Czech University of Life Sciences Prague
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Diploma Thesis

Analysis of Ethereum

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DIPLOMA THESIS ASSIGNMENT

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Thesis title

Analysis of Ethereum

Objectives of thesis

The aim of the thesis is to understand the current positions of Ethereum in the financial sector and to analyze possible development scenarios for the future.
The goals of the thesis are to consider the main differences between cash and non-cash payment systems; to analyze the factors that drive the development of alternative, digital and electronic currencies; to understand the main specificities of cryptocurrencies as a financial instrument and to investigate their main functions; to run an in-depth analysis of Ethereum, including its history dynamics and possible future scenarios of development, and to draw generalized conclusions based on the findings of the thesis.
The research questions of the thesis are the following:
RQ1: How is the future of Ethereum dependent on legislative initiatives of governments?
RQ2: What different scenarios of the development of events are possible for Ethereum in the future.
The hypothesis to be tested based on the findings of the thesis is the following:
H1: Legislative obstacles should be expected for Ethereum's development on the part of governments due to the threats the cryptocurrency imposes on centralized financial systems.

Methodology

The methodological tools to be used for carrying this research will combine both secondary and primary research. Thus, secondary research will be used in order to collect and analyze the theoretical information related to the research topic and to reveal the main theoretical aspects covering the circulation of cryptocurrencies, their specificities and functions, as well as the operation of Ethereum, its historical development, and recent dynamics. Data for secondary research will be drawn from available bibliographic sources in both print and electronic form. Primary research will be based on an interview to be held with the manager of World core, a Czech-based company specialized in operations with cryptocurrencies. In addition to this, deductive thinking and synthesis will be applied in order to draw conclusions based on the aim and goals of the research, and to bring additional value to the thesis through the author's own contribution to the analysis. Methods used in the thesis are also basic statistical methods, regression method and time series analysis methods.

The proposed extent of the thesis

60 pages

Keywords

Cryptocurrencies, Currencies, Ethereum, Payment systems, WorldCore, Bitcoin, Analysis

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Recommended information sources

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Prague on 30. 11. 2018

Declaration

I declare that I have worked on my diploma thesis titled " Analysis of Ethereum" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the diploma thesis, I declare that the thesis does not break copyrights of any their person.

In Prague on 30.11.2018 _____

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Analysis of Ethereum

Abstract

The findings of the article testify that the use of cryptocurrencies all over the world tends to keep growing. Their advantages such as anonymity and enhanced opportunities of data protection incite the desire of customers all over the world to use such assets for their settlements. Major cryptocurrencies such as Bitcoin and Ethereum already hold firm positions as virtual currencies used in settlements and money transfers. However, a considerable issue impeding further development of cryptocurrencies is the lack of their effective regulation on the part of governments. The forecasting analysis based on the ARIMA model run in this thesis suggests that the price dynamics of Ethereum are expected to remain negative in months to come. The statistical data revealed prove that the current trend is downward. This is preconditioned first of all by the overall negative dynamics of the cryptocurrency market and the high level of fluctuations associated with cryptoassets. However, according to expert estimates, Ethereum is highly likely to restore its growth soon, which is namely due to a more loyal attitude on the part of governments and to the undoubted benefits which Ethereum brings with its underlying technologies. Further growing use of the cryptocurrency and its benefits could contribute to an improved level of customer service all over the world, and to subsequent spreading of the use of cryptocurrencies in different economic sectors and industries.

Keywords: Bitcoin, blockchain, cryptocurrencies, distributed ledger, Ethereum, non-cash payments, payment systems, virtual currencies.

Analýza Ethereum

Abstrakt

Zjištění práce svědčí o tom, že používání kryptoměn na celém světě má tendenci pokračovat v růstu. Jejich výhody, jako je anonymita a vylepšené možnosti ochrany údajů, podněcují zákazníky z celého světa, aby využívali tyto aktiva pro své osídlení. Hlavní krypto měny jako Bitcoin a Ethereum již mají pevné pozice jako virtuální měny používané v osadách a převody peněz. Zásadním problémem, který brání dalšímu vývoji krypto měn, je však nedostatek jejich účinné regulace ze strany vlády. Analýza prognóz založená na modelu ARIMA v této práci naznačuje, že cenová dynamika společnosti Ethereum by měla v nadcházejících měsících zůstat negativní. Získané statistické údaje dokládají, že současný trend je klesající. Toto je předem podmíněno především celkovou negativní dynamikou trhu s kryptoměnami a vysokou fluktuací spojenou s krypto aktivami. Podle odborných odhadů však společnost Ethereum brzy obnoví svůj růst, což je způsobeno loajálnějším postojem vlád a nepochybnými výhodami, které společnost Ethereum přináší se základními technologiemi. Další rostoucí využívání krypto měn a jeho přínosů by mohlo přispět ke zlepšení úrovně služeb zákazníkům po celém světě a k následnému šíření využívání kryptoměn v různých hospodářských sektorů a odvětvích.

Klíčová slova: Bitcoin, blockchain, kryptoměny, distribuovaná účetní kniha, Ethereum, Bezhotovostní platby, platebních systémů, virtuální měny.

Table of content

List of figures

1 Introduction

The development of the global financial sector as of today is dependent to large extent on the development of technological progress, and specifically of up-to-date digital and Internet technologies. The financial sector is moving steadily toward the electronic environment, which allows improving the intensiveness of financial transaction through improvements made to their quality and speed. Actors in the financial sector benefit from wider opportunities of carrying out different sorts of transactions, and this allows them improving the overall quality of their business through better financial performance.

One of the main innovations in the financial sector created in the last decade is cryptocurrencies. Cryptocurrencies are a type of alternative currencies based on the use of sophisticated digital technologies, which allow their owners running the widest range of money transactions at the highest degree of anonymity. In contrast to fiat money, cryptocurrencies are based on decentralization, and thus they are beyond the control of national governments. Through the use of blockchain technologies, cryptocurrencies achieve anonymity. The use of cryptocurrencies is becoming more and more popular on the global scale thanks to the benefits and opportunities they provide to their owners, and also thanks to the positive dynamics of the market.

One of the world's most powerful cryptocurrencies is Ethereum. It accounts for one of the largest shares in global cryptocurrency trade. Ethereum is targeted by the governments of many states for control over cryptocurrencies and enjoys great demand of customers all over the world.

This thesis will be dedicated to the analysis of cryptocurrencies, and namely of Ethereum as one of the world's most powerful cryptocurrencies.

Bibliographic sources to be used for running this research will include Antonopoulos, A.M. (2014). *Mastering Bitcoin: Unlocking Digital Cryptocurrencies*; Narayanan, A., Bonneau, J., Felten, E., Miller, A., and Goldfelder, S. (2016). *Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction*; Heston, A. (2018). *Cryptocurrency: How to Safely Create Stable and Long-term Passive Income by Investing in Cryptocurrency*; Seiz, H. (2017). *The Future of Money: How Gold will Revolutionize our Method of Payments*; Kuo Chuen, D.L. (2015). *Handbook of Digital Currency:*

Bitcoin, Innovation, Financial Instruments, and Big Data; and other academic sources containing valuable information on the topic, as well as publications of reputable media and other reliable data sources containing the required material on cryptocurrencies and Ethereum.

The findings of the thesis should be helpful for understanding better the current position of Ethereum in the global financial market, and to run a deeper analysis of Ethereum's subsequent opportunities of development given the current market trends.

2 Objectives and Methodology

2.1 Objectives

The **aim** of the thesis is to understand the current positions of Ethereum in the financial sector and to analyze possible development scenarios for the future.

The **goals** of the thesis are to consider the main differences between cash and non-cash payment systems; to analyze the factors that drive the development of alternative, digital and electronic currencies; to understand the main specificities of cryptocurrencies as a financial instrument and to investigate their main functions; to run an in-depth analysis of Ethereum, including its history dynamics and possible future scenarios of development, and to draw generalized conclusions based on the findings of the thesis.

The **research questions** of the thesis are the following:

RQ1: How is the future of Ethereum dependent on legislative initiatives of governments?

RQ2: What different scenarios of the development of events are possible for Ethereum in the future.

The **hypothesis** to be tested based on the findings of the thesis is the following:

H1: Legislative obstacles should be expected for Ethereum's development on the part of governments due to the threats the cryptocurrency imposes on centralized financial systems.

2.2 Methodology

The methodological tools to be used for carrying this research will combine both secondary and primary research. Thus, secondary research will be used in order to collect and analyze the theoretical information related to the research topic and to reveal the main theoretical aspects covering the circulation of cryptocurrencies, their specificities, and functions, as well as the operation of Ethereum, its historical development, and recent dynamics.

Data for secondary research will be drawn from available bibliographic sources in both print and electronic form. Primary research will be based on an interview to be held with the manager of a Central European company specialized in operations with cryptocurrencies. The main goal of primary research will be to bring additional value to the thesis by collecting first-hand information on the Ethereum market and the opportunities of its subsequent development in the light of the existing threats and obstacles.

In addition to this, deductive thinking and synthesis will be applied in order to draw conclusions based on the aim and goals of the research, and to bring additional value to the thesis through the author's own contribution to the analysis. Methods used in the thesis are also basic statistical methods, regression method and time series analysis methods will be applied for the purpose of forecasting Ethereum's price development in the near future.

3 Theoretical Part

3.1 Cash and Non-Cash Payment Systems

Money has been playing an essential role in the development of humanity since the ancient times. According to Burns (2013, p. 315), initially, the role of money had been played by various products which had a particular value in communities where they were traded. With the course of time, the system of trade relationships evolved, and money appeared as a universal equivalent used in trade. Initially, the traditional cash systems used money costing the amount spent on its production. However, this system gradually evolved into money bearing a nominal value smaller than the resources used for its production. This system allows sparing costs on money production, and at the same time allows for the widest use of money in all production and commercial relationships between people in different fields and sectors.

Banerjee (2015, p. 129) notes that a cash payment system can be defined as a system where paper and metal money is used as a kind of product equivalent for which other products and services are exchanged. A cash payment system is a system of cash transactions regulated by common state laws as a single infrastructure of monetary relationships. The participants in this system include individuals, companies, and the state. Individuals and companies act as direct participants in the system who use cash funds for performing particular transactions, exchanging funds, purchasing and selling products or services, and so on. The state's participation can be considered from two different perspectives. On the one hand, the government is the user of the existing monetary system as well through its agencies and public companies. At the same time, the state operates as a lawmaker and regulator developing the common legal frameworks for regulating the money relationships between people. The government also issues cash funds, and thus regulates the aggregate amount of funds available in the national economy. In this context, an important role is also played by banking institutions. They ensure the application of the so-called multiplier effect: through their lending activities, banks multiply the monetary mass available in the economy.

Banerjee (2015, p. 129) notes further that a cash payment system consists of a number of important elements which should be considered more in detail.

Thus, the first element of any payment system is a currency. Most states have an own national currency, but sometimes states can use the same currency as their neighbours with a higher level of economic development. Each currency is used as a universal tool for monetary relationships within a community's national economy. Each currency has its own name and its scale, Also, each currency has a defined appearance and presentation of its bills (notes) and coins. The state sets regulations for the performance of cash exchange transactions, including the limitations regarding the use of foreign currencies, rules of monetary exchange, and so on. The government defines the currency to be used in cash exchanges within the economy, and also regulates the purchasing power of the national currency through a number of monetary and credit tools available to it.

Górka (2016, p. 28) states that while cash payment systems had played an essential role before the second half of the XX century, their role has been decreasing gradually since then. As of today, the use of cash payment systems is mostly limited to transactions between individuals, with the involvement of small amounts of funds. At the same time, in the relationships between companies and public bodies, non-cash payments are used more and more often for the sake of optimizing the structure of cash flow, minimizing the associated time expenditures, and raising the effectiveness of monetary relationships. The growing use of non-cash payment systems is associated directly with technological progress and wider accessibility of the Internet and portable devices all over the world. In addition to the aforesaid benefits, non-cash payments are also less costly for companies, and they allow for more effective monitoring and control, which is essential for achieving greater economic performance.

Non-cash payment systems are those payment systems where cash funds are not involved directly in the system of transactions between individuals and companies. As of today, there are a wide range of non-cash payment tools which can be used in the economy between its actors. The main ones are described below.

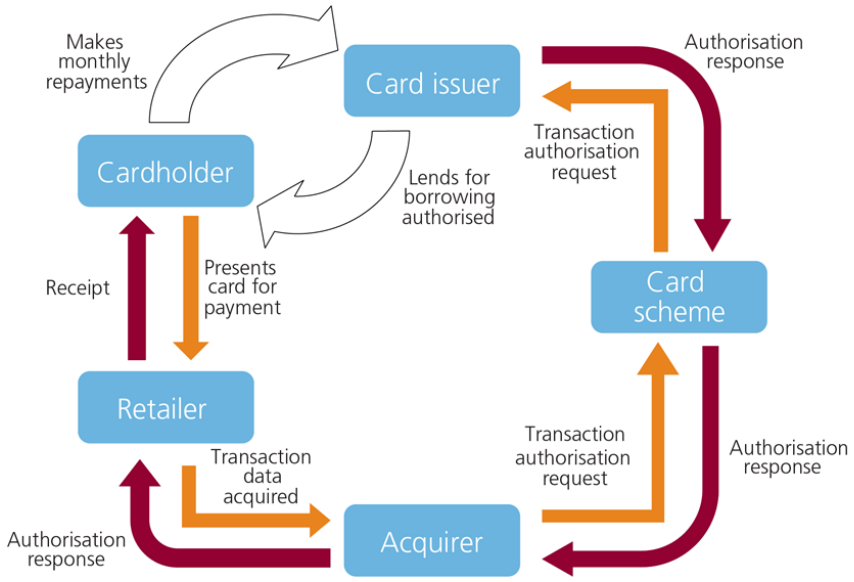
Debit and credit cards

According to Gurusami (2009, p. 31), a debit card is a plastic card bearing an amount of funds on it. As soon as an individual uses a debit card for purchases or payments, funds are debited directly from the associated card account. Thanks to the use

of debit cards, individuals avoid the need to bring cash with them. For companies accepting debit cards, the main benefit is that they avoid additional expenses on cash management, and all accounting is automated. Individuals can withdraw cash from their debit cards using ATMs. In this case, they convert their non-cash funds into cash funds. At the same time, credit cards are used by individuals for making their purchases for money which isn't available on their account. The bank provides loans to individuals having credit cards, and this allows individuals making their purchases for an additional interest payment.

Keene (2016, p. 147) states that another important form of plastic cards used commonly in commercial practice of companies as of today is prepaid cards. Prepaid cards are cards delivered to individuals with a predefined amount of funds available on them. Individuals can use prepaid cards for making purchases using the amount available on such cards. Amounts are debited from such cards until the balance touches zero. These cards can often be used as gift certificates and they are becoming more and more popular in commerce.

