Overview of Cryptocurrencies

In the following section, the aim is to understand what are cryptocurrencies, how do they differentiate from the remaining forms of digital money and what are the characteristics of cryptocurrencies. In addition, there is also a detailed analysis of five of the most important and market dominant cryptocurrencies operating at the moment. This section is structured by sub-sections to provide an easier understanding of the subjects concerning cryptocurrencies.

2.1 What Are Cryptocurrencies?

The year of 2007 set a new rhythm when it comes to the financial sector and how much people were willing to trust the system. After the crisis, many people who had lost everything, or almost everything, had to turn the page and look for new possibilities. The end of the last decade opened the door for new opportunities, and cryptocurrencies were right around the corner when it happened, which led to a great opportunity for many people who wanted to invest their money on something totally different and with a good growth margin.

"In the 19th century, you could find a dollar coin made of silver and a paper dollar that in those days could be exchanged for the same silver coin. More than 100 years ago paper dollar bills were backed by silver, a precious metal that theoretically should always have value. However, today that has changed, a modern dollar bill is backed by nothing but the word of the U.S. government." (Rose, 2015: 617).

Nowadays, cryptocurrencies are a daily topic. But what are exactly cryptocurrencies? The first thing we need to understand is how to settle the difference between a virtual currency, a digital currency and a cryptocurrency, because these are often used interchangeably.

The European Central Bank released an article about "Virtual Currency Schemes" in October 2012, where virtual currency was defined as a" type of unregulated, digital money, which is issued and usually controlled by its developers, and used and accepted among members of a specific virtual community". A digital currency can be defined as a form of virtual currency that is electronically created and stored. A digital currency can or cannot be a cryptocurrency. And last, a "cryptocurrency can be defined as a subset of digital currencies, however, it uses cryptography for security so this makes it extremely difficult to counterfeit" (Gilpin, 2014).

When we talk about cryptocurrencies, we talk about a certain type of virtual currencies. Rogojanu and Badea (2015) stated that "virtual currency continues to maintain the main features of a traditional currency, in other words, virtual money is a symbol or synonym for a value, a payment system technology which continued to grow over the past 20 years".

However, due the newness of this phenomenon and its rapid growth, suggesting a universal definition of cryptocurrency is still a challenge. Abboushi (2016), from Duquesne University tries to explain it according to four core dimensions: (1) virtual currency is a form of digital currency which is digital representation and measurement of economic value for an object or transaction; (2) it is issued by non-government party and remitted for the exclusive use by another private party; (3) it is denominated in units of account of its own system that may or may not be exchangeable to real currency; (4) it is used as a medium of exchange similar to real currencies but does not have legal tender status in any jurisdiction in the world.

Sauer (2016), describes cryptocurrency as money which does not exist in reality as coins, banknotes or bank deposits, but rather exists in digital form. The author also makes clear that cryptocurrencies are not e-commerce or e-payment systems or other ways of transferring money such as credit card systems or online banking. According to Sauer (2016), the first cryptocurrencies, or virtual currencies, were first seen in online gaming where it could be used to buy new equipment or characters. With time, the online gaming operators began to exchange their virtual currency for real money. The problem was that this market didn't work both ways, it was a one-way market as the players were unable to swap the virtual currency into real money.

In 2015, Edward V. Murphy, a specialist in Financial Economics published an article with questions and answers about cryptocurrencies to allow everyone to understand what was this new emerging market. According to him, "a cryptocurrency is a medium of exchange such as the US dollar" (Murphy, Murphy and Seitzinger; 2015: 1). Later in the same article, Edward clarifies that "like the US dollar, cryptocurrency has no intrinsic value and that it is not redeemable for another commodity, such as gold. Unlike the US dollar, however, cryptocurrency has no physical form, is not legal tender, and is not currently backed by any government or legal identity. In addition, its supply is not determined by a central bank and the

network is completely decentralized, with all transactions performed by the users of the system" (Murphy, Murphy and Seitzinger; 2015: 2).

"Cryptocurrency is based on the idea of exchanging value without the approval of an institution" (Maftei, 2014: 55). While being aware of a broad developments of various payment mechanisms and creation of alternative currencies, the bold question of what cryptocurrency is should be answered. Legislative acts of United States explain cryptocurrency to be a medium of exchange that operates like a currency in some environments, but does not have all the attributes of real currency, which points the absence of legal tender status in any jurisdiction.

So, cryptocurrencies can be described as a digital asset with the intention to function as a medium of exchange, based in the concept of cryptography, which refers to "techniques for secure communication in the presence of third parties called adversaries." (Rivest and Ronald, 1990).

2.2 Characteristics of Cryptocurrencies

Cryptocurrencies have several different characteristics when compared to the "traditional currencies". Some of these characteristics are: intrinsic value, legal tender, medium of exchange, how can it be used as a storage method, its structure, supply, cost of production and risk of inflation. It is obvious that neither cryptocurrencies or the US dollar have intrinsic value.

However, there are several differences when it comes to the rest of them. These new cryptocurrencies are still unregulated, and that means that they do not have, yet, legal tender. Also, the US dollar can be used as a medium of exchange with any other currency, while cryptocurrencies work as a medium of exchange with the limited number of participants who also own it. While the US dollar has a public supply source, the cryptocurrencies have a private one. The cost to produce a US dollar bill is relatively low, while producing another cryptocurrency unit has an attached cost, the cost of the computer utility power, through a process called mining. Another major characteristic of cryptocurrency is the fact that they are decentralized, which means that they are not backed by any governmental authority. And last, while the US dollar or any other real currency is subject to inflation, cryptocurrencies are not. Even though they are highly volatile and their value can go "zero to hundred" in a couple of days or even hours.

With this, we can say that cryptocurrencies have four completely new characteristics when compared to real currencies: they are unregulated, they are decentralized, they are highly volatile and they are "born" through a mining process that is available to every user, which will be explain forward.

When we describe cryptocurrencies as being decentralized, we mean that they are not controlled. Every currency in the world, apart from cryptocurrencies, is governed by some kind of authority. Every transaction goes through a bank, where people are charged enormous fees, and it normally takes a long time for the money to reach the recipient. Cryptocurrencies, on the other hand, are not controlled by anyone. It's a decentralised network and it's built on the cooperation and communication of all the people taking part in it. Because of that, even if some part of the network goes offline, transactions will still be coming through.

Cryptocurrencies are also unregulated. Ever since their first appearance, cryptocurrencies are still a skeptical topic to many people. While some believe that they are the future and investing on it is a really good opportunity, a lot of people are still uncertain about trusting something that is still unregulated and is only now being adopted by the financial authorities, and not by many.

Franklin (2016) states that the lack of regulation is one of the biggest issues when talking about cryptocurrencies: "One significant issue of virtual currency such as the Bitcoin is the lack of regulation and lack of bank or governmental control. Without the regulation, there is opportunity for investors, some of which are already taking advantage of opportunity, but also the risk that comes from the speculation that comes with investment around such an uncharted territory." (Franklin, 2016: 83). The lack of currency regulation is, as much as over regulation, a burden to many. When dealing with currency and market opportunity, basic regulation is needed to control markets from taking unfair advantage of arbitrage opportunity. Varriale (2013) discussed how should a cryptocurrency be regulated because in that same year, The New York Banking watchdog issued subpoenas to twenty-two cryptocurrency companies. The biggest concern with this currency is the ease that it can be used for illegal activities due to the anonymous nature of the transactions. Drug trade and terror funding are two significant concerns.

Tu and Meredith (2015) looked at the possible consequences of unregulated cryptocurrencies, as they currently are. The authors understand that the lack of regulation can create issues, like the opportunity to foster funds transfers for illegal activities. Slay, Kim-Kwang, and Lui (2014) alert that money laundering and terrorism funding can easily take place in the cyber environment, as a result of the high levels of anonymity, low levels of detection and ease to transact.

Another important characteristic of cryptocurrencies is its volatility. Ever since 2009, after the appearance of the first cryptocurrency, Bitcoin, the price had a lot of ups and downs. By being subject to so many speculation, the price of cryptocurrencies goes up and down every day, based on what people say, read and believe. From 2009 on, when Bitcoin started operating, the price has raised more than 8000%.

Dibrova (2016), state "… interesting how a digitally created code that has no back-up from any central government, nor financial institution or is ensured by any commodity could ever hit a price as, for instance, 1.145 USD, in January 2013". This concerns many investors, experts and Central Banks, due to its volatility, which leaves no suspicion about the absence of economic reasons to those.

According to Coindesk[4], cryptocurrency carries a lot of uncertainties. The volatility of Bitcoin against the dollar on a Bitcoin exchange is about five to seven times the volatility of traditional foreign exchange trading.

Gavin Anderson[5], a cryptocurrency enthusiast, consider that these new currencies are going to be the future, and presented us with the pros and cons of cryptocurrencies. The pros are:

- Freedom: cryptocurrencies where designed with freedom in mind, freedom from governing authorities controlling transactions, imposing feed and being in charge of people's money;
- High portability: it should be easy to carry and use. Cryptocurrencies are completely digital, which means the money can be easily stored online, in a wallet;

[4] http://www.coindesk.com
[5] Gavin Anderson is lead developer for Bitcoin and chief scientist of the Bitcoin Foundation.

- Safety and control: cryptocurrency users are able to control their transactions. No one can withdraw money from your account without you knowing and agreeing it;
- Transparent and neutral: one of the most unique aspects of cryptocurrencies, and mainly Bitcoin, is the Blockchain technology. This technology allows every single transaction, every single bit of information to be always available to everyone, which can be checked online;
- Cannot be counterfeited: one of the most popular ways of counterfeiting in the digital world is using the same money twice – the double spending situation. Due to technologies like Blockchain, this cannot be done.

The cons are:

- Legal parameters: obviously that the legal questions concerning cryptocurrencies is the most important aspect for some people to still doubt about it, and until they are not regulated, this dubious question will remain unanswered. However, there are already some countries where cryptocurrencies, or some of them, are encouraged. While in other countries they are being banned or remain outlawed;
- Level of recognition: in some countries, cryptocurrencies are perfectly legal, however some governments still do not have regulations regarding them, while others are trying to ban them;
- Volatility: probably the most concerning aspect about cryptocurrencies for those who are holding them. The price of several cryptocurrencies like Bitcoin has been up and down, going through various cycles of skyrocketing and plummeting, being referred by some agents as bubbles and busts.
- Development: the continuous development of cryptocurrencies is not a con, per se. This is referred by the author because cryptocurrencies are still evolving, and governments are trying to regulate it more and more, and when that happens, the cryptocurrencies as we know it nowadays, might change completely.

2.3 Existing and Dominating Cryptocurrencies

Advances in encryption and network technologies are introducing transformational changes in the valuation, exchange and accounting of economic assets and commercial transactions, and

the recent emergence of cryptocurrencies, which makes possible exchange of economic value between parties without the involvement of traditional clearing house or bank, is a notable example of transformation. Bitcoin began operating in January 2009 and is the first decentralised cryptocurrency. The second cryptocurrency, Namecoin, appeared more than two years later, in April 2011. Today, there are hundreds of cryptocurrencies traded on the market and therefore with market value. There are also thousands of cryptocurrencies that have existed at some point. As of April 2017, after Bitcoin, Ethereum, Ripple, Dash and Litecoin are the largest when it comes to market capitalisation.

2.3.1 Bitcoin

Bitcoin began operating in 2009, when a nine-page paper, "Bitcoin: A Peer-to-Peer Electronic Cash System", describing its activity was released by Satoshi Nakatomo, which is suspected to be a pseudonymous for a person or a group of people. In this same paper, all the important aspects of Bitcoin were described: transactions, timestamp server, proof-of-work (POW), network, incentive, reclaiming disk space, simplified payment verification, combining and splitting value and privacy.

Bitcoin is both a computer protocol and a digital or unit of account. Initially, Bitcoin was adopted by tech enthusiasts and libertarians. The first known purchase using Bitcoin happened in 2010. Laszlo Hanyecz, a programmer living in Florida, used Bitcoin to pay for a pizza, worth 25 USD. Back in 2010, 25 USD represented 10.000 BTC, and that was the amount paid by the programmer.

Bitcoin was the pioneer of cryptocurrencies, and a lot of authors consider that the majority of cryptocurrencies are clones of Bitcoin or other cryptocurrencies, which simply feature different parameter values like time, supply or issuance scheme. Bitcoin is not backed by a central bank, and everyone with a computer or a ASIC (Application- Specific Integrated Circuit) can create Bitcoin by a process called mining. Every Bitcoin user stores their own Bitcoin in a virtual account called wallet. Users can control their money and send micropayments that can go from one Satoshi or 0.00000001 BTC (a Bitcoin to eight decimal places), which is around 0.000175784 USD nowadays[6]. "If nobody used Bitcoin it would have no value but Bitcoin can have any price, and volatility is common, making and losing fortunes for many people in the

[6] Bitcoin (BTC) was worth 17.578,40 USD on January 6th, 2018. This means 1 USD = 17.578,40 BTC.

process" (Kelion, 2013). Another characteristic of Bitcoin is its limited supply, of 21 million BTC in circulation.

Nowadays, there are many authors discussing the importance of Bitcoin, and some of them believe that the value is not on the cryptocurrency itself, but mainly on the Blockchain technology, the technology that saves every transaction so that you cannot make it obscure. The Blockchain technology is the orchestration and application of three different technologies:

- Private key cryptography;
- Distributed network with a shared ledger;
- Incentive to service the network's transactions, record-keeping and security.

To illustrate with a simple example, imagine the following situation: I want to send some of my Bitcoins to you. I publish my intention and the nodes scan the entire Bitcoin network to validate that I have the amount of Bitcoin that I am trying to send, and that I have not already sent it to any other person. Once this is confirmed, the transaction I want to do is included in a "block", which gets attached to the previous block – hence the term "Blockchain". These transactions cannot be undone or tampered with, because it would mean re-doing all the blocks that came after.

As mentioned before, Bitcoin presents a limited supply of 21 million Bitcoins, which means that there are still 4.5 million Bitcoins to be mined since the number of Bitcoins in circulation was near 16.5 million in the end of 2017.

And how can these Bitcoins be produced? Through an innovative process called mining. Mining consists on the process of solving complex mathematical problems and once they are solved, by our computers, miners receive Bitcoins and transaction fees, as a reward.

While traditional money is created through (central) banks, Bitcoins are "mined" by Bitcoin miners: network participants that perform extra tasks. The mining process involves compiling recent transactions into blocks and trying to solve a computationally difficult puzzle and the first participant who solves the puzzle gets to place the next block on the Blockchain and claim the rewards. Bitcoin mining requires a computer and a special program and miners will

compete with other miners in solving complicated mathematical problems using this program and a lot of computer resources.

When Bitcoin started, back in 2009, it was the only cryptocurrency operating in the world, and there were a lot of new cryptocurrencies trying to enter the market. However, it was only two years later that Namecoin emerged in the market. Ever since its start, and until 2015, Bitcoin completely dominated the market, and it was responsible for more than 85% of the "market capitalization share". This dominance has started to drop in 2016, when new cryptocurrencies started increasing their market capitalization, such as Ethereum, Ripple, DASH or Litecoin, as we can see in Figure 1.

