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BITCOIN

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1. Introductory remarks

1.1. A short historical review of money

Modern money began with the practice of sovereign coinage, whose origins go back to the very dawn of civilization¹. That is to say, coins first appeared in eastern Mediterranean during the eighth and seventh centuries B.C. and in Far East in 1022 B.C. Nonetheless, the format of money has changed considerably since then. In particular, the early format was commodity money, for instance minted of base metals like copper or bronze alloy with a metallic content of intrinsic value² which had uses other than as a medium of exchange. Yet, the format of commodity-backed or representative money appeared around the eighteenth century; pieces of paper (e.g. gold certificates)³ were used as a claim on the commodity, promoting portability of money and facilitation of transactions⁴.

Nowadays, modern economies are based on fiat currencies - which are defined as any legal tender designated by a central authority⁵ that circulates and is customarily used and accepted by the issuing country⁶ - and resemble to the aforementioned form of commodity-backed money in terms of appearance, but not in terms of concept⁷. Thus, money as a tool created and marked by development, had been readjusted eventually to society's evolution, while maintaining three functions: it is performing a function as a medium of exchange (id est as an intermediary in trade and exchange of goods and services⁸), as a unit of account (which stands for the unit of measure used to value/cost goods, services, assets, liabilities, income, expenses⁹) and as a store of value (meaning an asset that can be saved, retrieved and exchanged at a later time, and be predictably useful when retrieved).

¹ See Cohen (2004), pp. 1-7

² Ibid, p. 3

³ See ECB (2012), p. 9

⁴ See Mankiw (2014), p. 220

⁵ See ECB (2012), p. 9

⁶ See FATF (2014), p. 4

⁷ See ECB (2012), p. 9. Commodity-backed money was being redeemed for a commodity.

⁸ Ibid

⁹ See Mankiw (2008), pp. 338-339

1.2. Theoretical analysis of money in the virtual world; background and definition of the terms ‘virtual currencies’ and ‘electronic money’

Likewise, money’s evolution could not have stayed unaffected by technological achievements and the creation of the World Wide Web in the mid-1990s which changed society’s habits and broadened internet users’ needs. In light of Internet World Stats, it is worth mentioning that there has been a tenfold increase in the number of internet users from 1999 to 2013, reaching the third billion in 2014 or else said 40% of the global population¹⁰. This massive penetration of the Internet caused structural changes in social behavior such as the proliferation of virtual communities where, other than social networking, the user can buy physical goods and services, play online games or be part of an online environment for gambling. Therefore, the roots of digital currencies can be found in the increased use of computers and Internet.

In some cases, users that carry out transactions use a digital representation of fiat currency in order to electronically transfer value denominated in fiat currency (a.k.a. ‘electronic money’ or ‘e-money’)¹¹. In essence, e-money is a digital transfer mechanism for fiat currency, which means that it transfers value characterized by legal tender status. In late 1990s, electronic money was mainly consisted of electronic checks and embedded smart cards. With the advent of e-mail, the transactions of electronic money started increasing. People started using credit card details via e-mail to buy goods. Later, the customers started having an online account to avoid transaction fees. However, some communities of the virtual world provide their own salient manifested, new -digital- currencies as a medium of exchange and a unit of account. In all cases, two of the functions of money are operated both by digital and fiat money formats.

The controversy aroused whether digital money fulfilled the store of value function¹² (the third one) was empowered by the creation and circulation of these ‘new’ released digital currencies as noted above. The ECB did set the question in the 2012 Report amidst a first analysis of virtual currencies, because as it is already

¹⁰ See the statistics at <http://www.internetworldstats.com>

¹¹ See FATF (2014), p. 4

¹² See ECB (2012), p. 11

mentioned, the store of value is closely affiliated to reliability and safety. With this in mind, the ECB highlighted its doubt about missing these two elements within the context of these new digital currencies created by virtual communities, which have no connection with real/fiat money. Today, the store of value function is considered as fulfilled¹³ in several cases. It is apparent that this is a new means of payment for exchanging the goods and services these virtual communities offer, thereby creating a new form of digital money; the virtual currencies. They are defined by standard-setting bodies as ‘a digital representation of value that can be digitally traded and that is neither issued by a central bank or authority nor necessarily attached to a fiat currency, but is accepted by natural or legal persons as a means of payment¹⁴’. It functions as medium of exchange and/or unit of account, and/or store of value but it does not have legal tender status in any jurisdiction, except the fact that in many jurisdictions, a private business, person or organization is free to develop policies on whether or not to accept the physical currency or coins as payment method¹⁵.

As is evident, the usage of the terms ‘currency’, ‘digital currency’, ‘electronic money’ and ‘virtual currency’ could be misleading ; to that end, a clear classification is required (see below, Table 1). Firstly, the usage of the term currency is allowed even though there is controversy and ambiguity concerning the question whether virtual currency attributes of a ‘typical’ currency¹⁶. However, just like in the real economy, in a virtual one the transactions settled are parts of a payment system. Secondly, digital currency can mean a digital representation of either e-money (fiat money) or virtual currency (non-fiat money). Virtual currency as defined above¹⁷ is distinguished from fiat money (a.k.a. real money/national currency) and from e-money, which is a digital representation of fiat money. In particular, according to the Electronic Money Directive (2009/110/EC), electronic money is monetary value as represented by a claim on the issuer which is stored electronically, issued on receipt of funds of an amount not less in value than the monetary value issued and

¹³ See EBA (2014), p. 7

¹⁴ See FATF (2014), p.4 and the EBA Opinion on Virtual Currencies (2014), p. 5

¹⁵ See FATF (2014), p. 13

¹⁶ See EBA (2014), p. 11

¹⁷ See the definition on p. 7 of this paper

accepted as a means of payment by undertakings other than issuer²¹. The unit of account that the e-money is expressed is traditional fiat money, because the stored funds are expressed in traditional money (e.g. US dollars, euro, etc.). Hence, the link between electronic money and traditional money is preserved and has legal foundation¹⁸¹⁹.

