Department of Economics and Finance

Chair of Money and Banking

How Bitcoin Changed the World

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INTRODUCTION

In 2009, with the birth of the first cryptocurrency much more than just a new monetary type was conceived. In the preceding decades many attempts had already been made, and yet only Satoshi Nakamoto succeeded in realizing what the others were dreaming of. Inspired by the noble intent of changing a financial system seen as obsolete and inappropriate, Bitcoin advocates economical ideals and tenets which evolved over time. Meanwhile, it exploits the new opportunities and trends available in the digitalized era, fostering technological progress.

Throughout the centuries money has changed its form multiple times, yet its true essence has been challenged for the first time only by the advent of cryptocurrencies. With Bitcoin, money acquires innovative dimensions and explores completely new functions towards society. Merging a unit of currency with a truly efficient payment solution, Bitcoin performs the same tasks as traditional types of money in a faster and cheaper way, while allowing new options none of the latter could have ever dreamed of. Being both means of speculation and medium of exchange, it entails a previously unknown individualistic dimension. At the same time the social aspect is in no way cast aside, and indeed is rather put in the spotlight.

By fostering financial inclusion through the services its platform renders available to anyone, Bitcoin promotes the modernization and civilization of the whole world and could thus accomplish what even the most important institutions couldn’t live up to. This makes the implications for those living in certain areas of the world much more compelling, up to a point where the lives of entire communities could depend upon the adoption of cryptocurrencies.

Moreover, due to its decentralized nature, Bitcoin may be seen also as an insurance and means of protection against oppressive and abusive institutions. No government

has the power to influence or affect the currency, which may be used as a refuge by dissidents around the world. This way, Bitcoin becomes the first currency ever which actively promotes human rights and freedom of speech.

In this paper, we are going to analyze the previously mentioned points, lingering also on the more technical features of the cryptocurrencies and their industry, ranging from the functioning of the blockchain technology up to the various complementary sectors born to increase the efficiency of the industry as a whole. As it is our primary goal to describe every tangible change caused by the birth of Bitcoin, and not only to examine the positive aspects, we will dedicate a section also to discuss the negative impact of cryptocurrencies, mainly regarding the adverse influence the latter have on earth's environment and ecosystem.

Eventually we will come to the conclusion that Bitcoin had a central role in many economical and financial changes that affected this century. The intrinsic importance of this changes, and the way they were involved in the improvement of the lives of people in the world, are the reasons why we believe that Bitcoin was a necessary consequence of some of the inadequacies of the modern financial system. Thus, despite the awareness that cryptocurrencies have also unfavorable features, throughout this paper a more supportive point of view will prevail. In a few sections we tried to suggest possible solutions to some of Bitcoin's controversies. In others we confined ourselves to mention how we believe said controversies may evolve in the future. Before starting with the actual content of our script we want to leave the reader with one final consideration; according to us, it would be highly beneficial if the international community informed itself about Bitcoin, giving it the proper relevance and appreciating its high potential without dwelling only on the financial side. This way institutions could recognize the fundamental role cryptocurrencies play in our society, establishing the right incentives for Bitcoin to overcome its pitfalls.

CHAPTER 1

BITCOIN AND ITS INDUSTRY

1.1 - *A brief reminder of monetary history*

"Money is a social artifact which evolved to facilitate market trading between individual agents who were not so otherwise bound together by family, tribal or social ties that an immediate exchange of equivalent values in trade was unnecessary[1]*"*

Much has changed since the day in 1989 that saw Goodhart state this sentence, and most probably the famous economist would have to add some details to his thought to keep it accurate if he would want to reformulate it today. According to the orthodox view on the origins of money, when the latter was first introduced thousands of years ago in the form of metallic coins, it was meant to reduce the transaction costs which inevitably arose from barter using commodities as a medium of exchange. In fact, coins were much more suited for the task, since they were not only durable and easily carriable, but also standardized and divisible. Moreover, this last two attributes had yet another very useful application, emphasized instead by the heterodox view about money's origin. Coins were perfectly apt to keep track of prices and debts, making them the first real units of account. Thus, they could be used by states with the purpose of regulating economic activities and relations between the

[1] See Charles Goodhart, "*The conduct of monetary policy*", ECONOMIC JOURNAL, p.22, 1989

public and private sector. From that moment on the concept of money has changed multiple times. First, the value of money lost any connection to the face value of the material it was made of, depending solely on the authority of the issuing entity; this way FIAT money was born. As Keynes stated it in 1930, "*Fiat currency is a representative or token Money, now generally made of paper except in the case of small denominations, which is created and issued by the State, but is not convertible by law into anything other than itself and has no fixed value in terms of an objective standard*[2]". Then, with the raise of modern banking which characterized Florence, Genoa, Bruges, and Flanders during the 13th century, bank money became widespread. The big news was that for the first time in history money lost its physical dimension, becoming nothing more than a ledger-record and a book value. Due to its abstract nature, in order to make bank money operational new ways of settlement had to be found, and between them electronic payment was surely the most relevant. And so it comes to our final type, electronic money, which uses computer networks and digital stored value systems in order to make payments to undertakings other than the issuer. Broadly speaking, it can be defined as an electronic store of monetary value (see **figure 1).**

Clearly the before mentioned types of money are very different one from another, but despite this they are all characterized by two common traits:

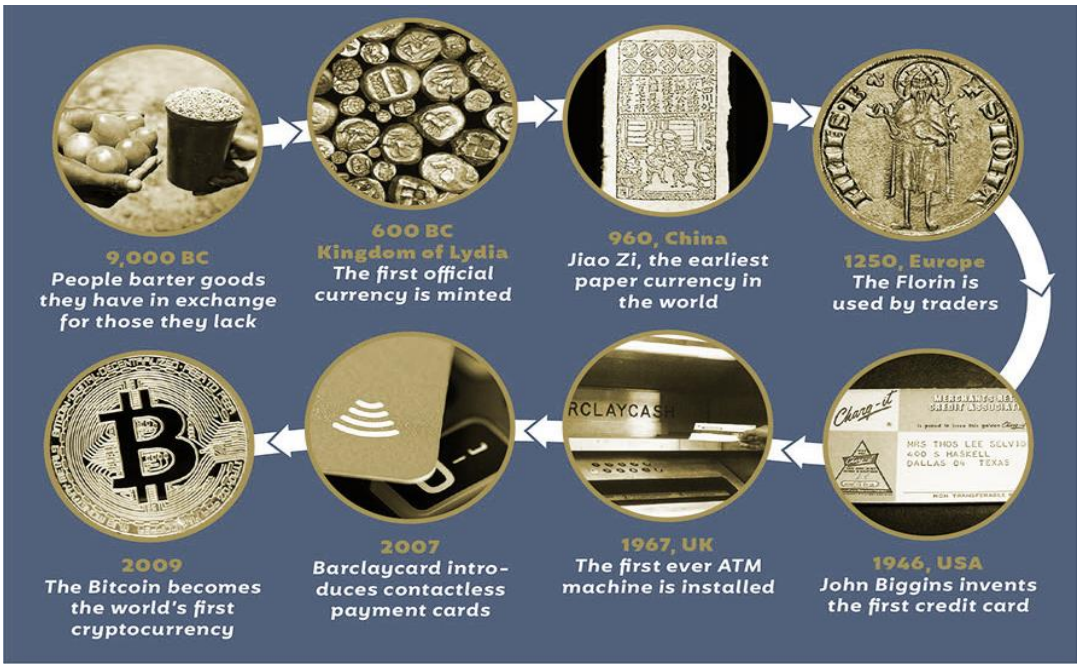
- They are issued by one central institution or authority.
- They serve primarily as mediums of exchange and units of account.

Then, in 2009, with the birth of the Bitcoin the perception of money changed forever. For the first time not only a type of money was completely decentralized and independent from any kind of institution, but it had also added a new dimension to the function of money, which is that of speculation. Now it becomes clear why

[2] See John Maynard Keynes, "*The Classification of Money*", A Treatise on Money, p.7, 1930

Goodhart's statement mentioned in the beginning of the section isn't strictly correct anymore. Nowadays money is much more than just an instrument born to facilitate transactions, since cryptocurrencies could be seen as a perfect example of financial assets entailing a risk and a possible profit. Even though virtual currencies can be exchanged for real goods like any other type of money, due to their volatility one of their primary purposes is to be speculated upon, and so they are mainly traded with other types of currencies. This fact has one big consequence: while in normal monetary exchanges each end of the transaction realizes a gain (the good is reallocated to the individual who obtains a higher utility from it, while the other individual obtains a fair price in terms of money which has been established preemptively), in this new kind of exchange not everybody can be made better off; the uncertain nature of the speculative act itself makes this impossible. While both parties of the transaction will think to have made a great deal, this is true only for one of them since the value of the asset can't increase and decrease at the same time. This way, with Bitcoin's birth one could believe that the social nature of money has been starting to fall short. Yet, as we will discuss in later sections, cryptocurrencies serve parts of the society in a completely new way. In fact, they alter the perception of money on dimensions which go far beyond the simple purpose of being speculated upon; we will delve deeper into this argument in the second chapter of this paper.

Figure 1: From barter to Bitcoin



Source: The Day Explorer, 7 September 2020

1.2 - Virtual currencies

Before widening the analysis of the Bitcoin, main topic of this paper, it seems appropriate to spend some time describing the monetary type of which the latter is not only part but building block, that is the **virtual currency**. This kind of currency has the feature of being digital in nature since it is primarily managed, stored and exchanged on computer systems over the internet. As the European Central Bank formulated it in 2012:

"*Virtual currency, or virtual money, is a type of unregulated digital currency, which is issued and usually controlled by its developers and used and accepted among the members of a specific virtual community; moreover, it is a digital representation of*

value that is neither issued by a central bank or a public authority, nor necessarily attached to a fiat currency, but is accepted by natural or legal persons as a means of payment and can be transferred, stored or traded electronically."

The first part of the description focuses on the unregulated, or decentralized, nature of this type of money; the US department of treasury defined a decentralized currency as a currency which has no central repository and no single administrator, and which persons may obtain by their own computing or manufacturing effort. Individuals making use of it rely on a distributed system of trust rather than on the confidence in a central authority[3]. Moreover, the US Financial Crimes Enforcement Network defined it as "*a medium of exchange that operates like a currency in some environments but does not have all the attributes of real currency*"[4]. In particular, virtual currency can't be used as legal tender in any jurisdiction, with one big exception which is the small state of El Salvador in South America, that recently proceeded to make the Bitcoin the official currency of the country. The reasons of this surprising decision will be analyzed later.

It is worth mentioning that not every type of digital money shares the unregulated attribute, and central banks in the world are starting to show interest in this side of the economy, developing their own Central Bank Digital Currencies. Currently, around 80 countries (representing over 90% of global GDP) are exploring the sector. Between them, China is racing ahead with its **Digital Yuan**, followed by the European Union (**Digital Euro**) and England (**Britcoin**). The United States instead are further behind and didn't completely clarify their position in regards of digital currencies yet[5]. There are many possible benefits deriving from the adoption of this new technology directly

[3] See European Central Banks, "*Virtual currency schemes*", Frankfurt am Main: European Central Bank. p. 5., 2012

[4]See Financial Crimes Enforcement Network, "*Application of FinCEN's Regulations to Persons Administering, Exchanging, or Using Virtual Currencies*", 18 March 2013

[5] See Atlantic Council, CENTRAL BANK DIGITAL CURRENCY TRACKER

by the states' institutions. According to the International Monetary Fund, not only would CBDC be more cost efficient than physical cash, but it could also foster financial inclusion[6] and help monetary policy flow more quickly and seamlessly. Yet the choice to introduce such an asset in the economy should be carefully evaluated before being implemented. A greater role for Central Banks in allocating economic resources mustn't necessarily entail benefits for the economy and could even bring significative losses should the private sector reveal itself as more efficient than the public one. Moreover, in periods of financial stress a flight towards Central Banks may occur on a fast and large scale, increasing the risk faced by commercial banks regarding their deposit fundings.

Virtual currencies are referred to as "closed" or "fictional" when they don't have any connection to the real economy and can't be exchanged with real goods or services. An example of this category is the money used in video games or video game consoles, like Nintendo coins or FIFA points. The latter's trade is limited to the official platforms which sell them, but nonetheless there may be so called "grey markets" that allow players to trade the currency between them or even exchange it for real-world assets, even if this kind of conduct goes against the terms of service of the game[7]. On the contrary, virtual currencies are said to be "bi-directional" or "convertible" if they not only can be bought with but also sold for any given FIAT currency.

[6] See *note 65*

[7] See Christina Majaski, "*closed virtual currency*", INVESTOPEDIA, 11 June 2021

1.3 – Differences between virtual currencies and electronic money

It is a common mistake to confuse virtual currencies with electronic money since both share a digital nature. Yet, they could not be any more different in terms of acceptance and limitations and therefore a clear line must be drawn between them. The first and maybe also most important distinction which jumps to mind is the lack of regulation that usually characterizes virtual money; however, this is only one of many differences (see **table 1**). We have already hinted at the fact that virtual currencies can't be used as legal tender, but we didn't specify the rationale behind this. The latter are unrelated to any real-world currency and their value changes unpredictably and can hardly be affected by decisions made by official institutions like governments and central banks. On the other hand, electronic money consists of traditional currencies issued in a controlled and organized way and then supplied to commercial banks which in return offer their services to private individuals and firms. Even though the effective amount of real money circulating in an economy is not completely foreseeable and depends on factors like liquidity preferences and other trends, traditional currencies and therefore also electronic money usually maintain a stable value, which helps us understand why governments would accept this kind of money as legal tender rather than its virtual counterpart.

Another important difference regards the acceptance of the two types of money discussed above. While electronic money is generally accepted by any undertaking other than the issuer, virtual money's acceptance may be limited to the members of a specific virtual community. Despite this in recent times more and more firms and entities are starting not only to invest heavily in this kind of assets, but also to accept them as a payment in return for their goods and services. A striking example regarding

this phenomenon is the big-tech company Tesla guided by the visionary entrepreneur Elon Musk who made it possible for his customers to pay for the Tesla cars with Bitcoins for a brief period of time (later on he took a step back removing this way of payment because of environmental concerns).

Moreover, a big drawback regarding digital currencies is that their users need to be aware of many more risks than individuals holding traditional types of money. Not only do they face the usual operational risks which characterize every kind of currency, but also credit risks arising from the impossibility of the debtor to pay back the creditor, liquidity risks since it sometimes may be difficult to convert this kind of assets into ordinary money, and legal risks such as fraud or uncertainty due to the lack of regulation.

Table 1: differences between electronic money schemes and virtual currency schemes.

