

# **Stakeholder Viewpoints on Cryptocurrencies**

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<p>Abstract:</p> <p>Cryptocurrency stakeholders include cryptocurrency end-users, investors, developers, market enablers, researchers, and financial regulatory agents. They are key components of the crypto ecosystem and major determinants of cryptocurrencies' future direction. Analyzing viewpoints of each stakeholder group help understand the impact of cryptocurrencies to the financial system and to society at large. Cryptocurrencies are one of the top financial innovations of our era and the technology behind it, the blockchain technology, is a technology that will revolutionize every sector in the future. Due to limited resources, scarcity of expertise and novelty of the research area, a systematic review of literature is used to understand stakeholder viewpoints on cryptocurrencies. Cryptocurrencies are unlikely to compete with legal currency (both fiat and virtual currencies) due to their price volatility and anonymity nature. However, depending on the economic and political stability of the region, they could be a preferred alternative to transfer money and storing of value. Short-term investors and cryptocurrency end-users in politically and economically stable regions (CESR) appreciate the price volatility of cryptocurrencies whereas retailers, end-users in politically and economically unstable regions (CEUR), and long-term investors demand a more stable cryptocurrency. Financial regulatory agents in most unstable regions find cryptocurrencies a threat and destabilizer of their financial system and mostly take a stance to impose harsh measures in restricting or banning their circulation within their territory.</p>	
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# 1 INTRODUCTION

## 1.1 Background

The increased adoption of privately-owned digital currencies (cryptocurrencies) in the financial market has recently grown by a rate that raised concerns to many, including central banks and financial regulatory agents around the world (Yermack 2018). This concern was also discussed at the European Parliament in a roundtable on cryptocurrencies and blockchain for the members of the EU (Patrick 2016).

The recent financial technology (FinTech) developments and innovations of the financial sector have created opportunity for many private players to establish themselves in the financial market, providing a cutting-edge financial solution. For instance, the creation, development, and adoption of cryptocurrencies have already addressed payment related issues and served as an additional function of money, like storing of value especially in politically and economically unstable regions (Badev & Chen 2014). At the same time, this development has posed concerns to central bank's monopoly power on money issuance, regulating price stability, assuring customer protection, and keeping their work structure due to the decentralized, speedy trans-border transaction and anonymity features of cryptocurrencies' underlying technology, blockchain (Potter 2018).

The possible impact of a further adoption of cryptocurrencies is under discussion and research by academia and practitioners all over the world. It has become a popular subject of discussion among economists, financial market specialists, and even politicians. The related impact to the monetary system is also yet to be investigated in-depth to understand the benefits and drawbacks it brings to the financial ecosystem. However, different stakeholders perceive cryptocurrencies differently. For instance, it is logical to assume that technology savvy individuals, the younger generation, and startup companies are likely to show a positive approach to the adoption of cryptocurrencies, as opposed to the older generation, financial regulatory authorities, or central banks.

Major reasons for financial regulatory agents not to support the increased adoption of cryptocurrencies include their anonymity and convenience to cross-border circulation, tax fraud, money laundering, terrorism financing, and their threats to monetary and financial stability (Foley et al. 2018).

## **1.2 Motivation**

A proper financial system and monetary policy are very important for a sovereign nation as they influence financial stability and life security (Schwartz 1998). Finance related activities involve money and therefore they need to be regulated and controlled as money could be one major determinant of life security, stability as well as a reason for conflict.

New technologies in the financial sector, such as blockchain technology created a decentralized financial solution that is mainly privately owned; examples include cryptocurrencies and different payment alternatives. These innovations can pose risks to monetary and financial systems such as consumer protection, market manipulation, and financial crimes (Kim-Kwang 2015). They also challenge the basic functions of financial regulatory agents and central banks like issuance of digital base money and central banks digital currency (CBDC) (Yves 2017; Alexander & Fabian 2018).

Therefore, whichever solutions and opportunities Decentralized Finance (DeFi) and Blockchain Technology (BT) deliver to the financial sector, from the financial regulation and controlling perspectives, the future financial ecosystem was put under unpredictability and so does the financial and other related life security of the society at large (Dirk et al. 2017).

### **1.2.1 Research Problem**

Unregulated nature of cryptocurrencies interrupts government and central banks controlled financial and monetary systems and poses a challenge of predictability to the financial world (Lagarde 2017). Not understanding or having a clear direction of the role cryptocurrencies are going to play in the future financial arena is a serious problem and it therefore requires deep study.

This thesis contributes to understanding the problem through a systematic review of previous studies on the different cryptocurrency related viewpoints by its stakeholders such as cryptocurrency end-users, investors, developers, market enablers, researchers, and financial regulatory agents.

### 1.2.2 Research Aim and Question

**Research Aim:** As stated earlier, the purpose of this thesis is to present the different cryptocurrency stakeholder viewpoints. Therefore, its aim extends to examining, analyzing, and evaluating stakeholder opinions and measurable actions to come up with a commonly agreed conclusion and recommendation about the future direction of cryptocurrency and to indicate study gaps.

**Research Question:** According to opinions by stakeholders, which role(s) are cryptocurrencies anticipated to play in future?

### 1.2.3 Limitation

This thesis work is conducted solely based on gathering and analyzing previous research on cryptocurrencies and related viewpoints by stakeholders. A systematic review to identify and analyze data was found suitable for this study due to expert and resource limitation, and difficulty of assuring consistency of information because of the instability of cryptocurrency related data.

In selecting of resources for the analysis, there were two key criteria. First, the number of citations in relation to its publication year. Preference is given to works that are highly cited. Second, priority is given to more recent studies and no article older than 10 years is considered. In the results, material published 2017 and later are given more emphasis. Material published before 2017 and used in the results are separately highlighted.

Concerning the geographical scope, no limitation was applied, and it was assumed this provides a global perspective of the topic. However, research published in the area and used in this thesis work weighs more from the European angle, more specifically those from the financial regulatory part, and therefore it subsequently has slightly more of European perspective compared to the rest of the world.



#### **1.2.4 Methods**

Locating, evaluating, synthesizing, and analyzing previously done studies, popular press briefings, well acknowledged scientific written materials and books in a similar topic was the most appropriate and chosen method for this thesis work to fulfil its aim. The novelty of the thesis topic was one major reason among others in choosing systematic review. Details of the process are found in the methodology section.

#### **1.2.5 Thesis Structure**

This thesis has six sections. The first one is an introduction section that describes the background of the research topic, the need for a research, research question, aim, limitations and the structure of this thesis.

Since the conducting of this study has fully been carried out based on a systematic review of previous studies, the literature review section (section two), was left to provide concepts and definitions that help strengthen the general knowledge surrounding the key points covered in depth in the result and discussion section (section four and five).

The third section is then the methodology section. In this section, the whole process of how the systematic review of the literatures was conducted and the precise details of the steps were explained.

Conclusions drawn from the result and discussion sections were provided in the last section (conclusion section) of this thesis with possible recommendations for future study directions.

## **2 LITERATURE REVIEW**

In this section, definition and other aspects of cryptocurrencies and the related technology that enabled their formation, blockchain technology, as well as other key components of the cryptocurrency ecosystem were explained in a more general level. This section also addressed the general advantages and disadvantages of cryptocurrencies in relation to fiat currency (legal money).

According to the literature review, cryptocurrency and its ecosystem are relatively new, highly discussed, and researched topics with information still built around them and knowledge on development. Cryptocurrency related topics are open for a lot more study to be carried out in the future to understand their potential contributions and drawbacks to the society at large.

As this section mainly focused on definition of key subjects and component parts of the cryptocurrency ecosystem, the cryptocurrency stakeholder part, which is one of the components of the cryptocurrency ecosystem, was defined at this stage without going into more details. Detailed knowledge, theories, information, and prospects on cryptocurrency stakeholder viewpoints gained from the systematic literature review were presented and discussed in the result and discussion section of this report.

## **2.1 Cryptocurrency Ecosystem**

Understanding what the blockchain-based cryptocurrency ecosystem consists of is an important factor in analyzing viewpoints and trust factors for adoption of cryptocurrencies among stakeholders. The cryptocurrency ecosystem consists of different cryptocurrencies, wallets, exchanges, mining systems, payment networks, blockchain systems, and key stakeholders.

### **2.1.1 Cryptocurrencies**

As to the real definition and explanation of cryptocurrencies, He et al. (2016) suggests that a clear definition of money must first be understood and basic differentiation between them distinguished before a deeper investigation. According to Dwyer (2015) bitcoin and other similar digital currencies are called cryptocurrencies because their underlying algorithms and security is intimately related to digital cryptographic algorithms.

The term “Virtual Currency” can also be misleading, and it is different from “Privately-Owned Virtual Currency”. The equivalent term for “Cryptocurrency” is “Privately Owned Virtual Currency” and not “Virtual Currency”. Virtual Currency is an officially recognized legal tender at least in one country and issued by a legal public authority of a

sovereign nation. Therefore, virtual currency is not the focus of this study as it is completely different from those privately-owned digital currencies.

The definition of money as it is discussed in many economic literatures and defined by Jevons (1875) fulfills three basic functions. The stated basic functions were serving as means of payment, store of value and unit of account. Referring to this definition, Söderberg (2018) & Yermack (2013) strongly argue considering cryptocurrencies as a fully-fledged money.

Different authorities have also defined cryptocurrencies in different ways. Here under are the direct quotation of the definitions by the European Banking Authority (EBA), The European Central Bank (ECB) and Financial Action Task Force (FATF).

**European Banking Authority (EBA)** defines Cryptocurrencies as a *“digital representation of value that is neither issued by a central bank or public authority nor necessarily attached to a fiat (conventional) currency but is accepted by natural or legal persons as a means of exchange and can be transferred, stored or traded electronically”* (EBA 2014, p. 7).

**The European Central Bank (ECB)** defines cryptocurrencies as a *“type of unregulated, digital money, which is issued and usually controlled by its developers, and used and accepted among the members of a specific virtual community”* (ECB 2012, p. 14).

**Financial Action Task Force (FATF)** defines Cryptocurrencies as a *“digital representation of value that can be digitally traded and functions as (1) a medium of exchange; and/or (2) a unit of account; and/or (3) a store of value, but does not have legal tender status (i.e., when tendered to a creditor, is a valid and legal offer of payment) in any jurisdiction”*. (FATF 2014, p. 4).

Cryptocurrencies are privately owned virtual currencies using cryptography to validate, which represent a decentralized digital value issued by private developers and denominated in their own unit of account (He et al. 2016). A common feature that most cryptocurrencies share is that they are not issued and controlled by a central or an individual entity. Additional units of cryptocurrencies are created through a mining process by individual and group of miners, and their supply is controlled by cryptographic algorithm.

Cryptocurrencies have higher degree of transactional anonymity. Each transaction is recorded in a public ledger and linked to an electronic address that belongs to a particular user. Therefore, unless the electronic address is found, it is impossible to trace who is

behind a certain transaction. However, if the electronic address is found, then not only the person behind the transaction but also all other transactions that are made under the same electronic address could be identified. One possible way to keep anonymity at the maximum is to use different electronic address for each transaction, even though, it is difficult to be certainly anonymous (Goldfeder et al. 2017).

Cryptocurrencies have no central authority in control like fiat currencies, but are convertible to real-world goods, services, or money (Peters et al. 2015). Thus, they can be obtained, stored, accessed, electronically transacted, and can be used for a variety of purposes if the transacting parties agree to use them. For that reason, virtual currency is based on the idea of exchanging value without the approval of an institution (Maftai 2014).