TABLE 1 : A money matrix			
		<i>Money format</i>	
		<i>PHYSICAL</i>	<i>DIGITAL</i>
<i>Legal status</i>	<i>Unregulated</i>	Certain types of local currencies	Virtual currency
	<i>Regulated</i>	Banknotes and coins (fiat currency)	E-money Commercial bank money (deposits)

Source: ECB²³

Notwithstanding the fact that some features of e-money are also met by virtual currencies, there is one fundamental difference concerning the aforementioned aspect; in virtual currency schemes the unit of account is changed into a virtual one, not in a fiat one. These virtual currencies could be considered as private money or a commodity and are not issued by a central bank or a public authority, like e-money that is issued by institutions being subject to prudential supervisory requirements. Some types of virtual currency schemes that are exchanged back-and-forth for fiat money at an exchange rate having an interaction with real economy are called convertible^{20 21} or open²², whereas others are called non-convertible (or closed); they have almost no link to the real economy and are called ‘in-game only’ schemes, because they can only be spent within the virtual community. Another key point to mention is that the term convertibility is used only as long as there is offer and acceptance within markets and private participants. To put it another way, it does not imply an ex officio convertibility, because it is not guaranteed by law. However, even

¹⁸ See ECB (2012), p. 16

¹⁹ See ECB (2012), p. 11

²⁰ See FATF (2014), p. 4

²¹ Examples include: Bitcoin, Ripple, Litecoin, Dash, Stellar

²² See EBA (2014), p. 13

a non-convertible/closed virtual currency could be exchanged for fiat currency or another virtual one in an unofficial secondary black market, other than the specific virtual community²³.

Strictly, virtual currencies are not ‘currencies’ in all cases, because they often meet the exchangeability, not the high liquidity and the wide acceptance in their geography. They are not money, because it is doubtful whether they could perform the three functions of money at the same time and to the same extent as real/fiat money. In theory, they could serve as money for anybody with an internet-cabled computer or device; at present, however, they fulfil the roles of money only to some extent and only for a number of people. They are likely at present to regularly serve all three purposes for perhaps only a few thousand people worldwide and even then only in parallel with users’ traditional currencies²⁴. Virtual currencies are not e-money - as analyzed above²⁵ - or legal tender yet. If virtual currencies were legal tenders, the creditor of payment obligation would be required to accept it as full face value and it would be sufficient to discharge a debtor from its payment obligations. Finally, given the fact that they do not represent a claim on the issuer, they are not redeemable.

²³ Ibid, p.5

²⁴ See Bank of England (2014a), p. 3

²⁵ See p. 8 of this paper

2. Bitcoin overview and basic features

More than 600 different virtual currency schemes (convertible/non-convertible) are said to be in circulation²⁶ at the time of writing, even though this is in stark contrast to the situation two years ago when it was the only one really known about, Bitcoin is still in the spotlight. It is probably the most successful convertible virtual currency scheme to date, albeit the most contentious. In just five years, Bitcoin scheme has seen enormous growth, both in value and public perception. It accounts for more than 80% of the market capitalisation of the around 500 known decentralised virtual currencies, so Bitcoin scheme still appears as the most prominent of them²⁷. This form of currency creation is the gold prospecting of the digital age²⁸. It operates at a global level and is used for the purchase for both virtual and real goods and services, competing the official currencies like the euro or the US dollar, even though it is not pegged to any currency- the exchange rate is determined by supply and demand in the market³⁶.

The importance of Bitcoin scheme lies not so much in its potential to become a substitute for money, but rather in its ability to act as the internet of money. Bitcoin is much more than a substitute - it is like a logical layer for finance that will support a revolution in the way people own and pay for goods and services. Like many underground, countercultural phenomena that suddenly find themselves rapidly adopted, Bitcoin scheme has reached the point of broad influence, with the potential to become of full mainstream acceptance²⁹. As it will be discussed in greater detail below, a variety of Bitcoin's unique characteristics have been touted as being particularly attractive to users and may have helped Bitcoin obtain wider acceptance than other virtual currencies. Bitcoin is not the only virtual currency or even the first virtual currency to be introduced to the public. In fact, a number of virtual currencies predate Bitcoin. However, each ultimately failed to reach Bitcoin's current level of popularity and mainstream acceptance. While virtual currencies are nothing new,

²⁶ For further information, see the following link : <http://www.coinmarketcap.com>

²⁷ See ECB (2015), p. 6

²⁸ See BaFin's Annual Report (2013), p.58 ³⁶ See the ECB Report (2012), p. 21

²⁹ See PwC (2014), p. 1

Bitcoin was developed and introduced in a way that allowed it to obtain a material level of use in the marketplace where other virtual currencies languished.

The Bitcoin phenomenon was a concept proposed and developed by the considered as pseudonymous entity Satoshi Nakamoto, with the initial open-source (freely distributable) client software being released on the 9th January 2009. The concept behind bitcoins originated in an online paper published under the pseudonym in November 2008 entitled Bitcoin: A Peer-to-Peer Electronic Cash System. Bitcoin scheme is based on an open peerto-peer network (P2P) - a network of computers configured to allow certain files and folders to be shared with everyone or with selected users³⁰ - and maintains a database that lists providers which accept bitcoins³¹. Moreover, it allows online payments to be sent directly from one party to another without going through a financial institution. During the early stages of the money, Bitcoin was hardly known or popular. However, throughout its short history, several occurrences, e.g. releases of newspaper articles boosted its popularity; this resulted in higher amounts of traded bitcoins and higher, but alternating, values against the US-Dollar or the Euro.

Bitcoin, the web-generated currency that allows online transactions without credit cards, direct debits or other traditional forms of payment, differs from other virtual currencies, in spite of the number of common characteristics, since it is the first decentralized digital currency. Some virtual currencies are issued and controlled by an individual or a group of individuals which function as an administrating authority – i.e. a third party that controls the system, issuing the currency, establishing rules, maintaining a central payment ledger and being authorized to withdraw it from circulation³² - while other virtual currency schemes, i.e. Bitcoin, are issued and operated in a decentralized manner³³. Bitcoin has no central administrating authority and no central monitoring or oversight. That is to say, it is a distributed, open-source math-based peer to peer scheme, developed by a worldwide collaborative community of ‘cyber’ volunteers. To put it another way, Bitcoin users

³⁰ Similar to Bit Torrent

³¹ See <http://en.bitcoin.it/wiki/Trade>

³² Examples include Second Life Linden Dollars, PerfectMoney, WebMoney Units.