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

Source: European Central Bank, "*Virtual currency schemes*", October 2012

1.4 - Introduction to cryptocurrencies

For the sake of our argument from now on we will focus mainly on one specific subset of virtual currencies, that is the cryptocurrency. More in particular, the latter are an unregulated and decentralized type of digital currencies which implement cryptographic technology to secure and authenticate transactions while at the same time managing the creation of new currency units[8]. It was back in 1983 when the American engineer David Lee Chaum tried for the first time to formalize the system underlying cryptography and at the same time design an anonymous payment system. This way **eCash** was born, an intricate form of cryptographic electronic payment through which money could be sent from one individual to another in an anonymous way thanks to specific encrypted keys[9]. Twelve years later Chaum wanted to implement a system able to guarantee total anonymity in online transactions through his company DigiCash, but the project revealed itself as a failure and in 2002 the company declared bankruptcy[10]. Later, in 1992 a team of scientists calling themselves the cypherpunks developed a new anonymous transaction system inspired on Chaum's one, with the noble intent to defend the privacy and the freedom of speech, which they believed neither the government nor other organizations could grant. The next big milestone in the history of cryptography was achieved in 1998, when the first paper dealing directly with cryptocurrencies was published by a Chinese computer engineer called Wei Dai. The latter designed yet another anonymous, distributed cash system which he called **b-money**. However, this had one big difference with its predecessors, being the fact that the creation of money was

[8] See Jake Frankenfield, "Difference between Digital, Virtual, and Crypto Currencies", INVESTOPEDIA, 30 June 2020

[9] See David Lee Chaum, "*Blind signatures for untraceable payments*", ADVANCES IN CRYPTOLOGY, 1983

[10] See Julia Kagan, "*eCash*", INVESTOPEDIA, 31 March 2021

computed by broadcasting the solution of an unsolved computational problem and the transfer of money was regulated by a contract specifying the maximum amount due in case of default. This was a first, shy introduction to the **proof of work** function, on which later on many of the most important cryptocurrencies would be based[11]. For many years afterwards not much progress in the field was made, and we must make a jump of more than a decade to see the next big innovation happening[12].

Which brings us to the fateful day in 2008, when an individual or a group of people named after the pseudonym of Satoshi Nakamoto published a paper in which they described the characteristics and functioning of a new digital currency, the Bitcoin. Taking inspiration from the projects discussed previously, in which electronic coins were introduced as a chain of digital signatures necessary to allow control of ownership on one side and of privacy on the other, Satoshi developed his network around the concept of proof of work. His mission was to create a system where the **miners** (individuals acting as gatekeepers which validate the transactions, basically playing the role of the central institution that regulates traditional types of money) were incentivized to follow the rules of the game without anyone telling them to do so. This was possible only if the reward for staying honest was greater than the profit for cheating, and Satoshi knew this very well. As he said in his paper:

"If a greedy attacker is able to assemble more CPU power than all the honest nodes, he would have to choose between using it to defraud people by stealing back his payments or using it to generate new coins. He ought to find it more profitable to play by the rules, such rules that favor him with more new coins than everyone else combined, than to undermine the system and the validity of his own wealth". [13]

[11] See Wei Dai, "*B-Money*", 1998

[12] See DaviesCoin, "*A short history of cryptocurrencies*", 2019

[13] See Satoshi Nakamoto, "*Bitcoin: A Peer-to-Peer Electronic Cash System"*, p.4, 2008

Every time a miner validated a transaction, he would be awarded not only with a transaction fee but also with new minted coins which he then could completely dispose of. All this was necessary to avoid **double spending**, the phenomenon defined as the possibility that the same digital token, consisting of a virtual file, would be spent more than once by being duplicated or falsified. This would in turn lead to inflation, devaluating the currency by creating a new amount of copied currency that did not previously exist[14]. To avoid this risk, in traditional currency schemes any transaction is surveilled by a trusted central authority which relies on a centralized double-entry ledger such as a balance sheet, but in a decentralized scheme as the one used by cryptocurrencies this would not be possible. Instead, a specific type of ledger, called the **blockchain**, is used to achieve the same result. This way every transaction is publicly announced and accessible to the users in any given moment.

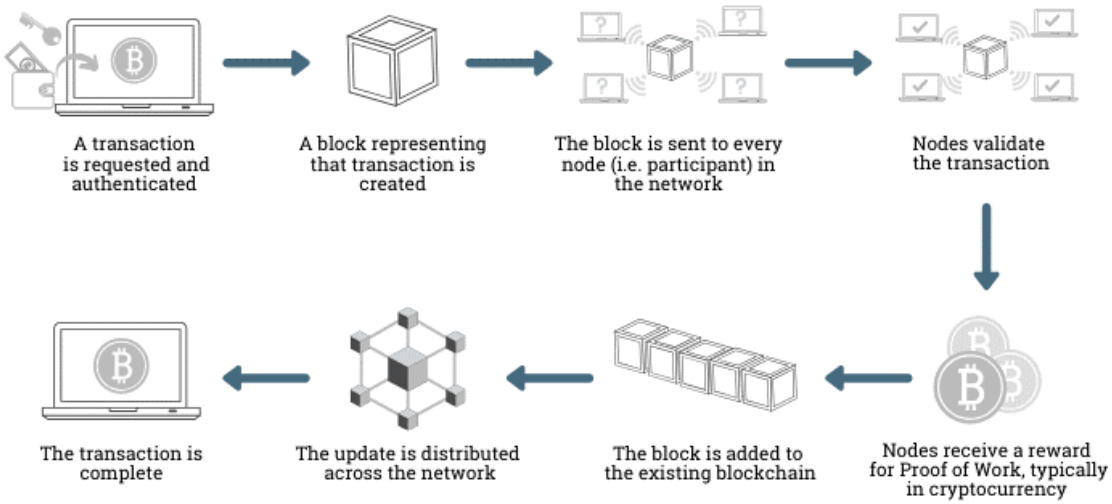
1.5 - A new type of electronic ledger: the Blockchain

Bitcoin's blockchain is an electronic ledger which ensures ownership and its transfer in transactions while maintaining security, stability, efficiency and non-modifiability. The program runs on a peer-to-peer network, distributed among the terminals of all the participants (referred to as nodes), thanks to a group-consensus protocol that validates the transactions. Inside of it each block contains a cryptographic hash of the previous block, a timestamp, and transaction data. The timestamp proves that the

[14]See Social Science Research Network, "*The Double Spending Problem and Cryptocurrencies*", Banking & Insurance Journal, 23 December 2017

transaction data existed when the block was published in order to get into its hash. Since every block contains information about the previous unit, a chain is created, allowing each additional unit to reinforce the ones before through a mathematical link[15]. More specifically, each transaction starts from a single network node which initiates a request to the other nodes. The latter must verify the transaction in question (i.e. new blocks can be added when the computing power of the nodes in the network reaches consensus, achieved with the help of the proof of work method); only at this point a new block of data is added to the ledger (see **figure 2**).

Figure 2: How a transaction enters the blockchain.



Source: EuroMoney Learning, "*How does a transaction get into the blockchain?*", 2020

[15] See George Davis, "*Blockchains: The great chain of being sure about things*", The Economist, 31 October 2015.

Adding a new row to the data requires the approval of the nodes, which is obtained through the verification algorithm we just discussed. The intrinsic structure of the blockchain makes editing or deleting rows almost impossible, since this would require all records in the chain to be changed. The cryptography makes the cryptocurrency secured and transparent, storing every transaction's detail on a public, distributed, interlocked and permanent ledger. Every node will have access to the list of all the transactions and can verify whether future transactions might be considered valid or an attempt to double spending. This way retrospective changes are made essentially impossible. Furthermore, in order to deconstruct the blocks, the approval would have to be entirely re-executed for every block added after the edited one, which would require an extreme amount of computational power and dedication[16]. Bitcoin was the first currency ever to adopt the blockchain as its ledger to record transactions. Inspiring many others for their own projects, nowadays this technology is widely diffused and shared by almost every cryptocurrency in circulation, which adopt it in more or less similar ways for purposes which may range from the ordinary exchange of monetary value up to the signing of digital contracts and other kinds of transaction.

1.6 – Bitcoin; uncertainty and speculation

The blockchain technology was set in motion for the first time on the third January 2009, when the initial block of the Bitcoin network, called the genesis block, was mined. Since then, Bitcoin has always maintained its leading position in the sector and today it is still the biggest available cryptocurrency, with a market capitalization of over 900 billion U.S. dollars and a price per unit of almost 50,000 U.S. dollars as of

[16] See Lisa Morhaim, "*Blockchain and cryptocurrencies technologies and network structures: applications, implications and beyond*", p. 24, 6 September 2019

August 2021. In the last years its name has become well known in the whole world and its value has skyrocketed to levels nobody could have foreseen. Until five years ago one Bitcoin could be bought for just about 500 dollars, meaning that it has had a growth of about 6,300%[17]. This abnormous increase can be explained by factors like the ever-increasing interest showed by celebrities and worldwide institutions which recently started to include cryptocurrencies inside their portfolios, by newly opened exchanges specialized in digital assets, by the recent attitude of individuals to step away from cash and physical money and finally by the investment strategies of speculators which tried to reap Bitcoin's popularity in order to realize capital gains.

But not always the currency's career has been a success, and whether an individual who invested in Bitcoin would have been happy or not by this choice pretty much depended upon the precise moment in time the investment had been done. As it is depicted in **figure 3**, there have been so many ups and downs during Bitcoin's history that it would be tedious to count them all, and even if in the long run a clear improvement in the cryptocurrency's value is undeniable, the latter has been nonetheless subject to numerous swings in the short period up to a point where it could double or halve within few weeks. This scenario, where the alternation of bearish and bullish positions on the currency were on the order of the day, can be summed up perfectly by the first months of 2021, when Bitcoin first set a record raising to never reached heights, only to lose every progress made after little time.

[17]See Kat Tretina, John Schmidt, "*Top 10 Cryptocurrencies in June 2021*", FORBES, 25 Jun 2021

Figure 3: The repeated rise and fall of Bitcoin (daily price of Bitcoin in U.S. dollars)

Source: CoinDesk

1.6.1 Price volatility

On April 16, 2021, Bitcoin traded for the huge price of 63,347 dollars per unit. The reasons of this unprecedented event could be found in the market, where recently the IPO of the crypto exchange Coinbase had took place, which people thought could push up the value of the currencies traded on it[18]. Moreover, big-tech company Tesla had just announced that it not only made an investment of around 1.5 billion dollars in the cryptocurrency, but that it would also start accepting payments for its cars in Bitcoins. In a filing with the Securities and Exchange Commission, the company said it bought the Bitcoins for "*more flexibility to further diversify and maximize returns on our cash*"[19]. While some people choose to believe this version, others more skeptical think that it was just a strategy of Tesla CEO Elon Musk, already known to have been

[18] See Bitcoin Magazine, "*Coinbase IPO Exceeds All Expectations, Showing More Promise For Bitcoin*", NASDAQ.COM, 19 April 2021

[19] See Steve Kovach, "*Tesla buys $1.5 billion in bitcoin, plans to accept it as payment*", CNBC, 8 February 2021

pushing up Bitcoin's value through tweets and announcements in the past, wanting to reap capital gains.

After Bitcoin's abrupt growth, crypto enthusiasts in the whole world celebrated believing that the currency's fortune was based on such solid foundations that it would never return to previous price levels, but already at that time it was a much-debated issue whether these foundations actually existed or not. As a matter of fact, neither of the two factors which were the growth's reason seemed to directly affect Bitcoin's usefulness, leaving the price levels reached without any apparent cause if not the numerous theories and hypothesis of a bright future of those that supported and believed in the project since the beginning.

Less than a month later, surprisingly or not, the house of cards collapsed, and Bitcoin returned to its 2020 levels. In a tweet Elon Musk clarified that Tesla wouldn't accept Bitcoins as a payment anymore because of environmental concerns[20]; "*we are worried about rapidly increasing use of fossil fuels for Bitcoin mining and transactions, especially coal, which has the worst emissions of any fuel*" Musk wrote, "*Cryptocurrency is a good idea... but this cannot come at great cost to the environment*"[21]. Moreover, in the same period the Chinese government decided to ban crypto exchanges and IPOs, only to start shutting down crypto-mining activities early after[22]. While China justifies this choice with its environmental policy and more in particular its carbon-neutrality objective, it is probable that its new hard approach

[20] The early withdrawal from Bitcoin of Tesla gives credit to the skeptical individuals mentioned earlier. It is hardly believable that Elon Musk just suddenly realized that the crypto industry is one of the most polluting of the world and that he hadn't already consider this factor before his investment. Moreover, Tesla reported highly growing profits of around 438 million dollars in the first three months of the year, up from only 16 million in the previous year, apparently boosted by the well-known sale of environmental credits which characterized the firm since its early days, but this time together with capital gains derived from the sale of Bitcoins… Nonetheless the entrepreneur stated that he did not intend to sell any of Tesla's Bitcoins and intended to use them for transactions as soon as mining would shift to using more sustainable energy.

[21] See Peter Hoskins, "*Tesla will no longer accept Bitcoin over climate concerns, says Musk*", BBC NEWS, 13 May 2021

[22]See David Pan, "*Why China's Ban on Crypto Mining Is More Serious Than Before*", COINDESK, 9 July 2021

on cryptocurrencies is somehow correlated to the project of launching its own digital currency, namely the digital Yuan, which aims to replace some cash in circulation[23]. What counts is that the government's choice badly influenced the performance of most cryptocurrencies, which isn't that surprising considering the estimation that up to 75% of Bitcoin mining happened in China because of its low energy costs, mainly in the province of Xinjiang, which was also the most hit by sanctions towards miners.

1.6.2 Difficulties in estimating Bitcoin's real value

After the colorful adventure that shocked Bitcoin within only a few months, it should appear rather clearly how its value may be influenced by so many different factors that it is hardly predictable to any extent. At this point one could argue that up to a certain extent neither the value of any other financial instrument can be predicted in a precise way[24], but there is one fundamental difference: traditional assets like bonds and shares base their value upon the underlying institution that issues them (which may be a firm, bank or government), and therefore, according to the performances of the latter, one can get a rough approximation of what should be the price of the assets, or at least one should recognize when said price is unjustifiably high or low. With Bitcoin the situation becomes more complicate, since because of its completely decentralized nature it has no institution whatsoever that backs its value, which is completely derived from the demand and supply conditions of the market.

[23] See Sumathi Bala, "*China's latest move to tighten crypto regulation is not new, says HSBC*", CNBC, 24 May 2021

[24] The **Efficient Market Theory** states that the price of an asset always perfectly reflects all the known information which is available about said asset at that given moment in time; since as soon as a new information becomes available the price of the asset immediately adjusts, it is impossible to choose a "bargain" asset which is underpriced and which will originate sure profits to its owner, unless illegal practices like receiving information from insiders are adopted. Moreover, since in the long run every asset will head towards its unknown equilibrium rate of return in which demand will be equal to supply, the future price of the asset cannot be foreseen.