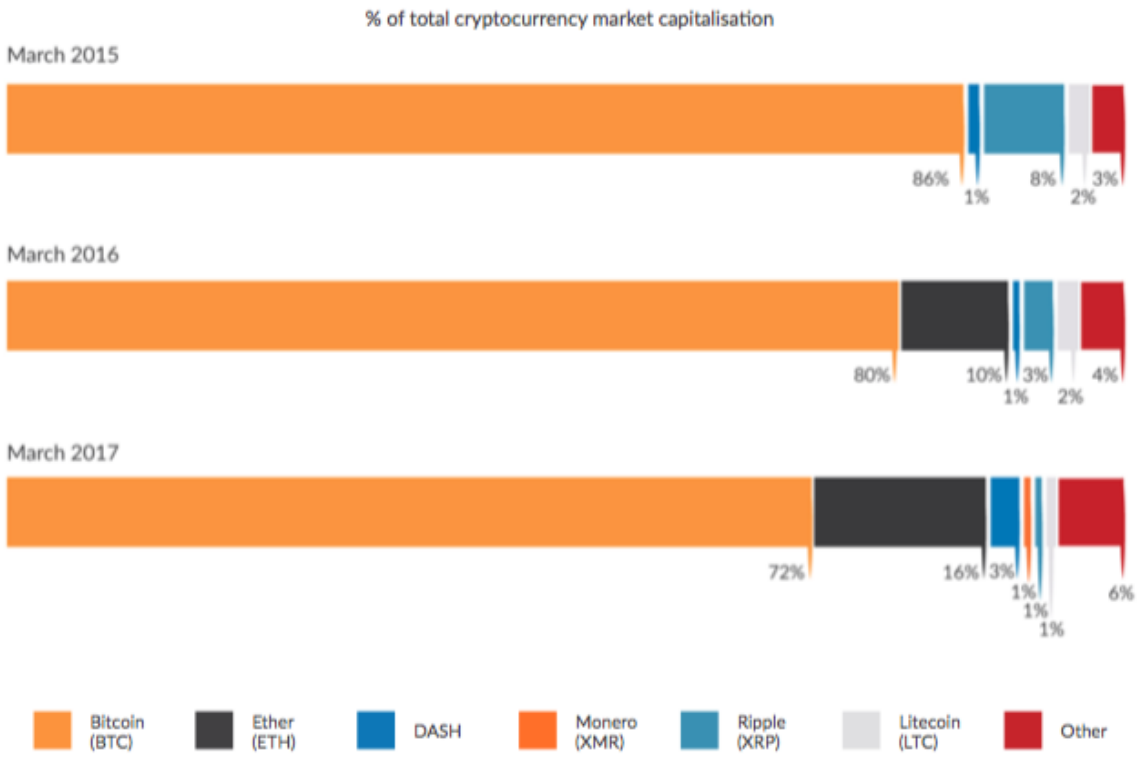

Figure 1: Percentage of total cryptocurrency market capitalisation from 2015 to 2017. Source: "Global Cryptocurrency Benchmarking Study 2017".

Although Bitcoin still dominates the cryptocurrency in terms of market capitalisation, other cryptocurrencies are now starting to have a more important presence in the market. Ether, the native cryptocurrency of the Ethereum network has established itself as the second-largest cryptocurrency. Also, the combined 'Other' segment has increased from 3% in 2015 to 6% in 2017.

Another important topic about Bitcoin is its price and volatility, something that concerns every cryptocurrency trader or enthusiast. For any traded currency or asset, volatility is a measure for the dispersion of value changes around the average change, changes that are usually looked on a daily basis. Volatility is measured as relative or percentage changes, because that is the only way to compare them over time. The higher the volatility the more uncertainty is attached to the expected return of the asset.

Bitcoin started their operations back in 2009, and ever since, the price of the currency has been up and down relatively easy, as we can see in Figure 2.

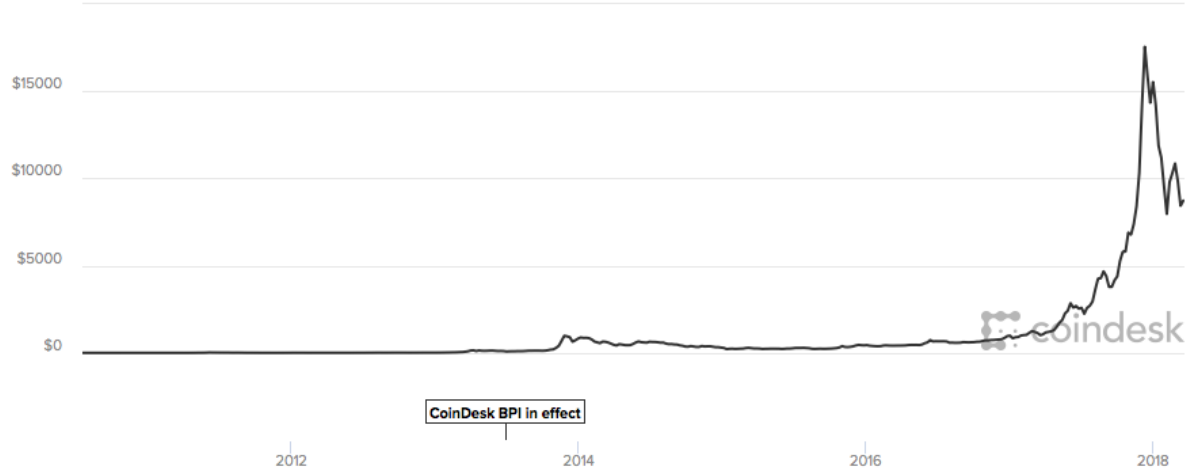

Figure 2: Bitcoin price evolution from January 2010 to March 2018. Source: Coindesk

In order to understand some of the reasons that explains price alterations, Higgins (2017) and Rosenfeld (2017) conducted a study to understand the reasons behind the changes. It was in February 2011 that Bitcoin reach their first milestone, the 1 USD mark. One year later, Bitcoin was valued at 5.66 USD, and in the end of the same year, 2012, it was worth 13.41 USD. The year 2013 was really good for Bitcoin due to the Cyprus Bail-in. A 10-billion-euro bailout is hoped to fortify the flagging Cypriot economy. Among its conditions is sizable levy collected from most banks accounts with holdings over 100.000 EUR. Seeking for new solutions to preserve their holdings before the bailout's conditions take effect, many of these holders began to buy Bitcoin in masse. In April 1st, 2013, Bitcoin hits 133 USD. The year of 2013 was already the best year ever for Bitcoin, but it was not over yet. Until the end of the year, the US Senate holds hearing on Bitcoin, with many panellists and senators agreeing that Bitcoin holds great promise. The price instantaneously skyrockets. In the end of 2013, Bitcoin reached 979.04 USD. Until the end of December there was still time for the first big slump, when the Chinese

Government banned financial institutions from using Bitcoin. The price evolution of Bitcoin throughout the year of 2013 can be verified in Figure 3.

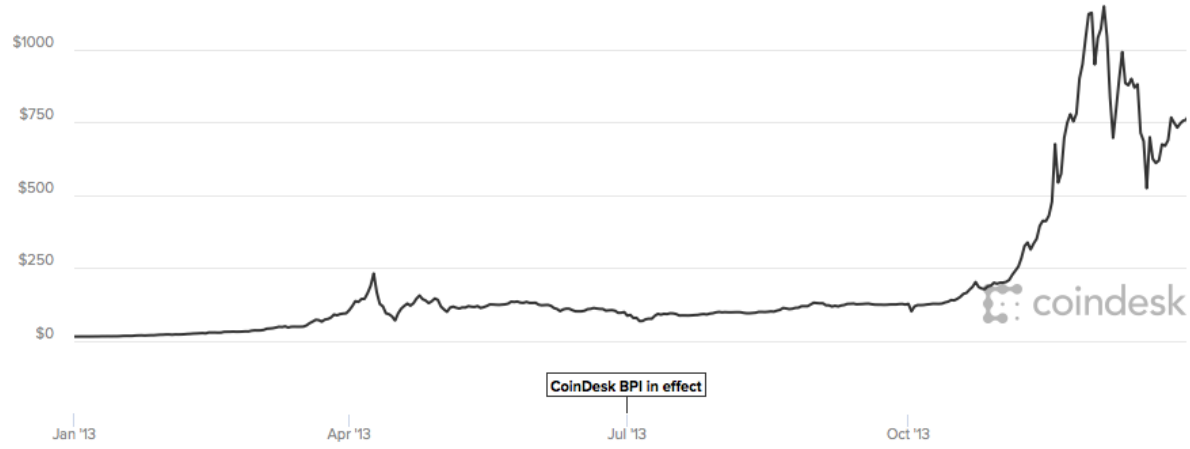

Figure 3: Bitcoin price evolution during the year of 2013. Source: Coindesk

The year of 2014 was not one of the best years for Bitcoin. It started trading at almost 1000 USD, and finished at almost half the price. Some of the most important facts for this drop were: the hacker attack on Mt. Gox and several other cryptocurrency exchanges; also, IRS declared Bitcoin to be taxed as property. Until the end of the year, several tech companies like Microsoft or Dell started to accept the currency. Bitcoin started 2015 dropping again, and by June, the price hit 232.05 USD. Why? The New York State Department of Financial Services released a set of rules meant to regulate cryptocurrencies, called BitLicense. It consists on a business license granted for the activities that involve cryptocurrencies and contains a set of regulations. BitLicense is required for those firms that are engaged in cryptocurrency business activities such as receiving or transmitting cryptocurrencies on behalf of consumers, performing exchange services, securing or maintaining control of cryptocurrencies on behalf of others, among others. Opposite to this, this regulation excludes who uses cryptocurrencies only for purchase or sale of goods or services, on personal terms.

In the same year, Bitcoin was declared a commodity by the US regulators and the European Court of Justice ruled that the exchange of Bitcoin and other cryptocurrencies were no subject to VAT, which lead to the price to start to increase again.

Through the year of 2016, Bitcoin's price started at somewhere near 400 USD and managed to end the year at 850 USD. An increase of more than 100%.

It was in January 2017 that Bitcoin reached another really important milestone. The 1000 USD barrier was reached, and in the same month it reached 1020.47 USD, which led to a significant mass media coverage and consequently an influx of new users. In March of the same year, Bitcoin almost hit 1200 USD, when the SEC denied a request to bring to the market a first-of-its-kind product tracking Bitcoin. The price kept on increasing: July, 2500 USD; September, 4760 USD; November, 7118 USD; December, 19343 USD. And this was, arguably, the best year Bitcoin ever experienced. The year ended with the currency evaluated at almost 20000 USD, which meant a high record value for any cryptocurrency in the market.

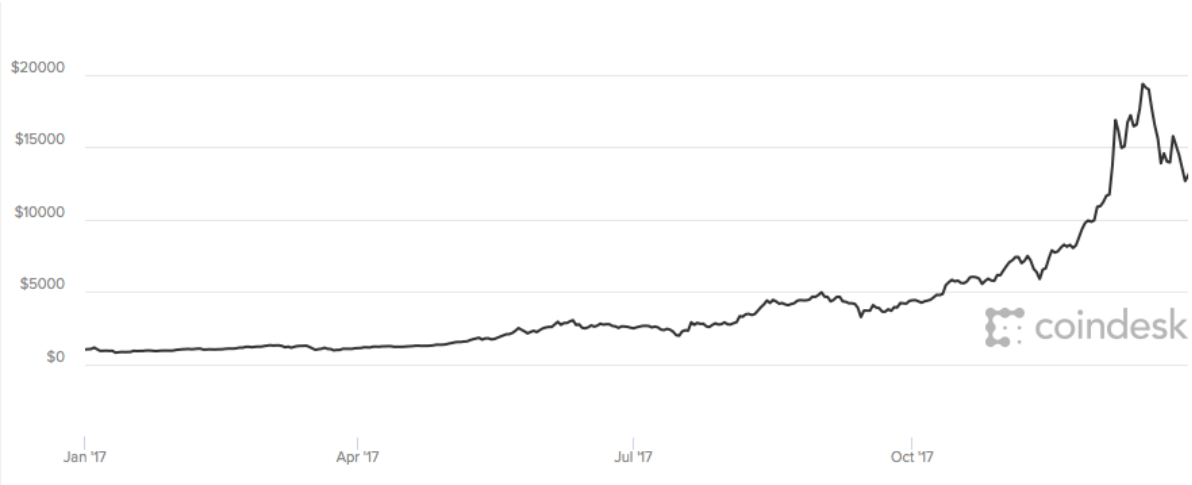

Figure 4: Bitcoin price evolution during the year of 2017. Source: Coindesk

Among the several reasons that explained this growth:

- The growing interest on cryptocurrencies by analysts, investors and people in general, recognizing this asset class to be particularly attractive;
- Media coverage;
- Sustained inflows: the total market capitalisation of all cryptocurrencies has risen sharply in 2017;
- ICO frenzy: the initial coin offerings have raised more than 1 billion USD in 2017. These ICO's raised six times as much money in 2017 as they did during all the previous year. The rising incidents of these tokens sales have pushed many investors to Bitcoin;
- Segregated witness, or SegWit, had made possible to Bitcoin's blocks to hold more

transactions by reducing their size;

- Significant progress, Bitcoin has made significant progress this year, reaching several milestones and enjoying the resulting price increases.

The following table summarizes everything said until now, with the price in the beginning and end of each year and how much it has grown in each year.

Year	Price (Jan 1st)	Price (Dec 31st)	Highest Price	Annual growth
2011	$0.3	$4.25	$29.6 (June)	1316,67%
2012	$5.27	$13.45	$13.7 (December)	155,22%
2013	$13.30	$757.50	$1 147.25 (December)	5595,49%
2014	$770.44	$309.87	$951.39 (January)	-59,7%
2015	$313.92	$430.05	$465.50 (December)	36,99%
2016	$434.46	$968.23	$968.23 (December)	122,86%
2017	$997.69	$12 629.81	$19 343.04 (December)	1165,9%

Table 1: Bitcoin - The beginning price of Bitcoin each year, the ending price of each year, the highest price reached every year and the annual growth percentage. Source: Coindesk

To summarize, Bitcoin was released in 2009 and was designed to act as a secure peer-to-peer decentralized payment system. In this cryptocurrency, users can be confident that every transaction is legitimate, because everything is shown on the Blockchain, the public ledger. Another important characteristic of Bitcoin is its transaction speed. In less than one hour every transaction will appear. Bitcoins are put in circulation through mining, which is the "process of adding transaction records to Bitcoin's public ledger of past transactions or Blockchain" (Hesoid Services LLC, 2016: 4). Bitcoin operates on a proof-of-work basis, which means that in order to create blocks and add them to the Blockchain, complex mathematical problems have to be solved.

2.3.2 Ethereum

In 2017, Garrick Hileman and Michel Rauchs released "Global Cryptocurrency Benchmarking Study" in the University of Cambridge. In this report, they announced Ethereum as the second largest cryptocurrency in terms of market capitalisation and described it as a "decentralised computing platform which features its own Turing-complete programming language". In this cryptocurrency, "the Blockchain records scripts or contracts that are run and executed by every participating node, and are actively through payments with the native cryptocurrency called ether".

Ethereum was officially launched in 2015, and has attracted significant interest from many developers and institutional actors ever since. It has been described as being much more than a payment system. 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 influence" (Ethereum Foundation, 2016).

Another Ethereum characteristic, different from Bitcoin, is that Ethereum's protocol was built to allow flexibility and increase functionality to program many types of smart contracts within Ethereum system. "Ethereum's smart contracts use Blockchain stored applications for contract negotiation and facilitation. The benefit of these contracts is that the Blockchain provides a decentralized way to verify and enforce them. The decentralized aspect makes it incredibly difficult for fraud or censorship. Ethereum's smart contracts aim to provide greater security than traditional contracts and bring down the associated costs." (Rosic, 2017).

When it was first released, they had an initial offering of ether, the cryptocurrency behind Ethereum, of 60 million ethers, with the additional ether being released via the mining process, similar to Bitcoin. Contrary to Bitcoin, Ethereum does not have a maximum total number of ether in circulation.

"Another difference will be the method of reward. Instead of rewarding miners for creating blocks, validators will earn a transaction fee for each transaction and smart contract they validate. This will be much more energy efficient and will put a focus on bandwidth rather than hash rate, the number of calculations per second. It will also help to put focus on collaboration rather than competition because the faster everyone can reach consensus, necessary to complete

a block, the more transactions they'll be able to complete, resulting in higher profits" (Janin, 2015).

In summary, Ethereum is different from Bitcoin. What are their main differences?

- Bitcoin trades in cryptocurrency, while Ethereum offers several methods of exchange, including cryptocurrency (Ethereum's is called Ether), smart contracts and the Ethereum Virtual Machine (EVM).
- They are based on different security protocols: Ethereum uses a "proof of stake" (POS) system as opposed the "proof of work" (POW) system used by Bitcoin.
- The average block time for Ethereum is significantly less than Bitcoin's: 12 seconds against 10 minutes. This translates into more block confirmations, which allows Ethereum's miners to complete more blocks and receive more Ether.