³³ See EBA (2014), p. 13

perform these tasks themselves. This aspect is established by a feature which launches the innovation that triggered the phenomenon of virtual currency schemes; Bitcoin was designed on a cryptographic basis. Thus, cryptography is the characteristic that secures the transactions and controls the creation of new units of bitcoins³⁴, turning the scheme into the first cryptocurrency. To be more precise, the cryptocurrency relies on public and private keys³⁵ to transfer value from one person (individual or entity) to another, and must be cryptographically signed its time it is transferred, meaning it incorporates principles of cryptography to implement a secure decentralized information economy. As will be explained later, the money supply is determined by a specific type of ‘mining’ activity³⁶.

³⁴ See <http://en.wikipedia.org/wiki/Cryptocurrency>

³⁵ Keys are numeric codes that are used to encrypt text for security purposes. See the definition on <http://www.pcmag.com/encyclopedia>

³⁶ See ECB (2012), p. 21

3. The components of Bitcoin scheme and a general empirical approach to the Bitcoin system functions concerning monetary aspects

The technical aspects of the Bitcoin system seem complex and on that account, a basic and simple description of its functioning is rendered as sufficient explanation of the mechanism, lying within the scope of this paper. Bitcoin scheme has undergone several changes since its first release at 2009, but the mining process and the rules and formats of transactions are described in the Bitcoin Protocol, which is updated and amended regularly by developers in the peer-to-peer network –the type of computer network that is characterized by the absence of a central server³⁷.

Bitcoin exists solely in electronic form through an online network open to everyone. According to the inventor³⁸ of the scheme, who can also be the issuer or administrator³⁹, an electronic coin can be defined as a chain of digital signatures⁴⁰. Each owner has a pair of keys, one public and one private that are saved locally in a file. Thus, bitcoins are computer files similar to mp3 or a text file that can be destroyed or lost and they are stored either on a personal computer or entrusted to an online service. This means their usage is easy, since they are simple files stores.

In order to hold and store, spend or accept bitcoins, all transactions - that are often referred to ‘smart contracts’ and are designed to take the form of decentralized exchange not reliant upon intermediaries such as banks, exchanges or dealers - must be logged on a public payment ledger (the ‘blockchain’, a transaction database which turns transactions into a public chain of actions)⁴¹. When an individual (‘A’) wishes to transfer bitcoins to another individual (‘B’), A creates a message (a ‘transaction’) containing B's public key and signing off with A's private key. The transaction is then recorded, time stamped and displayed in one "block" of the blockchain as part of the payment processing carried out by Miners. With this in mind, every single bitcoin

³⁷ See peer-to-peer definition at <http://www.oed.com>, Oxford English Dictionary, as designating or relating to a network in which each computer can act as a server for the others, allowing shared access to files and other resources.

³⁸ See ECB (2015), p. 8

³⁹ See FATF (2014), p. 7

⁴⁰ See Nakamoto's paper (2008) on the protocol, available at <http://www.bitcoin.org>

⁴¹ See ECB (2012), p. 23

carries the entire history of the transactions ('block') it has undergone and any transfer from one owner to another becomes part of the code.

However, a bitcoin is stored in such a way that the new owner is the only user allowed to spend it. Owning a bitcoin is perhaps most similar to owning land. The *conditio sine qua non* of land ownership is identification in the most recent deed within a chain of title found in a public record. The *conditio sine qua non* of Bitcoin ownership is holding the private key that links to the most recent recipient public address within a chain of title found in the blockchain.

One of the core design features of Bitcoin scheme reflects its fundamental innovation; there are a finite number of bitcoins in the system which is designed so that there is a slow release of additional coins through a process called mining. Participants download a special program for the purpose and contribute their computer processing power to the mining process, which can be seen as a form of network maintenance for which the reward is new bitcoins. In practice, mining involves solving complex mathematical algorithms by the miners

–the people who use their systems to undertake this activity on a voluntary basis. When the block is solved, it is immediately placed into the blockchain – who validate a set of transactions (block)⁴². To be included into the blockchain, the block should be 'solved' by the Bitcoin miners. Solving the block basically means finding the unique answer to the mathematical puzzle constituting the block. Likewise, without miners the decentralized Bitcoin scheme would not run smoothly, since they prevent a coin being copied or forged or double spent, considering the fact that there is no central/sole intermediary validating the transactions. As these computational powers –miners- tend to increase, so does the difficulty of the mathematical puzzles to solve⁴³. As mentioned, the amount of bitcoins constitutes a kind of reward for solving a block. When the block is solved, the generated reward in the amount of 25 bitcoins (currently) is automatically sent to the randomly chosen Bitcoin address of

⁴² See ECB(2015), p. 7

⁴³ See Shcherbak (2014) ⁶³ See Wallace' article (2011), on the Wired website at the following link:

http://www.wired.com/magazine/2011/11/mf_bitcoin/

the miner who has been contributing to the process of solving the block. The acquisition of the reward is always registered as the first transaction of the block and constitutes the essence of the Bitcoin mining. The bitcoins obtained in this way are considered to be mined by the miner. Moreover, the miner may also receive an additional reward in the form of a transaction fee if it has been initially assigned by a payer for the priority confirmation of a transaction.