The supply of Bitcoins is based on artificial scarcity and will completely stop once it reaches the upper limit of 21 million units. Nakamoto designed the protocol in a very specific way, ensuring that the reward in coins for adding a block would be halved every 210,000 blocks (approx. every four years), thus eventually, when the reward reaches zero, mining will lose part of its profitability since the transaction fees alone account only for a small share of the payment miners receive for their activity[25]. Nonetheless, even if a somewhat controlled supply should stabilize the value of the asset by controlling inflation, we have seen how this by no way puts a break to the cryptocurrency's volatility.

One could even go one step further by saying that Bitcoins aren't an investment, and that they are pure speculation. 20th century economist Benjamin Graham would strongly agree with this sentence; in his book "The intelligent Investor", he defines an investment operation as an activity which, after an in-depth analysis, promises the security of the invested capital added to an adequate return, while everything that doesn't correspond to this definition will be speculation instead[26]. It goes without saying that secure isn't exactly the best adjective to define the acquisition of Bitcoins. People speculating upon cryptocurrencies don't care neither about the return of their funds nor about the gain of adequate profits, and instead they look for huge capital earnings. Because of its extreme volatility, Bitcoin lacks one of the principal attributes of money, which is being a good store of value. Rather than keeping them for longer periods of time, people buy Bitcoins haunted by the **fear of missing out**[27] and with the aim of reselling them as quickly as possible in order to obtain a profitable margin.

[25] See Adam Hayes, "*What Happens to Bitcoin After All 21 million Are Mined?*", INVESTOPEDIA, 28 February 2021

[26]See Benjamin Graham, "*investment and speculation: the results which can be expected by the intelligent investor*", THE INTELLIGENT INVESTOR, p.1, 1973

[27] The fear of missing out (FOMO) is a social anxiety characterized by a desire to be continually connected with what others are doing, stemming from the belief that others might be heading the right way while the person experiencing it is not present. In behavioral finance this problem is often addressed, manifesting itself mainly through the acquisition

It could even be asserted that Bitcoin has no **intrinsic value**[28] at all, or, using the words of former chairman of the Federal Reserve Alan Greenspan, "*A currency needs to be backed by something in order to work properly, which may be gold or the trust in the issuer, otherwise its intrinsic value is purely fictitious, and it will reveal itself as a bubble*"[29]. Later also George Soros, investor with worldwide fame and president of the Soros fund, proceeded to call Bitcoin a bubble, adding that the latter couldn't even be defined as a currency, since "*A currency is supposed to be a stable store of value and one that can fluctuate by 25% in just a day couldn't be used for essential tasks like the payment of wages, because no worker would accept a drop in his payments by 25% from one day to another. It's a speculation, based on a misunderstanding* [30]". In finance, an asset bubble (sometimes also referred to as a **speculative bubble**), is a situation in which asset prices appear to be based on implausible or inconsistent views about the future. An alternative definition describes it as a trade in assets at a price or price range that strongly exceeds the assets' intrinsic value[31].

of financial assets which are experiencing a period of temporary growth, often due to an unjustified increase in demand pushed by the FOMO itself; this may give origin to so called **asset bubbles**.

[28] Intrinsic value is a measure of what an asset is worth, arrived at by means of an objective calculation rather than through the price at which the asset is currently trade in the market. In the calculation qualitative factors may be considered, such as the business model, governance, and target markets, as well as quantitative and perceptual factors, like financial ratios or statements and the perception of consumers.
See Will Kenton, "*Intrinsic value*", INVESTOPEDIA, 25 February 2021

[29] See Alan Greenspan, "*Greenspan on Bitcoin: I Guess it's a Bubble*", BLOOMBERG, 4 December 2017

[30] See "*George Soros From Davos: Bitcoin Is A Typical Bubble*", FORBES, 25 January 2018

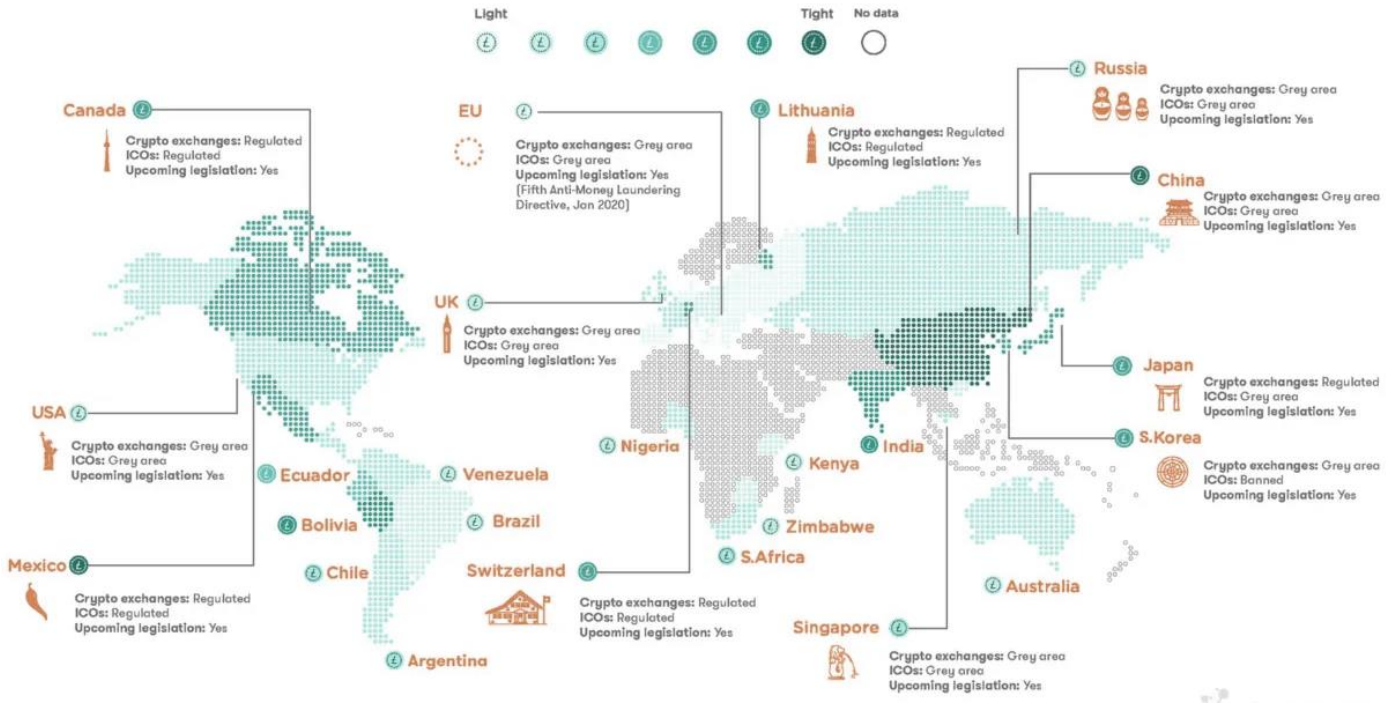
[31] See Alexandra Twin, "*Speculative Bubble*", INVESTOPEDIA, 5 January 2021

1.6.3 A currency in need for regulation

We don't agree with the economists mentioned above, and we do not think that Bitcoin's intrinsic value effectively is null, considering the highly efficient medium of exchange it stands for and the secure and transparent transactions it renders to everyone; we'll return to this matter later in the paper. Moreover, the sake of this section isn't the one to foster a reflection regarding the actual value of the cryptocurrency, but simply to remark its extreme volatility, and to note how its price variations are too wide, at least for now, to make it a good type of money which one could dispose of in everyday situations. The horizons to which Bitcoin gives access are almost infinite, yet many things must change before they may be reached. In one thing we agree with the previously stated theories, and that is that Bitcoin indeed is a speculative bubble as time goes. Too many factors can influence its price from one moment to the other, which by now is so high that it doesn't reflect the actual utility of the asset.

Despite the disastrous consequences this might have in the short run, it appears to us that Bitcoin needs a new kind of regulation, which in no way should undermine its anonymity or decentralization, but which limits itself to equilibrate its price by imposing similar restrictions as the ones used for regular stock markets. As shown in **figure 4**, a worldwide regulation of this kind is still missing. Moreover, while some countries seem to don't have addressed the matter at all, leaving the whole field a grey area, others have proceeded in the opposite direction, completely banning the exchange and/or mining of cryptocurrencies inside their boundaries. We believe that both approaches are equally wrong, being fostered either by negligence about something which could have a positive impact on humankind, or fear that said impact won't comply with the own vision and plans.

Figure 4: Crypto regulations by country



Source: ComplyAdvantage, 2021

In the United States, insider trading, known as the trading of public company's stock or other securities based on material, nonpublic information about the company, is directly prohibited and criminalized by sections 16 and 10 of the Securities Exchange Act of 1934. Consequently, if any director, officer or beneficial owner of more than 10% of a class of equity of the company would start to play with their statements, trying to exploit their influence in order to change the stock's value for their own purposes, the Securities and Exchange Commission would immediately address the situation trying to evaluate whether there would be the need to intervene[32]. Elon Musk, having invested multiple billions in Bitcoins, is seen as a reference point by the

[32] See Investor.gov, "*Securities Exchange Act of 1934*", THE LAWS THAT GOVERN THE SECURITIES INDUSTRY

crypto community, and may be imagined enjoying the same authority over said assets as a CEO would over his company, given his giant influence in the tech world and his nearly infinite resources, making him the second richest man in the world. Despite this, no institution can intervene if Musk starts sponsoring or blaming Bitcoin on his social network account, making its value change and adjust with a single tweet. For Bitcoin to truly live up to its potential, becoming an innovative financial instrument and useful medium of exchange, such a situation can't be tolerated and must be put to an end, since it would expose its users to too many risks, limiting the benefits of the currency.

The United States congress and the department of treasury are at the moment working on a regulation for cryptocurrencies. Recently, U.S. Securities and Exchange Commission Chairman Gary Gensler released an extensive interview in which he shared his view about the topic. Aware that the 1.6 trillion $ market represented by the cryptocurrencies needed rules constraining it, Gensler proposed a robust oversight regime, centered on establishing safeguard for the millions of investors who've been stocking their portfolios with tokens. "*While I'm neutral on the technology, even intrigued, I'm not neutral about investor protection*", Gensler said during his speech, "*If somebody wants to speculate, that's their choice, but we have a role as a nation to protect those investors against fraud*". Afterwards, the Chairman noted that exactly how technology had sparked economic progress throughout human history, a similar boost could come also from digital assets, but only together with a thoughtful regulation[33].

We strongly support his theories, and yet we are aware that imposing such a regulation is a big step which could as well have an outcome completely opposite to the intended one. Nobody can exactly predict whether it is going to give Bitcoin the

[33] See Robert Schmidt, Benjamin Bain, "*New SEC Boss Wants More Crypto Oversight to Protect Investors*", BLOOMBERG BUSINESSWEEK, 3 August 2021

needed stability or whether it will make its value collapse up to a point where no return would be possible. Very probably its speculative nature will fall short, and it will lose part of its charm towards the public. On the other hand, not only would his price be subject to less fluctuations, but the asset would also lose much of the risks associated to it. We believe that Bitcoin is destined to do great things in our world, improving the living conditions of thousands of people, facilitating transactions and giving birth to a new self-regulating and flawless financial system; if there is only the slightest possibility of this to happen, all risks are worth taking.

1.7 – Bitcoin's main competitors

Subsequently to Bitcoin's raise to power, it was possible to observe an increasing interest from the public towards the world of the cryptocurrencies, stimulated by the many opportunities available and by a growing market demand. As time passed many new digital currencies with structures similar to the one of Bitcoin were created and traded, up to a point where nowadays there are almost 1600 different types of cryptocurrencies available with a total market capitalization of around 2 trillion dollars (see **table 2**).

We can distinguish between two main types of cryptocurrencies, different in many regards but with the common feature of being coupled with a public ledger. There are the so-called altcoins, which share the same structure of the Bitcoin being built on a peer-to-peer network and a proof-of-work algorithm, and then there are other types of currencies which are more innovative and show large differences regarding the first cryptocurrency. Although it would be appropriate for this paper to analyze only the Bitcoin and it's matters since for the sake of our argument it presents the best incipit

to evolve our thought, we will briefly mention also the five remaining most important cryptocurrencies as of August 2021 in order to give some context.

- **Ethereum**: Having a market cap of around 384 billion dollars, Ethereum is the second biggest cryptocurrency after Bitcoin. What makes the latter particularly interesting is that it is not only a currency but also a blockchain platform that enables the use of so-called **smart contracts**[34]. The currency itself is called Ether and is mainly used as a vehicle for moving around on the platform by developers wanting to launch and run applications inside Ethereum, or as an investment vehicle for individuals trying to realize capital gains. Nowadays it trades for around 3,200 dollars, with an increase of more than 22,000 % in just five years. The goal behind Ethereum is to create a decentralized suite of financial products that anyone in the world can freely access, regardless of nationality, ethnicity, or faith. This aspect makes the implications for individuals living in some countries more compelling, as those without state infrastructure and state identifications could nonetheless get access to bank accounts, loans, insurance, or a variety of other financial products[35].

- **Cardano**: Like Ethereum, also Cardano provides a smart contract service on its platform, which is powered by its native coin ADA. Nonetheless, this crypto asset is very innovative since it was the first one to suggest a very different approach to the traditional proof-of-work algorithm, which is the so-called **proof-of-stake** function. This method decreases transaction time and energy usage, therefore lowering also the environmental impact, by removing the

[34] See pages 45 – 46 for the definition

[35] See Luke Conway, "*The 10 Most Important Cryptocurrencies Other Than Bitcoin*", INVESTOPEDIA, 1 June 2021

competitive problem-solving aspect of transaction verification present in platforms like Bitcoin. Even if the cryptocurrency is still in its early stage, it has already been dubbed as the Ethereum killer, as its blockchain is said to be capable of more, and it currently has a market capitalization of 79 billion dollars.

- **Binance Coin**: This utility cryptocurrency functions mainly as a payment method for the fees associated with trading on Binance, one of the largest crypto exchanges in the world, which in fact uses Binance coin's blockchain as the platform the exchange operates on. Since its value has recently reached the amount of 450 dollars per unit and a market capitalization of 76 billion dollars, it is frequently also used for trading and investment purposes[36].

- **Tether**: Unlike the other cryptographic assets we will analyze in this section, Tether is a stablecoin, which means that it is backed by FIAT currency like U.S. dollars and Euros and should hypothetically keep a value equal to one of those denominations. Because most digital currencies have experienced frequent periods of volatility, Tether and other stablecoins attempt to smooth out price fluctuations to attract users that may otherwise be too cautious to invest in the crypto world. This plan seemed to work greatly, since as of summer 2021 Tether is the fifth largest cryptocurrency with a market capitalization of 64 billion dollars.

