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Virtual Currency Schemes:

*An Assessment of Bitcoin in Respect to the Properties of Money
and the Real Economy*

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1 Introduction

The the internet has brought forward a new type of currencies. Digital payment systems and virtual currency schemes are used online to acquire digital as well as physical goods. Among these modern virtual currency schemes, crypto currencies could theoretically influence real economies. Bitcoin was the first crypto currency which was introduced and has the most significant market capitalization. Even though it acts as a digital payment system, its supporters claim Bitcoin to be the next generation of bona fide currency. Bitcoins, the medium of transaction in the payment system have been valued and are being traded for real currencies on online exchanges. It is unclear however, whether Bitcoin can really be considered a currency, which Bitcoin's supporters claim it to be (Wallace, 2011; European Central Bank, 2012; Yermack, 2014).

The purpose of this paper is to show that amongst the family of virtual currency schemes, crypto currencies are the type of virtual currency schemes which in a theoretical framework could influence the real world economy. Furthermore, the paper applies properties of money and real currencies provided by the economic research to Bitcoin, in order to show, that Bitcoin cannot be considered a currency system. The properties include *Medium of Exchange and Recognisability of Money*, *Unit of Account and Divisibility of Money* and *Portability and Store of Purchasing Power*. Moreover, the paper discusses the interaction of Bitcoin with the real economy.

The next section provides an overview of virtual currency schemes and digital payment systems which are currently available on the market and shows that cryptocurrencies can influence the real world economy. Afterwards, a summary of the functionality, market estate and regulation of Bitcoin will be provided. Bitcoin acts as the prime example of crypto currencies. Subsequently, properties of money will be explained and applied to the Bitcoin system taking the information from the previous chapter into account. Additionally, the interaction of Bitcoin with the real economy will be discussed. An outlook and a conclusion will form the final part of the paper.

2 Virtual Currency Schemes

The following chapter provides an overview of the different types of virtual currency schemes and digital payment systems which are available today. Furthermore, Bitcoin as the most prominent representation of the family of crypto currencies is discussed in detail. The section illustrates the functionality of Bitcoin, its current market estate and the current state of regulation.

2.1 Overview

The last two decades brought forward a variety of digital payment systems. Digital trade made it necessary to send money via the internet in a secure way. PayPal and Credit Card companies offer services which allow an individual to send real money in digital format via the internet to a receiver. Such services often require a commission fee based on the amount of money, which is transacted. Another form of digital payments system is E-Banking, which allows to access an account and transact payments (European Central Bank, 2012).

Such financial services implement a digital “mirror” of real currencies, transacting the digital format of real currencies. These digital services are only allowed to be provided under strict regulation by the country of residence of the institution. PayPal, for instance, resides in Luxembourg under the regulation of the Luxembourgian Banking Supervision and European Law (PayPal, 2014). This type of real money in digital form underlies the regulation of central banks as there is no difference between real currencies and digitized real currencies except for the form of appearance. It is estimated that 8 trillion US Dollars were traded for goods in e-commerce in 2011 (McKinsey Center for Business Technology, 2012).

In parallel to real money in digital form, three different types of virtual currency schemes have been developed. These virtual currency schemes are not regulated by a central authority. Regulation is either with the issuer or the scheme lacks regulation completely. Type I has no impact on real economy, because this type of virtual currency cannot be purchased through real money, nor can it be used to purchased real goods. The software industry implemented such currency schemes with the advent of online games. These schemes involve an in-game currency which is used to trade and purchase additional features and new content for the respective game. Type II virtual currency schemes can be obtained through real money and allows the user to purchase certain types of real and virtual goods and services. However, the exchange from Type II

virtual currency into a real currency is not allowed. Such currency systems have incentivized participants of Social media and online stores, to take part in various currency models offered by the internet service companies in order to activate certain features on their platforms. Similarly, suppliers of real goods and services have set up models to bind customers to their products. The suppliers offer a system involving a scoring model which allows the consumer to collect points either by buying a product¹ or by buying the points with real money. Frequent flyer miles are an example of Type II virtual currency schemes. Miles can be used to purchase flights and can be spent in duty-free shops, however they are not allowed to be exchanged for real money again (European Central Bank, 2012; Lehdonvirta, 2008).

Type III virtual currency schemes are a digital medium, which allow a bidirectional interaction with real currencies. Such currency schemes can be exchanged for real currencies and vice versa. Crypto currencies belong to Type III virtual currency schemes and allow the owner to purchase goods and services directly via transactions of the currency and also allow the exchange from and to real currencies via a third party institution. Bitcoin is the most prominent representation of the family of crypto currencies with the highest market capitalization of 7.5 billion US Dollars (CoinMarketCap, 2014; European Central Bank, 2012).

Regulatory definitions for Type III virtual currency schemes, especially for bitcoins, vary from country to country. The definitions and implications on regulation will be discussed in the course of this paper.

Considering the classification of the illustrated virtual currency schemes, it can be assumed, that Type I and II virtual currencies have little or no effect on real economy and will not be further discussed here. Type III however could theoretically impact the real economy, even though its current footprint is relatively small measured by the cryptocurrencies' market capitalization. The fact that crypto currencies could have an impact on real world economy requires the evaluation whether Bitcoin, representing crypto currencies, can be considered a real currency and also requires the analysis what the potential impact on real world economy could be.