The Bitcoin network is not, therefore, a tool for transmitting actual bitcoins. It is a tool for building an authoritative public record that records the chain of title for any current bitcoin holdings, and prevents individuals from creating fraudulent entries in that record by attempting to spend some other user's bitcoin or double-spend their bitcoins their own. In respect of double-spending, physical fiat currencies have a manifest built-in solution to this problem: if a consumer exchanges a euro for any good or service, absent illegal activity such as counterfeiting, they are no longer in possession of the unit of the currency and, therefore, cannot spend that one again to buy a another good or service from another vendor. Virtual currencies, which have no physical manifestation, however, cannot rely on this sort of built-in solution. Most virtual currencies have sought to address the problem by 'involving . . . a central clearinghouse to keep a real-time ledger of all transactions [involving the virtual currency]'⁶³. Implementing a central clearinghouse can mitigate the problem of double spending because any fraudulent transactions will be immediately logged and prevented; however, it can only be effective if the third-party is or should be trusted by the users of the currency. Nakamoto's proposal was unique because it eliminated the need for a third-party clearinghouse by turning over the authority to maintain a ledger of transactions to the users of the currency themselves. According to Nakamoto, mining is a reliable procedure for the security and safety of the system as it provided the incentive to act honestly⁴⁴, because 'a user ought to find it more profitable to play by the rules that favour him with more new coins than to undermine

⁴⁴ See ECB (2012), p. 24

the system and the validity of his own wealth⁴⁵. As of June 2015, approximately 14.3 million bitcoins had been mined and are in circulation⁴⁶.

Furthermore, a Bitcoin wallet⁴⁷, which is installed either on a computer or smart phone or held online, is needed to make and receive Bitcoin payments⁴⁸. Nevertheless, users can also set up and maintain a wallet themselves without making use of a wallet provider^{49 50}. A wallet provides access to a number of addresses each with its own balance of bitcoins, so if a user wishes to pay by bitcoin, he must know the payee's address - just as it is necessary to know the payee's registration and account number to make an ordinary online bank transfer. Once verified by the network, the transaction is considered to be final. The total transaction processing time for bitcoins is said to be between 10 and 60 minutes in such a way that virtual currency payments appear to compare favorably with credit transfers or card payments, particularly between different currency areas⁵¹. Moreover, they take place on an uninterrupted basis, unlike some traditional payment systems that do not function on a 24/7 basis, except those that concern the 35 countries of the Single Euro Payments Area (SEPA) Agreement⁵² and the countries that have established real-time payment services. It is worth mentioning that the total number of transactions converged has almost doubled during a period of one year: in June 2014, transactions reached 41million, while in June 2015 they reached 73 million. Moreover in July 2015 a new bitcoin email transfer service called MoneyPacket.org just adds complexity to the movement of cryptocurrency. In particular, it is a transitional

⁴⁵ See Nakamoto's paper (2008) on the protocol, available at <http://www.bitcoin.org>

⁴⁶ Total bitcoins in circulation as calculated at <https://blockchain.info/charts/totalbitcoins> (last visited June 23, 2015)

⁴⁷ There are two types of wallet, which differ as regards their immediate usability versus their safety from cyber crime: online wallets (hot storage) and offline wallets (cold storage).

⁴⁸ See FATF (2014), p. 7

⁴⁹ See ECB (2015), p. 8

⁵⁰ Coinbase and Circle are notable examples.

⁵¹ See EBA (2014), p. 17

⁵² See the Regulation (EU) No 260/2012 of the European Parliament and of the Council of 14 March 2012 - establishing technical and business requirements for credit transfers and direct debits in euro and amending Regulation (EC) No 924/2009- in the Official Journal of the European Union, L 94/22, 30 March 2012

tool, a new medium for users to get their first bitcoins before the installation of a wallet, expanding its easiness for users.

Therefore, the ecosystem supporting Bitcoin that has been growing exponentially is consisted of a broad list of VC market participants consists mainly of specific, new categories of actors which were not present in the payments environment before⁵³ and that can be classified in three main categories of systems:

- (1) the Bitcoin mining community as explained above⁵⁴,
- (2) Bitcoin exchanges and
- (3) merchants who accept bitcoins as payment for goods and services

In general, users that choose to obtain virtual currency for purchasing virtual or real goods and services from specific merchants, for making person-to-person payments (e.g. crossborder) or sending remittances, or for investment purposes, including speculation, are similar to consumers/clients. With this in mind, it is necessary to note the five ways to obtain units: i) purchase; ii) engage in activities that are rewarded with units of virtual currency (e.g. filling out a survey, participating in promotional activity); iii) self-generate units of the currency acting as a miner; iv) receive units as a payment; or v) receive units as a donation/gift⁵⁵. It is worth mentioning that users can buy bitcoins via traditional credit and debit cards or PayPal. Unlike most currencies, Bitcoin amounts are highly divisible. This has led to a desire to create names for smaller denominations of bitcoin amounts, especially since transactions involving whole bitcoins are no longer quite so common. Bitcoin is decentralized, so there is no organization that can set official names for units. Therefore, there are many different units with varying degrees of popularity. Many have adopted the practice of referring to the microbitcoin metric sub-unit as "bits": as of 2014, 1 bitcoin = 1 000 000.00 bits = 100 000 000 satoshi⁵⁶.

In respect of the second category, bitcoins also can be bought and sold on Bitcoin exchanges^{57 58}. These exchanges match buyers and sellers, and help create a

⁵³ See ECB (2015), p. 4

⁵⁴ See this paper, pp. 11-12

⁵⁵ See ECB (2015), p. 8

⁵⁶ See the Bitcoin Wikipedia at the following link <https://en.bitcoin.it/wiki/Units>

⁵⁷ See FATF (2014), p. 7 for the identification of exchanger/virtual currency exchange

market for bitcoins through ‘trading platforms’ that function as marketplaces. Due to the volume of transactions, these exchanges play a vital role in establishing the value of bitcoins. A transaction on the Bitcoin network is not denominated in real world currency units such as Dollars, Euros or Sterling as they are on PayPal, for example; nor is the value of the currency derived from gold or government fiat. Meanwhile, the Bitcoin value⁵⁹ is derived from the value that people assign to it and its value relative to other currencies as determined on an open market, just as the values of real world currencies are determined through exchange rates currently⁸⁴. Similar to stock exchanges, users can buy and sell bitcoins in exchange for popular currencies such as dollars or euros. In a nutshell, traders ‘regulate’ the cycle between Bitcoin and fiat currencies, while trying to feel the pulse of the price in order to profit from it. A few prominent Bitcoin exchanges include Bitstamp, CoinCorner and BTCN.