- **Dogecoin**: Famously started as a joke in 2013, Dogecoin has been a hot topic thanks to celebrities and billionaires like Elon Musk and began rapidly to become a prominent cryptocurrency option thanks to a dedicated community

[36] See Kat Tretina, John Schmidt, "*Top 10 Cryptocurrencies in June 2021*", FORBES, 25 Jun 2021

and creative memes that made it very popular. Its supply is theoretically infinite, which leaves the currency very volatile, and in fact in later times its price has been changing very often, currently being around 0.32 dollars. Nonetheless it is undoubted that Dogecoin has experienced a giant growth, with a price increase of almost 160,000 %. Its market capitalization is over 42 billion dollars.

Table 2: Two trillion dollars' worth of crypto (market caps of cryptocurrencies in billion U.S. dollars)

#	Name	Price	24h %	7d %	Market Cap	Volume(24h)	Circulating Supply	Last 7 Days
1	Bitcoin BTC	$48,853.99	3.34%	1.58%	$917,265,189,883	$38,927,995,793 797,543 BTC	18,792,600 BTC	
2	Ethereum ETH	$3,282.60	2.13%	1.30%	$384,294,970,982	$20,987,982,785 6,400,457 ETH	117,193,902 ETH	
3	Cardano ADA	$2.46	1.93%	9.61%	$79,016,895,453	$6,361,439,990 2,586,507,012 ADA	32,127,592,886 ADA	
4	Binance Coin BNB	$455.04	6.39%	8.80%	$76,378,714,082	$2,453,014,592 5,399,968 BNB	168,137,036 BNB	
5	Tether USDT	$1.00	0.03%	0.00%	$64,248,432,015	$77,209,449,416 77,159,459,873 USDT	64,206,834,131 USDT	
6	XRP XRP	$1.25	0.45%	5.16%	$57,938,718,313	$5,818,674,661 4,667,078,616 XRP	46,471,846,087 XRP	
7	Dogecoin DOGE	$0.3245	1.40%	9.87%	$42,490,747,776	$3,001,843,417 9,251,224,542 DOGE	130,950,017,720 DOGE	

Source: CoinMarketCap, 2021

1.8 – Connected services

While the cryptocurrency industry was prospering, becoming more solid and widespread as time went on, numerous companies emerged which tried to reap the

popularity of these assets by providing services related to them. As it is often the case with complementary goods, also this services, which were meant to facilitate the cryptocurrencies' usage by creating a link between them and other sectors of the traditional economy, have contributed to add value to the main product itself, and nowadays they are so closely interconnected that the sector couldn't exist anymore without them. We are talking about the **exchanges**, used to buy and sell the currencies; the **wallets**, the purpose of which is to store the cryptocurrencies; and the **payment gateways**, which facilitates the payment through cryptocurrencies of real goods and services[37]. We will now proceed to analyze each sector in more detail.

1.8.1 Exchanges

Working similarly to a stockbroker, they play a crucial role in the cryptocurrency industry, not only because they allow to trade digital assets for conventional FIAT money or other currencies and vice versa, offering a common marketplace for its participants, but also because they provide liquidity for assets which would otherwise be very difficult to exchange and help determine their prices. In fact, the first official exchange was founded in 2010, and was meant primarily to facilitate the trade of Bitcoin and to assess its market price. It is possible to divide exchanges in three categories based on the activities they perform in the sector: Order-book exchanges, which are platforms that use a trading engine in order to match requests from users to buy and sell; Brokerage services, which let users acquire or sell digital currencies at a given price in a convenient manner; Trading platforms, that provide a single

[37] There is a fourth service related to cryptocurrencies which we won't linger on in this section not because of its lack in importance but because of our concerns that otherwise we would strive away too much from our central topic. We are talking about the Bitcoin ATMs, which started to appear in February 2014, launched by the founder of Robocoin Jordan Kelley; this kiosk like service allows people to purchase Bitcoins and other cryptocurrencies using cash or debit cards, and sometimes also to perform the inverse activity, selling the crypto assets for FIAT currency. They look a lot like traditional banks ATMs, with the addition of scanners installed to read government-issued identifications to confirm users' identity

interface enabling users to connect to other exchanges and uses leveraged trading and cryptocurrency derivatives.

Tyrone Ross, financial advisor and CEO of Onramp Invest, a crypto investment platform, said in an interview that in order to evaluate the efficiency of an exchange one would need to consider different factors, starting from the accessibility, since the location of the user may prevent him from buying or selling currencies on a specific platform (for example, in China citizens are banned from accessing crypto exchanges at all, but there are also less radical examples), and going through other factors like security, fees, liquidity and finally tax information[38].

The most used Exchanges are **Coinbase** (allowing you to trade more than 50 cryptocurrencies with FIAT money, making buying and selling fairly easy thanks to its strong security and transparent pricing; moreover it offers multiple investment options for individual and institutional clients); **Binance** (as already mentioned, this exchange is directly tied to the cryptocurrency Binance coin, offering the interesting feature to earn interest on your coins up to 0.10% yearly by staking them for a while); **Robinhood** (launched in 2013, it originally started out as a simple broker company and got involved in crypto trading only in 2019. It supports only 7 cryptocurrencies, but despite this it has a good reputation mainly because of its user-friendly interface[39]); and **Etoro** (this trading app allows a wide variety of services regarding the

[38] See Kendall little, "*Want to buy a crypto? Here's what to look for in a crypto exchange*", NEXT ADVISOR, 20 July 2021

[39] The user-friendly interface of Robinhood, easy to understand even if the individual approaching it has no experience whatsoever in finance, was one of the main causes of the **short squeeze** of GameStop and other titles which took place in January 2021. The peculiarity of this event was the fact that no big players or institutions were involved in the squeeze, which was enacted entirely by small investors, some of which were underaged, that kept themselves in contact through a social network called Reddit. Many were the consequences of what happened in the beginning of 2021 which involved a variety of individuals, ranging from the directors of companies or investment funds that held equity in the shorted firms up to the ordinary households that invested their money in said funds. Until today it is much debated how this particular occurrence could have started a shift in the whole financial system towards a new equilibrium where private and small investors have much more power in affecting big outcomes in the economy, thanks to the advent of social

crypto genre, from buying and selling digital assets to practice trading accounts before dipping into real funds, which makes it a pretty good crypto exchange even if it offers services on only 6 different crypto coins)[40].

1.8.2 Wallets

These objects can be devices, programs or services which store the public and private keys for cryptocurrency transactions. More in particular, when activated the wallet generates a theoretical or random number (algorithms which vary depending on the cryptocurrency's technology requirement are used during this process) that later on is converted into a private key, from which also a public key will be generated. While the key that is private is used directly by the owner in order to spend or transfer his funds, the public one is meant to be shared to third parties which can then make payments to the address derived from it[41]. Formulating it with the words of Nicole DeCicco, founder of CryptoConsultz, "*The public key is like the bank account number, which you can share with other people or institutions so that they can send money to you or take money if you authorize it, while the private key is like the password of your home banking or the PIN of your card, which you wouldn't give to anyone without a really good reason*". The risk that the private keys of two different wallets will be

networks, which allow coordination, and of software like Robinhood, that open the financial world to anyone who wants to enter it.
To deepen the topic, see:

- Rob Davies, "*GameStop: how Reddit amateurs took aim at Wall Street's short-sellers*", THE GUARDIAN, 28 January 2021
- Jamie Powell, "*GameStop can't stop going up*", FINANCIAL TIMES, 29 January 2021
- Emily Stewart, "*The GameStop stock frenzy, explained*", VOX, 28 January 2021
- Jonathan Ponciano, "*Meme Stock Saga Officially Over? GameStop Short Interest Plunged 70% Amid $20 Billion Loss*", FORBES, 15 February 2021
- David J. Lynch, "*The GameStop stock craze is about a populist uprising against Wall Street. But it's more complicated than that*", THE WASHINGTON POST, 10 February 2021

[40] See "*Top 10 Cryptocurrency Exchanges*", THE EUROPEAN BUSINESS REVIEW, 23 July 2021

[41] See Lily hay Newman, "*How to Keep Your Bitcoin Safe and Secure*", WIRED, 10 March 2019

equal is, although possible in theory, so unlikely that it can be ignored[42]. Note that the wallet itself just serves as a method to gain access to the cryptocurrency, which is by no means contained inside of it but, as in the case of Bitcoin, is likely to be stored and maintained in the publicly distributed ledger known as blockchain[43]. As stated by Alexandre Kech, CEO of Onchain Custodian, a custody service for digital assets, "*A Bitcoin wallet (and any crypto wallet, for that matter) is a digital wallet storing the encryption material giving access to a Bitcoin public address and enabling transactions*". In addition to the basic functions of storing the keys, some wallets may have also other intrinsic features, for example the ability to digitally sign smart contracts through a key similar to the private one used to enable transactions.

There are two different crypto storage options that may be more or less suited depending on what is planned to do with the currency: hardware wallets, which usually look like regular USB drives or may even consist in sheets of printed paper, store the keys completely offline and have the benefit that they are the hardest one to hack. Nonetheless, they may be lost or damaged, and moreover they are not very practical if many transactions are intended to be performed, and therefore they are recommended for long-term investors which plan to hold onto the cryptocurrency for longer periods of time as a store of value. On the other side, software wallets keep the keys online, are often directly connected to an exchange and are related to a higher degree of risks and user-friendliness than their physical counterparts[44].

[42] There is approximately the same amount of combinations of numbers used for the generation of private keys as atoms in the universe, as stated in "*Secure Bitcoin Wallet*", UNIVERSITY OF TARTU FACULTY OF MATHEMATICS AND COMPUTER SCIENCE, 2015

[43] See "*What is a crypto wallet?*", COINBASE.COM

[44]See Kendall Little, "*A Crypto Wallet Can Help Keep Your Coins Safe. Here's How to Decide If You Need One*", NEXTADVISOR, 15 July 2021

1.8.3 Payment gateways

The cryptocurrency gateways allow businesses to accept transactions of cryptocurrencies as payment from customers in exchange for goods or services, putting emphasis on security and wide-spread acceptance. In order to avoid the volatility of prices, often the gateway accepts the payment using a fixed exchange rate, converting the cryptocurrency automatically into traditionally recognized FIAT currency. However, this option can be deactivated easily if the merchant should prefer to hold the digital coins instead. An interesting feature of these services is that they tend to offer lower fees than traditional credit card payment systems, making it rather convenient for merchants to adopt them[45]. Moreover, a set of tools and reports which characterizes these payment processors helps making the whole process as comfortable as possible.

[45] See "*Best Cryptocurrency Payment Apps*", g2.com

CHAPTER 2

BITCOIN CHANGES EVERYTHING

"Bitcoin changes absolutely everything, and what I'm drawn to the most about is the ethos - what it represents, how conditions that created it are so rare and so special and so precious. I don't think there's anything more important in my lifetime to work on, and I don't think there's anything more enabling for people around the world - I see it more as a tool for protecting human rights, rather than just an investment [46]"

We introduced the first part of this paper with a quote of the famous 20th century economist Charles Goodhart, in order to assert what money has been standing for over the centuries. Likewise, we chose to introduce the second chapter with a statement that illustrates what money could one day become. Not by chance did we pick Twitter's and square's CEO Jack Dorsey for our example, since we believe the latter can be used perfectly to highlight the differences and parallelisms between the current era, and the hundreds of years old tenets represented by Goodhart's thought. Both individuals are children of the time they were living in, both are outstanding and leading figures, both changed the world through their actions, and yet they couldn't be more different. One chief adviser of the bank of England, symbol of monetary conservatism and traditionalism, the other founder of the second most popular social network in the world, symbol of the revolutionary changes ongoing in our society due

[46] Jack Dorsey, co-founder and CEO of Twitter and Square during a Bitcoin webinar in 2021

to the ever-growing digitalization; one emeritus professor of banking and finance courses in which the centralized view of the financial system was carried forward, the other supporter of a completely different mentality were finance acquires a much more subjective dimension; one sceptic towards the new types of money that emerged during the beginning of the second decade of the century, the other strong sustainer of the cryptocurrency world and bitcoin-enthusiast. And yet, despite these striking differences, we believe that both Dorsey and Goodhart would agree on one point: Bitcoin has changed the world forever. In the twelve years following its creation, it revealed itself as a disruptive and innovative technology, which has been challenging the long-standing and unchanged financial payment systems reliant on FIAT currencies.

2.1 – Bitcoin as a way to end state's monopoly in monetary management

Many were the ideological implications that contributed to the birth of the first cryptocurrency, but it is safe to say that when in 2009 the first or *genesis* block was added to the blockchain, it was mainly the idealistic desire to deprive the central banks from some of their monopolistic power regarding monetary policy, which animated the entire process. In fact, it was a common sentiment in the aftermath of the 2008 global financial crisis to mistrust the old financial system based on intermediate banking which had revealed itself in all its inefficiencies, and Bitcoin, thanks to its anonymity, privacy and autonomy, seemed to provide the perfect alternative to the mistakes of the past[47]. Nonetheless the theoretical implications of the Bitcoin are found in less recent times, having their roots in the Austrian School of

[47] See Masooda Bashir, Beth Strickland, Jeremiah Bohr, "*What motivates people to use Bitcoin?*", 2016

Economics[48], as the ECB stated it during its first official study of decentralized cryptographic money which took place during November 2012. According to the report, proponents see Bitcoin as "*a good starting point to end the monopoly central banks have in the issuance of money*", being "*inspired by the formal gold standard*"[49].

