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THE IMPACT OF BLOCKCHAIN TECHNOLOGY ON CAPITAL MARKETS IN SLOVENIA

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VOCABULARY

AI - Artificial Intelligence
AML - Anti money laundering
API - Application Programming Interference
ASIC -An application-specific integrated circuit
BFTT- Byzantine fault tolerance
CCP - Central clearing party
CSD - Central security depository
dApp - Decentralized application
DLT - Distributed Ledger Technology
ETF - Exchange Traded Fund
FDI - Foreign direct investments
FinTech - Financial industry technology start-ups
FMU - Financial Market Utility
Hashrate - Hash per second, a speed at which a compute is completing an operation
HFT - High Frequency Trading
ICO - Intial Coin Offering
IOT - Internet-Of-Things
IPO - Initial Public Offering
KYC - Know your customer
P2P - Peer-to-peer
PoS - Proof-of-stake
PoW - Proof-of-work
Regtech - Regulation technology start-ups
SAFT - Simple Agreement for Future Tokens
STP - Straight Through Processing

INTRODUCTION

The financial crisis in 2008 revealed several shortcomings of the financial system, particularly, the credit crisis (Benmelech & Dlugosz, 2010), which led to increased regulation along with low economic growth (GDP Growth, 2017). Financial services must adopt the emerging fintech technologies to cut costs and provide better services through efficiency, such as almost instantaneous settlement, removal of clearing houses or even completely changing the current infrastructure (PWC Global research team, 2016).

In response to the changes in the last decade, some of the biggest financial companies, such as J.P Morgan in 2014, recognized the risk of fintech start-ups disrupting traditional banks along with API-platforms and technologies like Bitcoin, specifically addressing the need for a better understanding of these encryption techniques, cost reductions with blockchain, improvement of real-time systems and a better understanding of hurdles associated with the new technology (JPMorgan Chase & Co., 2014). Merely in 2017, J.P Morgan announced in their annual report that they: *"have assembled talented teams to drive innovation in artificial intelligence, blockchain technology, big data, machine learning and bots, with the objectives of improving our efficiency and enabling us to serve more clients with greater effectiveness, depth and sophistication. As a result, many of our initiatives are already showing promise in terms of charting their future expansion and application.*" (JPMorgan Chase & Co., 2017).

Financial services have been shown to be increasingly disrupted over the recent years with a number of emerging start-ups redefining services with different financial technology also referred to as "fintech". The fintech industry has been rising year-over-year with the total global investment funding of over $30 billion. As the market is maturing, investors are focusing on value and long-term sustainability. Furthermore, blockchain, along with insurtech, has seen a record number of VC investment deals exceeding $1 billion in 2016 and $0.5 billion in 2017. The growing interest in regulatory technology, also referred to as "regtech" and moreover AI and IoT, interconnects with the blockchain technology (Pollari et. al., 2017).

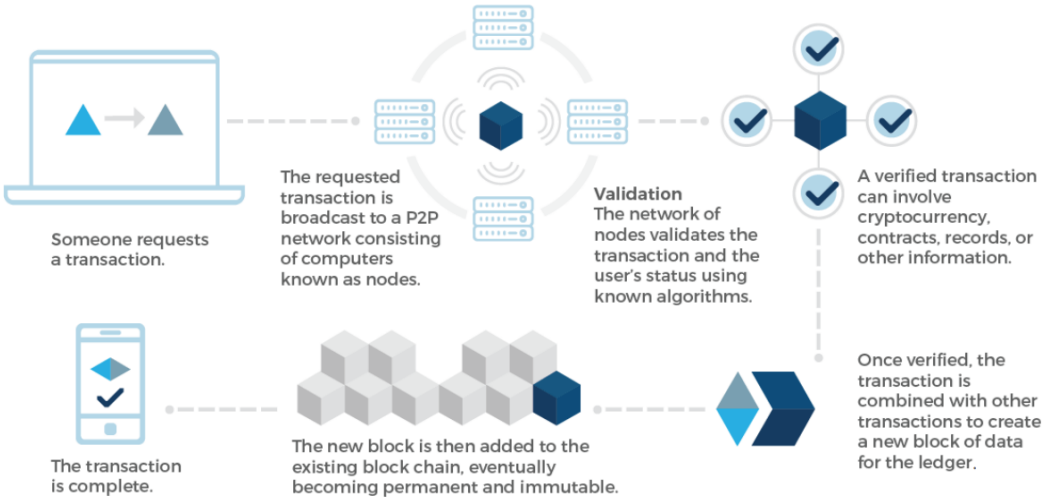
The blockchain technology is not only disruptive but foundational (Iansiti & Lakhani, 2017) and is considered one of the most prominent opportunities - but as such in an early stage of development - as it has the potential to transform the current infrastructure and eliminate central authorities (Pollari et. al., 2017). Our economical, legal and political systems are based on layers of contracts which govern transactions and records. Governance is based on these contracts and plays a vital role in the society by defining managerial and social actions of nations, companies and individuals. The blockchain technology promises a change in how we regulate and maintain administrative control and could introduce new ways of

governance, however, governments have been unable to keep pace with this new technology (Pollari et. al., 2017).

Blockchain is a decentralized network bypassing intermediaries, which is creating a new world of financial services that operate in a sharing economy that includes initial-coin-offerings (ICO), peer-to-peer lending, payments and other crowdfunding projects. It has "the power to harness the infrastructure of the market itself" (Amin, 2016).

Blockchain fuels hope towards new changes and represents a push towards transparency and independence from the central authorities. In the future, many intermediaries could be replaced by digital contracts with decentralized governance, which would eliminate the need for traditional intermediaries like law offices and courts, for example (Pollari et. al., 2017). The removal of intermediaries would have an immense impact and would make blockchain a foundational technology, which in turn could change the social and economic infrastructure of our society (Amin, 2016).

Figure 1: Transaction process in blockchain environment



Source: Meiklejohn &Cary (2017).

In a report by the PwC Global research team (2016), one third of executives in the capital market industry perceive that their biggest challenge lies in adopting new technologies alongside with increasing client profitability and retaining talented employees (PWC Global research team, 2016).

Over the history, the capital market was transformed by technology several times, ranging from innovations such as electronic exchanges, high frequency trading (HFT), and exchange traded funds (ETFs) (Diaz-Raineya, Ibikunleb & Mentionc, 2015). Even though a transaction may occur instantaneously for an investor, the main shortcomings derive from the fact that post-trade processing requires the work of multiple key participants (World

Economic Forum, 2016). This is why there is a need for advancements in settlement optimization, client on boarding KYC/AML, standard settlement instructions, collateral management, regulatory audit and reporting, which would result in a decrease in settlement time and would lower costs by up to fifty percent (Accenture, 2017).

The main participants in capital markets use centralized databases. These databases are fragmented, with different database architecture. Such outdated management systems and databases are still a part of earlier market infrastructures and are not shareable or cannot distribute data as efficiently (Pinna & Ruttenberg, 2016).

To address the current weaknesses of capital markets, industry participants have recently begun looking for an answer in the distributed ledger technology (DLT), which was first introduced with Bitcoin. Blockchain protocols, such as Bitcoin, mainly resolve peer-to-peer markets and payments, which are not the focus of this thesis. The focus is rather on the blockchain's potential as a standardized database, which can communicate and share KYC/AML thus reducing costs and aligning the settlement value chain. The distributed ledger technology allows for a universal database without the use of a centralized authority, which can potentially be used in financial markets in order to keep track of a distributed ledger. Bitcoin was released to the public in 2008 (Nakamoto, 2008), meaning that DLTs are still in an early market phase, and as such, their impact and potential use in capital markets remain unclear (van Oerle & Iemmens, 2016).

DLTs can offer enhanced tracking, clearing and settlement of trades through a universal database without a centralized management system, however, some processes in the middle- and back-office would still be processed by a centralized authority. This potential use of DLT could have impacts on European markets for securities, collateral, derivatives and cash. DLTs could resolve the outlined problems in capital markets but the financial industry relies on the regulatory framework of the European Union. A regulatory framework is key for the adoption of blockchain technology by the key market participants in capital markets (Pinna & Ruttenberg, 2016).

This thesis contains an in-depth theoretical-analytical overview of literature and research including publications in the field of the addressed topic. This part of the thesis is analyzed with the help of descriptive methods and compilation methods.

The thesis consists of four main chapters which are then additionally split into sub-chapters. In the introduction, I present the addressed problem and point out the main focuses of the thesis.

The thesis researches four main questions on:

- How can blockchain impact processes in capital markets?
- How and which processes in the capital markets can the blockchain technology impact in short term?

- What are the benefits of the main actors in capital markets adopting blockchain technology?
- How can the main actors in the capital markets in Slovenia adopt the blockchain technology?

The first chapter deals with a review of literature on the distributed ledger technology including its main features and impacts. I also present relevant literature on the opportunities and risks of DLTs in capital markets. Additionally, I research various practical actions that companies can take to benefit from the use of DLT. In the third part, I review the potential future implications of the distributed ledger technology in capital markets. The thesis researches and overviews the impacts on post-trading processes (clearing and settlement) and new ways of private-equity investing.

The second chapter presents the role of capital markets, their main participants and key processes in private equity and security markets. Through literature, the thesis will furthermore present the inefficiencies in the processes of capital markets today. Due to regulatory issues with implementing DLT, this thesis includes the current regulatory view of the European Union on DLT and their regulations regarding capital markets. Aside from literature review, the thesis includes an overview of the capital market industry in Slovenia.

Finally, in the practical chapter of the thesis, a structured interview is used to obtain insights on the current perspective on capital markets directly from its main participants. Through these insights, the thesis evaluates the short-term actions that the main participants in capital markets in Slovenia can take to overcome the shortcomings of the current technology in capital markets. The conclusion section includes an analysis of capital markets which might benefit from the use of DLT and the main conclusions of this thesis.

1 BLOCKCHAIN

1.1 Introduction to the blockchain technology

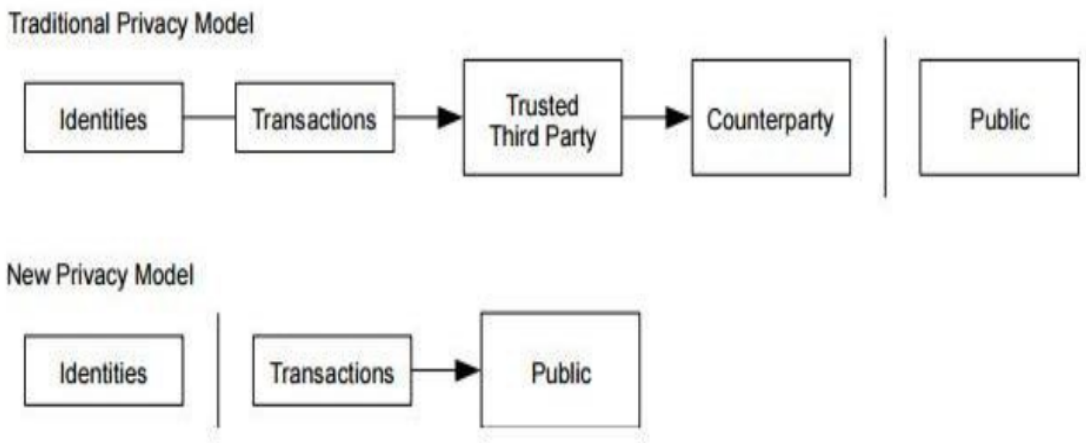
Blockchain was invented by Satoshi Nakamoto in 2008 with the cryptocurrency Bitcoin and its underlying blockchain protocol. By publishing the whitepaper *Bitcoin: A Peer-to-Peer Electronic Cash System*, an individual or a group of individuals under the pseudonym Satoshi Nakamoto featured a peer-to-peer payment network where value is exchanged and stored through a digital currency. Blockchain uses what is known as distributed ledger technology (hereinafter: DLT) (Investopedia, 2018), which is "an open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way" (Pollari et. al., 2017).

The blockchain is a fully decentralized public ledger. The blockchain network is encrypted and secured by numerous individuals or organizations, also referred to as miners, which dedicate a node to participate in the network. By participating, a miner is securing the network through different blockchain consensuses. Through a cryptographic proof, the network is able to verify and trust each block to be added onto the decentralized ledger. By keeping the decentralized ledger up to date with the network of decentralized nodes it solves the double spending problem without the need for a trusted authority or a central intermediate (Brito & Castillo, 2013). Whenever a change occurs on the ledger, it is replicated onto identical databases across the network of interested parties. Hence, "no need for third-party intermediaries to verify or transfer ownership" (Pollari et. al., 2017). Alas, blockchains are exposed to some security risks like the "51 % attack", the "selfish-mining attack", the "death spiral", etc. (Sprecher & Gallersdörfer, 2017).

A decentralized public ledger is simply a distributed database system as described by Özsu and Valduriez (2011), who state that a distributed database system is a collection of multiple, logically interrelated databases distributed over a computer network. The same researchers point out a difference between a system and a management system since a management system permits the management of the distributed database and makes the distribution transparent to the users (Özsu & Valduriez, 2011).

Before the blockchain technology, as seen in Figure 2 below, two individuals could trade financial assets or make transactions online with the assurance that money has not already been spent through a central authority which keeps up a centralized ledger. In the case of blockchain, a trusted third-party is not required as the decentralized ledger is upheld with the blockchain network and thus allows anyone to access and see the ledger.

Figure 2: The difference in making transactions online



Source: Rudina (2016).

A blockchain can be tailored with aligned incentive systems to ensure specific features, like immutability, security, verifiability, resilience, transparency, and from these, a blockchain's traits derive its main benefits (Meiklejohn & Cary, 2017). An additional overview of blockchain strengths lacking in the current environment can be seen in Table 1.

