

BITCOIN AS AN ELECTRONIC PAYMENT TOOL

BITCOIN JAKO ELEKTRONICZNY ŚRODEK PŁATNICZY

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Abstract. The article presents the results of research aimed at assessing the Bitcoin (BTC) capability to act as a widely accepted means of payment. The analysis includes technological and economic conditions of the BTC operation system. The research used data on market capitalization, the number of participants and the level of volatility of the BTC exchange rate in 2010-2018 from the portal *coinmarketcap.com*. The results of the research showed that BTC possesses certain characteristics typical of money, and has the potential to increase its share in the payment system in the future. BTC's ability to act as an electronic equivalent of cash depends on such factors as the stability of its exchange rate and the level of acceptance among users and payment acceptors. The statistical analysis of the correlation showed that along with the increase in the capitalization value of the BTC market the volatility of the exchange rate of this currency is lowered and the level of acceptance among e-commerce participants is increased. Such dependence will allow for further technological development of BTC and other cryptocurrencies and a wider use in trade.

Keywords: Bitcoin, cryptocurrencies, means of payment, cash

Streszczenie. W artykule zaprezentowano wyniki badań, których celem była ocena zdolności Bitcoina (BTC) do pełnienia funkcji szeroko rozpowszechnionego środka płatniczego. W analizie uwzględniono technologiczne i ekonomiczne uwarunkowania systemu działania BTC. W badaniach wykorzystano dane dotyczące kapitalizacji rynku, liczby jego uczestników i poziomu zmienności kursu BTC w latach 2010-2018 pochodzące z portalu *coinmarketcap.com*. Wyniki badań wykazały, że BTC posiada pewne cechy charakterystyczne dla pieniądza, a także ma potencjał do zwiększenia w przyszłości swego udziału w systemie płatniczym. Zdolność BTC do pełnienia funkcji elektronicznego odpowiednika gotówki uzależniona jest m.in. od takich czynników jak stabilność jego kursu oraz poziom akceptacji wśród użytkowników i akceptantów płatności. Analiza statystyczna korelacji wykazała, że wraz ze zwiększaniem wartości kapitalizacji rynku BTC obniża się poziom zmienności kursu tej waluty i zwiększa poziom akceptacji wśród uczestników handlu elektronicznego. Taka zależność pozwoli na dalszy rozwój technologiczny BTC i innych kryptowalut i szersze wykorzystanie w handlu.

Słowa kluczowe: Bitcoin, kryptowaluty, środek płatniczy, gotówka

Introduction

Cryptocurrencies are a new alternative form of money. Central banks do not participate in their issue, and governments do not control their level of supply. Their functioning is based on the blockchain technology. Thanks to cryptographic solutions, it is possible to transfer money directly without any involvement of a third party. The first cryptocurrency – Bitcoin (BTC) appeared in 2009. Since then, many other cryptocurrency projects have been created, the so-called altcoins, drawing on the technological solutions used in BTC.

The growing interest in this form of currency has resulted in a sharp increase in the capitalization of the BTC market and its price, which at the end of 2017 reached its maximum of about 20 thousand USD. One of the main motivations for the creation of BTC was the facilitation of cheap, fast and direct payments in e-commerce. The elimination of a financial intermediary was the factor which helped to reduce transaction costs and create the possibility of micropayments (Nakamoto, 2008). BTC was supposed to be, in some sense, the electronic equivalent of cash. After ten years of the functioning of this currency, the question arises whether

cryptocurrencies will find their permanent position in the economy as an effective means of payment?

The aim of the research is to assess BTC's capability to act as a widely accepted means of payment. The analysis includes technological and economic conditions of the BTC operation system. The research used data on market capitalization, the number of participants and the level of the volatility of the BTC exchange rate in the years 2010-2018 from the portal *coinmarketcap.com*.

The remaining part of the article is constructed as follows. The first part presents the technological and economic aspects of the BTC operation, discusses groups of entities participating in the BTC system and their impact on its development. In the second, the possibilities of performing the function of money by BTC were analysed. In the next part the current state and prospects of using BTC in e-commerce were examined. The entire analysis is summarized in the conclusions.