Digital currencies can be seen as a superior term of any value represented digitally (with no physical counterpart), which is denominated in legal tender (e.g., PayPal). Hence virtual currency represents a medium of exchange that operates like a currency in some environments but does not have all the attributes of real currency, which points out the absence of legal tender status in any jurisdiction (Ammous 2018 & Dibrova 2016).

The ideas behind cryptocurrencies such as, distributed ledger technology and private money are relatively old and they were in place before bitcoin; however, bitcoin has effectively integrated these ideas into work and gained the cryptocurrency market dominance. Cryptocurrency market is growing massively with its total market value being close to 1.75 trillion USD in January 2022.

Cryptocurrencies have revolutionized the way we transact over the internet without approval of a centralized authority. Bitcoin, being a pioneer in the cryptocurrency market, was first created on January 03, 2009 and the first notable transaction was made on May 22, 2010 (Nakamoto 2008). A decade has already passed since bitcoin was created and it still is a leading cryptocurrency among the more than 17,000 cryptocurrency alternatives with a 42.5% share of the total market by January 2022 (e.g. Coinmarketcup).

Although the number of cryptocurrencies in the market exceeded 17,000 today, a few have gained popularities. Table 1. presents key features of the ten most dominant cryptocurrencies possessing a market capital of about 85% of the total market cap.

The intrinsic value of a cryptocurrency is determined by the properties and functionality of the underlying blockchain system. Cryptographic functions of blockchain systems ensure the creation, circulation, and supply limit of the new coins.

TOP-10 CRYPTOCURRENCY PLATFORMS										
Cryptocurrency	Year of Launch	Maximum Supply	New Coin Creation Frequency	Tnx / Sec.	Network	Block Time	Consens Mech-anism	Hashing Algo-rithm	Difficulty Ad-just-ment	Unit of Mea-sure-ment
Bitcoin [2]	2009	21 mn.	12.5 per block	7	NA	8 mins 40s	PoW	SHA256	2016 blocks	Satoshi
Ethereum [36]	2015	unlimited	3 per block	20	Ethereum	15 sec.	PoW	Sthash	1 block	Wei
Ripple [37]	2012	100 bn.	1 bn. per month	1500	RippleNet	near instant	NA	NA	1 blok	Drop
Bitcoin Cash [38]	2017	21 mn.	12.5 per block	60	NA	10 mins	PoW	SHA256	6 blocks	Satoshi
EOS [39]	2018	unlimited	upto 5%	2800	EOS.IO	0.5 sec.	DPOS	DPOS	NA	NA
Stellar [40]	2014	unlimited	upto 1%	1000	Stellar	5 sec.	NA	NA	1 block	Lumen
Litecoin [41]	2011	84 mn.	25 per block	56	NA	2.5 mins	PoW	Scrypt	2016 blocks	Photon
Tether [42]	2014	NA	NA	NA	NA	NA	NA	NA	NA	Tether
Bitcoin SV [43]	2018	21 mn.	12.5 per block	7	NA	10 mins 22s	PoW	SHA256	2016 blocks	Satoshi
Tron [44]	2017	100 bn.	NA	NA	NA	NA	DPOS	NA	NA	NA

Table 1. The Top-10 cryptocurrency platforms

(Source: Rehman et al., 2020)

### 2.1.1.1 Types of Cryptocurrencies

#### Bitcoin

Bitcoin is the first cryptocurrency created in 2009 by an anonymous individual or group under a nickname of Satoshi Nakamoto (Söderberg 2018). As it is common with other innovations as well, it took time for bitcoin to get attention of the public and in the beginning, bitcoin was mainly used for online gambling (Badev & Chen 2014, p. 19).

Bitcoin is the most prominent cryptocurrency in the cryptocurrency market (Huberman et al. 2017). Bitcoin, as the first cryptocurrency, has gained popularity because of its ability to address the centralization and double-spending issues (Chiu et al. 2017).

The cryptographic system that bitcoin implemented was in use even before the creation of bitcoin mainly by governments to secure information. In the case of bitcoin,

cryptographic system was used to verify transactions and control the supply of new bitcoins to the network (Badev & Chen 2014).

Cryptography is a technique to encrypt a message using algorithm so that only those with a key can decrypt and read the message. Digital signature and hash functions are the two cryptographic schemes employed in bitcoin. Digital signature helps the recipient to identify who sent him/her the message and that no modification or change made to the message. The hash function ensures that transactions are recorded in the public ledger.

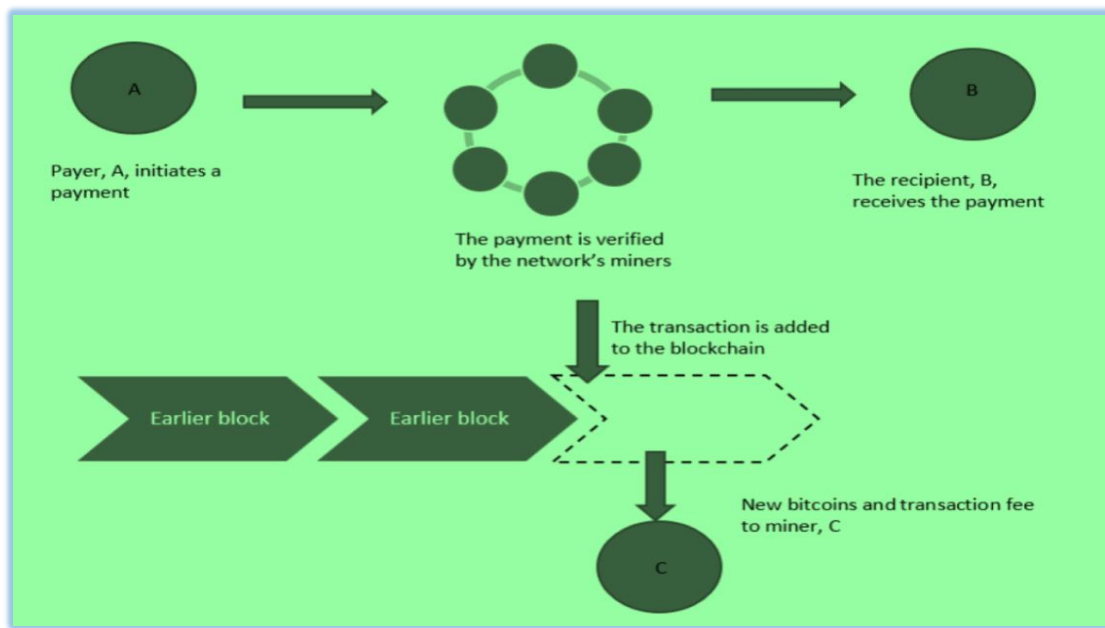


Figure 1. Overview of the bitcoin transaction structure (Söderberg 2018)

Although the current market status of bitcoin is way different from 2017, and it is common for bitcoin to face temporarily high volatility challenges, a recognizable demand for bitcoin started to grow up rapidly since the beginning of 2017 and the year became a historic moment for one bitcoin to approach an exchange rate of 20,000 USD with a market capitalization of over 300 billion USD. Figure 2 and Figure 3 respectively show the exchange rate of bitcoin against US dollars and market capitalization of bitcoin in USD.

Moreover, as illustrated in Figure 2, bitcoin exchange rate is highly vulnerable to asset bubble which resulted in a depreciation of about 64% in less than two months' time, from December 2017 to January 2018.

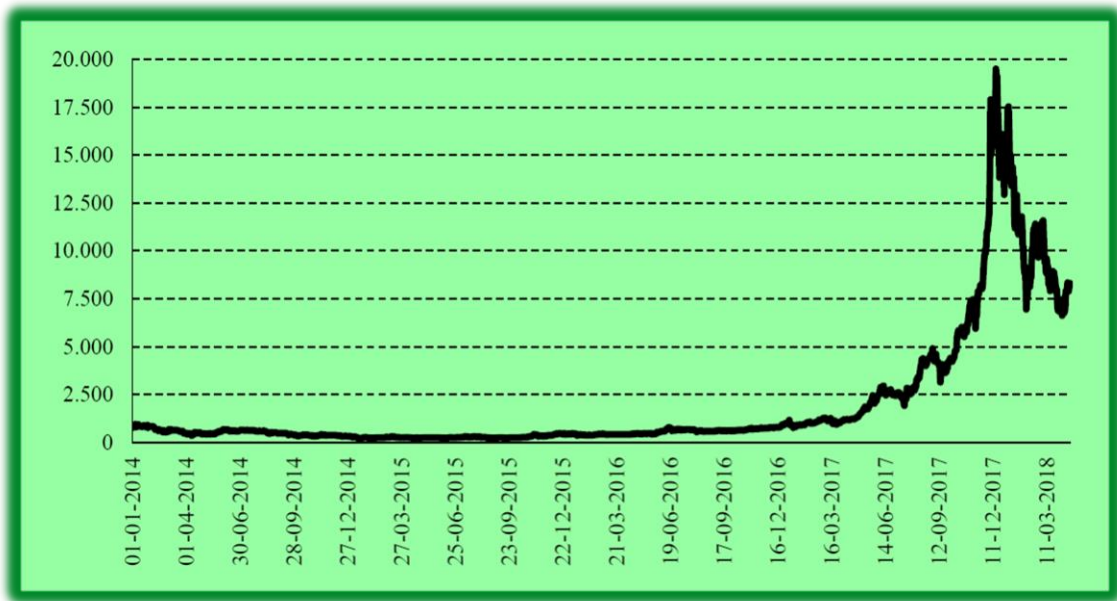


Figure 2. Bitcoin exchange rate against the USD.

Source: <https://coinmarketcap.com>, date of access: 20 April 2018.

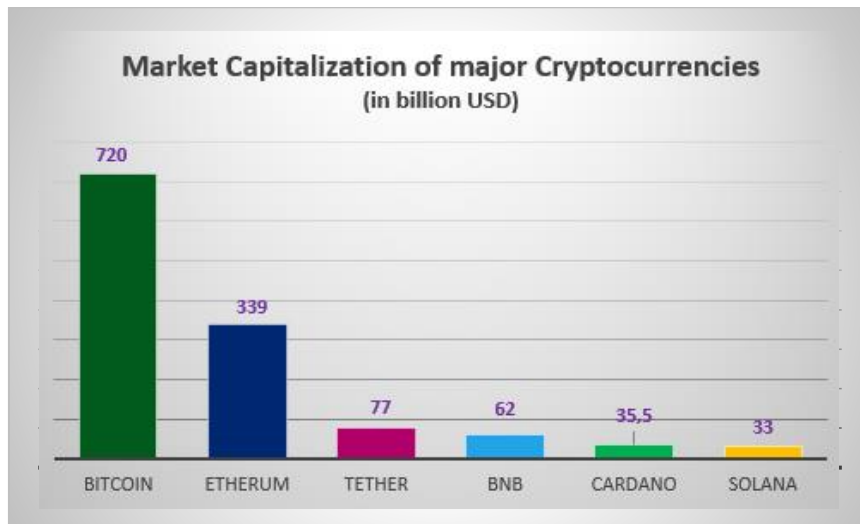


Figure 3. Market capitalization of major cryptocurrencies, (in billion USD)

Source: <https://coinmarketcap.com>, date of access: 4 February 2022.

## **Altcoins**

Almost all cryptocurrencies other than bitcoin are collectively called altcoins. Most altcoins share common characteristics with bitcoin; however, they also have different characteristics in some other respects. One example of that for instance could be the different consensus mechanism some altcoins use to validate transaction and produce blocks. Other altcoins differ from bitcoin due to their added features and capabilities to execute other functionality, such as executing smart contracts like Ethereum does, and keep price volatility lower as it is the case of stable coins.