¹ After buying a product, a certain amount of scores is reimbursed to the purchasers account.

2.2 Bitcoin

The following section provides an overview of the functionality of bitcoins, its market estate and the governmental regulation. It is to be understood that Bitcoin is the digital payment system and bitcoins are its medium of transactions.

2.2.1 Functionality of Bitcoin

The technical framework for bitcoins was defined in a paper published by Satoshi Nakamoto, whose true identity is unknown to the public.

Nakamoto describes a digital transaction system which allows the user to send and receive digital coins, supposedly without transaction costs. The system does not rely on trust between the payer, the receiver and an intermediary, but rather on trust in a set of logical functionalities realized by a coded system localized in a network.

The system allows an individual to send anonymously a unique block of digital information to a receiver from one account to another. The transmission of the information is verified by all participants of the network, as all participants own a file which includes data of all transmissions ever made. The block of information is a numerical quantity of a unit called bitcoins (Nakamoto, 2008).

The presumption that the participants do not trust each other, and the expectation that the participants act immorally imply two major issues. First, the expectation that a user might access another user's account and send bitcoins to himself is solved by password protection. The second issue is the so-called double-spending problem and shall be illustrated by an example:

Supposing that Peter sends a block of information to Paul, i.e. Peter sends 20 bitcoins to Paul. The *message*, that Peter sent 20 bitcoins to Paul, is then spread across the network verifying the transaction. As some participants may receive the *message* that Peter sent 20 bitcoins to Paul later than others, there is a danger of double spending. Double spending is possible when Peter sends 20 bitcoins to Paul and at the same time sends the same 20 bitcoins to himself. If Peter has a strong connection to the Network, the *message* that Peter sent 20 bitcoins to himself would spread faster than the *message* that Peter has sent the 20 bitcoins to Paul. At some point, an error would occur as synchronisation of the verification files would include conflicting data. Eventually, Paul would never receive the 20 bitcoins; rather Peter kept them for himself. This would cause an issue

if Paul was the owner of an online shop who shipped a good to Peter who claimed to have sent the 20 bitcoins to Paul and purchasing the good but did in fact, send them to himself again.

The problem of double spending is solved by a so called proof-of-work. The information “when” a transaction has occurred is not collected directly; rather the messages of all transactions which happened at the same point in time are collected and encrypted. This encrypted information is distributed across a peer-to-peer network whose participants are high powered computers or servers. The participants receive the encrypted file and bring up computation power in order to decrypt the file again. Once decrypted, the file can be allocated to the “block chain”, which defines which transactions happened at what point in time. The incentive for participating in this peer-to-peer network and bringing up computation power are newly issued bitcoins which are distributed to the computers which successfully decrypted the file. The act of earning bitcoins this way is called “mining”.

The overall amount of bitcoins to be issued is fixed at 21 million bitcoins. This amount will be reached in the year 2140 and the mining activity stops. The incentive to participate in the peer-to-peer network and to validate the transactions will then be a commission fee which has to be paid to the participants (Nakamoto, 2008; Standage, 2013).

Nakamoto’s conception of Bitcoin as a currency scheme can be related to the Austrian school of economy and the ideas of Friedrich A. Hayek. Nakamoto constructed Bitcoin to be a currency, which is free from influences of a central authority. Central bank would expand or contract the quantity of money, depending on the business cycle in order to ease inflation or deflation but there is no such functionality in Bitcoin. In order to do so, Nakamoto defined that the supply of bitcoins is formulated by a mathematical function² and will be fixed at one point in time. Bitcoin should be a decentralized system adopted by a large number of users which supposedly cannot be influenced by one individual (European Central Bank, 2012; Nakamoto, 2008).

2.2.2 History and Market Estate

The first 50 bitcoins were issued early 2009 by Nakamoto and only a limited number of users paid attention to the payment system. MtGox was the first organization which offered an exchange

² The quantity of bitcoins issued is halved every year.

platform which allowed individuals to trade bitcoins for real currency. When introduced, the exchange offered one bitcoin at the price of 4.951 cents. The number of users grew rapidly over time and more Bitcoin exchanges entered the market. The value of a bitcoin has increased almost 9000 fold and denotes currently at 443 US Dollars (Bitcoincharts, 8th of May 2014). The development of the exchange rate is strongly volatile. Goldman Sachs (2014) reports a volatility of 108.1% (Bitcoincharts, 2014; Yermack, 2014; Goldman Sachs, 2014).

Technically it is not possible to determine how many individuals own and use bitcoins. The amount of bitcoins traded on a daily basis is approximately 4 million transactions worldwide with a total of 12.7 million bitcoins existing as of May 2014 (Blockchain, 2014). Considering the development of bitcoins with respect to prices and transaction volume, one would assume that the number of businesses that accept Bitcoin as a payment have developed equally. The current situation suggests otherwise. Even though the website *www.spendbitcoins.com* reports almost 9000 shops accepting bitcoins, out of which only three are significantly large companies, which accept bitcoins as a means of payment. Overstock.com is the most noticeable. Major online services however, refrain from including bitcoins as an option to purchase their goods and services. Amazon abandoned the idea completely in April 2014 with the reason that the demand from customers is not existing (Cooper, 2014).

