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An exploratory study of

The Future of Money

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1.0 Abstract

This thesis investigates *The Future of Money* by analysing the history of money, the characteristics of money, the challenges found in the current monetary system and possible solutions in the form of new types of money. An empirical analysis was performed on the basis of a qualitative data collection process, which included four respondents representing five different money market actors, commercial banks, central banks, critics, police and fin-tech start-ups. A model illustrating new types of money was created and existing money characteristics was identified. Seven challenges in the existing monetary system were identified, and two possible solutions, Aryze and a state issued CBDC were analysed and discussed. The Future of Money was concluded to change considerably, as cash usage is expected to decline while public and private Central Bank Digital Currencies are implemented in the near future.

2.0 Introduction

The digital economy is growing at an accelerated pace. Cloud Computing, Artificial Intelligence, Blockchain and Internet of Things are just a few of the technologies merging the physical and digital worlds in ways that create opportunity for both individuals and organizations to positively impact industries, businesses and the standard of living. A key reason for the growth can be attributed to the 4.1 billion and rising internet users (ITU, 2019) that can access digital services using a $40 smartphone from almost anywhere in the world. In fact, according to the World Economic Forum, we are in the midst of the 4th industrial revolution (WEF, 2020), which is expected to exceed all previous economic transformations in scale, scope and complexity (Schwab, 2015).

These extraordinary technological advances have already disrupted countless industries and have fundamentally changed how we live, work and relate to each other. The financial industry in particular has seen immense transformation in recent years. A surge of countless FinTech start-ups penetrating into all domains of financial services has brought this revolution to the disruption of money itself (EY, 2017). Despite the recent development, the monetary system of today is still flawed, which presents several fundamental challenges:

1) To generate revenue financial institutions take opaque risks with their customers' money, which can leave the money at risk if the institution defaults.

2) 1.7 billion adults are excluded from the financial system with no access to traditional banking, even though 59% of these adults have mobile phones and nearly 30% have internet access (Demirgüç-Kunt et al., 2018).

3) Poor economic conditions have pushed approximately 164 million workers to search for employment beyond national borders (ILO, 2018). 800 million individuals rely on the remittance money sent back by those workers (UN, 2020), but on average 7% of the amount sent is absorbed by remittance fees. These fees amount to a jarring $48 billion per year paid by families affected by poverty (The World Bank, 2020a).

4) As the supply of electronic money has grown in recent decades (Nielsen, 2018), it has become increasingly necessary to track its movement due to money laundering. But the methods used to track transactions are increasingly mismatched to the methods used to perform them (Villasenor et al. (2011).

5) 95% of the money in the economy today exists as electronic money, which commercial banks create in the form of bank deposits, by granting loans (Gode Penge, 2020). Critics of the current financial system believe the privilege of creating money should be sovereign to central banks, as commercial banks are driven by shortsighted profits above the general interest of society (Gode Penge, 2020).

To address these challenges, businesses and states are now experimenting with the creation of new types of money. One start-up looking to modernize money is the danish company Aryze, who is challenging the status quo by building a new financial ecosystem by introducing direct, border-free and universally accessible Digital Cash that can be tracked. Big tech are also eyeing the opportunity to grasp more power and conquer new markets, as they have been pivoting heavily into financial services, offering payment and purchasing services to its users. In 2019, Facebook announced the digital Libra currency, a cryptocurrency stablecoin set to rival traditional currencies and established banking practices with the mission of serving the unbanked people of the world. The project met great opposition, as Facebook possess the infrastructure, the user base and the network effects to ultimately create a parallel economy that threatens the sovereignty of central financial institutions. Meanwhile cryptocurrencies such as Bitcoin and Ethereum have both been attracting attention, accolades and criticism due to its pioneering decentralised design that introduced new defining characteristics of programmable money.

The characteristics of money have since early history evolved to conform to the needs of society, but the digitalisation has expedited the progression as future money and payment methods now face greater change than ever. Though the potential for radical changes has been met with both excitement and a good dose of scepticism, states and financial institutions are forced to gravely consider the issuance of their own digital currency. Many countries have examined Central Bank Digital Currencies (CBDCs), but only a few have initiated pilot projects (Brookings, 2020). In 2017, The National Bank of Denmark concluded that the challenges of introducing a CBDC in Denmark would outweigh the benefits. As a consequence of the digitalisation of money, in which money has become invisible, instant and more inclusive, cash usage in Denmark has seen a steady decline (Danmarks Nationalbank, 2020). The recent effects of the global COVID-19 pandemic have only augmented this trend, as physical stores

have had to close, and E-commerce have seen a sharp increase in sales since the shutdown (Danmarks Statistik, 2020).

The future of cashless societies is likely a question of when and not if. But expert opinions on the timing deviates. Fabris (2018) argued, it is not unreasonable to expect a transition to a cashless society in the near future, whereas The National Bank of Denmark concluded it is "...*not envisaged in the foreseeable future"* (Danmarks Nationalbank, 2020). Two opposing conclusions which put states and financial institutions at a crossroad - evolve now with the digital age and face novel and uncertain challenges, or risk losing control and power to disruptive innovators. It seems inevitable that digital money will continue to develop, but the question as to which characteristics will construct future money remains undecided.

This thesis will investigate the main research topic ***What is the Future of Money?*** by answering three research subquestions:

(1) How has money historically evolved and which characteristics does money have?

In order to adequately answer this, the history of money is summarized to highlight key trends and characteristics in its development. The definition of money is examined and clarified and an analysis identifies the characteristics of money. The word *characteristics* is throughout the thesis used to describe the sum of functions, properties and traits of money.

(2) What are the challenges in the current monetary system?

As highlighted in the introduction, financial technology solutions have developed at an unprecedented pace, which begs the question, which problems are they trying to solve? To answer this, the thesis will begin by identifying the challenges in the current monetary system that has catalyzed fintech innovation.

(3) How can new types of money possibly address these challenges?

The thesis will analyze how new types of money such as CBDC and the Aryze platform can possibly address the previously identified challenges.

