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A TERMELÉSI FÜGGVÉNYEKTŐL AZ OKOS GAZDÁLKODÁSIG

JUBILEUMI TANULMÁNYKÖTET I.

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TARTALOM

Bitcoin – An empirical analysis on the investment and payment abilities of the cryptocurrency

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Abstract
This paper addresses the current state of research on cryptocurrencies. Not least the turbulences on the financial markets in the last two years have once again increased the interest in cryptocurrencies, but the enduring question of an alternative payment solution. Therefore, this article examines cryptocurrencies from an investment point of view with a quantitative analysis. It is shown that over a period from 2015 to 2021 cryptocurrencies demonstrate a significantly higher return profile with higher volatility and also show a statistically significant correlation with the major stock indices.

Introduction

In times of high inflation, the question of a stable currency value arises. For example, in the Euro area, the inflation rate was 5.0% (ECB dashboard, 2021) and in the US area 7.0% (Statista, 2022). The loss of purchasing power leads to a higher focus on alternative currencies. In particular, cryptocurrencies have attracted high interest and seem to be the solution to the weaknesses of the conventional fiat currencies. The network effect as an essential element of the underlying blockchain technology supports the store of value concept of cryptocurrencies due to the fact that the network effect postulates an increasing value of a network with its number of users (Roussou–Dritsaki–Stiakakis, 2019:1982-1983; Alden, 2021). For example, the number of active addresses of Bitcoin has increased from 20 active addresses in December 2009 to 1,141.226 active

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addresses per 29 December 2021 (Glassnode, 2022). In the same period, the price of Bitcoin has increased from 0.08 $ (July 2010) to 46,407 $ per 29 December 2021) respective 37,788 $ per 30 January 2022 and seems to support the key statement of the network effect. The volatility on the stock markets and the uncertainty factor regarding the value stability of investments are further impact factors that reinforce the debate on cryptocurrencies: In terms of struggling financial markets, reasoned by the current Covid-19-pandemic, investors are faced with remarkable capital declines, from 20 February 2020 to 23 March 2020 the Dow Jones decreased by 36.9%, the Nasdaq decreased by 30.1% and the DAX30 decreased by 52% (cp. wallstreet-online, 2021, no page). Baker et al. (2020:743) investigated the US stock market from 1900 to 2020 and found out that the volatility of the last two week resulted by the Covid-19 pandemic is largely comparable with the volatility resulted by the great crash in 1929, the great depression in 1933, the black Monday in 1987 and the global financial crisis in 2007/2008. Regarding to the stock market return, Al-Awadhi et al. (2020) observed negative effects of the Covid-19 pandemic on the stock returns of Hang Seng Index stocks and the Shanghai Stock Exchange Composite Index stocks (Al-Awadhi et al., 2020:4). In the context of a diverse asset management, cryptocurrencies get higher attention due to the market capitalization of the biggest currency Bitcoin (BTC) of 717 mn. USD per 30 January 2022 (Coingecko, 2022). On the other hand, bitcoin has a high volatility, for example a volatility over 100% in 2020 (Cp. cointelegraph, 2021). But it should be noted that the "…cryptocurrency network did not change significantly due to (i) the emergence of the COVID-19 outbreak…" (Tomás, 2021:10). Furthermore, the BTC is increasingly becoming an alternative payment solution (Bitcoin, 2021) and is already accepted by 36% of US small and medium businesses (HSB, 2020). Also, big players such as Microsoft, AT&T and Wikipedia started to accept Bitcoin as a means of payment. (99bitcoins, 2022). But the acceptance as a means of payment is controversial, for example the German Central Bank said that the BTC is not a virtual currency but a crypto token (Bundesbank, 2018). Furthermore, future competition between CBDC's (= Central Bank Digital Currencies) and cryptocurrencies such as Bitcoin could lead to significant regulatory restrictions from governments. The US government has declared regulation by the Biden Administration a matter of national security (Fonda, 2022). On the other hand, the central bank community eagerly discusses the benefits of introducing digital currencies by central banks (Gross–Siebenbrunner, 2019; Bindseil, 2020;

Bossu et al., 2020:4). Regarding these aspects, it's necessary to assess crypto currencies in order to evaluate the appropriateness as an investment or payment solution. Therefore, the aim of this article is to explain the functionality of BTC, the difference against the fiat currencies as the USD or Euro, and furthermore to work out the benefits and risks of bitcoin as a store of value.

Literature review

Bitcoin has its beginning with the paper of Satoshi Nakamoto (cp. Nakamoto, 2008). The origin is based on the idea that payments without a third party allow cost-minimization while the consideration of a third party contributes to rising transaction costs and cannot guarantee non-reversible transactions (cp. Nakamoto, 2008:1). This leads to a lack of confidence, which in turn leads to higher transactions costs (cp. Nakamoto, 2008:1). A peer-to-peer-network should solve the lack of confidence problem and additionally reduce the transaction costs (cp. Nakamoto, 2008:1). Therefore, the transaction structure is based on a chain of digital signatures (cp. Nakamoto, 2008:2). Each transaction is signed by a digital signature so that the "…chain of ownership" can be verified (cp. Nakamoto, 2008:2). In order to avoid mistreatment (double-spending of an electronic coin), the entire transaction chain is published so that a third party is not necessary (cp. Nakamoto, 2008:2; Rosenberger, 2018:9; James, 2018:18; IMF, no year:4; Bitcoin, 2021; Apopo–Phiri, 2021:1). The transparency is ensured by a timestamp server with a continuous digital documentation (cp. Nakamoto, 2008:2). Furthermore, the digital documentation by a timestamp server requires an exponential CPU (central processing unit) work so that a change of the transaction block includes "…[a] redoing [of] all the blocks after it." (Nakamoto, 2008:3). Essentially for a bitcoin production is the digital ledger technology (DLT) or commonly called the blockchain (BaFin, 2017; Bouveret–Haksar, 2018:27). A blockchain represents a chain of transactions and has to be decrypted (Finanzfluss, 2017) and can be defined as a cryptographic protected record of data (for example financial transactions) (Yermack, 2018:14). Ultimately, it could also be referred to as a digital cash book.