Table 1: Overview of blockchain strengths in the current environment

Strength	Description	Authors
Blockchain is distributed	By being a distributed database, it removes the threat of errors from the central authority.	Iansiti and Lakhani (2017); Tapscott and Tapscott (2017)
A single source of truth	All transactions reside on one single blockchain which is distributed, immutable and publicly available.	Iansiti and Lakhan (2017); Tapscott and Tapscott (2017); Underwood (2016)
No downtime	Due to the distribution and replication of the ledger by miners and validators of the network.	Lemieux, 2016; Tschorsch and Scheuermann (2016)
Transparency	Participants can write, read or participate in a publicly accessible manner.	Tapscott and Tapscott (2017); Underwood (2016)
Traceability	Every block generated includes a timestamp and metadata enabling traceability for every transaction ever to have taken place on the network.	Yuan and Wang (2016)

Source: Own work.

The ledger keeps a transparent and incorruptible record of all the transactions that have been made on the network, while keeping private identities anonymous/under pseudonym. Participants can send or receive transactions, view the blockchain data, or validate the transactions on the blockchain. These participants create a network in which transactions can be triggered and are validated by a consensus mechanism.

A system where individuals contribute computing power via nodes to create a distributed computing system is mentioned by Tanenbaum and Van Steen (2007), as a collection of individual nodes that appears to network users as a single coherent system. Furthermore, Özsu and Valduriez (2011) describe it as a number of autonomous elements that are interconnected with a computer network and are incentivized to participate in accomplishing assigned tasks.

1.2 Different typologies of blockchain

Since the creation of the public ledger technology, different variations of blockchain have been created. These variations can be complementary or they can function as substitutes for

another blockchain and they all include different features which can offer "faster settlement times, larger transaction sizes, different consensus methods, varying degrees of anonymity/pseudonymity, a more advanced functionality, permissioning features etc." (Needham, 2015).

Since there is no official taxonomy, this thesis researches different terms and finally concludes with a comparison of different blockchain types. One of the key differences between permissionless and permissioned ledger is that the latter controls access to the information stored on the ledger (Walport, 2016). Two of the main benefits of permissioned blockchain over permissionless blockchain are privacy and latency of transaction confirmations (Walport, 2016).

- A permissionless blockchain is where there are no restrictions on reading data, executing transactions or participating in the network (Buterin, 2015; BitFury Group 2015; Walport, 2016).

- A permissioned blockchain is a blockchain which has known participants/owners which check the ledger's integrity with a limited consensus process (Buterin, 2015; BitFury Group 2015; Walport, 2016).

There are several similarities between a public and a private blockchain as both are distributed peer-to-peer networks on which a replica of the ledger is verified via a protocol referred to as the consensus model. Furthermore, both maintain immutability of ledger to even out malicious nodes participating. The sole difference between a public and a private blockchain lies in who is allowed to participate in the network, to execute the consensus model and contribute to maintaining the ledger.

- A public blockchain is completely open and anyone can join and participate in the network. The network has a mechanism to encourage participants to join the network. A drawback is privacy which is merely a matter of a pseudonym (Buterin, 2015; BitFury Group, 2015).

- A private blockchain may limit reading access to certain individuals/organisations (this may be public or restricted) with write permissions being restricted by a central authority (Buterin, 2015; BitFury Group, 2015).

The overview of literature shows different types of blockchains created, each to fulfil its specialization and extend the features of the blockchain. Many researches (BitFury Group, 2015; Buterin, 2015; Walport, 2016; Needham, 2015) criticized these different types due to their limited traits in following the key characteristics of blockchain - immutability, security, verifiability, resilience, transparency. Nevertheless, these blockchains can use different consensus mechanisms to provide a higher transaction rate with scalability in mind.

1.3 Reaching consensus

Several variations of consensus mechanisms are being researched, published and created. Many of them have their own competitive advantages as well as disadvantages. Consensus mechanisms evolved to various different validation mechanisms on the blockchain and the scope of this thesis overviews only some of the most established and used models after a decade since the Proof-of-Work validation technique in 2008.

Proof-of-Work

Proof-of-Work (hereinafter PoW) is a type of Byzantine fault tolerant consensus model. It uses computing power to handle fault tolerance thus being resistant to Byzantine failures - a type of malicious node behaviour. PoW consensus is reached with computational power solving hash function. Costs associated with PoW are incentivized with the block reward and fees (Gervais et al., 2016). The longest chain is used as a main principle in PoW consensus (Nakamoto, 2008).

Proof-of-Stake

Proof-of-Stake (hereinafter PoS) is a category of consensus algorithms for public blockchains that depend on a validator's economic stake in the network. In PoS-based public blockchains (Ethereum's upcoming Casper implementation), a set of validators take turns proposing and voting on the next block, and the weight of each validator's vote depends on the size of its deposit (i.e. stake). Significant advantages of PoS include security, reduced risk of centralization, and energy efficiency (Ethereum, 2018).

There are many kinds of consensus algorithms, and many ways to assign rewards to validators who participate in the consensus algorithm. From an algorithmic perspective, there are two major types: chain-based proof-of-stake and BFT-style proof-of-stake (Ethereum, 2018).

Ethereum's Casper will be using chain-based proof-of-stake in which the algorithm pseudo-randomly selects a validator for each time slot (e.g. every period of 10 seconds might be a time slot), and assigns that validator the right to create a single block, and this block must point to some previous block (normally the block at the end of previously the longest chain), and so over time most blocks converge into a single constantly growing chain (Ethereum, 2018).

On the other hand, in a BFTT-style proof-of-stake, like NEO (Zhang, 2017), validators are randomly assigned the right to propose blocks, but agreeing on which block is canonical is done through a multi-round process where every validator sends a "vote" for some specific block during each round, and at the end of the process all (honest and online) validators permanently agree on whether or not any given block is part of the chain. Blocks may still

be chained together; the key difference is that consensus on a block can come within one block, and does not depend on the length or size of the chain after it (Ethereum, 2018).

Proof-of-stake counters Byzantine failures with the ability to use economic penalties to make various forms of 51 % attacks vastly more expensive to carry out than proof-of-work - to quote Vlad Zamfir, "it's as though your ASIC farm burned down if you participated in a 51 % attack" (Ethereum, 2018).

This overview of consensus models does not cover all the different consensus mechanisms of existing protocols. Different variations of consensus models are being developed and introduced. An example of such consensus model is the combination of PoW and threshold signature schemes or other consensus models, such as proof-of-authority, etc.

An overview of blockchain technology points out insights into the main variations of the distributed ledger technology with different access rules, each having its main advantages and disadvantages. By comparing literature by Brennan and Lunn (2016), Berke (2017), Provenance (2016), Walport (2016), Özsu and Valduriez (2011), Tanenbaum and Van Steen (2007), Buterin (2015a), BitFury Group (2015) and Walport (2016), the blockchain technology could be defined as, firstly, a distributed database system and secondly, as a distributed computing system. The database system is distributed, shared, encrypted, irreversible and incorruptible. The distributed computing system is public or private and has a permissionless or permissioned consensus mechanism, adding value with its special features, such as direct interactions.

1.4 The rise of smart contracts in blockchains

After the invention of Bitcoin, layers of the blockchain ecosystem were created (Mougayar, 2016). Infrastructure and base protocols act as the foundational layer for other layers which depend on the base protocol, for example, as validator. Middleware and services are built on top of base protocols extending base protocol features which serve as functionalities for a layer of dApp applications and solutions. Applications and solutions act as implementations of solutions for end-users (Mougayar, 2016).

In addition to colored coins, side chains and other different implementations on blockchains or of a blockchain led to the creation of a blockchain called Ethereum introduced by Vitalik Buterin (Buterin, 2013), using smart contracts in a Turing-complete manner (Szabo, 1994). The term smart contracts was first coined by a cryptographer Szabo in 1994. It is essentially a simple logic published on a blockchain and can act as an immutable argument. The purpose of smart contracts is to be a "computerised transaction protocol that executes terms of a contract" (Szabo, 1994).

In the Ethereum whitepaper, Buterin defines a smart contract as “a mechanism involving digital assets and two or more parties, where some or all of the parties put assets in and assets

are automatically redistributed among those parties according to a formula based on certain data that is not known at the time the contract is initiated" (Buterin, 2014). Furthermore, in 2016, PwC defined smart contracts as contracts that are "translated into computer programs and, as such, have the ability to be self-executing and self-maintaining" (PWC Global research team, 2016). These contracts have great potential for automating and speeding up manual and costly processes. As such, according to Luu et al. (2016), "smart contracts can implement a wide range of applications, including financial instruments (sub-currencies, financial derivatives, savings wallets, wills) and self-enforcing or autonomous governance applications …".

In recent years, several publications have reviewed smart contracts' potential for usage and disruption (Luu, Chu, Olickel, Saxena & Hobor, 2016; Swan, 2016; Yasin & Liu, 2016) and the possibilities they offer in terms of processing human-readable contracts (Frantz and Nowostawski, 2016; Idelberger, Governatori, Riveret & Sartor, 2016). Additionally, smart contracts are considered one of the main advantages of blockchain networks (Frantz & Nowostawski, 2016; Iansiti & Lakhani, 2017). The sentiment on the benefits of the blockchain technology for long settlement cycles, limited business hours and high fees in financial markets such as capital markets and securities markets has been reviewed by several institutions such as the European Central Bank (2016), ESMA (2016), SWIFT Institute (2016), Euroclear by Wyman (2016), DTCC (2016), IMF (2016), ECDSA (2015).

Smart contracts are young and time is required for these platforms to be revised and improved. As such, smart contracts and blockchains still have several security problems (Luu, Chu, Olickel, Saxena & Hobor, 2016):

- open (or permissionless) networks enable vulnerable execution of contracts because participants participate in an open network. This was previously restricted to accidental failures in traditional permissioned networks;

- contracts that do not execute as expected and/or that have locked away virtual coins;

- smart contracts are irreversible and immutable. Reasoning about the correctness of smart contracts before deployment is critical, as is designing a safe smart contract system.

Another challenge that needs to be overcome is the one that concerns throughput which is not sufficient for further growth (Dennis & Owenson, 2016; Swan, 2015; Yli-huumo, Ko, Choi, Park & Smolander, 2016). One of the problems is also the size of blockchains which becomes overwhelming for individuals, which ultimately leads to centralization performed by bigger miners (Dennis & Owenson, 2016; Tschorsch & Scheuermann, 2016; Yli-huumo, Ko, Choi, Park & Smolander, 2016). These problems are causing challenges for blockchain adoption due to the scalability of the blockchain (Dennis & Owenson, 2016; Yli-huumo, Ko, Choi, Park & Smolander, 2016). This particular problem being solved could cause negative consequences for the integrity of a system. Some argue side chains might be an appropriate solution, but they are difficult to implement as there would be no single truth anymore

(Swan, 2015; Yli-huumo, Ko, Choi, Park & Smolander, 2016). Challenges also arise from wasted resources due to computational power and resources invested into owning or creating hardware (Dennis and Owenson, 2016; Yli-huumo, Ko, Choi, Park & Smolander, 2016). Another issue, apart from scalability and power consumption, is the security threat posed by centralization (Dennis & Owenson, 2016).

Standards and regulations is another challenging area, as the blockchain technology is not adjusted to regulation and neither are regulations harmonised, which has a negative impact on investment risks and the attractiveness of the industry for investors (Godsiff, Jezic, Howlett & Jain, 2015; Reyes, 2016). The regulations are not harmonised due to almost non-existing technology standards as stated by Walport (2016) and the lack of a central legal entity with a formal responsibility over the system which is instead governed by ad hoc processes. Walport (2016) furthermore states that "governments should consider ways of regulating distributed ledger systems by influencing the technical code that defines their rules. In finding the right blend, the government should consider the strengths and weaknesses of both technical code and legal code, recognising that the two interact and should be designed accordingly" (Walport, 2016).

1.5 Proposition of the blockchain technology

The blockchain's impact should be considered from the micro level (users), the meso level (corporations), and the macro level (nations) (Giaglis & Kypriotaki, 2014). This thesis only deals with the meso level and the macro level as there is little literature on how end-users might perceive and use this technology and this issue remains a subject of further adoption of the blockchain (Lindman, Tuunainen & Rossi, 2017).

From the macro level perspective, the blockchain is seen as a general-purpose technology because from an innovation-centered perspective, it enables innovations with a wide penetration of markets (Davidson, Filippi & Potts 2016; Kane 2017). Impact is already seen, as the blockchain industry is gaining traction with high increase of venture capital investments and the ICOs phenomenon, which enables numerous innovative projects being launched by individuals and companies (Mattila & Seppälä, 2015). Secondly, it is seen as a new institutional technology for economic coordination (Davidson, Filippi & Potts, 2016) because it inherits potential strengths, as, for example, in comparison to the Internet, which transfers information, blockchain, apart from transferring information, also transfers value (Brennan & Lunn, 2016; Raval, 2016; Tapscott & Tapscott, 2017). Blockchain is transparent and traceable to its origin (Tapscott & Tapscott, 2017; Underwood, 2016; Yuan & Wang, 2016; Walport, 2016). Most importantly, various authors argue that these traits increase integrity, which results in the creation of trust (Lehmacher & McWaters, 2017; Yuan & Wang, 2016; Walport, 2016; Meijer, 2016). At the meso level, the blockchain technology is interesting for businesses as it represents an opportunity to reinvent business models and business operations (Glaser, 2017; Holotiuk 2017).

Blockchain utilises the disintermediation of trust (Glaser, 2017) due to disintermediation and transparency of blockchain which is inherent because of a decentralised and open design (Morabito, 2017; Nakamoto, 2008). Furthermore, because of such transparency, blockchain systems have the potential to overcome interoperability of ledgers, which can lead to the creation of new multi-sided platforms with broader network effects (Gupta, 2017; Nguyen, 2016). Blockchains enable new types of intermediation services as a consequence of digital trust (Morabito, 2017).

The blockchain technology lowers entry barriers and enables companies to obtain lower transaction costs (Iansiti & Lakhani, 2017; Lemieux, 2016; Tapscott & Tapscott, 2017) thus nurturing competition to increase and facilitate new networks (Gupta, 2017; Nguyen, 2016). The first movers to enjoy the benefits of the blockchain are peer-to-peer payments, cross-border payments and global trade financing networks (World Economic Forum, 2016; Tapscott & Tapscott, 2017).