Figure 1 Credit card scheme



Source: FCA, 2016

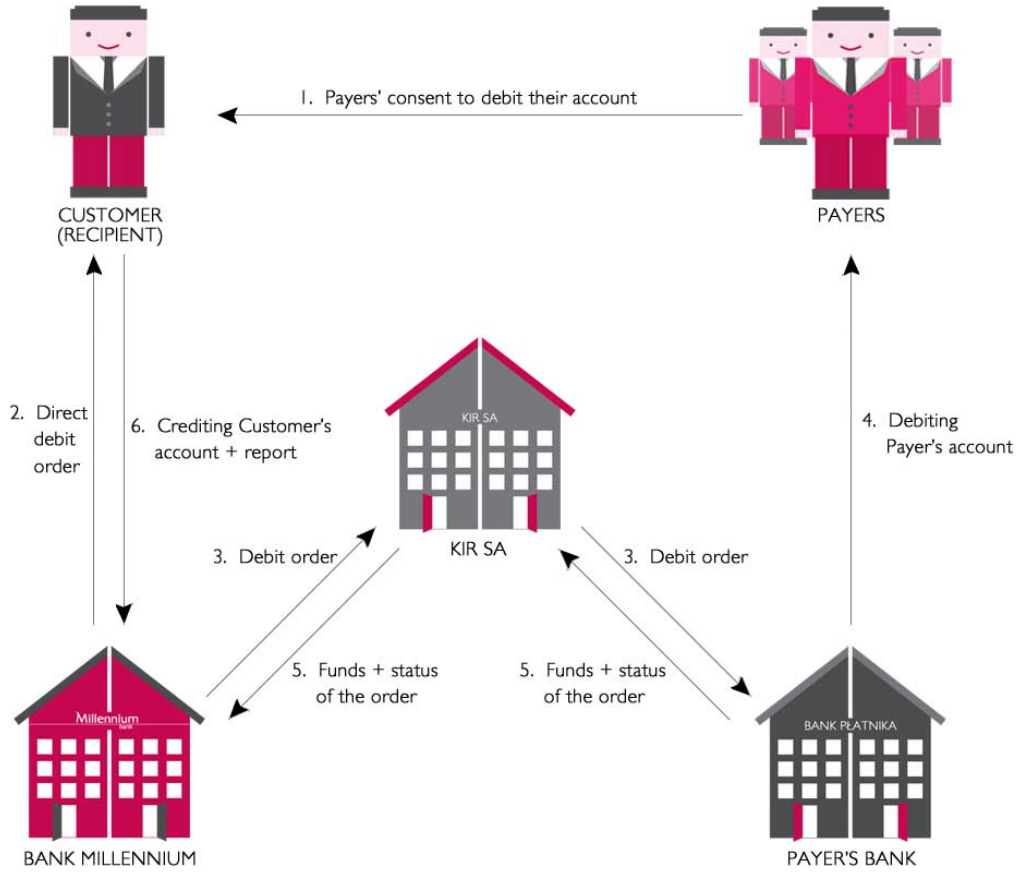
Cheques

Mukherjee (2002, p. 777) states that a cheque can be defined as a bill of exchange which a payer draws upon a specified bank. Such a bill of exchange is to be enforced upon the occurrence of an event, i.e. on demand of the recipient. Cheques are historically one of the oldest forms of non-cash payments. Their use in the current practices of banks tends to become less intensive with the growing availability of modern paperless payment tools and with the development of online banking services.

Direct debit

According to Essvale Corporation Limited (2007, p. 123), direct debit can be defined as *"a payment method that allows an organisation to instruct their bank to collect varying amounts directly from customers' accounts. It differs from a standing order in that it originates from the organisation that is to be paid and does not offer the customer any control over the payments."* Thus, direct debit should be understood as a kind of non-cash payment when a customer can withdraw an amount directly from another customer's account. In this case, the payee draws the order upon the payer's bank to transfer an amount of funds from the payer's account to the one of the payee. In this case, the bank acts based on the payer's instruction to perform this transaction.

Figure 2 Direct debit scheme



Source: Bankmillennium.pl, 2018

Bank transfers

According to BPP Learning Media (2017, p. 94), bank transfers as a type of non-cash payments stand for wire transfers which individuals can send to other individuals using the opportunities offered by banks. In this case, no cash funds are involved. The banks run a set-off between them, and the required amount of funds is credited by the beneficiary's bank to the beneficiary's account. The main advantage of bank transfers is that they are quicker compared to bills of exchange. As of today, the available bank technologies allow banks carrying out such bank transfers electronically, which further reduces the amount of costs to be borne by the parties involved, and also minimizes the associated time expenditures. For customers using bank

services, bank transfers are convenient, as they allow sending funds to other customers at great distances, which is complicated in the case of cash payments.

Online banking payments

Lee (2012, p. 345) notes that online banking payments are carried out with the use of online banking opportunities. This type of alternative bank payments is developing rapidly today thanks to the growing coverage of Internet connection on the global scale and thanks to the growing involvement of people in online interaction. Online banking payments are done by customers using specialized software which allows them connecting directly to their bank account using the Internet. Bank transactions in the online environment are carried out with the customer's access using their login and password. The main advantage of this type of non-cash payments is its relative simplicity, opportunity of online access from virtually anywhere around the globe, and the quick performance of transactions. For banks, the autonomous and automated nature of such payments allows minimizing the costs associated with personnel involvement, and also allows decreasing the fees charged from customers. One of the downsides is the fact that online transactions are often targeted by hackers who seek steeling individuals' funds or personal data for their own purposes. However, banks pay great attention to online protection as of today and use sophisticated encryption protocols and other types and tools of defence, which altogether make online payments more secure. For merchants, the development of online banking contributes to greater conversion rates and recurring transactions thanks to the convenience of online payments.

According to Zhang and Dodgson (2019, p. 19), mobile payments can be considered as one of the forms of online banking payments. The main characteristic trait of mobile payments is the fact that they are effected using mobile phones. Mobile payments can be considered to be a modern payment method. They are based on the use of the Internet as well. Smartphones allow connecting to online banking and performing all banking operations from mobile phones, which allows customers making their payments from anywhere where Internet connection is available. In the years to come, mobile payments will be increasing their role in the operation of non-cash payments given their popularization among customers all over the world. Within the structure of online payments, a particularly important role is played today by electronic payment systems.

Electronic payment systems act as electronic infrastructure for carrying out payments between individuals. Such payment systems can use either real or virtual currencies, which will be analyzed more in detail in the next chapters of the thesis. The main benefit of electronic payment systems for customers is the fact that they are not controlled by banks, offer lower commission fees, and allow improving the quality of money transactions between people on different web platforms, with integration in online stores, and so on.

According to Górka (2016, p. 28), the role of cash payments in the future should be expected to keep decreasing in the global economy, the main reason for it is the convenience of non-cash electronic payments and continued development of online and digital technologies. Non-cash payments already account for over 99 % in transactions between companies all over the world, and their share in transactions between individuals should be expected to keep increasing as well.

Taking into account the facts outlined above, it is worth now focusing on the analysis of traditional and modern currencies and the main differences between them.

3.2 Traditional and Modern Currencies

According to Camera (2017, p. 131), traditional and modern currencies differ mainly in terms of the actual type of monetary unit used within the payment system for performing monetary transactions between individuals and companies. In the case of traditional currencies, reference unit is central bank notes and coins. Such notes and coins are issued directly by the public authorities, namely by the country's central bank. They bear a particular nominal value, which doesn't correspond to the actual costs borne by the government for issuing such money. Camera (2017, p. 131) states that *"the currencies in existence today are typically issued by a sovereign institution, such as a central bank or a national mint. This is especially true for physical currencies, coins and banknotes. But cash, which is synonymous for physical currency, is not the predominant form of money: for example, U.S. banknotes and coins comprise slightly more than 2/5 of M1"*. The main characteristic trait of modern currencies (also commonly referred to as digital currencies) is the fact that they exist in the electronic

or virtual environment, and do not exist in the form of tangible monetary units. Nevertheless, modern currencies are similar to traditional currencies due to the fact that they bear a certain nominal value and can be used in transactions between individuals. The value of digital and other modern currencies is evaluated against the value of widely used traditional currencies in order to identify their actual purchasing capacity and to identify the number of products which can be purchased for a particular amount of the modern currency.

According to Bauknecht et al. (2003, pp. 87-88), an electronic currency is a currency which is *"stored in digital form and serves as a cash substitute for the Internet. It can be represented by electronic "bills and coins", certificates, packets of data, or, in other words, tokens"*. Therefore, in contrast to traditional currencies, electronic currencies do not exist in the physical environment and do not have any tangible representation. Most electronic payment systems are centralized, similarly to traditional currencies, and are based on a number of regulations identifying the rights and liabilities of the parties. Electronic currencies operate based on online and digital technologies. Historically, the first types of electronic currencies emerged in the late 1990's, with the development and spreading of the Internet. Subsequent development of online banking and growing competition between banks and non-banking financial institutions contributed further to the development of new electronic currencies. As of today, electronic currencies are widespread in a great number of commercial operations between individuals and companies, and they have become indispensable for effective settlements. Also, they act as a driving factor of competition, thanks to which traditional payment methods have to develop steadily in order to match the pace of development of electronic currencies.

In literature, electronic currencies are also commonly referred to as digital currencies. According to Fred et al. (2017, p. 157), a digital currency can be defined as *"an alternative currency which is exclusively electronic and thus has no physical form"*. The main advantages of digital currencies are the fact that the issuer doesn't bear any significant costs for issuing the currency. As a result, the costs of servicing digital currencies are significantly lower, and therefore customers can benefit from lower fees. Also, while there can be additional obstacles for the use of traditional currencies, such as banks' operating hours, electronic currencies can be used without any time limitations, and operations with them are most often instant, which means that customers can access

all transactions with digital currencies 24/7 from virtually anywhere in the world. Thanks to the development of this segment of the financial sector, digital currencies can be easily converted into traditional currencies, they are used widely in transactions, and they are convenient for trade on the web.

Camera (2017, p. 131) states further that *"a characteristic of digital currencies is that – unlike banknotes and coins, settlement cannot be completed by a simple physical transfer of the instrument. A ledger – i.e. a record-keeping system – must be in place to establish property rights over the instrument"*. Therefore, for the purpose of being used effectively in transactions between individuals, modern currencies have to rely on some reliable institution or body. This institution can be a bank or another participant or group of participants involved in the processing of transactions. Most often, the operation of modern currencies is controlled by the government. However, in the case of cryptocurrencies, the government's control is limited. The specificities of cryptocurrencies as a type of modern currencies will be analyzed more in detail in the next chapters of the thesis.

Camera (2017, pp. 131-132) notes that there are two main types of digital currencies which should be distinguished. Thus, sovereign digital currencies act as digital currencies denominated in a sovereign unit. Such currencies are issued by either central banks or other financial institutions such as commercial banks, and so on. In fact, such digital currencies act as *"an electronic representation of a physical sovereign currency"*. The second type of digital currencies is the so-called non-sovereign currencies, or abstract currencies. Such currencies are functioning based on a distributed ledger and they do not rely on any centralized authorities or issuers. This is the case of cryptocurrencies, which will be analyzed more in detail in the next chapters of the thesis.

Digital currencies should be distinguished clearly from virtual currencies. According to Reichel and Randa (2018, p. 133), *"a virtual currency can be defined as a type of unregulated, digital money, which is issued and usually controlled by its developers, and used and accepted among the members of a specific virtual community"*. Therefore, in contrast to electronic currencies which are available to the widest range of customers in the online environment, virtual currencies are only accepted as a means of payment within an enclosed virtual community. Virtual currencies

are not considered as legal payment instruments, and they have no direct control on the part of the government. The risks incurred by the persons involved in such transactions are borne by themselves, and they do not enjoy the level of security which is available for transactions with recognized digital currencies.

Halaburda and Sarvary (2016, pp. 4-5) note among the examples of virtual currencies used by Facebook and Amazon. This kind of money is used on the platforms of Facebook and Amazon for making particular internal purchases. The currencies of Facebook and Amazon are available only to registered users and are circulating only within the space of these web platforms. These currencies do not interfere with the functioning of the state currency, and do not aim to limit the national currency's circulation. Their circulation is regulated strictly by the respective network or web platform which is the issue of the currency, and their management is centralized. However, a common tendency for both virtual and electronic currencies is to keep expanding their fields of use and the range of services for which they can be used. Therefore, it is an important task of the government to monitor the development of digital and virtual currencies and to develop appropriate legal frameworks governing all operations with such currencies, so as to guarantee maximum customer security and so as to ensure minimized risks for the national economy.

The Information Resources Management Association (2018, p. 111) explains the difference between electronic and virtual currencies as follows. Virtual currencies are denominated in fiat money and serve for ensuring the performance of transactions with fiat money in the electronic environment. On the contrary, virtual currencies are not denominated in fiat money, but have their own unit of account. Virtual currencies have their own representation of value and can be used on the Internet for settlements with counterparties, purchases of goods and services, and so on. Examples of electronic currencies can include prepaid phone cards, smart cards with cash value, as well as money in electronic payment systems such as PayPal, Skrill, and so on. Token-based community currencies include Bristol Pound in England, Salt Spring Dollar in Canada, and so on. Examples of centralized digital currencies include Linden Dollar in Second life, Gold in World, of Warcraft, etc. The main specificity of these currencies used in computer games is the fact that they are most often non-convertible into fiat money, and they can be used only within the games to purchase particular items or artefacts. Finally, digital

currencies functioning based on a distributed ledger include cryptocurrencies such as Bitcoin, Ethereum, Litecoin, and a range of other cryptocurrencies, whose main characteristic is the fact that they do not have any centralized body of control and are anonymous.

Kuo Chen (2015, pp. 7-8) states that digital currencies will be growing and developing in the near future. The main reason for it is steady technological progress and the growing availability of various new technologies and tools to be used in the financial sector. At the same time, barriers for entering this segment of the financial market are low, the issuing costs are low, and in addition to the convenience of digital currencies, they are also becoming more popular among customers due to the fact that they are environmentally friendly, and their production doesn't bring any harm to nature.

Given the overview of electronic currencies presented above, it is now worth focusing more specifically on cryptocurrencies, their particularities, and history of their use.

3.3 Cryptocurrencies, Their Specificities and History

According to Janssen et al. (2015, p. 67), a cryptocurrency can be defined as a *"type of digital currency which relies on cryptography, usually alongside a proof-of-work scheme, in order to create and manage the currency. A decentralized network of peer-to-peer computer nodes working in sync creates and verifies transactions of transfer of said currency within the network"*. While this definition touches upon the technical aspects of cryptocurrencies and their use, Janssen et al. (2015, p. 67) also state that a cryptocurrency can be understood from the customer perspective as a type of digital currency which can be transferred quickly and securely between the parties to the transaction using the Internet infrastructure and cryptographic security. One of the characteristic traits of cryptocurrencies is the fact that they allow for customer anonymity thanks to the fact that there is no centralized control on the part of public authorities. All cryptocurrencies are based on the use of a peer-to-peer approach, which means that the users of cryptocurrencies themselves support the production of cryptocurrencies and development of the system. Also, thanks to the P2P system, transactions are carried out directly between the parties involved, which means

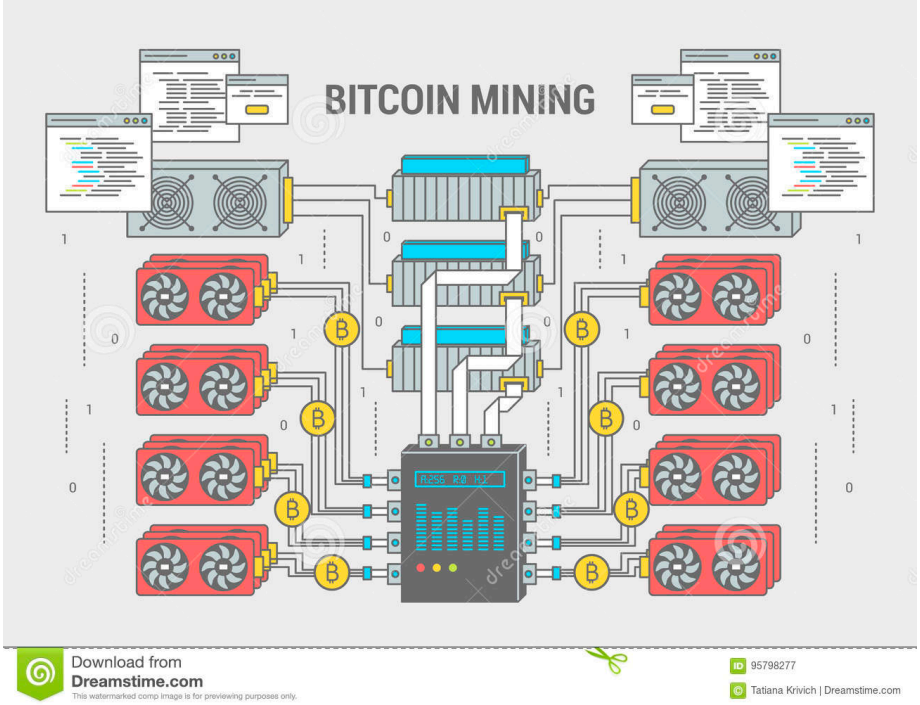
the elimination of fees which would be otherwise payable to financial intermediaries. Public-key cryptography allows raising the security of transactions and minimizes the risks of hackers' attacks. All these factors make cryptocurrencies popular as of today and contribute to their spreading on the global scale.