Material and methods

Electronic commerce uses various payment methods, among others, to adapt to consumer preferences. A common feature of all currently used in the payment systems is the involvement of a trusted third party, mainly a bank. Before 2009 there was no possibility of making direct irreversible electronic payments between the parties to the transaction. This need was met by the first cryptocurrency BTC, invented by Satoshi Nakamoto. In this electronic payment system trust was based on cryptographic proof. The problem of trust in traditional payment systems requires the financial intermediary to enforce information, including identity data of the parties to the transaction, which is not necessary in the case of direct money transfers using cryptocurrencies (Nakamoto, 2008). Payments using cryptocurrencies, like cash payments, are anonymous. This feature is due to the technological solutions proposed by Dawid Chaum – a cryptologist and propagator of anonymous electronic payments (Wiśniewska, 2015). He created a protocol known as a blind signature that permits hiding the identity of a person making payments with digital money (Chaum, 1982).

The Cypherpunks community also contributed to the creation of the anonymous electronic currency. It was a group of cryptologists founded in the early nineties of the twentieth century concerned about the progressive limitation of privacy, rights and personal freedom (Vigna, Casey, 2016). They developed,

among others a payment system in which the disclosure of the payer's identity would not be necessary to successfully execute the transaction (Hughes, 1993). This assumption was identified by the virtual currency b-money developed in 1998 (Dai, 1998). Its concept uses a mechanism of a distributed transaction register, of which each participant has copies. Such an organized system can function without the need for a central unit. This solution was used in BTC. In addition, the BTC operation mechanism uses the rule of limited supply developed by Nick Szabo (Szabo, 2005). Due to these innovations, BTC obtained the following features: anonymity, irreversibility of payments, a distributed emission and transaction confirmation mechanism, as well as a supply limited to 21 million units. The possibility of direct transfer of electronic money units between the payer and the payment recipient means that transaction costs can be extremely low, and the entire system operates outside the circulation of traditional banking channels.

BTC users are not related to the payment procedure, and the supply of currency is increased due to the mining of new BTCs by the so-called miners. In the case of BTC, every 10 minutes a new block/unit is added to the chronological sequence of the already existing blocks. Miners receive a payment in the form of newly-generated BTCs as a reward for sharing their own computing power for the BTC network. Additionally, the network is constructed in such a way that more devices participate in mining the currency, the more secure its network is (Antonopoulos, 2018). In the BTC system each executed transaction receives a time stamp and contains a specific function marking the previous transaction, which in turn has a time stamp and a marking function from the earlier operation. Such a secured cash flow chronology ensures the stability and security of the operation (DeMartino, 2016).

The BTC supply is therefore based on mining this currency. However, the rate of extraction decreases significantly over time (Figure 1). In the initial period, since the BTC system was launched, i.e. from January 2009, 50 BTCs were added to the miners register every 10 minutes. In November 2012, this number decreased to 25 BTCs, and in July 2016 to 12.5 BTCs. This number decreases exponentially until 672,000 blocks are extracted. Then the bonus obtained for mining one block will achieve the smallest reward, i.e. 1 satoshi (0.00000001 BTC). Such completion of the emission of new BTCs is expected in 2140 (Antonopoulos, 2018).

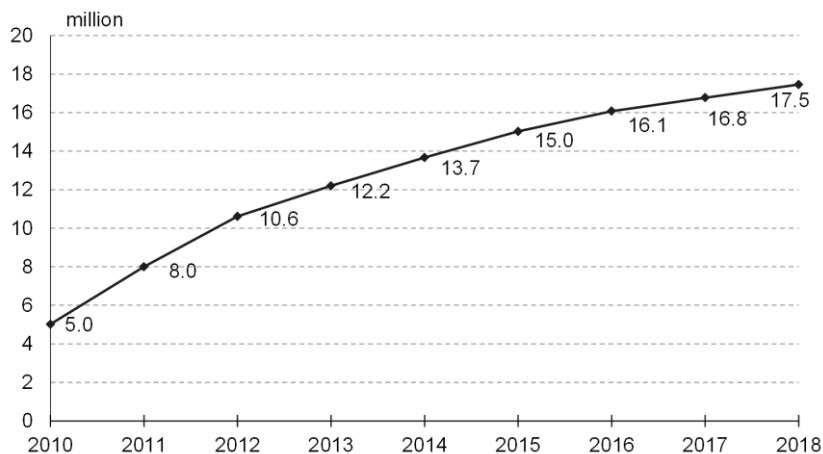


Figure 1. Total amount of issued BTCs in 2010-2018 (end of year)