As stated by Needham (2015) in accordance with Morabito (2017), "emerging trends in the industry, such as early enterprise adoption, usage trends, R&D expenditure and venture capital activity, suggest that blockchain technology is approaching an inflection point toward greater mainstream and enterprise adoption" (Needham, 2015).

2 CAPITAL MARKETS

Capital markets meditate capital with those who have shortfall and those who have surplus in an effective and low-cost manner (Byström, 2014). The capital market is divided into the credit market, the stock market and the derivative market. Each financial market consists of main participants, namely, a custodian bank, a central securities depository (hereinafter CSD), Central Counterparty Clearing House (hereinafter CCP), the European Union, a financial supervisory authority, investors, brokers, and exchanges.

One of the sectors in capital markets consists of alternative investments in which companies can borrow cash from banks, sell a part of their existing business, sell part of their ownership in the company or borrow cash from investors (issuing debentures) (Simmons, 2002). Secondly, the financial market also consists of publicly offered securities being offered on the stock market which is where owner rights to a company are bought and sold. The securities market is mostly a second-hand market where you buy assets from a current owner. and provides value with secondary liquidity, which refers to the ability of IPO investors to sell shares in order to have an effective primary market. The securities market also creates signals about the companies within the stock market situation from an economic perspective, which makes those signals important to identify (Byström, 2014).

When trading with securities, an individual investor rarely has contact with the counterpart and instead the investor trades shares through a bank or a broker. These intermediaries report

transactions to a central security depository which supervises various participants involved in the capital market (Byström, 2014).

2.1 Current state and efficiency of capital markets

Currently, the landscape of securities post-trade processing, clearing and settlement operations remains complex (World Economic Forum, 2016) and consists of global and regional actors, including custodian banks, investors, brokers, CSDs, CCPs and exchanges (Pinna & Ruttenberg, 2016). The process from trade to settlement is agreed on mostly in two (T+2) or three (T+3) days, but can take up to 30 days for more complicated financial instruments like swaps and loans (Wyman, 2016). Securities' post-trade market process consists of several organizations working as efficiently as possible together (Pinna & Ruttenberg, 2016).

Matching orders and completing trades are automated and have made progress in recent years, yet clearing and settlement are still done manually in back offices of intermediaries. In some situations, because of sudden market interest, some transactions may experience excessive volume and volatility, making a central participant overloaded with clearing, (Pinna & Ruttenberg, 2016) which possess the risk of a trade not being processed if settlement does not happen (World Economic Forum, 2016). According to the World Economic Forum (2016), especially "frequent changes to counterparty bank details" are the entry door to the risk of human error due to manual work.

Participants in the capital markets need to proactively manage risk, educate and work with regulators and capital, and, on the other hand, redefine the business model meanwhile taking into consideration fostering of stronger culture and conduct. Technology-wise, companies need to renew the operating model of IT process automation, consolidation and utilisation of middle office and back office activities in order to enable innovation and the capabilities to foster it, which in turn can give companies a competitive advantage (PWC Global research team, 2015).

2.2 Capital markets in Slovenia and their characteristics

Some development of capital markets in Slovenia took place when it was still part of former Yugoslavia in 1988. In later years, Slovenia fought for independence, which included political and economic reforms. One of these important reforms was the privatization of social properties and this transitional route proved efficient as Slovenia did not suffer a banking crisis in the 1990s. After Slovenia gained independence, capital markets did not play an important role, yet the country's efforts were focused on establishing an organized, safe, transparent, liquid capital market with low costs. The Slovenian Stock Exchange started trading private companies quite late, in fact, Slovenia was the last country in Europe to establish such trading (Štiblar, 2008). Privatization played an important role at this point. A

combination of granting methods and buying methods available to all citizens and the possibility of discounts for companies' former employees made way for numerous new shareholders in the early stages of this process (Mrak, Rojec & Silva-Jáuregui, 2004). Since companies were also offered to foreign enterprises, privatization ended with most of the companies exhibiting a ratio of 40:60 in terms of external versus internal ownership. Furthermore, the shareholders were inexperienced and many waited for the first opportunity to sell. As privatisation continued, companies were automatically listed on the Ljubljana Stock Exchange. Privatisation was run by the state's authority organs (KAD, SOD) which still successfully control it, however, its drawback in the late 1990s was a slower transition than most countries in Europe experienced. Before that, securities had been listed, but total market capitalization was trivial in its size (Štiblar, 2008).

The financial crisis in 2008 has worsened the situation on the capital markets in Slovenia and impacted the whole world (Simoneti, 2010). Up until 2009, only a dozen securities were offered on all the stock exchanges in Europe, none of them from Slovenia. Many companies that were about to be publicly sold were not, due to the financial crisis of 2008, which slowed the movement of public sales. Furthermore, in the next 5 years following the crisis, banks had significant write-offs, which tightened investment even more. The privatisation and the slow development of capital markets consequently left a structural barrier and therefore the Slovenian capital market is still small and owned mostly by a larger circle of domestic owners. This makes it unattractive for FDI and is limiting the power of foreign investors. The banking sector in Slovenia is fairly developed, however, the limited development of capital markets in Slovenia inhibits the country's development (Simoneti, 2010). The Slovenian capital market is seen as an emerging market in Europe, but will not play an important role in the near future due to its limited capabilities.

2.3 The main participants in the capital markets in Slovenia

The Slovenian financial system is still based on banks. The Slovenian capital market is inefficient but because it is small it did not suffer as much during the crisis. Even though being small has its flexibilities and as such it is seen as beneficial, further benefits can be reaped with correct developments in terms of corporate financing. Furthermore, for the capital market and its intermediates to be effective, it must have international confidence and attractiveness (Bank of Slovenia, 2018).

During and after the financial crisis, regulators tightened the regulations on banking and capital markets. With tighter regulations, financial systems are trying to restore trust and trade financial instruments in a transparent and regulated manner.

The Slovenian capital market will not be among the most developed in the world. It is not fair to compare it with global capital markets due to its small size and due to businesses

being limited with liquidity compared to the ones participating in other capital markets (Štiblar, 2013).

The Ljubljana Stock Exchange has been gaining in importance throughout the years since independence. This indicates a certain development and, consequently, an increase of interest in capital markets. In Slovenia, the central role in the capital market will continue to belong to universal banks or investment departments of universal banks. Financing of companies will and should remain the main task of banks. In the past, corporate growth was almost entirely dependent on bank financing, which was cheap and easily accessible. Banks will continue to issue both equity and debt securities on a regular basis, collecting the necessary funds for financing and forwarding them in the form of bank loans. Banks have so far been a tool for acquiring companies or property processes in Slovenia (Štiblar, 2013).

The low turnover on the Ljubljana Stock Exchange does not bring high earnings from brokerage fees. The number of brokerage companies in the Slovenian market will continue to decrease. Brokerage, as the main activity of stockbroking companies, will not be able to finance the operations of brokerage companies. In addition to the anticipated merger of some brokerage firms, their number on the market will probably also decrease due to compulsory discontinuation of operations. The number of banks that are members of the Ljubljana Stock Exchange is much less fluctuating. There should be no changes for the time being due to the entry of new competitors to the market (Ljubljana Stock Exchange, 2018; Štiblar, 2013).

2.3.1 Financial supervisory authority

Europe's capital market is greatly influenced by banks and requires supervision to assess its accordance with regulations. A supervisory authority subject requires expertise, access, the knowledge of the risks the main participants are taking and the knowledge of advances in the R&D. An effective supervisory system is linked to the established banking legislation and acts as the base for the functioning of supervision, in particular for the legal and accounting environment (Štiblar, 2013). Banking legislation defines which institutions can be considered as banks, including which services they can provide, and which are prohibited. It is also possible to set up a licensing policy with banking legislation. The most important thing is that the supervisory institution must be an independent organization, which enables decisions on an objective supervisory basis. The banking crisis in the recent decades has shown how investment risks can destabilize the financial systems of countries and endanger the entire economy. The supervision of the European banking system is currently taking place at the national level (Štiblar, 2013).

The EU Commission established a pan-European authority to recognize and address the risks to the financial system. The European Systemic Risk Board is headed by the President of the European Central Bank and by the financial supervisors and representatives of central banks of all European countries. In order to prevent the recurrence of the crisis, the G-20 countries are continuing to increase the strength and resilience of banks. Moreover, the Basel

Committee for Banking Supervision submitted several proposals for new capital and liquidity requirements in the last decade after the financial crisis. The proposals are the answer to the problems that the crisis had revealed in the regulation, supervision and risk management in global banking. Different institutions are entrusted with overseeing individual segments of the financial system in Slovenia (Schinasi, 2011; Štiblar, 2013).

2.3.2 The Bank of Slovenia and the Securities Market Agency (ATVP)

The Bank of Slovenia performs supervision over banks and savings banks in Slovenia. In doing so, it takes into account the fundamental principles for effective banking supervision, which represent the most important global standard for regulation and prudential supervision of banks. The basis on which the effectiveness of banking supervisory arrangements can be assessed, is the result of the work of the Basel Committee and the Banking Supervisors of different countries and consists of the basic principles which constitute the minimum conditions for performing effective supervision. For the continental part of Europe, including Slovenia, there are universal banks that can carry out all commercial and investment banking business (Štiblar, 2013; Bank of Slovenia, 2018a).

Each country in the European Union is supervised by another national supervisory institution in order to effectively control financial institutions and coordinate actions by all supervisory authorities. In 2007, the Rules on the Cooperation of Supervisory Authorities (Official Gazette of the Republic of Slovenia, No. 43/2007) were adopted for this purpose. The Rules determine the content and the manner of cooperation between the Bank of Slovenia, the Agency and the Insurance Supervision Agency of the Republic of Slovenia. The supervision of banks in the Republic of Slovenia, regarding the provision of investment services and transactions, is the responsibility of the Securities Market Agency (hereinafter ATVP), which carries out supervision in cooperation with the Bank of Slovenia. The legal basis for delimiting jurisdiction over banks is the Market in Financial Instruments Act (ZTFI) in conjunction with the Banking Act (ZBan-2). The Market in Financial Instruments Act defines three solutions: only the Bank of Slovenia is responsible for certain matters, while for others only the ATVP is responsible, and in two cases there is an urgent need for mutual cooperation or communication (Government of Slovenia, 2007).

The Bank of Slovenia is the central bank of the Republic of Slovenia. It was established with the adoption of the Bank of Slovenia Act (ZBS) on 25 June 1991. It is a legal entity governed by public law, which independently disposes of its own assets. The Bank of Slovenia is the only supervisory authority for all services and transactions including risk management, except for investment services and transactions, on the basis of the Market in Financial Instruments Act, which are performed by banks on the basis of the Banking Act (Bank of Slovenia, 2018a).

The ATVP was established on 13 March 1994 and is a legal entity governed by public law in charge of overseeing the market and financial instruments. Its operation is governed by

the Market in Financial Instruments Act. In performing its duties and responsibilities, it is autonomous and independent (ATVP, 2018). The ATVP has exclusive competence to impose supervisory and administrative measures on the basis of the Market in Financial Instruments Act against banks with the exception regarding the withdrawal of licenses. The ATVP is also a misdemeanour body that pronounces misdemeanour measures against banks, if they violate the provisions of the Market in Financial Instruments Act. The ATVP is also the only issuer of implementing regulations on the basis of the Market in Financial Instruments Act and specifies the operating rules for the provision of investment services of banks. Banks are required to report to the ATVP on traded transactions of financial instruments on a regulated market and report suspicious transactions. Supervision of banks regarding the provision of investment services and transactions from the Market in Financial Instruments Act is performed by the ATVP in cooperation with the banks. The supervisors are autonomous and banks, as control subjects, expect the method of cooperation to be clear and precise (ATVP, 2018).

2.3.3 Central securities depository

A central securities depository's key services include the initial recording of securities in a book-entry system, providing and maintaining securities accounts at the top tier level, and operating a securities settlement system. Moreover, CSDs offer services in a manner that contributes to the efficiency, the security and the reliability of the securities market as a whole and ensures the preservation of the rights of securities issuers and holders (Bank of Slovenia, 2018b). A central security depository keeps a record of all proprietorship of securities and a systematised registration of trades with shares. CSDs keep a record of the trades and maintain a register of the individual people owning shares, used to verify who has the right to vote (Wyman, 2016).

In Slovenia, the role of the central securities depository is played by the Central Securities Clearing Corporation (hereinafter KDD) and its operation is currently regulated by the relevant sectoral legislation, such as the Regulation on improving securities settlement in the European Union and on central securities depositories, the Market in Financial Instruments Act, the Book-Entry Securities Act, the Takeovers Act, etc. In relation to the CSDs, the Bank of Slovenia may act in different roles, such as a user of services that support Eurosystem credit operations, as the manager of its own portfolio of securities, and as the national competent authority (Bank Slovenia, 2018b).

The European Union plays an important function in regulating the capital markets. Regulations and decisions become automatically binding throughout the EU on the date they take effect even though some of the countries bind to comply less (EU, 2018). The European Securities and Markets Authority (hereinafter ESMA) is an authority of the EU with the objective "to enhance the investor protection and promote stable and orderly financial markets" (ESMA, 2018). ESMA is responsible for monitoring the implementations of

standardized frameworks of EU regulations in the central authorities of countries (ESMA, 2018).

2.4 Primary capital market in Slovenia

In the primary capital market, activities, such as the formation of securities, subscription, placement and distribution of securities along with the sale and quotation of securities, are carried out. In Slovenia, most of the funding is done through the banking system. Banks are by far the most important financial intermediary in Slovenia. According to the Bank of Slovenia, they account for three quarters of the entire financial sector (Simoneti, 2010). Businesses traditionally acquire money with banks or with closed securities issuing for long-term business development. In the past, such funding was favourable, since the liquidity of the Slovenian banking system was extremely high after the adoption of the euro and consequently offered a high availability of foreign sources of financing. Banks fought for each borrower with exceptionally favourable lending conditions (Simoneti, 2010). Due to insufficiently audited projects financed by bank loans, businesses exploited such favourable conditions of financing for property processes and only a small part of the loans was used to finance business development.