A similar definition of cryptocurrencies is provided by Christensen (2018, p. 32) who notes that a cryptocurrency can be defined as a *"virtual or digital currency that operates as a medium of exchange. Cryptocurrencies use cryptography to control the creation of additional tokens, to verify the transfer of assets, to secure transactions, and to maintain the integrity of the system"*. The researcher notes further that as an asset, cryptocurrencies do not have any intrinsic value and not have any physical form, as they only exist in the digital environment. Finally, as stated in the previous definition, there is no legal authority to assume control over the functioning and circulation of cryptocurrencies, which means that cryptocurrencies are decentralized and independent in their operation. Cryptocurrencies are based on the mechanisms of cryptography. Cryptography should be understood as a technique to convert legible information into a protected cryptographic code. Therefore, thanks to the use of cryptography in the operation of cryptocurrencies, a higher level of security is guaranteed not only compared to traditional currencies, but also compared to other digital currencies.

Christensen (2018, p. 34) explains further that unlike in centralized systems, in the systems of cryptocurrencies, all transactions are visible to all participants. This is achieved thanks to the operation of blockchain, which is a public ledger where the history of all transactions in the network is registered. Blockchain is accessible to all nodes. The information visible to all nodes includes the sender and the recipient of particular bitcoin amounts (the IDs of the sender and the recipient), and the amount transferred itself. Each cryptocurrency also has is miners. Miners produce the cryptocurrency until the maximum number of tokens is achieved. The reward the miners get for their work is a part of new cryptocurrency tokens. Miners also confirm transactions, as each transaction is subject to confirmation before its enters the blockchain. Customers using cryptocurrencies pay a small fee to the miners for the confirmation of their transactions. A typical process of cryptocurrency transfer occurs as follows: first, there is a user who requests a transaction to be performed. This message is introduced into the cryptocurrency's peer-to-peer network consisting of nodes (individual computers).

As soon as the transaction is performed, it is validated using predefined algorithms. The information on each transaction is added to the blockchain in the form of new blocks.

Figure 3 Bitcoin mining scheme



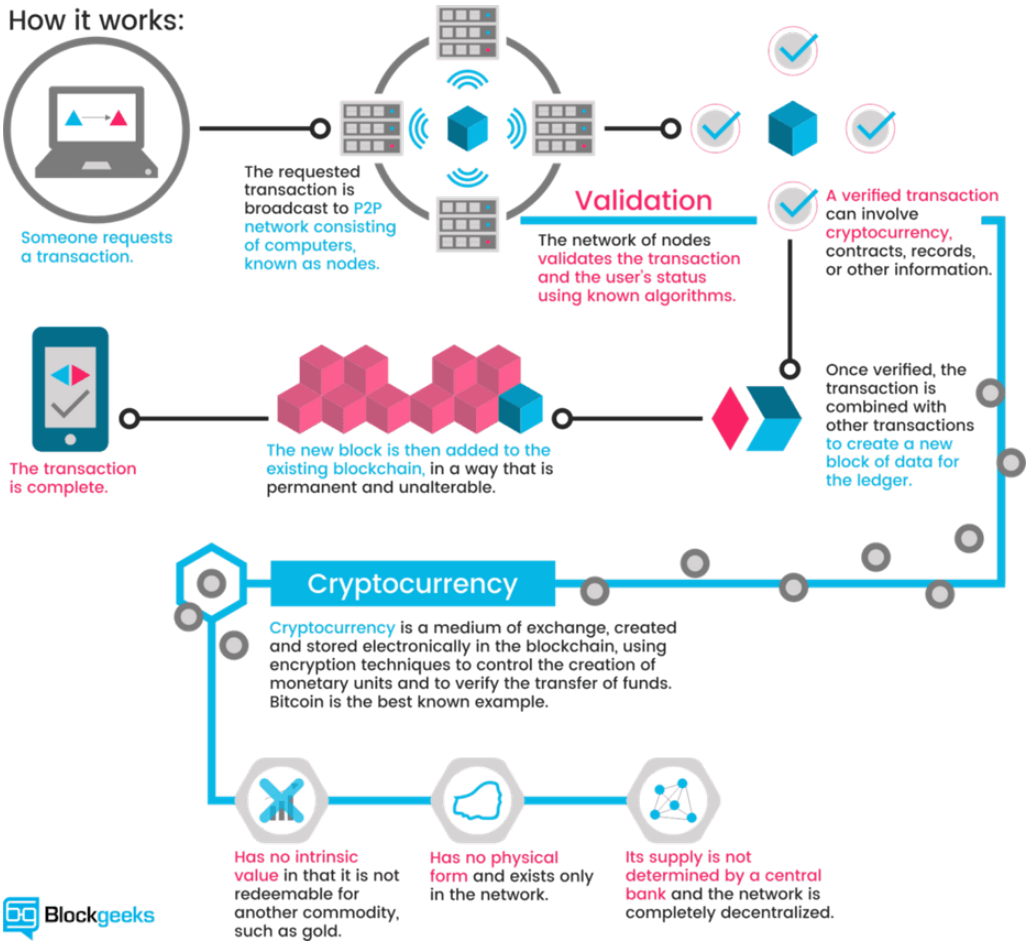
Source: Dreamstime.com, 2018

In association with cryptocurrencies, is it worth providing a definition of blockchain additionally. According to Gaur et al. (2018, p. 9), a blockchain can be defined as *"an immutable ledger for recording transactions, maintained within a distributed network of mutually untrusting peers. Every peer maintains a copy of the ledger. The peers execute a consensus protocol to validate transactions, group them into blocks, and build a hash chain over the blocks"*. A blockchain used in the support of a cryptocurrency is publicly accessible to everyone, and everyone can participate in them without any specific identity. Such blockchains are normally used based on proof-of-work (PoW) consensus protocols. Blockchains of newer generations are also based on the deployment of smart contracts. As explained by Gaur et al. (2018, p. 9), a smart contract *"functions as a trusted, distributed application and gains its security from the blockchain and underlying consensus among its peers"*. Before the emergence of cryptocurrencies, it had been believed that no financial system can be decentralized,

as the lack of consensus on the part of at least one of the peers would lead to the collapse of the entire system. However, the use of sophisticated algorithms which allow avoiding double spending within the systems of cryptocurrencies, it became possible to achieve consensus between all participants, which means that no specific central authority is required to support the existence of the system and guarantee its development.

The first digital cryptocurrency launched into operation was Bitcoin, which appeared in the market in 2009. According to Janssen et al. (2015, p. 67), there are several important characteristics which shape the operation of Bitcoin and other cryptocurrencies which developed after Bitcoin and based on its model. Thus, first of all, a key characteristic of Bitcoin is its scarcity. Given the fact that Bitcoin can be mined by everyone, and therefore in theory can be produced in unlimited quantities, its scarcity contributes to low inflation. The speed of mining tends to keep declining as more bitcoins have been mined. Another important characteristic of Bitcoin is the reliable security standards implemented within the system. Since a person is registered as a Bitcoin provider, they get a digital wallet identification number shown to other peers using bitcoins. Blockchain keeps the information on all previous operations which were effected with the use of this particular ID. Finally, a characteristic trait of Bitcoin and its successors is the fact that all transactions are easy to carry out. To perform a transaction in bitcoins, one only needs to have a Bitcoin application or wallet on their mobile phone. The completion of transactions with Bitcoin only takes minutes, regardless of the physical distance between the parties. The growing number of Bitcoin exchanges and ATMs also eases the operations with bitcoins and their widest use in the operations performed by people in their real life.

Figure 4 Scheme of transactions in cryptocurrencies



Source: Ellis, 2018

Bigmore (2018) states that after the launch of Bitcoin in 2009, in the next year, the cryptocurrency's system was hacked, which showed its major vulnerability. In 2010, Bitcoin was also used for the first time in a purchase transaction, as it was used for purchasing two pizzas. After Bitcoin's spreading in daily operations, in 2011, new cryptocurrencies started appearing in the financial sector, including Litecoin, Namecoin, and Swiftcoin. At the same time, despite the growing use of cryptocurrencies for transactions between people, cryptocurrencies also become popular among illegal dealers, which is due to their inherent traits such as anonymity. In 2013, national governments started paying greater attention to the operations with cryptocurrencies given their growing spreading in mutual transactions between people. Some of the countries prohibited the use of Bitcoin as an unrecognized monetary means, namely Thailand and China. At the same time, in other countries, cryptocurrencies continued growing

further, and the first Bitcoin ATM appeared in Canada. In 2014-2015, a large number of new cryptocurrency exchanges appear around the globe. In 2016, cryptocurrencies are already used widely for transactions not only by online stores, but also by physical retail outlets, coffee shops, taxi services, markets, and so on, which contributes to cryptocurrencies' subsequent expansion in the financial sector and as a means of payment in the real economic sector. In 2017-2018, cryptocurrencies continue spreading, and they are widely accepted by banks and other financial institutions which recognize cryptocurrencies as an important means of payment used by individuals and companies in their transactions.

As of today, one of the key issues associated with the development of cryptocurrencies is the legal status of such digital currencies and the degree of regulation applied by public authorities to the transactions involving cryptocurrencies. This issue is particularly topical for the authorities of states due to the fact that cryptocurrencies are used more and more widely in transactions between people and companies, but the state has no actual tools of control over such cryptocurrencies, in contrast to traditional currencies. According to the Library of Congress (2018), in the European Union, Bitcoin and other cryptocurrencies are not prohibited and can be used in transactions. There are no specific regulations governing the use of bitcoins in commercial transactions. However, transactions related to exchange of bitcoins into fiat money and vice versa are not VAT-taxed. As of today, the European authorities focus the scope of their attention on the establishment of effective means of monitoring and control, so as to reveal in a timely manner any suspicious activity associated with the use of Bitcoin, namely its use for the purposes of money laundering and financing of terrorism.

As the Library of Congress (2018) explains further, in the United States, Bitcoin enjoys a legal status and is characterized as a convertible decentralized virtual currency. Bitcoin is taxed as property. Companies running large-scale operations with bitcoins are required to register with the United States' responsible financial authorities. In Russia, no specific regulations are applicable to the transactions involving bitcoins. The central authorities refrain from the definition of Bitcoin's legal status; however, a number of court decisions prohibit the use of Bitcoin by individuals and companies. In China, Bitcoin is illegal, and the Chinese regulations prohibit any use of Bitcoin or any other

cryptocurrencies for commercial banks, payment companies, and other financial and non-financial institutions. Countries where cryptocurrencies are banned from any operations also include Saudi Arabia, Iran, Algeria, Egypt, Morocco, Colombia, Bolivia, Bangladesh, Ecuador, Nepal, Pakistan, Indonesia, and Cambodia. In most other states, the use of cryptocurrencies isn't anyhow regulated, and the central authorities prefer waiting in order to see how the cryptocurrencies will develop in the future.

Therefore, based on this overview, it can be stated that cryptocurrencies play an essential role in the financial sector as of today, and they are penetrating more and more deeply in the operations between both individuals and companies. Given these facts, in the next chapter of the thesis, the key functions of cryptocurrencies played in modern global economy will be considered more in detail.

3.4 Functions of Cryptocurrencies in the Global Economy

According to Putnik (2018, p. 22), cryptocurrencies play an important role in the global economy, and their primary function consists in the contribution to effective money transactions between people in the online environment. Therefore, the first major function of cryptocurrencies is their contribution to easier and more effective monetary transactions between individuals and companies. Putnik states that all inherent specificities of cryptocurrencies are adapted specifically to the needs of customers in terms of their effective money transactions. Thus, first of all, cryptocurrencies allow for the quickest performance of monetary transactions on the web. They are not dependent on the operation of any system, and therefore all operations can be performed 24/7, without the intervention of the human factor and any possible errors or omissions. At the same time, cryptocurrencies are based on distributed ledgers and peer-to-peer mechanisms, which means that all persons involved in transactions support the operation of cryptocurrencies with their activities. Also, people benefit from the fact that all operations between them are anonymous, which means that people's names cannot be revealed, and no information leakages can occur for third parties. This allows for greater confidentiality and privacy of customers' data, which means that they are granted the opportunity to make their transactions freely. Operations with cryptocurrencies are often untaxed in developed states, which means that people also benefit from significant tax privileges when using cryptocurrencies instead of fiat money or other types of digital currencies. Finally,

cryptocurrencies also involve significantly smaller fees for transactions, which allows people sparing their fund they would otherwise be liable to pay as commission fees to banks or other financial institutions.

Another important function of cryptocurrencies is their contribution to improved security of financial transactions. As noted earlier in this thesis, thanks to the fact that the history of all transactions is recorded into the blockchain and no person has any control over this information, all people using cryptocurrencies can review the history of all transactions in the networks, which lowers the risks associated with possible direct control over transactions. Also, one of the main benefits of cryptocurrencies in terms of security is the fact that there are small opportunities of successful attacks on the part of hackers thanks to the effective security algorithms and tools used within cryptocurrency systems.

Marinova (2018) notes further that the blockchain technology itself, which is put into the core of cryptocurrencies, contributes effectively to the overall level of security in terms of operations in the financial market. Banks are already implementing blockchain in the structure of their security and protection systems. The technology is particularly popular and used widely in digital-only banks, where online security is of key importance for effective financial operations. Distributed ledgers used within the systems of banks' security allow lowering the risks associated with possible interventions from outsiders, and at the same time improve the quality of control on the part of bank managers. In its turn, this leads to improved conditions of service for bank customers, as they get an opportunity to operate more securely their funds in the course of transactions. Marinova (2018) notes further that banks tend to use cryptocurrencies more and more often in their financial operations alongside traditional currencies, and this is favoured by the growing use of blockchain technologies in bank security mechanisms.