3.0 Phenomenon of interest

3.1 Research worthy problems

As a student of both business and information technology, I was interested in researching a topic that inherently combines both subjects. To argue my choice to research *The Future of Mone*y, I will use the theory of "research worthy problems" constructed by Ellis and Levy (2008) from the article "*A Guide for Novice Researchers on the Development of a Research-Worthy Problem*". They present research-worthiness as a construct in three parts: *problem*, *research* and *research-worthiness.*

3.1.1 Problem

Ellis and Levy (2008) defines a research problem as a problem that is active, has an impact and does not have adequate solutions available. Money is central to all on earth, as it is the medium we use to fulfill our individual and societal needs. The contemporary issues of money mentioned in the introduction outlines impactful issues where the need for change is growing. The availability of new types of money and digital payment services emphasises the strong potential, many money market participants envision could improve the current monetary system. While a wealth of different money transforming solutions are in development too, non adequately solve the outlined problems as of today.

3.1.2 Research

According to Creswell (2005), research is *"a process of steps used to collect and analyze information in order to increase our understanding of a topic or issue"*. Knowledge of what is known is a prerequisite for identifying what is unknown (Davis and Parker, 1997), so in order to contribute with new knowledge in the context of the future of money, an understanding of the current body of knowledge must be obtained (Ellis and Levy, 2008). To identify what is already known, a literature review was performed. To collect relevant data, the primary data collection method of interviews were employed. Four interviews with select technology and economy experts representing different market actors were performed, and subsequently codified, analysed and discussed.

3.1.3 Research-worthiness

To identify research worthy problems, Ellis and Levy (2008) recommend novice researchers to follow four key steps: Look, Read, Synthesize, Consult. *Look,* where personal interests, hunches and gut feelings act as a starting point for locating research-worthy problems. *Read*, where scholarly literature is absorbed and gaps in the body of knowledge are identified. *Synthesize*, where the researcher weaves together the insights derived from varying sources to develop research-worthy problems. And lastly, *Consult,* where the identified research-worthy problem is consulted with an experienced researcher. Cryptocurrencies sparked my interest in 2017 and I have followed the development closely ever since. I have often pondered over why cryptocurrencies never reached noticeable adoption. I used cryptocurrencies as a starting point, and in the processes of reading I learned more about other types of digital currencies that could influence future money and the monetary system, such as CBDC's. This gave me the idea to investigate which characteristics of money that could be important for future money. Lastly, I consulted the topic of *The Future of Money* with my supervisor who gave me a clearer direction.

3.2 Scope limitations

The analysis focuses on two possible solutions to address the identified challenges in the current monetary system: A central bank issued CBDC and the Aryze platform. These are two possible solutions out of a sea of other possible solutions, that could alleviate the challenges.
While the lens of the research is focused from the perspective of Denmark, the thesis also aims to conclude general global challenges and money solutions.

4.0 Literature review

The purpose of this literature review is to create an overview of the existing literature that relates to money as a payment instrument. As the thesis investigates the future of money, the selected articles chosen for review covers present and future types of money.
The search for relevant academic articles show it is possible to find literature and vast and thorough analysis regarding various types of money. To guide the construction of the literature review, guides recommended by Mongan-Rallis (2018) and Galvan (2006) were followed. To create an overview for the chosen literature for review, a table was created that shows author, year, title, method, focus and summary of findings.(Appendix 4.0).

The literature was found by using two search engines, Google Scholar and the CBS library search engine in the period of November 2019 to September 2020. Articles were also found by scanning the reference lists of relevant articles.

Central Bank Digital Currencies

Central Bank Digital Currencies (CBDC) has in recent years emerged as a hot topic amongst national banks and economic researchers. A rise in popularity of digital payment solutions (Söderberg, 2019), a decline in cash usage (Heisel, 2020), radical innovations, improvements in the underlying technology and new threatening market participants such as Libra has led central banks all over the world to seriously consider the potential issuance of a CBDC as a substitute or complement to cash (Brunnermeier et al., 2019). A central bank digital currency would be a digital form of central bank money that households and businesses could use to make payments and store value. A CBDC would provide both a new form of central bank money as well as new payment infrastructure (Bank of England, 2020).
This has resulted in a surge of papers discussing the ramifications of issuing a CBDC. However, at this point there is insufficient empirical evidence on the technology and the economic impacts of CBDC as the technology has not yet been implemented at full scale. While no country has fully implemented a CBDC, Barontini and Holden (2019) reports that 63 central banks

representing 80% of the world's population are working on the issue, either in form of analytical work or by testing prototypes and evaluating different types of underlying technology.

Instant payments and decline in cash

The National Bank of Sweden reports a sharp increase in the volume of instant payments in the form of electronic money as a result of the interaction between technical development and changed habits and expectations of the swedish population (Söderberg, 2019). Instant payments have gained popularity as they offer a fast and convenient way to transfer value through instant payment apps on mobile platforms. The increase in volume of instant payments has equally increased their significance for the economy, which has surged central banks around the globe to examine how digital payments can be made securely and efficiently from society's point of view. Other scandinavian national banks report similar trends that have led to a decline in cash use due to the technical development (Söderberg, 2019; Grym, 2017; Spange et al., 2017). Söderberg argues the decline in cash use changes the role of the national bank in the payment market, as private money is replacing state money to an ever greater extent. Private money can be defined as money that is issued by a private entity such as a bank, whereas state money (i.e. cash) is issued by the national bank.

Marginalization of the Central Banks control in the money market

Unlike descriptions found in some economics textbooks, most money in circulation today takes the form of bank deposits. These bank deposits are created through the issuance of loans by commercial banks (McLeay et al., 2014). By creating money, commercial banks earn seigniorage that substantiates a significant part of commercial banks' profit (Bjerg et al., 2017). The creation of money has over time changed from being in the hands of the central banks to commercial banks, as cash has declined.

In 2019 Facebook announced their intention to issue a permissioned blockchain digital currency Libra, which could have a substantial impact in the payment market. Their mission is to serve the unbanked people of the world, who are outside the financial system. Aker's (2018) findings suggest one primary barrier could be the lack of access to the necessary infrastructure.

New entrants in the market such as Facebook pressures the national banks to act or risk being left behind by the rapid technological transformation. Söderberg argues If the state's role on the payment market is marginalised, several issues could arise: (1) Monopolization tendencies in the payment market could weaken competition, which in the long run would result in higher costs for the general public and could also result in stagnation of innovation. (2) The robustness of the payment system will decline. (3) Basic trust in the Swedish krona and the monetary system could be undermined if it is impossible for the general public to exchange their digital money into cash. Thus, to mitigate these potential risks the National Bank of Sweden believes an e-kroner could be the solution. However, the National Bank of Denmark concluded the opposite as they in 2017 determined that the potential benefits of introducing a CBDC would not match the considerable challenges it would present (Spange et al., 2017), citing reasons such as the risk of bank runs, the impact on financial stability and the cost of implementation. Kirkby (2018) concurs as he concludes it would be a bad idea to make the central bank responsible for the entire money supply. However, according to (Nielsen and Bjerg, 2018), their analysis fails to take into account the potentials for increased financial stability given the fact that CBDC carries no credit risk. Brunnermeier & Niepeltz (2019) concluded that bank runs would be unlikely with the introduction of a CBDC.