The primary capital market in Slovenia was impacted by the global financial crisis that began at the end of 2007. The lack of funding in the financial system, led to a lack of funds for business financing. Despite several decreases in the discount rates of central banks, the banks' interest increased, which resulted in a higher cost of repayment of loans from abroad and more expensive bank lending to the population and the economy.

Changes in the EU legislation have progressed since the financial crisis in 2008. Legislation is still being developed in mature capital markets, promising that, in the future, capital requirements for banks will be stricter, including the limiting of funds and the access of businesses to banking assets. This means that companies will also have to raise capital for development in the capital market. Enterprises will have to come up with new assets by issuing shares, bonds and other securities. The attitude of companies towards investors will play an essential role in financing business development (Simoneti, 2010).

2.5 Secondary capital market in Slovenia

The secondary capital market in Slovenia started with the creation of the Ljubljana Stock Exchange in 1989. The Stock Exchange is an organized securities market, directly or indirectly accessible to the public, where trading is conducted regularly, is regulated and supervised by competent authorities (Mrak, Rojec & Silva-Jáuregui, 2004).

The Stock Exchange is a public limited company, established in order to ensure the integration of supply and demand for securities, for trading with other financial instruments

or for organized, transparent, liquid and efficient dealing with securities and other financial instruments, in accordance with the law and other regulations. In the last two decades, there were several mergers by the Ljubljana Stock Exchange and an acquisition of the Ljubljana Stock Exchange itself (Ljubljana Stock Exchange, 2018).

The Ljubljana Stock Exchange Inc. is an institution of the capital market. It began publishing the stocks' exchange rate in 1993. In the same year, securities were traded through the BIS electronic system. In 1997, the Ljubljana Stock Exchange Inc. became the 50th full member of the World Securities Exchange Association. In 2006, a new blue-chip SBI TOP index was introduced, which was later replaced with the SBI 20. SBI 20 was renamed LJSE Composite and then abolished in 2010 (Ljubljana Stock Exchange, 2018) with the introduction of SBI TOP, which provides information on the movement of prices of the largest and most liquid shares on the regulated market. Its purpose is to follow the best shares on the Ljubljana Stock Exchange and to provide the basis for advanced financial products (Ljubljana Stock Exchange, 2018). The structure of the market by the stock exchange, for the purposes of statistical processing, consists of the stock market (the first quotation, the standard listing, the entry listing), bond market (bonds, money market instruments) and the market of structured products (shares of investment companies, investment coupons, certificates, warrants, rights, other product) (The Official Gazette of the Republic of Slovenia 45/2013, 2013).

On the secondary market of financial instruments, there are mainly two entities, the brokerage companies and the banks. The Banking Act and the Market in Financial Instruments Act prescribe the conditions that banks must fulfil, in order to provide services related to financial instruments or securities. Before starting business, the bank must obtain the appropriate authorization from the Bank of Slovenia (Bank of Slovenia, 2018b).

Banks have always been the most important institutions in the Slovenian financial market. Given the financial means in the Slovenian financial system, the banking sector is still dominating. This is seen from the evaluation of different groups of financial institutions and the view of the balance sheets, which exposes certain features of the Slovenian financial system (Bank of Slovenia, 2018b). A strong role of banks is typical for European continental countries and Slovenia is no exception (Bank of Slovenia, 2018b).

Banks are the only financial institutions in the Slovenian capital market that are sufficiently strong for public or private offering of securities. For now, brokerage companies only issue their own bonds, primarily to ensure the operations of companies (Štiblar, 2013). Another service offered by banks is mediation in the trading of financial instruments. Banks have their own trading departments, allowing customers to trade on a regular basis (Štiblar, 2013). Banks have the largest share in turnover on the Ljubljana Stock Exchange and the largest volume of transactions (Bank of Slovenia, 2018a).

3 BLOCKCHAIN TECHNOLOGY IN CAPITAL MARKETS

The future landscape requires businesses to transform due to new technologies. Innovations, such as straight-through processing (STP), changed from being expensive and challenging towards being the means of client value and efficiency. In the future, all players will need to challenge the established order by supplying capital and becoming leaders in product innovation. Being reactive to regulators, public opinion, and market idiosyncrasies is no longer an option (PWC Global research team, 2015).

The business model needs to be refocused to emphasize the clients and their needs. The operating models should be re-engineered to enable simplification and reduction of costs (PWC Global research team, 2015). Moreover, the PwC report (PWC Global research team, 2015) further analyzes events that might influence a faster change of capital markets towards 2020:

- If the impact of legislation on economic growth becomes apparent, then governments consider the cause of economic stagnation, which can lead to rules being loosened at both the global and local levels.

- Many new product innovations and market players will emerge in the capital markets, bringing both new management and new regulatory challenges, due to the cost and efficiency benefits of new business models and technologies.

- The overregulation of financial markets will stimulate significant additional growth in the shadow banking system, further magnifying growth for monoline finance companies, hedge funds, private equity firms and other buy-side players. Traditional financial institutions will lose market share to non-traditional players.

The environment in which financial institutions operate will change significantly and this change will derive from new innovations, changes in government policies, more demanding clients, and from the continued growth of the shadow banking system (PWC Global research team, 2015).

In capital markets, one of the core operations is storing and agreeing datasets of financial obligations and ownership forms. Nevertheless, currently, core operations remain highly complex, utilizing fragmented IT and data architectures, and suffer from a lack of common standards. Drawbacks of such infrastructures derive from a continuing need to reconcile data and the need for duplication of data, leading to wasted workforce time and a high cost of systems maintenance. In this narrative, the blockchain technology promises to solve many issues in the capital markets (Wyman, 2016). The recent technological innovations and the drawbacks of the current infrastructure made many market players and financial institutions start outsourcing and participating in the development of fintech start-ups, as well as building capabilities by creating in-house blockchain departments and trading desks. (Wyman, 2016).

Wyman (2016) estimates it will take 5 years before the applications start gaining wide industry traction and the initial adoption of distributed ledgers is complete in an industry-wide value chain. Furthermore, he predicts that in merely 10 years, mass adoption with major industry-wide disruptions, legislation and confidence in technology will be in place.

The benefits of the blockchain technology can be used for a more efficient settlement of transactions. Moreover, processing could enable everyone to see the same data with updates quickly circulating across the market. Transactions could settle in (near) real-time, since the trade is complete when the next update to the blockchain is agreed upon, embedding the transfer of ownership of an asset or other agreement. This removes the need for post-trade validation and central clearing during the settlement cycle thus speeding up the end-to-end process (Wyman, 2016). Moreover, audit of records can be instant and independently verified while still complying with the regulatory framework via scripting of smart contracts (Filipowski, 2017).

The blockchain technology has many novelty use-cases and improvements used in crowdfunding, decentralized governance services, identity services, tokenization, decentralized storage, etc. Applications will be made for efficient supply chain management, in order to coordinate logistics, payments, financial terms, and contract rules from end-to-end, which will enable visibility and the tracking of supply chain process in real-time.

3.1 Implications of the blockchain technology solutions for the capital markets

In last two decades, technology has transformed society, people's interactions and many other industries including financial services, however, capital markets have yet to change. Because of fragmented IT departments and separated databases, the blockchain technology offers a solution, allowing users and participants in capital markets to shift by using a shared database, which impacts how intermediaries communicate amongst themselves (Pinna & Ruttenberg, 2016).

Capital markets are suffering from outdated infrastructure with little changes over the past decade and the trend of many existing companies facing difficult times has shown a decline of the industry. The blockchain technology is, from this point of view, a double-sided push towards a change to a more efficient infrastructure and an opportunity to renew industry (Pinna & Ruttenberg, 2016; Wyman, 2016).

3.1.1 The implications of smart contracts in capital markets

Some financial instruments can be verified without lawyers and transferred without central authority or other intermediaries. Vigna and Casey (2015) point out that even after the implementation of the blockchain technology, some processes, such as the clearing function and the notary function, will still be done by participants in the capital markets.

Blockchain features could be built into the existing market infrastructure, allowing the auto-execution of coded logic embedded into smart contracts. Indeed, smart contracts already exist in their basic form (Wyman, 2016).

With the cooperation of banks and litigation by lawyers, programming securities could be digitalized and automated (Vigna & Casey, 2015; Wyman, 2016). On the other hand, because of the shared ledger, all intermediaries could be removed from the ecosystem, leading to a loss of jobs and the creation of new jobs. The blockchain technology will impact bankers, lawyers and brokers first (Vigna & Casey, 2015).

The enhancement of blockchain with smart contract features could enable a central authority to maintain a single universal source of the truth database and record asset transactions of all participants using it as their golden source. The blockchain technology could essentially offer an expansion of the role played by a CSD in a traditional infrastructure (Wyman, 2016).

Having all the participants operate from their own local version of the golden source reduces system duplication and is associated with a decrease of cost and a lower risk of errors. With the blockchain technology, no mass demand is placed on any central authority. It enables counterparties to bilaterally reveal information to each other without querying the centre. With no central authority, there is no single point of failure (Wyman, 2016). Furthermore, blockchain technology can reduce costs of IT and data-warehousing along with other overheads such as security, etc. In order to enable changes, investments are required to create infrastructure and tools (Wyman, 2016). Development will enable standardisation of the blockchain technology, which will improve clearing and settlement processes and enable the industry to cut costs within the existing market practices and infrastructure (Wyman, 2016).

The blockchain technology is an area of strong interest not only for the 'participants' (i.e. investment banks, broker-dealers, financial market utilities and the like), but also the 'users' (i.e. private equity firms, pension funds, hedge funds, other non-bank financial intermediaries and corporates). Policymakers and regulators need to develop the right balance between investor and system protection and on the other hand, allow markets to function freely and efficiently in order to support economic growth (PWC Global research team, 2015).

Given the relatively nascent state of DLT development and the highly regulated nature of the financial markets, many enterprises are exploring a variety of potential use cases for DLT (WFE, AMCC & IOSCO 2016). The DLT's potential is seen in use-cases such as clearing and settlement, corporate actions (voting rights and dividend payments), securities issuance particularly for private issuances, crowd-funding, proxy-voting, trade registration, regulatory reporting and transparency, trade finance facilities, asset registration facilities, database on agricultural receivables, digital assets and associated products. These are the use-cases most likely to materialise (WFE, AMCC & IOSCO, 2016).

The first blockchain technology applications across financial services will be related to wholesale payments/correspondent banking, trade finance and other forms of transaction banking. These include base protocols for the capital markets and applications associated with activities such as post-trade and securities servicing. Smart contracts could enable many improvements but disruption is happening within a highly regulated environment. The legislation remains a cause for alternative self-regulation of businesses and stagnation of the development of the industry (Wyman, 2016).

The blockchain technology disrupts securities transactions, by enabling a safer and cheaper transaction from point A to point B and asset servicing, which could be issued directly onto the asset ledger with dividends being managed via smart contracts. This removes the need for the custodian layer, which in the traditional infrastructure, can be held in as many as five or six layers of custody (stockbroker, sell-side bank, local custodian, global custodian, CSD, etc.), each with their own accounting views. Moreover, derivatives are created as pre-programmed smart contracts, capturing the obligations of the two counterparties (Wyman, 2016).

3.1.2 Clearing, settlement and custody

Clearing and settlement are managed by multiple intermediaries servicing both sides, buyer and seller, to trade securely and refer to the publicly traded securities' post-trade process. It is one of the areas to be most impacted by the blockchain technology. The biggest change is simultaneous consensus on a transaction from all counterparties, which reduces workforce through smart contracts. Smart contracts can remove the risk of the central counterparty, reducing risks tremendously (Mills et al., 2016).

The DLT enables a single source of data for each participant. A standardised use of the blockchain technology could make for a more efficient settlement of transactions and processing (Wyman, 2016). Settlement time can be instantaneous (which is not the case in the current market where settlement takes from 2 to 30 days), because DLT updates records with each new block produced, thus speeding up settlement. Furthermore, it removes the need for trust in the cases of post-trade confirmation and central clearing, thus further contributing to reduced time (Wyman, 2016).

Instantaneous settlement time can already be achieved with an updated standardisation. The time for a settlement cycle has deliberately been set to two days (Wyman, 2016). In order to achieve faster settlement time, cash and securities must be available when conducting the trade, thus eliminating liquidity and credit risk for any executed trade (Pinna & Ruttenberg, 2016). Such exploitation of DLT could reduce costs to up to half of the current expenses (Accenture, 2017), but significance of impact could be achieved if the industry was embraced as a whole instead of some separate entities embracing DLTs.

Furthermore, the current real-time settling deals with security issues which can be managed using DLTs, but this is currently not possible because fiat currency needs to be pegged to digital tokens backed by national currencies (Pinna & Ruttenberg, 2016). In the current paradigm, securities are managed by TARGET2-Securities in Europe, which is a central-bank system that provides funds for trades to be settled (European Central Bank, 2016). The current real-time settling is limited until the blockchain industry has received attention and is being researched by multiple central banks, along with national currencies pegged to digital tokens (Wild, 2016).

The technology for real-time settling has been researched and developed in recent years. It still lacks in scalability of the transaction amount (Schneider et al., 2016), but there are numerous projects and start-ups trying to defeat the scalability problems. Only recently, with the rise of smart contracts, blockchain has enabled the removal of the counterparty risk. A strict conditional programming of smart contracts enables fully automated validation and the reduction of the risk for a custodian waiting for the validation from CSDs (Pinna & Ruttenberg, 2016). To some extent, blockchain reduces the risk of invalid data through DLTs, provides a single source of truth, and, furthermore, enables the distribution and easy sharing of standardized data which is constantly being updated (Pinna & Ruttenberg, 2016).

Regulators would benefit from the blockchain environment with monitoring unparalleled to the current standards (van Oerle & Iemmens, 2016). Settlement can be done by smart contracts, which minimizes the operational risk of manual input errors. It also provides an independent service for trading cash to seller and security to buyer (World Economic Forum, 2016).