Source: own calculations based on data from Quandl: [<https://www.quandl.com/data/BCHAIN/TOTBC-Total-Bitcoins>] (access: 07.01.2019).

Not all cryptocurrencies are issued in a manner similar to BTC issues. Differences in their functioning relate to, among others, algorithm, a planned maximum amount of coins, or a method of reducing issuance. Not all cryptocurrencies have a certain upper limit for a number of monetary units, and some of them are not mined at all. In many cases all coins are created only in the initial stages of their existence and are then distributed at different time intervals. Most often in such cases certain pools of coins remain at the disposal of the project creators and are allocated to financing the development of the currency.

After its issuance, the coin may go into circulation and be used in payments. It can also be exchanged for other traditional currencies such as the euro or dollar (Saito, 2013). The issuance and flow of cryptocurrencies between users and exchange for traditional money is possible due to units operating within the cryptocurrency network and units that serve as connectors with the banking system. All these units form a special system, which includes miners, currency makers, stock exchanges, exchange offices, cryptocurrency portfolio providers, as well as users. The creators play a key role as they decide on the currency properties (e.g. the maximum number of coins or the time of creating a new block) and participate in its technological improvement. Sometimes they also carry out their mission after being introduced to the market (European Central Bank, 2015).

The role of an intermediary which is a platform for meeting buyers and sellers and for performing exchange transactions between them is played by cryptocurrency exchanges. They differ significantly from the stock exchange functioning in the real economy. They are usually conducted by private entities (Bala et al., 2016). The transactions carried out through them are determined based on market prices. They also enable the purchase, sale or

exchange of a given cryptocurrency for another or for traditional currencies, i.e. the euro, the dollar or the zloty. These entities are not supervised by governmental financial authorities. However, with the introduction of new regulations on the cryptocurrency market their status is gradually changing. Supplying the system with traditional money is carried out using bank transfers, credit and debit cards, cash or cryptocurrency deposits. In addition, some exchanges offer a portfolio service, as well as provide statistics on, among others, the exchange rate or volume.

Simplified versions of exchanges are online currency exchange offices. They offer exchange of traditional currencies for certain cryptocurrencies. These exchange offices charge relatively high commissions, which are usually higher than commissions charged by cryptocurrency exchanges. In addition, the maximum transaction amount is lower due to the limited possibility of customer verification (Grzybkowski, Bentyn, 2018).

In turn, crypto-portfolios most often take the form of mobile and Internet applications and enable the storage of funds as well as receiving and making payments in a given cryptocurrency. The operation of the portfolio is limited to storing and securing cryptographic private keys, thanks to which it is possible to have funds under one's own control. Unfortunately, the loss of the key is associated with the loss of funds accumulated in the portfolio. In addition, keys stored in a digital form on devices connected to the Internet are exposed to hacker attacks (Antonopoulos, 2018). Other participants of the cryptocurrency system are entities that provide and analyse market information, as well as buyers who accept cryptocurrencies in exchange for goods and services. The development of cryptocurrencies makes the number of merchants accepting payments in BTC constantly growing. Among them are globally recognized brands, such as Dell, Target,

Expedia, Bloomberg, PayPal or Tesla Motors (Lima, 2015).

To obtain the goal of the research, it means the presentation of the mechanisms of functioning and basic features of BTC, and investigating if BTC can fulfil the basic functions of money, we use the following methods: analysis of domestic and foreign literature, and next the descriptive, graphical and tabular methods as well as the Pearson correlation of numeric data on the BTC market.