Programmable money

In the last decade, cryptocurrencies have evolved at rapid speed and have been a hot topic discussed for its unique design and characteristics (Alazahrani & Daim, 2019). The most famous cryptocurrency, Bitcoin was designed by the unknown author Satoshi Nakamoto with the intention of replacing existing printed currencies by using blockchain technology. By utilizing cryptographic methods to transmit digital information to ensure valid and legit transactions, the idea was to reduce transaction costs and remove the need of intermediaries to provide trust in the transaction (Nakamoto, 2008). It inherents the main functions of money such as medium of exchange, unit of account and store of value which fulfills the definition of money (Eikmanns & Sandner, 2015).

As such, DeVries (2016) suggests the ability for cryptocurrencies to facilitate micro transactions with blockchain technology may allow it to bridge an economic gap that state sponsored

currencies like cash and electronic money does not solve. Since the emergence of Bitcoin, alternative types of blockchain based currencies which support ‘smart contracts’ have surfaced (Elsden et al., 2019). Smart contracts are immutable and self-enforcing applications that can automatically run across a distributed blockchain network in which transactions are trackable and irreversible (Catlow et al., 2017; Nissen et al., 2018; Luu et al, 2016). Programmable money shows the opportunity to deliver a more nuanced, flexible and contextualized form of digital money, which could be used to improve everyday social practices in the form of banking services, management of money, contracts and much more Elsden et al. (2019).

5.0 Methodology

5.1 Research design

Based on the problem statement of this thesis, the research design is formed as an exploratory study seeking to comprehend the future of money and the current situation of the monetary system. Hence the purpose of the study is not to come up with solutions to existing problems, but rather to highlight which solutions and characteristics that can solve the challenges of the current monetary system. Exploratory research is typically designed to investigate new phenomena, and while money can hardly be argued to be a new phenomenon, it has changed in both characteristic and form in recent years. This calls for a more comprehensive study of money itself and the coexisting monetary system. As exploratory research has no predefined structure, it was possible to approach the subject in an inductive manner. An inductive method is based upon generalizations as a result of observations (Erhardt, 2011). In regards to the collection of data, this means that an investigator collects a specific amount of data with the intention of making a general conclusion. A deductive reasoning approach could also have guided the research process, but was decided against for several reasons. A deductive method is based on existing knowledge and the creation of hypotheses upon this knowledge (Erhardt, 2011). This means assumptions on a certain topic are constructed based on what the researcher presumes to know. The research topic of future money was chosen because I have observed a transformation of money in recent years, and was curious to investigate the reasonings as to why this was happening. Thus, an inductive approach made it easy to gather

data and assign relevant labels and categories without being restrained by preceding theories as it seemed counterintuitive to investigate the future on the basis of earlier developed theories.

5.2 Data collection

To be able to answer the research questions, several instances of data collection were performed. To collect primary data, four interviews with experts representing different actors of the monetary system were carried out. In order to obtain data triangularity, secondary data sources such as scientific articles, reports and statistics were also used. Data triangularity is important to obtain as it increases the confidence in the research findings (Guion et al., 2015)

The data from scientific articles and interviews with select experts constituted the base for analysis. Exploratory research design typically uses qualitative data in the form of interviews, which was one of the deciding considerations when choosing to collect data through interviews. As qualitative methods are concerned with meaning and significance of data rather than the counting of data (Rasmussen et al., 2006), using a qualitative approach allows the exploration of the respondents perception of future money. Interviews were found to be a superior method for the research, as it provides in-depth information and clarification about a topic. Furthermore, it makes it easy to tailor the discussion to the respondent, which was very relevant in my case as the four respondents represented different market actors. While interviews can provide unique and insightful data, it can be challenging to generalize the data as it consists of respondents' subjective opinions and experiences about the topic.

5.2.1 Respondent attributes

Interviews with experts can provide incredible insights to subjects, but also suffer from bias. To reduce the bias of the findings and obtain a higher degree of holistic and comprehensive data, the respondents were chosen from different money market actors to represent different views of opinion on money. The respondents were selected as they all had relevant backgrounds and job positions which would label them as experts and could offer different perspectives to the research questions. The respondents respectively represent five different actors: commercial banks, central banks, critics, police and fin-tech start-ups.

Søren Truels Nielsen was selected to represent the central banks, as he from his position as financial advisor at Nationalbanken could offer an expert opinion on payment systems and

CBDC. In addition, he also co-wrote *"Central bank digital currency in Denmark?"* (Spange et al., 2017).

Mads Clemmensen was selected as an expert to represent the commercial banks, as his position as Lead Blockchain Specialist at Danske Bank has allowed him to gather unique insights from inside the banking industry.

Rasmus Nielsen was selected to represent critics of the current monetary system and the police, as he is co-founder and chairman of the board of the association *Gode Penge*, known for its critical views of the current monetary system. In addition, he works as an economic consultant at Bagmandspolitiet where he has deep insight knowledge regarding money laundering. Furthermore, he also wrote and co-wrote several scientific articles about the monetary system such as "*Pengepolitik i krise - Fra ineffektiv rentepolitik til digitale centralbankpenge*" (Nielsen, (2018).

Morten Nielsen was selected as an expert to represent the fintech start-ups, as he is the CFO and co-founder of Aryze, a Copenhagen based fin-tech innovator. From his position at Aryze and previous position as JP-Morgan, he has deep insight knowledge of the commercial banking industry as well as blockchain technologies. In June of 2018, Aryze was named Denmark's Best New Startup at Copenhagen fintech week.