Furthermore, the custody of assets can be held directly by the final investor or organization. With the security of blockchain and the utilization of smart contracts, the collateral eligibility could be automated. Such contracts could facilitate a number of services, such as automated collection and distribution of dividends for investors on the due date, or settling any transactions triggered by an event and carried out by smart contract. With the adoption of the blockchain technology, a better and standardized identification of the final investor and the company issuing tokens will be required. Gatekeeping can be held by the final investor or a bank/public authority, and can change services of collateral management and securities lending, making the custodian role less important (Pinna & Ruttenberg, 2016).

In conclusion, there are many aspects to be improved for DLT to be used efficiently in clearing and settlement of trades. The current technology cannot process the vast amount of trades occurring in the securities markets throughout the word. The lack of trusted, central bank backed digital tokens pegged to fiat currencies is an obstacle preventing the distributed ledgers from becoming globally used (Schneider et al., 2017).

3.1.3 Private-equity crowdfunding novelties

Private equity investing refers to capital investments made directly to non-listed companies in an exchange for a stake of the firm by institutional investors, like venture capital firms, angel investors and pension funds (Investopedia, 2018c). Recent trends have increased investing in private-equity companies which deal with distributed technology. Moreover, venture capital investments exceeded $1,5 billion in 2017 (CoinDesk, 2017).

In the current system, an individual investor cannot take part in almost any private equity deal, due to the size of the minimum offering or by not being an accredited investor (Investopedia, 2017c). Meanwhile, initial public offerings are open for individual investors. In the current landscape, private equity market does not offer attractive environment because of the risk of illiquid assets in private equity markets (Lundy, Burke & van Ammers, 2016). Transparency in private-equity markets is not efficient even though more information and data can be found with research (Kastelein, 2017). In the case of initial public offering the issuance of shares is an expensive procedure including several intermediaries (Tapscott & Tapscott, 2017) and can cost up to 5 % of the company's valuation (Strategy & PwC, 2012).

Private-equity investing and initial public offerings currently suffer from complex regulation, lack of transparency or costly issuance of shares in the case of IPO (Strategy & PwC, 2012). As an alternative, initial coin offering (hereinafter ICO) emerged with the rise of smart contracts. Even though colored coins had existed before, Ethereum offered a solution for financial markets in equity issuance on blockchains, as these tokens in many cases represent a piece of the company's equity, a process similar to issuance of shares in the case of an IPO. ICO is legally in a grey area of the financial industry (Lundy, Burke & van Ammers, 2016).

The idea is still highly similar to the equity crowdfunding but executed completely without intermediaries and using only cryptocurrencies (Kastelein, 2017). What makes the idea more intriguing is the size of these ICOs, which is comparable to "Series B venture capital rounds" (Laurent, 2017). ICO tokens' valuations multiplied in value during 2016 and 2017. ICOs are here to stay and their functionalities should be considered in further research because the business model provides simpler and cheaper financing by traditional and individual investors (Tapscott & Tapscott, 2017). Furthermore, with regulatory approval, some companies have already proceeded to start issuing assets using the blockchain technology. In the USA for example, the SEC first approved issuance and trading of securities on a blockchain in 2016 (Pinna & Ruttenberg, 2016).

In conclusion, the blockchain technology is a simple innovation which simplifies and streamlines the process of how to issue, transfer and keep track of equity shares. By removing intermediaries and letting the issuer lead their own offering, a proposition emerges for a secondary market of start-ups to issue and trade a company's equity stakes provided that the company desires liquidity features for their equity stakes. Start-ups are finding

alternative solutions to financing via crowdfunding options like ICOs. Traditional public issuance of shares is costly and complex, meanwhile issuance on blockchain could eliminate most of the intermediaries in the current capital markets and simplify asset issuance. Even though a lot of ICOs are under regulatory scrutiny, fintech companies are forcing regulators to rethink legislation and offer opportunities for new entrants and the existing market players to reinvent financial services and further design for efficiency.

3.2 Implications for market participants

With the blockchain technology, capital markets can be disrupted because intermediaries could be cut out (Pinna & Ruttenberg, 2016). It can change the role of various market participants such as banks, clearinghouses and CSDs. Scripted contracts can remove the need for banks and lawyers (Vigna & Casey, 2015). If issuance of shares, even in current traditional systems, was based on a blockchain, then several intermediaries could be removed from the process with lawyers, bankers and brokers being the most endangered (Vigna & Casey, 2015).

Moreover, for most market participants, the internal costs of IT systems are based on redundant database systems, which have high operational overheads. Costs can be reduced with the blockchain technology via distribution of data, enhanced security and a single source of truth (Pinna & Ruttenberg, 2016).

The role of brokers will change and their primary value will be advising and execution management instead of providing market access, sourcing liquidity for assets, and taking principal risks where liquidity in the capital market is low. Moreover, in the future, the need for CCP may be removed due to an almost real-time asset transaction settlement for fiat currency. Brokers may eventually become liquidity hubs and/or validators of transactions in peer-to-peer networks (Wyman, 2016).

Front-office processes could still be performed at traditional exchanges, but post-trade securities processing could be implemented via DLTs as a mechanism for settlement, safe keeping and asset servicing. A decentralized platform (for post-trade operations - settlement) to be used in parallel with a conventional trading platform (order execution) (Wyman, 2016) would be beneficial for clients with lower costs of securities servicing. It could enable retail and wholesale investors to participate with guaranteed execution on open markets. When new consumers are signed up onto decentralized networks, companies will be required to comply to AML and KYC norms. Moreover, global and national regulators need to provide standardized legislation. A digital representation of assets to be transferred to the participant's digital account is needed. This will require support from current state position keepers (custodians/CSDs) and is an area where they can have commercial incentives (Wyman, 2016).

The book of records previously held in central databases of CSDs, will shift towards the decentralized ledger by the initiation of clients due to a better security-by-security basis (Wyman, 2016). A report by WFE, AMCC and IOSCO (2016) analyzed responses from participants in the capital market industries. The respondents manifested opposite opinions on whether or not the fundamental roles will change, with some claiming that the blockchain technology/DLT will not cause material changes for participants, and some stating that we will see less central reconciliations and more P2P transactions. The respondents had different views on the impact of clearing and settlement but noted that with the use of DLTs the processes could involve less intermediaries (WFE, AMCC & IOSCO, 2016).

Moreover, in the case of equity markets, the impact of DLTs is enhancing the trust amongst parties. On blockchain platforms, a transaction between a buyer and a seller can be direct thus eliminating the need for an intermediary. Miners protecting the chain are acting as intermediaries by providing accuracy of records and security to the network. All transactions are stored on a single, transparent and immutable ledger making it very secure and difficult to be tampered with (Vigna & Casey, 2015).

In conclusion, the benefits of DLTs can be used in settlement and clearing. Moreover, blockchain can be used as a holistic solution to transform the current infrastructure. This poses threats and opportunities for brokers, clearing houses and settlement organizations. Central authorities, which run the central ledger or authorize/verify transactions, can be replaced by a decentralized ledger. A transaction is broadcast to the network automatically, further diminishing the value of brokers. The risk of double-spending is eliminated, since all holdings can be verified on the network, which reduces the importance of clearing and supervision. Once the transaction is confirmed by miners within the mined block, the settlement process is done automatically with the execution of the smart contract verifying the transaction and finally transferring the digital assets (White & Case, 2016).

3.3 Tackling regulation problems associated with blockchain

Regulators do not want financial institutions to simply look at the rules as they are written. Rather, they want institutions to embrace intent and create sound, secure, straightforward business models, supported by strong governance, risk and capital management frameworks, where regulatory compliance is embedded in the processes and values of everyday operations (PWC Global research team, 2015). To maximize the benefits and the use of the blockchain technology, regulators need to keep up with the pace of the developments because legislation needs to be reinterpreted or changed (Wyman, 2016).

Regulatory frameworks do not change fast because regulation serves the current infrastructure and prefers slower evolutions, which can eventually lead to the disruption of existing markets. Regulations can limit markets, encourage the use or enable a higher prioritisation of new technology (Varga, 2017). History tells us that once regulation is shown to be the cause of economic stagnation, as in the case of blockchain technology, regulations

tend to loosen globally and locally. According to the PwC report, this is already the case with the inflow of new capital, liquidity and new business models (ICO, token economics, etc.) in the blockchain industry (PWC Global research team, 2015). Regulation will adapt by harmonising existing policies with the adjustment of new technologies to the regulatory framework (Varga, 2017).

Most regulatory issues connected to blockchain derive from money laundering and anonymity (Tapscott & Tapscott, 2017), but according to Pinna and Ruttenberg (2016), KYC and AML processes will become more transparent as technology develops. Automated reports, transparency and supervision will offer implementation of higher anti-money laundering standards in the future (Pinna & Ruttenberg, 2016).

A report by PWC Global research team (2015) is looking into potential changes in capital markets by 2020 and states that with the strict regulations accepted after the crisis in 2008, financial market utility (FMU) has begun playing a significant role because it is the core of all capital market investments. With the blockchain technology, the utility will expand and enable new players to emerge and enter the market. Newly emerged FMUs will be facilitating core processes with lower costs, such as client on boarding, reporting and other processes of non-strategic importance. With time, emerging utilities will be owned by different consortiums of financial institutions, FMUs and financial technology players. Newly emerged FMUs and the entities that own them will be both highly acquisitive and open to new partnerships. Leading institutions will be in a position to practice more proactive regulatory management. A decade after the financial crisis, the relationship between banks and regulators will reach a new equilibrium as banks fully integrate policy objectives of governments into their day-to-day business. Leading banks will take a comprehensive approach to managing regulatory change, internally and externally. Internally, they will look at the integration strategically, managing programmes holistically, regularly checking interdependencies and validating the implication on their business models. Externally, banks will continue to engage with regulators in a meaningful dialogue, as well as facilitate lobbying efforts where necessary (PWC Global research team, 2015).

In another report done by WFE, AMCC and IOSCO (2016), respondents reported a lack of legal and regulatory clarity on some of the current blockchain industry's issues as one of the largest risks associated with the adoption of DLT in the capital markets. As such, existing companies face ongoing efforts to comply with the newly mandated regulations (Basel III, MiFID, EMIR) and many are finding themselves regulated by new supervisors, to whom they have previously not reported. With current regulations, the difficulty of complying to changes is harder due to the extensive regulations, which may lock regulatory changes for a longer time (Pinna & Ruttenberg, 2016). Nevertheless, the European Union changes its regulatory aspects based on consultation papers, which guides the forming of new policies (Pinna & Ruttenberg, 2016). With a surge in new financial instruments, like financing application tokens through ICOs, many projects practice a proactive regulatory management because the regulatory landscape is complex and difficult to navigate. Companies are

working on regulatory compliance early, before all of the regulations have been written, basing their plans on assumptions and expectations, which is contributing to the issue of governments' clarity on the blockchain technology (Pinna & Ruttenberg, 2016).

No clarity on the implementation of a regulatory framework additionally complicates the regulatory process because regulations require extensive knowledge. This could be a cause for a slower development of the blockchain technology because the market is ready but the regulations are not (PWC Global research team, 2015). A regulatory framework is essential for blockchain to become adopted in the mainstream society. At the moment, companies are adopting the "act first, seek forgiveness later" technique, which was also the case for Airbnb and Uber, but these cases are more complex due to the strict rules of the financial industry (Wyman, 2016).

Regulators are seeking to recognize the development of this cross-border technology because countries are struggling to apply their existing regulations to the blockchain technology (Swan, 2015; Tapscott & Tapscott, 2016). The disintermediation cannot be put into the regulatory framework as it is currently (Wright & De Filippi, 2015). This is especially problematic in the case of public blockchains (Mainelli & Manson, 2016). Furthermore, the EU has recently introduced new data protection laws (hereinafter: GDPR) (PWC Global research team, 2016), which state that data must only be used for specific purposes, should be used only as necessary, and can be used only in the European Union. The newly introduced rule of the "right to be forgotten" is one of the issues due to the immutability of the blockchain (Mainelli & Manson, 2016).

3.4 Opportunities and applications of DLTs in capital markets

Capital market players are increasing expenditure on IT and DLTs (Lee and Wang, 2015) and engaging in the adoption of the blockchain technology with several different approaches, such as investments, partnerships, consortiums or in-house development (Evry, 2015).

In the first adoption wave, according to Wayne (2016), the initial use cases will be the tokenising of assets, such as pre-IPO equity shares and non-fungible digital assets, which will enable physical objects like diamonds and paintings to be tokenised. All these use-cases derive from better settlement efficiency and proof of ownership. Moreover, blockchain will be able to efficiently share data, which will impact how KYC and AML compliance is done. The use-cases deriving from better efficiency of information collection will impact supply chain invoicing and its tracking along with the emergence of new business models in trading finance. In the first wave of adoption, fundamental parts of financial services will be challenged because the DLT processes transactions more efficiently. The use-cases will impact fund portfolio management, book running, and, in the case of banks, cross-border services will be more efficient on the blockchain due to the removal of intermediaries and a simplified infrastructure (Wyman, 2016). In the second adoption wave, use-cases will enable better market data efficiency due to its availability. Such market data efficiency will enable

improved market surveillance and monitoring (Wyman, 2016). Regulators will further benefit from the financial system due to a better identification of patterns related to fraud. Companies will gain access to a transparent and immutable ledger of transactions (Swen, 2015).

The White and Case report (2015) points out trade execution and settlement, where data on the ledger automatically distributes the proof of change of ownership, which makes transaction settlements faster and cheaper. Custodian management with the blockchain technology has a fast settlement time and only few intermediaries are required in the process. The settlement risk diminishes because the transaction is final, fast and securely stored on the blockchain.

The rise of FinTech companies has already commenced with projects that held an ICO or have issued a new kind of financial instruments via the blockchain technology. The trend has emerged because scripting of smart contracts allows for transactions to be structured and conditionally programmed in order to allow complex automated contracts to be executed without intermediaries and risk counterparties (White & Case, 2015)

In conclusion, financial institutions which are major players in traditional settings understand the disruptive potential of DLTs and the blockchain technology. Many are exploring benefits and development with various approaches. Some understand not only its disruptive impact but also their role as foundational technology, which could change the fundamentals of the industry.