Furthermore, the blockchain can be differentiated into two approaches: public-blockchain approach and the private-blockchain approach (BaFin, 2017). In the public-blockchain approach, all nodes (called

miners) have the same rights within a blockchain (BaFin, 2017). Miners are participants of the network and are responsible for decrypting the blockchain and for providing of their CPU power, they receive a reward (BTC Echo, 2021; Finanzfluss, 2017; Sixt, 2017:11; Alden, no year). In a private-blockchain, a central party and limited rights for the miners exist (BaFin, 2017). The BTC is limited to 21 mn. BTC (BTC Echo, 2021; Finanzfluss, 2017; Kelleher, 2021).

In order to prevent double-spending of a crypto currency, the proof of work (PoW) concept is used. The PoW is a consensus-algorithm and ensures that a transaction is only valid if the transaction is added to the blockchain (Binance Academy, 2021). The adding of a transaction to the blockchain is performed only when the miners solve a complex task for which a lot of CPU power is required (Sixt, 2017:11) and they therefore gain a reward in form of pre-defined number of Bitcoins (Kraus–Schmitz, 2020). The PoW concept is related to the mining concept, since the reward for the miner are Bitcoins (Ankalkoti, 2017:1757). The first approach of a PoW was developed by Dwark and Naor in 1993 in order to reduce junk e-mails by solving a "…moderately expensive, but not intractable, function of the message and some additional information." (Dwark–Naor, 1993:139-140). The benefit of the PoW is the security against attacks against a transaction of the risk of incorrect transaction because the attackers have to use a lot of computing power and furthermore the PoW artificially slows down the procedure due to the predefined block production per hour (Kraus–Schmitz, 2020). On the other side, the main disadvantage is that the miners compete against each other and therefore task solving requires a lot of energy (Kraus–Schmitz, 2020; Yang–Paudel–Gooi, 2021:3253). To compensate for the disadvantage of the high energy consumption, the proof of stake (PoS) has been developed (Yang–Paudel–Gooi, 2021:3253). In the PoS approach, one node is nearly randomly chosen by an election process for solving the task and validating the new block (Li et al., 2017; Li–Wei–He, 2020:3-4). Therefore, the PoS have instead of the miners' validators and for accepting as a validator, a node has to deposit a certain number of coins to the network (Ledger Academy, 2020; Alden, 2022). The deposit size determines the probability to be chosen as a validator (Leger Academy, 2020). Instead of using CPU power with a necessary energy consumption, miners use their own stake of coins to build a new block (Alden, 2022). The risk of invalid blocks is lower because there is a motivation for the miners in the PoS approach to create a valid block, since on the other side bad miners will

be burdened by their own energy production (with costs) for an invalid block with no reward (Alden, 2022).

This aspect is a major difference of cryptocurrency gaining: While the mining concept requires CPU power for the PoW concept, the PoS concept requires the holding of cryptocurrencies and reward the wallet owner with further cryptocurrencies (Tokens24, 2021).