Results and discussion

The development of money forms has included primitive, metallic, paper, banking, and electronic money. The period and scale of the application of individual forms of money have changed in an irregular way. Transformations in the preferred forms of money have often led to a significant improvement in the efficiency of the economy (Franków, Kopyściański, 2016). Nowadays money exists in two basic forms:

- currency – in the form of banknotes and coins, issued by the central bank of a given country;
- non-cash – the subject of bank accounting records, not having a physical form and created in the banking system by a loan.

The existence of certain forms of money does not exclude the appearance of new ones that may compete or even supplant the current form. In this perspective, cryptocurrencies can be treated as an alternative to both cash and non-cash forms of money. The extent to which BTC is a more advantageous alternative to the currently functioning forms of money depends on its fulfilment of certain requirements. Money, according to the economic theory, should have several specific features. One of them is a rarity that makes it reliable with limited availability. BTC rarity can be related to the limitation of its supply. Every 4 years it decreases by approximately a half, and the number of currently available and future units of this currency is immutable and already recorded in its algorithm.

Another feature of money is its divisibility, i.e. the possibility of dividing it into smaller units without loss of value. Each BTC is divided into 100,000,000 smaller units called satoshi. This means that the basic unit of account is valued to eight decimal places, while the classic currency only to four. This property increases the accuracy of the valuation of assets using BTC and raises its usefulness in the course of trade. It also permits acquiring goods with a relatively low price using BTC. Money is also expected to be able to carry large values. BTC has no volume and weight and is only a record of a string of characters that constitute a unique private key.

Money should also be durable, i.e. relatively resistant to the aging process and the possibility of destruction. The lack of material form of BTC means it effectively meets this requirement. Records of the transaction history are distributed among all devices that are involved in every BTC transaction. The more devices are involved in the BTC system, the more copies of the register are created. High computing power protects BTC against potential attacks and guarantees the inviolability of transaction history. Investors invest their capital in BTC believing that it will be safe in this form.

Unfortunately, there is also a risk of affecting the operation of all computer systems by the Internet. However the risk is not greater than in the case of traditional non-cash money transfer (Franków, Kopyściański, 2016). Uniformity is another feature expected from money. In the case of BTC, the criterion is also fulfilled. In terms of use, individual BTC units are the same. They have the same value and purchasing power.

BTC allows individuals to transfer values from one digital address to another. This feature is utilized in the e-commerce which in effect promotes the BTC network and creates a positive incentive for more frequent use of this cryptocurrency. Appropriate motivations, above all financial ones, may be necessary to achieve critical mass for launching innovations in the innovative payment system (Polasik, et al., 2015). From the consumer point of view, acceptance of BTC becomes more attractive if more sellers use it. Similarly, the interest of BTC payment vendors may be higher if the adoption of BTC and other cryptocurrencies by consumers becomes larger. Merchants may benefit from the fact that centralized platforms offering standard forms of payment, like debit or credit cards maximize their income by imposing transaction fees on the sellers (McAndrews, Wang, 2008). In contrast, payment with cryptocurrency could be cost-free.

It should be clarified that unlike the centralized standard payment systems (i.e. payment cards) the decentralized cryptocurrency networks (e.g. BTC) do not impose obligatory transaction fees on either the payer or the payee. Such a fee is voluntary and is borne by the payer (e.g. customer). The higher the transaction fee, the faster the transaction could be executed and confirmed. However, when the user decides to make a cost-free transfer of funds, such a transaction could also be conducted, though it may take longer. The transaction fee is paid to the miners in the form of new BTCs as remuneration for the process of transaction confirmation, which is sent to the network with a specified algorithm. In theory, BTC assumes the possibility of free anonymous payments without the involvement of a trusted third party. Such mechanism is viewed as advantageous in e-commerce and distance marketing. The BTC

network has no hierarchical structure, and the rules of using it are identical for each user (Antonopoulos, 2016). BTC transactions are possible anywhere in the world with Internet access which makes them attractive, especially for participants interested in international cash transfers.