3.5 The current issues with the blockchain technology in capital markets

The blockchain technology promises changes in the capital markets, but there are barriers to DLT and blockchain adoption in capital markets, such as regulatory barriers, technological barriers, an interest in preserving status-quo of the current system and uncertainty about the technology (WFE, AMCC & IOSCO, 2016).

As previously stated, the market of clearing and settlement consists of custodian banks, investors, brokers, CSDs, CCPs and exchanges (World Economic Forum, 2016; Pinna and Ruttenberg, 2016). It takes several intermediaries to settle a transaction and it can take from 2/3 days or in the case of a complex financial instrument up to a few weeks (UBS, 2016). On the other hand, the blockchain technology's drawbacks derive from:

- ***Scalability:*** One of the issues with the blockchain technology remains scalability and its throughput capacities, which are still under the current standard of technology. Furthermore, the current blockchain infrastructure cannot offer the high security standards in the financial industry along with the requirements to be robust and handle large datasets. Blockchain technology projects will need to adapt to existing non-blockchain systems (Wyman, 2016).

- ***Regulation:*** The incumbents in the blockchain and financial services industry adopted an 'act first, seek forgiveness later' approach to regulation but will nevertheless need to comply with the regulatory principles. The newly accepted privacy law GDPR, which requires an option to be forgotten, represents an issue because the records are irrevocable once entered into a blockchain and amendments require changes to all subsequent blocks (Wyman, 2016).

- ***Stable coins:*** The inability of the existing cryptocurrencies to be perceived as stable sources of value will need to be tackled with fiat peg to a digital token (Wyman, 2016).

- ***Managing anonymity:*** Anonymity is a critical requirement for many processes in the capital markets. Cryptography could go a long way in protecting anonymity with the blockchain. Moreover, regulators are likely to have a great insight into the data on the ledger in order to perform adequate market surveillance, maintain anti-money laundering and decrease anti-terrorist financing processes (Wyman, 2016).

To conclude, companies recognize the associated costs and risks of being a first mover and an early adopter. Achieving interoperability across different ledgers and networks and addressing regulatory risks remains difficult in the highly regulated financial industry.

3.6 The advantages of using the blockchain technology in capital markets

Most of the advantages from the use of blockchain arise from the enhancement of efficiency, risk reduction and cost savings. Furthermore, it reduces the time for transaction settlements, allows streamlining and automation of processes, diminishes the need for clearing and manual reconciliations, and enables greater data efficiencies.

On the other hand, the blockchain technology faces concerns regarding its security, scalability, throughput capacity and ability to ensure data privacy. Moreover, companies need to better identify, understand, and deal with the technical problems and barriers. Other drawbacks arise due to the complex integration into the existing infrastructure (WFE, AMCC & IOSCO, 2016).

The advantages of the blockchain technology in capital markets can be applied to benefit the processes in capital markets and contribute to an improved equity market infrastructure. The blockchain technology is disintermediated and secure, meaning it can streamline processes and remove intermediaries due to the trust created by the security and integrity of the blockchain, which will set new grounds for private-equity investing and will remove custodians and central authorities from the capital markets. Secondly, with the use of the blockchain technology, the processes are cheaper and faster because of a decrease in costs in clearing and reconciliation due to the removal of intermediaries. Moreover, the use of a blockchain is transparent and reliable due to the transparency enabled by a single source of

truth. The database is distributed and shared to the parties involved making it secure and public at all times (WFE, AMCC & IOSCO, 2016).

The advantages of the blockchain technology in post-trading in capital markets

Clearing and verification of transactions done by brokers, clearing houses and settlement companies could diminish or even be removed with the use of the blockchain technology. Furthermore, because the DLT holds all the records publicly and securely, the need for a central exchange ledger diminishes.

The implementation of blockchain technologies would greatly improve transparency, traceability and verifiability of transactions because of the blockchain technology being transparent and reliable. It reduces the need for post-trade affirmation or confirmation and central clearing during the settlement cycle, which further contributes to the reduced settlement time (Pinna & Ruttenberg, 2016).

Transparency is important for regulators, which have struggled with compliant reporting in existing markets. The blockchain increases trust and enables regulators to detect anomalies better. Market players will have lower costs associated with regulatory compliance and reporting, which will decrease overall expenditure on regulatory compliance (Cognizant, 2016).

Another impact of the blockchain technology is a decrease in operational costs and the time needed for settlement. For the first time, blockchain can enable an end-to-end model including only the buyer and the seller to trade and settle a transaction. More applications will emerge in forms of decentralized platforms, where trading (including settlement on ledger) will enable transactions without borders globally.

The advantages of the blockchain technology on securities servicing and private-equity investing

The advantages of the blockchain technology for private-equity investing and securities servicing are a decrease in costs and time benefits. In the case of blockchain powered platforms, securities can be issued and traded solely on the DLT, with transactions executed faster and with less complexity in comparison to the current systems. Instead of private investments or initial public offerings (IPOs), the company can instead decide to find financing via crowdfunding or placements via the blockchain technology in this use-case being utilised for issuance of tokens and receiving investments. This lowers the costs of an IPO because in current systems, banks take, on average, a 5 % fee of the total IPO (Lee, 2016). In the case of a VC or individual investment, it removes the need for intermediaries' dealings, which can take a fee of up to 5 % (Varga, 2017).

Furthermore, most of the VC investments and individual placements are usually locked or suffer from illiquidity, since such investments are not traded publicly. This is eliminated with the blockchain technology because the digital tokens can be traded on blockchain platforms. Moreover, the cost reduction derives from the scripting of smart contracts, allowing for more efficient and less costly investor management and equity bookkeeping.

The blockchain technology has strong implications for private equity markets, as a simple and a revolutionary way to issue, transfer and keep track of non-listed stocks. This represents a fundamental change in streamlining the process, which is currently complicated and not transparent. In the future, the companies can take charge and bypass central authorities with the ICO phenomenon, which can be scripted conditionally to oblige companies in achieving certain milestones and if not, funds can be retrieved via decentralized governance or smart contracts. The blockchain ledger is transparent and allows companies to have access to the entire history of transactions. It enables ownership of stock along with better control and monitoring of the equity. Moreover, assets can automatically record change of ownership with transactions being executed by smart contracts thus saving time and reducing costs. Streamlining of processes in a transparent, robust and simple blockchain-based systems will in future remove central and other intermediaries.

3.7 The disadvantages of using the blockchain technology in capital markets

One of the biggest disadvantages of using the blockchain technology in capital markets is regulatory uncertainty. Many regulators pointed out that some of the start-ups utilising ICOs will need to comply with the regulation for securities offerings. Controversial business models arising with the blockchain technology, claim that, at least in Europe, they do not represent securities as they are defined per se. In the USA, securities are more broadly defined and thus recognize many blockchain offerings as issued securities. As commented by the SEC: "all issuers selling securities to the public must comply with the registration provisions of the securities laws, including issuers who seek to raise funds using Bitcoin" (SEC, 2014). In response to a non-existent regulatory framework, many companies are bypassing regulation because of the innovations in the financial market, proposing there is an opportunity in newly created financial instruments. The financial market is highly regulated and uncertainty remains, until there is more clarity and the current issues are resolved (Wyman, 2016).

Secondly, some of the regulatory requirements are not compatible with the blockchain technology. The issue arises from the immutability of the blockchain where a transaction is irreversible. The technology must adapt to create room for necessary judicial intervention, which is currently almost impossible because of the immutable recordkeeping or the automatic execution of smart contracts. Vigna and Casey (2015) further explain that adoption will only take place through the compromise of hybrid and pragmatic solutions.

Another disadvantage of blockchain derives from the complexity of the current landscape in capital markets. Because DLTs and the blockchain technology are still being developed and are in early development, technology lacks robust systems, which are required for the ever increasing operational complexity and the capital flows of the modern financial market.

Disadvantages could arise from the fundamentals of the blockchain technology thus proving it is a foundational technology. The polemic regarding decentralization of financial systems with the blockchain technology, is whether to use a permissioned or permissionless system. Swanson (2015) states that "permissioned systems as a whole are capable of clearing and settling assets faster and are cheaper to maintain than capital intensive permissionless systems". For now, the question posed by Amin (2016), “if blockchain will be used to replicate existing oligopolies or open a more democratic and open marketplace”, remains.

Immutability and transparency along with distributed records safekeeping in the permissionless blockchain, come with the cost of speed and the cost of securing the chain. Nevertheless, Swanson (2015) states that "permissionless blockchains are more disruptive and transformative" and have no single point of failure, meanwhile permissioned blockchains only improve the current infrastructure. On the question of permissionless or permissioned blockchains, the community is very vivid, as stated by Vigna and Casey (2015): "The hope is that those who issue a cryptocurrency won't exploit the unique power of that role, that they won't engage in the same seigniorage practices as traditional central banks and make money for themselves simply by making currency". Moreover, the scepticism and the different views on how to implement the technology pose as barriers to change because all existing structures cannot be suddenly and entirely disintermediated. Intermediaries play an essential role in all the segments of capital markets, yet blockchains are flourishing because they are disrupting the intermediary services (Kaminska, 2015).

In the case of ICOs, the disadvantages arise from poorly scripted contracts and lack of platforms which would execute issuance in case projects do not have the resources or/and the capabilities to make an ICO in-house. In some of the cases, such platforms could increase the reach of investors in a fundraising campaign. Secondly, in the cases of private placements in traditional markets, intermediaries are crucial in the process of performing activities such as doing the due diligence, seeking for the opportunity, advising and consulting the issuing company and bringing the expertise. From the consumer point of view, many individuals are not experienced enough to trade without a broker. Furthermore, the market would not be efficient without the liquidity providers matching orders, namely exchanges, market makers and broker-dealers (Lee, 2016).

Finally, the security disadvantages arise from the previously mentioned technology limitations, such as poorly scripted contracts, network protection, privacy (in case a company wishes to keep some transactions private), the 51 % attack, energy consumption, capacity and speed (Lee & Wang, 2015). In conclusion, the blockchain technology offers better solutions with several improvements to the financial services but comes with

uncertainties mainly related to the regulatory uncertainties due to highly and strictly regulated financial markets.

4 EMPIRICAL RESEARCH

In the practical part, the interviews are analyzed providing insights into the main areas of interest: the companies' approach to the blockchain technology, the impact of the blockchain technology, the risks and opportunities of the blockchain technology in the capital markets, and governance and regulation related questions. The participants' descriptions are anonymous with the exception of the description of their expertise. Their opinions are not official opinions of the companies they work for. Some of the participants are early adopters of the blockchain technology and/or have expertise in the capital markets industry.

4.1 Participants

Participant 1 is a co-founder of a cryptocurrency asset management fund present in the industry since 2017. Previously active as a Lead Fund Manager in an investment management company, the interviewee had previously also served as Fund Manager and CIO until he co-founded an asset management company. His company's funds were consistently ranked among the top performing funds in their categories. He holds an MSc in Investment Management. The interview was conducted via Skype.

Participant 2 works as a Legal Compliance Officer at a platform aiming to be a cryptocurrency asset management platform offering tokenized Real Estate Funds, Crypto Asset Funds and Initial Coin Funds (ICF). She is active as a Community Manager at the Blockchain Think Tank and as a Legal at a start-up aiming to rethink how we manage our data. She holds a master's degree in Law from the Faculty of Law. The interview was conducted face to face.

Participant 3 is a co-founder of a company providing clients with custom management solutions for the crypto asset class, such as portfolio advisory and market research. He previously worked as a treasury manager and portfolio adviser in the cryptocurrency sphere. He also worked as a Fund Manager and Risk Manager. He holds a degree in Risk Management and is a certified Financial Risk Manager. The interview was conducted face to face.

Participant 4 is the CEO of an asset management platform which includes the creation and management of cryptocurrency funds. He previously served as a Member and the President of the Management Board. In 2006, he established an investment company and held the office of the President of the Management Board. He has a long-standing experience in the financial industry, having first worked as an Analyst, Stockbroker, Asset Manager and then

as a co-founder of private consultancy companies. He graduated from the Faculty of Economics in Ljubljana. The interview was conducted face to face.

4.2 The state of the blockchain technology

The blockchain technology can have a very wide array of use-cases and influence, but in its essence, it is a new asset class, even though there is a lot of emphasis on the technology. It suits the industry completely, being an additional industry in a traditional world (Interviewee 1). Some look at cryptocurrencies as a new asset class, the same way as commodities have arrived to financial services as a new asset class. Interviewee 3 states that their company is developing products and metrics for smart money to enter. These products and metrics are unique to blockchain and include hashrates, protocols, staking, etc. (Interviewee 3). Nowadays companies are looking into the blockchain technology. Products can be improved with the use of the blockchain technology because it can be faster, in comparison to, for example, settlements in traditional capital markets. Strategically, it is important because it enables new and enhanced propositions in security and verification of transactions (Interviewee 2). The main challenge remains the current outdated post-trading processes in the financial system, such as settlement and transfer of ownership (Interviewee 4). Regarding implementation, Interviewee 1 explained that they have several people working on the development and research of different blockchain implementations. They are adding and utilising additional techniques, which are unique to cryptocurrencies, like staking, for example. In the future, they will allocate additional resources to implementing and researching these techniques (Interviewee 1). With the blockchain technology you can utilise techniques, the use of which is not possible in the traditional world. Nowadays, you can stake, mine, loan or own a governance stake. Moreover, you can have non fungible tokens (Interviewee 3).

The predominant strategy of institutions and corporations at the moment is the development of private blockchains. Banks are developing blockchain technologies for the front- or the back-office. At the moment, nobody is using tokenized and public digital tokens. The opportunity might be in this sector. The banking infrastructure is huge, robust and it works. Ideally, this is the opportunity for new incumbents to come into the industry (Interviewee 1).