Ever since it first showed up, Ethereum has been conquering a big part of the market. One year after starting operating, Ethereum had already conquered 10% of the market capitalisation, and in 2017 was responsible for more than 16% of the cryptocurrency market.

Figure 5: Ethereum price evolution from 2015 to 2018. Source: Coindesk

Ethereum's first year started with the cryptocurrency trading at 1.33 USD, but a few months later it was trading at 0.44 USD and at the end of 2015 was valued at 0.9 USD. In 2016, Ethereum reached the 10 USD milestone, in March. Later, in June, another record value for the cryptocurrency, reaching 18.44 USD. Until the end of the year, the currency started losing strength, and ended the year trading at 8.07 USD.

The year of 2017 was clearly Ethereum's best year. From January, trading at 8 USD, to June, the currency increased its value by 4672,5%, reaching almost 390 USD per coin. Until November, the currency had a lot of ups and downs, but still managed to recover and ended 2017 trading at a record price of 719.55 USD, as we can see in Figure 6.

Ethereum started 2018 on the same way it ended 2017, growing. In January, Ethereum achieved another milestone, the 1000 USD milestone. In the same month, it reached its record price, of 1366.9 USD.

Figure 6: Ethereum price evolution from January 2017 to January 2018. Source: Coindesk

2.3.3 Ripple

Ripple is the only cryptocurrency that does not have a Blockchain but instead uses a global consensus ledger. The Ripple protocol is used by institutional actors such as large banks and money service businesses. A function of the native token, XRP, is to serve as a bridge currency between national currency pairs that are rarely traded, and to prevent spam attacks.

Ripple was developed and released in 2012 by a company with the same name, in order to enable "secure, instant and nearly free global financial transactions". It was built on similar principles to Bitcoin, however, unlike Bitcoin, the source code of Ripple's technology is owned privately by the company, and cannot be verified of accessed by any outsider.

Ripple is a very popular network, and has been used by many banks across the world, who use it as the basis for their own settlement infrastructure. Its native currency, XRP, has been

consistently present in the top five cryptocurrencies by market capitalisation for the past several years.

Nowadays, Ripple is trading at a value of 0.6 USD. However, in January 2018 it reached a record value of 3.4 USD.

Figure 7: Ripple price evolution from September 2013 to March 2018. Source: CoinMarketCap.

2.3.4 Litecoin

Litecoin was launched in 2011 and is considered to be the "silver" to Bitcoin's "gold" due to its more plentiful total supply of 84 million LTC. It borrows the main concepts from Bitcoin but has changed some key parameters, like the mining algorithm.

Litecoin, on its own webpage, is described as "… a peer-to-peer Internet currency that enables instant, near-zero cost payments to anyone in the world. Litecoin is an open source, global payment network that is fully decentralized without any central authorities. Mathematics secures the network and empowers individuals to control their own finances. Litecoin features faster transaction confirmation times and improved storage efficiency than the leading math-based currency. With substantial industry support, trade volume and liquidity, Litecoin is a proven medium of commerce complementary to Bitcoin." [7]

[7] From Litecoin website, https://litecoin.org

When compared with Bitcoin, Litecoin lands on some main differences, like: total amount of coins, which is relatively higher on Litecoin; transaction processing speed, which is lower than Bitcoin's; and a different algorithm.

Ever since 2011, and until 2016, Litecoin presented a "stable" value between 3 USD and 4 USD. The year of 2017 marked a different milestone also for Litecoin. In the beginning of the year, the price started to increase, reaching almost 40 USD in July, 80 USD in September and 366 USD in December. After December, the price started to decline, and nowadays it is at 144 USD per coin.

Figure 8: Litecoin price evolution from September 2013 to April 2018. Source: CoinMarketCap.

2.3.5 DASH

DASH is a privacy-focused cryptocurrency launched in early 2014 that has recently experienced a significant increase in market value, since the beginning of 2017. In contrast to most other cryptocurrencies, block rewards are being equally shared between miners and "masternodes", with 10% of revenues going to the "treasury" to fund development, community projects and marketing.

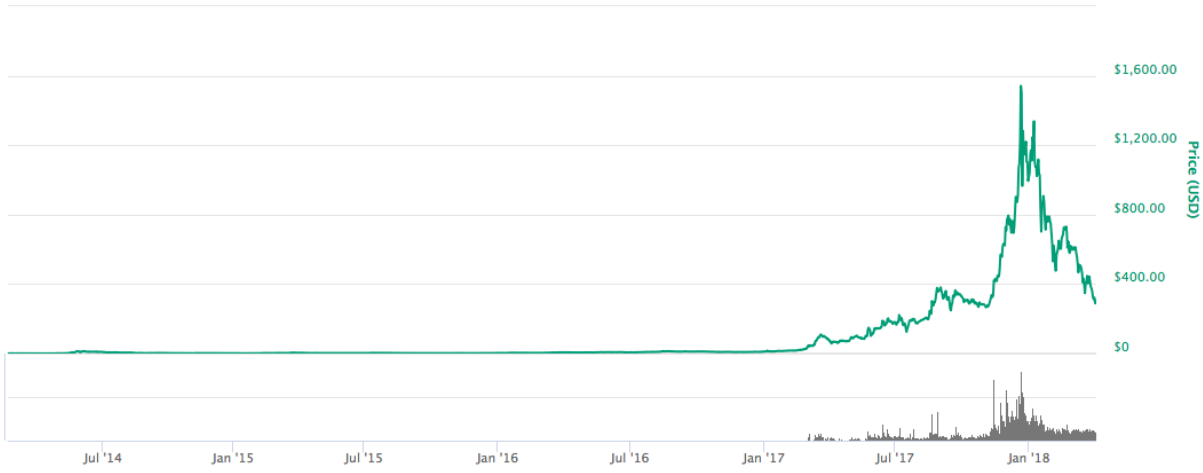

Figure 9: DASH price evolution from July 2014 to January 2018. Source: CoinMarketCap.

As all the other main cryptocurrencies, DASH also experienced a skyrocketing growth in 2017. The year started with the coin trading at 11.22 USD. In March, the first peak: DASH reached the 100 US milestone, and that never happened before, not even close. In September, another peak and DASH reached more than 370 USD per coin. And the year was still not over, because in December, DASH reached a record value of 1542 USD, setting a new record value and reaching another really important milestone, the thousand-dollar milestone.

Section 3: The Market for Cryptocurrencies - Primary and Secondary

In this section, the aim is to fully understand the cryptocurrency market that exists nowadays. A detailed analysis of the primary market, composed by Initial Coin Offerings, and the secondary market, composed by Exchanges, Wallets, Mining and Payments. In this section, all the pieces of the market have been studied: how they operate, how long have they been operating and the differences between every sector of the cryptocurrency market.

3.1 The Growing Market for Cryptocurrencies

Cryptocurrencies have been described as "one of the greatest technological breakthroughs since the internet" (PwC, 2015: 1) but also as a "black-hole" (PwC, 2015: 1), into which a consumer's money could just disappear. Nowadays, the issue that analysts and specialists are facing is no longer if cryptocurrencies will survive, but rather how are they going to evolve in the future and when it will reach maturity.

"Growth within the cryptocurrency market has been driven largely by venture capitalists investing in technology infrastructure, and other investors seeking to profit from price fluctuations, rather than by consumers actually using cryptocurrencies." (PwC, 2015: 5). The PwC report (2015) also states that despite the vast potential of cryptocurrencies, the current state of this market remains fragile, due to several threats that have appeared in the last years. However, the following years are still subject to challenges, such as tax evasion, bribery payments, illicit financing, and so on, which means that the cryptocurrency market will develop at a pace set by its key participants. There key participants are merchants and consumers, technology developers, investors, financial institutions and regulators.

For consumers and merchants, cryptocurrencies offer a faster and cheaper peer-to-peer payment option without the need to provide personal information. In the future, consumers will accept and adopt cryptocurrency as payment method, but for that to happen, they need to have a better knowledge of it, improved availability, reliable cash exchange and an affordable level of consumer protection, as well as considering cryptocurrencies as a stable currency in which they can rely. This required level of acceptance will be easier to achieve "when consumers have access to innovative offering and services not otherwise available through traditional payment systems" (PwC, 2015: 7).

Nowadays, one of the most limiting aspects for cryptocurrencies is consumer awareness. PwC (2015) conducted a study where they concluded that only 6% of the respondents are "very familiar or extremely familiar" with cryptocurrencies. More than 80% of the respondents answered, "slightly familiar or not familiar at all" when asked about this topic. Another misconception about cryptocurrencies is that transactions are completely anonymous. In the same study, PwC tried to understand how have people been using cryptocurrencies in their personal life. The largest amount of the respondents, 81%, have been using cryptocurrency for online shopping. 17% of the respondents use cryptocurrency to online gaming or gambling sites, as well as anonymity when buying certain products. The respondents are also using cryptocurrencies to pay credit cards bills (14%), mortgage payments (10%), international transactions (5%), micropayments (3%) and peer-to-peer payments (3%).

Another challenge, mainly for merchants, is the price volatility associated to cryptocurrencies. Currently, even the market for Bitcoin is "illiquid, fragmented and volatile" (PwC, 2015: 9). The lack of liquidity means that there are higher costs to exchange it into traditional currency, in the form of significant fees. The associated volatility also discourages both consumers and merchants from holding cryptocurrencies for a higher period of time. On the positive side, as the cryptocurrency market continues to grow and mature, liquidity will also increase, which will lead to lower fees, reduced volatility, and will help the cryptocurrency to develop characteristics that are more like widely accepted traditional currency, instead of associated with a commodity.

For technology developers, cryptocurrencies are offering them the possibility to develop exchanges, wallets and alternative cryptocurrencies, as well as mining. Besides this, there is also an enormous market potential for these technology developers who are developing applications based on this new technology. However, for this to work, consumers need to rely on it as a user-friendly solution for their daily transactions, which requires protocols and cybersecurity technologies to be developed and adopted.

For investors, opportunities associated with cryptocurrencies and cryptography are always seen as a good opportunity, due to its inherent value and underlying technology, like the Blockchain. However, in order to reach its full market potential, cryptocurrencies must develop in harmony with applicable regulations.

For financial institutions this is not new, as they have seen the middleman position being diluted in the last years, due to internet banking and the increase in consumer alternative methods like Apple Pay, PayPal or even Google Wallet. Theoretically, with cryptocurrencies, no traditional banking players are needed, so the more cryptocurrencies gains acceptance, the less there will be a need for traditional institutions. Cryptocurrencies will never replace banks but in the future, it will be the main responsible from transforming them. Until now, financial institutions had a skeptical position about involving in the cryptocurrency market, mainly due to the uncertainty about regulation, the costs of integrating such technology and the lack of demand from consumers.

"Cryptocurrency growth over the next year is expected to be solid but not spectacular, and it is important to note that this growth starts from a very low base. Frequency of use is expected to remain low." (PwC, 2015: 14). Cryptocurrency users are frequently asked about their concerns and the most common answers are fraud, value fluctuations and lack of acceptance among vendors and merchants. The concerns enumerated by users are realistic and do represent big obstacles that must be addressed before cryptocurrency being accepted by a larger number of people.

"While retailers are starting to officially respond to the virtual currency market, the scope of the currency's success is ultimately contingent on gaining public acceptance. The intrinsic value of cryptocurrency is in its number of users; without public trust, the system of virtual currency as an alternative payment method is unsustainable. This road is complicated and will require massive amounts of education and assurance to assuage a sceptical public, particularly in light of recent events indicating the volatility of cryptocurrency." (Farell, 2015: 12).

Slowly, with news stories and pioneering individuals, cryptocurrencies are gaining a presence in the global market. However, despite the recent surge of media coverage, cryptocurrency remain widely unknown by the public. The average person is still uninformed about cryptocurrencies, or recognize it just by name, without knowing anything else about it. Coincenter.com, a website concerning all the cryptocurrency topics, published an online survey in April 2015, where only 4.5% of the inquiries had used Bitcoin prior to that date[8].

[8] Data available at https://coincenter.org/surveys

In the cryptocurrency industry, there are three main indicators of success: market capitalisation, estimated amount of cryptocurrency users and the volume of transactions. The market capitalisation was discussed in the first part. Bitcoin still leads when it comes to market capitalisation, but other cryptocurrencies like Ethereum have been conquering its space and reducing Bitcoin's strength in the market. From 2015 to 2017, Bitcoin reduced from 86% to 72% of the market capitalisation, with Ethereum being now responsible for more than 16% of it (Hileman and Rauchs, 2017: 16). The estimated amount of cryptocurrency users is impossible to determine, and it is even difficult to estimate a value, as one of the most important characteristics of cryptocurrencies is the anonymity it provides to its users. The easiest way to try to estimate the number of users is by the number of wallets created. Since 2013, the number of wallets has increased drastically. In 2015, a large online wallet called My Wallet, registered 3.3 million registers, and the number increases by approximately 5000 wallets per day [9]. This numbers provides us with an estimated value, because a single user can own several wallets. The last indicator is the volume of transactions, which is easier to obtain because every transaction is transparent and registered on the chain of blocks that will create the Blockchain. "The transaction volume of Bitcoin on a monthly basis had held steady over the past year, and averaged just under 50 million USD" (Farell, 2015: 13).

The following table describes the amount of daily transaction for the largest cryptocurrencies in 2016 and 2017. "When comparing the average number of daily transactions performed on each cryptocurrency's payment network, Bitcoin is by far the most widely used, followed by considerably distant second-place Ethereum. All other cryptocurrencies have rather low transaction volumes in comparison." (Hileman and Rauchs, 2017: 18).

[9] Data available at https://blockchain.info/

	Bitcoin	Ethereum	DASH	Ripple	Monero	Litecoin
Q1 2016	201,595	20,242	1,582	N/A	579	4,453
Q2 2016	221,018	40,895	1,184	N/A	435	5,520
Q3 2016	219,624	45,109	1,549	N/A	1,045	3,432
Q4 2016	261,710	42,908	1,238	N/A	1,598	3,455
January – February 2017	284,419	47,792	1,800	N/A	2,611	3,244

Table 2: Average daily number of transactions for the largest cryptocurrencies. Source: "Global Cryptocurrency Benchmarking Study 2017".

Although Bitcoin is clearly the leader of the amount of transactions, we can observe that a generalized trend took place in the last quarter of 2016, and ever since, every cryptocurrency besides Litecoin presents a rise in their transaction volumes with DASH and Monero being the ones growing faster than all the others.

Bitcoin is nowadays, not only the leader when it comes to market capitalisation but also the most used cryptocurrency, despite the rising interest of users and investors on different cryptocurrencies, like Ethereum or Ripple. Bitcoin is also the cryptocurrency supported by almost every available wallet, with a quota of 98%. The other cryptocurrencies are growing its popularity, and Ethereum is now available in 33% of the wallets, Litecoin in 26% and Ripple in 13% of the existing wallets[10].

3.2 Primary Market

The primary market of cryptocurrencies consists on ICO's, or Initial Coin Offerings.

An ICO can be described as a non-regulated mean to raise funds for a new cryptocurrency venture. This type of funding is used by start-ups to overcome the highly regulated and rigid capital-rising process required by banks or venture capitalists.

[10] Data available at Global Cryptocurrency Benchmarking Study 2017

Initial Coin Offerings are appealing to traders and investors in the same way that Initial Public Offerings (IPO's) are. They offer a high volatility as the market comes up with an appropriate price of the asset.

A good example of an ICO project that was successful, that lead investors to profit, is the smart contract platform called Ethereum, that was presented in the first part of this dissertation. This project was announced in 2014 and its Initial Coin Offering raised more than 18 million USD (in Bitcoin) or 0.4 per Ether. Later, in 2015, the project went live, and one year later, the price per coin, reached 14 USD, with a market capitalisation of more than 1 billion USD.

"Coinciding with the substantial growth in cryptocurrencies, companies and individuals increasingly have been using Initial Coin Offerings to raise capital for their businesses and projects. Typically, these offerings involve the opportunity for individual investors to exchange currency such as U.S. dollars or cryptocurrencies in return for a digital asset labelled as a coin or token." (SEC, 2017: 3).