## **Stablecoins**

Stablecoins are type of cryptocurrencies whereby their formation is attempted to offer price stability and lower the risk of high volatility associated with other type of cryptocurrencies. Stablecoins price stability is achieved by pegging their price with some other stable reserve asset such as national fiat currency, other cryptocurrency, tradable commodities including precious metals (e.g. Coinbase).

Stablecoins have gained attention in the cryptocurrency world because of their capacity to possess both the almost volatility-free valuation of the stable asset they are pegged with, and the secured and instantaneous processing and payments features of cryptocurrencies.

Tether is one of the famous and first stablecoins emerged in 2014. After Tether many more stablecoins flourished including BitShares and NuBits. Basically, there are three types of stablecoin. They are algorithmic stablecoin, On-Chain collateralized stablecoin and Off-Chain collateralized stablecoin. Their difference is mainly due to the mechanism applied to assure their stability (Berentsen & Schär 2019).

### **2.1.2 Blockchain Technology**

Blockchain, being as an immutable distributed ledger, is the underlying technology behind cryptocurrencies. The basic concept of a blockchain technology is that blockchain network participants, with having the system and compatible device, transact information using a peer-to-peer network that stores the transactions in a distributed manner across the nodes (Back et al. 2014).



The core elements of blockchain include complex cryptographic functions for security, transparency and immutability, linear and non-linear data structures to store, manage, and process cryptocurrency transactions, peer-to-peer (P2P) networks for multiparty transaction verification, and distributed consensus protocols to handle centralization and double-spending issues.

Basic features that a blockchain system provide includes faster transaction, reduced transaction fee, privacy, security, decentralization (distributed ledger technology), trustless and tamper-free environment (Li & Wang 2017).

The components of blockchain are the transaction, the block, and the chain of blocks. Transactions could be digital assets or information that a participant in the blockchain network transfers to another. A block is a structure that collects the information together in groups. Every block has a data storage capacity and once a block is filled up with data, it will then be chained on top of a previously chained block making a chain of blocks. So, the data storage continues the same way forming information or data in a block and blocks in a chain.

A filled-up block is added on the top of a blockchain if it is broadcasted and validated by the nodes and when the real time for the adding of the block is synchronized across the database of all nodes. The records of the transaction will then be chronologically timestamped with the previous block using a reference or hash number (Gupta 2017).

There are different consensus mechanisms used to verify and validate a blockchain transaction. Those mechanisms are protocols that synchronizes all participants of the blockchain network and assure that participants are provided with an agreed share on the distributed ledger and equal chance of getting access to the next block.

In practical terms, users of the blockchain network agree on terms of transactions like verification of transactions and acknowledgements. Which protocol to choose depends on the type and the need for a blockchain network so that the blockchain ledger functions properly and precisely. Common consensus mechanisms include proof of work (PoW), proof of stake (PoS), delegated proof of stake (DPoS) and practical byzantine fault tolerance (PBFT).

PoW is the most common consensus mechanism because it is the protocol that bitcoin uses to create blocks and verify transactions (Zheng et al. 2017). Blocks are usually created by those nodes with the strongest computational power and having the capacity to be the first to solve the mathematical (cryptographic) problem of a specific transaction. Individuals having the computational power to solve the problem are called miners and they are authorized by consensus mechanism.

Under PoW, miners are competing with each other in solving the difficult cryptographic problem of a transaction using their time and computational power (Böhme et al. 2015). Miners usually are compensated with financial rewards for the job they are doing (Crosby et al. 2016). PoW is relatively slow in speed in validating transaction because it is open to anyone, and it takes time to reach an agreement. The average time it takes to create a block is 10 minutes and seven transactions per second (Zheng et al. 2017).

PoS consensus mechanism is relatively new and developed to provide nodes with more token coins the priority to create the next block (Reyna et al. 2018).

DPoS is a consensus mechanism that rely only on delegated nodes to create the next block. This mechanism reduces the time and cost of block generation as only limited number of nodes have the authority to do so (Aras & Kulkarni 2017).

PBFT is a consensus mechanism developed mainly to prevent malicious attacks. In PBFT mechanism one participant (node) will be given the authority power and only this node can verify transaction upon communicating and validating with every participant. The advantage is that all participants agree or confirm the verification process; however, on the other hand it is a slower process as every node is involved in the agreement of a transaction verification (Lemieux 2017).

The form and type of blockchain also varies depending on the purpose for which it is intended. The common types are permission-less (public) blockchains and permissioned (private, consortium, and cloud-based) blockchains (Salah et al. 2019).

The common example of a public blockchain type is the one bitcoin uses and it is open to anyone (Rennoek et al. 2018). Since public blockchain is open to anyone and that every participant has free access to the network and data, it has a scalability problem of

expanding the network and high consumption of computing power for the PoW consensus process (Pilkington & Swan 2015).

A permissioned (private) blockchain system has a restriction on network participation which enables the participants to build a fast and stable decentralized system and only those nodes with permission can participate on the network (Sankar et al. 2017). Transactions are approved and validated transparently without the need for mining only by a central agent and therefore it raises the question of being a true decentralized system. However, it is ideal for companies, especially banks to use private blockchain systems to customize their operation.

Consortium blockchain is an extended version of a private blockchain system. In consortium blockchain setting, permission is granted to more than one node to validate transactions (Sankar et al. 2017). Thus, DPoS is the ideal consensus mechanism for consortium blockchain system and that solves the network scalability and slow transaction issues and enhances network security.

Blockchain, through time, has evolved from a payment system to an industry platform technology. According to Swan (2015), the development of blockchain technology can be divided into three phases. Which are the first generation (Blockchain 1.0), the second generation (Blockchain 2.0), and the third generation (Blockchain 3.0).

Bitcoin and many other cryptocurrency payment systems are using first generation blockchain and they can create a single global financial system for payment and remittance based on decentralization and distributed ledger technology (DLT).

The second generation blockchain is the one that executes autonomous contract and integrated in Ethereum's smart contract. The conditions and execution of the details of the contract are set in advance and executed automatically when fulfilled (Buterin 2014).

The legally binding of a smart contract is done through computer codes, and thus no third trusted party (TTP) is involved. Smart contracts extended the applicability of a blockchain from payment system to an online platform (Buterin 2014; Reyna et al. 2018).

The third generation blockchain is the phase that the potential of blockchain technology is well understood by the society at large and become applicable across different industries creating an industrial ecosystem.

The current evolution of blockchain technology is rapid. Due to the development of consensus mechanisms for decentralized systems, performance and scalability of blockchain technology is increasing. Although it is in its initial phase, customized blockchain forms that are meant to address different business models are emerging in different sectors; however, a development in the computing technology world is the major driving force to a further blockchain technology evolution and more progress in this regard is expected in the future (Diedrich 2016).

In general, blockchain is revolutionizing the way of communication through the internet. Mainly due to its potential in improving information and transaction transparency and security, it becomes the focus of not only cryptocurrency ecosystem but also other industries and businesses (Tapscott & Tapscott 2016). Blockchain has the potential to eliminate central (third-party) agents and helps allocate resources directly to service users, value providers and thereby contribute to an increased shift in token-based economy in the future in various industries.

### **2.1.3 Wallets**

Wallets are software application used to create, store, transact and manage cryptocurrency user's identity using a random sequence of characters known as Keys. There are private keys and public keys that correspond to the individual's secret password and public username respectively.

Minted cryptocurrencies normally come with their own wallets having the basic features. However, innovators and developers are releasing different types of wallets for commercial and advanced purposes such as increased security, and user interface. A good example of user security and interface integrated wallets on the market are privacy preserving hierarchical deterministic wallets (HD wallets).

HD wallets provide extra protection by allowing users to create mnemonics which are understandable and memorable phrases to replace long private keys (Gutoski & Stebila 2015). In addition, HD wallets enable users to generate and associate multiple private keys with a single phrase to enhance security.

The developing and added features of HD wallets are overtaking the role and services of cryptocurrency exchanges, which previously were their core function. Notable features include integrated currency exchange, linked credit and debit cards, key recovery services, zero-fee off-chain and on-chain transactions, insurance coverage, and support through email and SMS services.

Wallets vary depending on which type of storage they support. The major forms of wallets are cold storage wallets and hot storage wallets.

Cold storage wallets turn online only when user needs to make a transaction otherwise they remain offline. They include a physical device (hardware) wherein wallet software, balance of cryptocurrency, and users' keys are stored (Gentilal et al. 2017). They can get online through connected device and provide intrinsic security feature; however, portability remains the challenge of hardware wallets. Another example of cold storage wallet are paper wallets whereby users take note on paper or generate and print quick response (QR) codes of their secret key. Users can print multiple copies and put them on different places to avoid risk of being lost.

On the other hand, hot storage wallets normally remain connected to store online information. Hot storage wallets come in the form of mobile and desktop applications or hosted on web and cloud servers.

Mobile-based wallets store information in mobile applications and these wallets are highly insecure as compared to the other types of wallets (Shin 2009). Desktop-based wallets are used by downloading and installing the wallet applications on personal computers and these wallets are also considered to be insecure due to accessibility through the Internet (Volety et al. 2019). Finally, cloud-based wallets are provided by third-party cloud service providers. Although these wallets operate in highly secure environments, handing over personal keys to cloud service providers is a risky decision (Karegar et al. 2018).

Additional types of wallets include multi-signature wallets (Goldfeder et al. 2015), simplified payment verification (SPV) wallets (Kaushal et al. 2017), and brain wallets (Vasek et al. 2016).

The multi-signature wallets are designed just like a joint account in traditional banking system whereby multiple account holders authenticate a transaction before it is processed by a bank. Similarly, multi-signature wallets use multiple private keys before transferring money. Multi-signature protocols are mostly used when multiple parties are involved in a transaction, and they do not trust each other. In this case, multi-signature wallets ensure agreement of majority before making any transaction (Goldfeder et al. 2015).

SPV, on the other hand, are light-weight wallets and they operate without downloading the entire blockchain. SPV wallets rely on their connected nodes which have full copy of the blockchain (Kaushal et al. 2017). SPV wallets are fast and storage-efficient, and therefore these wallets are very useful for resource-constrained mobile devices.

Finally, the brain wallets do not randomly generate complex cryptographic keys. Instead, they ask the users to provide any random paraphrase and they create new combinations to generate private keys (Vasek et al. 2016). However, brain wallets are not reliable as these wallets could be easily hacked.

The cost of most wallets to users is in the form of either product fee, annual fee, or transaction fee in exchange for provision of quality services provided to them. Table 2 presents the comparison of the top 10 widely used cryptocurrency wallets. However, selection of wallets depends upon type and the number of cryptocurrencies, frequency of usage, affordability of transaction fee, ability to carry physical wallets, privacy, security, and trust measures enabled by wallet providers.

TOP-10 CRYPTOCURRENCY WALLETS															
Wallet	Type	No. of currencies	Easy of use	Security level	Anonymity	Cold Storage	Fees/ Cost	User Control	Hosted	Decen.	Validation	HD	MFA	Open Source	Integrated Exchange
Ledger Nano S [46]	hardware	1000+	average	high	high	yes	70 USD	yes	no	yes	SPV	yes	2FA	yes	no
Ledger Blue [54]	hardware	1000+	easy	high	high	yes	270 USD	yes	no	yes	SPV	yes	2FA	yes	no
KeepKey [55]	hardware	50+	difficult	high	medium	yes	129 USD	yes	no	yes	SPV	yes	no	no	no
Jaxx [56]	mobile, desktop	80+	average	medium	high	yes	free	yes	no	no	centralized	yes	no	no	yes
Trezor [57]	hardware	9	average	medium	medium	yes	EUR 149	yes	no	yes	full node	yes	2FA	yes	no
Guarda [58]	mobile, desktop, web	38	easy	medium	high	no	free	yes	yes	no	SPV	yes	no	yes	yes
Exodus [59]	desktop	100+	easy	medium	high	no	free	yes	yes	no	full node	yes	no	yes	yes
Ethos [60]	mobile	150+	easy	high	medium	no	free	yes	yes	yes	SPV	yes	3FA	no	no
Paytomat [61]	mobile	18+	easy	high	high	no	various	yes	no	no	centralized	yes	no	no	yes
Coinomi [62]	mobile, desktop	500+	easy	high	medium	yes	free	yes	yes	no	spv	yes	no	no	yes

Table 2. Top-10 cryptocurrency wallets (Rehman et al., 2020)

#### **2.1.4 Mining Systems**

Cryptocurrency mining is a process whereby users of a blockchain network strives to solve the difficult question associated with creating the next block of a given blockchain network. As specified by the bitcoin protocol, miners with having a powerful computational device and contribute to the solution will get rewarded with a fraction of newly minted coins.