2.1.1 Connections to the Austrian School of Economics

The scholars of the Austrian School tried to give an answer to different issues that afflicted the society in which they lived, some of which are still actual in today's world, and one can see how up to a certain extent the Bitcoin could represent a solution for these problems. Between the latter there is particularly one that jumps to mind, being the Austrian theory of business cycles (ABCT). This gives an original interpretation about business cycles[50], seen as phenomena completely determined by bank's excessive issuance of credit. The analysis, led by Eugen von Böhm-Bawerk, Ludwig von Mises and Friedrich A. Hayek, focuses on the process through which central banks

[48] The Austrian School is a school of economic thought which puts great emphasis on the so-called **methodological individualism**, believing that the majority of social phenomena happing both on a micro- and macro-economic horizon result exclusively from motivations and actions of individuals. It originated in the late 19th century in Wien under the Austrian Empire, seeing brilliant economist like Carl Menger, Eugen Böhm von Bawerk and Friedrich von Wieser defend its ideology. The Austrian School contributed to many important milestones in modern economics like the **subjective theory of value**, **marginalism in price theory** and the formulation of the **economic calculation problem**.
To deepen the topic, see:

- Mary Hall, "*The Austrian School of Economics*", INVESTOPEDIA, 28 July 2021
- Israel M. Kirzner, "*The Austrian School of Economics*", THE NEW PALGRAVE: A DICTIONARY OF ECONOMICS, 1987

[49] See Jon Matonis, "*ECB: Roots of Bitcoin can be found in the Austrian School of Economics*", FORBES, 3 November 2012

[50] Business cycles are movements in the economic output, characterized by expansions and recessions, which usually alternate themselves in the short run with a periodicity ranging from around two to ten years. They may have huge implications for the welfare of the broad population as well as for private institutions and governments. The conditions affecting them are generally considered unpredictable and may range through a large number of variables going from the sudden change in oil prices due to a new decision of the OPEC cartel to decrease the quantity supplied, up to a variation in consumer sentiment caused by changed trends or preferences, that affects overall spending in the macroeconomy and thus investment and firms' profits. The interpretation of the Austrian School is only one of many, yet it gained a conspicuous success; it differs significantly from the mainstream understanding of business cycles, which views them as essentially random shocks that average out over time, or as economist Eugen Slutzky stated it, they are "random summation of random causes". The view which instead enjoyed most acceptance during the years is the Keynesian one, which asserts that fluctuations in aggregate demand cause the economy to come short run equilibria at levels which may differ from the long term one.

extend their credit to commercial banks by increasing their money supply, which in turn will inevitably decrease interest rates to artificially low levels; at this point entrepreneurs will be motivated by distorted rate signals to embark in overly ambitious investment projects, also defined as **malinvestment**, giving birth to a credit boom. Eventually this expansion is doomed to bust starting a recession, because following the Austrian view, government manipulation of credit and money will always throw savings and investment out of balance by favoring investment decisions which won't match consumers' preferences relating to intertemporal consumption[51]. As Austrian economist Fritz Machlup summarized it, "*Monetary factors cause the cycle, real phenomena constitute it*".

Even though Central banks alone should recognize as desirable the target of monetary stability and therefore dedicate the necessary resources and focus in order to achieve it, complete independence of the banking sector from government intervention may be hardly preservable given the strong necessity of countries to be financed by external actors mainly in times of unrest. Statutory laws may be applied in order to maintain it, but extreme events can nonetheless erode it as time passes. During Austria's history, as shown in **figure 5**, it happened many times that rulers and politicians, pushed by wars or other adverse factors, were forced to directly influence monetary policy by printing money at their will in order to increase the output of their countries at least in the short term[52].

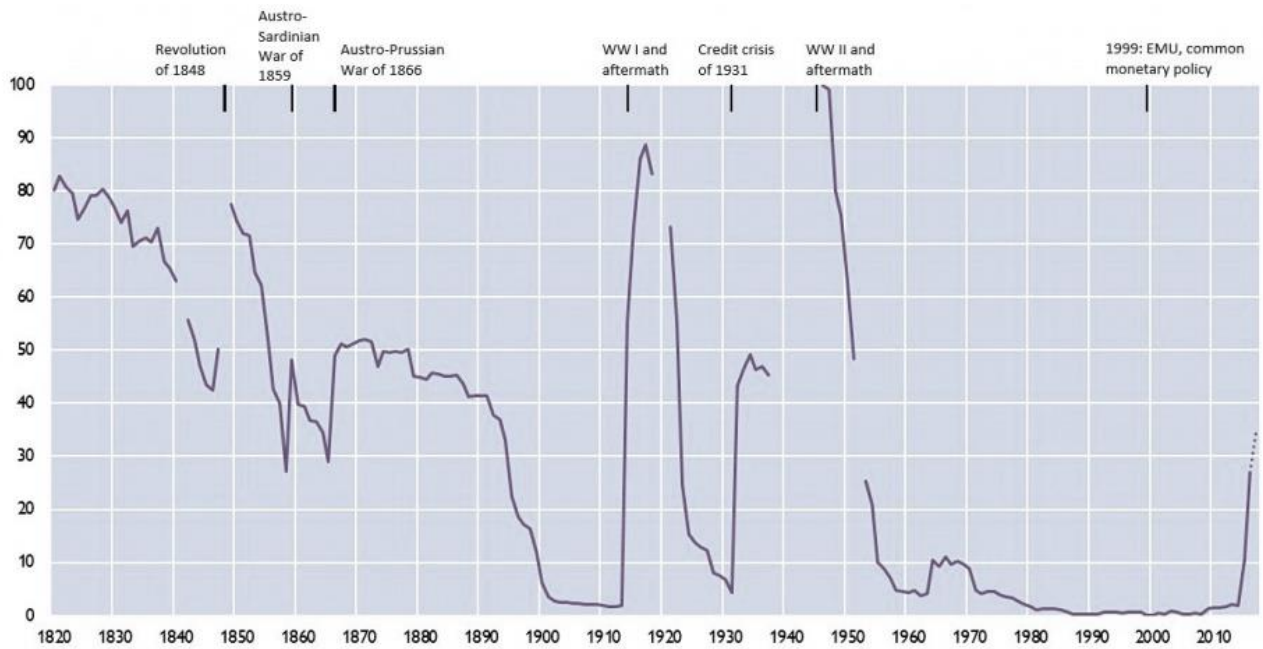
Given these factors, it becomes obvious why Austrian scholars thought that the phenomenon of recessions could be put to an end only through radical means. In his publication "The Denationalization of Money", Hayek suggested to change the system in a way that allowed also private banks to issue non-interest-bearing certificates

[51] See European Central Bank, *"virtual currency schemes*", p.22, October 2012

[52] See Ernest Gnan, Clemens Jobst, "*Two turbulent centuries: Lessons from Austria's monetary policy, 1816-2016*", THE EUROPEAN MONEY AND FINANCE FORUM, December 2016

based on their own registered trademark; these currencies would compete for acceptance and, based on their value derived from the credibility of the institution issuing them, only the most stable ones would survive. This way the monetary monopoly would cease to exist once and for all, leaving room for a highly efficient system where only currencies with a stable purchasing power would coexist[53]. Many scholars of the Austrian doctrine suggested other, less radical ways to contrast the fractional reserve banking system, indicating a return to the gold standard as a possible solution, since the issuing power of central banks would this way be limited decreasing also the possibility of interference in monetary policy by other authorities.

Figure 5: Domestic public debt held by the Austrian National bank (percentage of balance sheet total adjusted for gov. paper money)



Source: Jobst and Kernbauer, "*Eurosystem holdings of Austrian public debt recorded on the OeNB's balance sheet*", ECB & OeNB

[53] See Friedrich Hayek, THE DENATIONALIZATION OF MONEY, 1976

Supporters of Bitcoin have always been fascinated by the Austrian School's ideas. Sharing their point of view, they believe that the cryptocurrency could indeed be used as a good starting point to end the vicious circle represented by continuous central bank intervention in the economy and subsequent recessions. As of today, it seems that at least partially the Austrian theories may contain righteous arguments, masked under radical and probably unrealistic solutions doubtlessly originated from the different historical context in which they were formulated that doesn't perfectly reflect our present society anymore. Nowadays central bank independence is more safeguarded then once, since the present (at least in the civilized western hemisphere) lacks the before mentioned extreme situations that may have pushed governors to directly intervene in monetary policy[54]. Moreover, like in the case of the ECB, it seems that the serving of one central bank towards more than one state can de facto increase ulteriorly its autonomy furthering the pursuit of monetary stability[55]. Nonetheless, the 2009 Global Financial Crisis has shown how precarious our financial system can be, highlighting what Austrians would call a failure of the modern monetary policy.

2.1.2 Limits of the fractional-reserve banking system

The subprime mortgage bubble which burst in 2008 was directly catalyzed by the federal reserve's expansive monetary policy from 2001 to 2006 as well as the poor governmental regulation regarding real estate. At the same time, the artificially low interest rates resulted in significant malinvestment in the economy, fostering the banking crisis which took place early after. The same situation, to a less disruptive

[54] Here we are speaking of wars, social unrests or famines; nonetheless the recent Coronavirus crisis has demonstrated how "extreme events" may come also in less violent forms

[55] See *note 54*

extent, has been verifying itself multiple times over the last decades, and may be happening again right know during the Covid-19 pandemic crisis, where the permanent quantitative easing of the federal reserve has been pumping trillions of new dollars in the economy after the directive of the government. The strategy effectively worked in the short run, slightly decreasing the unemployment rate while starting to get the consumption and investment expenditures back to their original levels, but at the same time also the inflation rate skyrocketed, reaching a maximum in summer 2021 of more than 5%. While the U.S. authorities, first and foremost Fed CEO Jerome Powell, continue to insist that the inflation is just a temporary phenomenon in order to prevent expectations to adjust, it goes without saying that given their position they couldn't state anything else even if they would be convinced of the opposite[56].

Monetary theories of the last century have thought us that after an increase in the supply of money, the lower interest rates may have beneficial effects on a country's output in the short run. Nonetheless, in the long run prices will always adjust, bringing output back to its initial level. The effectiveness of the move depends upon the stickiness of prices, which usually will take some time to change. While it is proved that a permanent increase in inflation will always be of monetary nature, prices may temporarily increase also due to other factors affected by the demand side of the economy, like a momentaneous increase in consumption following a change in trends or preferences. Since consumption effectively began to grow after the lockdowns imposed because of the virus, supporters of the government's strategy believe the

[56] In economics, with the term **self-fulfilling prophecy** a situation is addressed in which a future situation may realize itself based just on the change of expectations in the present caused by the prophecy itself. In these circumstances, if the highest monetary authority of the United States would publicly declare that the C.P.I increase was permanent, workers adjusting their future expectations would request higher wages, prices would consequently rise and interest rates would increase to compensate the decreasing purchasing power. This would happen regardless of whether the inflation would have increased in the first place, thus we can speak of a prophecy which, just through the power of changing expectations, transforms the future according to its message.

words of the president of the Federal Reserve, while other individuals are more skeptical, and prepare themselves for the worse. Independently from which scenario will realize itself in the near future, the fractional-reserve banking system is showing once again its possible limits, and the Bitcoin could one day reveal itself as a valid alternative.

2.1.3 Bitcoin's exchange value

In 1912 Ludwig Von Mises proposed the so-called **Regression Theorem**, claiming that the value of money should be traced back to the goods and services it could obtain. In other words, following his view no good could be used as a medium of exchange if at the very beginning of its use it didn't have exchange value on the account of other employment. For example, gold coins derived their prior exchange value from the intrinsic value of the material they were composed of, while FIAT currency not backed by gold, introduced with the end of the Bretton Woods regime, could be used as medium of exchange because governments had previously imposed it as legal tender[57]. At first glance the Bitcoin, composed of bits stored digitally with no concrete value at all, doesn't correspond to Von Mises' definition, meaning that cryptocurrency could neither constitute an alternative to our present banking system nor be considered as money at all. Nonetheless, we believe that Bitcoin is much more than what initially meets the eye, and that lingering on opinions of conservatory individuals who's distrust in new types of currencies is based on mere prejudice would be futile and counterproductive.

Bitcoin's exchange value is given by the extraordinary possibilities to which it gives access, possibilities that no type of money in the past would have ever dreamed of.

[57] See Andrew Tu, "*On Austrian Economics and Bitcoin*", MEDIUM, 16 April 2020

Bitcoin can be transferred between individuals without a third party, it is nearly costless to exchange, it is durable, fungible and divisible and most importantly, it creates a monetary system that doesn't depend neither on trust and identity, nor on central banks and governments. It truly is a new system for the digital age. As famous Austrian economist Jeffrey Tucker once said:

"*Bitcoin's value derives from itself, being both a payment solution and a unit of currency at the same time; the extraordinary utility of its blockchain provided it value before it even became a medium of exchange, and this actually confirmed Mises's Regression Theorem*"[58].

Once this point has been stated, it should become clear why defining the Bitcoin as nothing more than digitally stored bits would be completely inappropriate. The blockchain is its source of value, while the Bitcoin as unit of account merely expresses this value in terms of a price; this online ledger, observable in operation by anyone at any time, allows the transference of securable and non-repeatable bits of information from one person to another anywhere in the world, and this without having to depend on some third-party trust agency. Moreover, it is important to note how the blockchain isn't only about money, but that it regards any information transfer requiring security, confirmation and authenticity, comprehending contracts and transactions of all sorts.

2.1.4 Towards a new equilibrium

An additional interesting feature about the Bitcoin is its limited supply, which makes it structed similarly to another medium of exchange used for many centuries, that is gold. This is a fundamental attribute from the point of view of the Austrian School's

[58] See Jeffrey Tucker, "*Bitcoin and Mises's Regression Theorem*", BEAUTIFUL ANARCHY, 7 September 2014

theories, since, exactly like the noble metal, it can't be infinitely inflated. Moreover, it could even be adopted as a world reserve currency, preventing the artificial distortions of money supply and credit associated with central banking, basically putting an end to the contractive phases of the economy and to the business cycles problem mentioned before[59]. Of course, this kind of reasoning couldn't come without critiques pointing out how such a situation would inevitably give birth to deflation, typically seen as disastrous by most economists[60]. Two economic schools, rival to the Austrian one, namely the Keynesians and the Monetarists, have long debated over this issue coming to different yet analogous conclusions. While the first ones argued that a flexible monetary policy was necessary in order to stimulate aggregate demand during bad economic circumstances, the seconds believed that money supply had to be adjusted to match changes in production.

The Austrians didn't see deflation as a problem, believing that since in the eyes of the consumers absolute price levels were less relevant than the spreads between sales and costs, likely to be unaffected by decreasing prices, investment demand wouldn't change at all. A recurring example used to justify this thesis is the situation which occurred during the late 19th century in the U.S., where a period of strong deflation was accompanied by rapid economic growth[61]. Moreover, in the eyes of the Austrian School the inability of central banks to adjust money supply according to their discretion due to a possible Bitcoin standard would actually be a solution more than a problem, since it would prevent the exacerbation of Business Cycles.