"Regardless of their functions on the platform, cryptocurrencies have also turned out to be a very successful way for start-ups to raise early financing. Instead of going to the expense of making an Initial Public Offering (IPO) of stock or the trouble of convincing a venture capitalist to back the company, Blockchain companies have started to make Initial Coin Offerings (ICO's)." (Conley, 2017: 1).

The typical procedure for a start-up is to produce a white paper with the details about the functions that the tokens issued during the ICO will perform. It should contain what the project is about, what needs it will fulfil, how much money is needed, what type of money is accepted, how long will the ICO campaign last and it must be clear about the limits of the tokens created. The legal status of ICO's is still unsettled at this point. "If cryptocurrencies are considered a form of currency, then the issuing start-up may need to comply with know your customer (KYC) and anti-money laundering (AML) rules." (Conley, 2017: 2). However, if they are considered as a form of stock, start-ups must comply with certain securities and exchange commission (SEC) regulations.

Whether cryptocurrencies are currencies, securities or something entirely new, also affects their impact and how they should be considered from an economic point of view. Even though there are a lot of studies and a well-developed body of theory in monetary and financial economies, how it should be applied to cryptocurrencies and ICO's is only beginning to be explored. At this point, there are not many economic guidelines about how potential investors should vale the tokens that are offered for sale, how start-ups should structure their own Initial Coin Offerings, and what are the implications of assigning various roles to tokens on a platform might be.

3.3 Secondary Market

The secondary market of cryptocurrencies consists of four main industry sectors: exchanges, wallets, payments and mining. Exchanges have the primary function of purchase, sale and trading these currencies. Wallets are responsible for the storage of cryptocurrencies. Payments have the primary function of facilitating payments while using cryptocurrencies and the last one, mining, consists of securing the ledger by computing large amounts of hashes to find a block that gets added to the Blockchain.

All of these industry sectors are truly important for the cryptocurrency ecosystem, because they build an interface between traditional finance and several economic sectors. Also, the existence of these sectors adds significant value to cryptocurrencies, "as they provide means for public Blockchains and their native currencies to be used beyond in the broader economy." (Hileman and Rauchs, 2017: 19).

3.3.1 Exchanges

The exchanges are where buyers and sellers of cryptocurrency trade. The main function of these cryptocurrency exchanges is to allow users to easily trade with publicly posted prices and order books. The orders made by customers are anonymously and directly matched using automated algorithms. "Exchanges provide on-off ramps for users wishing to buy or sell cryptocurrency. The exchange sector is the first to have emerged in the cryptocurrency industry and remains the largest sector both in terms of companies and employees." (Hileman and Rauchs, 2017: 26).

"The primary advantage of these exchange-based accounts is faster confirmation of trades, because the exchanges act as the intermediary, offering instantaneous verification of the trades between affiliated accounts so that the transaction does not have to go out to the network at large and await verification by miners, which can take up to an hour." (Lo and Wang, 2014: 14).

Hileman and Rauchs (2017) conducted a study on cryptocurrency and they understood that exchange services could be divided into three categories: order-book exchanges, brokerage service and trading platform. Order-book exchange consists on a "platform that uses a trading engine to match buy and sell orders from users". Brokerage service is a "service that lets users conveniently acquire and/or sell cryptocurrencies at a given price". The trading platform is a "platform that provides a single interface for connecting to several other exchanges and/or offers leveraged trading and cryptocurrency derivatives".

Exchanges provide a service to allow investors and traders to buy and/or sell cryptocurrencies and other digital assets for national currencies and other cryptocurrencies. This industry sector plays an essential role for the cryptocurrency economy, providing everyone with a marketplace for trading, liquidity and price discovery.

It was one of the first services to emerge on the cryptocurrency industry, with the first exchange being founded in 2010. This was a project that had the intention to allow investors to trade Bitcoin, the only cryptocurrency at the time, and establish a market price. As said before, this is the most "populated" sector of the cryptocurrency industry, with more than 138 different cryptocurrency exchanges.

In 2014, there were five main exchanges in the ecosystem of cryptocurrencies that were responsible for almost all the trading volume of Bitcoin: Mt. Gox, prior to its bankruptcy, was responsible for 51,7% of the market share, with a volume ascending to 41.6 million USD; Btcchina and Huobi were responsible for 12,3% and 11,4%, respectively, with a volume of 9.9 million USD and 9.16 million USD; Bitstamp held 10,7% of the market with a volume of 8.6 million USD; and Btce, with a volume of 6.86 million USD, which represented 8,54% of the market[11] . The reason why there are several exchanges is that traders may place different

[11] Data available at Global Cryptocurrency Benchmarking Study 2017

weights on different attributes. Some traders or investors might prioritize receiving the best price offer, while others are mostly preoccupied with the transaction speed.

In 2017, the trading volume across the most important exchanges can be seen on the following figure. Exchanges like Btcchina (BTCC) or Huobi started losing its importance due to the changes in regulation that happened in China.

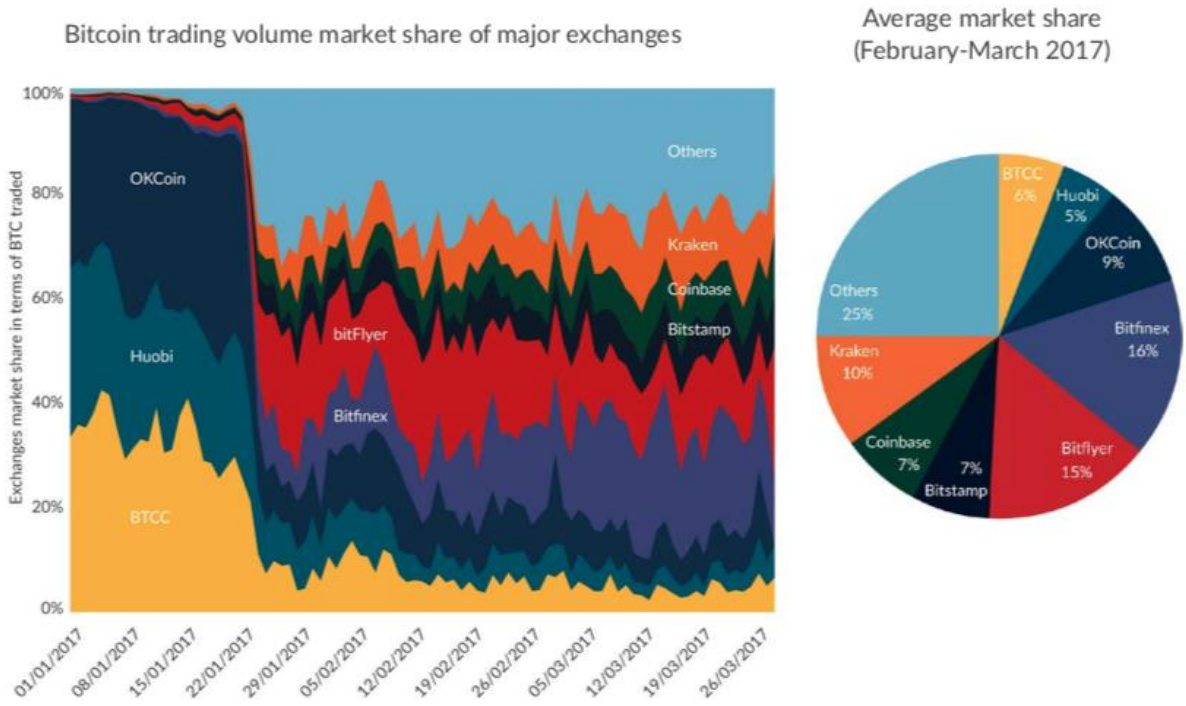

Figure 10: Trading volumes across the top exchanges are more evenly distributed following increased regulation of Chinese exchanges in early 2017. Source: "Global Cryptocurrency Benchmarking Study 2017".

There are several differences between exchanges when it comes to trading by national currency. The US dollar is the most supported national currency traded in exchanges, with 65% of them allowing investors to trade with the American currency. The Euro is accepted in 49% of the exchanges and the British Pound in 39% of the exchanges. The Chinese Renminbi represented a significant majority of trading volumes until the year of 2016. After this year, and affected by the thigh regulation approved by the People's Bank of China, the Chinese currency is now responsible for only 20% of Bitcoin's trading volume, and its exchanges have also suffered a huge loss in terms of market share.

"The majority of exchanges (mostly small) specialise in local markets by supporting local currencies: 53% of all exchanges support national currencies other than the five reserve

currencies. Trading volumes at most small exchanges are insignificant compared to the market leaders, but these exchanges service local markets and make cryptocurrencies more available in many countries." (Hileman and Rauchs, 2017: 30).

Nowadays, every exchange supports Bitcoin, and Ethereum is the second most present cryptocurrency in worldwide exchanges, being present in 43% of them. Litecoin can be find in 35% of exchanges, and Ripple only in 16% of exchanges. Figure 2 shows the percentage of exchanges where the main cryptocurrencies can be traded.

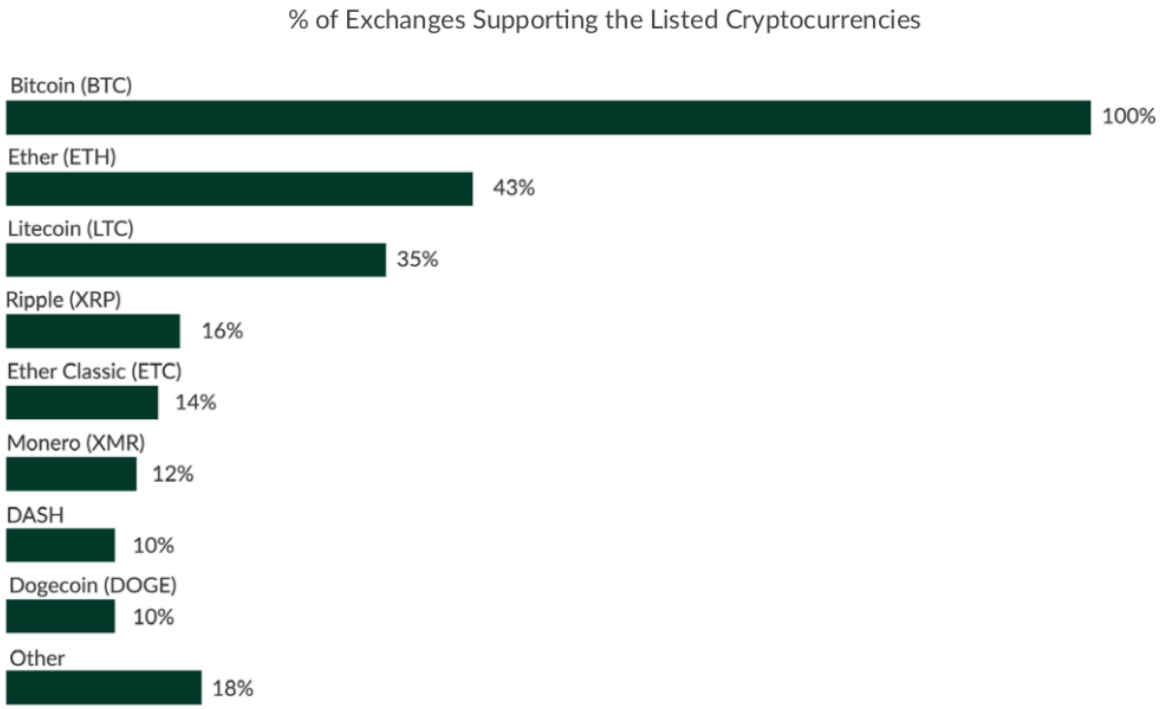

Figure 11:Bitcoin is listed on all every exchange worldwide; Ethereum and Litecoin are also widely supported. Source: "Global Cryptocurrency Benchmarking Study 2017".

Besides this, there are 39% of exchanges that solely support Bitcoin. A quarter of the worldwide exchanges only support two cryptocurrencies and 36% of all exchanges enable trading three or more cryptocurrencies.

3.3.2 Wallets

This type of intermediaries are the ones responsible for connecting the final user-owner of cryptocurrency with the network. A good example of a cryptocurrency wallet is Coinbase Incorporated, which is a platform for users to exchange their currencies into and out of Bitcoin,

or any other cryptocurrency, manage their balances and transact with others in the same currency, even if it is to pay for goods or services.

A digital wallet can be described as a system that safely stores user's passwords and payment information for different payment methods and websites. By using a digital wallet, users are allowed to complete purchases in an easier and quicker way with near-field communications (NFC) technology.

"A wallet generally is a software program that is used to securely store, send and receive cryptocurrencies through the management of private and public cryptography keys." (Hileman and Rauchs, 2017: 48) Wallets are also responsible for providing user interface for things like tracking the balance of cryptocurrency holdings, and automate certain functions, such as estimating what fee to pay to achieve a desired transaction confirmation time.

One important service that wallets provide to retail users that transact with others using a determined cryptocurrency, is that the wallet will manage all the verification process on behalf of the account owners. Their transaction request will be verified in a more timely and safer manner without the need of a continuous monitoring of each part of the transaction. On the other hand, wallets also make the process easier and more secure for the merchants.

As the same happened with exchanges, there are also hundreds of different wallets, and different wallets provide charge for their services in somewhat different ways. Coinbase charges 1% fee for exchanging Bitcoin into and out of a traditional currency.

Wallets are needed when it comes to acquiring and storing cryptocurrencies, and there are several different types of wallets, varying in terms of safety, convenience, accessibility and so on. Wallets can be divided into: paper, physical currency, mobile, web, desktop, hardware or bank. Mobile wallets are the most common one, and mainly used by people who are already using cryptocurrencies on a daily basis, using it to pay for goods or services. It runs on a smartphone app and allows users to pay directly from their smartphones. This type of wallet is the preferred one for the users.

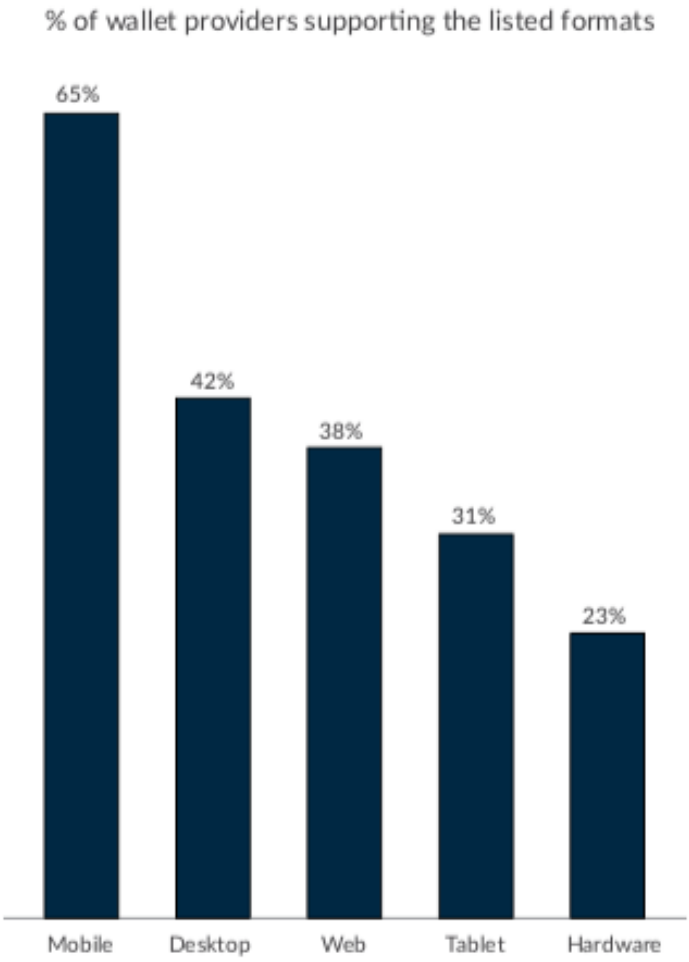

Figure 12: Percentage of each type of wallet used nowadays; Mobile wallet app is the most widely offered form of wallet. Source: "Global Cryptocurrency Benchmarking Study 2017".

Web wallets are similar to mobile wallets. They enable their users to access their fund on-the-go from any device connected to the internet. Desktop wallets are, by definition, the most secure type of wallet because they do not rely on third parties for their data and are much harder to hack. These desktop wallets are usually the preference of users trading small amounts of a determined cryptocurrency.