Respondent	Workplace	Job title	Expertise	Interview date	Interview duration	Codification reference tag
Søren Truels Nielsen	Danmarks Nationalbank	Financial advisor	Payment systems, Macro economy, Financial stability	27/08-2020	49:11	SN
Rasmus H. Nielsen	Gode Penge and Bagmandspolitiet	Co-founder and chairman of the board and Economic consultant	Macro economy, CBDC, Money laundering	27/08-2020	45:10	RN

	POLITI					
Morten Nielsen	Aryze	CFO & Co-Founder	Financial technology, Cryptocurrencies	11/04-2020	1:06:04	MN
Mads Clemmensen	Danske Bank	Lead Blockchain Specialist	Blockchain, Commercial banking	08/04-2020	56:15	MC

Table 1. Interview and respondent information

5.2.2 The Interviews

According to Kvale (2007), a semi-structured interview should be focused such as it is neither entirely open nor structured with standard questions, as it allows the interviewer to be open towards opinions and the perspectives of the respondents, while at the same time guiding the interview to the subject of choice. From the knowledge and understanding of money and the monetary system gathered from the literature review, an interview guide (Appendix 1.0) was created to help conduct the interview, collect relevant data and create a good flow in the conversation.

The interviews were semi-structured allowing the interviewer to ask follow-up questions when needed. The semi-structured interview is suitable for an exploratory study as the interview style allows the respondents answers to guide the questions and themes of the interview. In other words, the interview is not determined by the researchers prior understanding alone. All interviews had a duration of 45-65 minutes and were all held online via Skype or Facetime. Two of the interviews were performed in english, which later made it necessary to translate selected quotes. The interview guide was structured in such a way the respondents could ease into the conversation as they were informed about the purpose of the thesis, how the interview would proceed and how their answers would be used in the study.

5.3 Codification

In order to systematically analyze the collected data all interviews were subsequently transcribed (Appendix 2.0) and coded (Appendix 3.0). An inductive research approach was

chosen, by which the data was processed and labeled to identify and compare patterns and themes. This approach is suitable for an exploratory study as the coding process is not controlled or limited by theoretical concepts or hypotheses but rather letting the data "speak for itself". The coding sheet was split into four columns: *category, subcategory, summary of key points* and *reference.* The main themes of the interview data were then sorted into five different categories in the first column to create a better overview: *Challenges, Characteristics of money, Alternative solutions, The Future of Money* and *Problems with alternative money*. After the first round of labeling and sorting was performed, a second round was applied to further sort and label the data as overview and understanding of the complete data was insufficient. Specific themes were labeled as subcategories in the second column to understand the more specific themes of the data. The third column was used to summarize key points from the data, which gave a much better overview of the data. The final column "Reference" labeled the respondents initials and key point-number, which was used to find the complete quote in the transcribed data. Finally, color coding was used to separate themes and respondents from each other.

Category	Subcategory	Summary of key points	Reference
Challenges	Money laundering	There are inherent challenges in physical money regarding black economy, theft, robery and money laundering	SN4
		Criminal financial activities is something that happens digitally. You can trace cash, but not digital cash	RN17
		Financial criminality is much less with physical cash compared to digital money	SN6
	Financial exclusion	You have to pay money to be part of the banking system, leads to financial exclusiveness	MN5
		Poverty should not be something that prevents you from having at least very basic financial services	M29
		You need to be an asset to the bank, you're not if you only have 10 dollars because the bank won't be able to earn money from you	M30
		Financial exclusion is not a problem in Denmark	SN3
	High barriers to entry	As a business, you need a bank license if you engage in a business of managing money	M12
		Regulatory and compliance issues makes it hard to get blockchain banking approved	M13
		The money system is driven by strong network effects, which gives high entry barriers to the payment market, which gives a great amount of power to the established actors.	SN11
		Monopoly and regulation	SN23

Figure 1. Snippet of the codification sheet (Appendix 3.0)

6.0 Analysis

6.1 Analysis: Part 1

To answer the first problem subquestion (1) "*How has money historically evolved and which characteristics does existing money have?"* various data collection methods were utilized, including interviews, scientific articles and academic books. The knowledge and data collected from the four interviews and researched articles clarified which types of money exists today and various defining characteristics of money.

6.1.1 History of money

To understand the future of money, we must be conscious of its history. Before man invented money to facilitate trade, the exchange of goods and services in society was performed through direct barter. A hunter could perhaps barter a deer skin for a basket of berries from a gatherer, or two deer skins for a jacket from a tailor. This meant that to complete a trade, one would have to find someone with the exact opposite need, also known as the double coincidence of wants (Szabo, 2002). These types of exchanges were the foundation of the bartering economy that dominated the early years of mankind. A direct barter economy would for several reasons not be feasible in today's society with its division of labour. For example, a computer science professor wanting a haircut would probably find it hard to locate a hairdresser who would be willing to cut his or her hair against payment in the form of a lesson in Python or C# from the professor. Another problem is the large amount of relative prices one would have to juggle, for instance the price of deer skin to apples, to clothing or to grain.

Later in history, indirect barter economy became the norm (Abildgren, 2018). This meant a standard good was chosen and accepted by everyone in exchange of their own goods and services. This drastically reduced the amount of relative prices, as it was only necessary to know the prices in relation to the standard good (Abildgren, 2018). Standard goods such as cattle or grain were characterized by being relatable and easy to assess its value. Cattle or grain partly satisfied the three functions of money that later was defined as store of value, medium of exchange and unit of account (Jevons, 1875).

Over time other goods such as gold and silver gained popularity as a medium of exchange. The precious metals had superior properties and enhanced functions of money that made them more convenient as a means of payment. Unlike grain, metals do not suffer from spoilage or gradual deterioration. They are durable, do not rot or get eaten by rodents, and unlike cattle they are divisible as well as being easier to store and more convenient to transport. Furthermore, the metals are scarce and visually striking making it hard to counterfeit (Weatherford, 1998).

The above mentioned examples of money can be categorized as commodity money, as each example possesses intrinsic value independent of any governing body. However, as society developed, kings or other public authorities started to mint their own coins, guaranteeing the value of the precious metals. This increased the convenience to pay with metals, as the use of scales were now redundant, except when the coins showed signs of manipulation. Although precious metal coins improved money as a medium of exchange from bartering, they were still heavy to carry while travelling and not suitable for large transactions.

Eventually paper bills were introduced in 12th century China that could be exchanged for their face value in precious metals or used to buy goods and services, yet again improving the convenience of money (Pickering, 1844). However, it would take a few hundred years before paper money gained traction in Europe.