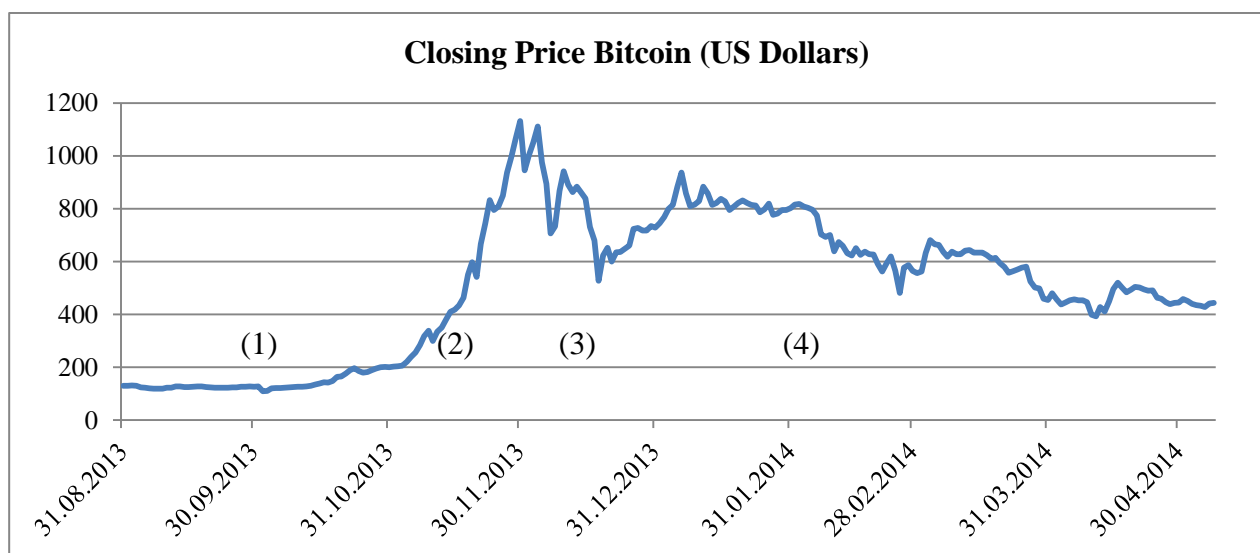
It is unclear why the business is hesitant to accept bitcoins but the facts that Bitcoin is a novelty to the real economy and that authorities are still vague about the regulation of Bitcoin might support the current situation. Another reason for this hesitancy is the image, that Bitcoin gained through the connection to a criminal webpage named *Silkroad*. The site offered illegal transactions for drugs and weapons. Transactions of purchases on *Silkroad* were only processed in bitcoins making use of the anonymity of the system. The FBI shut down the website and arrested the owner in October 2013, confiscating bitcoins worth 28.5 million US dollars from the owner's account (Greenberg, 2013).

An incident which challenged Bitcoin's allegedly high security standards was the attack and subsequent crash of the online Bitcoin exchange MtGox. MtGox, formerly a trading platform for game cards, had evolved into the largest Bitcoin exchange platform by the end of 2013. The Japan based company was accounted for 70% of bitcoin trade, even though it was led under poor management. In February 2014 the platform was attacked by cyber criminals who made use of a

weakness in the exchange’s software system. The attack led to a theft of 744’400 bitcoins with a current value of 330 million US dollars and the disappearing of 6% of all bitcoins which existed (The Economist, 2014; McMillan, 2014).

The MtGox incident was partially due to human failure but it also shows the weakness of Bitcoin as a currency system. A Bitcoin is a set of encrypted information or data. It is the owner’s choice to store his bitcoins on a local harddisk or to trust a third party which stores it on a cloud server. In the case of disappearance of bitcoins, either by destroying the physical media or by theft through a hacker attack, the bitcoins cannot be reimbursed. This is due to the fact that each Bitcoin is different from another and cannot be recreated once destroyed. As the quantity of bitcoins is predefined, eventual vanishing of bitcoins would influence the real world value of bitcoins.

The following part illustrates the development of the closing price of bitcoins in US Dollars in respect to events relating to Bitcoin:



Graph: Closing price of bitcoins in US Dollars from Sep 2013- May 2014 on online exchange Bitstamp
 Source: Bitcoincharts (8 May 2014)

The graph above shows the closing price of Bitcoins in US dollars to on the online exchange Bitstamp from September 2013 to May 2014. Reviewing the incidents relating to bitcoins during this period and considering the drifts of the exchange rate, it could be assumed that the market reacts to the events. (1) On October 2nd 2013, the FBI shut down the black market online site Silkroad which led to a drop in the exchange rate; however the US Government shutdown has increased the interest into alternative currencies. (2) On the 18th of November, the U.S. Senate

Committee on Homeland Security and Governmental Affairs held the first congressional hearing on Bitcoin, the situation seemed in Bitcoin's favour. (3) Mid-December 2013 though, the price decayed by more than almost 50% after an announcement from an online exchange in China. The announcement stated that the exchange would not accept new trader accounts in Yuan. (4) Another price drop was detected after the hacking attack at MtGox and its subsequent closure beginning February 2014 (Goldman Sachs, 2014; Hern, 2013).