The same way Bitcoin was the cryptocurrency with more presence in exchanges, it also happens with wallets. Bitcoin is present in almost every wallet available, while Ethereum and Litecoin are only present in 23% of the worldwide wallets.

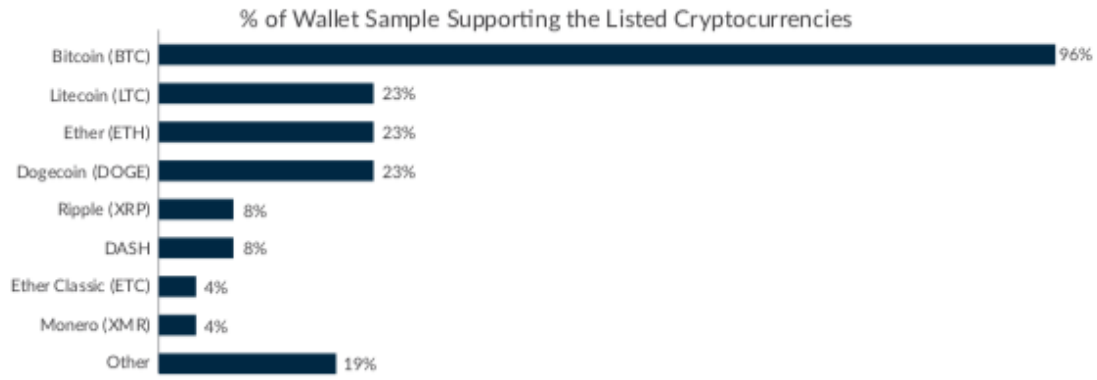

Figure 13: Percentage of wallets that support a determined cryptocurrency; Litecoin, Ethereum and Dogecoin are the most widely supported ones after Bitcoin. Source: "Global Cryptocurrency Benchmarking Study 2017".

"Wallets have evolved from simple software programs handling key management to sophisticated applications that offer a variety of technical features and additional services that go beyond the simple storage of cryptocurrency" (Hileman and Rauchs, 2017: 46). In the study conducted by both authors, they found out that between 5.8 million and 11.5 million wallets are estimated to be active today, that mobile wallet apps are the most widely offered format, followed by desktop and web wallets and that 39% of wallets are already offering multi-cryptocurrency support and a good percentage of the existing wallets are going to implement this feature in a near future.

It is estimated that the number of wallets has increased from around 8 million in 2013 to almost 35 million in 2016. However, this is just an estimated number, because there is no data available to confirm it. This number is estimated according to the number of downloaded wallets. Also, the number of active wallets ranges from 7.5% to 31% of the total number of wallets.

3.3.3 Payments

Payment companies usually act as gateways between the users of the Blockchain technology and the broader economy, bridging national currencies and cryptocurrencies.

All cryptocurrency systems must have an integrated payment network to process the transactions in the native token. Payments can be divided in two broad categories: payment

rail, where cryptocurrencies are used as a fast channel for faster and cost-effective transfer of national currencies, and cryptocurrency payments, focused on facilitating the use of cryptocurrencies. The first one, payment rail, can be split in two payment activities:

- Money transfer services, that are services that provide international money transfers for investors denominated in national currency;
- B2B payments, where the platforms provide payments for businesses.

The second division of payments consists on payments focused on cryptocurrencies. And these payments can also have two different activities:

- Merchant services, by processing payments for cryptocurrency-accepting merchants;
- General-purpose cryptocurrency platform, which contains a variety of cryptocurrency services like instant payments to other users, payroll or other services.

According to Hileman and Rauchs (2017) study, more than half of the payment companies provide merchant services. 46% of payment service providers feature a fuller-featured platform that lets users buy, store and transfer cryptocurrency. However, only 19% of them are offering B2B payments. Also, 56% of these companies are supporting Euro and Dollar, but all the other national currencies remain "short". The British Pound is supported in 42% of the companies, the Chinese Renminbi in 33% and the Mexican Peso, the Canadian Dollar and the Australian Dollar somewhere around 21% to 27%. This means that these national currencies are supported because there is local demand in these countries for services provided by the payments companies.

3.3.4 Mining

Another type of intermediary are miners, who operate individually or as a part of a coalition, in a process called mining. A good example is the Bitcoin network, that was designed to rely on the miners to verify and validate every transaction that came across the Blockchain.

Miners are "those who own underlying resource, and thus expend it – secure the network, and are compensated for their work in the form of either transaction fees or newly minted coins. The mechanism used to secure the network determines the resource chosen and the method used to pay the miners". (Farell, 2015: 4).

Miners play an essential role in every cryptocurrency system as they are the ones responsible for grouping the unconfirmed transactions into new blocks and growing them to the global ledger, the so called Blockchain. What miners do is providing the computing power to secure the Blockchain, by computing vast numbers of hashes to find an acceptable block. For each block that a miner validates, a reward is generated and makes it harder for an attacker to reorganise the ledger and double-spend already confirmed transactions.

Ever since the beginning of Bitcoin, the mining activity has grown from a simple hobby performed by tech enthusiasts and using ordinary equipment, into a capital-intensive industry with custom hardware equipment and features a specialised value chain. The mining activities can now be summarized into five categories, according to Hileman and Rauchs (2017).

The five categories are:

- Mining: individuals and organisations using their own mining equipment to process transactions and earn the mining reward and/or transaction fees;
- Mining pool: combines computational resources from multiple miners to increase the likelihood and frequency of funding a new block, and then distributes the mining rewards among participating miners based on the proportion of contributed computational resources;
- Mining hardware manufacturing: organisations designing and building specialised mining equipment;
- Cloud mining services: organisations renting out hashing power to customers;
- Remote hosting services: organisations hosting and maintaining customer-owned mining equipment.

In 2010, and motivated by the increasing in the computing power by miners, emerged the first Bitcoin mining pool. This allowed participants to share a reward based on how much contributed, with computing power, to the pool. Ever since 2010, the revenues associated to mining have increased drastically, reaching over 2 billion USD in the year of 2016. This further evidence the evolution of cryptocurrency mining, that went from a hobby activity for some tech enthusiasts in the early days to a professional industry, with large amounts of capital at stake.

Some estimates indicate that users, alone, would have to spend more on electricity and equipment than what they were going to obtain by doing it. Because of this, users often pool their hardware together to increase computational power and then share the rewards between everyone involved.

"… a user can acquire new Bitcoins by serving as miner and applying his or her computer's processing power to successfully verify the validity of new network transactions. The probability of an individual discovering Bitcoins through mining is proportional to the amount of computer processing power that can be applied." (Murphy, Murphy and Seitzinger, 2015: 2).

Section 4: Investing on Cryptocurrencies

In this section, the aim is to give insight and clear understating on how cryptocurrency is being used, not only as an investment method but also as a transactional method. Besides that, the availability of having cryptocurrency, and is this particular case Bitcoin, as money, where we can evaluate its performance while working as a medium of exchange, unit of account or store of value. To end the section, a detailed explanation on how cryptocurrencies are being called of a "bubble".

4.1 Investment Adaptation

Bitcoin and its technological innovation, Blockchain, have become the next big thing ever since it was firstly introduced by Satoshi Nakatomo. Someone who invested in Bitcoin in the beginning of 2012 would now be a multimillionaire, and many believe that price volatility, bad actors, sensational media and some technical jargon are the main reasons why much of the masses are still unaware from what could be the biggest technological development ever since the Internet.

One of the things that still generates a lot of discussion is the classification of Bitcoin, or any other cryptocurrency, as an asset. Burniske and White (2017) find that even the financial institutions were classifying it in different ways. The Commodity Futures Trading Commission (CfTC) asserts it is a commodity. The Internal Revenue Service (IRS) deems it as property. And lastly, the Securities Exchange Commission (SEC) decided to approach it on case-by-case basis.

The definition of asset was firstly introduced by Greer (1997). In this paper, the author divided assets into three super classes: capital assets, consumable or transformable assets and store of value assets. He then clarifies that "the lines between asset classes can still be fuzzy". Capital assets are described as "ongoing source of something of value; valued on the basis of net present value of its expected returns" (Greer, 1997) and equities, bonds and income-producing real state are examples of this class. Consumable or transformable assets are what we can consume and/or transform into another asset. It has economic value but it does not yield an ongoing stream of value. Examples are physical commodities and precious metals like gold. The last class of assets are store of value assets. These cannot be consumed nor can generate

income. Precious metals are eligible to also be considered as store of value assets, as well as currency and fine art.

Burniske and White (2017: 4) have defined four main characteristics to delineate the boundaries among assets. First, "we think that an asset class must be sufficiently investable, providing ample liquidity and opportunity to invest". Second, "it should have a distinct politico-economic profile that arises from its basis of value, governance and use cases". Third, "an asset's market value should fluctuate independently of other assets in the marketplace, exhibiting low correlation of returns". And lastly, "the prior three characteristics should lead to a differentiated risk-reward profile, which can be broken down into absolute returns and volatility". However, when analyzing Bitcoin's situation, or any other cryptocurrency situation, they could not prove Bitcoin's asset class without observing its behavior when compared to traditional asset classes like equities, bonds, precious metals, fiat currencies, and so on.

4.2 Investability: Trading versus Transactional

Investability is defined as "providing ample liquidity and opportunity to invest" (Burniske and White, 2017: 6). This means that Bitcoin is a good measure of liquidity to investors because of the daily exchanged traded volumes, that have been increasing steadily and averaged 1.5 billion USD a day, in 2016. However, the picture is different if we look only at Bitcoin traded as a cross with the US Dollar, Euro and British Pound. Ever since 2014, daily trades with these three main currencies have been ranging between 10 million and 150 million USD. For 2016, this comparison put these currencies between 1% to 8% of the globally traded amount of Bitcoin. Figure 14 shows the dominance of the exchanged traded volume using the Chinese Yuan[12] until the end of 2016, prior to the regulations imposed by the national regulators.

[12] The Chinese Yuan is also represented as Chinese Renminbi.

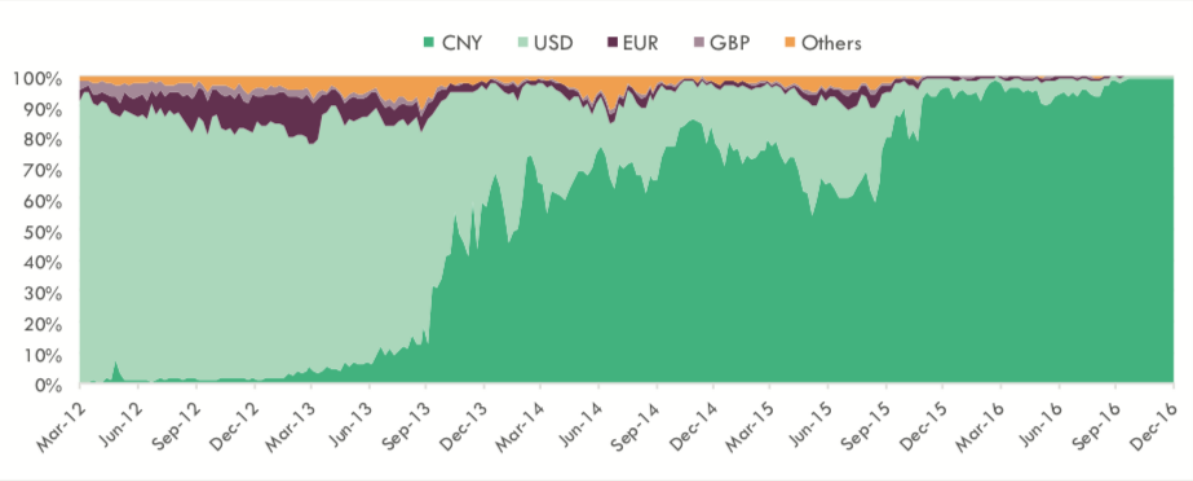

Figure 14: Global Bitcoin exchange traded volume share by currency (EUR, USD, GBP, CNY and others). Source: "Bitcoin: Ringing The Bell For A New Asset Class"

Another metric analysis, that was also conducted by Burniske and White (2017), to understand the speculative versus fundamental value of Bitcoin is the ratio of transaction volume to trading volume. Transactional volume is measured according to the estimated number of coins sent over the Bitcoin network. Trading volume is measured by the number of coins traded on exchanges.

In the last couple of years, Bitcoin and all the other cryptocurrencies have been used in two different situations: for trading means and for transactional means. "Trading is only half of the investability equation, as traders are short-term investors, while many retail holders are long-term orientated." (Burniske and White, 2017: 8). Ever since 2012 that many users of Coinbase wallet service have been using Bitcoin strictly as an investment, instead of using it as a transactional medium. Figure 15 describes how Coinbase users have been interacting with Bitcoin: as an investment or a transaction.

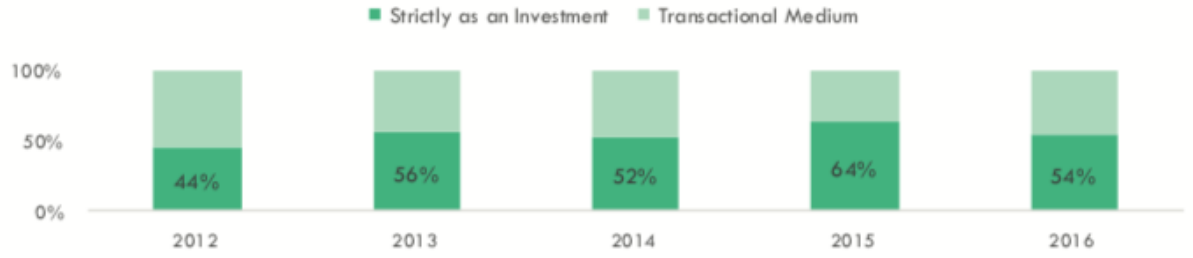

Figure 15: How Coinbase users have been interaction with Bitcoin. Source: "Bitcoin: Ringing The Bell For A New Asset Class".

The volume of Bitcoin used for transactional operations has also been growing rapidly and has reached over 200 million USD on a daily average, in January 2017. Over the last few years, transactional volume grew 60% in 2014, 15% in 2015 and 118% in 2016, which demonstrates real underlying demand for Bitcoin as a means of exchange, to be used on a daily basis.

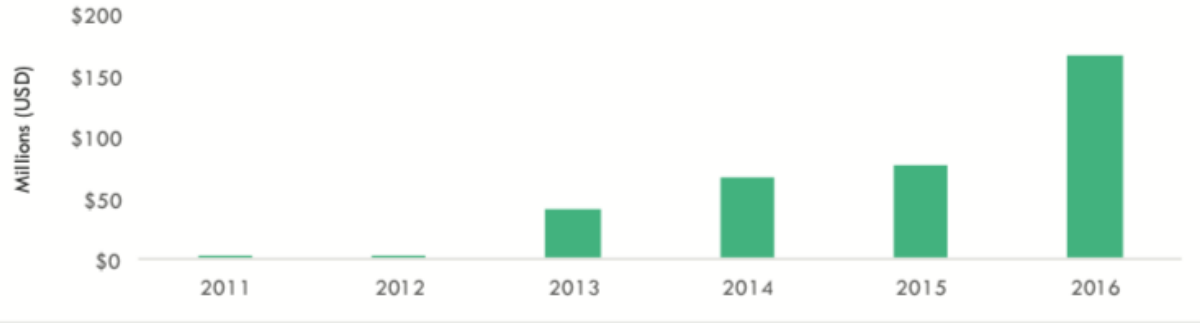

Figure 16: Daily Bitcoin Transactional Volume. Source: "Bitcoin: Ringing The Bell For A New Asset Class".

"A comparison of Bitcoin's global trading volume to its transactional volume highlights that the use of Bitcoin as an investment medium is increasing faster than its transactional applications. Despite day-to-day fluctuations, the significant shift towards trading volume became clear in 2015." (Burniske and White, 2017: 13). The following analysis can be seen in Figure 17.