Blockchain's use-cases are not applicable yet, because in reality it turns out that a blockchain is an expensive distributed database, which is not agile and is not as efficient as people expect. A blockchain is very expensive and its developers always have to choose between the scalability or the immutability of the network. From this aspect, the blockchain technology is not as applicable as it was initially believed to be, and has only experienced a lot of hype, because the technology itself is very interesting. However, decentralized programmable payments were introduced, all without intermediaries (Interviewee 3).

Bitcoin was never really approved by the corporations and governments because it is associated with criminal activities and other marginal groups. The blockchain technology has an interesting psychological component but what is interesting is what Satoshi made by connecting the blockchain with a PoW consensus. This created a unique digital asset, which can be independently transferred on the internet. The blockchain is most applicable in already proven use-cases of value transfer, such as a store of value, like in the case of Bitcoin, or as the medium of an exchange, like in the case of BitcoinCash, Litecoin, etc. Until there is a proven use-case for another utility, applicability remains only in tokens trying to be digital assets that transfer value (Interviewee 3).

As with any newly developed technology, there are always limitations. For instance, this was also the case with mobile phones which gradually improved and expanded their capabilities as the technology developed. Interviewee 4 believes that the same thing will happen with the blockchain technology. One of the most prominent technological limitations is scalability. Security per se, is not an issue for the blockchain technology, however it is an issue for all the other layers, such as the applications and other use-cases using the blockchain technology, which can be hacked if not properly secured (Interviewee 2). A new paradigm can be reached but only with different technology because the current PoW technology is not scalable from this point on. Scaling can be done with second-layer technologies, which is what Bitcoin is trying to achieve by implementing the lightning network. Nevertheless, there will always be trade-offs between scalability and an immutable database. Centralized networks are currently faster but not immutable. On the other hand, decentralized networks, such as Bitcoin, are slow but immutable. Complete immutability is very expensive and very slow. Interviewee 3 points out that he cannot see the scalability issue being solved at the current paradigm of PoW. He explains that, on the second layer, blockchains are less secure but fast and still peer-to-peer without intermediaries. According to his predictions, the industry will continue to develop solutions on the second layer, given that the first layer blockchains are not scalable to the VISA transaction frequency. To transmit so many transactions with complete immutability of the blockchain would be very expensive (Interviewee 3). Another limitation derives from the blockchain's reliance on the code, which, if faultily scripted, can pose as a security risk. The technical limitations are changing already. In terms of scalability, many projects are being developed and issues are being worked on (Interviewee 2). The consumers will benefit the most. The cost will go down and the speed will go up (Interviewee 1).

The market participants also comment extensively on the subject of central authorities. The blockchain technology will weaken central authorities, since they are at an obvious point of risk. Never have we lived in a more centralized world than we live in today (Interviewee 1) but it can be decentralized. Any intermediary service that can be optimized with the blockchain technology, will be optimized or replaced. Optimization will happen, mostly in code development, meaning that some intermediaries will be removed but more programmers will be working to support blockchain networks (Interviewee 2). Central authorities understand the impact of the technology and will adapt by going hand in hand

with the market developments. It is an opportunity for them to flourish in these settings because they can easily adapt their infrastructure and increase or sustain the market share (Interviewee 1). In theory, the blockchain technology should remove central authority intermediaries. But in reality, central authorities will continue to have a certain role in compliant clearing and settlement (Interviewee 3). Interviewee 4 sees the beauty in the fact that the technology is evolving. He explains that various specific cases can be coded and that somewhere down the road, programmable securities with clear guidelines and finality concepts will be introduced. He views the blockchain technology as having the potential to change the nature of products in the financial industry (Interviewee 4).

At some point in history, the society started using paper money and then electronic money. The transition to tokenized money seems natural in that sense and does not change the social aspect of money. Tokenized money is now a proven use-case for the blockchain technology and involves the requirement of governance. Monetary policy is still dependant on the developers, whether it has limited, unlimited supply, etc. If decentralized governance experiences significant developments, we could see advancements in regulation and in the workings of the society as a whole. Moreover, the current system of discretionary decision making, where a certain monetary system, like a country or a super nation, can simply print money, is not sustainable. Interviewee 1 suggests that people are not ready for the change this technology might bring and emphasizes the need for some kind of rational substance to form (Interviewee 1).

4.3 Regulation hurdles

Regulation is a grey area due to the nature of the business. Cryptocurrencies are merging all of the categories because they have elements and characteristics of a currency, a security and an asset. We lack legislation because regulators are lagging behind. Companies in Slovenia are trying to self-regulate and help the regulators, but first they need to understand the implications of blockchains (Interviewee 2). Interviewee 4 is convinced the markets will see legislation that will show the participants what is needed and what must be done. How companies will evaluate the prospects of the new plan remains to be seen (Interviewee 4).

As suggested by Interviewee 3, over-regulation has always been present. The current markets are over-regulated and thus more complex. The regulations implemented after the financial crisis in 2008, concerning banks and the financial sector in general, at first only established loose rules that later became stricter with various non-important clauses. Interviewee 3 explains that he understands the regulator's need to remove the threats, however, over-regulation led to complex bureaucracy. In the banking sector, it is known that they do not work on business development but instead experience overhead associated with bureaucracy (Interviewee 3). Interviewee 1 points out that, usually, extensive economic development brings deregulation. When the efforts fail, regulators come back and re-regulate excessively again, which causes over-regulation (Interviewee 1). In industries

where over-regulation is present, a phenomenon of "forum-shopping" usually appears (Interviewee 2).

Interviewee 3 explains that there are a lot of trade-offs with the blockchain industry. Given the fact that cryptocurrencies on the blockchain can function as decentralized money, criminals can use them to launder money and avoid government taxation. This is definitely one of the aspects the regulators should consider (Interviewee 3).

Regulators are already reacting to the blockchain technology, but there are many countries where regulators do not want to adopt it. With time, regulators will have to use parts of the blockchain (Interviewee 2). Furthermore, a respondent added that a significant amount of cooperation with the regulators is needed to tackle the uncertainties of the industry. It would help if there were more guidelines on how to self-regulate. Accepted regulation should be standardized along with finality of concepts from a regulatory point of view (Interviewee 2). Interviewee 1 claims that regulators are quite knowledgeable and are beginning to catch up and trying to understand the opportunities and the risks the blockchain technology brings. He mentions protection of the investors as one of the principal worries regulators express, however, he is optimistic about the future of Slovenian blockchain legislation (Interviewee 1). Interviewee 2 adds that, in Slovenia, a lot of progress has been made with the Blockchain Think Tank. According to her, the organization established a channel through which people can talk to the leaders of the industry and help them understand how blockchain works and how it can be utilized. Since the technology is in its early developmental stages, it lacks a regulatory framework, which means that the companies pursuing projects need to be aware of the self-regulation option (Interviewee 2).

The regulators are not acting hostile towards the blockchain industry, they are, instead, taking time to understand the technology (Interviewee 1). Nevertheless, through the terms of the ICO and the terms of the platform, a company can protect its investors and ensure the safety of the company (Interviewee 2). Interviewee 1 stated that their company is not self-regulated as they fit into the regulatory bracket they work in (Interviewee 1). To self-regulate is a risk. Companies should be in the process of obtaining a licence (Interviewee 3). This is a legitimate risk for uneducated investors. Initial coin offerings should be regulated and the trend of SAFT agreements and regulated token securities is on the rise. The rules in these settings are very similar to start-up rules, with only accredited investors eligible, which is already a standard in the traditional infrastructure (Interviewee 1).

Regulators will be able to perform enhanced reporting and auditing due to the transparency of the blockchain technology, however, they must first understand and regulate the blockchain industry. After implementing regulations, the regulators will be able to use the blockchain technology's potential for transparency. At that point, it might turn out that it may even be too transparent by providing comprehensive data information, sometimes offering too much sensitive information (Interviewee 2). Interviewee 3 states that with the regulatory enforcement of KYC, the blockchain would stop being anonymous, which would

make monitoring much more effective due to the transparency of the network. The basic premise of cryptocurrencies is the transfer of value, not just information, in a much more efficient way. Unfortunately, criminals have seen an opportunity to exploit the anonymity blockchain provides, however, regulators can still leverage it (Interviewee 3). Interviewee 1 added that on the other hand, in the case of a completely decentralized network, one does not need regulators, but they could adopt the blockchain technology (Interviewee 1).

In traditional markets, the biggest problems are regulation, stagnation and the pace of technological development, which is faster than the changes in the legislation (Interviewee 2). Solutions to be used in practice, on a large scale, can appear in maybe a decade, it is hard to tell. It would be much easier if we had clear regulatory guidelines (Interviewee 1).

Because of the rapid development of the blockchain technology even laws accepted last year would need to be changed today. In a way, it is better for regulators to wait and establish free zones and agreements, where companies can work but are not entirely regulated (Interviewee 2). Regulators are not the catalyst for the stagnation of the blockchain industry. Regulators instead do not want a financial crisis again. Nowadays, markets are back to an all-time-high, but the experience of the financial crisis is still fresh. When the memory fades, regulations will loosen as well. Interviewee 1 sees this as a market cycle (Interviewee 1).

When faced with the question whether or not the legal industry is threatened by the blockchain technology, Interviewee 2 pointed out that she sees it not so much as a threat but more as an opportunity for legal experts to stop dealing with simple issues that could be solved by introducing smart coded laws and focus their attention on more demanding issues having to do with ethics and the moral code. The legal industry would have to transform, but she does not perceive the potential change negatively (Interviewee 2).

4.4 The impact of the blockchain technology in capital markets

The market will show demand for new functions of the blockchain technology and the financial industry will adapt to it. Some market participants will be removed and some will become more competitive, developing new functions. The biggest advantage is the democratization of entry for retail and consumers, transmitting business without intermediaries. Still, with the entry of bigger companies from the traditional world, a big market share could be theirs (Interviewee 3). Furthermore, banks will adopt the blockchain technology, however, new incumbents will appear with solutions which will be superior. Banks will change and adapt to the blockchain technology, either by buying or licensing it. A great opportunity for everybody is presenting itself as services could become cheaper and banks could further increase adoption. Frontier service providers have an immense opportunity but must allocate more effort to effectively compete with bigger firms (Interviewee 2).

Generally speaking, first the infrastructure, i.e. custody and fiat gateways, will be adopted, and after that, we will see more concrete products (Interviewee 4). The blockchain technology currently developed by banks is meant for front- or back-office. (Interviewee 1).

The main barrier to the adoption of the blockchain technology in the capital markets are probably the traditional ways of thinking. Capital markets right now are utilising traditional assets which are already at their disposal (Interviewee 2).

4.4.1 The impact on equity investing in capital markets

Cryptographic tokens are different from traditional securities because they are scripted digital tokens, meaning they can be coupons, bonds or securities (Interviewee 3). ICO is less costly and enables the crowdfunding of the product and the issuance of tokens, which are traded and liquid (Interviewee 2). Furthermore, with the emergence of regulated digital tokens, the token becomes very similar to traditional security. On the other hand, the utility token is a novelty and is definitely more exciting. ICO represents a very idealistic principle, because of the democratization of the fundraising. In the case of ICOs, liquidity is the biggest advantage. But the negative side of liquidity is that it brings speculation and funds that are not being allocated properly due to speculations. Investment markets are regulated and consist of well informed investors. In the case of ICOs in the last year, the trend has been overhyped with many ICOs taking place, and many are now shifting towards SAFT agreements or towards a regulated token security because of the strict regulatory compliance demands (Interviewee 3).

When a company uses the traditional IPO it needs to take into consideration various settlement and custody operations along with a decrease in costs and simplified processes. Instead of an IPO, a company can do issuance of assets with digital tokens through the use of the blockchain technology. The blockchain enables settlement and custody operations on-chain. Nevertheless, a link to a traditional company is required along with regulated settlement and custody solutions. Settlement and custody are two issues that banks are working hard on (Interviewee 1).

4.4.2 The impact on post-trade in capital markets

The first impact of the blockchain technology will be seen in the changes of the current infrastructure's blockchain solutions, such as custody and fiat gateways, and then we will see more commercial products and applications (Interviewee 4). Efficiency will go up and people will be able to build on top of that (Interviewee 1). The execution of scripted agreements is instant and removes intermediaries (Interviewee 2). Still, the roads of the market participants need to be separated. There is a need to have all the market participants separated by law. Many market participants will change and adapt (Interviewee 1). The banks will change, a number of jobs will change, move, adapt and new jobs will appear. An

immense opportunity for everybody is presenting itself because services could be cheaper (Interviewee 1).

According to Interviewee 1, the biggest bottleneck remains custody. It needs to be done the old way, with a treasury administrator needed, and this was usually done by banks. In reality, there are currently no banks performing the role of a regulated custodian. At the moment, the incumbents are the ones trying to get bank licences in order to be regulated (Interviewee 3). For some changes in the capital market processes, the entire capital market infrastructure would need to change heavily. Interviewee 1 states that the first simple solutions are settlement and custody processes on the blockchain, but ideally a P2P exchange settlement could be developed. Nevertheless, the current financial system is a robust system, which is the legacy of the industry development during the last 40 years and will not change swiftly (Interviewee 1).

If you have a centralized system like the one already established, removing the counterparty risk is not possible because some central authority organisations are too big to fail and be removed. You can remove the counterparty risk with settlement and custody on the blockchain but the technology is young and the operational risk is high. Potentially, it could remove some risks associated with reconciliation and audit of records (Interviewee 1).

The front offices are quite developed but back offices see little development in capital markets nowadays (Interviewee 1). Front offices have developed due to the wide use of internet which enabled the speed of transactions to go up, however, that is not the case with back-offices. Nevertheless, in the recent years, there are many new incumbents in back-office sectors (Interviewee 1).

Back-office has yet to become the focus of the development in capital markets. To change the current infrastructure, a concrete push towards development is needed and for that, the benefits need to be apparent. What the concrete benefits are, is yet to be seen. Booking and accounting are done very differently all around the world and the blockchain technology could be a potential solution for standardization (Interviewee 3).