It would be a subject for quantitative research to analyse the exchange rate in relation to the listed incidents. The evaluation of the events lead to the tentative conclusion that the exchange rate and therefore the volatility of the price of bitcoins are strongly influenced by events and media announcement, but this has to be proven in an empirical study.

2.2.3 Governmental Regulation of Bitcoin

The US Senate Committee on Homeland Security and Governmental Affairs hearing on virtual currencies was held in the aftermath of the shutdown of the black market online shop Silkroad. The general reception regarding Bitcoin was positive, even though, the anonymity the system provides, could support money laundering and other criminal activities. It was stated that Bitcoin provides legal means of exchange; the Internal Revenue Service however dampened the mood with an official announcement in March 2014 (Goldman Sachs, 2014). The statement included the clarification on how to treat bitcoins in tax related matters. Bitcoin shall be treated as property, not as real currency and "(...) it does not have legal tender status in any jurisdiction" (Internal Revenue Service, 2014a, IR-2014-36). The implications of the statement are that the USA does not forbid the creation and trading of bitcoins, nor does it forbid using Bitcoin as means of payment. The fact that Bitcoin does not have legal tender status implies that if a buyer of a good offers bitcoins as currency, the seller is not obligated to accept it.

Further notice from the IRS explained that all income an individual receives in bitcoins has to be declared. The declaration is to be stated in US Dollars, which requires the conversion of the Bitcoin price into US Dollars at fair market value. The fair market value has to be measured by the exchange rate which was current when the transaction of the income has happened (Internal Revenue Service, 2014b). bitcoins as a long position in a portfolio may pose a direct risk due to the high volatility and hence to the value of the portfolio, but it also poses an indirect risk for US

citizens holding bitcoins, considering their taxation of income. An individual may receive a payment for his services in bitcoins at which point in time the exchange rate is 1000 US Dollars per Bitcoin. Assuming he received 100 bitcoins, his taxable income would be 100'000 US Dollars. On the day the tax is due, the exchange rate of bitcoins may have dropped to 500 US Dollars³. In the case the individual did not sell the 100 bitcoins until the day the tax is due, the value of his bitcoins would be 50'000 US dollars, the tax however, has to be paid on the 100'000 US Dollars. The exchange rate might have also increased to 2000 US Dollars, in which case the individual would have a tax gain by not selling the bitcoins.

The situation in Switzerland is as follows. In December 2013, a postulate was handed to the National Assembly of Switzerland requesting clarification on legal status of Bitcoin. A report was released on the 25th of June 2014. The report does not foresee a new law in regards to regulation of virtual currencies such as bitcoins due to the fact that the usage of Bitcoin is insignificant compared to the use of other payment methods and medias. It is however stated, that bitcoins undergo the Swiss applicable private law in terms of using bitcoins as a means of payment nationally. It is also emphasized that international transactions are subject to investigations in order to find out which law would be applicable if legal persecution would be required. This is due to the fact that there is no internationally shared view on a legal and regulatory framework in regards to Bitcoin. Additionally, financial institutions which provide online exchange services must receive a banking license from the Finma, requiring that for all transactions, the identity of all involved parties must be disclosed (Swiss Federal Council, 2014).

The there is no legal tender state of Bitcoin in Switzerland as the monetary policy is defined as follows:

“I. The Confederation shall be responsible for money and currency. The Confederation has the exclusive right to issue coins and banknotes. Thus, it holds the right of coinage and the monopoly over issuing banknotes.” (Swiss Federal Council, 2014, p. 5)

“II. Furthermore, monetary policy is pursued by an independent central bank, the SNB, in the overall interests of the country. These principles are enshrined in the Federal Constitution.” (Swiss Federal Council, 2014, p. 5)

³ Considering the development of the exchange rate in Graph 1, this is a potential scenario.

Concludingly, the Swiss Federation does not consider bitcoins as a currency, because it does not comply with the definitions above as the issuance cannot be controlled by the central bank, nor is there a regulatory or legal foundation underlying the Bitcoin system.

Bitcoin can be seen as a digital payment system, whose medium of exchange, the bitcoins, are not denoted in a real currency as opposed to the digital form of real currencies described in section 2.1. The lacking of denotement in a real currency allowed Bitcoin to be valued by its owners and traders, leading to a volatile price development. Even though the industry is hesitant to allow bitcoins as a means of payment and governments are reluctant to grant Bitcoin the status of a currency, Bitcoin's supporters are positive that the usage of the crypto currency is sustainable and could even replace real currencies. The next chapter provides a critical evaluation based on economic theory whether Bitcoin could be considered a currency and how Bitcoin interacts economical system.

3 Evaluation of bitcoins

Various economic papers and reports have approached the question whether Bitcoin can be considered a currency or not. A report released by Goldman Sachs Investment Research (2014) and a paper by David Yermack (2014) conclude, it cannot be considered a currency. The existing research however is based on empirical events. The following assessment includes latest events and governmental announcements as well as the theoretical framework of bitcoins. Both subjects are applied to the traditional properties of money, medium of exchange, unit of account and store of purchasing power (White, 1999) as well as to the extended properties mentioned in Money, Payments and Liquidity (Nosal & Rocheteau, 2011). The final section of this chapter discusses the the interaction of Bitcoin with the real economy.