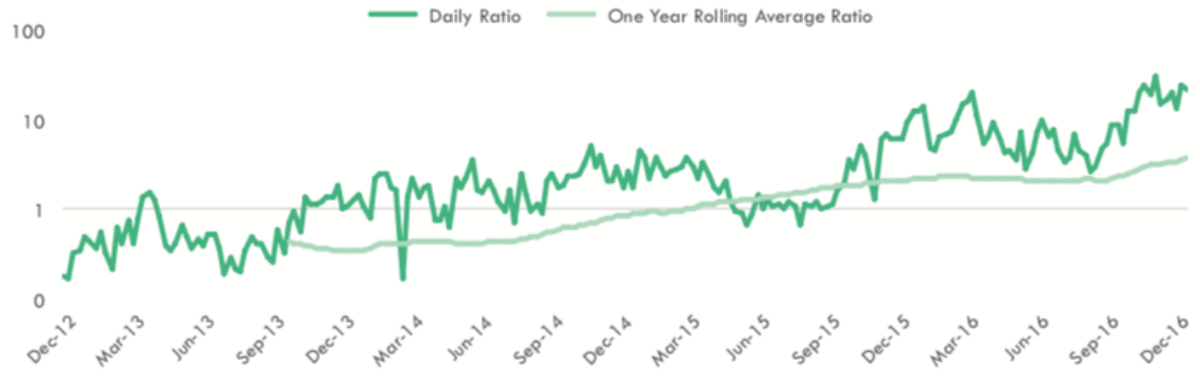

Figure 17: Global daily Bitcoin volumes: trading relative to transacting (log scale). Source: "Bitcoin: Ringing The Bell For A New Asset Class".

A lot of investors describe Bitcoin as an alarming speculative instrument when it is compared to fiat currencies[13]. However, Bitcoin strikes a closer balance between these two, trading and

[13] A fiat currency is also known as fiat money. It is a currency that has been declared by a governmental institution to be legal tender. However, it is not backed as a commodity. The value of it is derived from the relation between supply and demand instead of the material from which the currency is made. It has no intrinsic value, its only value is because every participant in the economy agrees to trust the government issuing the currency.

transacting. This means that when people use cryptocurrency, instead of fiat currencies, they are more likely to use it to transmit value for goods and services.

Another good analysis is if we restrict trading to the US dollar, Euro and British pound. Although trading relative to transacting changes on a daily basis, the trend has been to stabilize over time. "Roughly half as much trading volume, relative to global transactional volume, goes through these three currency pairs. The stable ratio implies that Bitcoin trading in the more regulated currencies has been growing at roughly the same ratio as worldwide Bitcoin transactional volume." (Burniske and White, 2017: 15).

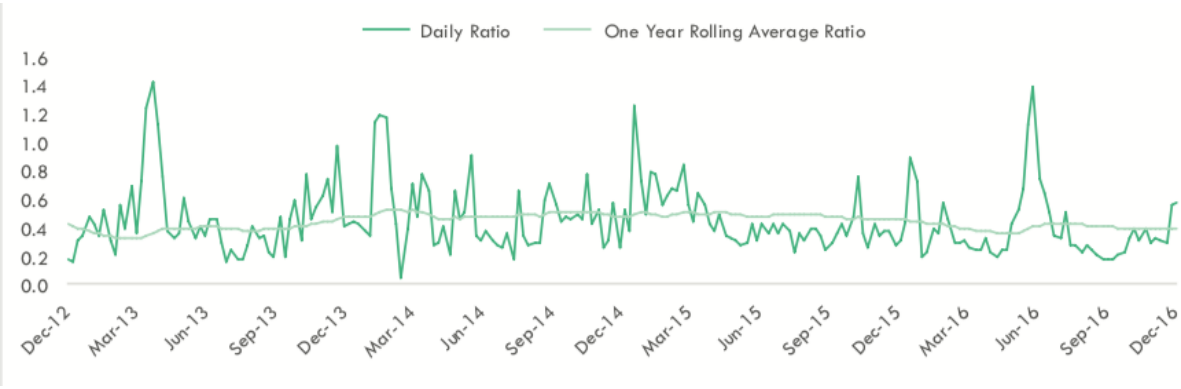

Figure 18: Global daily Bitcoin volumes: trading (USD, EUR, GBP) relative to transacting. Source: "Bitcoin: Ringing The Bell For A New Asset Class".

Bitcoin and the cryptocurrency world keeps adding new investors and new users, and using it to transact will keep growing as its more innovative use cases evolve. These cases may control the power of the Blockchain in an abstract way, facilitating the transfer of real estate, bonds, autos, decentralized venture funding or even votes in an election where smart contracts can be used. This is the main reason why Bitcoin is completely different than all the other classes of assets.

4.3 Bitcoin as Money

Lo and Wang (2014) confronted themselves with a simple question: if Bitcoin's invention is to serve as an alternative to money, and to be used to transact with other individual or collective entities, how well has it served the function of real money, real currency? Generally, economists consider money to be an instrument that serves three purposes: as a medium of

exchange, as a unit of account and as a store of value. Considering all these three scenarios, the authors clarified Bitcoin's different ways of being considered as money. "Whether money comes in the form of paper, shells, precious metals or even cigarettes, it has three primary functions in any economy: as a medium of exchange, a unit of account and a store of value" (Sehra, Cohen, and Arulchandran, 2018: 14).

4.3.1 Bitcoin as a Medium of Exchange

In order for Bitcoin to be accepted as a medium of exchange, it must be accepted as a payment for a sufficiently set of services, goods and other assets. "A user is willing to accept a fiat money as payment for other objects of value only if she is confident that enough others will be willing to accept it in turn for her." (Lo and Wang, 2014: 3).
Unlike fiat currencies, Bitcoin and all the cryptocurrencies, are not yet backed by any sovereign entity. Which means that for them to serve as a medium of exchange, they must rely on the self-fulfilling expectation that it will be accepted.

"The use of money as a medium of exchange enables economic efficiency by eliminating the time and effort required to execute a transaction, known as a transaction cost." (Sehra, Cohen, and Arulchandran, 2018: 14).

Using Bitcoin and the technology attached to it has received a positive feedback, offering sufficiently positive net benefits to be worth experimentation. One of the most important benefits would be saving on payment processing costs incurred by merchants, even though they have to deal with extreme volatility.

4.3.2 Bitcoin as a Unit of Account

"Bitcoin's use as a unit of account is so far entirely derived from, and hence secondary to, its medium of exchange function. In fact, even merchants who accept Bitcoin as payment tend to post prices in standard currencies, such as dollars or euros, instead of Bitcoins." (Lo and Wang, 2014: 10). However, due to its volatility, many investors have chosen to minimize the exchange rate risk by converting cryptocurrency into fiat currency more frequently. It is also understandable that cryptocurrency's volatility diminishes its ability to serve as a medium of exchange. Why? Because users do not like to not know how many coins they will have to pay for a determined good or service.

4.3.3 Bitcoin as Store of Value

Bitcoin, as everyone knows, can also be used as a store of value and can easily become a vehicle for speculative investment. When we compare cryptocurrency with gold or any fiat money that is backed by a sovereign entity and we know for a fact that it has intrinsic value, the current market value of cryptocurrency hinges entirely on the expectation the people have on it to be valued at a greater value.

"Viewed from this perspective, Bitcoin becomes conducive to speculation, and hence subject to bubbles, because its value in any equilibrium rests wholly on self-fulfilling expectations." (Lo and Wang, 2014: 11).

One of the key functions of money is to be a repository of purchasing power, which means money can and is used as a store of value. This is a fundamental function of money because people usually do not want to spend the money right after receiving it. People prefer to wait until they have a determined amount, need or even time. There are many assets that can be considered as a store of value: bonds, stocks, art, estate, jewels, and so on. This means "…scarcity and demand for these assets makes them a useful store of value compared with money, it may diminish their benefits as a medium of exchange and unit of account, which require properties such as stability, standardisation, liquidity, divisibility and portability." (Sehra, Cohen, and Arulchandran, 2018: 14). Therefore, while most of the assets may work as a store of value, only a fraction of these provide the characteristics for a medium of exchange, and an even smaller part can be considered as a unit of account.

There are several reasons that suggest that Bitcoin, and cryptocurrencies in general, display characteristics associated to speculative bubbles. They are: extreme price volatility, numerous headlines about large speculative holdings and large swings in transaction volume. All of these are correlated with price movements, and suggest that cryptocurrency may be a speculative bubble.

4.4 Cryptocurrency "Bubbles"

One of the most unanswered question when it comes to cryptocurrencies is "Is it a speculative bubble or not?" In 2012, the European Central Bank report that cryptocurrencies do not put at

risk financial stability, and the reasons for that to happen are: the limitations when it comes to connect with the real economy, the low volumes that are traded and, in 2012, the lack of acceptance by users, that were still skeptical about using cryptocurrencies. "The ECB conclusion in 2012 was associated with the caveat that the growth of cryptocurrency markets and their integration to the global economy must be monitored, since cryptocurrencies remain the potential source of financial instability." (Corbet et al, 2017: 1).

In this article, Corbet wanted to understand if the Blockchain position, the hash rate[14] and the liquidity measured by the volume of day to day transactions, could be designated as drivers of price growth on cryptocurrencies like Bitcoin and Ethereum. Corbet used three different measures to detect and date stamp bubbles. The first measure concerns on the difficulty on the mining activity. It reflects the difficulty to find a new block when compared to how easy it was to find a block in the beginning of Bitcoin. The second measure used by the author relates to the hash rate. A higher hash rate increases the possibility of finding the next block and receiving the rewards for it. The last measure was the relationship between cryptocurrency returns, volatility and liquidity. In the end, Corbet and the rest of the authors, concluded that there was no clear evidence of such a persistent bubble in the market of Bitcoin or Ethereum. However, this does not mean that the valuation is correct.

The question remains, what is a bubble? In economics, a bubble is the process of self-reinforcing reflexive exponential rise in prices in a certain market, based not solely on the increase of the fundamental value of the underlying asset - the subject of investing, trading and speculation - but mostly because of the fact itself, that the price is rising, and "everyone is buying". A huge difference between the actual value and the market price of the asset in that particular market is created, which is the bubble itself. At a certain point, an event occurs that proves in a spectacular way, that the unfounded prices are much higher than should be, and a massive panic selling starts, which is the burst of the bubble. After a while, everyone is involved, the price of the assets is really high, the energy and the optimism reach higher levels that no one understands the underlying reality and are unable to maintain it sustainable. As soon as the market is destroyed, the bubble pops. The same event has already happened before in history, in several different situations. In the 17th century, there was the "Tulip Mania" in

[14] The hash rate is the measuring unit of processing power of the Bitcoin network. The Bitcoin network must make intensive mathematical operations for security purposes. For example, when the network reaches a hash rate of 10 Th/s, it means that it makes 10 trillion calculations per second.

the Netherlands. In the beginning of this century there were numerous stock market and real estate bubbles. The dot com crash in 2000 is another great example.

A lot of people have been saying that Bitcoin is a speculative bubble, even though they do not have clear proof on it. In December 2017, Janet Yellen called Bitcoin a "highly speculative asset" on CNN Money. A few days later, Paul Krugman, from Business Insider, implied that Bitcoin is the most obvious bubble. Ron Paul, from CNBC, argued that cryptocurrencies in general are in an exponential bubble. And Rich Ross, from the Financial Times, says that Bitcoin "is a classic bubble".

Many investors and analysts have claimed that Bitcoin and every other cryptocurrency are scams and their prices will eventually fall to zero, while others believe that they will still have an enormous growth and will still be adapted, being often compared to the market capitalization of monetary assets or stores of value. Robert Shiller, a Nobel Prize laureate and expert on bubbles, epitomized this ambiguity of Bitcoin price predictions when he stated, at the Davos World Economic Forum that "Bitcoin could be here for 100 years but it's more likely to totally collapse.". He also said "you just put an upper bound on Bitcoin with the value of the world's money supply. But that upper bound is awfully big. So, it can be anywhere between zero and there."

"Although it seems relatively obvious that bubbles exist within cryptocurrencies, it is not a straw man argument that, in finance and economics, financial bubbles are often excluded based on market efficiency rationalization, which assume an unpredictable market price, for instance following a kind of geometrical walk." (Gantner, Huber, Reppen, Sornette and Wheatley, 2018: 2-3). In a totally different perspective, Didier Sornette (2018) believes that bubbles exist and are ubiquitous. They are present, they appear and they can be found everywhere. The authors also make noticeable that bubbles can de described by a deterministic nonlinear trend called LPPLS model, or Log-Periodic Power Law Singularity. This model combines two features of bubbles:

- "The price exhibits a transient faster-than-exponential growth (i.e., where the growth rate itself is growing) - resulting from positive feedbacks like herding (…)"

- "It is also decorated with accelerating log-periodic volatility fluctuations, embodying spirals of competing expectations of higher returns (bullish) and an impeding crash (bearish)."

This is the model used by Sornette (2018) and the rest of the authors. It characterizes a process "in which, as speculative frenzy intensifies, the bubble matures towards its endogenous critical point, and becomes increasingly unstable, such that any small disturbance can trigger a crash." (Gantner, Huber, Reppen, Sornette and Wheatley, 2018: 3). The authors emphasize that the focus is not on the instantaneous trigger by itself, but monitoring the increasingly unstable state of the bubbly market, and prepare to make certain corrections. When it happens, a generalized Metcalfe's law and the LPPLS model are combined, with the objective of diagnose bubbles in Bitcoin. When both coincide, the idea of a bubble becomes certain and it should be corrected. "If, in hindsight, such signals are followed by a correction similar to that suggested, they provide compelling evidence that a bubble and crash did indeed take place." (Gantner, Huber, Reppen, Sornette and Wheatley, 2018: 3).

As mentioned before, every currency should fulfil a number of functions: unit of account, mean of payment and store of value. Basically, Bitcoin or any other cryptocurrency, must represent value and command a determined level of confidence among investors and users. Dowd (2014) realized that Bitcoin prices appeared to contain "a substantial speculative component" due to the recent fluctuations that were happening in that year which lead to undermine the role of the cryptocurrency when considered as a unit of account. At the same time, this speculative component could possibly signify the existence of a bubble. Cheah and Fry (2015) tried to study and understand if there were speculative bubbles in Bitcoin markets. To conduct these study, the authors analyzed the prices of Bitcoin from July 2010 until July 2014. One thing was easily noticeable: Bitcoin prices were stable before peaking drastically in the end of 2013.

Followed by this, google trends shows also a notable peak in searches concerning Bitcoin and the cryptocurrency topics. This was the first time the authors found evidence for a speculative bubble on Bitcoin markets. Why? Because "speculative bubbles are characterised by a peculiar kind of fad or social epidemic following principles of social psychology, imperfect news media and information channels." (Shiller, 2014: 1487).

"Given that 70% of existing Bitcoins are held in dormant accounts, Bitcoin seems to behave more like an asset than a currency. Bitcoin's main attraction seems to lie in being an object of speculation instead of functioning as money." (Cheah and Fry, 2015: 34).

Speculative bubbles can be categorised as rational or irrational. The reasons to explain the formation of these bubbles can be: "self-fulfilling expectations (rational bubble), mispricing of fundamentals (intrinsic rational bubble) and endowment of irrelevant exogenous variables with asset pricing value (extrinsic rational bubble)." (Cheah and Fry, 2015: 34). Rational bubbles exist when investors understand that a determined asset is overvalued and realize that they can sell it, and profit, at an even higher price. On the contrary, irrational bubbles appear when investors let themselves affect by psychological factors, unrelated to the asset value.

The authors conducted several studies and hypothesis and concluded that "as any other asset classes, Bitcoin prices are prone to speculative bubbles" (Cheah and Fry, 2015: 35). They also concluded that "the bubble component contained within Bitcoin prices is substantial" (Cheah and Fry, 2015: 35) and "…the fundamental value of Bitcoin is zero." (Cheah and Fry, 2015: 35) and gave a clear point that cryptocurrency markets share some empirical facts with other markets: a vulnerability to speculative bubbles.

Section 5: What Affects Cryptocurrencies and How They Correlate with Other Assets

In this section, the aim is to understand what are the reasons behind cryptocurrency price oscillations and its nature, and also verifying how volatility has such a determinant impact on its price. In the end of the section there is also a correlation analysis to understand how cryptocurrency, and mainly Bitcoin, relates with other different assets or different currencies.