There are, however, some obstacles that stand in the way of wider acceptance of BTC and other cryptocurrencies. The volatility of the cryptocurrency exchange rate is one of the most important factor and is a weakness compared to the payment system based on traditional money. In addition, the use of cryptocurrencies creates a risk to which both parties of payments are exposed. The decentralized nature of the network means that each of the users of cryptocurrencies is responsible for the security of their own funds. In addition, payments and

owners of cryptocurrency are not secured by a deposit guarantee and no consumer is able to claim compensation in the event of fraud (Jonker, 2018).

Currently in the BTC user community the majority acquired and holds BTCs for long-term investment, this stands in opposition to the use of BTC as digital cash. However, it does not change the long-term increasing trend in capitalization of the BTC market (Figure 2) and the growing price of individual units due to limited supply. Additionally, such a trend does not encourage BTC holders to sell previously acquired BTCs or use them in purchasing transactions. BTC is sometimes referred to as digital gold, and despite the designer's intention to create an electronic equivalent of cash, the investment function of this currency now seems to be more important than its payment function.

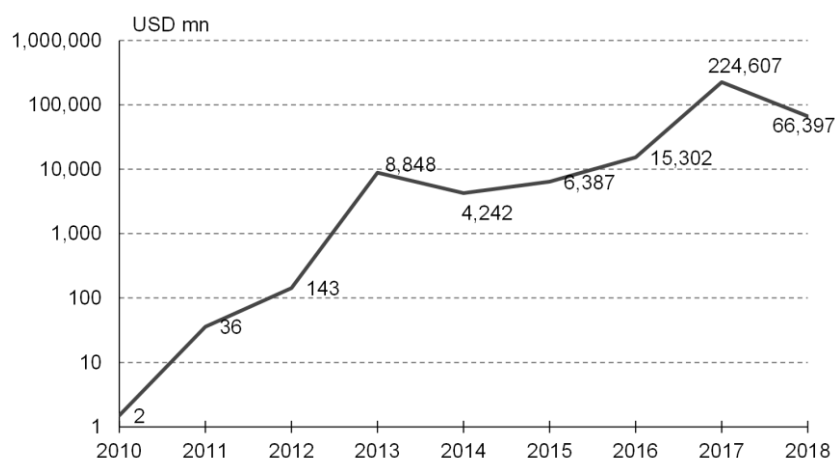


Figure 2. Capitalization of the BTC market in 2010-2018 (logarithmic scale at the base 10)
Source: own calculations based on data from Coinmarketcap: [https://coinmarketcap.com] (access: Feb. 2, 2019).

Despite the significant volatility of BTC quotations, it should be noted that in 2010-2018 the capitalization of the BTC market increased from USD 1.5 million to USD 66 billion, i.e. about 44 times. At that time both the market capitalization and the BTC exchange rate against the US dollar recorded rapid increases and decreases often reaching 50% of the value. High fluctuations in quotations could be a symptom of an early stage of cryptocurrency market development. However, it should be expected that in the longer time horizon, with the increase in acceptance of sellers and consumers in BTC, the exchange rate will be approaching the level of equilibrium (Jonker, 2018). Under such conditions, a balanced price could bring BTC closer to effectively fulfilling other functions of money as a means of exchange and a measure of value.

The constantly evolving blockchain technology used in the BTC system tolerates putting a question whether the electronic cash function can

be taken over by other cryptocurrencies. Among them some cryptocurrencies can be distinguished with a relatively large market capitalization and efficiently solved technological solutions making them properly serve as a means of payment (Table 1). One example is Ethereum, the currency which is not limited by the number of units going into circulation. On the other hand some cryptocurrencies are characterized by a shorter time necessary to extract one of its blocks. Such a feature helps them to conduct the payment and confirmation process much quicker compared to BTC. In turn, the application of advanced cryptographic solutions in Monero and Dash currencies raises the level of anonymity of transaction participants higher than in BTC. The innovative approach to blockchain technology also allows conducting completely cost-free transactions with the use of IOTA currency.