One commonality of the Bitcoin with the fiat currencies is the store of value, because both currencies are not backed with commodities, however most of the fiat currencies based on the fact that they can be exchanged into goods and services so that governments or individuals will accept the fiat currencies so that a store of value is ascribed to them (Kelleher, 2021). A store of value is characterized by its value retainability over time, but it should be noted that the fiat currencies store of value is burdened by the inflation (resulted by an increased supply of the currencies) due to the decreasing purchasing power over time (Binance Academy, 2021). The latest development of the US and EU inflation rate can be seen in the following figures.
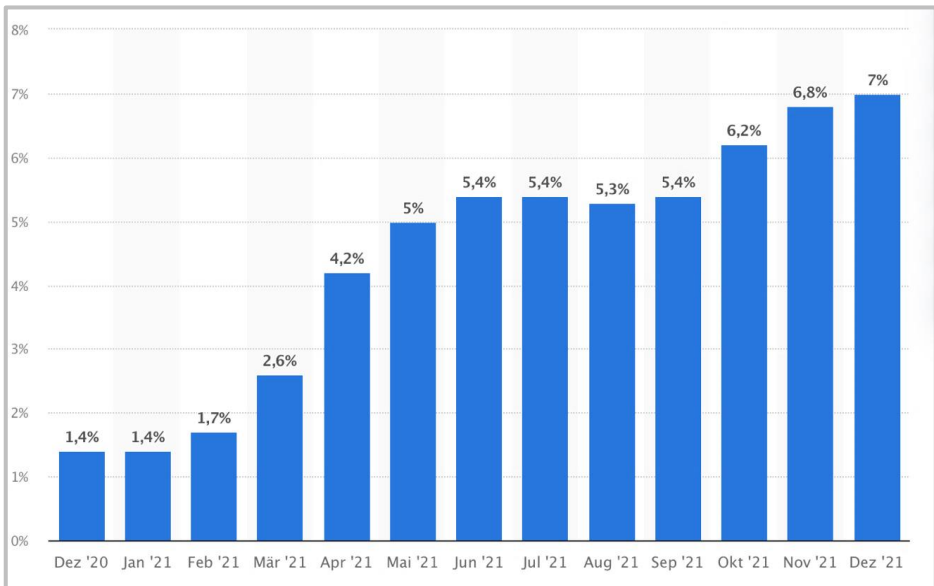
Figure 1: US inflation rate
Source: Statista, 2022
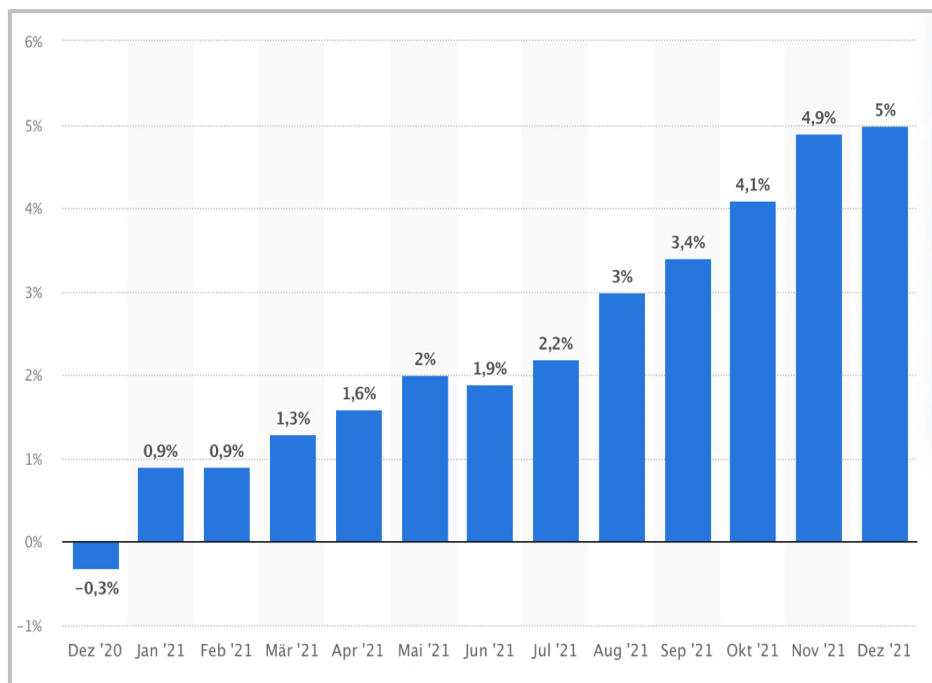
Figure 2: EU inflation rate

Source: Statista, 2022

In particular, the fixed amount of Bitcoins (21 mn.), its related unchanged share of the total amount of a Bitcoin holder and the mining process as a production of new Bitcoins are the key arguments that the Bitcoin is a store of value (Izevbigie, 2021; Binance Academy, 2021). Furthermore, the fixed supply plan of the Bitcoin works deflationary due to the decreasing amount of mining every four years when 210,000 blocks are reached, which is called halving (Munster, 2020). Supported by that, the stock-to-flow-model can be adopted to the cryptocurrency market.

The stock-to-flow-model relates the stock of a resource (for example Bitcoin) to the yearly produced amount of a resource and reflects the time which is needed to maintain the current stock of a resource (BTC Echo, 2021). PlanB (2022) created a stock-to-flow-model in order to forecast a possible Bitcoin value and reflects the key statement of an increasing value based on the limited resource.

Figure 3: PlanB Stock-to-flow-model
Source: Buy Bitcoin worldwide, 2022

In this context, a higher stock-to-flow-ratio supports the story of value concept, because a higher ratio reflects a higher engagement to get the current stock of the Bitcoin (BTC Echo, 2021). The CEO of MicroStrategy Michael Saylor sees cryptocurrencies as the next step of the evolution of the monetary system (Saylor, interview by Daniela Cambone, *Stransberry Research*, April 22, 2021). There are several fact-based reasons (against the faith of a store of value of the fiat currencies) to describe the Bitcoin as a store of value.

Bitcoin as a payment solution

A currency is mainly based on people's confidence in the issuer, which is normally a government or a central bank (IG, 2021). The currency value is not determined by the price of a commodity (for example gold or silver) and is called fiat currency or fiat money (WiWo, 2017). Fiat currencies are characterized by three main features: (1) production by a national central bank, (2) no intrinsic value and (3) the money quantity can be expanded at will (Koenig, 2017; WiWo, 2017; Bödeker, 2021:10). Remarkably the fiat currencies resulted as an elimination of gold-backed currencies (Bouveret–Haksar, 2018:26; von Jan, 2020). The decoupling is also

known as the Nixon shock because President Nixon suspended the convertibility of the USD into gold in 1971 (Nixon, 1971). The key advantage of fiat money is the possibility of intervention through the central banks (Yermack, 2018:16). Cryptocurrencies represent a new concept regarding the limitations of the previous money concept (centralization, transaction costs and its unlimited quantity) (Bartos, 2015:12). To reduce the volatility of the cryptocurrencies and to ensure financial usability, stablecoins were introduced (Laboure–Reid, 2020:11). Stablecoins are linked to fiat currencies (Laboure–Reid, 2020:11) in order to provide a low volatility for the respective digital currency. Therefore, stablecoins could be a payment solution based on the cryptocurrency technology (Blockchainwelt, 2022). For a debate of cryptocurrencies as a payment solution, the blockchain transaction structure should be taken into account. Laboure and Reid (2020:9) describe the structure as follows:

The first step of a blockchain transaction is the initiation of a transaction between two parties. After that, the blockchain assigns an encryption.