5.1 Factors Influencing Cryptocurrencies Prices

Cryptocurrencies, and Bitcoin in particularly, have been in vogue since 2009. However, it was in the last couple of years, and mainly in 2017 that the popularity of these new currencies has increased like never before. Nowadays, what we can arguably see is that people are investing their money into "assets" that do not have, yet, history of providing revenue. More, these "assets" are only having their rises in price because people believe in them and are pouring money into it. In the last year, billions of dollars have been poured into start-ups that are issuing new cryptocurrencies.

The majority of cryptocurrencies have a limited supply, as mentioned in Section 2.2. Bitcoin has a roof of 21 million BTC in circulation. Ethereum is an example of a cryptocurrency that does not have a limit of coins in circulation, but Litecoin, presents themselves with 84 million units of LTC tokens in circulation. This means that cryptocurrencies supply would decrease over time, and, concerning the *ceteris paribus* condition, this decrease should lead to inflation, and for a fact, to higher prices.

Between April 2013 and May 2017, El Bahrawy and Alessandretti (2017) examined the behaviour of the entire cryptocurrency market and understood that a lot of cryptocurrencies are always appearing and disappearing and their market capitalisation is increasing exponentially.

Poyser (2017) points out three different types of cryptocurrency price drivers, that can be organized into two categories: internal factors (supply and demand) and external factors (cryptomarket, macro-financial and political).

The internal factors are the ones concerning supply and demand issues, like transaction costs, the reward system that each cryptocurrency has, the mining difficulty which relates directly to

the hash rate, the limited or unlimited amount of coins in circulation and the forks (rule changes). Bitcoin has controlled their supply of BTC according to the block heights and the rewards they provide for the blocks. According to this, it is easy to imply that Bitcoin's supply is "exogenously determined and secondly, it is deflationary constructed." (Poyser, 2017: 10). The consensus is that Bitcoin's supply represents a serious drawback on becoming a real currency and being adopted according to the economic principles. Supply is deterministic so, the demand side of the equation is the only one that can have an impact on Bitcoin price.

The external factors, according to Poyser (2017), can be grouped in three different categories. The cryptomarket consists on the attractiveness, the popularity of cryptocurrencies, the market trend and the speculations created by investors and media. The macro-financial factors, like the stock markets, the exchange rate, the price of gold at a determined point in time and also the interest rate. And lastly, the political factors such as legalization, like adopting the cryptocurrencies or even legislating its usage and the restrictions that are imposed by certain regulators or countries. China is a good example where political factors determined Bitcoin's absence in the Chinese market for cryptocurrencies. These are, besides demand variables, the factors that can influence Bitcoin's, or cryptocurrencies, price.

Ciaian, Rajcaniova and Kancs (2016) conducted the first study of Bitcoin price formation, having in mind not only the traditional determinants of currency prices, like supply and demand market forces, but also digital currency specific factors, like investment attractiveness. As mentioned before, the interaction between Bitcoin's supply and demand is an important determinant of Bitcoin price. The supply determines the amount of coins in circulation, and thus, it scarcity on the market. The demand is usually determined by the amount of transactions where Bitcoin is used as a medium of exchange for different kinds of services and goods, and it is driven mainly by its value in a future exchange. "The price formation of Bitcoin cannot be explained by standard economic theories, such as cash-flows model, purchasing power parity, or uncovered interest rate parity, because several features of currency supply and demand, which usually form the basis of currency price, are absent on Bitcoin markets." (Kristoufek, 2013: 1). Why? Because Bitcoin, or any other cryptocurrency, is not backed by a specific government of central bank. This means, it is detached from the real economy, and that there cannot be any macroeconomic fundamentals that support its price formation.

Van Wijk (2013) finds evidence that there are external factors having an impact on Bitcoin's price formation on a long-run perspective, like the Dow Jones index, the euro-dollar exchange rate and the oil prices.

However, when Ciaian, Rajcaniova and Kancs (2016) conducted their study, they did it with a different perspective. All the previous studies looked separately at specific Bitcoin price determinants, without ever thinking they might have interactions between them. So, the three authors focused their research based on three types of Bitcoin price determinants: market forces of supply and demand, attractiveness to investment and global macroeconomic and financial development, without forgetting the possible interactions between the three factors. The empirical results in Ciaian, Rakcaniova e Kancs (2016) confirm that market forces like supply and demand have a really big impact on Bitcoin price and their importance tends to increase over time. Another finding was that investors speculative behaviour affects cryptocurrencies prices in the short-run and long-run. In the short-run, price fluctuations are motivated by online information, and in the following years it becomes more established on the markets, which will lead to a minimal impact on the long-run. Negative news concerning Bitcoin or any other cryptocurrency, and specifically negative news about their security systems are one of the most impactful situations to reduce investor and investment attractiveness. The opposite situation also occurs, and confidence is increased or restored.

Bitcoin is intrinsically worthless, which means that it is based on trust, and that trust is what makes it valuable and accepted as a medium of exchange in the future. These expectations that investors have on its value are highly relevant for Bitcoin or any other cryptocurrency, since they are establishing themselves in the market and need to build a trustful and credible image among market participants. "Overall, an increased demand for Bitcoin due to higher attractiveness may exercise upward pressure on Bitcoin price, whereas a lower attractiveness may imply a decrease in Bitcoin demand and its price." (Ciaian, Rajcaniova, and Kancs, 2016: 1803). Attention-driven behaviour from not only investors but also users, can have an impact on Bitcoin's price, either positively or negatively, depending on the type of information that concerns the media at a given point in time. The last result was that macro-financial indicators do not drive Bitcoin price. Favourable indicators may stimulate the use of cryptocurrency in trades and exchanges, and it will strengthen its demand, which might have a positive impact on its price. Unfavourable factors can lead to depreciation of a determined currency, but at the

same time may stimulate Bitcoin's price if investors decide to change their investments in stocks for investments in cryptocurrency. These three results were possible to accomplish because the authors never analyzed them on an individual perspective. They do have interactions between them and that is how they should be studied and analyzed.

To summarize, Ciaian, Rajcaniova and Kancs (2016) confirm that market forces like demand and supply have a really important impact on Bitcoin and cryptocurrencies in general. Also, recent information (short-run) provided by the media have a positive impact in Bitcoin price, which might be a result of trust among investors and users. Finally, the authors believe that macro-financial factors do not have a significant impact in Bitcoin price.

Kristoufek (2013) focused his studies on the social media impact on cryptocurrencies. By conducting search queries on platforms like Google and Wikipedia, the author clarified that not only bubbles but also bust cycles of cryptocurrency, and specially Bitcoin, can be explained by the interest demonstrated by investors and users on cryptocurrencies. Later, Kristoufek (2015) focused on "various possible sources of price movements, ranging from fundamental sources to speculative and technical sources" (Kristoufek, 2015: 2). When we observe Bitcoin's price, it is easily perceptible that the price evolution is dominated by several episodes of explosive bubbles, followed by corrections. Although, the price never returns to the value of the pre-bubble phase. That is why, Bitcoin's price was 5 USD in September 2011 and reached approximately 600 USD in the beginning of 2014. This evolution represents an appreciation of almost 12000%, in less than thirty months, which is really important for investors, and a great opportunity to raise investment attractiveness.

Kristoufek (2015) understands that there are several reasons to explain price drivers in Bitcoin, which can be applied to any other cryptocurrency. They are: economic drivers, transaction drivers, technical drivers, influences on the interest rate, and the effects of the Chinese Bitcoin market.

5.1.1 Economic Drivers

"In economic theory, the price of a currency is standardly driven by its use in transactions, its supply and the price level." (Kristoufek, 2015: 6). According to his studies, Bitcoin appreciates in the long run if it is used more for trading means, for non-exchange transactions, and the

higher price is responsible for boosting the exchange transactions in the short run. This means Bitcoin behaves according to the expected economic theory, specifically the quantity theory of money.

Price level is also an important economic driver of Bitcoin price because the expectation is that services and goods should be available for the same price everywhere and the misbalances are controlled by the exchange rate. This means that when the price of one currency decreases with respect to the price level of another currency, the first currency should appreciate and an increase of the exchange rate should be verified. The author verifies that this relationship is negative, as excepted, and confirms that Bitcoin behaviour does not contradict the law of one price in the long run.

The money supply works in a way that its increase leads to price decrease and a negative relationship is expected. However, due to the algorithm that Bitcoin presents, and its Blockchain technology, only long-run horizons are expected to play a role.

5.1.2 Transaction Drivers

The use of a cryptocurrency like Bitcoin in real transactions is highly interconnected to the fundamental aspects of its value. Although, "there are two possibly contradictory effects between the usage of Bitcoins and their price, which might be caused by its speculative aspect." (Kristoufek, 2015: 8). The first is related to the usage of Bitcoins. The more frequently they are transacted, the demand will increase and consequently also the price will be higher. However, if Bitcoin's price is affected by volatility and speculation, as well as an increase on the transaction fees, a negative relationship will happen, and its price will decrease.

5.1.3 Technical Drivers

Technical drivers consist on the mining activity and the miners themselves. As mentioned before, in Section 3.3.4, mining is a secondary market of cryptocurrencies and is contingent on solving a computationally demanding problem. To maintain the creation on new Bitcoins, and put them on circulation, miners need a lot of computational power to solve the problems they face. "The difficulty is then provided by the minimal needed computational efficiency of miners, and it reflects the current computational power of the system measured in hashes." (Kristoufek, 2015: 9). So, the mining activity is an investment opportunity where

computational power is exchanged for rewards, in the form of coins, or partially. There are two different effects between Bitcoin price and the mining activity, as well as the hash rate. When we consider mining as an investment, it means that users are investing in hardware, to solve the problems and collect the rewards. The miners obtain coins indirectly through mining. This can lead to two possible effects. The price increase may motivate participants to invest in hardware and start mining, which will lead to a higher hash rate and a higher difficulty to obtain coins, rewards. However, the higher the hash rate and the more difficult situation of obtaining coins, as well as the costs of the hardware and the electricity bills, might lead more miners to abandon the mining pools.

5.1.4 Interest Rate

Popularity is one of the possible drivers of Bitcoin price. "Increasing interest rate in the currency, connected with a simple way of actually investing in it, leads to increasing demand and thus increasing prices." (Kristoufek, 2015: 10).

5.1.5 The influence of China

Ever since Bitcoin first appeared, in 2009, that events happening on the Chinese market have a really significant impact on the rest of the markets. "Some of the extreme drops as well as price increases in the Bitcoin exchange rate do coincide with dramatic events in China and Chinese regulation of the Bitcoin." (Kristoufek, 2015: 12). As mentioned before, the Chinese Renminbi (CNY) was one of the most traded currencies in the cryptocurrency markets until the Chinese regulators blocked its activity.

Kristoufek (2015) conducted several interesting findings. Firstly, it is known that Bitcoin is considered a speculative asset. However, standard fundamental factors like money supply and price level, play an important role in Bitcoin's price, on the long-run. Second, according to mining, the increase of the price motivates users to become miners and invest in hardware. This effect tends to disappear in the long-run, because it will increase the difficulty in generating rewards and will increase the hash rate. Third, the price is mainly driven by its popularity and the interest that investors have in that determined cryptocurrency in a determined point in time. Fourth, CNY and USD are highly connected, although there is no clear evidence that the Chinese market influences directly the USD market. Investors might see as a caution, but not as an impactful influence. To summarize, "Bitcoin forms a unique

asset possessing properties of both a standard financial asset and a speculative one." (Kristoufek, 2015: 14).

"The Bitcoin currency, due to its extraordinary price growth, attracted the public attention. Investors increased their interest because of possible profits of hundreds percent in just a few weeks. The market value kept building up supported by its high volatility that invited risk taking investors. The strong network effects that cause a high positive trend, and the increased social media awareness, all this together, empowered the Bitcoin price, and, therefore, led the Bitcoin price." (Letra, 2016: 31).

5.2 The Impact of Volatility on Cryptocurrencies

Volatility has already been mentioned before as one of the biggest problems that cryptocurrencies face nowadays. Ever since 2013, Bitcoin's exchange rate volatility has been around 133%, which represents a much higher exchange rate volatility than any other currency. Gold, which is considered a "risk-free" investment, has had a volatility of 22% since the beginning of 2013. As a comparison, we can see that the most widely traded stock have volatilities of around 20% to 30%, since 2013, while even riskier stocks rarely exhibit volatilities higher than 100%.

With daily price changes of more than 50%, Bitcoin has been one of the most volatile assets ever since 2011. In contrast, bonds and stocks don't usually present fluctuations of more than 50% in the absence of a financial crisis. Nowadays, Bitcoin still presents large price alterations, but the magnitude of them has diminished, resulting in decreased volatility. In January 2017, Bitcoin's volatility was 20% than it has five years before, and 28% less than it was in January 2016.

In April 2016, a lower level of volatility conducted many investors to realize that Bitcoin had been more stable than gold, for a short period of time. This happened due to several factors: more stable and liquid spot exchanges, greater regulatory clarity, broader ownership and increasingly reliable price discovery data.

Bitcoin's volatility has dropped considerably throughout the years, but it still the most volatile of the broad asset classes. Figure 19 describes this situation, by comparing Bitcoin's volatility

with US Equities, US Bonds, Gold, US Real Estate, Oil and Emerging Currency Markets volatility.

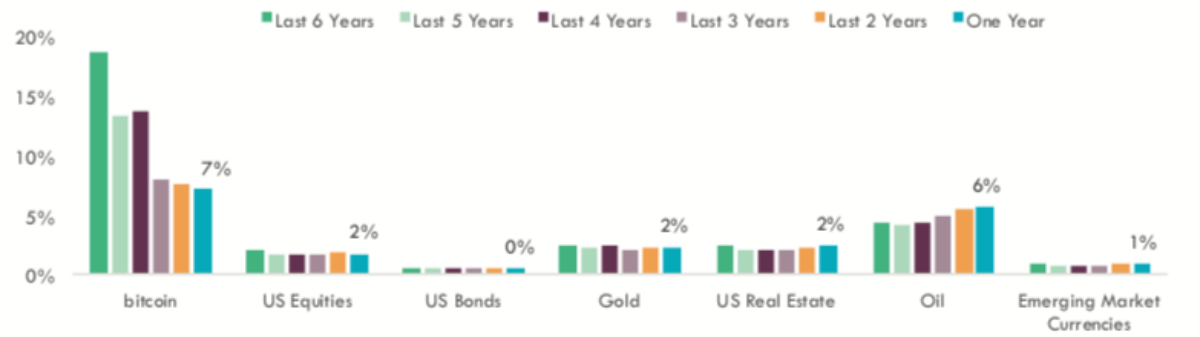

Figure 19: Comparing Bitcoin's weekly volatility with the remaining major assets. Source: "Bitcoin: Ringing The Bell For A New Asset Class".

In Figure 19, it is easily understandable that Bitcoin, and cryptocurrencies in general, have been suffering with volatility ever since its primordial days. Bitcoin had presented itself with annual values of 20% volatility, which is too high for any assets that we are used to. Oil, that we know that changes a lot as well, never faced, in the last six years, more than 6% a year when it comes to volatility. Bitcoin and cryptocurrencies have been highly affected by volatility. However, the verified tendency has decreased in the last few years, which represents stability in the cryptocurrency market and allows investors to trust more on it. All the other assets represented in Figure 19 have regular volatility values.

5.3 Correlations: Bitcoin against gold, currencies and traditional assets

Bitcoin's characteristics allows us to understand that it is a unique asset and behaves in a different way when compared to other assets, as it is pushed and pulled by distinct market forces. Malkiel (2015) created a correlation coefficient to quantify the market behaviour of assets, that ranges from "+1", where no risk reduction is possible and a strong positive relationship is verified, to "-1", where all risk can be eliminated, which represents a situation of strong negative relationship. If two assets are positively correlated, a "+1" situation, then when one of the assets is up by 5%, to other asset is also up by the same percentage, 5%. If they are negatively correlated, a "-1" situation, when one of the assets is up by 5%, the remaining asset is down by 5%. According to Malkiel (2015), the more negatively correlated the assets are, the more diversified will be the overall portfolio of an investor, representing low overall risk.