Table 1. Cryptocurrencies with the largest market capitalization (Dec. 31, 2018)

No.	Name	Code	Market capitalization (USD mn)	Price (USD)	Price volatility (CV in %)	Daily turnover (USD mn)	Number of units in circulation (mn)
1	Bitcoin	BTC	61 150.1	3491.5000	41.9	5 469.8	17.51
2	XRP	XRP	12 691.6	0.3083	65.4	581.2	41 163.47
3	Ethereum	ETH	11 270.2	107.6700	63.5	2 575.7	104.67
4	EOS	EOS	2 128.1	2.3500	59.2	653.9	906.25
5	Bitcoin Cash	BCH	2 055.1	116.7700	56.9	249.1	17.60
6	Tether	USDT	2 032.1	1.0100	17.1	3 975.1	2 020.86
7	Litecoin	LTC	2 003.9	33.2400	68.8	800.1	60.28
8	TRON	TRX	1 751.3	0.0263	55.7	273.7	66 666.32
9	Stellar	XLM	1 574.7	0.0822	80.8	151.1	19 167.47
10	Bitcoin SV	BSV	1 134.3	64.4600	12.9	64.6	17.60
11	Cardano	ADA	1 008.3	0.0389	69.5	20.1	25 927.07
12	Binance Coin	BNB	849.6	6.5800	44.1	58.7	129.18
13	Monero	XMR	733.2	43.7400	64.1	35.5	16.76
14	IOTA	MIOTA	717.1	0.2580	67.2	8.4	2 779.53
15	Dash	DASH	582.5	67.6800	66.8	174.5	8.61

Note: CV – coefficient of variation defined as the ratio of the standard deviation divided by the mean value (in percent).

Source: own calculations based on data from Coinmarketcap: [<https://coinmarketcap.com>] (access: Feb. 2, 2019).

However, at the current juncture, the analysis of market capitalization of cryptocurrencies indicates its significant concentration and dominance of one currency. The share of BTC in the market of all cryptocurrencies (over 2100 currencies) exceeds 53%. Despite the technical advantages of some currencies in relation to BTC, they are characterized by a rather higher exchange rate volatility (Table 1). Investors treat these currencies as highly speculative investment vehicles. One of the reasons for the higher volatility is their low capitalization. The Pearson correlation coefficient the between cryptocurrency market capitalization and its coefficient of variation for the analysed period equals to -13%. It means that the small size of the currency market fosters its volatility and raises difficulties in maintaining its stable exchange rate. The shallowness of the markets of most of cryptocurrencies lowers demand for them and lowers the rate of acceptance of new market participants (Torpey, 2014). Such market organization favours BTC, however, it is not conducive for a development of the system of cryptocurrencies and performing their payment functions.

Conclusions

1. The answer to the question whether BTC can effectively function as an electronic equivalent of cash in e-commerce is complex and marked by many uncertainties. The presence on the market

and the uninterrupted operation of the BTC network for over ten years testifies to the effectiveness of the technology that creates it. The increasing number of payment and user acceptors confirms the demand for new forms of money in the economy, which are BTC and other cryptocurrencies.

2. The aspect of anonymity, the lack of governmental control over BTC issues, as well as the irreversibility of payments and low transaction costs (important especially in international transfers) are the advantages over other digital forms of money. These arguments allow us to conclude that the demand for BTC from users sensitive to such currency properties is expected to significantly increase in the near future.
3. At the current juncture it is difficult to confirm that the BTC market will reach such a high capitalization that its exchange rate will obtain the equilibrium. However, from the technological point of view and the current effectiveness of fulfilling the function of money, it can be expected that BTC possesses the ability to become a widely accepted means of payment in e-commerce, which was the intention of its creator.
4. The cryptocurrency market is characterized by the features of the young market. Large fluctuations in quotations and a small group of users and merchants are reminiscent of the initial stages of development of other breakthrough technologies, such as the Internet. Rapidly

growing technology means that the use of cryptocurrencies can become easier, which will in the future increase the number of their users and merchants. Such a process would contribute to an increase in market capitalisation and greater stabilisation of the market, which attracts new users, companies and software developers to it. The cryptocurrency market does not require any particular administrative intervention. The activities of participants of the cryptocurrency market would determine the pace and extent of the market development.

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