The transaction is verified by the blockchain and a block is created.

The newly formed block is attached to the blockchain.

Transaction completion and updating of the ledger.
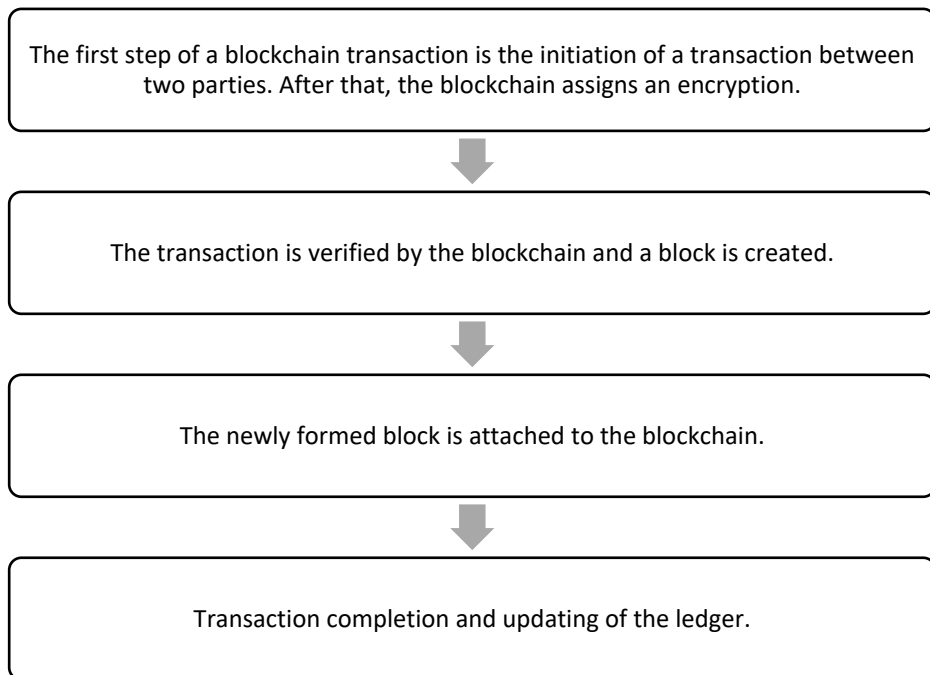
Figure 4: Blockchain transaction structure

Source: Own figure, modeled on Laboure and Reid, 2020, p. 9

Obviously, a blockchain transaction has no third party and a peer-to-peer transaction is ensured. This allows a prompt payment execution against an execution period of one day of fiat currency payment order within the EU (BGB 675s, 2022).

In contrast to this, a fiat money-based transaction is structured as follows:

Issuing of payment order

Bank of the issuer receives the payment order

Clearing

Bank of the payee receives the payment

Payee bank provides the transfer amount to the payee
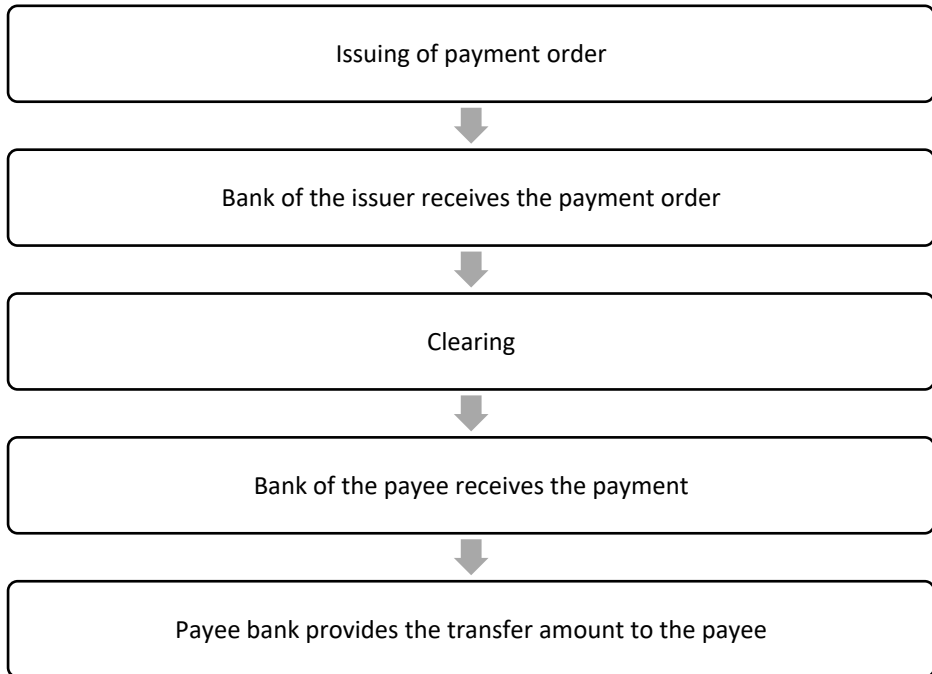
Figure 5: Fiat money-based transaction
Source: Own figure, modeled on GeVestor, 2021