Besides, merchants are a key component of the Bitcoin ecosystem. These virtual currency actors are users in a trade, business or professional role who accept bitcoins in exchange for goods and services⁶⁰. However, all roles are intertwined, due to the system’s particularity where one person⁶¹⁶² can be a miner, a trader and merchant at the same time. Yet they hold an intricate relationship that determines price. For instance, much is said about price when a big merchant adopts Bitcoin as a form of payment. The most common reaction can be summed up in the common phrase among Bitcoin world ‘to the moon!’. The logic of this expression is simple: as more people adopt Bitcoin, there will be more demand for it, and its price will be increasing. Then again, the opposite is likely to happen. A big merchant needs lots of fiat to survive, and when it acquires lots of Bitcoin, it needs to sell it. Thus, the

⁵⁸ According to the ECB Report on Virtual Currency Schemes- a further analysis (2015), most of them are non-financial companies

⁵⁹ In June 2015, 1 Bitcoin equals to 220,70 Euros and to 248,41 US Dollars.

⁶⁰ See EBA (2014), p. 14

⁶¹ See an updated list of merchants accepting bitcoins at the following link: <https://en.bitcoin.it/wiki/Trade>

⁶² Despite the media hype, the acceptance of virtual currencies by “bricks-and-mortar” or online shops selling “real” goods and services does not seem widespread; a rough estimate would be three in every 10,000 businesses. A majority of these shops sell computer hardware and software related to Bitcoin. However, others – mainly e-commerce merchants, including one of the world’s largest online travel agencies – have started accepting payments in Bitcoin

supply of tradable bitcoin increases, lowering its market price. However, not all bitcoin-possessing entities share the same urgency to trade them. Although Bitcoin scheme is a virtual currency, its purchasing power is not limited to the Internet. Like online retailers, merchants that operate brick and mortar stores have also been drawn to the perceived advantages of Bitcoin⁸⁹. Merchants, both small and large, have started to accept Bitcoin at store locations⁹⁰. Although the number of stores that accept Bitcoin does not come close to rivaling those that accept more traditional payment methods, this growth provides further evidence of the inroads that Bitcoin continues to make in becoming an increasingly mainstream alternative payment method⁶³. Like online retailers, the owners of brick and mortar stores are attracted by Bitcoin scheme's promises of advantages over traditional payment forms (e.g. lower costs⁶⁴, potential for growth and publicity).

In addition to market participants named hereinabove, there are other numerous innovative ventures based on Bitcoin, from Bitcoin automated teller machines ('ATMs') to Bitcoin-based investment instruments. There have been a plethora of innovative ventures that draw on the development of Bitcoin. For example, on October 29th 2013, Robocoin started deploying Bitcoin ATMs that allow users to purchase bitcoins in person⁶⁵. From a financial investment perspective, there are also providers of investment vehicles and brokers which facilitate investment in start-up companies and design specific financial products, such as exchange-traded funds (ETFs) or derivatives. Other actors that have appeared are "tumblers", which provide a service for further increasing the anonymity of the payer by making it more difficult to find out where the virtual currency transaction came from.

Equally interesting is the fact that there are already physical coins as a form of Bitcoin scheme. An example would be Casascius physical coin which is made from metal (gold, silver or bronze depending on the denomination) and contains a new keypair (private and public key, as explained in a previous subsection) of a Bitcoin address. The coin is constructed in such a way that the private key could be

⁶³ See Tu and Meredith (2015), p. 290

⁶⁴ See this paper, pp. 18-22

⁶⁵ See ABC NEWS (2013) at the following link:

<http://abcnews.go.com/Technology/bitcoin-atmconducts-10000-worthtransactions-day/story?id=20730762>

decoded only if the physical coin is visibly damaged⁶⁶. Additionally, banknotes can be constructed similarly to coins and Bitcoin cheques are in a development stage⁹⁶. Finally, there are also Bitcoin debit cards.

⁶⁶ In contrast, the public key is visible on the outside of the coin.

4. Monetary aspects of Bitcoin scheme

As can be seen, the Bitcoin scheme and its functions, including various components, constitute a system which introduces new money as analyzed previously. Consequently, Bitcoin supply does not depend on the monetary policy of neither a virtual nor a traditional central bank, but rather evolves based on interested users performing the specific activity of mining. Given statistical analysis results by the Bitcoin society⁶⁷, the supply will develop in a predictable growing geometrically pace based on its technical design⁶⁸ and will reach its upper limit of 21 million in around 2040. In other words, it mimics the extraction of gold or other precious metals from the Earth in the sense that only a limited amount can ever be mined⁶⁹.

In effect, the fixed and determined supply of Bitcoin money indicates that any intervention by a central authority or even an internal VC actor will have no impact on the system as regards the number of bitcoins created⁷⁰. From the quantity theory of money of Austrian School of Economics, it is widely accepted that there is a link between inflation and the money supply. A substantial growth of the money supply through money printing/creating at some point is going to cause a loss of purchasing power. Therefore the Bitcoin system is supposed to avoid inflation⁷¹ in long term, even though Bitcoin supply inflation is currently 10%⁷². To put it differently, inflation may occur if demand is significantly reduced. However, as Bitcoin is a distributed system of currency, if demand were to decrease to such an extent as to cause inflation then the system itself would fail in any case¹⁰⁴. If Bitcoin continues to be adopted and eventually becomes a mainstream unit of currency then this is unlikely to be of any concern.

⁶⁷ See the Bitcoin Wikipedia at the following link <https://en.wikipedia.org/wiki/Bitcoin>

⁶⁸ Based on the algorithm that issues only 25 new bitcoin every 10 minutes

⁶⁹ See Memorandum for Clifford Chance LLP (2014), p. 4

⁷⁰ See ECB (2012), p. 25

⁷¹ Ibid

⁷² See statistics at the following link: https://en.bitcoin.it/Controlled_inflation ¹⁰⁴See at the Bitcoin Wikipedia:

https://en.bitcoin.it/wiki/Myths#Bitcoin_can.27t_work_because_there_is_no_way_to_control_inflation

On the other hand, the system has been accused of leading to a possible deflationary spiral^{73 74}, considering the eventuality of a great increase of Bitcoin users in the near future and a non-proportional increase of velocity of money which will lead to depreciation of the prices of goods and services quoted in bitcoins. However, Bitcoin is not a currency of a country or a currency area and such a hypothetical perspective is not clear¹⁰⁷.