Promissory notes were widely used in medieval Italy as a legal instrument to pay a determinate sum of money from one party to another, as it was a light and more secure way of transporting large sums of cash over long distances. In the 17th century banks began to give out the notes as payable to the bearer, instead of the original depositor. In effect this changed the notes to a currency that was backed by the banks and not the account holder of the bank (Faure, 2013). Fractional reserve banking was created as bankers began to issue loans at a greater value of notes than they held in reserves, under the assumption that the notes would not be redeemed at once. This changed the promissory note to not only function as a medium of exchange, but also as an instrument for banks to expand the monetary supply (Lannoye, 2011).

It was not until 1661 that paper money as we know it today, that assumes money is determined by a social and legal consensus, was introduced in Europe. A swedish bank named Stockholm Banco was the first european bank to issue their own bank notes in consultation with the government. Unfortunately Banco issued more notes than the bank could afford to redeem,

which led the public to lose trust and confidence in the notes ultimately resulting in bankruptcy. However, that didn't deter other banks from following suit as they recognized a need to expand the currency supply beyond the availability of precious metals. Given that the financial system was unregulated, the issuance of bank notes resulted in frequent bank runs and financial instability.

As time passed, the public confidence of bank notes gradually grew especially as national banks started to issue notes as legal tender with the backing of government reserves. With governments issuing the bank notes, the inherent danger was no longer bankruptcy, but inflation (Lannoye, 2011). To combat this, the gold standard was widely adopted which afforded central banks monetary tools to better control the money supply. Furthermore, the gold standard made it easier to trade across borders as paper notes would always be redeemable in gold (Bordo, 1981). Following the consequences of the great depression in the 1930s, the gold standard was phased out as governments had difficulties stimulating the economy and was finally completely abandoned in the US in 1971. The dollar became the world's reserve currency and fiat money became legal tender backed only by the trust and confidence in national currencies.

As the age of digitalisation drew closer, the use of physical money was and is gradually used less. Instead the use of electronic money, money created by commercial banks through loans and not by the central banks, have become the predominant medium of exchange. The popularity of electronic money can be attributed to credit cards or digital payment systems as they have proven to be a user friendly and more convenient alternative to physical cash in most situations.

In resistance to the current monetary system, historically dominated by actors such as states, government and central banks, a new form of secure decentralised money run on blockchain technology was created in 2009. Bitcoin, the first and most known cryptocurrency, not controlled by a central entity, but by the large and global network of users exemplifies a digital type of money opposite to the current centralized monetary system. Since its birth, a wave of innovative money services and digital currencies have emerged to solve the growing deficiencies of the current monetary system.

Money has in terms of its form and appearance changed drastically over time. In the following paragraph the definition of money is elaborated together with a description of the types of money and characteristics that exist.

6.1.2 Types of money and their characteristics

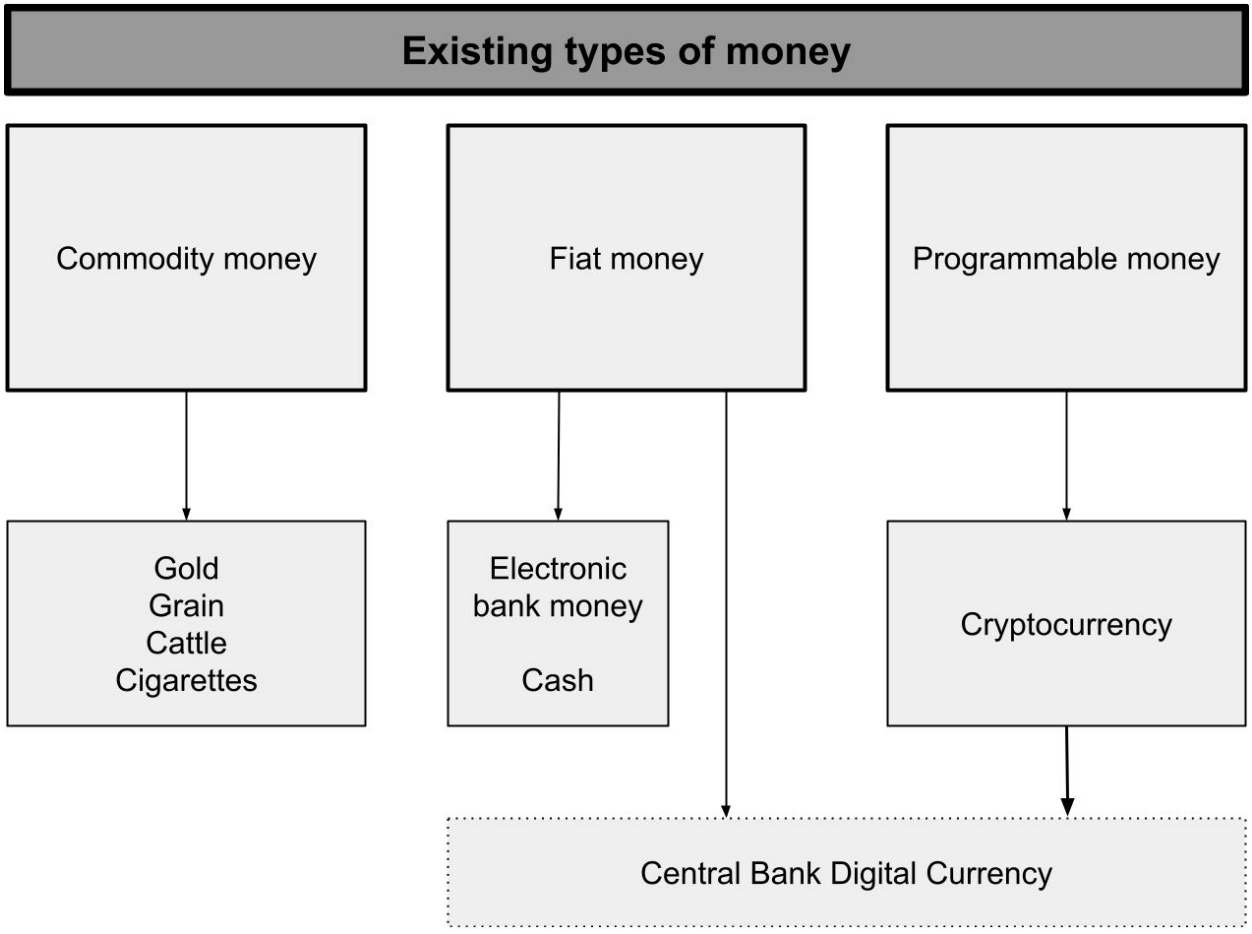
From reading relevant literature it is apparent that different terminologies are used to describe money, so for the sake of clarity these terminologies will be explained. Before analysing the different types of money currently in existence, we must start by clarifying the definition of money itself. According to Mankiw (2016), "*money is the stock of assets that can be readily used to make transactions"*. While this definition is accurate regarding commodity money and cash, it could be argued it inadequately describes digital forms of money. Contemporary money is rarely physical, which means in order to *readily use it to make transactions* as per the definition of Mankiw (2016), an underlying payment system is needed to facilitate such transactions. As such, Søren Nielsen of The National Bank of Denmark defines money as *assets* plus the *underlying payment systems* that make digital transactions possible (SN1).