As described, the fiat money-based transaction structure includes a third party (issuer bank and payee bank). Furthermore, the involvement of a bank as a third party creates costs. Depending on the order transaction costs are incurred for the issuer or the payee (especially for cross country payments in different currencies). Moreover, the payment may take significant amount of time to process or may only reach the payee in the short term upon payment of an additional fee. However, the disadvantages are offset by an over many decades established and evolved system and enjoyed society's trust, but which is crumbling over the time due the lack of

trust (cp. Nakamoto, 2008:1). It is necessary to mention here that an exclusion from the fiat currency payment system SWIFT can be enforced by national or international authorities (SWIFT, 2022) so that the confidence in an irreversible execution has been weakened. The ever-growing acceptance of cryptocurrencies is also increasingly recognized by many companies according to a survey of the HSB (HSB, 2020). The HSB (part of the reinsurer Munich RE) found out that 36% of US SME's (based on a sample of 505 SME's) accept cryptocurrency as a payment (HSB, 2020). Furthermore, large corporations have also adopted cryptocurrencies as a payment method, for example Microsoft, AT&T or Overstock (Beigel, 2021). Therefore, it can be stated that the cryptocurrency acceptance increases and that a further increase in the number of acceptance points can be assumed. As already mentioned, the network effect supports the acceptance of cryptocurrencies with its number of users. The number of active addresses of Bitcoin has increased from 20 active addresses in December 2009 to 966,666 active addresses in December 2021 (Glassnode, 2022). Furthermore, the development of acceptance can be seen by its adaption curve.
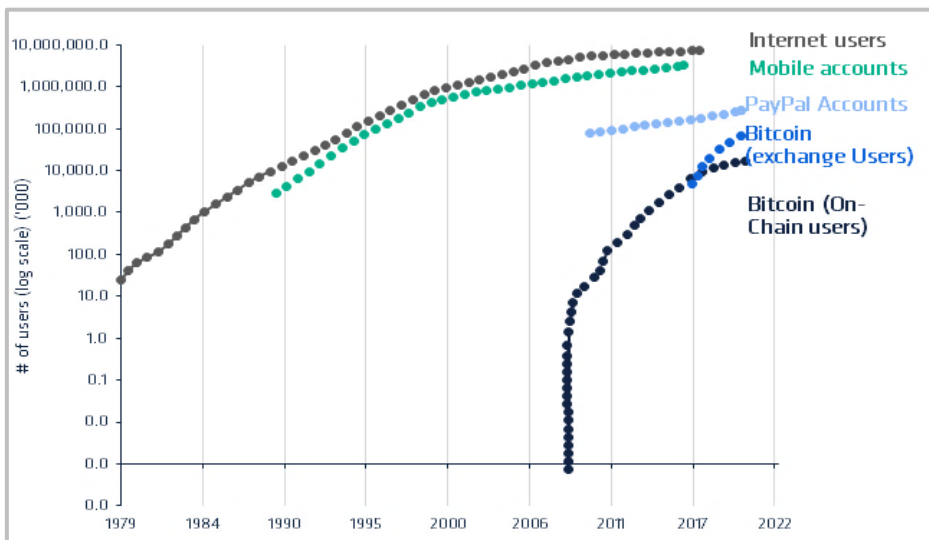

Figure 6: Adaption curves of various technologies
Source: Coinshares, 2021

The comparison with other technologies shows clearly that the adaptation of Bitcoin is more rapid and thus implying a faster acceptance of

the technology. Even the comparison of Bitcoin users with Internet users shows that the adoption of the Bitcoin at its current level has only taken about half of the time period (13 years (2008 to 2021) against 21 years (1979 to 1990)).

Bitcoin as an investment

The very rapid price performance of the cryptocurrencies, especially bitcoin, raises the question of the investability of cryptocurrencies. The following table shows the return development of the largest cryptocurrencies (based on their market cap) in comparison with the stock market indices DAX, Dow Jones, NASDAQ, NIKKEI, Hang Seng Index.

Table 1: Yearly return overview (in percent)

	2015	2016	2017	2018	2019	2020	Mean	SD
DAX	9.56	6.87	12.51	-18.26	25.48	3.55	6.62	14.33
DOW	-2.23	13.54	24.39	-5.97	23.76	6.87	10.06	12.83
NASDAQ	5.19	9.91	27.24	-4.36	37.89	42.58	19.74	18.96
HSI	-7.53	1.00	36.04	-13.93	9.16	-3.60	3.52	17.74
NIKKEI	7.52	1.57	1.57	-13.26	20.36	17.69	5.91	12.29
BTC	34.37	123.75	1369.03	-73.48	92.00	303.09	308.13	534.19
ETH	-31.03	753.49	9380.13	-82.35	469.16	469.16	1826.42	3,714.50
XRP	-75.30	6.77	35168.59	-84.64	-45.28	13.96	5830.68	14,372.64

Source: Own table

It can be seen that the cryptocurrencies have considerably higher returns, both on average and in the standard deviation, and thus also arouse greater interest for investors. Thus, it's necessary to take several research results regarding cryptocurrency investments into account. Leirvik (2021) found out that there is a time-varying positive correlation of the cryptocurrency liquidity and return so that investors require a risk premium for the liquidity volatility. The relationship of liquidity volatility and return for bitcoin is lower than for other cryptocurrencies (Ethereum, Litecoin, Ripple) and is linked to the popularity of this cryptocurrency (Leirvik, 2021:7). Furthermore, cryptocurrencies can be viewed from the perspective of market efficiency. Apopo and Phiri (2021:9) found out that "…cryptocurrencies are not market efficient enough to be considered as a more formal exchange system…". From a corporate view, the blockchain

technology could increase the transparency for investors due to its public and especially real time overview of corporate debt and equity (Yermack, 2018:16) and therefore generate benefits for investors and corporates due to mitigated information asymmetries. Regarding to the information asymmetries theories, information is not freely available for all shareholders and stakeholders (Strzyz, 2012:16) and incentive problems and interest conflicts could exist (Jensen–Meckling, 1976:305; Al Taleb, 2012:234). Bartos (2015:10) confirmed that the cryptocurrency bitcoin reflects the efficient market theory that the price reacts immediately on information.