Furthermore, it is generally accepted that a core characteristic of money is that its value is stable, i.e. that its purchasing power is constant. This helps to provide a framework for sound economic development with appropriate use of society's resources. However, the value of the Bitcoin, and thus its purchasing power, has turned out to fluctuate widely against national currencies. It has been stated that the finite Bitcoin supply may exert an underlying upward pressure on its price. This could give Bitcoin holders an incentive to hold on to their bitcoins as an investment rather than spending them, leading again to deflationary effects in a Bitcoinbased economy.

Moreover, while Bitcoin represents one of many private means of payment⁷⁵, it entails three peculiarities: it introduces Bitcoin a separate unit of account, it has no single and identified issuer and its quantity is ultimately fixed once and for all. Built around the model of gold, the Bitcoin is a pure asset not related to credit creation processes. It has no central issuer and does not represent anybody's liability. This implies that its quantity cannot be adjusted to variations in demand, and it does not come with anybody's promise to convert it into official currency at a certain rate. Being nobody's liability is a feature the Bitcoin shares with gold. But in contrast to gold, which is customarily used for various products (e.g. electronics, industry, dental fillings or jewellery) and has a commodity value, the Bitcoin has no use value other than serving its role in the Bitcoin system⁷⁶.

⁷³ See the ECB (2012), p. 25

⁷⁴ Paul Krugman was the first to note the deflation risk in the Bitcoin economy, comparing it to the gold standard (2011). See more on New York Times Blogs at the following link: <http://krugman.blogs.nytimes.com/2011/09/07/golden-cyberfettters/>. (2011)

⁷⁵ See at this paper pp. 6-7

⁷⁶ See Beer and Weber (2015), pp. 60-61

5. The reasons for implementing Bitcoin and similar virtual currency schemes, relating to the finance innovation

There are several reasons for a virtual community to issue its own virtual currency which lie outside the scope of this dissertation. However, when a type of virtual currency with potentially broader perspectives and with wider application like Bitcoin scheme emerges, the question is why use a virtual currency like Bitcoin instead of a real currency such as the Euro or the US Dollar. Supporters of virtual currency schemes attribute numerous advantages to them, while many remain hypothetical as they have often not –yet- materialized.

5.1. Potential economic benefits

Some of the advantages for users, i.e. payer and payee, can be characterized as potential economic benefits of financial, practical or conceptual nature⁷⁷.

The use of virtual currencies like Bitcoin scheme can help motivate users by simplifying transactions.

In his seminal article, *The Problem of Social Cost*, Ronald Coase argued that where transaction costs are significant, they may lead to inefficient results if not controlled for⁷⁸. Since Coase published his article in 1960, however, the technological revolution has enabled a reduction in many kinds of transaction costs. Transaction costs associated with Bitcoin scheme are much lower than with traditional payment systems. Firstly, due to the absence of intermediaries and regulatory requirements, transaction fees are generally significantly either lower than those charged for credit and debit card purchases or zero. For that reason, Bitcoin is cost-efficient: especially for the payee, the strongest advantage is the low cost for acceptance. In fact, the payee just needs to open a Bitcoin account and install an e-wallet to be able to receive payments. During the enrolment of a newly set-up wallet into the virtual currency's network, the consumer is not usually requested to agree on a contract with the inventors and to pay them a participation fee⁷⁹. It is important to note that when

⁷⁷ See EBA (2014), p. 16

⁷⁸ See Coase (1960), pp. 15-16

⁷⁹ See the ECB (2015), p. 18

using a virtual currency like Bitcoin, as opposed to a currency that needs to be converted, there is no foreign exchange cost. Yet, the differences between fiat currency and Bitcoin transaction costs could be considered not that important, due to the Single Euro Payments Area (SEPA) Agreement⁸⁰ and the Regulation 924/2009 which eliminates differences in charges for crossborder and national payments in Euros.

Moreover, with transactions in Bitcoin, users might include fees in order to process them faster. The higher the fee, the more priority it gets within the network and the quicker it gets processed. In addition, since there is no way for third parties to identify, track or intercept transactions that are denominated in Bitcoin, one of the major advantages of it is that sales taxes are not added onto any purchases. Consequently, it makes a particularly attractive way to effect micropayments⁸¹, allowing businesses to monetise very low-cost goods or services sold on the Internet⁸². However, according to European Banking Authority's report on virtual currencies, 'as the number of newly issued units decreases over time, users/miners will have to rely more on transaction fees to recoup their investment of processing power', so it would be reasonable to note an increase in the future⁸³.

Secondly, as it is already mentioned, the payer might benefit from a relatively short time for the verification and settlement of the payment transaction and on 24/7 basis. The total transaction processing time for bitcoins is usually less than one hour for decentralised VCS like Bitcoin; it is said to be between 10 and 60 minutes. Furthermore, the speed of verification and settlement are not linked to the geographical location of the sender and receiver. In fact, the reach of each currency is potentially global and almost every modern electronic communication device can access the internet and store a Bitcoin wallet.

⁸⁰ See the Regulation (EU) No 260/2012 of the European Parliament and of the Council of 14 March 2012 - establishing technical and business requirements for credit transfers and direct debits in euro and amending Regulation (EC) No 924/2009- in the Official Journal of the European Union, L 94/22, 30 March 2012

⁸¹ See EBA (2014), p. 16

⁸² See FATF (2014), p. 9

⁸³ See EBA (2014), p. 16

Thirdly, Bitcoin purchases are final, so there are no chargebacks or retrievals, like those rife in credit card dealings, yet another way transacting in the virtual currency saves merchants money. Merchants avoid refunding transactions, particularly those based on an alleged nonfulfilment of a contract⁸⁴. Thus, one of the economic benefits that a Bitcoin user would acquire is a kind of certainty of payments received.