Figure 2. Money can be defined as assets plus payment systems.

To illustrate the different types of existing money found from the literature review and the history of money, a model was developed (see Model 1). The model describes three main types of money: *Commodity money, fiat money* and *programmable money*.

As the history of money revealed, commodity money is nowadays very uncommon, as historic commodities such as gold, grain and cattle cannot be used as a medium of exchange. Nevertheless, in rare circumstances commodity money is still relevant. For instance in prisons where cigarettes operate as a commodity because other types of money are inaccessible (Burdett et al., 2000). However, commodity money is less relevant to analyse in the context of future money. As such, the analysis will focus on the two remaining types of money as well as the different characteristics that define them.

Fiat money is the most common type of money in existence, as *electronic money* and *cash* make up all existing money backed by states. Programmable money is money represented in digital form, also known as tokens. Cryptocurrencies is in essence programmable money, but the design of cryptocurrencies varies greatly. CBDC is a unique type of currency that lends characteristics from both fiat money and programmable money issued by a central bank.



Model 1. The existing types of money. This model shows the three existing types of money and its relationship with existing currencies. As CBDC are not currently in circulation, it is illustrated by dashes.

To create an overview of the characteristics of existing money a table was developed (See table 2). The table accounts for the relevant and different characteristics derived from the literature and data collection process. While each characteristic might not be equally important, all are relevant to account for and analyse as they characterize the existing types of money. The four currencies chosen for review are *cash*, *electronic money*, *CBDC* and *cryptocurrency.*

Below follows a clarification of the 30 identified characteristics of money and a subsequent analysis of the characteristics in relation to the four currencies. While CBDC has not been fully implemented in any country as of yet, some assumptions about the likely characteristics are made. A currency can be defined as a system of money in use. All four currencies share the three functions of money described by Mankiw (2016): **store of value** - meaning it can be used to store value, **unit of account** - making it easy to measure economic transactions, **medium of exchange** - the ease with which an asset can be converted into the medium of exchange and used to buy other things. Cash and electronic money are an imperfect store of value, as the buying power of a fixed amount decreases over time due to inflation. The same will likely be true for CBDCs as well, as they will be pegged to their respective national currencies. Cryptocurrencies on the other hand are known to be volatile, which makes them an undesirable store of value. However, stablecoins that are pegged to a currency such as the US dollar, can be used as a store of value on equal footing with fiat money.

Fungibility - *the interchangeability of the money*.
Cash and electronic money are fungible, as they are essentially interchangeable with itself. Some cryptocurrencies are fungible, but it depends on the design. For example, Bitcoin lacks fungibility. As every bitcoin is traceable, some bitcoins could have a lower perceived value than others, if it has been used as a medium of exchange in illicit activities, also referred to as taint.
Durability - *if it is able to withstand repeated use.*
Each type is durable, although banknotes have a limited lifespan of 9.9 years on average (FED, 2020).
Divisibility - *if it can be divided into smaller units.*
Each type is also divisible into smaller units, however cash is only divisible through predetermined values, whereas cryptocurrencies can be divisible into much smaller values. Bitcoin can for instance be divided down to 8 decimal places, known as a Satoshi.
Portability - *if it can be easily carried and transported.*
As electronic money, CBDC and cryptocurrencies in essence are numbers in a computer system, they are easily transported via electronic networks. Cash is easily carried and transported in small amounts, but becomes an inconvenience in larger quantities.
Cognizability - *if the value is easily identified.*

The value of cash and electronic money is easily identified to consumers. The same goes for CBDC's as they are pegged to a national currency. Cryptocurrencies are routinely measured in dollar value to make the value easilier identified, but the tokens themselves are hard to value (MN11).

Scarcity - *if the supply in circulation is limited.*

The supply of cash, electronic money and CBDC's can be expanded by commercial banks and central banks. Many believe the ability to make adjustments to the money supply depending upon economic factors is vital to maintain financial stability. Scarcity varies per design of the cryptocurrency. For instance, there will never be more than 21 million bitcoins. Many argue this to be a strength, as it could help keep the price of Bitcoin stable in the future. However, bitcoin won't be fully mined until 2140. Other cryptocurrencies types such as stablecoins can expand the supply of tokens.

Acceptability - *if the money will be accepted as a means of payment.*

Cash and electronic money is widely accepted as a means of payment. Whether CBDC can be utilized in a commercial setting depends on the design. Cryptocurrencies have not been able to gain market traction yet, as there are several issues that hinder adoption, such as usability and insufficient network effects.

Stability of value - *if the price of the money is stable.*

The price stability of fiat money has historically fluctuated, especially in times of war or economic crisis. Supporters of CBDC believe it could be used to help stabilize price levels, but this remains uncertain if possible. Cryptocurrencies are notoriously volatile, but stablecoins are per definition stable as they are backed by a reserve asset.

Physical - *if the money is physical of nature.*

Cash is physical, the remaining types of money are not.

Digital - if the money carries traits beyond its dependence on electricity.

The words *electronic* and *digital* are often used interchangeably, but in the context of money the difference is important to note. While the distinction depends on the context, electronic money can generally be seen as a system of operation that involves the control of a flow of electrons (Cambridge, 2020). As such, electronic data is typically in the form of documentation that is static. Digital money, which i*s issued and usually controlled by its developers, and used and accepted among the members of a specific community* (ECB, 2012). Thus, the key difference is

digital data includes the metadata of any object, usually the data about an electronic file.

Legal tender - *states recognize the money as satisfactory payment for monetary debt.*

In some countries, it is not possible to pay taxes with cash. Electronic money is the standard medium to pay taxes. CBDC could in the future be used instead. Cryptocurrencies cannot be used to pay debt to states.