Miners get compensation in the form of fees and freshly minted coins. Bitcoin for instance has a limited number of coins that could be circulated in the system and the maximum number of bitcoins in the circulation is 21,000,000. Every time a block is created additional bitcoins are minted to the circulation. Therefore, mining in bitcoin, and other cryptocurrencies with similar protocols, is a way of entering new coins into circulation (Tschorsch & Scheuermann 2016). It is also likely that the fee paid to miners will increase in the future as the number of available bitcoins to be minted decreases.

When the bitcoin concept was introduced and new, there was only a solo type of mining meaning that, each miner mines individually. However, as the bitcoin network and market became increased and sophisticated, miners understood that competing for generating the next block individually is an exhausting and expensive process and that it could take longer time or even years to create one. Therefore, to reduce the block creation frequency and resource consumption challenges of solo mining, the concept of pool mining is introduced in December 2010 (Palatinus 2010).

Initially, mining was started with Central Processing Unit (CPU) but as the network got increased and sophisticated, it became difficult to guess the correct hash keys and for that reason other types of mining systems with more powerful and computing systems were developed.

These days several new types of Bitcoin mining systems exist which include graphics processing unit (GPU) miners, field programmable gate array (FPGA) miners, application-specific integrated circuit (ASIC) miners, professional Bitcoin mining farms, large mining pools, cloud-mining, mobile mining, and remote-mining (via web-browser), to name a few.

Pool mining is a way that each miner within a specific pool (pool of miners) contributes his/her own part (share) in solving the complicated mathematical equation that relates to creating the next block. Miners are therefore not required to find a full solution but only deliver their share to a pool manager to proof their effort and they will be rewarded accordingly.

In pool mining, although several techniques are there to distribute rewards and profit to miners, the three major ones are proportional, pay per share and score-based (Rosenfeld 2011). In pool mining, pay-per share is the most common way to distribute profit within the pool, and it is the way rewards are distributed proportionally according to the share percentage they contributed to the pool.

Pools that use score based as a rewarding technique are immune to attacks by those miners who seek increased reward through switching between pools (Courtois & Bahack 2014). Due to this reason, pools with score-based rewarding techniques are not advised for a continuous mining. In addition, as the size of a pool increases, it is more prone to attack and therefore large pools do not necessarily mean that they are the better ones.

There are several mining pools in the networks of bitcoin and other digital currencies; however, for a new miner to choose the most profitable one is a difficult choice to make. Making profit out of pool mining depends on numerous parameters and they can be categorized as pool specific and miner specific parameters.

Pool specific parameters that determine miners' profit are pools hash distribution, fee for mining, chosen rewarding method, current value of the related cryptocurrency, pool size and current reward for solving a block.

Miner specific parameters that determine profit are miners hash rate power (time specified computing power to perform guesses), choice of pool, risk taken by miner and electricity cost.

### **2.1.5 Exchanges**

Online Exchange (Exchanges) is a collective name given to one or more of the three service category providers. These categories are brokerage services, trading platforms and order-booking exchanges. Exchanges are key players of the cryptocurrency ecosystem,



and they enable the market and transactions keep running by making the inter-platform and cross-platform borderless transactions possible.

The major service of brokerages is to provide the service possibility for customers to buy and sell cryptocurrencies. Order-bookings provide the different cryptocurrency trading engines. Trading platforms provide exchanges of cryptocurrencies with other legal currencies and other digital assets.

Not all exchanges offer all the three services. In most cases, the larger the size of the exchange the more services it provides to customers. However, there are some exchanges that are small but offer all the three services (Hileman & Rauchs 2017).

Major challenge that is associated with exchanges is risk factors. One of the numerous challenges they encounter is operational and capability trust issues that mainly arises from their size. For instance, small exchanges do not have enough customer base and financial capability, therefore, large banks and creditors do not feel guaranteed to make financial means available for them. On the contrary, larger ones put customers money at risk and they mostly face a strong control by regulatory agents.

The other risk factor exchanges face is securing the private keys of their customers. Nearly 73% of exchanges keep their customer private keys themselves. Most large exchanges have their own security personnel to perform the security setups; however, small exchanges rely on third-party security services for authentication. Theft from internal security staff is always a challenge and accounts to be the largest form of theft (Hileman & Rauchs 2017).

### **2.1.6 Payment Networks**

Payment networks are categorized broadly in to two groups. These are payment companies that operate as a payment rail and those that focus on cryptocurrency-based payments. The focus of payment rails is on national currency, and they operate as a bridging network enabling trade between the national currency at least at one end.

The major purpose of payment rails is to perform fast cross-border transactions. Payment rails provide money transfer services both to individuals as well as to businesses and they operate based on legal frameworks. However, since they also involve cryptocurrency

payments at some level and due to the pseudonymization of cryptocurrencies, payment rails are difficult to be monitored and regulated by governments.

Payment networks provide payment alternatives in four different ways: national currency-to-national currency, national currency-to-cryptocurrency, cryptocurrency-to-national currency, and cryptocurrency-to-cryptocurrency (Hileman & Rauchs 2017).

On the other hand, cryptocurrency-based payment networks involve the use of cryptocurrencies at least at one end point. These networks are used as general cryptocurrency platforms and mainly serve those merchants who accept cryptocurrency as a payment system.

## **2.1.7 Key Stakeholders**

### **2.1.7.1 End-Users**

The end-user category group is subdivided into two to elaborate viewpoints of the group in a more vibrant way in the result section of this thesis. The subgroups are cryptocurrency end-users who live in politically and economically unstable regions (CEUR) and cryptocurrency end-users in politically and economically stable regions (CESR).

CEUR use cryptocurrency just because it is way better for them to transfer money, secure their asset and other finance related transactions using cryptocurrency than using the service provided to them by the financial infrastructure of their own country.

CESR use cryptocurrency not because of the political, economic, and financial instability and insecurity of their country but rather motivated by factors related to technology, social and economic. CESR share some commonalities with investors when it comes to assuming economical reward but still their scall of investing is immense to be considered investors and their cryptocurrency investment is not what they depend on to make their living.

### **2.1.7.2 Retailers**

Retailers stakeholder group refers to any form of businesses who let their customers make cryptocurrency-based payments regardless of their reason for acceptance. These businesses can operate in any sector and industry. The only important remark to put in this category to avoid overlapping issue is, the payment service providing businesses. These businesses are market enablers and therefore not regarded as retailers for the purpose and convenience of this thesis.

### ***2.1.7.3 Investors***

Investors are individuals or groups who invest in cryptocurrencies or cryptocurrencies related businesses in relatively large scale and/or, investment of cryptocurrencies is the major way of running their business and life.

### ***2.1.7.4 Developers and Market Enablers***

Developers and market enablers are categorized in one stakeholder group because of their importance and similarity in serving the cryptocurrency ecosystem as a backbone to run. Developers are commonly group of people working for the development of an altcoin in an open and mostly blockchain based software system. Market enablers includes exchanges and those involved in the cryptocurrency-based payment networks.

### ***2.1.7.5 Researchers***

Researchers includes people both from the academia and practitioners in the cryptocurrency area. These group of people are those who performs a continuous scientific and factual based research about the developments of the cryptocurrency world on behalf of their commissioned purpose.

### ***2.1.7.6 Regulatory Agents***

Financial regulatory agents are key stakeholders of the cryptocurrency ecosystem because cryptocurrencies hold high price volatility and uncertainty, and the major role of regulatory agents is to stabilize economy and assure security of financial services in a society. Government and central banks are the most mentionable example of financial regulatory agents, however, depending on the sovereign system and region, regulatory power can be extended to other financial institutions and authorities including tax offices.

## **2.2 Fiat Currencies (Legal Money)**

According to the European Central Bank, ECB (2015), Fiat currencies are defined as any legal tender issued and designated by a central authority of a sovereign country and its people are willing to accept in exchange for goods and services because it is backed by regulation and trust for this central authority. The most common form of currency backing is therefore at the sovereign state's government level.

While there are many different fiat currencies worldwide, each currency is traditionally issued by a single centralized monopolist, the central bank, which typically is a government organization that focuses on keeping the objective of price stability. Private intermediaries can offer inside money under the regulation and control of central banks or other bank regulators, and they often need to obtain money from central bank to do so (Schilling & Uhlig 2018).

## **2.3 Advantage and Disadvantage of Cryptocurrency in Relation to Fiat Currencies**

### **2.3.1 Advantages**

Cryptocurrencies have advantage over fiat currencies in some aspect. The most mentionable advantages are the speedy cross-border transaction, low transaction fee, anonymity, and financial inclusion. However, these advantages are primarily true in regions where payment infrastructure is less developed and trustworthy (EBA 2014). EBA argues that none of the advantages are free of risks, and they are made less significant within EU through an EU legislation.

Cryptocurrency transactions are validated by miners through pre-defined algorithmic consensus mechanism that controls the supply and maintain the right equilibrium and intrinsic value of minted coins. Since fees payable to the miners are negotiable, it is difficult to be certain about the exact cost. However, according to evidence, it is estimated to be less than 1% of the transaction amount, and in the case of traditional online payment systems, the fees can rise up to 2-4 % (EBA 2014, p. 16). Additional costs related to currency conversion is also avoided in the case of cryptocurrency transaction.

Cryptocurrencies are also transacted round the clock with a nearly instantaneous speed compared to banking by overcoming institutional and territorial hurdles. For instance, in the case of bitcoin it takes 10 minutes to process one transaction and this duration is very much lower in other cryptocurrency protocols (Badev & Chen 2014).

In the case of cryptocurrency transaction, the user's personal data are secured and untraceable by hiding original identities of transacting stakeholders, thereby excluding any

potential identity theft (EBA 2014, p. 19). In addition, cryptocurrencies benefit by enabling multiparty transaction verification through decentralization that reduces the risk of theft. However, perfect anonymity and security is almost impossible (Goldfeder et al. 2017).

Although there are arguments with regarding to knowledge access and resource difficulties associated with using cryptocurrencies, they became a means of financial inclusion mostly in an economic and political unstable region. However, EBA (2014, pp. 18-19) argues that the challenge of financial inclusion does not apply to the EU, as the Payment Accounts Directive provides cheap basic bank accounts for all citizens in the EU.

Cryptocurrency can also serve as a unified currency all over the world. People from every corner of the world can use it to pay the same price for a given product and service. Other related advantage is its convertibility to other cryptocurrencies and fiat currency.

### **2.3.2 Disadvantages**

Alongside the advantages, using cryptocurrencies have many risks to the stakeholders and to financial stability in general that are mentioned in various research. EBA (2014) identified numerous risks that associates with cryptocurrency stakeholders and to the sovereign currency and emphasized that it is mainly because of lack of proper regulations.