Due to the low interest rate environment, creating a return on investment for investors becomes more difficult. In 2020 the bitcoin price increased by 300% based on financial market speculations (Sarkodie–Ahmed–Owusu, 2021:2). The speculative investment in the bitcoin resulted from hedging against an inflation of the fiat currency during the Covid-19 pandemic and the bitcoin is limited to 21 million coins and therefore could resist inflation (He, 2018:13; Sarkodie–Ahmed–Owusu, 2021:2). Therefore, cryptocurrencies are called alternative investments with benefits in diversification and could improve the risk-return relation of a portfolio (Briére–Oosterlinck–Szafarz, 2015:365, 371). On the one hand, the impact of the attractiveness of bitcoin on its price and vice versa has been examined by Kristoufek (2013). He found a strong relationship between the price and its attractiveness, measured by searching bitcoin terms on Google terms and Wikipedia (Kristoufek, 2013:5). On the other hand, already in 2012 Buchholz, Delaney and Warren found that the volatility of the bitcoin had a significant impact on its price and is explained by the increased demand due to a positive interpretation of the volatility regarding to generate quick wins with a bitcoin investment (Buchholz–Delaney–Warren, 2012:46).

Methodology

For a risk return comparison of the cryptocurrencies and the stock market development, the cryptocurrencies data of the 3 largest cryptocurrencies (based on their market capitalization per 1 May 2021, cp. coindesk, 2021, no page) Bitcoin (BTC), Ethereum (ETH) and Ripple (XRP) are contrasted to the development of the stock indices Dow Jones (DOW), Nasdaq and DAX30 (DAX), Hang Seng Index (HIS) and the NIKKEI 225 (NIKKEI). The data were collected from Yahoo Finance. Since the

data availability has different points in time, a uniform time period is chosen (starting with the common earliest possible point in time). The time period extends from September 2015 to April 2021. In total, 8 variables and 544 observations are used. For each variable 68 observations are considered. Based on the opening and closed price of each month, a monthly return is calculated. After that a descriptive statistic has been performed, which is followed by a correlation analysis in order to evaluate whether linearity is given.

Results

For all variables, a descriptive statistic has been performed. In the first step, the monthly and yearly return has been calculated.

Table 2: Yearly and monthly return average

No.	Variable	Monthly return on average	Yearly return on average
1	DAX	0.71	8.52
2	DOW	1.09	13.08
3	NASDAQ	1.57	18.84
4	HSI	0.29	3.48
5	NIKKEI	0.74	8.88
6	BTC	10.87	130.44
7	ETH	21.02	252.24
8	XRP	28.91	346.92

Source: Own table

The established stock market indices DAX, Dow Jones, NASDAQ, Hang Seng Index and the NIKKEI show that during the observed time period the monthly return on average is smaller compared to the cryptocurrencies monthly return. The HSI average return of 0.29% is the lowest observation, followed by a largely similar average return of the DAX and NIKKEI with 0.71% and 0.74%. The US stock market indices Dow Jones and NASDAQ show the highest monthly return on average (1.09% for the Dow Jones and 1.57% for the NASDAQ). The volatility, measured with the standard deviation, is largely similar for all indices. Although the DAX has the second lowest return on average, the volatility has the highest value with 5.32%, which is not in accordance with the risk-return-rela-

tionship. On the other side, the NASDAQ has the highest return on average and the second highest standard deviation. This goes in line with the principle that a higher return goes in hand with a higher risk. The cryptocurrencies show a remarkable pattern. Both the return and the volatility are considerably higher than the return and volatility pattern of the stock market indices. Although the cryptocurrencies return on average is much higher than the return on average of the stock market indices, the largest cryptocurrency Bitcoin has the lowest return on average (10.87%) compared to the other cryptocurrencies ETH (21.02%) and XRP (28.91%) from 09/2015 to 04/2021. At the same time, the volatility of the BTC is compared to the other cryptocurrencies the lowest with a volatility of 23.46%. The ETH has a volatility of 53.08% and the XRP has a volatility of 120.63%. The comparison of the range shows a similar picture. The BTC has a range of 105.99%, the ETH a range of 269.43% and the XRP a range of 885.85%. The above-mentioned store of value concept is currently doubtful due to the high volatility. The entire results of the descriptive statistic with boxplots as an instrument to visualize outliers are given in the following table.

Table 3: Descriptive statistic of the monthly return 2015 to 2021

| No.	Variable	n	Mean	Sd	Median	Min	Max	Range	Skew	Kurtosis
1	DAX	68	0.71	5.32	0.6	-16.44	15.01	31.45	-0.21	0.81
2	DOW	68	1.09	4.66	1.42	-14.35	14.69	29.04	-0.37	1.77
3	NASDAQ	68	1.57	5.20	1.2	-11.37	19.17	30.54	0.11	1.47
4	HSI	68	0.29	4.63	0.76	-9.87	9.52	19.39	-0.28	-0.44
5	NIKKEI	68	0.74	5.06	1.06	-11.55	14.38	25.93	-0.29	0.10
6	BTC	68	10.87	23.46	7.99	-36.42	69.58	105.99	0.41	-0.31
7	ETH	68	21.02	53.08	7.54	-53.69	215.75	269.43	1.62	3.05
8	XRP	68	28.91	120.63	-3.71	-66.92	818.93	885.85	4.65	25.46