Banks deal with a lot of bureaucracy. In order to comply with all the conditions, they use T+2 (Interviewee 3). The removal of the liquidity risk requires regulators to have two days' settlement, which can be eliminated with the blockchain technology. Peer-to-peer definitely has a future here because there is no need for the middle man, along with no T-2 clearing (Interviewee 3). The settlement we know today is T+2 or T+3, which means that the waiting time for the transfer is two or three days. With blockchain it is instantaneous. Shorter time is needed and the benefits include more liquidity along with the removal of a third party risk (Interviewee 4).

Shorter settlement time would also be better from the accounting point of view. If someone transfers money and it arrives with time difference, opportunity costs could occur. The faster money is exchanged, the better, especially money used for investments (Interviewee 3). With

transactions taking place on the blockchain, neither party is risking the conditions of the contract being settled, because programmable securities are not going to change and affect the deal (Interviewee 3).

The perceived risk in using the blockchain technology on capital markets is volatility and self-regulation. The negative sides lie in heavy reliance on the code, which poses a security risk (Interviewee 3). The evolvement of the market itself brings certain risks because the blockchain technology is young, but once the blockchain technology is standardized and present in the existing markets, it will not be a problem (Interviewee 4).

DISCUSSION

Bitcoin has created the first decentralization of trust. The underlying blockchain technology has the potential to transform the capital market's infrastructure and central intermediaries. In simple terms, the blockchain technology removes the need for a central authority. Permissionless, permissioned, public and private blockchains differ in terms of who can participate and how they can participate in the network. My findings suggest that institutions prefer to participate in research and the development of private blockchains. Permissioned networks are more popular since they provide different and less costly validation methods by considering the trade-off between scalability and decentralization, which is of importance for the immutability of the network. On the other hand, some respondents state that there is no need for a centralized blockchain technology because it brings no change in comparison to the existing infrastructure.

A respondent suggests that the problem lies in discovering a new technical paradigm, where we would be able to connect consensus methods, making scalable and less costly consensuses, which would provide an intact immutability. On the other hand, research suggests that nowadays companies build on the second layer of blockchains, which provide scalability and, to some extent, verify the ledger with the first layer, which can be more decentralized.

The blockchain technology has proven itself as a use-case of value transferring. Incumbents have utilised this value transferring in a sharing economy, which enables ICOs, crowdfunding, peer-to-peer lending, P2P and other payments. Some of the respondents agree that Bitcoin and cryptocurrencies need to be seen as a new asset class, meanwhile two respondents see the core value in digital tokens transferring value and utilising P2P payments. A respondent also added that blockchain could influence huge advancements in regulation and changes in the workings of the society. The blockchain technology enables value transfer, enables economic coordination and can enable innovation of processes by being a foundational technology. On the other hand, respondents agree that major market participants are working in a very centralized environment and that the blockchain

technology cannot simply replace them, but can instead become integrated and enable collaboration within systems.

The blockchain technology is already impacting and will further impact central authorities, with our respondents suggesting that some intermediaries will change, some adapt and some diminish due to the utilisation of smart contract programming. The blockchain technology is highly associated with trust, which needs to be ensured for its success. Most of the financial infrastructure is intermediaries who profit off the fee charges. Blockchain technology can lower fees and allow participants to be free of intermediaries. Decentralization of the financial industry could change the nature of the products in the industry. On the other hand, respondents do not agree with the literature review, which states that blockchain can remove most, if not all of the intermediaries in capital markets, because it would either require radical changes in the infrastructure or significant advancements in regulation, yet a need for a central authority in adapted roles would still most likely remain. Respondents are positive that the current technical limitations will be overcome within a decade, stating that, for now, the technology is not mature enough for dApps. Some were sceptical towards different use-cases of the blockchain, excepting its use for value transfer. The respondents state that a huge number of incumbents is entering the industry and many are pioneering in the development of the blockchain technology, not only in terms of technology but also in terms of product side, thus becoming new participants in the blockchain infrastructure.

Cryptocurrencies are an emerging class of assets, which have characteristics of currencies, securities and assets. Such a class does not fit into the current legislation since it introduces novelties, such as utility tokens, and techniques, such as governance and staking. The respondents firmly believe in the tokenization of assets and the introduction of regulated programmable securities. Furthermore, the respondents stated that after regulatory clarity, companies may evaluate new prospects but until there is no regulation, companies will continue to adapt using the "act first, seek forgiveness later" approach and aim to self-regulate. The respondents see the current traditional capital markets as over-regulated but agree that the current regulation is not the cause of economic stagnation, however, it does slow down the process of regulating, obstructs business performance and creates uncertainty. My findings suggest that the respondents agree on the need for comprehensive research and the development of appropriate legislation but would welcome clear guidelines and some finality of concepts from regulators. Due to all the unique parameters of cryptocurrencies, regulators are having a tough time understanding existing assets circulating on blockchains. That is because the technology introduces a programmable currency, which can fit into a coupon, a bond or a security in the current settings. Regulators need to understand what kinds of opportunities can derive from it and understand the risks associated with it.

The blockchain technology is connected to the financial industry, because it enables double-entry accounting on the ledger with a long-term possibility of introducing triple-entry accounting in a holistic blockchain infrastructure. According to recent trends, many initial

coin offerings have started to conform to SAFT rules and the trend of regulated crowdfunding and ICOs is expected to continue because there is little room for uneducated investors in the financial markets. Regulation will affect reporting and auditing due to the transparency of the blockchain technology.

The blockchain technology disrupts the financial industry with the introduction of a somewhat isolated but wholly functional blockchain infrastructure, which does not rely on the traditional capital markets' infrastructure. It allows for the issuance of tokens in a completely decentralized manner, which is referred to as initial-coin-offering and enables transfer of value, governance stake, an ownership in a company and much more.

In recent decades we have seen a shift in funding. Funding used to be done with early seed investments and loan-taking from the banks, which are still possible options for a non-accredited investor. The next possibility, with a higher funding cap, are angel early seed investments and VCs. Furthermore, bigger companies can raise financing with private equity investing and later on with debt capital markets. Climbing this ladder enables you to lower the costs of capital. Nowadays, a company or an individual can raise funds with crowdfunding, crowd-investments, crowd lending. The advancements in blockchain development introduced a novelty of ICO.

With the introduction of ICO, anyone can utilise a token, which can represent ownership and shareholder rights while being liquid and traded on asset exchanges, which is a novelty compared to VC investing in the traditional setting. Still, respondents suggest that regulated programmable securities or guidelines are needed to serve as a link to traditional markets, in order for market participants to develop products, such as regulated settlement and custody.

Blockchain ecosystems are actively expanding by trying to innovate in the existing industries. Blockchain start-ups working toward integrating the blockchain technology into the existing systems are creating a link with the regulators. My findings suggest that banks are the first to adopt the blockchain technology, by buying or licensing the technology from pioneering service providers. The blockchain technology could speed up settlement and improve custodial services because it inherently does these functions on-chain. Respondents agree that some intermediaries' roles will only be adapted and will not apply to all processes as some will require a link to a regulator. Some argued that a shorter settlement time lowers costs due to opportunity costs from the accounting point of view. Furthermore, this technology could remove the need for liquidity risks of transactions and credit risks from participants.

The findings suggest that the drawbacks and risks of the blockchain technology lie in the volatility of the markets and the lack of legislation guidelines, which leads to self-regulation and obstruction of new business model innovation. Negative sides involve reliance on the code, which poses a security risk, and the immaturity of the technology, which causes uncertainties throughout the industry.

CONCLUSION

In the conclusion, I assess the research questions of the thesis paper, beginning with how blockchain can impact processes in capital markets.

The blockchain technology can impact trade execution and settlement by enabling the change of ownership, utilisation of shareholder rights and by being liquid. Issuance of tokens introduces a novelty amongst financial instruments and will innovate business models of the existing industries with the use of blockchain. It can impact custodian services with little need of intermediaries, it lowers costs because of a single database and a short settlement time. Programming smart contracts allows for automated transactions to be executed without intermediaries. Moreover, the regulators of the capital markets can develop better reporting and monitoring services.

How and which processes in the capital markets can the blockchain technology impact in short-term?

Participants can get involved with the blockchain technology by utilising ICO and entering the ecosystem by developing support solutions, such as settlement and custodian services. There is an opportunity for new incumbents to provide services for the financial services, such as asset management for the new blockchain infrastructure, and an opportunity for an entry to the existing non-financial markets, if it lowers costs or provides added value in the existing markets.

What are the benefits of the main actors in capital markets adopting the blockchain technology?

The main actors benefiting from the blockchain technology remain the consumers. With the introduction of ICOs, we have seen the democratization of crowdfunding, which enables an average Joe to transfer value without an intermediary. Even though these types of investments are expected to be more strictly regulated in the coming years, this introduced decentralized ways of value and ownership transfer. With blockchain, there is little need for intermediaries. The immaturity of the industry is an opportunity for the entry of new incumbents and existing players, because the roles of market participants will change or adapt but not necessarily be removed. Furthermore, blockchain can decrease liquidity problems and credit exposure risk in the processes of middle- and back-offices.

How can the main actors in the capital markets in Slovenia adopt the blockchain technology?

Companies in Slovenia need to fit into a regulatory bracket or try to self-regulate and seek legislation guidelines because the current situation poses uncertainty, which needs to be considered for companies entering the blockchain industry. Uncertainty can act as a cause of economic stagnation for business model innovation and business performance. Major capital market actors and banks have the capabilities and have researched the opportunities

and risks of the blockchain technology. Some are even developing in-house solutions. Furthermore, there are opportunities, for new incumbents and the existing players, in the development of regulated services for the blockchain industry.

To conclude, in a utopian blockchain world, one can imagine a digital state where money supply consists of cryptocurrencies enabling complete transparency made by governments, which could decrease corruption and push for better decision making. Its disinflationary attributes could make a digital token increase in value over time for each owner. It could enable digital identity systems, which would further decrease frauds regarding identity theft and enable governments to remove passports as we know them. The blockchain technology could influence changes in supply chains, and some argue it already is making changes in fields like digital voting, digital health systems and data protection. Most importantly, it will influence corporate governance, which can be improved with decentralised governance, removing the need to trust humans to conduct reporting and accounting.

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APPENDICES

APPENDIX 1: Povzetek v slovenskem jeziku

Mnoge slabosti finančnega sistema so bile prepoznane po finančni krizi leta 2008, ki je v zadnjem desetletju svoje sledi pustila v poostreni regulaciji finančnih trgov, manjši ekonomski rasti ter tudi pojavu tehnologije blockchain, ki preko veriženja blokov omogoča decentralizirano valuto za prenost vrednosti. Blockchain tehnologija lahko izboljša storitve, kot na primer takojšnja poravnava, odstranitev klirinških hiš ali celo spreminjanje obstoječe infrastrukture. Magistersko delo ocenjuje glavne prednosti in slabosti blockchain tehnologije in kako lahko glavni akterji na finančnem trgu izkoristijo priložnosti v blockchain industriji. V magistrskem delu so uporabljene deskriptivne in kompilacijske metode. V praktičnem delu ocenjujemo kriptovalute kot novo nastajajoč finančni instrument, ki ima lastnosti valut, vrednostnih papirjev ter ostalih finančnih sredstev. Intervjuvanci menijo, da bodo kriptovalute regulirane, s pričakovanimi vrednostmi za vse glavne akterje, razen tistih, ki opravljajo izključno posredniške storitve. Regulacija kriptovalut bo vplivala na poročanje in revizijo, in to prav zaradi preglednosti blokov. Blockchain bi lahko pospešil poravnavo in skrbništvo, saj omogoča obe funkciji intrinzično na verigi. S poravnavo in skrbništvom na verigi lahko odpravi potrebo po T + 2. Omogoča odpravo potrebe po likvidnostnem tveganju transakcij in zmanjša kreditna tveganja udeležencev. Blockchain tehnologija omogoča izdajo žetona, prenos vrednosti ter omogoča upravljanje z deleži v podjetju na popolnoma decentraliziran način.

APPENDIX 2: Interview

1. Is your company interested in or is looking into the blockchain technology? If yes, is it of strategic importance?
2. Are you allocating any resources for the blockchain technology? If yes, what for:
    1. Research
    2. Implementation
    3. Diversification
3. If yes, what kind? Size of the deal? Type of diversification?
4. If yes, what is the expected potential of the investment?
5. Do you expect to allocate more resources to it over the next 5 years?
6. Is your company part of any partnerships, consortiums or ventures within the blockchain industry?
7. What are the use-cases of the blockchain technology your company is interested in?
8. What is the impact of these use-cases in terms of financial, operational and strategic impact? Any other perceived impacts?
9. The blockchain technology is in early development, do you have any concerns regarding technological limitations?
10. Is there any regulatory uncertainty regarding your company? If yes, what are the uncertainties?
11. Do your use-cases comply with the national laws? If not, why not? How are you dealing with regulatory hurdles?
12. How do you think regulators will react to the blockchain technology?
13. Which risks do you perceive in using the blockchain technology in capital markets?
14. What could be a barrier to the adoption of the blockchain technology in the capital markets?
15. Which implications of the blockchain technology will have the biggest impact on capital markets? Why?

16. How and which market participants will benefit from the use-cases of the blockchain technology?

17. How will blockchain transform capital markets in terms of its structure, the roles of the main participants such as intermediaries, exchanges, central counterparties, and regulators?

18. How will regulators benefit from the blockchain technology in capital markets?

19. When do you think initiatives concerning the blockchain technology will be launched?

20. What is your company's role on the capital market today? What is your current role at the company?

21. What are current trends on capital markets?

22. How do over-regulation and the European Union impact capital markets?

23. Today's capital markets are complicated thus implementing the blockchain technology poses technical limits to changing the capital markets' infrastructure. How fast and how can technical changes be implemented (based on your experience)?

24. How do you think the blockchain technology can impact central authority intermediaries?

25. In a blockchain based ecosystem, which main participants in capital markets would be removed?

26. Why does the traditional capital market take 2 days for settlement? Is a shorter time needed? What are some benefits of instantaneous settlements?

27. What are some regulatory objectives your company needs to comply with in capital markets nowadays?

28. When do you believe the blockchain technology will be ready for mainstream adoption and when for the adoption of the blockchain technology in capital markets?