Likewise, virtual currency schemes and especially the new-era phenomenon Bitcoin, offer various new types of businesses and business opportunities. In particular, activities (for example, mining) taking place in terms of the Bitcoin system led to the creation of new hardware, services, trade and exchanges platforms⁸⁵. Releases of new software versions and other updates have taken place smoothly and with relative ease⁸⁶. To put it differently, they can contribute to economic growth and development.

They could present some advantages for the payment system at a general level. The most notable one in decentralised virtual currency schemes like Bitcoin is that the processing costs are distributed over multiple subjects, namely the miners. This characteristic allows the network to reach reasonable computing power without requiring any major single investment, and it grants the network a strong scalability, as long as enough miners are willing to participate. This also means that new and agile actors, mostly with a background in IT and knowledge of its possibilities, have been able to enter the world of payments. They are suggesting new payment solutions for the digital age⁸⁷.

Furthermore, the digital coins have also become very popular as an investment. Despite the original purpose for bitcoins, many people have viewed them as a means to make money rather than to use as money⁸⁸. This is because the value of bitcoins has changed wildly during the past years. While volatility in the value of Bitcoin may be viewed as a potential risk to retailers that accept Bitcoin as payment, that same volatility is potentially attractive to investors who seek to profit from

⁸⁴ See EBA (2014), p. 18

⁸⁵ Ibid

⁸⁶ See ECB (2015), p. 20

⁸⁷ See ECB (2015), p. 19

⁸⁸ See Surowiecki (2011), p.106

buying low and selling high. Accordingly, Bitcoin's use in the marketplace is not limited serving as an alternative payment method. Instead, Bitcoin has also developed into an investment opportunity such that there is a growing number of investors who buy and sell bitcoins like one might buy and sell stock or trade traditional currencies⁸⁹. Some commentators have argued that the fluctuation in value and the ability to exchange bitcoins for other currencies has led to hoarding or has actually harmed the adoption of the currency⁹⁰. Regardless of this behaviour, bitcoins appear to be steadily becoming an established and recognized payment system as acceptance and use grows on both the merchant and consumer sides of the market. Accordingly, it is possible categorizing Bitcoin as an asset instead of a currency, or alternatively, accepting that Bitcoin may share traits of both an asset and a currency⁹¹.

In addition, access to basic financial services is a significant hindrance to combating poverty⁹² or to financial inclusion outside the European Union⁹³. Due to the impediments to developing traditional branch banking in under-developed areas, people in developing countries have turned to mobile banking services for their financial needs. Bitcoin scheme is able to provide people in developing countries with inexpensive access to financial services on a global scale. This is beginning to be seen in countries such as Kenya, Tanzania and Afghanistan, where the closed-system mobile payment service M-Pesa has been particularly successful; the Wallet service provider Kipochi recently developed a product that allows MPesa users to exchange bitcoins⁹⁴. Bitcoin may also be able to provide relief to countries with strict capital controls as there is no central authority that can reverse transactions or prevent the exchange of bitcoins between countries.

Bitcoin therefore provides an alternative in countries with devalued currencies or frozen capital markets. For example, some Argentines have adopted Bitcoin in response to the country's high inflation rate and strict capital controls;

⁸⁹ See Tu and Meredith (2015), p. 293

⁹⁰ See Surowiecki (2011), p.106

⁹¹ See Tu and Meredith (2015), p. 293

⁹² See Brito and Castillo (2013), pp. 14-15

⁹³ See EBA (2014), p. 18

⁹⁴ See Memorandum for Clifford Chance LLP (2014), p. 5 ¹²⁹
See Popper (2015)

demand was so high in Argentina that one popular Bitcoin exchange immediately planned to open an office in the country. With its volatile currency and dysfunctional banks, the country was the first perfect place to experiment with a new digital currency¹²⁹. Argentines, at least the most technologically savvy of them, are turning to bitcoin as a way to exchange their pesos for what they're actually worth, rather than what the government says they should be worth⁹⁵. Bitcoin, in other words, is simply a way for Argentines to make an end-run around their banking system, which works with the Argentine government to force its citizens to use the ever-devaluing peso. Similarly, ex Minister of Finance of Greece, Yanis Varoufakis, who is considered as a Bitcoin and virtual currencies' supporter, has said, during the debt crisis in Greece, he would consider as a solution creating a parallel digital currency, using Bitcoin's digital security and transparency¹³¹; as a consequence, he characterised Bitcoin as a 'future-tax coin'⁹⁶. He asserted that Bitcoin or a Bitcoin-style currency 'is the smartest move to beat corruption and tax evasion, all transactions will be recorded to the Greek Ministry of Finance new secure and dedicated Bitcoin servers and will be tracked at any given moment', after explaining that it could be implemented into Greeks' day to day life by using a special mini computerized card with a chip. He also suggested that the technology of Bitcoin, if suitably adapted, can be employed profitably in the eurozone as a weapon against deflation.

Finally, another benefit of Bitcoin, albeit possibly unintended, is that it provides financial stability where a national currency is unstable⁹⁷. To put it differently, bitcoins are also very attractive to citizens and governments of sanctioned nations⁹⁸. For instance, in 2012, the Iranian Rial was experiencing hyperinflation⁹⁹. At

⁹⁵ See related Matthews' article(2015) on Fortune website at the following link: <http://fortune.com/2015/05/04/bitcoin-argentina/> ¹³¹ See Paul Mason's article (2015) on Guardian site at the following link:

<http://www.theguardian.com/commentisfree/2015/feb/22/can-a-parallel-digital-currency-solve-the-greek-financial-crisis>

⁹⁶ See related article at <http://www.yanisvaroufakis.eu>

⁹⁷ See the Bitcoin project at the following link:

<https://bitcoin.org/en/faq#what-are-the-advantages-of-bitcoin>

⁹⁸ See Turpin (2014), p. 359

⁹⁹ See Jon Matonis' article (2012a) on Forbes website at the following link

<http://www.forbes.com/sites/jonmatonis/2012/10/09/as-inflation-rages-in-iran-bitcoin-software-not-available>

the same time, there was a shortfall of US Dollar in Iran due to sanctions by the United States and its allies. Unable to buy the more stable US Dollar and faced with holding onto the hyper-inflating Rial, some Iranians turned to bitcoins as a haven for financial stability. The value of bitcoins was deemed more stable than the Rial and funds could easily be transferred into and out of Iran over the Internet.