[59] See Mark Justin Valek, "*Austrian school meets Bitcoin*", INCREMENTUM, 5 December 2020

[60] Deflation is a situation converse to inflation in which price levels decrease as time goes on, therefore increasing the purchasing power of consumers. It is usually associated with a contraction in the supply of money and credit in the economy, and it may be cause of recessions and poor economic growth; in fact, mainstream economist claim that since consumers expect future prices to drop, extended deflationary periods may decrease demand for goods and services. See Michael Sonnenshein, "*Deflation*", INVESTOPEDIA, 30 June 2020

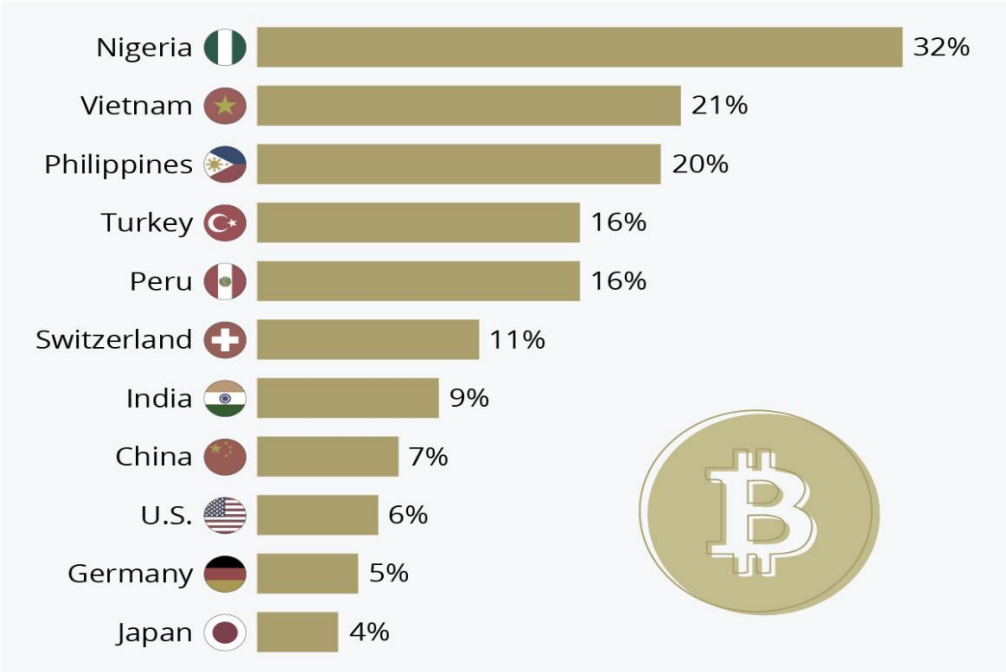
[61] See Philipp Bagus, "*The Fear of Deflation Is Unfounded*", AUSTRIAN INSTITUTE, 19 December 2019

It is our aim in this paper to encourage reflection on how the Bitcoin is changing our world, not to argue which economic thought is the most apt to be followed for the wellness of the society, thus we won't linger on commentaries regarding the dispute between Keynesians, Monetarists and Austrians. Yet, after these remarks, one should start seeing Bitcoin in a new light. Not only was the cryptocurrency inspired by a philosophy older than a century which saw under its rankings some of the most important economist of our time, but it could provide an answer to one of the dilemmas this philosophy is based upon. The concept that something which came out of nowhere promoted by a small group of anonymous people could one day overthrow a regime supported by the most important institutions of the world is truly overwhelming.

2.2 – Bitcoin's usefulness in developing countries

Thanks to the popularity the cryptocurrency enjoys, its transaction volume is increasing at a steady rate. Due to its speculative nature which may be exploitable to increase profit opportunities in investment portfolios, one may be led to think that Bitcoin is mainly used in countries which have already developed and functioning financial systems and intermediaries. Nonetheless, as the 2020 global consumer survey (illustrated in **table 3)** testifies, the highest transaction volume is registered in emerging and frontier markets rather than in well-established ones. This can be explained through the innovative payment system which Bitcoin's blockchain renders to anyone, the functioning of which is of extraordinary importance to individuals living in developing countries.

Table 3: Share of respondents in selected countries who said that they used or owned cryptocurrencies (1,000 – 4,000 respondents per country)



Source: Statista global consumer survey, 2020

2.2.1 The importance of financial intermediation

According to the United Nations Development Program, even though income may be positively correlated with human wellbeing, the latter is strongly affected also by many other factors, including the development of the country, reason why in 1990 the Human Development Index was conceived[62]. Among the aspects influencing development, the effectiveness of the mechanism with which resources are transferred from savers to investors is certainly one of the most relevant. The process of borrowing and lending may be hindered because of agency problems, fostered by

[62] See Human Development Report, UNITED NATIONS DEVELOPMENT PROGRAM, 2015

information asymmetries[63] and limited enforceability of contracts. For these reasons the presence of healthy financial markets and intermediaries is critical for economic wealth due to their role in transferring funds from individuals having a surplus to others having a shortage. In fact, commercial banks and other types of intermediaries may be able to benefit the complete society thanks to their ability to reduce transaction costs exploiting economics of scale and scope, this way offering their services to common individuals at convenient prices and with reduced exposure to investment risks[64]. Furthermore, through screening and monitoring activities banks may succeed in controlling for asymmetric information issues which would otherwise impede the judgment of single investors.

Without a well-functioning financial system, the country might experience disastrous consequences on multiple fields. Due to the lack of trust in the system, a crunch in investments following ever increasing interest rates will inevitably make aggregate output collapse and unemployment rate increase. If handled in the wrong way, like often the case in emerging countries, recover from such a recession may be an almost impossible task, and the poverty and desperation arising from it may give birth to social unrest and fights, followed by even more poverty than to begin with.

[63] There are mainly two forms of asymmetric information damaging the financial redistribution of resources: the moral hazard problem, occurring after the transaction has taken place, regards the possible attitude of the borrower to hide information from the creditor and engage in activities which are undesirable from the latter's point of view. Since moral hazard lowers the repayment probability, it reduces the expected return of an investment decision; The adverse selection problem instead regards the difficulties that could arise before the transaction takes place and verifies itself because borrowers who are most likely to produce adverse outcomes are also the ones that will most actively seek a loan, not caring about the high interest rates. Thus, the chances of selecting a bad borrower are actually higher than to select an honest one, and so lenders may decide not to make any loans at all even though there may be good opportunities in the credit market.
See:

- Jonathan Bonnitcha, "*The problem of moral hazard and its implications for the protection of legitimate expectations under the fair and equitable treatment standard*", INVESTMENT TREATY NEWS, 7 April 2011
- Adam Hayes, "*Adverse Selection*", INVESTOPEDIA, 19 January 2021

[64] See Bank Negara Malaysia, "*The importance of financial stability*"

Financial intermediaries are crucial not only for individuals but also for companies, mainly small or medium sized enterprises (SMEs) and businesses in search for loans. These are strongly affected by the lack of access to finance and affordable credit and have encountered numerous obstacles and burdens in trying to establish themselves in developing countries. The extent of the dilemma becomes understandable if one takes in account that in the EU the SMEs represent 99% of the businesses in circulation, creating 85% of all new jobs and generating about three-fifth of the EU value-added[65].

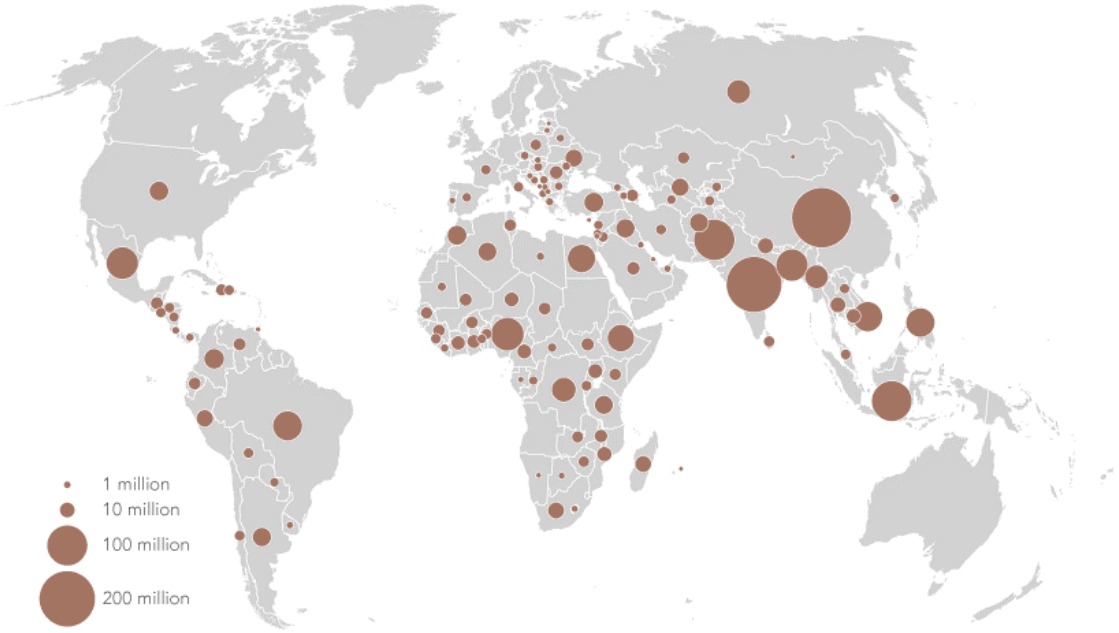
Nowadays, in many parts of the world people take the presence of essential services like banks as granted, safe in the knowledge that their money is securely stored and easily redeemable. Nonetheless, financial inclusion[66] is far from being a worldwide phenomenon, and according to the latest Findex data close to one-third of adults (about 1.7 billion), mainly located in developing countries as shown in **figure 6**, still lives without having access to a banking account. Even if the situation is slowly improving, with 1.2 billion people getting access to proper banking since 2011[67], the problem remains huge and institutions like the World Banks Group and the G20 affirmed their commitment to implement programs in order to come to a solution, identified as the Universal Financial Access (UFA).

[65] European Commission, "*Access to finance for SMEs*", INTERNAL MARKET, INDUSTRY, ENTERPRENEURSHIP AND SMES

[66] Financial inclusion is defined as a condition in which individuals and businesses have access to useful and affordable financial products and services that meet their needs such as transactions, payments, savings, credit and insurance, delivered in a responsible and sustainable way.
See World Bank, FINANCIAL INCLUSION

[67] See Niall McCarthy, "*1.7 billion Adults Worldwide Do Not Have Access to A Bank Account*", FORBES, 8 June 2018

Figure 6: Number of adult individuals lacking a bank account around the world



Source: Global Findex database, 2018

Yet, it appears that there might be another way to grant financial services to people living in the third world, a way that doesn't include the intervention of institutions which may take too long to arrive, but that sees the individuals directly involved deal by their own with the problem, exploiting the new digital opportunities offered by the 21st century and embodied in the crypto world. Technology entrepreneur Jack Dorsey, already mentioned before due to his strong involvement in the crypto world, was able to perfectly resume in a sentence what Bitcoin stands for in underdeveloped countries:

"*I believe that Bitcoin has the potential to create a new financial infrastructure that is more inclusive and supportive for underserved communities; for those living in different countries around the world, the cryptocurrency could be seen also as a way*

to expedite transfers of funds across border lines and to protect against currency devaluation[68]".

2.2.2 An unconventional type of financial inclusion

In the past years, third-world countries have been proven capable to leapfrog decades of development in the West, bypassing physical banks, infrastructures, governance and entire systems of production, replaced by peer-to-peer digital currencies based on blockchain technology. This way it becomes clear how the improvement of financial inclusion is the most significant and developed benefit of cryptocurrencies for populations of developing countries[69]. Because of the lack of trusted third parties, individuals had to switch to solutions not requiring guarantors, finding the perfect solution in programs like Bitcoin which allow for individuals to exchange currency requiring just a mobile phone[70]. Traditionally, because of the unfamiliarity which characterizes the relationship between payer and payee, the need for trust in mediating individuals or institutions has pushed humankind to adopt a centralized organizational system typically perceived as the most efficient to devise, settle and enforce rules. However, should the authorities of the relevant country not be strong enough to guarantee the fairness and honesty of the system, the centralized institution could exploit its powers going against the interest of its investors.

Cryptocurrencies allow people to store their money by improving the transparency of information exchanges, rendering trust obligations easier to discard between

[68] Jack Dorsey on stage at the Bitcoin 2021 convention, Mana Convention Center, Miami, Florida, 4 June 2021

[69] See Philipp Sandner, THE IMPACT OF CRYPTOCURRENCIES ON DEVELOPING COUNTRIES, 21 January 2020

[70] Following the data collected in 2018 by the Gallup World Poll, two-thirds of individuals living in unbanked areas own a mobile phone; moreover, there seems to be a positive correlation between distrust in banking sector and the ownership of phones in third-world countries.

transacting parties and reducing drastically the information asymmetry in all sort of transactions as well. All this is possible through a shift from the trust in intermediaries to the faith in the devised code and rules that define how the network reaches consensus, offering a technology-based means of currency generation and value exchange while preventing abuses from MFIs' managers or employees[71].

It is important to notice that the financial advantages promoted by the blockchain technology aren't connected solely to the cryptocurrencies, but that they comprehend a multitude of sectors and applications (see **figure 7**). In fact, this technology offers the possibility to innovate in virtually any area. Besides its uses for monetary exchanges, it is mainly regarding the so-called *decentralized finance applications,* also referred to as smart contracts, that these innovations are being exploited[72]. The latter are types of contracts which allow to automatically execute, control or document legally relevant events according to the terms of the contract itself without any fraud, control or interference from a third party[73]. We have already mentioned them before while talking about Ethereum, which is the most important platform currently available to implement them. They were created with the objective to reduce the need in trusted intermediation, arbitrations and fraud losses, while at the same time controlling for malicious and accidental exceptions. The U.S. National Institute of Standards and Technology describes smart contracts as "*a collection of code and data that is deployed using cryptographically signed transactions on the blockchain network*[74]". They are seen as completely secured procedures, as their execution and codified effects like the transfer of value between

[71] See Elena Russo, "*Potential benefits of cryptocurrencies' adoption in developing countries*", CRYPTOCURRENCIES' ADOPTION IN DEVELOPING COUNTRIES, p.37, 2019

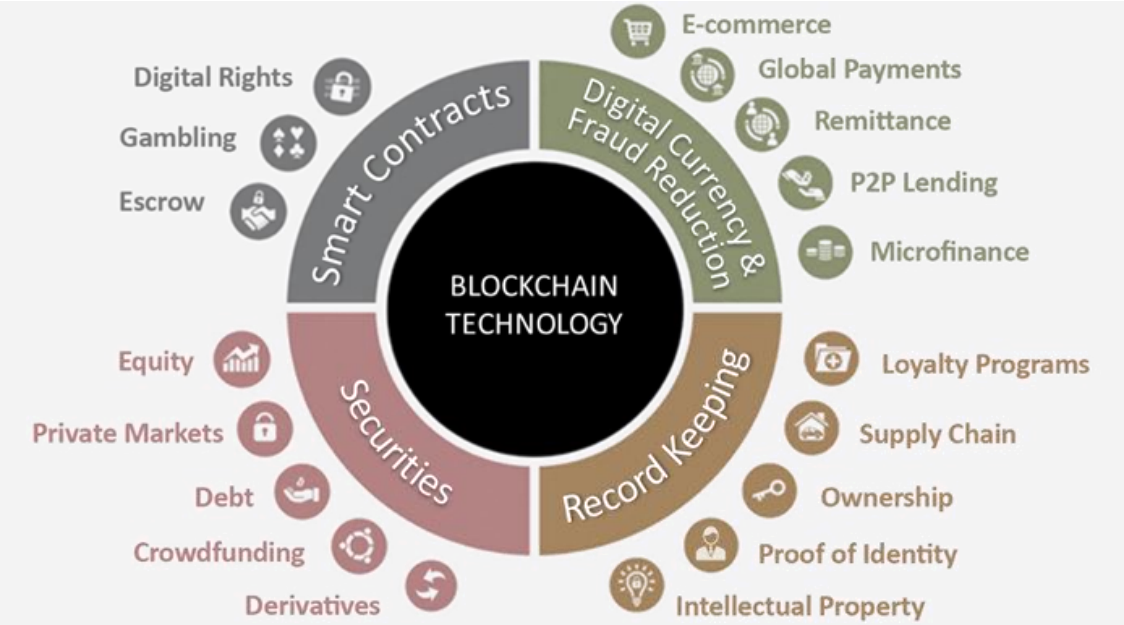
[72] See Shamika Sirimanne, "*How blockchain can power sustainable development*", THE FINANCIAL EXPRESS, 27 July 2021

[73]See Fries Martin, P. Paal, "*Smart Contracts* ", ISBN, 2019

[74] National Institute of Standards and Technology, "*Blockchain Technology Review*", INTERAGENCY REPORT 8202, 2018

parties are strictly enforced and can't be manipulated, once the transaction has been stored into a blockchain. In 2017, Belarus became the first-ever country to legalize smart contracts.