Gupta (2017) notes that *"blockchain technology is being used to protect sensitive records and to authenticate the identity of a user. Keyless Security Infrastructure (KSI) stores data hashes on blockchains and runs a hashing algorithm for their verification. Public Key Infrastructure (PKI), an encryption approach which is particularly vulnerable to man-in-the-middle and DDoS attacks, is therefore deleted out of the equation".* Thanks

to this, banks get an opportunity to spot in a timely manner any possible events of data manipulation, and therefore can react more effectively to any such cases. Therefore, by using the basic technologies integrated in cryptocurrencies, banks can implement asymmetric security, which allows them treating more effectively possible vulnerabilities of banks' online security systems.

As the role of cryptocurrencies in the global financial sector is steadily growing, this leads to the fact that they act as important competitors of traditional fiat money and the services provided by banks. As a result, it can be stated that cryptocurrencies are an important factor driving higher competition in the financial sector, which in its turn contributes to improved quality of financial services obtained by customers from banks and other financial institutions. Thus, Marinova (2018) states that many banks have already integrated the use of cryptocurrencies into their financial services and transactions: *"HSBC recently said it performed the world's first trade finance transaction using blockchain technology. Santander last month launched a foreign exchange service that uses the distributed ledger tech to make same-day international money transfers. J.P. Morgan recently applied for a patent to facilitate payments between banks using the blockchain"*. Therefore, it can be stated that as of today, even large banking institutions are recognizing the importance of cryptocurrencies in effective customer service, and therefore invest funds in the development of their cryptocurrency-related business directions in order to get the leading positions in these banking segments.

Taggart (2018) further confirms this with other examples. Namely, the researcher states that *"one of the fintech companies backed by Goldman Sachs, Circle, recently purchased one of the most well-known and largest exchanges on the market, Poloniex. Most of us have likely seen the exchange before, even if we haven't used it. CNBC's "Fast Money" used the platform to show the public how to purchase cryptocurrencies and get involved in the industry…"*. Banks benefit from the opportunities offered by cryptocurrencies, as they can use their tokenized assets for easier and more effective management of other, traditional, assets. The use of cryptocurrencies further promotes banks' activities in the field of research and development, as banking institutions understand the indispensability of effective innovative growth for the sake of procuring long-term market stability and security. Also, it should be noted that the legislation of states tend to pay greater attention to the operation of cryptocurrencies in different

respects, and subsequent elaboration and development of legislation on this segment should contribute to further improvement of cryptocurrency-related products delivered to the market by banks and other financial institutions. The range and quality of financial products should be expected to keep growing further, while the associated costs for both financial institutions and their customers should be expected to keep decreasing. In the long run, all this contributes to customers improve experience in the financial market and to more effective performance of all financial transactions.

Therefore, based on the data outlined above, it can be stated that the development of the segment of cryptocurrencies brings major benefits to the whole global financial market, but also to the real economy, through a number of different mechanisms. Cryptocurrencies raise the quality of customers' financial operations, allow minimizing associated financial and time expenditures, raise the level of security of associated transactions, and contribute to growing competition in the financial market, which is beneficial for end customers. However, despite performing these important functions, cryptocurrencies also bear an important amount of risks which should be taken into account specifically by customers who use cryptocurrencies in their transactions.

According to Disparte (2018), the main risks and disadvantages associated with cryptocurrencies are the following:

- *lack of insurance and liquidity*. While one of the main growth factors of cryptocurrencies is the fact that double counting is done without any intermediaries, this feature also preconditions the fact that cryptocurrencies are illiquid. They are not recognized as currencies in most states, they are not used as widely as other digital currencies or fiat money, and therefore customers using cryptocurrencies in their transactions bear an important amount of risks. Also, due to the lack of any financial authority responsible for issuing and regulating cryptocurrencies, they remain uninsured. As a result, there are no guarantees, and all risks are borne by the customers using cryptocurrencies themselves.
- *High volatility*. Due to the fact that no governments have any direct control over cryptocurrencies, they are inherently volatile, and their exchange rate is subject to major fluctuations. This is also driven by the fact that the market

of cryptocurrencies is rapidly developing. Therefore, people holding cryptocurrencies risk of losing major funds in case of any adverse fluctuations of their exchange rate. Given the illiquidity of cryptocurrencies, the risks associated with high volatility are only further increased.

- *Risks associated with government controls and regulations.* The issue of cryptocurrencies is being considered by national authorities, as they understand the inherent risks associated with cryptocurrencies and possible consequences. Therefore, there are risks that the government might block the operation of cryptocurrencies, which would entail considerable losses for the holders of such cryptocurrencies.
- *Use of cryptocurrencies for illegal operations.* Due to the fact that cryptocurrencies guarantee anonymity of all transactions, they are very popular in Darknet, the illegal segment of the Internet. Cryptocurrencies are used widely for financial the production of pornography, sales of organs, and other cases of illegal activities paid with cryptocurrencies for avoiding controls on the part of law enforcement agencies.
- *Technological risks.* The mining of cryptocurrencies requires significant energy consumption, which only tends to grow in aggregate figures with the development of cryptocurrencies and expansion of the range of transactions in which they are used.

Taking into account the information on cryptocurrencies and their key functions and associated risks, it is now worth considering Ethereum as an example of a popular cryptocurrency, before proceeding to a more detailed analysis of this cryptocurrency in the practical part of the research.

3.5 Ethereum as One of the World's Major Cryptocurrencies

According to the definition provided by Ethereum (2018), Ethereum is a *"decentralized platform that runs smart contracts: applications that run exactly as programmed without any possibility of downtime, censorship, fraud or third-party interference. These apps run on a custom built blockchain, an enormously powerful shared global infrastructure that can move value around and represent the ownership*

of property". The basic scheme of Ethereum's operation is similar to Bitcoin and other cryptocurrencies: there are nodes which run mining operations based on the computing actions performed. Users of Ethereum can exchange funds between them. All operations are recording as new blocks to the common blockchain, and all such operations are visible to everyone using the network. Similarly, to Bitcoin, Ethereum is an anonymous cryptocurrency, and the history of transactions is visible publicly only in terms of use IDs and the amounts transferred. Historically, Ethereum was launched in 2015, and its developers were Vitalik Buterin, Gavin Wood, and Joseph Lubin. The main difference in the operation of Ethereum compared to Bitcoin is the fact that Ethereum uses smart contract. According to its developers, the use of this element was seen by them as a way to complement the existing drawbacks of Bitcoin, which didn't have a scripting language for development of applications.

According to Marr (2018), the initial plans for launching Ethereum appeared back in 2013. In 2014, the initiators of Ethereum launched a crowdfunding campaign within which they sought raising financing for their project, offering investors free Ether instead. In 2016, the company suffered a hacker attack as a result of which it lost USD 50 million. As a result of this event, the cryptocurrency's developers were split in two, and this gave birth to two cryptocurrencies: Ethereum (ETH) and Ethereum Classic (ETC). As Marr (2018) explains, *"it's still a very young platform, but its potential and applications could be limitless. Ethereum's infrastructure was enhanced over the last few years when it was challenged with security issues and since it's less monopolistic than Bitcoin, it is more open to reform measures that might ultimately make it a superior solution to Bitcoin."*

Marr (2018) notes that the main differences between Ethereum and Bitcoin can be described as follows:

- Ethereum offers more exchange methods compared to Bitcoin. While Bitcoin trades only in cryptocurrency, Ethereum offers methods of exchange such as cryptocurrency (Ether), smart contracts, and EVM (Ethereum Virtual Machine).
- Ethereum uses a different security protocol: 'proof-of-stake' instead of Bitcoin's 'proof-of-work'.

- Bitcoin allows public permissionless or censor-proof transactions, while Ehtereum allows permissionless or permissioned transactions.
- Mining in Ethereum is significantly quicker compared to Bitcoin: one block is mined during 12 seconds compared to Bitcoin's 10 minutes. As a result, there are more block confirmations, and Ethereum miners have an opportunity to mine more Ether.
- In Bitcoin, miners who confirm transactions are entitled to receive particular rewards. In Ethereum, no rewards are offered to miners, but they can set their transactions fees for the confirmation of other people's transactions in the system.

According to Rooney (2018), Ethereum developers are currently working on new solutions to improve customers' operations with the cryptocurrency. However, even despite being one of the world's major cryptocurrencies, as of today Ethereum is enduring considerable difficulties. Namely, one of the major issues faced by the developers of the cryptocurrency is the lack of the desired interest on the part of investors. Also, the cryptocurrency's exchange rate has been fluctuating significantly in recent years along with other cryptocurrencies, which only affects further Ethereum's opportunities for rapid market expansion. As Rooney (2018) explains further, *"Ethereum certainly has a first-mover advantage, but with that comes the target on its back. Cayman Islands-based start-up EOS, for example, has been billed as the "ethereum killer" and raised $4 billion in its ICO before the product even went live in June. While it had a rocky launch, the project is spending part of that treasure chest to incentivize developers to build applications on its platform, instead of Ethereum"*.

Therefore, based on this information, it can be stated that Ethereum is one of the world's most developed cryptocurrencies, but as of today the market is developing at a very rapid pace, and therefore the cryptocurrency might incur great risks affecting its stability in the future. Taking into consideration these facts, it is now worth proceeding to the practical part of the research and analysing more in detail the current trends persisting in the development of Ethereum.

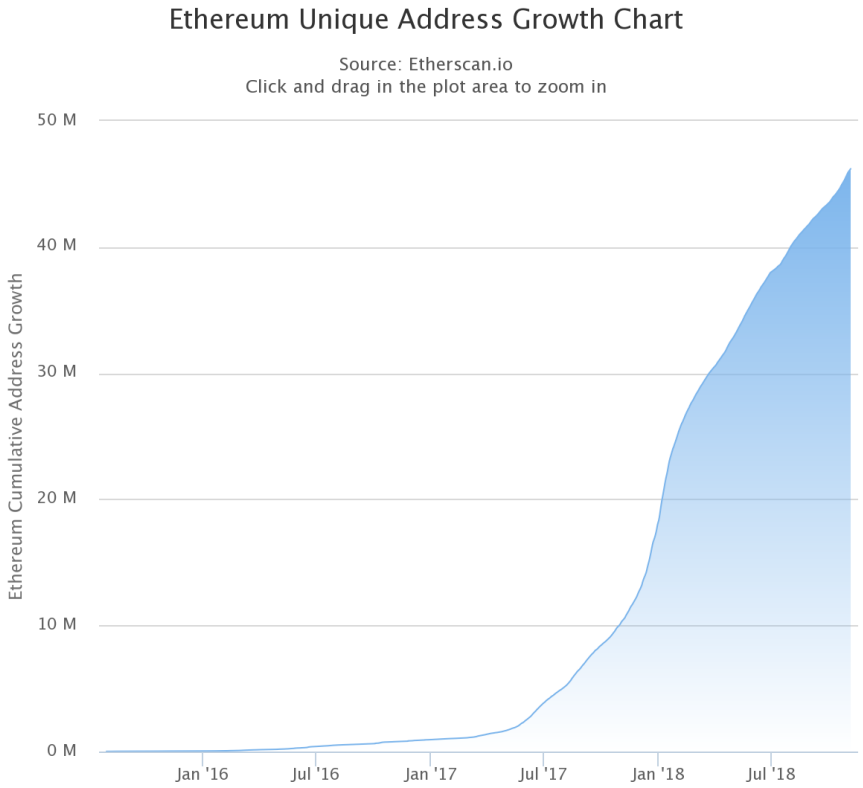
4 Practical Part

4.1 Dynamics of Ethereum Trade and Exchange Rate

To analyze more in detail the current usage of Ethereum as one of the world's most popular cryptocurrencies, it is worth investigating the statistics associated with Ethereum trade and exchange rate against both other cryptocurrencies and fiat currencies. This should allow understanding better Ethereum's current positions in the cryptocurrency market and its opportunities of subsequent growth.

According to Etherscan.io (2018), there are currently over 46 million unique addresses on the Ethereum blockchain.

Figure 5 Ethereum unique address growth chart



Source: Etherscan.io, 2018

As can be seen from the chart provided above, major growth started in late 2017. In one year, the total number of Ethereum unique addresses grew from slightly over

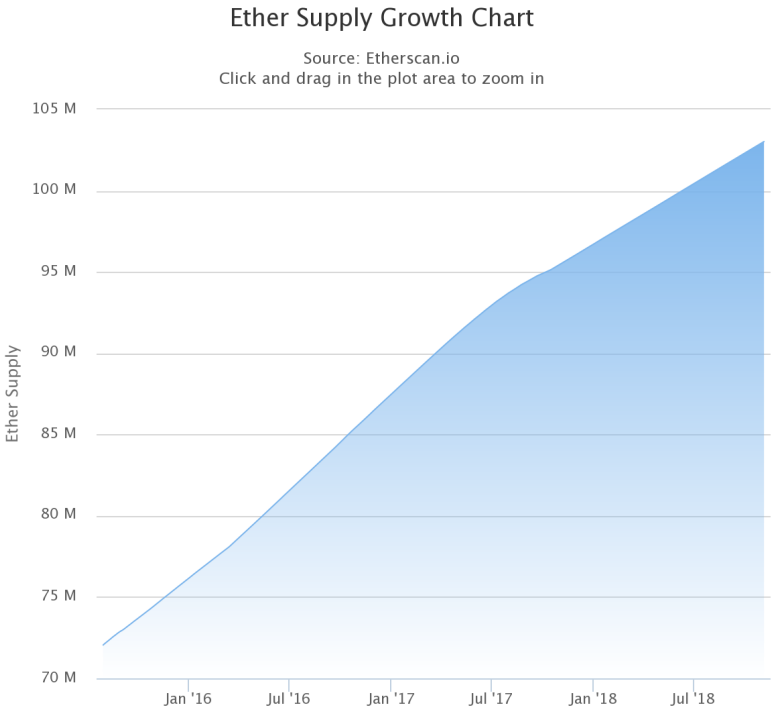
10 million to over 46 million, i.e. more than 4.5 times. This proves that Ethereum as a cryptocurrency is rapidly gaining popularity among customers, and is becoming more and more widespread in circulation on the cryptocurrency market.

Figure 6 Ethereum transaction chart (per day)

Source: Etherscan.io, 2018

The chart above illustrates that the total number of daily Ethereum transactions as of today amounts to over 580,000. Since December 2017, the average number of daily transactions has been dropping. In less than one year, this figure decreased from over 1,300,000 to over 580,000, i.e. more than twice. This can be associated with Ethereum's rapid popularization in December 2017.