Burniske and White (2017) conducted a study where correlations among various standard assets over the last five years were calculated. Many assets may be uncorrelated when times are good for investments, however, when times are not that good, assets tend to frequently move in tandem, as pairs, resulting on correlations of "+1" or "-1". In their study, the authors have used the following assets: S&P 500, US Bonds, Bitcoin, Gold, US Real Estate, Oil and Emerging Market Currencies. "Strikingly, Bitcoin's price movements have been separate and distinct from those of other asset classes during the last six years." (Burniske and White, 2017: 16). Bitcoin presented itself as the only asset to maintain consistently low levels of correlations with every asset in study.

Firstly, the authors compared Bitcoin's return with the MSCI Global Currency Index[15]. In order for Bitcoin to be considered as part of the fiat currency asset class, it should have a similar behaviour to the rest of the fiat currencies in the marketplace. Given its nature, it is expected for it to behave somewhat similarly to the emerging market currencies. The results can be observed in Figure 20.

Figure 20: One year rolling correlation: Bitcoin and Emerging Market Currencies. Source: "Bitcoin: Ringing The Bell For A New Asset Class".

Ever since December 2011, Bitcoin had an average year correlation of "-0,05" with Emerging Market Currencies, never reaching higher than "+0,27". These values give a clear vision that Bitcoin and fiat currencies do not belong to the same asset class. "Bitcoin's value is almost completely untethered to that of other currencies… Macroeconomic events that cause similar

[15] The MSCI is an independent provider of research drive insights and tools for institutional investors. Source: https://www.msci.com

impacts on the value of various currencies do not seem to affect [Bitcoin] either positively or negatively" (Yermack, 2013: 2)

Secondly, Burniske and White (2017) investigated Bitcoin's performance when compared against gold. Gold is often recognized by investors as a safe investment because its value is not associated with any economic conditions. And, as mentioned before, Bitcoin has been compared to gold and even named of "digital gold", ever since it first appeared. If gold and Bitcoin were highly correlated, this would mean that both could be used as "risk-off" investments, and Bitcoin could be part of the precious metal asset class. The authors conducted their study and realized that Bitcoin and gold present a positive correlation ever since December 2011. However, for most of 2015 and 2016, this positive correlation changed into a negative correlation, reaching its higher point between September and December of 2015. "Investors may have learned gold is not the safe heaven once believed, as vehicles like the SPDR Gold Shares[16] ETF lost more than 40% of their value from 2011 peaks to 2015 troughs." (Burniske and White, 2017: 17). Figure 21 shows the correlations between gold and Bitcoin.

Between 2015 and 2016, the correlation between both assets changed into a negative correlation. This may suggest that some financial markets investors might have exchanged Bitcoin at the margin. In 2013, when Bitcoin first reached the one-thousand-dollar milestone, there were net outflows from gold ETF's and similar investment products.

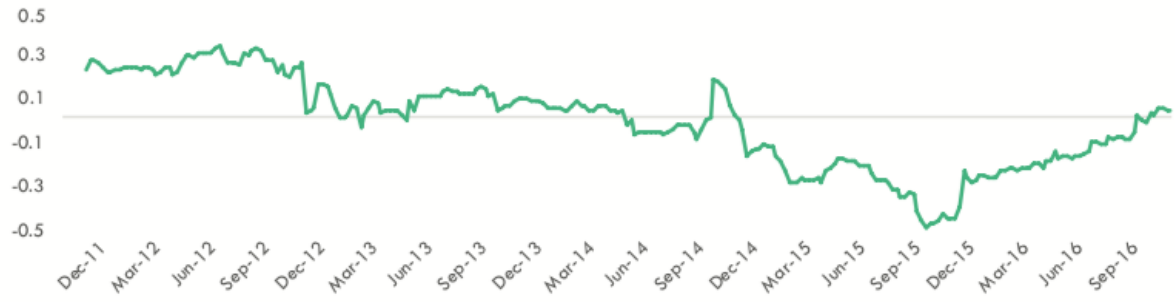

Figure 21: One year rolling correlation: Bitcoin and Gold. Source: "Bitcoin: Ringing The Bell For A New Asset Class".

[16] https://www.spdrgoldshares.com

Another fact that verifies this theory is that the Assets Under Management[17] (AUM) for the two largest ETF's[18], dropped from 85.4 billion USD to 36.2 billion USD by the end of 2013. In the same year, the price of gold dropped 25%, which means that a large piece of this AUM drop can be attributed to outflows. At the same time, Bitcoin started 2013 with a market capitalisation of 143 million USD and ended the year at 8.9 billion USD. Basically, while the two largest ETF's assets under management were halved in the year of 2013, Bitcoin's assets under management grew more than sixty times.

During December 2011 and June 2014, the positive correlation verified between both assets averaged "+0.14", which points to a rather weak relationship. As mentioned before, a "+1" situation would indicate their returns followed each other in a perfect way. However, with a "+0.14", which is close to zero, it points to a very firm relationship between gold and Bitcoin. From the rest of 2014 until the end of 2016, the correlation became negative, and averaged "-0.2". Once again, it failed to illustrate a strong relationship between both assets.

The last correlation analysis made by Burniske and White (2017), combined Bitcoin with US Equities, US Bonds, US Real Estate and Oil. With these major assets, "Bitcoin consistently has stayed within boundaries qualifying it as a differentiated risk reducer." (Burniske and White, 2017: 18). When we compare Bitcoin with US Real Estate, Bitcoin has experienced low or even negative correlation. This is, according to the authors, an ironic situation, because the IRS has deemed it as property, as was mentioned before. When comparing Bitcoin with Oil, it is verified a similarly low correlation. This correlation, between Bitcoin and the remaining major assets, can be verified in Figure 22.

[17] An AUM, or Asset Under Management, refers to the total market value of investments managed by a mutual fund, money management firm, hedge fund, portfolio manager, or other financial services company.
[18] An ETF, or Exchanged-Traded Fund, is a marketable security that tracks an index, a commodity, bond or a basket of assets like an index fund.

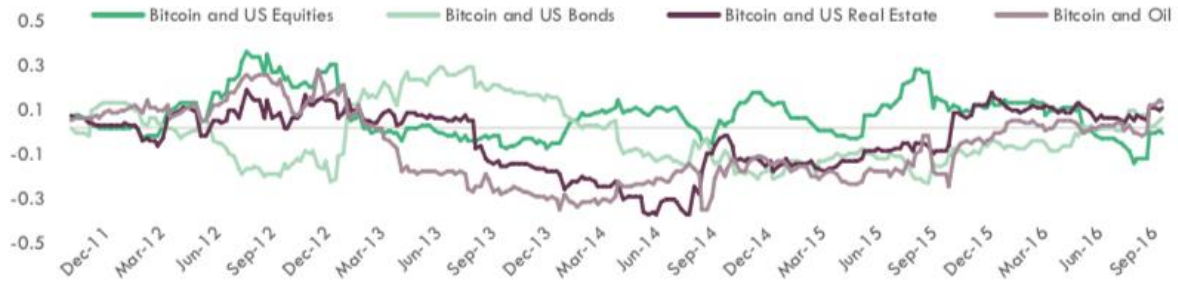

Figure 22: One year rolling correlation: Bitcoin and US Equities, US Bonds, US Real Estate and Oil. Source: "Bitcoin: Ringing The Bell For A New Asset Class".

Burniske and White (2017) concluded their analysis realizing that Bitcoin, or cryptocurrencies in general, do not belong in any of the previous enumerated major assets classes, and classifying it into an asset class still remains a challenge. Not only due to its unique characteristics but also because of how they behave when compared with different assets.

Yermack (2013) studied the movement of Bitcoin when compared to other different currencies and gold. The study was based on the daily changes in the London gold price and each currency's exchange rate against the US dollar, using data from 2010 to 2013. The currency used were: Euro, Japanese Yen, Swiss Franc, British Pound and gold. The results can be seen in Table 3.

	EUR	**JPY**	**CHF**	**GBP**	**Gold**	**Bitcoin**
EUR	1.00	0.19	0.60	0.65	0.21	0.05
JPY		1.00	0.33	0.21	0.08	-0.02
CHF			1.00	0.42	0.20	0.04
GBP				1.00	0.21	0.02
Gold					1.00	0.06
Bitcoin						1.00

Table 3: Correlation matrix of daily changes in exchange rates, Bitcoin and Gold, between 2010 and 2013. Source: "Is Bitcoin a Real Currency?".

"The table shows simple correlations of the percentage changes in daily exchanges rates for pairs of currencies, with all the exchange rates measured against the US dollar." (Yermack, 2013: 14). The European currencies exhibit strong correlations between each other. The Japanese Yen exchange rate is also positively correlated, however, at a more reduced level.

The same happens with gold's price. The only contrasting situation occurs with Bitcoin. It exhibits almost zero correlation with the exchange rates of any of the studied currencies or with gold. Bitcoin doesn't seem to be affected by any macroeconomic events that cause an impact on the traditional currencies, either positively or negatively.

Cheun, Guo and Wang (2017) conducted a correlation analysis between several different cryptocurrencies that are present in the market, and different traditional assets. The cryptocurrencies used were: Bitcoin (BTC), Ethereum (XRP), Litecoin (LTC), DASH (DASH), Dogecoin (DOGE), Monero (XMR), BitShares (BTS), MaidSafeCoin (MAID), Nxt (NXT) and Bytecoin (BCN). Besides all these cryptocurrencies, the authors also used a Cryptocurrency Index, represented in the table with CRIX. To compare the correlations with cryptocurrencies, authors used assets like: S&P 500, T-Note, Gold, Oil, GSCI Index[19], REIT's[20] and Private Equity (PE). The data collected to study the correlations is relative to the period of August 11th, 2014, to March 27th, 2017 and can be seen in Table 4.

	CRIX	BTC	XRP	LTC	DASH	DOGE	XMR	BTS	MAID	NXT	BCN
S&P 500	0.036	0.038	0.022	0.013	0.102	-0.001	0.084	0.044	0.058	0.057	0.044
T-Note	-0.02	0.017	-0.01	0.006	-0.013	-0.037	-0.011	-0.04	0.058	-0.072	-0.035
Gold	0.036	0.069	-0.064	0.045	0.045	0.01	-0.053	0.02	0.018	0.041	0.047
Oil	-0.065	-0.075	-0.006	-0.076	-0.03	-0.094	0.032	0.005	0.009	-0.021	-0.025
GSCI	0.015	0.03	0.004	0.031	0.043	0.029	-0.01	-0.033	0.028	0.003	-0.015
REITs	-0.014	0.004	0.003	0.043	-0.025	-0.016	-0.045	-0.058	0.011	-0.036	-0.052
PE	-0.037	-0.007	-0.02	-0.029	-0.039	-0.017	-0.02	-0.094	0.024	-0.079	-0.012

Table 4: Correlation for Traditional Asset Class against Cryptocurrencies. Source: "Cryptocurrency: A New Investment Opportunity"

The table provides the information that almost every correlation is below "0.1", representing a low level of correlation between both variables. In the first row is clear that almost every correlation between S&P 500 and cryptocurrencies is less than "0.05", and the highest level is

[19] The Goldman Sachs Commodity Index Works as a benchmark for investment in the commodity market as a measurement of performance over time. Originally created by Goldman Sachs, and transferred in 2007 to Standard & Poor's. Also known as S&P GSCI.
[20] REIT's is the designation for Real Estate Investment Trust.

"0.102", which is still very small. All cryptocurrencies are, in some way, negatively correlated with some mainstream investment assets. Bitcoin is negatively correlated with Oil prices, Ethereum is negatively correlated with Gold prices, and Litecoin is negatively correlated with not only Oil prices but also Private Equity. And these are just some examples. "The very low correlations reinforce the assertion that cryptocurrencies may be a promising investment class in terms of hedging the risk of mainstream assets." (Cheun, Guo, and Wang, 2017: 17)

The results of the correlation analysis promoted by Chuen, Guo and Wang (2017) allows to conclude that the CRIX Index and cryptocurrencies can be a good solution to diversify an investor's portfolio and the attached risks, as the correlations between traditional assets and cryptocurrencies are consistently low. Also, the average returns for most of the cryptocurrencies are higher than the traditional assets.

Section 6: Conclusion

This dissertation aims to explore every characteristic, functionality, market concerns and everything that anyone who wants to know more before entering this new market, should know. It starts by pointing out the main differences between traditional currencies and these new virtual currencies, also known as cryptocurrencies, that have been entering our lives for the last couple of years, with a more predominant impact since 2013. Then, every characteristic, pros and cons about cryptocurrencies are analyzed, with a main focus on the fact that they are decentralized, unregulated, extremely volatile and mined by miners. A detailed description of the most dominant cryptocurrencies - Bitcoin, Ethereum, Litecoin, Ripple and DASH – is also included. Bitcoin is still the most important cryptocurrency in the market although Ethereum have been conquering a lot of space due to its differential and unique characteristics.

The emerging market for cryptocurrencies is analyzed. The market can be divided into two main sections: primary market and secondary market. The primary market consists on Initial Coin Offerings, and it has been used in several different situations in order to raise capital. The secondary market has four different approaches: exchanges, wallets, payments and mining. All of them have been growing a lot in the last years, with miners and mining activities having a primordial role in the sector. Miners are responsible for solving the complex mathematical problems that will generate a new block in the Blockchain. Without miners, mining and mining pools, using cryptocurrencies, and in this particular case, using Bitcoin, is not possible.

We move on to focus on the investment and investability situations that concern cryptocurrencies. Cryptocurrencies can be used in several different ways, with some investors using it for transactional means, and hoping that it becomes a day-to-day transaction currency, like the Euro or the Dollar. On the opposite, some investors are using it for trading means, profiting with the short-term appreciations that affect cryptocurrencies, motivated by its high volatility. Another conclusion is that Bitcoin, and cryptocurrencies and general, are still poorly catalogued. Due to that situation, economists are considering cryptocurrency to have three different scenarios: it can be considered as a medium of exchange, as a unit of account or even as a store of value.

Lastly, the reasons behind cryptocurrencies price alterations have been pointed out. It becomes easily understandable that cryptocurrencies prices are being affected by several reasons, that

can be: economic, transactional, technical, due to interest rates or even the impact that a determined market and/or country can have in the "global picture" of cryptocurrencies. Besides this, volatility is one of the most important concerns of cryptocurrencies investors. The price instability that the cryptocurrency market has, is the most problematic and main reason of skepticism that weights the most when investors decide, or not, to enter the cryptocurrency market.

Cryptocurrency had, in the last couple of years, experienced an immense price appreciation, which attracted not only the public attention but also the interest of investors. The high volatility and the growth of the market has been responsible for more and more investors being available to risk it and invest on it. Nowadays, the scenario is a bit different. The year of 2018 has been negative for investors, and the price of the most important cryptocurrencies is now lower than it was in the previous year.

However, many still believe in cryptocurrencies and are positive that they will take part in the future of transactions. Technology is increasing like never seen before, and as it increases, the world and its economies will remain interconnected. Cryptocurrencies are here to stay, and will have an important role in developing markets, even if they do not represent a position of dominant currency. They are still going to be impacted by laws and regulations, because there are still many differences when recognizing its usage and application. When all the laws and regulators are determined and consensus is achieved, cryptocurrencies will be able to enter our lives and assume a role of global currency.

Several things can be understood as limitations to the study. The first is obviously the impact that volatility has on cryptocurrencies. From December 2017 to June 2018, Bitcoin's price has depreciated more than 60%, and all the data used in this dissertation is prior to those major setbacks on its price. Another limitation is the limited supply that some cryptocurrencies have, like Bitcoin. Also, the mining dependency. Nowadays, mining one coin requires a lot of computational power, electricity, and so on, and that is why miners are joining more and more mining pools, and sharing the rewards between members of the pool. The question for miners is whether it is still profitable to keep the mining pools or even mining individually. The lack of regulations and a governmental authority to back up cryptocurrencies still concerns many investors and should be taken into account before entering the market.

The suggestion for further investigations is that cryptocurrencies keep being monitored, because they are probably the future of all currencies, or are already somehow, close to the future of currencies. Bitcoin might not be the future of currencies, but it is definitely the pioneering cryptocurrency and might be the basis for the future of currencies.

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