3.1 Can Bitcoin be considered a currency?

Medium of Exchange and Recognisability of Money

A currency which fulfils the requirement as a medium of exchange solves the problem of the lack of double-coincide of wants, which would arise in a barter system with minimal transaction costs. A situation that illustrates the problem of double-coincide of wants in a barter system is the following: Paul has strawberries but wants cherries, George has cherries but much rather prefers

apples, John has apples but would like to have some strawberries. If only two of the mentioned individuals ever meet, but not all three at the same time, and they are not able to commit, a deal between them would never happen. This is because, if Paul meets George, Paul would like to have George's cherries, but Paul doesn't have the product to trade with, which meets George's preferences, which are apples. The same happens when George meets John or when John meets Paul; an optimal allocation of goods cannot be reached unless all parties meet at the same time. A medium of exchange would solve this allocation problem. The medium of exchange has to be of the same value as one of the goods would be to the individuals or, would give the right to receive a good in return of the medium (Nosal & Rocheteau, 2011; White, 1999).

bitcoins, the medium of exchange in the digital payment system, has no intrinsic value as seen in section 2.2.1. The composition of a Bitcoin is nothing but a string of coded information as a result of a network processed tasks. In a barter system, the value of a Bitcoin could not replace the value of a real good, because its value was not defined and denoted. Furthermore, the existence of a Bitcoin is only limited to the virtual world, hence, the trading of bitcoins would always require a carrier medium, such as a computer, a smart phone or a laptop. Considering the very basic problem of a simple barter system as mentioned above, Bitcoin would not be able to solve the problem. Before John, Paul and George could trade bitcoins for their fruits, they would have to purchase a computer and connect to the internet, then find a medium of real value, trade this medium for bitcoins and then finally, would be able to trade bitcoins for fruits. It may seem obvious that John, Paul and George would have to go through this effort in order to get to the fruit of their desire paying with bitcoins, yet it shows the complexity of Bitcoin as a currency scheme and demonstrates, that the problems which Bitcoin tries to solve are actually being solved, but on the account of new and different problems arising.

Bitcoin was established as a digital payment system without any transaction costs. It is actually the case that, when processing a transaction in bitcoins, no third party is involved and no transaction fee is required. However, only early adopters who earned bitcoins by "mining", benefit from this property of the system. The entry costs of bitcoins, when purchasing bitcoins through an online exchange, are very high and should actually prevent the rationally thinking individual from adopting Bitcoin as a payment system. In order to purchase bitcoins on an online exchange, a thorough process of identity validation has to be administered. When validation of the identity has

succeeded, a transaction fee, variable in relation to the transaction amount, has to be paid when purchasing bitcoins for real currency⁴.

Another source of transaction costs arises through commercial transactions which are processed directly. Shop owners can offer their customers bitcoins to be an option of payment. The prices however are denoted in a real currency such as Euros or US dollars. BitPay is a service which allows a real-time transformation from real currency to bitcoins the transaction. The service transforms this price into bitcoins at the current exchange rate and sends this amount from the customer's account to the account of the seller of the product. There is however, a timely lag during the transaction, meaning that there is a risk of exchange rate variability due to the volatility of the Bitcoin exchange rate. Additionally, the BitPay service charges a commission fee to the seller of the product.

Both examples mentioned above show, that the system, analysed from an external point of view, is not transaction cost free.

The medium of exchange which solves the problem of lack of double-coincide has to be accepted individually by all participants of the barter system. In case the medium was not accepted by one of the participants, no participant would receive the good they prefer and no optimal allocation would be accomplished. As stated in the previous section, empirical evidence shows, that some private individuals have started adopting bitcoins, the actual number of people owning bitcoins however, cannot be determined. Evidence also shows, that only a very limited number of businesses have officially announced the acceptance of bitcoins. Furthermore, no governmental regulation of the countries analysed above grants Bitcoin the legal tender right, leading to the fact that suppliers of goods and services may be allowed to accept bitcoins as payment, but are not obligated to do so. If Bitcoin is not a universally accepted medium of exchange, it would not solve the problem of lack of double-coincide and hence not fulfil the requirement of medium of exchange.

Nosal and Rocheteau discuss the existence of counterfeiting money and assume that money is imperfectly recognizable. bitcoins, as explained in section 2.2.1. are indeed unique and cannot be counterfeited because of the validation network. The incentive to participate in the validation

⁴ www.kraken.com is an Bitcoin online exchange requiring a fee of 0.03% for amounts transacted smaller than 10'000 US dollars.

network is the return of bitcoins. In theory, the system is a payment system which keeps itself secure, due to its highly complex structure. The participation in the validation network however, is not an easy task for individuals without profound knowledge of the technical background. Moreover, the participation in the network requires high investment and carrying costs, because a highly technically developed computer is required to benefit from the “mining” activity which requires a high amount of electricity. There are numerous websites which calculate the break-even point when starting “mining” to date. An investment of 7’080 US dollars in hardware and an electricity price of 1 cent per kWh and considering the current price per Bitcoin would not reach a break even, meaning that the investment would partially be sunk costs (Bitcoin Wisdom, 2014).