Transparency - *the transparency of the underlying payment system.*

The transparency of the current monetary system is opaque, as it is very complex and full of intermediaries. The transparency of cryptocurrencies vary greatly, depending on the design. Bitcoin is known for its transparency, as it is possible to track all the transactions of the network. The transparency of CBDC's depends on the future design.

Convenient - *the convenience of using the money.*

The history of money revealed convenience to be a great factor of money's success. As technology evolved, so has what is considered convenient also. Moreso, as convenience is relative to how familiar you are to the technology, it's hard to quantify what type of money is most convenient. In general, electronic money is the most convenient type of money, as cash is physical and cryptocurrencies often require technical expertise. The convenience of a CBDC would depend on the design.

Speed - *the speed of the transaction.*

Cash is not particularly slow, but not known for its transaction speed. Currently electronic money is the fastest type of money, as most popular payment solutions are developed to facilitate electronic money. Cryptocurrency has the technical capabilities of being just as quick, but decentralised designs hinder the speed, as the network must facilitate high quantities of computations before a transaction can be completed. As CBDC are centrally designed, the speed would likely match electronic money.

Inclusive - *if the use of the money excludes certain demographics.*

Cash is very inclusive as everyone is familiar with the use of cash. Electronic money is less inclusive, as the payment system is riddled with fees to pay the many intermediaries, making it expensive to use in certain regions. Cryptocurrency excludes technology averse people, but offers new possibilities to include people who are excluded from the current monetary system. A CBDC would likely be very inclusive for the nationals of the country that issue the CBDC.

Anonymous - *if the money can be used anonymously.*

Cash can be used anonymously, as no third party is necessary to facilitate a payment. Electronic payments are not anonymous, as KYC (Know Your Customer) regulations require financial institutions to collect personal information on its customers. CBDC would likely not be anonymous. The anonymity of cryptocurrencies depends on the design, but some are characterized as privacy coins as they make it possible to hide the source, amount or destination from an outside observer.

Technology-dependent - *if the money is dependent on technology.*

Electronic money, CBDC and cryptocurrency all rely on technology. Cash relies less so on technology, and could serve a purpose in the case of prolonged system shutdowns.

Centralized - *if the design of the money is centralized or decentralized.*

Cash, electronic money and CBDC are all centrally designed, as several entities control the supply. Some cryptocurrencies, like Bitcoin are decentralised by design, as the supply of money is scarce, and trust in a third party like a bank is replaced by anonymous people who verify the accuracy and trustworthiness of the transaction.

Intermediary required - *if a third party is required to facilitate the transaction*

An intermediary is not required to perform a cash transaction, nor is it needed for permissionless cryptocurrency such as Bitcoin. A CBDC could be exchanged between a citizen and the central bank. Electronic money requires commercial banks are intermediates.

Trackable - *if the money can be tracked.*

Electronic money can be tracked to some extent, but has its limitations when it leaves certain jurisdictions. Cash is also hard to track, but each bank note contains a serial number that makes it possible to connect certain bills with certain crimes (RN16). Cryptocurrencies like Bitcoin can be tracked, as the transactions of the network are transparent. However, other cryptocurrencies are not designed as transparent, which makes tracking individual tokens impossible. The tracking of a CBDC would depend on the design as well as the cooperation with other national CBDC's.

Transaction cost - *if the money requires fees to use.*

Cash is feeless as a P2P (Person to Person) payment (RN5). Electronic money introduces several fees when using credits cards or wire transfers. Most cryptocurrencies require the user to pay a gas fee to successfully conduct a transaction (MN8). However, some cryptocurrencies like Nano are feeless. The fees of using a CBDC would depend on the design.

Relies on trust - *if the money relies on trust.*

Cash and electronic money relies on trust in a third party to conduct the transactions. Many cryptocurrencies are designed as trustless networks where the network cannot be altered or manipulated by a central authority without consensus of the public. CBDC could in theory utilize a trustless design, but that would be unlikely as governments want control.

Secure - *if using the money is safe to use.*

Cash and electronic money is generally secure to use, however the use of both can invite certain risks such as theft and robbery. CBDC's would likely be more secure, as it would require a higher degree authorization to access, such as NEMid or Two Factor Authentication. Cryptocurrencies are known for its cryptographic capabilities, and are by design often very secure. The networks can withstand attacks such as a 51% attack, where a group of miners try to control more than 50% of the networks' hash rate. However, the users are often the weak link as the use of cryptocurrencies requires technical expertise (MN9).

Intrinsic value - *if the money itself has value.*

All four types have no intrinsic value. Cash and electronic money is valuable because the central bank declares it so and society accepts it (SN14). The same is true regarding CBDC.

Cryptocurrencies are also digital and contain no clear intrinsic value. However, some argue its intrinsic value depends on its ability to create a trusted network.

Immutable - *the money is tamper proof.*

Cash is very hard to tamper with without it being noticed due to several security features. Electronic money can be tampered, but is subject to a lot of control mechanisms in the banking systems. CBDC and Cryptocurrencies can be designed to be immutable, meaning a smart contract can never be changed.

Self-enforcing - *they money is self-enforcing when all rules are met.*

This characteristic only applies to CBDC and cryptocurrency, as they both are a type of programmable money. Smart contracts can self-enforce if certain conditions are fulfilled and execute a piece of code.

Health risk - *if disease can be transmitted through the use of money.*

As cash is physical, the handling of it permits the transfer of disease, which could represent a possible health risk. As the remaining types of money are digital, this is not possible.