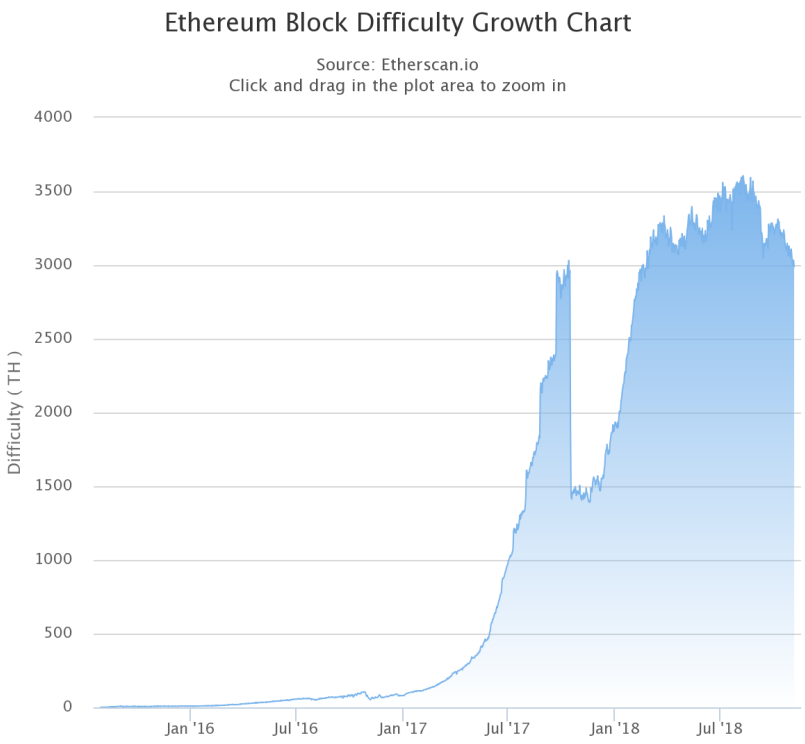
Figure 7 Ethereum supply growth chart



Source: Etherscan.io, 2018

The supply of Ethereum coins is growing steadily. As the chart above reveals, the current supply of Ethereum is over 103 million coins. I.e. it grew by over 40 % in the last three years. The cryptocurrency's growing total supply testifies that mining is being performed more actively, and therefore Ethereum is indeed popular among customers. The current trend testifies that further growth of Ethereum supply should be expected, however the rate of this growth tends to get slower with the course of time, just as with Bitcoin or other widely used cryptocurrencies.

Figure 8 Ethereum block difficulty growth chart



Source: Etherscan.io, 2018

Ethereum's block difficulty has remained rather steady in recent times, and has even dropped slightly. However, this trend rather occurs in iterated steps, and therefore on the next stage, further growth can be expected to occur, particularly with the growing number of total supply and decreasing reserves.

Figure 9 Ethereum historic market capitalization (USD)

Source: Etherscan.io, 2018

As revealed by the chart presented above, Ethereum's market capitalization has been decreasing steadily in recent years. The peak of the cryptocurrency's market capitalization occurred in December 2017, when the total value of capitalization amounted to over USD 130 billion. However, since then, the tendency has remained negative, and the current market capitalization of Ethereum is USD 21.52 billion.

Now, it is worth proceeding to an analysis of Ethereum's exchange rate against Bitcoin and against fiat currencies.

Figure 10 Ethereum to Bitcoin exchange rate

Source: Coingecko.com, 2018

As can be seen from the chart presented above, Ethereum's exchange rate against Bitcoin has been dropping recently. As of today, it amounts to almost 0.033 BTC per 1 ETH. The maximum value of the exchange rate was registered in June 2017, when it amounted to 0.147 BTC per 1 ETH.

Figure 11 Ethereum to USD exchange rate

Source: Coingecko.com, 2018

The tendency is even more prominent with Ethereum's exchange rate against the US dollar. As can be seen from the chart provided above, the current exchange rate of Ethereum against the dollar is USD 212.88 per 1 ETH. The peak value of the exchange rate in this pair was registered in January 2018, when 1 ETH was traded for USD 1,448.18. Therefore, this tendency confirms further that the relative purchasing power of the ETH has been devaluating steadily in recent years.

Figure 12 Ethereum to EUR exchange rate

Source: Coingecko.com, 2018

The patterns of Ethereum's exchange rate against the euro are similar to the patterns in the exchange rate of Ethereum against the US dollar. Currently, 1 ETH is worth EUR 186.43, while the peak value of the exchange rate in the pair was registered in January 2018: EUR 1,187.08 per 1 ETH. Since then, the exchange rate has been dropping steadily, with shorter periods of growth.

Therefore, analysing the dynamics of Ethereum's exchange rate against Bitcoin, the US dollar, and the euro, it can be stated that the tendencies have remained steadily negative in recent years. Therefore, it is worth understanding why the exchange rate of Ethereum has been dropping in order to understand further prospects that the cryptocurrency has in the financial market.

According to Shieber and Russell (2018), there are different opinions on the reasons of the negative dynamics of Ethereum's exchange rate and possible consequences of the process. While the cryptocurrency's founders affirm that the situation is due to market cycles, among cryptocurrency experts' opinions are less optimistic. As Shieber and Russell state, *"among some investors canvassed by TechCrunch, the sense is that with the downturn of the ICO funding boom that fuelled much of Ethereum's rise,*

there may be less incentive to hold as the broader market's interest in the cryptocurrency wanes". The authors note further that *"another long-term problem that Ethereum faces, according to this investor, is that the promise of decentralized apps backed by the token is yet to be released"*. Market experts believe that the recent negative price dynamics represent the first major test faced by Ethereum, which should prove the cryptocurrency's viability and ability to withstand market fluctuations, preserving its popularity among customers.

Carey (2018) notes that any fluctuations in Ethereum's exchange rate are associated closely with market rumours and speculations. As Carey notes, *"Ed Cooper, from the Revolut exchange, stated that the massive spikes and troughs "are fuelled by speculation". He stated: "the swings are fuelled by speculation rather than technological advances and so many people entered the space drawn by the price headlines only." Mr Cooper declared that the current "market movements" are not down to any "current news story" as he attempts to calm Ethereum investors."* Therefore, it can be stated that the market is still volatile, and the exchange rate of Ethereum is affected by a number of both objective and subjective factors. The situation tends to change with the perceptions of customers, which is also due to the fact that the status of cryptocurrencies, including Ethereum, is still not officially regulated in most countries in the world. This amount of fluctuations affects the opportunities of Ethereum's further growth, as it affects the interest of investors willing to purchase an amount of cryptocurrencies due to high risks.

Taking into account the trends with Ethereum outlined above, it can be stated that the effects with the cryptocurrency's dropping market capitalization and other negative tendencies outlined earlier in this chapter are intertwined closely. However, Partz (2018) notes that these tendencies affect not only Ethereum, but also other cryptocurrencies, including Bitcoin. After their rapid growth in previous periods, the second half of 2018 was marked by a rapid depreciation of all cryptocurrencies and their decreasing market capitalization. At the same time, Partz affirms that these negative tendencies only strengthen further the positions of Bitcoin against other cryptocurrencies: *"during this downward trend on the market, Bitcoin has again seen significant growth in terms of dominance over the rest of cryptocurrencies. Going in parallel with the sharp plunge of the markets, Bitcoin's dominance has significantly increased over a short period of time,*

up one percent, currently amounting to 54.3 percent. This is the highest point of BTC dominance over the past two weeks." If the trend persists, the relative value of Bitcoin compared to other cryptocurrencies can only be expected to grow further. Therefore, the founders of Ethereum should evaluate carefully all risks and develop a strategy which would allow ensuring the minimization of risks and maximization of the cryptocurrency's growth. Yet this is complicated by external factors, and namely by the fact that Ethereum is not recognized as an official means of payment in most countries, as stated earlier in this research.

Therefore, as can be seen from the information presented above, one of the key obstacles for cryptocurrencies as of today is the lack of their explicitly defined legal status in most states. This raises the volatility on the market of cryptocurrencies, and consequently raises the risks incurred by the users of cryptocurrencies all over the world. Taking into account this fact, the next chapter of the thesis will be dedicated to an analysis of Ethereum's legal status in different countries.

4.2 Legal Status of Ethereum in Different Countries

Prior to proceeding more specifically to an analysis of the legal status of Ethereum, it is worth first providing a brief overview of the general legal status of cryptocurrencies as a kind of financial assets functioning based on its own principles.

According to Rooney (2018), the issue of cryptocurrencies is among the most important issues in the agenda of the world's most developed states as of today. Thus, at a G20 meeting in March 2018, among debate on cryptocurrencies, the representatives of the central banks of the United Kingdom, Italy, Argentina, and a number of other states claimed for the need to leave cryptocurrencies in their free circulation on the market, opposing the offers to ban cryptocurrencies. This opinion was also supported by international institutions. Thus, as Rooney notes, *"the Financial Stability Board, a global watchdog that runs financial regulation for G-20 economies, took a cautious tone in responding to calls from some countries to crack down on digital currencies. "The FSB's initial assessment is that crypto-assets do not pose risks to global financial stability at this time," board Chairman Mark Carney said in a letter on March 18."* The opinion of the International Monetary Fund was rather more cautious:

the international organization stated that cryptocurrencies have a significant potential of use for the purpose of money laundering and financing of terrorism, and therefore they should be regulated in a similar way as assets in the traditional financial sector.

Analysing more specifically the legal status of cryptocurrencies in different countries, Rooney (2018) notes the following. In Japan, cryptocurrencies enjoy an official legal status, and cryptocurrency exchanges are recognized as legal if they are registered officially with the Japanese Financial Services Agency. In the United States, cryptocurrencies do not have a legal tender status, however policies on cryptocurrency exchanges are different depending on each particular state. Furthermore, the opinions of different regulators on the status of cryptocurrencies differ, and therefore there is ongoing debate as to the use of cryptocurrencies and their regulation by official authorities. As for the European Union, Rooney states, *"no EU member state can introduce its own currency, according to European Central Bank President Mario Draghi. EU leaders have voiced concern about money laundering. European Commission Vice President Valdis Dombrovskis, pictured above, said at a February roundtable in Brussels that digital assets "present risks relating to money laundering and the financing of illicit activities."* In the United Kingdom, cryptocurrencies are not a legal tender. In South Korea, cryptocurrencies are not a legal tender; the operation of cryptocurrency exchanges is permitted, but the use of anonymous accounts on such exchanges is prohibited for the population. In China, the use of cryptocurrencies is totally prohibited, and all cryptocurrency exchanges are seen as illegal. However, Rooney notes that *"activity in crypto has carried on through alternative channels like mining. Chinese authorities are looking to end the practice, according to Reuters, which cited an internal memo from a government meeting in January".* In Singapore, cryptocurrencies are not a legal tender, but the operation of cryptocurrency exchanges is permitted under the regulation of the local authorities. In India, cryptocurrencies are not a legal tender, but cryptocurrency exchanges can operate without additional restrictions. In Switzerland, cryptocurrencies are seen as legal means of exchange, and exchanges should be registered with the Swiss authorities.

O'Neal (2018) notes that *"the Russian government has maintained a mixed stance on Bitcoin and cryptocurrencies, proposing legislation to ban it outright, and then retracting those statements. However, once President Vladimir Putin announced*

his decision to begin crypto regulation, a substantial bill was introduced, which the State Duma has recently approved, in its first reading. The document was expected to enter into force on July 1, although official confirmation is yet to surface." In other Eastern and Central European states, the stance toward cryptocurrencies is rather mixed as well. Thus, in Poland, the trading and mining of cryptocurrencies is recognized officially, however the government considers further prospects of cryptocurrencies sceptically in the light of the general European trend toward considering them as a powerful tool of money laundering and terrorist financing. In Ukraine, cryptocurrencies enjoy no official legal status. However, there are rumours that the Ukrainian government is considering legalizing the use of cryptocurrencies. In Belarus, the businesses operating based on blockchain was legalized through official regulations in 2018. Furthermore, the Belarusian government provided significant tax holidays for business operating with cryptocurrencies and for individuals: no income in cryptocurrencies should be declared with the tax authorities until January 1, 2023. According to experts, this is seen as a definite step on the way toward subsequent popularization of cryptocurrencies in Belarus and the complete legalization of their use. In Estonia, Latvia, and Lithuania, cryptocurrencies do not enjoy the status of a legal tender, and the governments have a prudent stance toward such assets, but the use of blockchain technologies on the state level has been expanding steadily in recent years. As for the Czech Republic, O'Neal states that the government had initially adopted liberal views toward the use of cryptocurrencies; *"however, by the end of 2017, the Finance Ministry introduced an anti-money laundering law restricting Bitcoin. The bill requires crypto exchanges to reveal the identity of customers, so that they will no longer be able to "hide behind fake names or nicknames". The Finance Ministry argued that virtual currency might be linked to criminal activity and tax fraud."* As for the stance of the Croatian government toward the use of cryptocurrencies, O'Neal states that *"currently, Bitcoin and altcoins are not legal tender in Croatia, but can be legally used. Reportedly, there's a capital gains tax on cryptocurrencies (12 percent and a surtax of 18 percent for Zagreb), however there are no clear official guidelines on how they should be paid".*

Therefore, based on the information on the legal status of cryptocurrencies in different states outlined above, it can be noted that as of today cryptocurrencies still

do not enjoy the status of a legal tender in most jurisdiction, which limits the scope of their use. Furthermore, in most countries, the official bodies have not adopted any explicit regulations to govern all issues associated with cryptocurrencies. It can be stated that the official authorities are rather monitoring the current trends and tendencies in the cryptocurrency market and have postponed their decisions until such trends and tendencies become more evident. One of the main obstacles on the way to the legalization of cryptocurrencies and their greater use is the associated risks of cryptocurrencies' involvements in activities associated with money laundering and terrorist financing. As the use of cryptocurrencies is based on anonymity, this raises official bodies' concerns regarding their appropriateness for running illicit operations, and this can be seen as one of the key restraining factors in the development of cryptocurrency assets.

Focusing specifically on the legal status of Ethereum, Antonovici (2018) notes that the US authorities are considering the issues associated specifically with Ethereum, as it is the world's second largest cryptocurrency in terms of market capitalization. The main question is whether Ethereum should be treated as securities. As Antonovici notes, *"when it comes to Ether, some regulators believe the token is in a "grey zone," but its creation back in 2014 resembled an illegal securities sale… In 2014, Ethereum Foundation, which developed the blockchain-based project, conducted an initial coin offering (ICO) – a form of fundraising, but didn't register the deal with the SEC and sold the tokens to anyone willing to purchase."* Considering the specificities of Ethereum's functioning, US regulators claim that Ethereum Foundation has direct control over the price of the cryptocurrency: *"regulators have researched the Ethereum Foundation's impact on the asset's price. The foundation is known to pay "bug bounties," which reward participants who fix bugs in Ethereum's code. This is a sign that the non-profit organization has an indirect influence on the token's value, one of the people familiar with the matter hinted."* According to official bodies, this is one of the main signs testifying that the same legal regulations should apply to Ethereum as to all securities. However, Ethereum Foundation denies its opportunity of controlling the price of Ethereum. Also, a number of market experts oppose the regulator's inclination toward considering Ethereum as a type of securities.

However, in recent months, the SEC has decided not to consider Ethereum as a type of securities, primarily due to the cryptocurrency's decentralization. Harrer (2018) notes further that while the SEC's speech cannot be considered as a legal regulation, it still affects directly the expectations of cryptocurrency customers, including the customers of not only Ethereum, but also other cryptocurrencies. As Harrer states, *""decentralization" is what takes Ethereum and Bitcoin out of the securities realm. So, what is "decentralization"? In the case of tokens, it appears defined in large part by the absence of a "central actor" or third party who meaningfully determines "the enterprise's success. Bottom line: Ethereum and its offshoot, Ethereum Classic, (which Coinbase added this week) are in the clear, and it's a safe bet another popular cryptocurrency that is highly decentralized — Litecoin — is, too."* Nevertheless, the definition of securities is still vague as applied to cryptocurrencies, and therefore most smaller cryptocurrencies fall into the so-called 'grey' zone, and therefore can be targeted by the authorities in subsequent periods. This is also true speaking of Ethereum, as the opinion of the public bodies can change. Possible recognition of Ethereum as a security would affect significantly the cryptocurrency's positions in the market and would lead to its major losses in terms of both the number of users, transactions and market capitalization.