Source: Own table
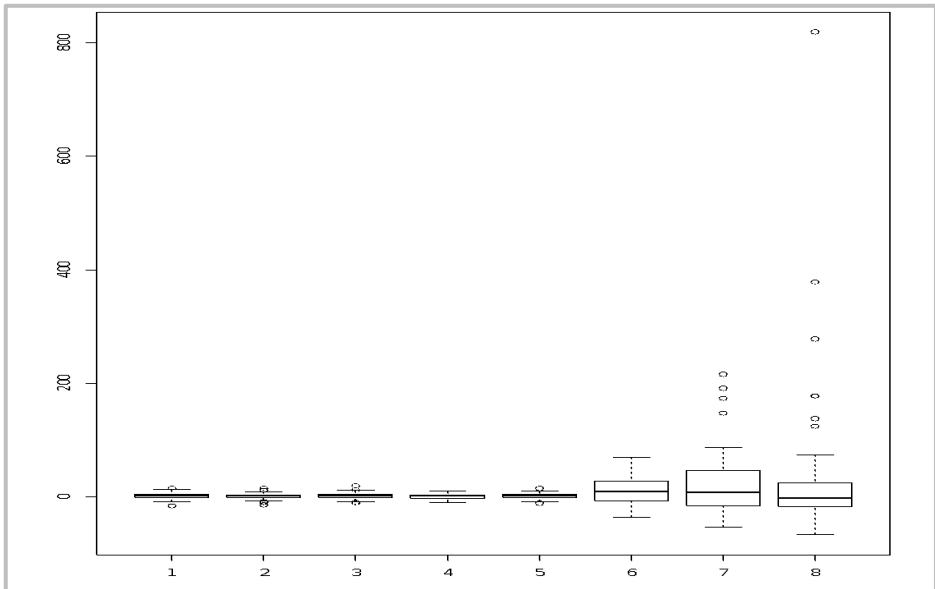
Figure 7: Boxplots for all variables
Source: Own figure

The largely similar development and the risk-return-pattern of the stock market indices can also be seen in the correlation analysis. All stock market indices correlate positive and statistically significant. The German stock market index DAX correlates with the Dow Jones with a correlation coefficient of 0.83(***). Also, the correlation between the DAX and NIK-KEI is strong positive (0.80***). The correlation coefficient between the German/US stock market and the Chinese stock market is also positive (0.56***, 0.63*** and 0.68***) but compared to the other stock market correlation lower. The relationship between the stock market indices and the Bitcoin is also positive, but considerably lower than the stock market correlation. Statistically significant are the correlation between the DAX and BTC (0.26*) and DOW and BTC (0.25*). The correlation between the cryptocurrencies is statistically significant too (BTC/ETH 0.40***, BTC/XRP 0.32*** and ETH/XRP 0.50***). Remarkable is that the correlation between the cryptocurrencies is recognizable lower than the stock market correlation. The entire correlation results are given in the following table.

Table 4: Correlation matrix

	DAX	DOW	NASDAQ	HSI	NIKKEI	BTC	ETH	XRP
DAX								
DOW	0.83***							
NASDAQ	0.75***	0.88***						
HSI	0.56***	0.63***	0.68***					
NIKKEI	0.80***	0.75***	0.72***	0.55***				
BTC	0.26*	0.25*	0.16	0.13	0.22			
ETH	0.11	0.05	0.08	0.13	-0.06	0.40***		
XRP	0.05	0.04	0.03	0.13	0.01	0.32**	0.50***	

Source: Own table

Summary

The cryptocurrencies and especially the underlying blockchain technology are regarded to many other uses. In the context of the financial market, the blockchain can be applied to listed corporations in order to record timely their shareholder structure or the using of smart contracts as an autonomously execution of financial instruments like financial derivatives (Yermack, 2018:16). The enforcement and the continuation of cryptocurrencies can be explained by the Lindy effect, which describes the life expectancy of a technology based on its previous lifetime (Moore, 2021; BTC Echo, 2020). Based on that, it can be assumed that with every "survived" day the life expectancy of the Bitcoin will increase.

The classification of cryptocurrencies as a currency or an asset should be further developed. The identified high volatility in this study is in contrast to a sustainable use of a cryptocurrency at this time. Due to this fact, a stablecoin could be the next evolution step. A stablecoin is an instrument of cryptocurrencies with a link to the fiat currencies (Laboure–Reid, 2020:11) and should decrease the volatility and increase the useability of cryptocurrencies as a currency.

From an investment point of view, the cryptocurrencies show a higher risk-return-pattern and seem to be an interesting asset class for risk-taking investors. Furthermore, it should be noted that the largest cryptocurrency Bitcoin has the lowest risk-return relationship within the considered cryptocurrencies in this study, which seems to be an indicator for an ongoing establishment as an asset class. This could support the broader acceptance of Bitcoin as an asset class in the context of portfolio management. In

order to fulfill the benefits and limitations of cryptocurrencies with the results of this study, the following table gives an overview.