Figure 7: Main applications of the blockchain



Source: Cyber-Security Research Innovation Lab

2.2.3 Bitcoin reduces transaction costs: the case of El Salvador

Another important benefit offered by cryptocurrencies to developing countries is the consistent reduction in transaction costs with regards to traditional payment systems. The latter's burden may be so high that individuals are disincentivized to conduct transactions in the first place, seeing the benefits drastically reduced. Fortunately Bitcoin, removing the intermediary, has the potential to avoid the related transaction fees; as a matter of fact, in theory transaction costs in digital peer-to-peer systems

are close to zero, and in practice, even if for maintaining security standards many exchange platforms charge fees, these are nonetheless considerably lower than what financial institutions demand for exchanges of comparable value. This is particularly relevant with smaller transactions, such as donations, microloans or expatriate workers' remittances. In order to highlight up to what extent such a characteristic could influence the lives of people, we will take as an example what happened in the small South American republic of El Salvador at the beginning of summer 2021.

On the 9th of June, El Salvador's congress approved the proposal of president Nayib Bukele for Bitcoin to become legal tender within the nation. This move has many implications: not only is it going to be possible to pay taxes and services offered directly by the government using the cryptocurrency, but also every other economic agent in the country will have to accept Bitcoin as a payment when offered to him by whoever acquires a good or a service. Yet, there is much more to it. Being a digital decentralized currency, the Bitcoin can't be subject to monetary policy decisions as easily as ordinary currencies, and the large fluctuations to which its value is subject on a daily basis could foster price instability and social turmoil[75]. Nonetheless the country proceeded with its intent. To understand this questionable choice, one must consider that El Salvador, like approximately twelve other countries in South America (most of them micro-states like Andorra and Nauru), doesn't have its own currency, since it abandoned the "colon" in 2001 and adopted the US dollar as only legal tender. In principle, this act seemed to have achieved its goal, reducing inflation and interest rates on one hand and improving the terms of trade on the other (mainly since the U.S. were El Salvador's most important trading partner), but soon it became clear that forever living in the United States' backyard wasn't in the full interest of the country

[75] See John Hawkins, "Can Bitcoin become a real currency? Here's what's wrong with El Salvador's crypto plan", THE CONVERSATION, 13 June 2021

for several reasons[76]. With the Bitcoin, Bukele hoped to regain part of the lost control as well as some sort of independence from the United States' moves, while boosting the economy thanks to an increase in foreign investment attracted by the liberalization of cryptocurrencies[77]. The decision acquires even more credibility considering that more than 70% of the adult population in El Salvador doesn't have a banks account, thus giving a progressive touch to the democratization of the access to electronic payments.

But the main reason behind this scenario, as the American Bank emphasized in its latest Global Research report, is strictly connected to the before mentioned cost reduction characteristic of crypto transactions. According to the Census Bureau, Salvadorans constitute 3.8% of the total Latino population in the U.S., making them the largest group of Central Americans of the American Isthmus community in the United States. A big chunk of the population is resident outside the small country due to better employment opportunities. This in turn has as a consequence that 24% of El Salvador's GDP is constituted by remittance flows, stemming from outside workers sending paychecks to their families residing in the country. The Bank for International Settlements estimates that the average cost of a bank-based cross-border remittance is over 10%, thus 2.4% of the whole nation's GDP would get lost in transaction costs. Switching to Bitcoin for remittances would reduce this burden by a lot, and the volatility could be overcome by automatically converting to dollars once the transaction has been made[78].

[76] In fact, the monetary policy decisions of the Federal Reserve where shaped for the economic conditions of the United States which didn't always mirror those of the South American country. Despite this, El Salvador had to adapt itself to changes in money supply meant to benefit another environment, with obvious negative repercussions on its home economy.

[77] See Doug Specht, "*El Salvador has made bitcoin legal tender; why*?", GEOGRAPHICAL, 27 July 2021

[78] See Sam Bourgi, "*Bank of America outlines 4 potential benefits of El Salvador's Bitcoin strategy*", COINTELEGRAPH, 1 August 2021

Whether Bukele's plan will work accordingly to its expectations is a question only time will answer. The first problems started to emerge during the inauguration day which took place in September 2021, when the Wallet software ideated by the government showed its limits, with servers crashing and transactions not working. Moreover, surveys exhibited how a large chunk of El Salvador's population completely ignores the risks associated with holding cryptocurrencies instead of FIAT money, which may give origin to further problems in the near future. A big challenge, as highlighted by the International Monetary Fund, is faced also by the Finance Ministry of the country, which is going to plan its tax revenue and its public expenses according to a highly volatile means of payment. Yet, El Salvador's example may be a step in the right direction, and in the long run it could prove as a valid possibility for countries experiencing similar issues as the South American republic.

2.2.4 Bitcoin protects against currency devaluation: the case of Lebanon

El Salvador's example isn't an isolated case, and even if currently no one else has proceeded to adopt the cryptocurrency as legal tender, more and more countries are beginning to get seriously involved with it, for reasons which may take into account issues similar or quite different to the ones of the South American nation. In the Middle East, Lebanon is struggling to exit one of the worst economic crises it ever went through, seeming constantly on the verge of collapse. Due to an instable government which succeeded a power vacuum lasting almost 300 days, a failed and corrupt banking system and fuel shortages causing the rationing of essential services like electricity and water, Lebanon's inhabitants are losing their trust towards institutions. People, already torn out by the tremendous explosion which caused the destruction of large part of the capital Beirut, must deal with the abuses of the

authorities, not missing an opportunity to respond with violence to the numerous demonstrations[79].

In addition to this, the value of the Lebanese Pound plummet, devaluating the currency up to 90% in regard to the U.S. dollar. In a strong and productive economy, as may be the case with China, a weak currency will increase aggregate output, making exports more attractive in the eyes of foreigners. Yet, for a small country like Lebanon, which mainly depends on imports to supply its domestic demand, this will have disastrous consequences, crunching purchasing power and consumption. For these reasons, seeing themselves endowed with almost worthless money and oppressed by financial institutions that impose informal and illegal capital controls, people have increasingly turned to Bitcoin as a way to gain financial security and independence[80]. Like Dorsey said in his interview, if a country's government isn't credible enough for its FIAT currency to acquire any exchange value, people lose their faith in institutions and may find help in decentralized stores of value which, although themselves volatile and speculative, grant a much safer purchasing power than the available substitutes.

2.2.5 Bitcoin defends human rights: the case of Nigeria

The final example we have chosen for this section is the one of Nigeria, country tied to the crypto world for yet another reason. Similarly to Lebanon, also in Nigeria many individuals have started converting their financial holdings into Bitcoin once they realized that inflation was slowly eroding their wealth. In fact, the value of the Nigerian Naira has plummeted almost 30% against the U.S. dollar in the past five

[79] See Nimrod Lehavi, "*Crypto Adoption in Middle East Will Come From Unstable Nations",* COINDESK, 10 August 2021

[80] See Lauren Holtmeier, "*How crypto-remittances offer Lebanese a way around defunct financial system*", ARABIAN BUSINESS, 4 July 2021

years, while the price of goods and services has doubled multiple times (in 2021 food prices have reached their highest level since July 2008). Moreover, the huge commission charges applied by Nigerian banks for cash transfers between the country and the rest of the world nurtured the mistrust of people towards the ordinary banking system, like it was the case in El Salvador[81]. In spite of that, it was another factor which made Nigeria the second country in the world for Bitcoin trading, preceded only by the United State.

Way back in 2019, the government of the African country started imposing multiple bans on working branches which according to its point of view endangered the domestic economy, like textile import companies. This in turn contributed to drastically worsen the already precarious living conditions of many workers which remained unemployed from one day to the next. In 2020 Nigeria was shock by the largest protest in decades, fueled also by hate of people against the police brutality[82]. Consequently, the government started to suspend the bank accounts of every protester they succeeded to identify, in addition to the ones of civil society organizations, protest groups and more in general every individual supporting the demonstrators. This episode reinforced the need many Nigerians felt to insure themselves against sudden moves by the authorities, thus more and more privates and organizations started to keep at least part of their holdings in Bitcoins. Digital

[81] See "*Cryptocurrencies: Why Nigeria is a global leader in Bitcoin trade*", BBC NEWS, 28 February 2021

[82] Nigeria is known for its infamous SARS police unit, the Special Anti-Robbery Squad created in 1992. It was originally meant to deal with crimes associated with robbery, theft, kidnapping and firearms, but became quickly notorious for its links with extrajudicial killings, extortion, torture, blackmailing up to kidnapping and armed robbery, ironically the crimes which they should have fought. In 2017 the End SARS movement started, which demanded the disbanding of the unit by the Nigerian government. The protests culminated in October 2020 following more revelations of the unit's abuses; the security forces responded using water cannons and teargas on them, and more than 50 protesters were killed.
See:

- Sada Malumfashi, "*Nigeria's SARS: A brief history of the Special Anti-Robbery Squad*", AL JAZEERA, 22 October 2020
- *"The Killing Force: Nigeria Police Turn Their Guns on Defenseless Citizens"*, P.M. NEWS, 7 November 2011
- Nqobani Ndlovu, "*Nigeria's dirty cops*", THE ARTICLE, 26 October 2020
- *"End SARS, The Vital First Step",* THECITYCELEB, *14* October 2020

currencies became the symbol of insurance against hostile interventions. The dollar value of crypto received by users in Nigeria skyrocketed, reaching the height of $2.4 billion in May 2021, up from $684 million in December 2020[83].

2.2.6 Higher involvement, higher risk

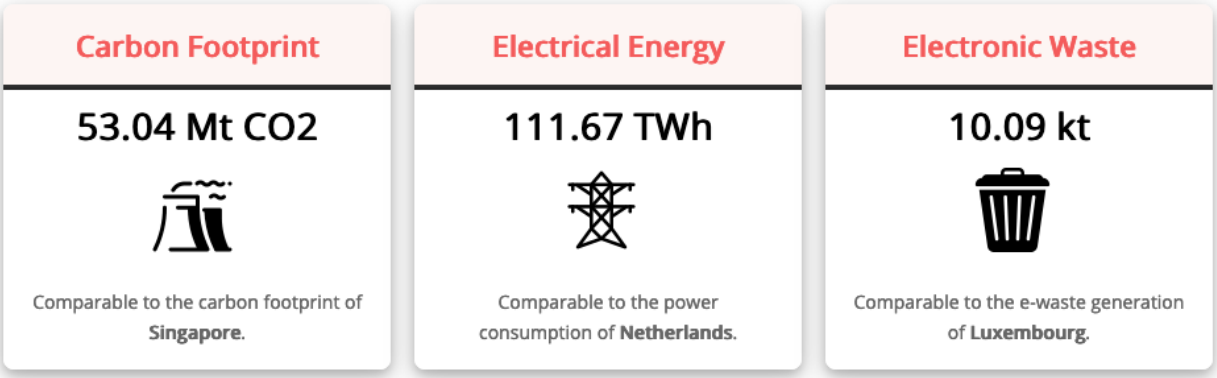
Unfortunately, as the involvement in the cryptocurrency world becomes stronger, also the risks increase significantly. Right now, emerging countries are by far the players most exposed to the dangers related to holding and transacting virtual currencies. Even though, as we saw, also the domestic currencies aren't safe stores of value, keeping a large share of wealth in cryptocurrencies may be unrecommended because of the price fluctuations. Moreover, to avoid sanctions of hostile governments a large chunk of the trading activities is conducted underground on unsecure channels like Telegram and WhatsApp, where people trade directly with each other, meaning that consumers are much more likely of being defrauded. We have already mentioned the need of regulating the cryptocurrency sector before. After this section, it should have gotten even clearer why this need is so urgent. While experiencing capital losses for an ordinary investor living in a developed country may be a mere nuisance, for one living in the third world it might be a matter of life and death

[83] Emmanuel Akinwotu, "*Out of control and rising: why bitcoin has Nigeria's government in a panic*", THE GUARDIAN, 31 July 2021

2.3 – Bitcoin's negative impact on the world

Arrived at this point of the paper it could seem to the reader that the Bitcoin's few disadvantages are completely overshadowed by the numerous benefits it is bringing to the society. The cryptocurrency is symbol of a financial revolution, it stands for freedom of speech, inclusion, insurance and convenience. It might be used both to diversify a financial portfolio and to fight an oppressive government. All this embodied in the same digital asset, born to challenge a financial framework seen as obsolete. Yet, it would be incorrect and wrong not to acknowledge that Bitcoin has also its weak points, which go far beyond the volatility afflicting its price. In fact, to some extent Bitcoin is changing our world in a quite negative way, mainly connected to environmental aspects. In this last section we will analyze its adverse attributes, reasoning upon their implications while trying to establish if the problems caused are really as bad as they seem.

Figure 8: Annualized total Bitcoin footprints



Source: Digiconomist, "*Bitcoin energy consumption index*", 2021

2.3.1 The environmental footprint

It is a common attitude of miners to pool their resources together through companies that aggregate a large group of assets used to reap economies of scale, later sharing the rewards and fees offered by the blockchain network. Since, as the blockchain grows, the problems which need to be addressed to validate the transactions become harder and harder to solve, the nodes are forced to use an increasing amount of computational and electric power if they want to stay operative. This in turn creates huge entry barriers towards new miners which would have to make a consistent capital expenditure in order to start their work, and so as time passes mining power has become concentrated in the hands of only a few mining pools.