ConsenSys (2018) notes that earlier growth of Ethereum has prompted the governments of a number of states to consider the issues associated with the cryptocurrency's legal status more in detail. Thus, *"in the beginning of this year, the government of Brazil announced its intention to move petitions and popular voting onto Ethereum. Canada is testing out using Ethereum to provide transparency to the use of government grants to ease citizens' concerns of misappropriation and corruption."* In addition to this, Ethereum is now used for providing citizen IDs in the city of Zug, Switzerland. The Chilean government is using Ethereum to monitoring and control in the field of energy production and is using the associated blockchain technologies for ensuring greater transparency in public management and for providing citizens with the best opportunities of control over the government's activities. As ConsenSys (2018) states further, *"Dubai is on the move to become an entirely integrated, blockchain-powered city by 2020. Estonia became the poster child of the distributed ecosystem and matured into a "digital republic" by moving many of its national systems onto*

the Ethereum blockchain." Therefore, based on these examples, it can be stated that while the legal status of cryptocurrencies, including Ethereum, still remains undefined in most countries over the world, the current tendencies definitely favour Ethereum's greater use in a number of domains by public bodies, which contributes positively to the cryptocurrency's growth prospects, and to further extension of the areas of its application.

Sunny (2018) cites a case from a Chinese court which occurred in 2018. Although cryptocurrencies are officially prohibited for circulation in the country, the Shanghai Hongkou District has ruled that the owners of cryptocurrencies still enjoy the rights of protection of their property, namely speaking of Ethereum and Bitcoin. As the court stated, in Sunny's translation, *"although the state does not recognize the monetary attributes of so-called "virtual currency" such as the currency, it does not deny that the Ethereum is generally protected by the law as a property in the general legal sense".*

Thus, it can be stated that the market of cryptocurrencies is still affected greatly by the lack of a clearly identified legal status of cryptocurrencies in different states, the sphere of such assets' usages is gradually growing on the global scale, and the use of cryptocurrencies by official bodies tends to keep growing as well. Subsequent collisions between the two trends and their opposition should be seen as one of the key factors affecting the actual prospects of cryptocurrencies, including Ethereum.

Taking into consideration the facts presented in this chapter, it is worth now proceeding to an investigation of possible subsequent development scenarios of Ethereum and the cryptocurrency's growth prospects in the future.

4.3 Possible Subsequent Development of Ethereum

As stated earlier in this thesis, the prospects of Ethereum should be considered within the wider prospects of cryptocurrencies, especially in terms of the legal status of cryptocurrencies in different countries and the existence of specific barriers to hinder the growth and development of the cryptocurrency market. This chapter is going to focus more specifically on the prospects of Ethereum, without paying attention to the wider

prospects of cryptocurrencies as a type of assets, as this issue has already been discussed earlier in the thesis.

According to Bovaird (2018a), Ethereum as a cryptocurrency is rather undervalued today, and therefore it has some great growth potential: *""I still see ETH as having the brightest prospects of any cryptocoin, both as a platform for dapps etc. and as a globally usable digital money/store of value," said Jacob Eliosoff, a cryptocurrency fund manager. By fulfilling that role, the digital currency is far more than its current market capitalization, he stated."* On the present stage, Ethereum's price is low, and its deviation from the average price of Bitcoin is quite great, which makes experts think that the market is not in a normal condition. Given the popularity of Ethereum and the emergence of new exchanges and services working with Ethereum all over the world, the cryptocurrency has all the required preconditions to become more widespread on the market in the near future. However, Bovaird states that not all experts share this opinion on Ethereum's prospects: Michael Conn, founder and managing partner of blockchain advisory and investing firm Quail Creek Ventures, stated, *""I wouldn't buy it at its current price." Conn emphasized that while Ethereum "continues to be the most robust platform for creation and buildout," ether has been suffering "significant downward pricing pressure.""* Therefore, it can be stated that there is no unequivocal opinion on the future price trends of Ethereum, which can be associated namely with the overall vagueness of the prospects of the cryptocurrency market.

Among the positive factors contributing to Ethereum's growth perspectives, Bovaird (2018b) notes the integration of new technologies and the use of Ethereum in a growing number of different technological applications: *"whether it's Sharding, Plasma, or OpenST Mosaic, there are tremendous technological reasons to be bullish on Ethereum and to believe in a speculatively high price moving in 2019. Ethereum is aggressively oversold and overdue for a rally going into 2019."*

Kaplan (2018) cites the creators of Ethereum stating, *"what you're seeing with ethereum is exponential increase in the number of projects — there are billions of dollars being poured into the ecosystem right now — maybe 10 times more projects this year than last year, which could easily lead to a doubling, probably a tripling in price by the end of the year"*. The main difference between Bitcoin and Ethereum

is that the former was initially created for operating as a peer-to-peer electronic payment system, Ethereum's initial destination was to service smart contracts. As a result, the creators of Ethereum see the range of Bitcoin's application as rather limited, while Ethereum has prospects to be used widely in a variety of industries, specifically those which are growing rapidly. Another important advantage of Etehreum is the fact that it can process transactions more quickly, and the price of its use is considerably lower. Therefore, in addition to smart contracts, Ethereum also has a great potential to develop as a cryptocurrency used by people for their transactions and settlements. As Kaplan (2018) argues, *"in the current year that is 2018, it is predicted that Ethereum would reach around $ 2500. By the end of next year that is 2019, it is expected that Ethereum would be somewhere around $ 14,000. Similarly, by the end of the year 2020, it is assumed that Ethereum would be around $ 31,000."*

According to King (2018), *"when it comes to discussing Ethereum crash, many Ethereum price predictions tend to look sceptical at it. Many thinks of Ethereum as the soil of cryptocurrency — so many things are built on it. For these reasons, it is hard to imagine that Ethereum will crash without then recovering afterwards."* The author states that the recent negative dynamics with Ethereum's price movements should not be seen as an indicator of the cryptocurrency's decline, but rather as an element of wider market fluctuations. The cryptocurrency market has great growth opportunities, and this is proven by the fact that governments refrain from introducing their control over the industry or banning the use of cryptoassets in most developed states. Therefore, in the near future, Ethereum should be expected to keep growing, even though some periods of decline can occur. The long-term upward growth trend will be affected by the emergence of new competitors on the cryptocurrency market and by the effectiveness of the conditions offered by them to target customers.

To understand better the prospects of Ethereum, it is also worth providing a brief overview of modern applications operating based on the use of Ethereum. According to NewGen Apps (2018), one of the revolutionizing apps in the industry operating based on Ethereum is EOS: *"EOS uses its own blockchain and offers an operating system like architecture that allows for both horizontal and vertical scaling. Horizontal scaling here means that multiple contracts can be executed simultaneously which will improve the speed. In this way, it combines the best of both Bitcoin and Ethereum. These unique*

characteristics give EOS an upper hand over Ethereum." Other important innovative projects based on the use of Ethereum-based technologies include VeChain Thor, Tron, OmiseGo, and ICON. VeChain Thor is an industrial solution destined to maximize the effectiveness of business supply chain management based on the use of blockchain technologies. Tron is a decentralized platform aimed at eliminating intermediaries between content consumption and distribution. According to NewGen Apps (2018), the main functions of Tron include *"free and uncontrolled use of data for both creators and consumers of content; a content ecosystem that allows users to spread content and obtain digital assets in return; the ability for creators to introduce their personal ICO around the main TRX; supportive Infrastructure for the exchange of distributed digital assets and market forecasting".* OmiseGo is a banking platform operating based on smart contracts and offering decentralized banking services to customers. Finally, ICON is a project aimed at uniting different blockchain technologies without any centralization of their interaction. NewGen Apps (2018) states that *"the project has been recently started and raised 150,000 ETH on its first token sale in October 2017. If this project is successful it can be used as the connecting bridge for communications between different institutions like hospital and insurance companies, e-commerce, and currency etc."*

Therefore, as can be seen from the information presented above, Ethereum is used widely in a great number of different industry-specific applications. This proves that the cryptocurrency and its basic technologies are popular among a wide range of customers. The development of these and other field-specific platforms in the future will require further involvement of Ethereum and other cryptocurrencies and blockchain technologies, which should contribute positively to Ethereum's growth opportunities.

As noted by Katalyse.io (2018), despite the positive factors contributing to Ethereum's growth prospects, there are also potential obstacles which should be taken into account by both the developers of Ethereum and the investors in the cryptocurrency: *"the fact that so many active projects run on the Ethereum network is both an advantage and a disadvantage. As the number of users on the network begins to expand, the quintessential blockchain conundrum of scalability becomes an issue. Unless Ethereum is able to come up with a creative way around this issue then it will most likely suffer the inevitable resolution of all scalability related conflicts—hard forks."* This trend

will be causing negative pressures on the prospects of Ethereum on the market of cryptocurrencies. Also, one of the main negative factors is the fluctuations of customers' opinions based on possible negative expectations. In order for Ethereum to maintain its steady positions on the cryptocurrency market, negative customer expectations should be avoided. However, this is dependent on a large number of factors, including those beyond the control of the cryptocurrency's creators. Based on the previous findings of the thesis, it is possible to assume that this will be preconditioned to a large extent by the actual trends associated with the regulation of cryptocurrencies in the legal field and the stance adopted toward cryptocurrencies by governments of different states.

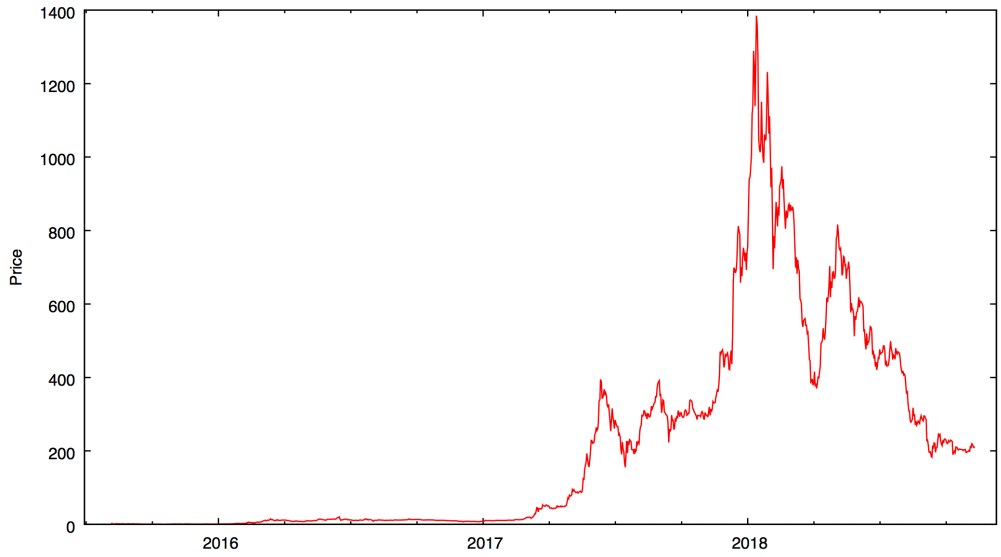
Therefore, based on this overview of Ethereum's further prospects of development on the market of cryptocurrencies, it can be stated that experts do not share a common opinion: while some posit that Ethereum's growth should be restored soon and the cryptocurrency has great opportunities to achieve subsequent development in different industries, some experts claim that negative tendencies can persist, and therefore the prospects of the cryptocurrencies might be affected considerably. Furthermore, the reliability of any forecasting in this case is affected by the overall volatility of the cryptocurrency market: the future of Ethereum is definitely dependent on the overall conjuncture of the financial market and the market of cryptoassets, and therefore the cryptocurrency's subsequent growth will be dependent on a wide range of factors.

4.3.1 Ethereum price forecasting using ARIMA model

Time series can be better understood by usage of an autoregressive integrated moving average, also known as ARIMA. By using ARIMA model the Ethereum price will be forecasted.

The ARIMA model is conducted from three different parameters also knows as p d q. To identify the "d" parameter, firstly it is needed to determine whether the time series is stationary or not. Therefore, following null hypothesis will be tested.

Figure 13 Ether price's trend from Gretl



Source: Gretl computation

H0: time series has a unit root.

HA: there is no unit root.

The time series plot is generated in Gretl software to perform a vision control as a sub step in verification of the null hypothesis.

As may be seen from the figure number 13 the values of the time series apparently are not fixed around a mean value. To verify the conclusion, ADF Unit roof test will be used.

Figure 14 Augmented Dickey Fuller test from Gretl

```
Augmented Dickey-Fuller test for Price
including 21 lags of (1-L)Price
(max was 22, criterion AIC)
sample size 1178
unit-root null hypothesis: a = 1

  test with constant
  model: (1-L)y = b0 + (a-1)*y(-1) + ... + e
  estimated value of (a - 1): -0.00468282
  test statistic: tau_c(1) = -2.06594
  asymptotic p-value 0.2588
  1st-order autocorrelation coeff. for e: -0.002
  lagged differences: F(21, 1155) = 8.522 [0.0000]

  with constant and trend
  model: (1-L)y = b0 + b1*t + (a-1)*y(-1) + ... + e
  estimated value of (a - 1): -0.00890813
  test statistic: tau_ct(1) = -2.67351
  asymptotic p-value 0.2477
  1st-order autocorrelation coeff. for e: -0.002
  lagged differences: F(21, 1154) = 8.643 [0.0000]
```

Source: Gretl computation

Figure 15 Augmented Dickey Fuller test 2 from Gretl

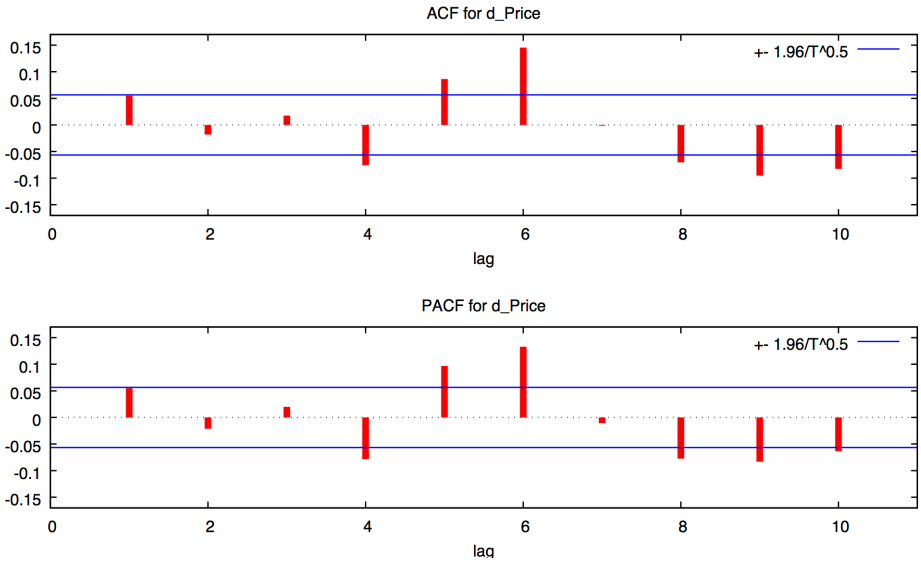
```
Augmented Dickey-Fuller test for d_Price
including 22 lags of (1-L)d_Price
(max was 22, criterion AIC)
sample size 1176
unit-root null hypothesis: a = 1

  test with constant
  model: (1-L)y = b0 + (a-1)*y(-1) + ... + e
  estimated value of (a - 1): -0.741984
  test statistic: tau_c(1) = -6.1329
  asymptotic p-value 5.7e-08
  1st-order autocorrelation coeff. for e: -0.003
  lagged differences: F(22, 1152) = 8.311 [0.0000]

  with constant and trend
  model: (1-L)y = b0 + b1*t + (a-1)*y(-1) + ... + e
  estimated value of (a - 1): -0.74499
  test statistic: tau_ct(1) = -6.1429
  asymptotic p-value 5.146e-07
  1st-order autocorrelation coeff. for e: -0.003
  lagged differences: F(22, 1151) = 8.301 [0.0000]
```

Source: Gretl computation

The Augmented Dickey Fuller test was provided to verify the null hypothesis. The p-value generated in the test is above 0.005. Therefore, the null hypothesis is accepted.