5.2. Potential individual benefits

Except the alleged economic advantages, whether real or only perceived, which could have an impact as an advancement for society or some market participants, individuals might also benefit from aspects that Bitcoin scheme can provide.

In the first place, virtual currency payment transactions do not require the provision of personal or sensitive data¹⁰⁰, because public and private key encryption was created especially for the Internet age, as opposed to credit cards which have no private values or tokens other than the physical card, which is unnecessary for online transactions. Credit cards data and passwords are secret information that could be stolen or forged, but are required in case of conventional payment methods. On the other hand, coinwallet addresses are public but anonymous, thus the public ledger of Bitcoin creates a money trail and prevents double spending. Hence, when a user sends a bitcoin, he ‘signs’ the transaction by combining public and private keys together, and applying a mathematical function to them. Then a certificate is created that proves the transaction came from this specific user. This greatly increases privacy when compared to traditional currency systems and conventional payment methods, where third parties potentially have access to personal financial data. Silicon Valley engineer Stuart

Eichert mentions how ‘Bitcoin is like cash, whoever has them owns them, so processing and transacting can be really safe for customers. Unlike the recent attack on Target, customers using Bitcoin leave no data behind that can be used to steal their identity or print fake credit cards’¹⁰¹. At this point it is important to note that - contrary to common belief - Bitcoin transactions are not, strictly speaking,

¹⁰⁰ See EBA (2014), p. 19

¹⁰¹ See article on the Forbes site (2014) at the following link:
<http://www.forbes.com/sites/groupthink/2014/02/13/why-we-accept-bitcoin/>

anonymous, to the extent that the Bitcoin protocol makes it possible to trace all transactions to and from a pseudonymous Bitcoin address, which can eventually be linked to a particular identity¹⁰².

Secondly, supporters of virtual currencies assert that Bitcoin is more trustworthy than fiat currencies, basing their opinion on the absence or limited interference of public authorities in charge of money supply¹³⁹. In particular, governments' or central banks' power to control the supply of money could lead theoretically to instability or political risks. For instance, in 25 March 2013, a €10 billion international bail-out by the Eurogroup, the European Commission (EC), European Central Bank (ECB) and the International Monetary Fund (IMF) was announced, in return for Cyprus agreeing to close the country's second largest bank, the Cyprus Popular Bank (also known as Laiki Bank), imposing a one-time bank deposit levy on all uninsured deposits there, and possibly around 48% of uninsured deposits in the Bank of Cyprus (the island's largest commercial bank), many held by wealthy citizens of other countries (many of them from Russia) who were using Cyprus as tax heaven¹⁴⁰. This could not happen to Bitcoin's circulation due to the decentralization of its system¹⁴¹. Thus Cyprus was a perfect place for experimenting Bitcoin's useful function. In particular, Bitcoin scheme was growing slowly until the announcement of the unprecedented bail-in for Cypriot banks.

The country was a catalyst for the big increase in Bitcoin scheme's price, because depositors withdrew funds and transferred them to bitcoins¹⁰³. It is worth mentioning that the first Bitcoin ATM globally was installed in Cyprus.

In addition, following the establishment of capital controls and bank holiday in Greece in July 2015 -amidst the debt crisis-, Bitcoin usage miming Cypriots' (and Argentines') method is considered helpful. Using Bitcoin allowed Greeks to transfer money out of bank accounts or out of country. New customers depositing at least 50

¹⁰² See Brito and Castillo (2013) ¹³⁹ See EBA (2014), p. 19 ¹⁴⁰ See Ehrenfreund's article (2013) on Washington Post at the following link:

http://www.washingtonpost.com/business/cypriot-banks-to-reopen-amid-criticism-ofbailout/2013/03/27/dd56757c-96e1-11e2-b68f-de5c4b47e519_story.html

¹⁰³ See Hargreaves article (2013), on CNNMoney website at the following link:
<http://money.cnn.com/2013/03/28/investing/bitcoin-cyprus/>

Euros with BTCGreece, the only Greek-based Bitcoin exchange, open solely to Greeks, rose by 400% during this period, according to its founder¹⁰⁴. In general, Bitcoin supporters argue that Bitcoin is particularly well-suited to avoid capital controls and it is about ‘preventing monetary tyranny’¹⁰⁵.

In this case, the reason why Bitcoin is a big deal in China and other countries with potentially unstable political and economic situations might be explained. Given that bitcoins are nearly impossible to forge and can be taken and spent across national borders but still are able to be transported easily (say, compared with gold bars), there is no need for state backing¹⁰⁶. Many people are attracted to a means of payment that does not involve a state actor and use bitcoins out of a distrust of any government to oversee their currency¹⁰⁷. However, the influence of money supply from a central bank or authority does not automatically mean that the superior alternative is to have money supply set by an algorithm, as in Bitcoin scheme.

¹⁰⁴ See Mandravelis’ article (2015) at Kathimerini

¹⁰⁵ See Matonis’ article (2012b) at Forbes website at the following link: <http://www.forbes.com/sites/jonmatonis/2012/10/04/bitcoin-prevents-monetary-tyranny/>. According to the writer, monetary tyranny can be deliberate inflation, persecutory capital controls, prearranged defaults within banking system.

¹⁰⁶ See Greenberg (2011), p. 40

¹⁰⁷ See Birch’s article (2011) at the following link: <http://www.prospectmagazine.co.uk/2011/07/bitcoin-economist-new-york-times-currency-mining/>

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<http://www.coindesk.com>

<https://en.bitcoin.it>

<http://eur-lex.europa.eu/>

<http://www.eba.europa.eu>

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