But there is also another even worse dimension to the problem; as the mining activity consumes enormous quantities of energy, it is responsible for high amounts of carbon emissions which endanger the world's ecosystem. Miners are attracted by places like Iceland, Tibet, Quebec or Austria, where hydroelectric or geothermal energy sources can be exploited, not because they care about the benefits which the latter can bring to the environment but because they are interested in the cost savings they can this way realize. This explains also why we can see a large number of miners concentrated in continental China, where the electricity is subsidized by the government (nonetheless in recent times a massive migration of miners away from China is taking place, because of the new regulatory approach the country is adopting)[84]. In this profit pursuing perspective, not always miners find it appropriate to use renewable sources of energy because alternatives which are even cheaper may be available, and so a large chunk of mining activities is powered by coal or other types of fossil fuels, having

[84] See:
- Allisson Lampert, "*Chinese bitcoin miners eye sites in energy-rich Canada",* REUTERS, 11 January 2018;
- Alessandra Potenza, "*Can renewable power offset bitcoin's massive energy demands*?", THEVERGE NEWS, 21 December 2017

disastrous consequences on the environmental impact of cryptocurrencies (a study published in Nature Climate Change in 2018 claims that bitcoin "could alone produce enough CO2 emissions to push warming above 2 °C within less than three decades")[85].

To get a grasp at how large the energy consumption of cryptocurrencies really is, in 2020 the Cambridge Bitcoin Electricity Consumption Index estimated that the Bitcoin mining network consumes almost 70 terawatt-hours (TWh) of electricity per year, ranking as the 40th largest consumer of electricity *by country*. By way of comparison, Ireland (ranked 68th) uses just over a third of Bitcoin's consumption, while Austria at number 42 consumes only 64.6 TWh per year[86]. Moreover, the energy consumption of digital currencies is in no way comparable to the one of traditional means of payment, with the Cambridge Centre for Alternative Finance estimating that a single transaction of Bitcoin has the same carbon footprint as 680,000 Visa transactions.

Unfortunately, there is even more to it. A research conducted by Stoll et al. in 2019 points out how the mining activity may have a negative impact on the environment also on another level, relatively to the huge amounts of electronic waste it produces (see **table 4**). The continuously increasing energy efficiency of newer iterations of mining devices means older machines inevitably become obsolete on a regular basis, sooner or later being pressured out of the market. The estimated lifetime of these types of hardware is around 1.5 years, and afterwards, due to the large difficulty in using such specialized systems for other tasks, they immediately become waste[87].

[85] See Camilo Mora, "*Bitcoin emissions alone could push global warming above 2°C*", NATURAL CLIMATE CHANGE, 28 October 2018

[86] See Euromoney Learning, "*How does a transaction get into the blockchain?*", 2020

[87] See Andrè Goncalves, "*Is Bitcoin Bad For the Environment? Energy and Pollution Impacts*", YOUMATTER, 22 May 2021

Table 4: Electronic waste generation by country (annualized kilotons)

Source: BitcoinElectronicWaste.com, 2021

These things said, it is understandable why environmentalists have put on much effort in ruining the cryptocurrency's good name, often forcing investors and firms who would have otherwise gladly invested in the asset to take a step back reconsidering their choices. Yet, recent studies have shown how Bitcoin mining is becoming more sustainable as time passes, not being nearly as bad for the environment as it used to be. Following new data collected by Cambridge University, China's mining ban started in spring 2021 could be the beginning of an ecological transformation of the cryptocurrency. In fact, once the cheap coal available in large amounts on the Chinese soil couldn't be exploited anymore, miners migrating to new locations in search of cheap energy sources found that the latter were, more often than not, renewable. The main place which they chose as their new home were the United States, which quickly became the new hotspot for the world's global crypto mining. Given both the cheaply available renewable energy sources attainable in the U.S. (mainly in places like Texas due to its high subsidies towards wind power), and the need perceived by miners to hedge themselves against future regulatory risks, it is likely that in the near future Bitcoin's carbon footprint will consistently decrease[88].

[88] See MacKenzie Sigalos, "*Bitcoin mining isn't nearly as bad for the environment as it used to be, new data shows*", CNBC, 20 July 2021

Not all miners, however, are headed to eco-friendly destinations, and a large share still finds themselves in places like Kazakhstan, were due to its cheap and abundant supply, coal is still the most used energy source. Moreover, the effective calculations of Bitcoin's renewable energy usage are controversial and often disputed. For example, while a report by the Cambridge Center for Alternative Finance found that this share accounted only for 39% of Bitcoin mining, a pro-cryptocurrency research firm called CoinShares estimated that the percentage was much higher, being around 75%, which would have made Bitcoin more renewables-driven than almost every other large-scale industry in the world[89].

Many critics have also pointed out how there is a large number of valid substitutes for the Bitcoin, namely cryptocurrencies which have negligible environmental consequences. In particular, currencies with blockchains based on proof-of-stake algorithms, like Cardano, allow transactions to be processed with the same energy requirements as an ordinary computer network[90].

2.3.2 Cryptocurrencies' role in criminal activities

Another reason why Bitcoin has been often criticized by the public opinion is it's presumed use for illicit transactions. Several news outlets have asserted that the popularity of Bitcoins hinges on the ability to use them to purchase illegal goods. In fact, the anonymity on which Bitcoin's blockchain is based may be exploited for money laundering and other crime schemes[91]. The U.S government claimed that the

[89] See CoinShares, "*The Bitcoin Mining Network: Trends, Average Creation Costs, Energy Consumption & Sources*", 20 June 2019

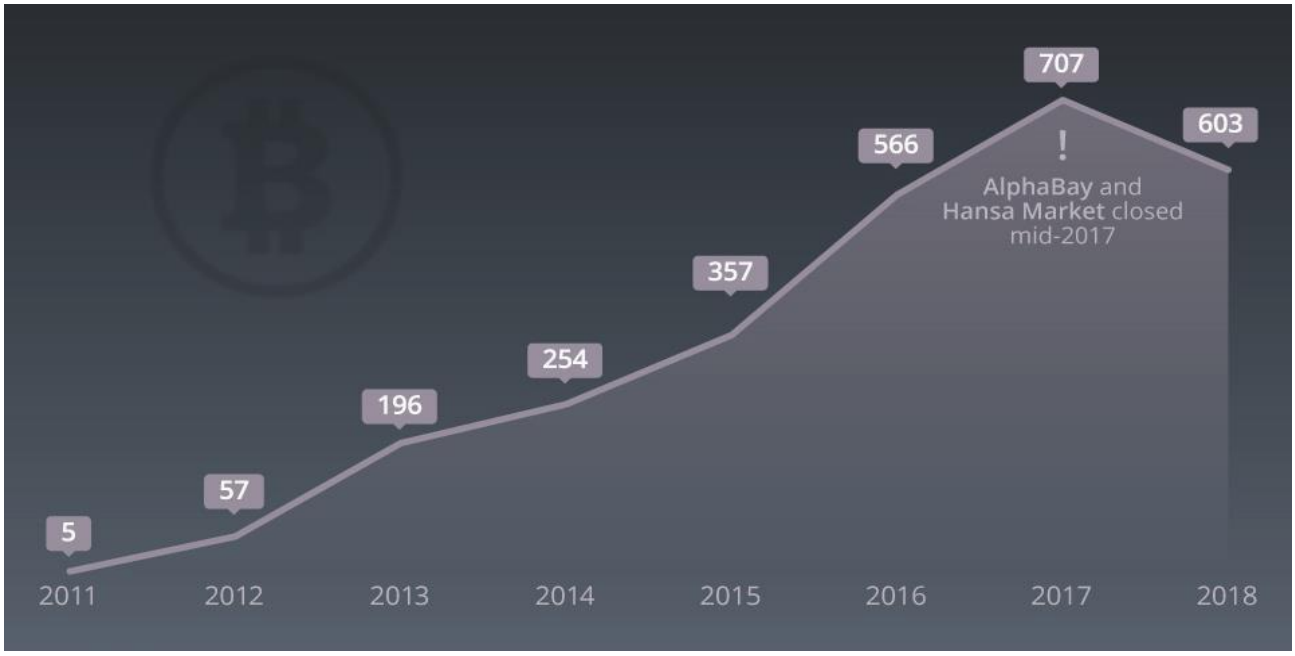
[90] See Nathan Reiff, "*What's the Environmental Impact of Cryptocurrency?*", INVESTOPEDIA, 13 May 2021

[91] See the Economist, "*Monetarists Anonymous*", THE ECONOMIST NEWSPAPER LIMITED, 29 September 2012

virtual currency had a fundamental role during the Russian interference in the 2016 United States elections in facilitating bribe payments[92].

Moreover, the amount of cryptocurrency spent on darknet markets has been growing exponentially since its launch in 2009, and the continuous efforts that the regulating authorities have been dedicated to stop this phenomenon don't seem to be quite enough (see **figure 9**). Apparently even Bitcoin's early notoriety is due to its use on the *Silk Road*, an online black market and the first darknet market, best known as a platform for selling illegal drugs, which could be browsed anonymously and securely without potential traffic monitoring.

Figure 9: Estimated amount of Bitcoins flowing to darknet markets (in millions of U.S. dollars)



Source: Chainalysis

[92] See Nathaniel Popper, "How Russian Spies Hid Behind Bitcoin in Hacking Campaign", NEW YORK TIMES, 14 July 2018

Bitcoin played a crucial role also in the recent growth of so-called **ransomware attacks**, in which hackers steal or encrypt computer files and refuse to give them back unless a payment in Bitcoins is made to them[93]. This doesn't regard only single individuals or firms and can have disastrous consequences even on the economy of entire countries, as the recent ransomware attack on U.S. company Colonial Pipeline testifies; on May 7, 2021, the company that carries gasoline and jet fuel mainly to the Southeastern United States, but which has infrastructures covering the territory of the whole country, suffered a cyberattack which forced it to completely stop its operations for a few days. Consequently, many airlines had to change their flight schedules, airports had to switch to other more costly suppliers and in many states oil shortages were reported, up to a point where fuel prices in areas ranging from South Carolina to Southern Virginia rose to their highest since 2014, reaching more than 3 dollars a gallon[94]. The company had no other choice than to pay the ransom of almost 5 million dollars in Bitcoin in order to restart its operations.

Despite the overwhelming evidence that cryptocurrencies are in fact used for illegal activities, recent studies, like the one conducted by former CIA director Michael Morell in 2021, show that broad generalizations about the use of bitcoin and other crypto assets in illicit finance are significantly overstated and that in fact the majority of cryptocurrencies is used for purposes other than illegal ones. This study illustrates how in 2019 criminal activity represented only 2.1% of all cryptocurrency transaction volume, while in 2020 this share fell to 0.34%, meaning that traditional FIAT currency is actually much more involved in crime than Bitcoin and its similars[95].

[93] See Nathaniel Popper, "Bitcoin *Has Lost Steam. But Criminals Still Love It*", NEW YORK TIMES, 28 January 2020

[94] See Will Englund, Ellen Nakashima, "*Panic buying strikes Southeastern United States as shuttered pipeline resumes operations*", Washington Post, 13 May 2021

[95] See Hailey Lennon, "The False Narrative of Bitcoin's Role In Illicit Activity", FORBES, 19 January 2021

CONCLUSIONS

Estimates from the World Economic Forum suggest that over 10% of global GDP will be stored on blockchain by 2025. Until a decade ago economist would have laughed hearing a story of this kind, considering it impossible for a system ideated to serve a digital decentralized currency to reach any sort of milestone. Yet today Bitcoin is the ninth biggest asset in the world regarding market capitalization, beaten only by gold, silver and the well-known big-tech companies supplying half of the world[96]. Moreover, cryptocurrency and blockchain technology company TripleA approximates that more than 300 million people across the world are now cryptocurrency users, and that around 18,000 businesses worldwide accept this digital type of money as payment.

Bitcoin is traded at an increasing rate around the world by people living in both developed and developing countries for different purposes. Its blockchain has inspired the creation of multiple other currencies; even whole new branches of finance, using so called decentralized financial applications in order to supply their services, are based upon it. Central banks, representing the highest monetary authorities in the world, are taking Bitcoin as an example in order to create their own digital currencies with features similar to the ones of the first cryptographic token.

One could argue that Bitcoin's role isn't as central as we are sustaining. That Central Bank Digital Currencies differ from Bitcoin because of their regulated and centralized nature; that the first cryptocurrency is soon going to lose its appeal, substituted with more innovative ones like Ethereum, more sustainable ones like Cardano, or less

[96] See "*Top Assets by Market Cap*", COMPANIESMARKETCAP, 13 August 2021

volatile ones like Tether; that once real financial institutions are going to be established in third world countries, Bitcoin is going to have a more marginal role within them. And yet for all these years in emerging countries Bitcoin has made the difference because real financial institutions couldn't. As for the rest, it may be true that C.B.C.D. aren't strictly related to cryptocurrencies. As we saw in previous sections, Bitcoin's decentralization is one of the main reasons of the currency's success in emerging countries. Such a feature could, for obvious reasons, never be provided by central banks. It may also be true that Bitcoin's glorious days are coming to an end, given the amount of possible substitutes which have intrinsic functionalities the first cryptocurrency probably won't ever be capable of. We have stated our point of view multiple times in this paper, thus it shouldn't come as a surprise that we consider Bitcoin's days far from over. With the help of a thoughtful regulation, it could reach many more important milestones, given its well-established reputation and its proven resilience.

From our point of view, Bitcoin's centrality is due to the fact that, regardless of what will happen in the future, without it we would have never reached this point. Undoubtedly the crypto asset has revealed itself as a true game changer in the world's economic system, starting a process the consequences of which will be felt in the coming years. In the last decade it has been a building block and a reference point of the entire sector, ad even if it is possible that this influence will one day fade away, Bitcoin will nonetheless enter history as the currency that changed the world forever.

Returning to the points stated in the introduction, we strongly support a more involved role of governments regarding the cryptocurrency industry. This should be oriented not only towards the financial world, limiting the price volatility we spent so much time to describe. It should consider also the environmental aspects, main topic in the second chapter of this paper. As history has taught us, prohibition rarely is an answer to world's problems, and neither is ignoring them. Institutions should

incentivize the use of renewable sources of energy regarding the mining of tokens; doing so would not only reduce the carbon footprint these assets produce, but it may even have beneficial effects upon the countries' economies by fostering foreign investments. Moreover, institutions of developing countries should acknowledge the inadequacy of their financial intermediaries and invest more heavily on cryptocurrency related services to allow their citizens to live a life standard worthy of the 21st century. These things said, we hope to have succeeded in the main intent of this paper: raising the awareness about a topic seen by many in a way to superficial way. Time won't stop, and neither does progress. Our duty is to make sure that great opportunities won't go wasted.

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