Now when the time series is evaluated as non-stationary with a Unit root, the second step in the "d" value determination is to perform another ADF test from a first-degree differenced time series.

Figure 16 Correlogram of the differenced time series



Source: Gretl computation

The second ADF test performed from a differenced time series with a p-value 5.7e-08 leads to rejection of the null hypothesis. Therefore, the first-degree differenced time series is evaluated as stationary and number 1 will be used as the "d" in the ARIMA model.

Next step is to determine the "p" and "q" parameters of the ARIMA model. To do that, a correlogram is created from the first-degree differenced time series.

At the correlogram with lags up to 10 in figure 16 it appears, that the "p" and the "q" parameters tends to be significant at the same levels. The most significant lags appear to be at the level 5, 6 and 9. Various combinations were created for a comparison.

In the table 1 various combinations are compared by values of Schwarz's, Akaik's and Hannan-Quinn's criteria.

Table 1 Various ARIMA models' comparison

	Akaik's criteria	Schwarz's criteria	Hannan-Quinn's criteria
ARIMA (5,1,6)	10757,17	10823,33	10782,09
ARIMA (5,1,9)	10799,82	10881,25	10830,50
ARIMA (6,1,6)	10758,93	10830,18	10785,77
ARIMA (9,1,6)	10737,90	10824,41	10770,49

Source: Own table based on Gretl computation

According to the criteria, ARIMA (9,1,6) is the most accurate model.

Figure 17 The selected ARIMA model 9, 1, 6

```
Function evaluations: 227
Evaluations of gradient: 63

ARIMA(9,1,6):
ARIMA, using observations 2015-07-31:2018-11-10 (T = 1199)
Estimated using Kalman filter (exact ML)
Dependent variable: (1-L) Price
Standard errors based on Hessian

             coefficient   std. error      z        p-value
  ---------------------------------------------------------
  const       0.169240     0.597634       0.2832   0.7770
  phi_1       0.882466     0.0656610     13.44     3.54e-41  ***
  phi_2      -0.946365     0.0693774    -13.64     2.29e-42  ***
  phi_3       1.08273      0.0552297     19.60     1.43e-85  ***
  phi_4      -1.14340      0.0648239    -17.64     1.25e-69  ***
  phi_5       0.956841     0.0935902     10.22     1.55e-24  ***
  phi_6      -0.838677     0.0665163    -12.61     1.89e-36  ***
  phi_7       0.143472     0.0485269      2.957    0.0031    ***
  phi_8      -0.159867     0.0417126     -3.833    0.0001    ***
  phi_9      -0.00449637   0.0370974     -0.1212   0.9035
  theta_1    -0.864502     0.0589999    -14.65     1.30e-48  ***
  theta_2     0.927501     0.0594204     15.61     6.31e-55  ***
  theta_3    -1.04126      0.0303504    -34.31     5.99e-258 ***
  theta_4     1.02322      0.0446800     22.90     4.53e-116 ***
  theta_5    -0.745653     0.0708319    -10.53     6.48e-26  ***
  theta_6     0.825145     0.0345249     23.90     3.06e-126 ***

Mean dependent var   0.176731   S.D. dependent var   22.47292
Mean of innovations  0.000068   S.D. of innovations  20.97510
Log-likelihood      -5351.948   Akaike criterion     10737.90
Schwarz criterion    10824.41   Hannan-Quinn         10770.49
```

Source: Gretl computation

As can be seen in the figure 17, all of the parameters are statistically significant except the phi_9 due to the p-values below the level 0,005. Therefore, the ARIMA (8, 1, 6) was conducted, but all of the criteria were higher than those of the ARIMA (9, 1, 6).

The selected ARIMA model (9, 1, 6) is now used for an ex-post prognosis to evaluate, if the model is suitable for an ex-ante prognosis or not. The criteria used to evaluate the suitability of the model is the MAPE criteria – Mean Average Percentage Error.

Figure 18 Ex-post 14 days prognosis using ARIMA (9, 1, 6)

2018-10-25	201.23	207.85			
2018-10-26	203.37	202.54			
2018-10-27	202.79	210.41			
2018-10-28	203.72	203.25	21.140	161.82 -	244.68
2018-10-29	195.67	207.14	30.189	147.97 -	266.31
2018-10-30	196.19	205.03	36.921	132.67 -	277.39
2018-10-31	197.85	201.29	43.052	116.91 -	285.67
2018-11-01	198.73	200.33	47.828	106.59 -	294.07
2018-11-02	201.02	193.79	52.673	90.56 -	297.03
2018-11-03	199.47	193.86	59.301	77.63 -	310.08
2018-11-04	211.30	190.01	65.805	61.03 -	318.98
2018-11-05	209.70	190.73	71.333	50.92 -	330.54
2018-11-06	219.56	192.09	75.703	43.72 -	340.47
2018-11-07	217.99	192.64	79.683	36.46 -	348.81
2018-11-08	211.29	197.90	83.631	33.98 -	361.81
2018-11-09	209.39	198.15	86.925	27.78 -	368.52
2018-11-10	211.90	202.96	89.715	27.12 -	378.80

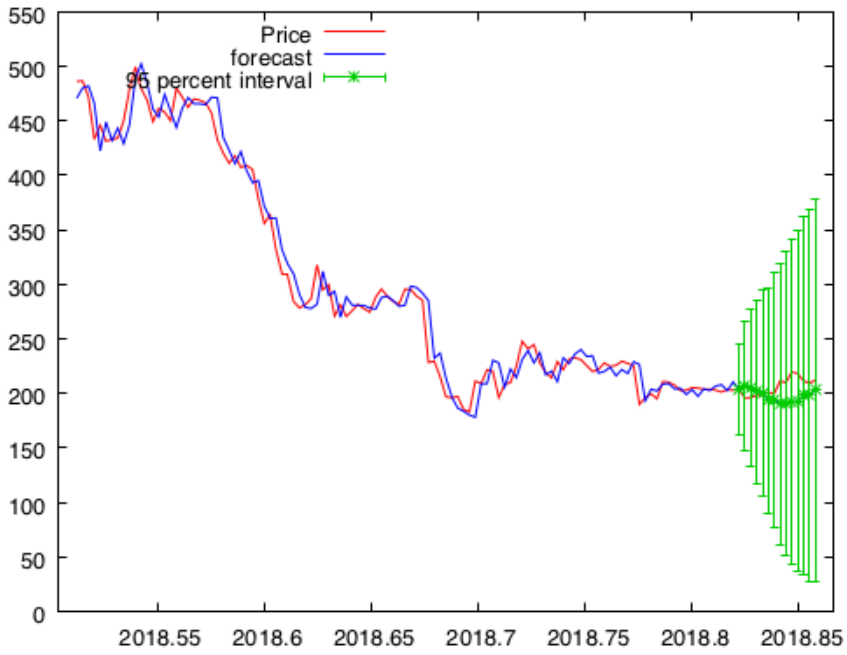
Forecast evaluation statistics

Mean Error	4.3268
Mean Squared Error	115.63
Root Mean Squared Error	10.753
Mean Absolute Error	7.7148
Mean Percentage Error	1.9935
Mean Absolute Percentage Error	3.6964
Theil's U	2.666
Bias proportion, UM	0.16191
Regression proportion, UR	0.58234
Disturbance proportion, UD	0.25575

Source: Gretl computation

As can be seen in figure 18, the MAPE of the ex-post prognosis by using the selected model is 3.7 %. From the figure 19 it may be evaluated as a prognosis relatively close to the real price.

Figure 19 Graph of an ex-post 14 days prognosis



Source: Gretl computation

The ex-post prognosis is also performed for the last 28 days to determine whether a forecast of the price would be suitable with a similar MAPE also for next 28 days as for 14 days.

Figure 20 Ex-post 28 days prognosis using ARIMA (9, 1, 6)

2018-11-02	201.02	202.32	105.295	-4.06 -	408.69
2018-11-03	199.47	203.06	108.265	-9.14 -	415.25
2018-11-04	211.30	199.26	111.278	-18.84 -	417.36
2018-11-05	209.70	198.75	114.282	-25.24 -	422.74
2018-11-06	219.56	198.35	117.123	-31.21 -	427.91
2018-11-07	217.99	197.91	119.704	-36.71 -	432.52
2018-11-08	211.29	201.66	122.214	-37.88 -	441.19
2018-11-09	209.39	201.33	124.455	-42.60 -	445.26
2018-11-10	211.90	205.26	126.599	-42.87 -	453.39

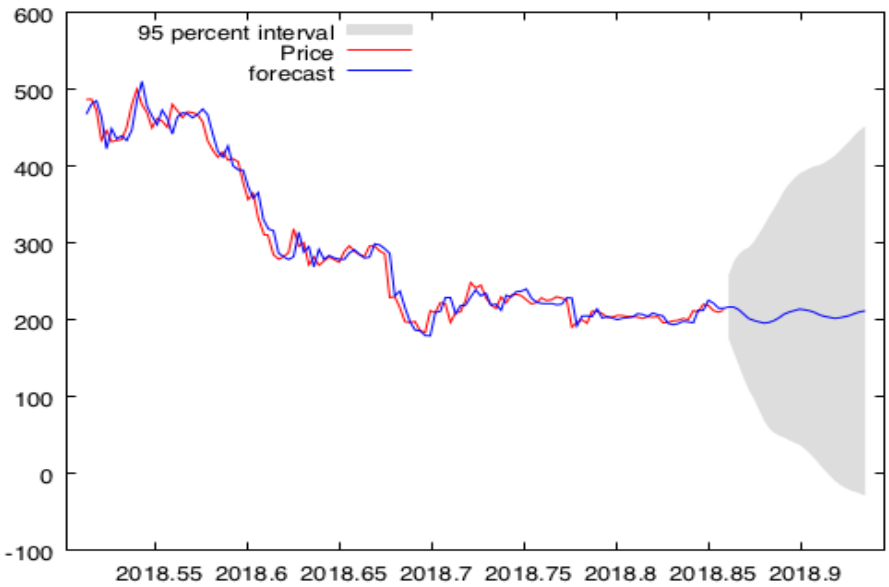
Forecast evaluation statistics

Mean Error	0.77283
Mean Squared Error	126.17
Root Mean Squared Error	11.233
Mean Absolute Error	8.6828
Mean Percentage Error	0.22976
Mean Absolute Percentage Error	4.0892
Theil's U	1.2685
Bias proportion, UM	0.0047338
Regression proportion, UR	0.18385
Disturbance proportion, UD	0.81141

Source: Gretl computation

In the figure 20 the MAPE of the 28 days ex-post prognosis is 4.09 %. The MAPE in this case is more similar to the MAPE of the 14 days ex-post prognosis than expected because of the volatility of the Ethereum price. Even when there might be some unexpected events that have unexpected effect to the Ethereum price, the ARIMA (9, 1, 6) model seems to be relatively accurate as can be also seen in the figure 22.

Figure 21 Ethereum's price forecast

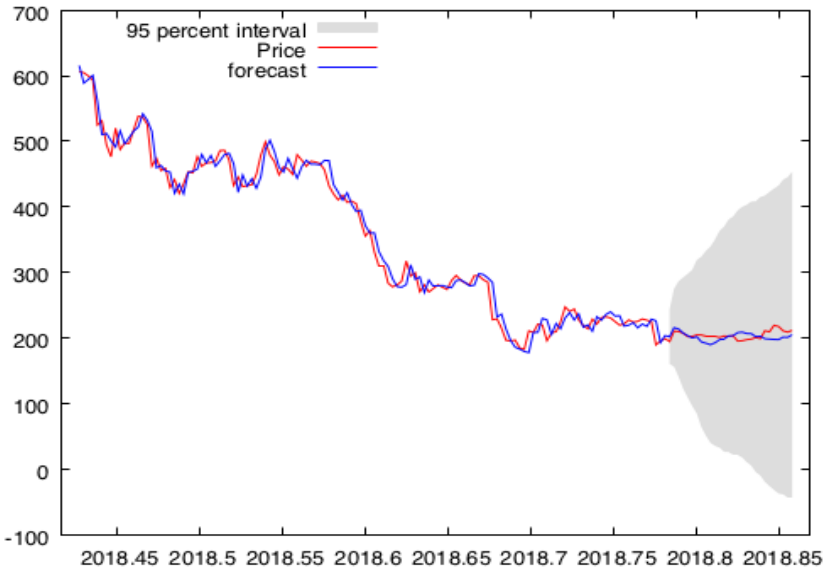


Source: Gretl computation

For the relative accuracy of the estimated model, the ARIMA (9, 1, 6) is used for a 28 days ex-ante prognosis as a forecast.

The 28 days forecast of Ethereum price is shown in the figure 21 and appears to be oscillating around the level of 205.92 USD. As the ex-post prognosis for the last 28 days has been evaluated as accurate with a MAPE of 4.09 %, the forecast of the Ethereum price might be evaluated as highly probable. Even if an unexpected event happens, the price should stay in the 95 % grey zone in the next 28 days.

Figure 22 Graph of an ex-post 28 days prognosis



Source: Gretl computation

At first sight the selected ARIMA model might appear as a suitable model to forecast Ethereum price, because of the relatively low error rate indicator MAPE, that was around 4 % in a 28 days ex-post prognosis. However, when it comes to daily trading, 4 % seems to be a significant difference, when the "spread" - transaction fee is around 3 %. The forecast might seem relatively accurate despite the high volatility of the Ethereum price, nevertheless, the volatility of the price is not only due to natural variation, but also connected with price manipulation. Therefore, it would be very risky to implement the selected model into a day-to-day trading only by itself.

To understand the situation further better and to check Ethereum's practical positions, the next chapter of the thesis will be dedicated to an interview to be held with the manager of a company dealing with cryptocurrency trade in Europe, and namely with transactions based on Ethereum. The interview is expected to provide additional data and information on an expert's vision of the cryptocurrency's further growth prospects and opportunities of its use in different industries.

4.4 Interview with the Manager of a Company Operating Ethereum

The interview presented in this chapter was held with the manager of a company in Central Europe operating with cryptocurrencies and offering services associated with transactions in cryptocurrencies and exchange of cryptocurrencies. In accordance with the agreement with the manager, the name of the company is not disclosed. The interview was held using Skype messenger and lasted approximately 40 to 50 minutes. Important information was registered and subsequently processed by the thesis author. The questions used in the interview are presented in Appendix 1 to this thesis. The main purpose of the interview was to reveal the manager's opinion on the current situation with Ethereum, the prospects which the cryptocurrency has on the market given the existing trends, and to analyze what investors in cryptocurrencies in general should expect from the market in years to come.