One major disadvantage associated with cryptocurrency is that they are vulnerable to fraud and theft from an e-wallet or an exchange by misconduct of an insider expert. The bankruptcy of the Tokyo based Mt. Cox company is a good example (Badev & Chen 2014, p. 25; Hals 2014). Similar cases are very common in the cryptocurrency world than the controlled and regulated traditional financial service industry.

The other disadvantage of using cryptocurrencies is the volatility risk associated with it and the chance and magnitude of exchange rate fluctuation that could happen at any given point in time mainly due to bubbles related to price and other market determinants. Exchange rate fluctuations are common even among sovereign currencies, however, the intensity with cryptocurrency could be very high as no authority controls the movement. Good examples of it are the 65% bitcoin to US dollar exchange rate drops off between

December 2017 and January 2018 as well as the more than 10% bitcoin price drop off hours after following Tesla's announcement of suspending purchases in bitcoin by its CEO Elon Musk in May 2021.

The anonymity feature of cryptocurrency is also a disadvantage to the financial ecosystem as well as to the society at large as it could facilitate illegal activities such as terrorism financing, drug and illegal weapon trading, tax avoidance and finance related transactional fraud. About 75% of bitcoin users and 50% of bitcoin transactions are related to illegal activities (Foley et al. 2018). Moreover, cryptocurrencies undermine effectiveness of foreign policies especially with regarding to financial sanctions.

High electric consumption in relation to cryptocurrency mining is another big disadvantage to the environment and a concern to the climate change. To provide an example, (e.g. Digiconomist) reported that the total electric consumption of bitcoin alone in 2018 was 65.26 TWh, when this amount is converted into practical terms, it is almost equivalent to the 2018 annual consumption of Czech Republic with total population of 10.5 million. Also, for the same year, if the total transaction of bitcoin compared to that of Czech Republic, it is only a fraction of it. Cryptocurrencies have also directly or indirectly caused price increase and scarcity of computer components (Gilbert 2018).

Despite having advanced features, cryptocurrencies are still not mature enough to dominate the currency markets due to their uncontrolled and unregulated nature. More efforts are needed and yet to be done to ensure cryptocurrency transaction trustworthiness among stakeholders.

Unlike fiat currencies, cryptocurrencies do not have a regulatory agent that would implements a policy to keep their purchasing power and price volatility stable. Price volatility is one of the challenges of cryptocurrencies to be considered as a medium of exchange over a price-stable alternative and therefore difficult to form the credit and debt market of cryptocurrencies as opposed to fiat currency.

### 3 METHODOLOGY

The data gathering and analysis technique applied in this thesis work was a systematic review of previous literature. The suitability of the applied method to the research area of this thesis was well examined by considering specific questions (see table 3 for the questions). Answering a ‘YES’ to at least one or more of the questions assure the suitability of the project for a systematic review (Petticrew & Roberts 2016)

Establishing whether a Project may be suitable for Systematic Review
✓ Is there uncertainty about the effectiveness of the policy/service/intervention?
✓ Is there a need for evidence about the likely effects of the policy/service/intervention?
✓ Despite a large amount of research on the topic, do key questions remained unanswered?
✓ Is there a need for a general overall picture of the research evidence on the topic to direct future research?
✓ Is an accurate picture of past research and associated methods needed to help develop new methods?

Table 3. Checklist for suitability of a systematic review (Petticrew & Roberts 2016)

Here under is an illustration of the questions and the related answers of this thesis to the systematic review suitability checklist

**Question 1.** Is there uncertainty about the effect of cryptocurrencies to the financial ecosystem?

➤ **Answer 1.** Yes. In the first instance, cryptocurrencies are highly price volatile, and they are not controlled by central authority. They are also vulnerable to market price bubble and highly affectable by external factors such as influencers involvement, and global attention. Therefore, it is very difficult to be certain about the magnitude of their effect to the financial system at any given point in time.

**Question 2.** Is there a need for evidence about the likely effects of cryptocurrencies to the financial system?

➤ **Answer 2.** Yes. Cryptocurrencies’ effect to the financial ecosystem varies from region to region depending on how developed the financial infrastructure, economic and political situation of that region is. However, no matter what the situation of the region is, it is very important to evaluate the effect of cryptocurrencies to the financial ecosystem of that specific sovereign territory and act accordingly.

**Question 3.** Despite a large amount of research on cryptocurrencies, do key questions remained unanswered?

➤ **Answer 3.** Yes. Cryptocurrencies are new phenomenon. Based on the scoping study done for this thesis work and considering the novelty of cryptocurrencies, the amount of research studies published on the topic and those underway could be considered large. The main purpose of this thesis work is to analyze cryptocurrency stakeholders' viewpoints to determine present and future possible role of cryptocurrencies. According to the scoping study, studies on cryptocurrencies future role could be regarded immature.

**Question 4.** Is there a need for research evidence on cryptocurrencies to direct future research?

➤ **Answer 4.** Yes. As it is the case with many research areas, cryptocurrency related studies consider wide range of literature reviews, sufficient source of data and adequate analysis techniques. Therefore, it is feasible to indicate future study direction as the researcher builds knowledge and has better opinion on what is sufficiently known and not known in the area.

**Question 5.** Is past research on cryptocurrencies and associated methods needed to help develop new methods?

➤ **Answer 5.** Yes. It is always beneficiary to refer to applied methods when thinking of developing a new method. Considering past research methods would contribute to the developing of new methods in terms of time, knowledge, and resource optimization.

In choosing of a systematic review methodology for this thesis work, the relatively new concept, and a developing technology that this thesis work focused were considered. The difficulty of obtaining empirical data due to scarcity of experts in the field, resource constraints and the instability and uncertainty associated with cryptocurrencies were also additional supportive reasons to conclude that systematic review was indeed the appropriate method.

As part of the systematic review process, supportive and useful information from different popular and reliable sources were used to analyze viewpoints, new insights, and perspectives of the different cryptocurrency stakeholders. The foundation for the result and conclusion of this thesis was, therefore, done through implementing a systematic review



which was based on other previous studies that have been carried out on similar and related topics.

Systematic review focuses on using a pre-planned and all-inclusive strategy to locate existing literatures, evaluate their contribution, analyze, and synthesize their findings to conclude what is known and not known about the topic (Denyer & Tranfield 2009).

According to Denyer & Tranfield, most writers suggest prior to undertaking a systematic review, to conduct an exploratory scoping study to assess whether other systematic reviews in the area have already been published and to get a general understanding of the topic that would help formulate a pre-planned strategy for the systematic review.

The 5-stage process of a systematic review by Denyer & Tranfield (2009) was applied in this thesis work. On the first stage, the review questions were formulated (see Table 4). Through the formulated review questions, lists of potentially relevant research studies were located and generated on the second stage using online data base and other sources such as Google Scholar and school provided online library sources. On the third stage, relevant research studies were selected and evaluated using inclusion and exclusion techniques. On the fourth stage, the selected studies were analyzed and synthesized. On the final stage the findings were presented.

### **3.1 Processes of Data Gathering and Analysis**

The first stage of the systematic review, formulating the review questions, was done by implementing a prior scoping study to build knowledge on the research area and identify what is known and which information are the most crucial. The scoping study also helped assure the formulated questions met their target. When the review questions were formulated, the CIMO acronym was applied where C stands for context, I for intervention, M for mechanism and O for outcome (Jones & Gatrell 2014).

By integrating the CIMO suggestion and knowledge built from the scoping study, the review questions found in Table 4 were formulated to locate relevant literature sources to this thesis work.

Review Questions
✓ What is cryptocurrency and who are its stakeholders?
✓ How do stakeholders perceive cryptocurrency in comparison with fiat currency?
✓ What motivated stakeholders to use or not use cryptocurrencies?
✓ How do cryptocurrency stakeholder's behavior impact legal money (fiat currency)?

*Table 4. Review questions of the thesis*

The above four questions were pre-planned, well thought, and formulated review questions mainly used to locate those relevant studies and literatures that were used as an input for this study. The first question addressed the searching of relevant material with regard to the C (context) of this thesis research. The second question addressed the I (intervention), in what way the new context (phenomenon) affects some area? The third question addressed the M (mechanism), what are the bridging factors for the context to intervene. The last question addresses the O (outcome), what is the general result of the intervention by the new phenomenon?

The second stage carried out in the systematic literature review process was to use key search words and phrases referring to the already formulated review questions mainly using online database.

The found materials were well labeled and gone through the selection and evaluation criteria for their relevancy to this thesis work on stage three. The selection criteria were done with an explicit predetermined inclusion and exclusion criterion in relations to the review questions.

For the selection and evaluation of materials, a system was developed to better manage the labeling of the articles. The developed method was that each found material was assigned with a three letter characters, where the first character stands for the Title, the second character for Abstract and the third for Full Text. In addition, each character was denominated by a letter out of the letters N, P and F, where N = not checked, P = Passed and F = Failed.

Therefore, the initial stage of selection and evaluation of the materials was by reading their title and abstract and label it accordingly. Those materials that could not be judged from their title and abstract passed to the next level, which was reading their entire content until they were judged to be a pass or a failure.

By the end of the evaluation, materials with PPP rating were considered for the data analysis and common criteria used in screening out good and relevant materials to this study was by checking their utilization of adequate methods, clear data analysis and conclusion derived from findings.

After a careful selection and evaluation of the materials for the review was completed, a thorough analysis of the research studies was conducted by breaking down the research into its constituent parts and key points such as research question and aim, context, region and sector, methods of data collection, demographics, and relevance to review questions.

Because the research aim of each evaluated material was different, this thesis work formulated the framework for the result section and proceeded presenting viewpoints, arguments and conclusions from the sources to where they should belong in the result section.

On the last stage of the review process, findings were well organized and reported using an introduction chapter that stated the problem and a research question from which review questions were based to be derived. This section, the methodology section, that provided details of the systematic review conducted. A results and discussion sections that presented and evaluated all the findings of the reviewed materials. Finally, a conclusion that indicated what was known and not known on the topic.

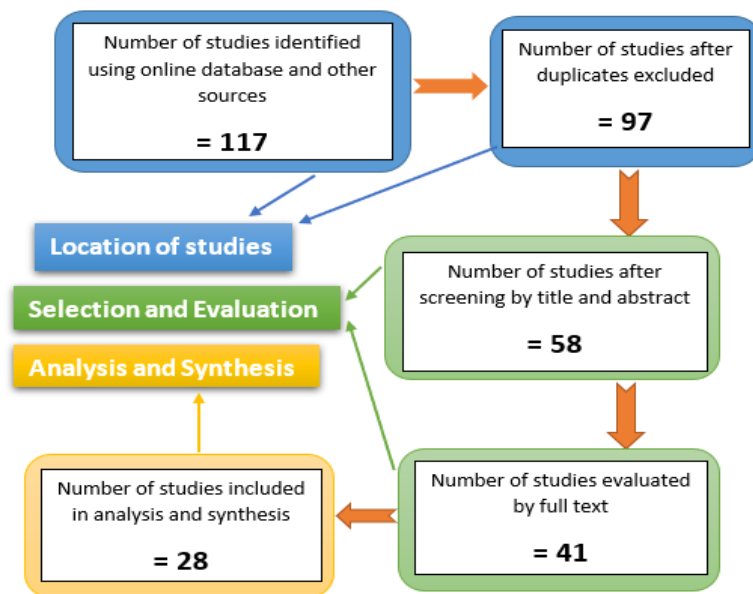


Figure 4. Reporting of the systematic review of this thesis work

Source of the model: Moher et al. 2019

## 4 RESULT

### 4.1 Cryptocurrency Stakeholders and their Viewpoints

As for the definition and identification of stakeholders, Miles (2012) outlined that there are several ways to identify stakeholders and no consensus for the exact definition of stakeholder. Most stakeholder theories are derived from an organizational management perspective. Johns (1980) defined stakeholders as any entities in addition to stockholders, that do not hold any ownership. However, this definition is broad, and Freeman (1984) argued with the term that stakeholders could be any entity. According to Clarkson (1998), stakeholders should have something to lose or gain directly because of actions of organizations.