High entry costs and the lack of general acceptance are an indicator that Bitcoin cannot be considered a currency. Moreover, the initial real investments and costs of making Bitcoin a secure payment system have succeeded the return which should incentivize the participants to take part in the validation network. Concludingly it can be stated that the costs of maintaining bitcoins are higher than its benefits. The next section analyses the criteria unit of account in regards to Bitcoin.

Unit of Account and Divisibility of Money

David Yermack (2014) elaborates on the format and structure of the denotement of bitcoins. Yermack states that bitcoins faces pricing issues when transforming real currency values into bitcoins resulting in inconvenient numbers. A chewing gum which costs 1 US Dollar would cost 0.00227272 bitcoins. The general perception of prices, which the consumer currently has could not be applied to a world in which all prices would be denoted in bitcoins.

Another problem which arises from implementing Bitcoin as a currency in regards to unit of account is the technical restriction, that bitcoins’ smallest unit of account is 0.00000001 bitcoins, also called a satoshi. Assuming that the price of a Bitcoin would exceed 10 million US Dollars per bitcoins, prices denoted in cents could not be paid anymore, because Bitcoin’s technical framework would not allow doing so. This leads to another problem when considering Rocheteau and Nosal’s requirement that a currency must not be scarce, otherwise, the currency scheme is inefficient (Nosal & Rocheteau, 2011).

The technical restriction that bitcoins in theory are not infinitesimally divisionisable, the definition that the supply of bitcoins is fixed and also the fact that if bitcoins are destroyed they cannot be reimbursed result in the fact that bitcoins are scarce. The scarcity of bitcoins implies that Bitcoin, if it would be considered a currency scheme, would appreciate constantly.

Generally it can be said that the bitcoins' denotement compared to the current exchange rate would result in a problematic pricing landscape in the consumer economy. The calculation of prices in micro bitcoins for instance would lead to complex situation when trying to compare goods and their prices. Additionally, the technical restrictions of bitcoins show that, depending on the development of the exchange rate, Bitcoin would not be a suitable currency scheme to be implemented in a real world economy.

Portability and Store of Purchasing Power

Nosal and Rocheteau's analysis of properties of money implements the existence of costs of portability of money. That is for instance the cost of storing money or the cost of bringing money to a bilateral meeting.

Bitcoin as a digital payment system requires no direct cost of portability. The subscription to sign up to a Bitcoin account and the transaction from one account to another is free of charge and requires only a minor amount of effort. The indirect cost of adopting Bitcoin as a payment system however, can be significant, depending on the user's infrastructure. Fixed costs include the investments in an electronic device which allows the operation of an account. Variable costs include commission fees which are due when purchasing bitcoins with a real currency. Additionally, if the individual would like to participate in the validation network in order to earn bitcoins by "mining", the fixed and the variable costs accumulate as well. Therefore it can be said that Bitcoin as a closed system is transaction cost free. Each interaction with the real world economy however requires investment as well as carrying costs. The costs appear to be significant, especially when considering the actual value of bitcoins and their ability to store purchasing power.

Historical evidence has shown, that before bona fide currencies were implemented, civilization has used media of exchange which have an intrinsic value, such as gold, pearls or even chocolate

(Weatherford, 2009). When first implemented by governmental institutions, bona fide currencies were based on a defined legal foundation, including the rules of regulation. Bona fide currencies act as instruments to influence and regulate the business cycle, in order to avoid any depressions or high inflation rates. The legal framework provides a contractual obligation of the government towards its citizens, that the central authority which can regulate the supply does every means possible that the economy is stable (Swiss Federal Council, 2014). The value of bona fide currencies, as opposed to historic currencies with intrinsic value, is more of an intangible value, providing trust into the governmental system. Bitcoin lacks both, intrinsic value as well as trust based value, especially due to the fact that Bitcoin was constructed on the general presumption that there is a no trust between the involved participants.

Why does Bitcoin have a value which would provide the ability to store purchasing power? It is important to distinguish between the two perspectives, that is, what Bitcoin claims to be and what Bitcoin actually is.

Bitcoin is a digital payment system, whose medium of exchange, bitcoins, at some point in time was valued by one or more individuals participating in the system. The supposedly first commercial transaction which was processed in bitcoins was the acquisition of two pizzas involving a third party. The buyer of the pizzas had to contact a volunteer to whom the bitcoins were sent. The volunteer then called a credit card order, allowing the buyer to pay the pizzas (Wallace, 2011). Why the volunteer valued the bitcoins which he was sent and traded the bitcoins for real money, one can only speculate. A likely explanation is that the actual pricing of bitcoins was due to the marketing strategy of Bitcoin. Nakamoto claimed to construct Bitcoin's system upon the presumption that there is neither a need for financial intermediaries, nor the need for regulation, nor the need for general trust shared between the interacting parties. These presumptions were ideological on one hand, but also acted as a marketing strategy to sell the concept of Bitcoin. This marketing strategy was supported by the general negative mood in the aftermath of the financial crisis. Voices against banks and financial intermediaries were raised and means to oppose the financial system were looked for by movements such as the Occupy Wallstreet. Bitcoin, seen as an alternative to real currencies, were growing in demand, and since bitcoins are scarce, their value increased. Bitcoin's presence in the media amplified its growing demand and moreover, drew the interest of venture capitalists and speculators. The venture capitalists were looking into investments in businesses whose ideas were based on Bitcoin;