Answering the question about the specificities of his company's operation, the manager stated that the company offers a range of services to customers aiming at simplifying their settlements with cryptocurrencies. First of all, the company allows its customers paying their invoices with cryptocurrencies, namely with Bitcoin and Ethereum. The company performs all the required operations with the exchange of customers' funds from cryptocurrencies into fiat currencies and credits the required amounts to the accounts of the transferees. This allows customers using their cryptocurrency funds for paying a wide range of services without any additional difficulties, inconveniences or time losses. All operations are carried out instantly, which contributes to fast payments and set-offs. The company also allows customers linking their bank account within the system, so as to ensure automatic replenishment of their cryptocurrency reserves as soon as some expenses occur. The company operates in a number of European jurisdictions and allows crossborder payments for its customers. For raising the convenience of all operation, customers enjoy round-the-clock support from the company's customer service. The company has been involved in a series of effective coin offerings, and it enjoys steady interest on the part of third-party investors. The company operates based on the use of innovative technologies and sees this approach as a key competitive advantage in its target market. Also, the company operates a platform based on Ethereum, which focuses on the creation of cryptocurrency funds by individuals.

As for the range of cryptocurrency services offered, the manager stated that his company only focuses in servicing customers' transactions in Bitcoin and Ethereum. The choice of these two cryptocurrencies is preconditioned by the current market conjuncture and the demand existing on the part of customers. The manager stated that the company considers the opportunity of including other cryptocurrencies in the range of its services, but it is complicated by a number of factors. Namely, the company's management studies thoroughly the associated risks. While Bitcoin and Ethereum are used widely, some of the less popular cryptocurrencies imply high risks of involvement in illicit operations associated with money laundering and terrorist financing. Therefore, the manager stated that the company is evaluating possible risks and possible issues in terms of legal compliance. Also, the introduction of new cryptocurrencies will be associated directly with the expected financial return they can bring to the company.

Answering the question related to the reason for the company's choice of Ethereum as one of the cryptocurrencies served, the manager stated that Ethereum is an obvious choice due to the cryptocurrency's current popularity on the market: it is the world's second leading cryptocurrency in terms of market capitalization after Bitcoin. Also, the technologies associated with Ethereum are used widely in a great range of operations beyond settlements of cryptocurrencies. Namely, while Bitcoin is only used for such settlements, Ethereum's basis is the use with smart contracts, which allows the company extending significantly the range of applications of Ethereum, providing it with additional opportunities and further prospects of effective profit generation.

Regarding the current downward trend with Ethereum, the manager stated that the company considers it as a temporary event. The manager believes that such fluctuations are rather speculative in their nature and are preconditioned to a large extent by negative expectations of customers due to the negative attitude toward cryptocurrencies spread in the media. This situation affects not only Ethereum, but also all cryptocurrencies, and the manager believes that an upward trend will follow soon. Already today, a number of governments recognize the need to provide a legal status to cryptocurrencies, and the gradual shift of their opinion to a positive stance toward cryptocurrencies should become one of the main factors contributing to the market's growth. In overall terms, in addition to the manager's positive expectations regarding

the price dynamics of Ethereum, he also stated that the use of the cryptocurrency's blockchain technology for smart contracts has great prospects in a wide range of industry-specific fields. As a result, the company believes that the presence of Ethereum in its business portfolio in the near future should be one of the main factors of its growing popularity and should generate steady interest on the part of target customers on the cryptocurrency market.

The company's platform for creating cryptocurrency funds in Ethereum has been operating for almost two years already. The system was designed by the company with the aim of diversifying its business portfolio more from Bitcoin, and to cover a wider range of target audience for the purpose of generating its steady interest and generation of additional income. With the launch of its Ethereum-based platform, the company pioneered this niche in the target market and conquered new customers. After a successful initial coin offering, the platform started growing rapidly and became popular among customers not only in Central Europe, but also beyond. The company provides all customers with a zero-commission fee period in its system for a trial period of one month. During this time, customers can run all their transactions in Ethereum without paying any additional commission fees. This approach was chosen by the company as a kind of marketing activities, and the manager believes that this is one of the important steps to promote interest on the part of customers in cryptocurrencies. As there is negative advertising of cryptocurrencies in the media, the company believes that customers should try transactions in such currencies first in order to understand that the operations are trouble-free and cheap. The company's income is generated from trading operations of institutional investors. The company does not disclose its customers anonymity in operations with amounts below EUR 1,000. However, in any transactions exceeding this amount, the company discloses the identity of the participants. The main reason for it is the need for the company to maintain its full legal compliance and to avoid possible risks associated with its customers performing operations related to money laundering and terrorist financing.

Naming the main advantages for the customers associated with the use of the company's Ethereum-based services, the manager stated that the main advantage is the simplicity of use, lack of any additional difficulties in operations with cryptocurrencies, and transparency. The company believes its mission

to be the simplification of all transactions for the sake of allowing customers to operate with cryptocurrencies more conveniently. At the same time, they continue enjoying anonymity, as most transactions occur below the threshold level of disclosure set by the company. As for the company's Ethereum-based platform, it is a unique platform for creating private funds in Etehreum and developing them. The main risk is that control over such funds is limited, but proficient investors can earn significant profits from such activities, and they do not have to incur great costs as in the case with traditional financial institutions.

The use of distributed ledgers and smart contracts is another important advantage for customers, which minimizes the risks they incur and contributes to the customers' greater opportunities in their transactions with cryptocurrencies in different sectors. As stated earlier in this chapter, this is one of the main reasons why the company currently prioritizes Ethereum over other cryptocurrencies in its business portfolio and why the manager thinks that Ethereum's future is bright on the market.

As for the regulation of the company's activities, the manager stated that his company complies fully with all the rules applicable to financial companies in the European Union. Even though cryptocurrencies themselves are not regulated, as the company processes transactions in cryptocurrencies and provides a platform for the performance of such operations, it has to comply in full with the requirements applicable under European law in order to avoid possible negative consequences from the legal perspective. The company's management also sees it as a key prerequisite for guaranteeing maximum customer protection and for minimizing the risks incurred by customers. However, the manager confirms that the overall situations with the lack of governments' unequivocal stance to the issue of regulation of cryptocurrencies is one of the main destabilizing factors, which affect negatively the overall growth of the market. In the manager's opinion, legalization of cryptocurrencies is unavoidable in the long-term perspective, as the amount of their use is growing steadily.

As for the investors in cryptocurrencies, the manager believes that no excessive risks are borne by people who are proficient in operations with cryptocurrencies. In the manager's opinion, people who are not well acquainted with the principles of cryptocurrencies and are not experienced in cryptocurrency trading should refrain

from being involved in such transactions. Cryptocurrencies can be used without any risk as a tool of payment. However, when people want to operate such cryptoassets in a way to create and manage investment funds, this requires specific knowledge and skills. Otherwise, the risks become quite high, but they are not due to the nature of cryptocurrencies and their operation. Choosing the cryptocurrency to invest in, the manager stated that recommendations can be different for different investors. Thus, investors can build their portfolio taking different amounts of risks and pursuing either quick and riskier or delayed and less risky profits. Furthermore, as the marker is very volatile, it is impossible to forecast reliably how each cryptocurrency will be performing. In the short-term perspective, even smaller cryptocurrencies or market newcomers can demonstrate very rapid growth, and investment in them can be a very effective tool in the hands of speculative investors. The manager expects both Bitcoin and Ethereum to preserve their leading positions in the market of cryptocurrencies in years to come. In his opinion, Ethereum will take an even more rapid growth as soon as the trend becomes upward again. Nevertheless, the manager recommends that all transactions be carried out by investors only with their complete understanding of possible consequences based on a thorough evaluation of the risks incurred. This is the only way to minimize possible negative outcomes.

Therefore, based on the findings of the interview presented above, it can be stated that as of today, Ethereum is indeed one of the world's major cryptocurrencies, and it enjoys great growth opportunities on the cryptocurrency market. One of the key competitive advantages of Ethereum is the fact that the basic technologies used in the cryptocurrency are used in smart contracts, and therefore Ethereum can be used effectively in a wide range of industry-specific applications. Investing in Ethereum should be seen as a valid way to use one's funds on the market of cryptocurrencies, yet all associated risks should be evaluated in a grounded and justified manner. The manager's company will continue focusing on the development of its Ethereum-based portfolio, and the company's Ethereum fund management platform is seen by the manager as its core business asset.

Taking into account these findings, it is now possible to discuss the results of this chapter and to summarize the information revealed in it.

4.5 Discussion of Results

The findings of this chapter testify that as of today, Ethereum is the world's second major cryptocurrency in terms of the total amount of transactions and market capitalization beyond Bitcoin. The Ethereum platform developing Ethereum's blockchain provides a set of unique blockchain technologies for smart contracts, which makes the range of the cryptocurrency's possible applications considerably wider than only in settlements between individuals and companies. This is one of the main reasons for the popularity of Ethereum, including for its use by the governments of a number of states.

Recently, Ethereum has been demonstrating negative price and market capitalization dynamics. The main reason for this negative trend is the overall downturn on the cryptocurrency market. All major cryptocurrencies have been losing in price, and Ethereum follows the general trends. However, in the opinion of experts, the situation can take various development in the future: the majority of cryptocurrency market professionals agree that an upward trend should follow soon, and it will be the main tendency preconditioning the market's growth in the future. Although Ethereum is currently losing to Bitcoin as its main competitor, it can also take faster growth as soon as the trend becomes reversed. One of the favourable factors contributing to Ethereum's growth prospects is the cryptocurrency's versatility, flexibility, and applicability in a wide range of industry-specific fields.

Also, according to experts, the overall situation on the Ethereum segment will be affected by the same risk factors as the wider cryptocurrency market. Namely, a key issue remains the lack of a unified approach toward the regulation of cryptocurrencies on the part of governments. This situation, with negative advertising run by the media, is one of the reasons for the dissemination of negative expectations among the population fuelling the current downward trend. Nevertheless, further legalization of cryptocurrencies can be expected in the future, and this is favoured in particular by governments' growing use of blockchain technologies in their security mechanisms.

The interview with the manager of a Central European company focusing on the operations with cryptocurrencies, and namely with Ethereum, proved the findings of secondary research. Despite the current persistence of negative market trends,

the company is confident in Ethereum's growth in the future, and therefore bases its core business operations on the use of Ethereum and the associated technologies. As the manager stated, Ethereum is overall more versatile compared to Bitcoin, and its applicability in industry-specific environments can be seen as one of the main positive factors to favour its growth in years to come. In order to avoid additional risks, guarantee maximum transparency and provide its customers with additional incentives to engage in operations with cryptocurrencies, the company focuses on full legal compliance and integrated innovative blockchain-based technologies in the operation of its business platforms. Thus, its investment fund management platform based on the use of Ethereum is a unique market product which allows the company holding its niche positions on the market and standing out among its key competitors.

The company plans to develop this direction of its business activities further, as it expects the market of cryptocurrencies in general to resume growth. However, the manager noted that the company deals cautiously with other, smaller, cryptocurrencies. This is namely due to the fact that some of them are involved in illicit activities consisting in money laundering and terrorist financing. Therefore, on the present stage, the company refrains from extending the range of cryptocurrencies served within its portfolio.

Overall, the findings obtained prove that Ethereum has growth prospects in the future, and therefore should be considered by investors in cryptocurrencies as one of the first choices. Nevertheless, as the manager suggested, all investment in cryptocurrencies should be done carefully and with due knowledge of the sector. Otherwise, risks of loss become high, as the market is quite volatile and subject to significant fluctuations. If investment is carried out with due knowledge, it can be expected to provide investors with profits in the long-term perspective.

Conclusion

Traditional cash payment systems are gradually losing their importance in the current conditions. They are no longer sufficient for serving effectively the needs of both corporate and individual customers all over the world, and therefore non-cash payment systems are becoming more widespread. The development of non-cash payments is favoured by the steady development of online and digital technologies, growing use of portable devices and new forms of quasi-banking services on the global scale.

Among the most up-to-date non-cash payment technologies, it is worth noting in particular cryptocurrencies, a new form of virtual currencies based on the of the blockchain technology. Cryptocurrencies operate based on a distributed ledger and cannot be controlled from a single centre. As a result, this means of payment in the online environment allows customers remaining anonymous, at the same time preserving the integrity of their data and ensuring smaller commission fees compared to traditional financial institutions' services.

The world's most widely used cryptocurrencies include Bitcoin and Ethereum. Other, smaller, cryptocurrencies are emerging on the market and rapidly gaining popularity. While such cryptoassets are becoming widespread, the market is fluctuating significantly, and no price stability has been achieved yet. This is namely due to the lack of official recognition of cryptocurrencies on the part of governments of most states.

Recalling the research questions stated in the beginning of the thesis, answers can be formulated as follows:

- RQ1: How is the future of Ethereum dependent on legislative initiatives of governments?

Governments' legislative efforts are among the main factors affecting the development of cryptocurrencies on the global scale in general, and namely of Ethereum. Investors' condition on the cryptocurrency market is vulnerable, as the situation tends to change rapidly. Moreover, cryptocurrencies are used for the purposes of illicit activities such as money laundering and terrorist financing. In order to minimize the risks associated with this situation and to provide people and companies with the free opportunities of using cryptocurrencies in their settlements,

the ultimate solution of the issue on the part of governments and international organizations is required.

- RQ2: What different scenarios of the development of events are possible for Ethereum in the future.

Using the ARIMA model, it was evaluated that the price trend of Ethereum should be expected to remain downward in months to come. This is due to the overall negative trends existing on the cryptocurrency market. Nevertheless, expert estimates testify that the trend should revert soon. As cryptocurrencies' prices will start growing, Ethereum could demonstrate an even higher growth rate compared to Bitcoin, as it can be used in a wider range of applications, namely thanks to the basic technologies associated with smart contracts. The ultimate opportunities of Ethereum's subsequent development and growth will anyway depend on the general patterns of governments' attitude to cryptocurrencies all over the world.

The **hypothesis** stated in the beginning of the thesis was the following:

- H1: Legislative obstacles should be expected for Ethereum's development on the part of governments due to the threats the cryptocurrency imposes on centralized financial systems.

The hypothesis cannot be either confirmed or disapproved. Thus, the findings of the thesis testify that governments' attitude toward cryptocurrencies has become loyal in recent years, as public bodies recognize the steadily growing use of such cryptoassets by people and companies around the globe. However, the risks associated with the involvement of cryptocurrencies in money laundering and terrorist financing might affect governments' decisions in relation to cryptocurrencies.

If the market remains stable and no radical changes are implemented on the legislative level, Ethereum's prospects on the cryptocurrency market can be evaluated as overall positive.

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Appendix

Appendix 1 Structure of the Interview

1. Please describe briefly the nature of your company's business and the specificities of its activities with cryptocurrencies.
2. What are the cryptocurrencies you currently work with and why?
3. Do you plan to extend the range of cryptocurrencies in the future?
4. Why do you focus specifically on Ethereum?
5. Taking into account the current negative tendencies in terms of Ethereum's price and market capitalization, how would you evaluate the associated risks?
6. Overall, you believe that the prospects are great with Ethereum? What are the main reasons for it?
7. Please describe your application that operates based on Ethereum.
8. What are the main advantages for the customers?
9. Do you think that Ethereum will continue penetrating into particular sectors through its particular blockchain technology?
10. To which extent is your business regulated, and which risks are borne by both you and your customers?
11. How would you rate the overall level of stability on the cryptocurrency market?
12. What recommendations would you provide for private investors in cryptocurrencies as of today? Bitcoin or Ethereum?