Stakeholders for this thesis work are grouped accordingly by referring to the above concise definition of stakeholder theory and also by considering the presenting of viewpoints to make more clear, logical and chronological.

### **4.1.1 End-Users**

The end-user's stakeholder category focuses on presenting factors affecting the viewpoints of individuals in adopting cryptocurrencies. For convenience, two categories of end-users are under focus of this section. The cryptocurrency end-users in politically or economically unstable regions (CEUR), and those living in politically and economically stable regions (CESR). CEUR are those individuals and groups that circumstances such as economic or political factors, directly or indirectly forced them to use cryptocurrency. CESR are not forced by external factors for adoption but fascinated to use it due to their own personal preference and reason, or in other words, these are cryptocurrency users who are living in a more developed regions in terms of financial infrastructure, economic and geopolitics.

#### ***Cryptocurrency End-Users in Politically or Economically Unstable Regions (CEUR)***

The primary goal of CEUR is to look for an alternative means of financial security for their asset, financial inclusion with the rest of the world, and probably to engage and facilitate financial activities which were concluded to be illegal by law makers. Therefore, investment opportunities and related benefits from cryptocurrency adoption is just an extraordinary activity for these groups.

CEUR typically are those individuals and groups who live in a politically and economically unstable regions where financial infrastructure is the lowest. In most politically unstable countries, the national currency is unstable and highly volatile than the volatility rate of cryptocurrency so that some people tend to adopt cryptocurrency, especially bitcoin, as a storing of value for their asset and investments (Sas & Khairuddin 2017).

People in under developing countries suffer from improper functioning of monetary systems and economic instability. They mostly face hyperinflation, fraud, financial inaccessibility, and lack of proper financial and banking system. According to a study by Larios-Hernández (2017), it is estimated that more than 2 billion people in mostly developing regions do not have access to a proper banking and therefore adopting cryptocurrency is a better solution for them to address finance related issues (Presthus & O'Malley 2017). However, the related underdeveloped technological infrastructure of these countries and

the fear and trust issues for new technology by the society is hindering the nation from getting full advantage of cryptocurrencies (Darlington III, 2014).

The low transaction cost of cryptocurrencies compared to the traditional banking system is also a factor for CEUR to adopt cryptocurrency, most CEUR heavily rely on remittance money and mostly live-in underdeveloped countries. The traditional remittance market is known for its higher transaction cost and in some poor countries, the cost is estimated to be double the global average cost (Kim 2017). The almost instantaneous transfer around the clock capacity, even for international transfers, of cryptocurrency is another reason for remittance dependent societies to adopt cryptocurrency.

People who are involved in illegal activity are also interested in using cryptocurrency because of the anonymity feature. Cryptocurrency is famous and highly used among these groups of individuals in facilitating the transfer of illegal goods all over the world. Criminal activities are common in economically and politically unstable regions and adopting altcoins in purchasing of illicit goods could be a better option to keep their anonymity and facilitate their activity (Van Hout & Bingham 2013).

### ***Cryptocurrency End-Users in Politically or Economically Stable Regions (CESR)***

According to Glaser et al. (2014), in the context of CESR, user's interest in cryptocurrency is mainly driven by the investment opportunity that it provides rather than considering it-as substitute currency, or storing of value.

Although cryptocurrencies are characterized by their high price volatility and exchange rate fluctuations, their market price have increased looking back to their price trend over the years. So, this trend would motivate CESR to use or invest on altcoins in the hope that their price would somehow increase in the future as well. The price affordability of buying altcoins, the fact that there are so many altcoins in the market and some with a price of as lower as one dollar, would attract users of any economic background to invest and learn their development as well as afford the risk of losing their money.

The increase in demand for altcoins is also an influential factor that trigger the minds of many to consider using cryptocurrency. Increased number of cryptocurrency users have

direct effect on the market price, and this leads to many users adopting cryptocurrency. Other factor for cryptocurrency adoption by CESR is the supply limit of the altcoins. Cryptocurrency supply is represented by the circulating, total, and maximum supply of coins. Cryptocurrencies with having a limited supply are more valuable and attract users because, their price would likely to go up as there will not be any additional coins once the maximum limit of the coins are reached.

Acceptance of cryptocurrency-based payments by businesses especially those famous ones like Microsoft, Tesla and Expedia is another motivational factor for users to adopt cryptocurrency. Users normally rely on and adopt technology together with related services when they value the reputation of the providing company and trust the people and team behind it (Gaines-Ross 2000). Therefore, most cryptocurrency user value who is behind the development of a certain altcoin and that is the major criteria they consider, among others, when deciding which altcoin to adopt.

Social related factors like subjective norms also have a bigger share when it comes to CESR's cryptocurrency adoption. People are more likely to adopt cryptocurrency if people around them like their family members, and friends are using them - subjective norm (Fishbein & Ajzen 1975). Theories like Technology Acceptance Model 2 (TAM2) by Venkatesh and Davis (2000), and the Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh et al. (2003) also applied and supported the influences of social factors on cryptocurrency adoption by users (Gunawan & Novendra 2017).

Global attention and influencers involvement also play an influential role in adopting cryptocurrency. For instance, the 2017 - 2018 global news about the high price increase of cryptocurrencies engaged many people around the world to follow cryptocurrency related news and trends (see Figure 2), as well as alarmed most governments in the world to react to it (Darlington III, 2014). Moreover, comments from worlds' famous and top businesspeople such as Bill Gates, Eric Peter, John McAfee, and Peter Thiel would affect cryptocurrency adoption rate by users (Clifford 2018).

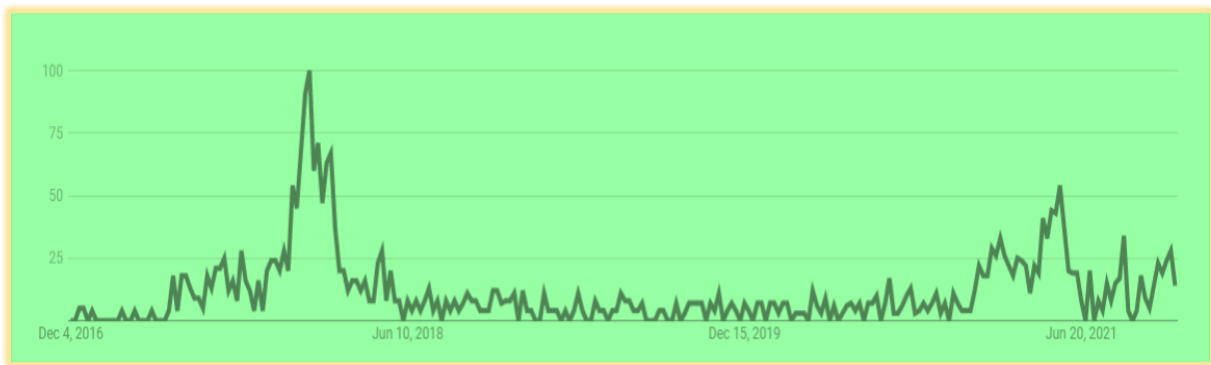


Figure 5. Search trend for the term "Cryptocurrency"

(Source: Google Trends ([trends.google.com](https://trends.google.com)))

#### 4.1.2 Investors

An increase in demand for altcoins following their rapid price increases in December 2017 has attracted investors more than any other stakeholder group to involve their selves in the cryptocurrency market. Moreover, the increased market value of cryptocurrencies has also attracted big companies to invest in and consider cryptocurrencies as additional trade instruments (e.g. JPMorgan). In addition, mass media has played its leading role in attracting global attention about the developments of cryptocurrencies. According to a study in 2018, about 35% of the Germans consider cryptocurrencies as possible investment alternatives (Postbank 2018).

The primary focus of cryptocurrency investors is to make profit out of it. Most cryptocurrency investors do not consider cryptocurrency as a potential currency, or a means to secure the value of their asset. However, they are concerned about their cryptocurrency investment benefit. They demand that cryptocurrency has extended network externality, recognized, and accepted in the financial market, and easily convertible to sovereign currency (Glaser et al. 2014).

Investors invest with different objectives and scenarios. Some investors have a short-term investment plan. This type of investors is aiming to get quick advantage from their investment by taking risk. They normally aim at altcoins with high volatility rate, and they use the volatility as a means of getting advantage. Short-term investors focus relatively more on high risk – high return cryptocurrencies. Other investors have a long-term investment plan. These investors do not see the cryptocurrency volatility rate as



advantageous as the short-term investors do; however, by considering the historical development of altcoins market and overall analysis, they invest in altcoin types that they assume the price would increase in the future. They normally tend to invest more on less riskier cryptocurrencies but with a potential to grow in the future no matter far it would go.

Investors normally do a careful analysis on which altcoins to invest. Two major aspects most investors consider are the technological background of the altcoins that governs the supply limit of new coins, and who is behind the technology of a specific altcoin. The supply of cryptocurrencies is represented by the amount of its circulating supply, total supply, and maximum supply. Investors normally focus on altcoins with a limited or having a maximum supply of coins to be minted. The reason is because once that maximum level is reached there will not be additional coins to be mined. Therefore, their assumption is that the demand for such altcoins would increase as the maximum limit gets approached. That is the reason why altcoins with having lower maximum supply limit worth more than those with higher maximum supply limit.

The other crucial trust factor for investors to invest in a certain cryptocurrency is trusting the technology used to form and govern the altcoins and being informed and aware of the people who developed the altcoin. Altcoins that have been developed by individuals who are famous and known for their success of other previously done projects are more likely to be chosen by investors.

Furthermore, subjective norms are also very common among investors to decide to invest in cryptocurrencies. Investors are influenced by the activities of other investors, and they normally are in a constant screening of what is going on around them and the world to get advantage from any investment opportunity.

### **4.1.3 Retailers**

The involvement of retailers in accepting cryptocurrencies as a payment option is increasing from time to time. However, still limited number of retailers accept bitcoin and other cryptocurrencies directly as a means of payment. The well-established infrastructure to process bitcoin related payments directly by retailers such as BitPay avoids intermediary related transaction costs and therefore attracts retailers to use and benefit from it.

Examples of businesses that accept cryptocurrency payments are Microsoft, Expedia, Dish Network, Overstock, Shopify, CheapAir, Newegg, Roadway, and Reeds Jewellers (Moreau 2018). Other platforms such as (e.g. Egifter) and (e.g. Gyft) act as intermediaries between customer and retailer and enables bitcoin payments to buy a gift card that can later be used only for products and services bought from specified retailers such as Walmart, Starbucks, Uber and Amazon. The retailers receive the money converted to sovereign currency.

The major reason that most retailers accept cryptocurrency payment is to maximize their means of growing their sales. Obviously, retailers understand the price-volatility risk associated with cryptocurrencies and most of them are accepting it only to generate revenue. Because these merchants are not in the business of speculating cryptocurrency market, they would convert the cryptocurrency to their national or preferred legal currency immediately. The challenge retailers face when accepting cryptocurrency payments directly from customers is constantly adjusting their price to cope with the price-stability challenge raised by cryptocurrency market value and exchange rate fluctuations. This challenge would also pose a negative user experience on the minds of customers.

The increased number of cryptocurrency users and the related massive growth of the cryptocurrency market with a total market value of about \$2 trillion by December 2021 (e.g. Coinmarketcup) have attracted many retailers to accept it as means of payment. Big corporations and businesses, other than accepting cryptocurrencies as payment alternatives, have also considered them to be their major online trading instruments, and started investing on them (e.g. JPMorgan).