Table 5: Benefits and limitations of cryptocurrencies

Benefits	Limitations
Low transaction costs due to the no-third party-concept	High privacy promotes illegal businesses
Decentralized	High volatility compared to the volatility of the German, US, Japan and China stock market volatility
Blockchain technology ensures a high transparency	Technical know-how is necessary
No personal data available, only the wallet ID	Vulnerable to cyber-attacks, but which is limited due to the PoW and PoS
No geographical, time or amount restrictions	Currently no broader acceptance of the BTC
Store of value	High energy input required
Successive development (for example from PoW to PoS)	
Higher return on average as the stock market return on average in Germany, US, Japan and China	

Source: Own table

Outlook

Cryptocurrencies are regarding to their relatively short existence still in process and the development continues. The cryptocurrency system will surely benefit from the network effect, which describes an increasing value of a system by an increasing number of users (Alden, 2020; Alden, no year). The initial volatile and not positive development of an asset value has to be relativized when taking a retrospective view at companies that have brought a disruption for their relevant market (i.e., information technology companies). Investors did not initially enjoy a remarkable positive development here. In the long-term perspective, for example the enterprise values of Microsoft, Cisco and Amazon have increased considerably.

Figure 8: Chart of Cisco
Source: Onvista, 2022

Figure 9: Chart of Amazon
Source: Onvista, 2022

Figure 10: Chart of Microsoft

Source: Onvista, 2022, no page

Therefore, the evaluation of the development of the cryptocurrencies should be given more time. Furthermore, the relatively new establishment of the cryptocurrencies can be identified by the risk-return-pattern of the observed time period in this study. At the same time, the Bitcoin seems to develop to a lower volatility, which will support the attractiveness of this asset class, in particular to the current investment circumstances (i.e., low interest rate environment and high stock market valuation). Since the Bitcoin as the largest cryptocurrencies as well as the entire cryptocurrency market is relatively new, a wide range for further studies is given and should therefore be further investigated.

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Székely Csaba 1947-ben született Sopronban. Középiskolai tanulmányait a soproni Széchenyi István Gimnáziumban végezte. A Gödöllői Agrártudományi Egyetemen végzett tanulmányokat, ahol 1969-ben mezőgazdasági mérnöki diplomát szerzett. 1970 januárjában a gödöllői egyetem Mezőgazdaságtudományi Karának Üzemtani Tanszékére került tanársegédnek. 1971-ben a bonni Friedrich Wilhelm Egyetemen folytatott üzemgazdasági tanulmányokat. 1974-ben egyetemi doktorátust szerezett, és adjunktusnak nevezték ki. 1977-ben a giesseni Justus-Liebig Egyetemen végzett kutatómunkát az operációkutatási módszerek területén. Kandidátusi disszertációját 1980 januárjában védte meg.

1980-tól négy éven át mezőgazdasági attaséként dolgozott Bonnban. 1984 októberében egyetemi docensként tért vissza a Gödöllői Agrártudományi Egyetemre. 1985-ben megbízást kapott az Üzemtani Tanszék vezetésére, és ezt a feladatot 20 éven keresztül látta el. 1989-ben egyetemi tanárrá nevezték ki. 1987-ben megalakult az egyetem Gazdaság- és Társadalomtudományi Kara, ahol kezdetben dékánhelyettesként, majd 1990-től két cikluson keresztül dékánként tevékenykedett. A kar munkájának szervezése mellett jelentős szerepet töltött be a PhD képzés megalapozásában, és a tudományos továbbképzésben is.

1996-ban a GATE rektorává választották. A három éves vezetési ciklus alatt feladata elsősorban az akkori időszakban zajló egyetemi integrációs folyamatok Gödöllő számára kedvező alakítása, befolyásolása volt. A partnerekkel közösen végzett munkát siker koronázta, mert az Országgyűlés 1999 márciusában jóváhagyta a Szent István Egyetem megalakulását, Gödöllő székhellyel. Rektori tevékenysége a ciklus lezárásával, 1999. június 30-án fejeződött be.

2000-től nagyobb energiát fordított a kutatási feladatokra, több kutatási programot indított el. Az 1992-ben általa létrehozott Józsefmajori Kísérleti és Tangazdaság fejlesztését tovább folytatta, és az elméleti kutatási eredmények gyakorlatban való megvalósítására törekedett, amelynek alapján elkészítette MTA doktori értekezését. A disszertációt 2005 júniusában védte meg.

2003-tól egyre nagyobb időráfordítással vett részt szülővárosában, Sopronban a Nyugat-magyarországi Egyetem Közgazdaságtudományi Karának oktató munkájában. 2005 márciusában egyetemi tanárrá nevezték ki Sopronban is. 2005 szeptemberében a NYME Közgazdaságtudományi Karán dékánná választották, amely mellett egy ideig a Szent István Egyetem Gazdaság- és Társadalomtudományi Karán is folytatta egyetemi oktatói tevékenységét. Két dékáni ciklus lezárása után 2017-ig a Széchenyi István Gazdálkodási és Szervezéstudományok Doktori Iskola vezetőjeként, illetőleg egyetemi tanárként tevékenykedett. Jelenleg professor emeritus, és aktívan közreműködik a doktori iskola munkájában. 2009 óta tölti be Gazdálkodás folyóirat szerkesztőbizottságának elnöki tisztjét, és ugyanezen évtől fogva a Gazdaság és Társadalom folyóirat főszerkesztője. 2010-ben az FM Agrárgazdasági Tanácsa elnökévé választották, amely feladatot 2017-ig látta el.

Munkásságáért Szent-Györgyi Albert díjat, Pro re Rustica Promovenda kitüntetést, illetőleg Nagyváthy János díjat adományoztak számára. A Giesseni Justus Liebig Egyetem és a Szent István Egyetem honoris causa doktora. A felsőoktatás fejlesztéséért 2014-ben Magyar Érdemérem Tiszti Keresztje kitüntetést kapott. 2019-től a Kismartoni Főiskola tiszteletbeli professzora.