speculators on the other hand, were buying bitcoins as a risky financial asset to benefit from its volatile price development. The trading activity supported the already significant volatility of bitcoins' volatility (Yermack, 2014; Wallace, 2011). It could even be concluded that Bitcoin, seen as an investment asset, has the properties of a financial bubble. Given the fragility of the system, which comes from its existence only in digital form and considering the lack of intrinsic value, the appreciation of bitcoins could be seen as hype. An eventual burst of this bubble could be caused by technological failure, regulatory sanctions or mere future lack of demand. A burst would not only lead to a decrease of financial value in the investor's portfolio but also impact the businesses and start-ups that have specialized in bitcoins. Hence, it can be concluded that Bitcoin is a digital payment system upon which many upcoming start-ups rely on. Bitcoin's currency is being valued and handled as an investment asset on financial markets by speculators and other investors. The trading of this asset and therefore the development of the price relies very much on external information presented by the media and governments.

The bitcoins do not meet the properties of money discussed previously and given its volatile development in price and its character as risky financial asset, bitcoins cannot be considered to be a medium to store purchase power. Given these facts, Bitcoin cannot be considered a real currency. The following section discusses the interaction of Bitcoin as a system with the real economy.

3.2 Interaction of Bitcoin with the Real Economy

The previous section showed, that Bitcoin cannot be considered a real currency;. It rather is a digital payment system whose transaction medium shows the character of a risky investment asset. Nevertheless, Bitcoin's presence in the media is indisputable and the public's interest in Bitcoin seems to be growing. The adoption of Bitcoin had a bottom-up character, the growing acceptance of Bitcoin as a means of payment system was not due to implementation by an authority or an institution as a central bank, it rather was introduced by an independent community. Even though the usage of Bitcoin is currently insignificant compared to the use of real currencies, regulatory attention is lagging as official announcements were released five years after the invention of a newly issued type of payment system. A continuation of the circulation of bitcoins would pose several impacts and risks to an economy.

The presumptions and ideological ideas upon which Bitcoin is based imply the lack of any regulation. Bitcoin's initial setup was defined in Nakamoto's paper and included the definition of the yearly supply of bitcoins and the total quantity of bitcoins to be issued. Hence, the inelastic supply in Bitcoin would imply, that, if there was no alternative medium of exchange to bitcoins, bitcoins would appreciate continuously over time. Supposing an economy's value creation would continue, prices for goods would never be stable and the economy would suffer continuous deflation. Additionally, the predefined quantity and supply of bitcoins are not based on economic reasoning; they rather seem to be arbitrary as there is no economic reasoning to be found in Nakamoto's paper which would justify the said quantity and supply. Bitcoin, if it was considered a currency, would act as a complete rigid system without any possibility to influence the initial setup.

Moreover, Bitcoin lacks any legal foundation and can be used under complete anonymity. Even though the system was based on the presumption that a legal framework is obsolete, interactions with the real world economy make it necessary to have a legal foundation. The example of *Silkroad* illustrated in section 2.2.2. has shown that an anonymous payment system free of any legal foundation supports criminal activities as well as money laundering. The report of the Swiss Federal Council explained, that Bitcoin does not operate in a legal vacuum (Swiss Federal Council, 2014). A transaction of bitcoins from one account to another does not need a legal foundation, but the implementation of Bitcoin in a real economy does.

Another presumption that Nakamoto implied in his paper was the lack of trust between the interacting parties. The expectation that individuals would trust a system which is based on highly complex cryptographies but do not trust each other shows the character of a paradox. Securing Bitcoin's transaction system involves mathematical problems which only high computing power can solve and only few individuals talented in mathematics would understand, still, individuals trust the system. Moreover, the system was created by one or more individuals, which means that participants trust the system, but indirectly also trust the inventors of bitcoins, even though they presume that individuals do not trust each other.

The lack of trust within the system, apart from the paradoxon explained, is however not necessary. Without trust an individual is still able to send bitcoins to another. Implementing Bitcoin in a real economy however, requires trust. Considering for instance a purchase made

online. A consumer might buy a good through bitcoins online and send the seller of the good the bitcoins. Without trust, the customer cannot be sure that the good will actually be delivered. Similarly to the lack of legal framework. Bitcoin seen as a closed system does not require trust. The implementation of Bitcoin in a real economy on the other hand requires trust between the market participants in order to function.