Other than the price volatility risk of cryptocurrencies, retailers do value the fast transfer and low transaction cost of cryptocurrencies especially for international sales and these advantages motivate retailers to use cryptocurrency as a direct payment system. Cryptocurrencies are transacted round the clock with a nearly instantaneous speed compared to banking transaction. For instance, in the case of bitcoin it takes 10 minutes to process one transaction and less in other cryptocurrency protocols (Badev & Chen 2014).

Social factors such as global attention and subjective norms play an important role in the case of retailers, as it did in other cryptocurrency stakeholder groups, to consider and accept cryptocurrencies as an alternative payment method.

#### **4.1.4 Researchers**

Cryptocurrency is a relatively new concept of the financial technology world with bitcoin being a pioneer and market leader up until now. Bitcoin is founded in 2008 and many more altcoins were introduced by different developers since then with some using a different technology of formation. The technology that bitcoin used, blockchain technology, was not a completely new technology; however, bitcoin developers managed to bring out the other potential and dimension of the already invented technology, Distributed Ledger Technology (DLT).

Since cryptocurrency concept and blockchain technology is on development across the society, many research and studies are under way and the knowledge and research gap is still present in the area. As it did to other stakeholders of cryptocurrency, the 2018 bitcoin and other cryptocurrencies market price increase got the attentions of researchers to study and find out more about the advantages and disadvantages of adopting cryptocurrency. Researchers are also concerned and investigating the impacts that cryptocurrencies impose to the financial system and to the society at large from every angle.

Speculation of cryptocurrencies to be a future substitute of legal currency, or to fulfill only components of fully-fledged currency, or just an instrument for investment, or private digital currency that must operate under the regulation and control of a government or central bank, or just an illegal instrument that needs to be banned are all opinions that have something to do with personal interest. However, although it is impossible to conclude that researcher's conclusion and opinion is totally unbiased by the circumstances of the region they are living in and their interests, the conclusion they derive should be based on proper methodology of analysis and presenting of facts.

According to many studies and researches about cryptocurrencies, most researchers have concluded that cryptocurrencies would not at least in the foreseeable future challenge or substitute legal money, their adoption rate would increase, regulatory authorities are unlikely to ban them but probably impose some kind of regulation on how to use, require taxation on gains from investing, and consider them more as an investment and digital trading instrument than a digital currency, even if some additional features like making payments, money transfer, and substituting currency in politically unstable regions remain possible and become their additional advantages (Dabrowski & Janikowski 2018).

#### **4.1.5 Developers and Market Enablers**

According to information from GitHub, most blockchain and cryptocurrency-based projects are conducted using OSS (Open-Source Software) development projects. In March 2018, a study reported that BCS (Blockchain Software) projects hosted on GitHub alone were 3,000, and this number has increased to 6,800 on October 2018 (Chakraborty et al. 2018). The same study also found out that most BCS developers are experienced in a non-BCS development project; however, they are motivated to shift to BCS developments because of the potential future of the BC (Blockchain) technology, the promising high reward, and the motive to create a decentralized financial solution.

The other key market player of the cryptocurrency industry is exchanges. Exchanges are the first to emerge and provide service in the industry. They provide services to buy and sell cryptocurrencies for national currencies and other cryptocurrencies. Competition among exchanges in providing services to customers is very high. The exchange price of cryptocurrencies to other cryptocurrency and to national currency offered by exchanges are slightly different for the same altcoin at a specified time, and that is one of their major competitive advantages to attract customers (Neil & Hanna 2014).

#### **4.1.6 Regulators**

Financial regulatory agents around the world have expressed their concern about the status and possible future impact of cryptocurrencies (Lagarde 2018). The timing for their reaction can be considered relatively late even if the inception of cryptocurrencies is not considered an old phenomenon to the financial industry either.

Among the many financial regulatory agents of a sovereign country, central banks are the primary institution to regulate the financial stability of a nation. Some of the major tasks of central banks are to assure price stability through implementing monetary policy and protect consumer through imposing a regulatory and supervisory affair across the financial service providing agencies.

Cryptocurrencies have potentials that is understood by financial regulatory agents in completing the uncomplete financial markets. Example of such potentials are addressing agency costs that arise from information asymmetry, solving the double-spending

problem and providing global wide peer-to-peer digital payment systems. On the other hand, the predicted challenges of cryptocurrencies by financial regulatory agents on the monetary and financial system is diverse. Some of the major risks include consumer protection, financial crime, taxation policy, monetary policy, and financial stability.

The development of cryptocurrency ecosystem therefore affects the basic functions of central banks and other regulatory agents. In the European context, the European Central Bank (ECB) for instance has the mandate to intervene based on articles 127 and 28 of the treaty on the functioning of the European union (TFEU), and article 3 of the protocol (No 4) on the statute of the European system of Central Banks.

Different countries have different viewpoints and approaches towards cryptocurrencies. Most countries chose not to react their concern and viewpoints about the increased cryptocurrency adoption immediately and boldly. Most countries took the stance to wait, study and follow developments and learn in the process to be able to understand the possible pros and cons of cryptocurrency to the financial ecosystem and react accordingly.

Other countries, for instance China, took a harsh measure in banning cryptocurrency (Nelson 2018). Switzerland showed a friendly approach to the technology by attracting investors and operators through providing friendly landscape for innovation and development (Diemers 2017). Venezuela even adopted the technology to develop a national virtual currency - the “petro”. The issuance of petro by the Venezuelan government is assumed to find ways out from the sanction imposed by the US. The US president, Donald J. Trump reacted by ordering a ban to any virtual currency transaction issued by the Venezuelan government (Fanusie & Frai 2018). However, most of the world biggest economies such as US, UK and Germany didn’t ban but warned their society about the dangers of using cryptocurrencies.

Even though responding attitude of individual country to cryptocurrencies is different, major authority representatives of the financial world highlighted the potential of it for money laundering and terrorist acts and considered a regulation and supervision with regarding to cryptocurrencies that would lead to an international financial integrity and a policy that protect consumers in the cryptocurrency world (Lagarde 2018). In March

2018, during the G20 meeting in Argentina, representatives of the central bank and finance ministers agreed to insert a deeper concern and a closer watch to cryptocurrencies.

The money-laundering issue that is connected to the anonymity nature of cryptocurrencies is significant and remained a concern for governments and regulatory agents of many countries. Regulatory authorities in these countries are working hard to address the issue of cryptocurrency related money-laundering activities and one good example with this regard could be the passing of amendment by the Australian government to the Anti-Money Laundering and Counter-Terrorism act of 2006 on the 7th of December 2017 (McKenna 2017).

In many countries public authorities remained decisive with tax-related and financial regulation issues. For instance, Germany and France proposed to ban any marketing activity to the public that attract people to invest and trade in cryptocurrencies. They have also proposed banning cryptocurrency related loans and deposits because of their potential threat to the financial stability (Canepa 2018). However, on the other hand, the chairman of the Financial Stability Board (FSB), Mr. Mark Carney, described on his letter to the G20 that FSB's initial assessment of the crypto asset indicated that cryptocurrencies do not affect or risks the global financial stability considering their current market position (Carney 2018).

Tax authorities of many countries, for example, the US, Germany, Norway, Sweden, Australia recognize cryptocurrencies as some form of financial asset and request payment of tax on profits made by investing and trading of cryptocurrencies (McKenna 2017).

## **5 DISCUSSION**

Cryptocurrencies are financial technology inventions that have gained more attention by the public following the bitcoin financial bubble in 2017 and its subsequent burst in early 2018. Their usage in a day-to-day transaction since then has increased exponentially with more and more businesses recognizing and accepting them as a supplementary payment method. At the time of writing this report, the end of 2021, the sum of all cryptocurrencies

has surpassed a global crypto market cup of 1.95 trillion dollars with bitcoin alone capturing 40.5 % of the total market cup (e.g. coinmarketcup).

When comparing the current global cryptocurrency market cup which is estimated to be around 2 trillion dollars with the end of 2017 and beginning of 2018, a time of bitcoin financial bubble as well as a global attention and increased acceptance of cryptocurrencies, which is estimated to be 790 billion dollars (see Figure 5), one can easily imagine the growth and acceptance rate of cryptocurrencies by the public.



Figure 6. Total cryptocurrency market cup

(Source: coinmarketcup.com)

The role of media is one of the most mentionable of all the factors that have played major role in the increased acceptance and adoption of cryptocurrencies. For example, major medias have broadcasted the 2017 bitcoin price bubble and by the end of the year bitcoin has recorded historical high market price. Since then, the price of bitcoin and other alt-coins continued to increase even if temporary price volatility challenges are much common and frequent. Cryptocurrencies price increase led the cryptocurrency market to become famous and known by the public in using them as means of payment and trading

instrument mainly through exchanges. Acceptance rate of cryptocurrencies by businesses as means of payment has also increased following the massive growth potential they recorded in the market.

Even though the payment acceptance rate of cryptocurrencies by businesses has increased from time to time, due to the high volatility rate of cryptocurrencies, most businesses have still not taken the risk of accepting them as payment option. Major reasons that hinder the mass adoption and acceptance rate of cryptocurrencies by businesses are the legal and regulatory uncertainties that might arise anytime by financial regulatory authorities and the price volatility risk attached with cryptocurrencies. The motive behind most businesses who accept cryptocurrency as payment alternative is to increase sales. These businesses convert the cryptocurrency to fiat currency right away because they do not want to take the volatility risk of their cryptocurrency-based revenue.

Other interesting and hot topic with regarding to cryptocurrencies is whether cryptocurrencies could substitute or supplement the legal money system. This specific topic or question consists multiple interests as well as situational factors in it. Based on the findings of this thesis work, it cannot be boldly explained or answered without specifying the different situations and interests.

First, the future of cryptocurrencies is decided by the different stakeholders (groups) who can potentially affect the market. For the convenience of the discussion, let us start by dividing these group of people from the top layer and go downwards by screening and subdividing.

At the top layer there are group of people who have at least some knowledge about cryptocurrencies and those who do not have a clue about it. Obviously, those people who do not have any knowledge about cryptocurrency are not the interest of this thesis and are excluded from the discussion. The group of people who has knowledge, interest, or concerns in cryptocurrencies could generally be divided into supporter and opposer of cryptocurrency.

Those group of people who support cryptocurrencies have again different interests and they could further be divided into two. Those who advocate for price stability of cryptocurrencies and those who see the price volatility of cryptocurrencies as an advantage. On



the other hand, those group of people who oppose cryptocurrencies can also be divided into two, those who are flexible and recognize the potentials of cryptocurrencies in completing the incomplete financial market but demand for tighter regulation to protect theft related customer protection, tax frauds and so on, and there are other group of people who are too strict and propagate the cryptocurrencies existence to be a complete threat to the financial stability and system, legal financial framework, and work structure of financial regulatory agents.

Stakeholder groups who support the ideology of cryptocurrencies but demand for a more stable cryptocurrency than the price volatile ones, as it is common in the cryptocurrency market, and the group that appreciate their price volatility, can both be looked at from end-user, business, and investor perspectives.

From the end-user perspective, those who appreciate cryptocurrency price stability are individuals who live in economically and geo-politically unstable regions and adopt cryptocurrency as a storing of their asset and/or highly dependent on remittance money. End-users who appreciate cryptocurrency price volatility are mostly those individuals who live in a stable region but use cryptocurrency just because they are fascinated by the social and technological factors and seeks a long-term economic reward from their cryptocurrency investment.