The presumptions imposed by Nakamoto are consistent within the system, but would not allow a functioning interaction with a real economy and therefore do not hold. In addition to those presumptions, the current interaction of Bitcoin with the real economy involves decentralized third party online exchanges. The exchanges allow a trade of bitcoins for real currencies but due to their decentralization, they offer different exchange rates depending on trading volume, trading frequency and geographic location of the exchange. In theory it is possible to practice arbitrage by buying bitcoins on an exchange and sell them on a different exchange which offers bitcoins for a higher exchange rate. In practice it is not possible due to the intertemporal lag between buying and selling, the possibility however, is existing. This implies that the current market situation of Bitcoin does not fulfil the concept of purchasing power parity (Mankiw & Taylor, 2008, pp. 796-797). Even though it cannot be assumed that in a real economy with frictions, the concept of purchasing power parity holds consistently, differences in currency exchange rates however are being levelled out over time. This though, cannot be seen when observing the Bitcoin exchange rates on different online exchanges over time and bitcoins acquired from different online exchanges imply different purchasing power of bitcoins⁵. Therefore, the assumption that Bitcoin acts as a financial investment asset rather than a currency holds.

⁵ <http://www.bitcoincharts.com/markets/> provides an overview of different Bitcoin exchanges and their exchange rates.

4 Outlook

Bitcoin was introduced in 2009 and gained the attention of the media over the last two years. Not only the public but also the scientific community showed interest in Bitcoin. Apart from papers which discuss the technical aspects of the systems, there are also reports which discuss the financial and economic properties of Bitcoin. The fact that mass trading of bitcoins only started approximately two years ago, the amount of data which would allow empirical analysis of Bitcoin is not sufficient yet. A question for further research would address the sustainability of bitcoins as financial assets, considering the fact that it lacks the properties of a real currency and also lacks the presence of intrinsic value. Statistical analytics might show, that the price of bitcoins is driven by external factors such as Government announcements and incidents mentioned in public media.

Another research question would address the legality of Bitcoin and questions regarding a global regulation. The current situation suggests that Bitcoin is handled on a national basis, imposing problematic legal issues when transacting Bitcoin internationally. Currently, the technology does not allow an exact determination of the locality of a Bitcoin account, complicating the question of which law is applicable in the case, legal persecution is required.

In general, it could also be assumed that the technological aspects on which Bitcoin is based could give ideas to a new innovative payment system which would be self securing. It would have to be developed in collaboration with financial regulatory bodies though, because as the example of Bitcoin suggests, without the collaboration of the authorities, a frictionless implementation of a payment system is almost impossible.

5 Conclusion

The paper gave an overview of virtual currency schemes available on the market today and showed, that cryptocurrencies are the type of virtual currency scheme which theoretically has an impact on real economy. Bitcoin was considered to be the most prominent representation of the family of cryptocurrency and hence was analysed and evaluated. Investigation has shown that Bitcoin is a digital payment system which is based on a complex technological foundation. The medium of transactions, the so called bitcoins, have been attributed financial value by its initial users. The development of bitcoins showed, that decentralized online exchange services offer bitcoin in return of real currency. The decentralization of online exchanges also show that there are

different exchange rates. Bitcoin as a payment system is not accepted by the majority of businesses. The anonymity which Bitcoin provides, supported criminal activities on the criminal webpage *Silkroad*, as it acted as the only payment option to purchase drugs and weapons. The governments of the United States and Switzerland have released official statements which explained the treatment of Bitcoin from a legal and a tax perspective. Both countries do not grant legal tender rights to Bitcoin.

The application of the properties of money show, that Bitcoin cannot be considered a currency. It primarily lacks the characteristics of a universally accepted medium of exchange. A medium of exchange is required to solve the problem of lack of double-coincide of wants. Bitcoins are not able to do so, because the majority of market participants do not accept bitcoins as means of payment. Moreover, Bitcoin is not granted legal tender rights in the countries analysed. Furthermore, the technical construction of Bitcoin implies that bitcoins are a scarce medium and therefore would cause continuous deflation in case it would act as a major currency. Another property Bitcoin does not fulfill is store of purchasing power. Bitcoin showed a price development which is highly volatile and additionally bitcoins have no intrinsic value nor is it based on a legal foundation which would provide the means of a purchase power storing medium. Based on this evaluation, it can be said that Bitcoin is in fact, not a real currency, but a digital payment system whose medium of transaction was valued on decentralized online exchanges. These findings are coherent with the opinions of Governmental authorities as well as the findings of the analysed scientific papers.

A discussion of the impacts of Bitcoin on a real economy have shown that the ideological presumptions upon which Bitcoin is based, hold within the system of Bitcoin but have to be rejected once Bitcoin interacts with a real economy. Moreover, the implication of the presumption that market participants would not trust each other imposes a paradoxon. A general lack of trust would also induce the market participants' lack of trust into the system Bitcoin.

Bitcoin's technical approach to deliver a secure digital payment system could act as the basis for further innovations. The economic presumptions upon which Bitcoin is based cannot hold when Bitcoin interacts with the real economy. The claims that Bitcoin are a real currency and could replace major bona fide currencies cannot be supported.

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Plagiats-Erklärung

Ich bezeuge mit meiner Unterschrift, dass meine Angaben über die bei der Abfassung meiner Arbeit benutzten Hilfsmittel sowie über die mir zuteil gewordene Hilfe in jeder Hinsicht der Wahrheit entsprechen und vollständig sind.

Ich habe das Merkblatt zu Plagiat und Betrug vom 22. Februar 2011 gelesen und bin mir der Konsequenzen eines solchen Handelns bewusst.

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