From business perspective, those who demand price stability are businesses located primarily in politically and economically unstable regions. These businesses accept cryptocurrency payment both as a means of growing their sales and securing revenue and the value of their asset. However, in the case of businesses in a stable region, their focus is mainly on the increased sales opportunity they get from cryptocurrency, and they normally do not tend to keep their cryptocurrency revenue for long to avoid volatility risk.

From investors perspective, long-term investors are focusing on less risky investment options and choose price stable cryptocurrencies to invest in. These investors normally trust the long-term growth opportunity than focus on gambling with the price volatility of cryptocurrencies. They very much concerned about the technology, who is behind a certain cryptocurrency (stablecoin), and the total supply limit of cryptocurrencies when they decide to invest.

In the case of short-term cryptocurrency investors, the way they see cryptocurrencies is much more different from just a storing of value or long-term investment. Short-term cryptocurrency investors rather appreciate the price volatility of cryptocurrencies and consider them as a high frequency digital trading instrument. As the major focus of these group is to get quick profit from their investment, they are fully devoted in screening and analyzing the price as well as other key market indicators associated with each and collective cryptocurrency market to get advantage of quick and frequent profit every time price volatility occurs.

Most short-term cryptocurrency investors both individuals and businesses are risk takers. They normally increase their funds (buy cryptocurrencies) when the price of a certain cryptocurrency is nearing or exceeding record low - depending on the referenced time interval - and when the price curve starts to bend upwards. With the same logic, they sell their cryptocurrencies when the price is approaching or exceeding record high and when the price curve starts to bend downwards. Therefore, they are very conscious about the market trend and appreciate the volatility as it is the major risk-taking scenario from which they assume to generate profit.

On the other hand, there are stakeholders who are either neutral, flexible, or totally oppose the ideology of cryptocurrencies. The financial regulatory authorities of mostly developed regions are flexible about cryptocurrencies. Their focus is to regulate cryptocurrencies through demanding income tax on profits generated from them and by issuing a legal digital currency and instant payment infrastructure global wide. A good example of these countries is Switzerland and much of the EU countries. They consider cryptocurrency as a virtual trading instrument.

On the other hand, there are countries who banned cryptocurrency related activity because of its threat to their financial system, the general economy, and the security of the nation. China is one of the most mentionable countries when it comes to stricter rules and ban of cryptocurrencies. However, there are also countries like Nigeria that banned cryptocurrency-based transaction.

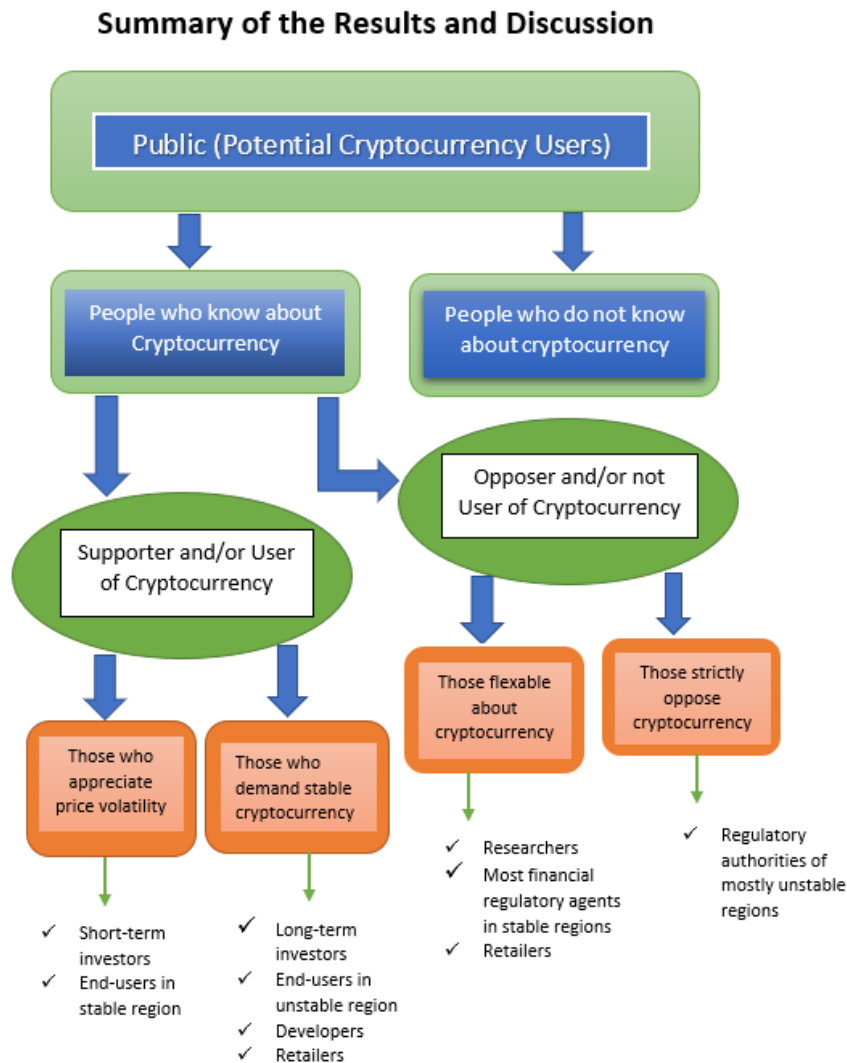


Figure 7. Summary of the systematic review result

## 6 CONCLUSION

Cryptocurrencies by far are one of the most financial technology innovations of our era. The most common and underlying technology that enabled the formation of cryptocurrencies is blockchain technology. Moreover, blockchain technology is one of the most promising technologies that would change the work structure of our world by revolutionizing almost all sectors and industries in the years to come.

A unique character with cryptocurrencies is their capacity to serve as a better means of payment, money transfer and storing of value depending on which part of the world we are in. Due to cryptocurrencies' spontaneous high price volatility rate, it is unlikely to conclude that they fulfil to serve as a unit of account, which in the case of national currency is one of the basic functions, and therefore considering cryptocurrency as a fully-fledged currency is inappropriate.

Even though it is still in a developing stage, there have been quite several studies conducted and published that help understand the viewpoints of cryptocurrency stakeholders. Cryptocurrency stakeholders could be categorized as end-users, investors, retailers, regulators, researchers, developers, and market enablers.

One of the crucial factors that affect the viewpoints of each cryptocurrency stakeholder is the political and economic situation of their region. However, the commonly agreed viewpoints discovered from this thesis work is that cryptocurrency end-users living in politically and economically unstable regions use it actively as it is a better means of transferring money and storing their asset and therefore, they demand for a more stable cryptocurrency type. Whereas end-users in stable regions adopt cryptocurrency mainly because they admire and want to know the technology better, to try out if it is a better investment option, and for other social related factors.

Retailers' viewpoints are somehow similar to end-users when compared by the stability of the region they are in; however, most businesses in stable region accept cryptocurrency only for the reason of maximizing their sales and therefore they convert their cryptocurrency-based revenue to fiat currency within few days to avoid price volatility risk.

Cryptocurrency investors in general are the most active stakeholder group when it comes to analyzing cryptocurrency market trend and following-up developments. Short-term investors admire the price volatility as it is their major profit-making stream while long-term investors focus on long-term profit and target stable cryptocurrencies to invest in.

Financial regulatory agents are one of the most important cryptocurrency stakeholder groups. Government and central banks have the power to regulate and control the financial stability of their country mainly through fiscal policy and assuring price stability.

They also have the mandate to influence any activity that would challenge the financial stability of a country.

In stable regions, the sovereign currency is stable and cryptocurrencies impact to the financial stability is little. Therefore, central banks and government in this region do not tend to take immediate and harsh action but they aim to regulate cryptocurrency activities through indirect means such as requiring tax to be paid on profit gains, and work on improving their payment and financial infrastructure to make it preferable by users.

However, the threat of cryptocurrency to the financial stability of unstable regions is immense. Governments and central banks in these regions do not have any space to wait and follow developments of cryptocurrencies on top of the financial instability challenge they already have, and they use their authoritarian power to take harsh measures including banning cryptocurrency related activities.

The viewpoints of cryptocurrency developers and market enablers towards the future of cryptocurrency are the most unresearched topic in this regard according to the literature search scope of this study. Therefore, this particular study is concluded through a recommendation on future research gap on developers' viewpoints on the overall cryptocurrency future rather than focusing only on projects they have participated.

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## APPENDICES

### Lists of Major Articles (Materials) Used for Literature Review and Analysis

<b>Title</b>	<b>Author(s)</b>
Basis: A Price-Stable Cryptocurrency with an Algorithmic Central Bank	Nader et al., 2018
Coexistence of Cryptocurrencies and Central Bank Issued Fiat Currencies	Julia K.T. Lutz, 2019
Trust in Blockchain Cryptocurrency Ecosystem	Rehman et al., 2020
A decentralized token economy: How blockchain and cryptocurrency can revolutionize business	Lee, J.Y., 2019
Adaptation of cryptocurrencies in listed companies: empirical findings of a CFO survey in the German capital market	Andrashko, L., and Britzelmaier, B., 2020
An Analysis of Cryptocurrency, Bitcoin, and the Future	Shankar, S., 2019
Analysis of the Cryptocurrency Adoption Decision	Alzahrani, S., and Daim, T.U., 2019
Bitcoin and Cryptocurrency: Challenges, Opportunities and Future Works	Fauzi et al., 2020
Understanding the Motivations, Challenges and Needs of Blockchain Software Developers: A Survey	Bosu et al., 2019
Can We Stabilize the Price of a Cryptocurrency?	Iwamura et al., 2014
Central Banks and Regulation of Cryptocurrencies	Nabilou, H., and Prum, A., 2019
Crypto Assets Require Better Regulation: Statement of the Financial Economists Roundtable on Crypto Assets	Franklin et al., 2019
Cryptocurrency vs Fiat Currency: Architecture, Algorithm, Cashflow & Ledger Technology on Emerging Economy	Yaseen, T., and Kabir, S., 2018



Cryptocurrencies, monetary stability, and regulation	Mandeng, O. J., 2018
Identifying factors that influence the adoption of cryptocurrencies from a multiple stakeholder perspective	Spengelink, H., 2014
Worrisome Patterns in Developers: A Survey in Cryptography	Hazhirpasand et al., 2021
Virtual currencies and central bank's monetary policy: challenges ahead	Dabrowski, M., and Janikowski, L., 2018
Facebook's Project Libra: Will Libra Sputter Out or Spur Central Banks to Introduce Their Own Unique Cryptocurrency Projects?	Taskinsoy, J., 2019
Global Cryptocurrency Benchmarking Study	Hileman, G., and Rauchs, M., 2017
Governance and control in distributed ledgers: Understanding the challenges facing blockchain technology in financial services	Zachariadis et al., 2019
How to Regulate Bitcoin? Decentralized Regulation for a Decentralized Cryptocurrency	Nabilou, H., 2019
In search for stability in crypto assets: Are stablecoins the solution?	Dirk et al., 2019
Investor attention and cryptocurrency performance	Zih-Ying Lin, 2021
Investors' Beliefs and Asset Prices: A Structural Model of Cryptocurrency Demand	Benetton, M., and Compiani, G., 2020
Monetary Reform, Central Banks, and Digital Currencies	Dow, S., 2018
Motivations, Barriers and Risk-Taking When Investing in Cryptocurrencies	Smutny et al., 2021
Ownership, uses and perceptions of cryptocurrency: Results from a population survey	Steinmetz et al., 2021
Predicting Future Cryptocurrency Investment Trends by Conjoint Analysis	Yilmaz, K., and Hazar, B., 2018

Exploring Miner Evolution in Bitcoin Network	Wang, L., and Liu, Y., 2015
What drives the adoption of crypto payments by online retailers?	Jonker, N., 2019