Characteristics of money				
	Cash	**Electronic money**	**CBDC**	**Cryptocurrency**
Functions of money (Mankiw, 2016)				
Medium of exchange	Yes	Yes	Yes	Yes
Store of value	Depreciates slowly	Depreciates slowly	Depends on design	Volatile, or depreciates slowly
Unit of account	Yes	Yes	Yes	Yes
Properties of money (Mankiw, 2016; VisualCapitalist, 2020; Weatherford, 1998)				
Fungible	Yes	Yes	Yes	Yes
Durable	Yes	Yes	Yes	Yes
Divisible	Yes, but predetermined values	Yes	Yes	Yes
Portable	Not as practical in rare cases	Yes	Yes	Yes
Cognizable	Yes	Yes	Yes	Hard to determine the value
Scarce	No	No	No	Depends on design
Acceptability	High	High	Depends on design	Low
Stability of value	Stable in general	Stable in general	Depends on design	Varies depending on the design
General characteristics				
Physical	Yes	No	No	No
Digital	No	It is a question of definition	Yes	Yes

Legal tender (Royal mint, 2020)	Can't pay taxes in some countries	Yes	Yes	No
Transparent (MC21)	No	No	Depends on design	Varies, but generally yes
Convenient (Söderberg, 2019)	In some situations	Yes	Depends on design	Depends on design
Speed (Söderberg, 2019)	Fast in general	Yes	Yes	Fast in general
Inclusive (MN7)	Yes	In general, yes	Depends on design	Depends
Anonymous (SN5)	Yes	No	No	In general, no
Technology-dependent (MN1)	No	Yes	Yes	Yes
Centralized (RN13)	Yes	Yes	Yes	Varies, but in general no
Intermediary required (MC2)	No	Yes	No	No
Trackable (RN17)	Yes	Yes, to some extent	Depends on design	In general, yes
Transaction cost (RN5)	Low	Depends, but generally high	Depends on design	Varies, but in general no
Relies on trust (Nakamoto, 2008)	Yes	Yes	Yes	Depends on design
Secure (MC16)	Yes	Yes	Yes	Yes
Intrinsic value (Mankiw, 2016)	No	No	No	No
Immutable	Not completely	Not completely	Depends on design	Yes
Self-enforcing	No	No	Depends on design	Yes

Health risk (Kampf et al., 2020)	Low, but possible	No	No	No

Table 2. This table shows the 31 identified different characteristics of money.

6.1.3 Summary of analysis: Part 1

To answer the research subquestion (1) "*How has money historically evolved and which characteristics does existing money have?"*, various data collection methods were utilized, including interviews, scientific articles and academic books. (1) The analysis outlined the history of money and the persisting characteristics of money. (2) Mankiw's (2016) definition of money was expanded as assets plus payment systems to fit contemporary types of money. (3) The different types of money were identified and a fitting model was constructed to describe their relationships. (4) The three main types of money identified were Commodity money, Fiat money and Programmable money. (5) 30 characteristics of money were identified and briefly discussed.

6.2 Analysis: Part 2

To answer the second problem subquestion (2) *What are the challenges in the current monetary system?"*, the subsequent codification of the data collected from the four interviews revealed several challenges regarding the current monetary system.

6.2.1 Monetary system inefficiencies and risks

Critics of the current monetary system view it as unfair and inefficient. Rasmus Nielsen of Gode Penge points out the whole system is based on debt created by the commercial banks. Today 95% of the money supply consists of electronic money. This money is created when commercial banks in the form of bank deposits issue loans (McLeay et al., 2014). Rasmus Nielsen believes the central bank's control of the money supply is being marginalized, as commercial banks to a great extent control their own credit policies (Nielsen, 2018; RN1). Money creation is a privilege that is far too important to be left in the hands of commercial banks, as they eye short-term profits over what is in the best interest of society (Gode Penge, 2020). He argues the creation of money by commercial banks is a source to rising housing prices, financial instability and rising

risks. The debt created by the issuance of loans are subject to different kinds of systemic risks such as liquidity risk and credit risk, that ultimately shifts to the consumer. For example if homeowners can't sell off their property in a illiquid market without a significant loss due to market conditions or when less well-off bank customers face higher credit risks which usually results in higher interest rates on loans. He further argues the financial system of today enables wealthy individuals or businesses to maintain or even expand their wealth, as it accommodates different types of advantages, such as low interest rates and easy access to loans, that can be used to buy up competitors (RN1 & RN2).

Morten Nielsen of Aryze also believes the current monetary system invites unnecessary risks: *“core money has become a part of very complex banking business that all have different risk parameters attached to it, of which we have absolutely no control.”* - Morten Nielsen (Aryze - MN16). He argues consumers do not care about commercial banks' money policies, because of government guaranteed deposit insurances such as "Indskydergaranti" that covers up to 750.000 kr. in Denmark, or the FDIC (Federal Deposit Insurance Corporation) deposit insurance in the US should the bank default. While he emphasizes this type of money insurance works well for consumers, he believes corporations face a high amount of risk, as business accounts are not government guaranteed in Denmark, and generally speaking not FDIC insured in the US. *“So that means that if the bank fails, you will lose your money”* - Morten Nielsen (Aryze - MN15). Especially in times of economic booms, credit risk becomes less of an issue. *“Every time there isn’t a crisis for 4 to 5 years, credit risk becomes less of an issue but then all the sudden it comes back to the forefront again”* (MN36). While Morten Nielsen believes it to be a systemic problem, some regions suffer the adverse effects of risk to a higher degree:

“So take that problem, and then multiply it by a factor of ten when you are in Hungary, where 95% of the population don’t trust the banking system at all, thinking its corrupt, inefficient and would rather have cash in the pocket than in a banking system.” - Morten Nielsen (Aryze - MN16). To compensate for the amount of risks, Rasmus Nielsen points to the massive amount of regulation that heavily contributes to the inefficiency of the monetary system (RN2). Mads Clemmensen of Danske bank calls attention to the number of intermediaries needed to settle a payment as a concrete inefficiency in the current banking system. He explains the high number of up to seven intermediaries needed to settle a transaction contributes to the complexity of the system, which adds to the overall level of risk (MC2). *“The more complex a transaction is, the*

bigger the risk of something going wrong along the way" - Mads Clemmensen (Danske Bank - MC4). In addition to the added risks, the number of intermediaries also increases the time it takes to complete the transfer (MC3), which can take up to a few bank days (Wells Fargo, 2020).

6.2.2 Transaction costs and financial inclusion

According to the respondents, one of the biggest challenges in the current monetary system is the high remittance fees when sending money across borders (MC9; SN20; MN1). These fees are caused by the many intermediaries a transaction must go through (MC3). The World Bank recently estimated that a global average of 6.67% of the amount transferred is absorbed by remittance fees. A number which amounts to roughly $48 billion per year. In poor regions like Sub-Saharan Africa, the remittance fees are as high as 8.71% (The World Bank, 2020a). Although the global average has decreased around 1% from 7.68% since 2015, it is still an active problem for the 800 million people who rely on remittances to get by. The global pandemic has only augmented the problem, as unemployment has risen dramatically since the outbreak of the COVID-19 virus, which has haltet the amount of remittances sent (Eurostat). Research shows half of the remittances flow to rural areas, where poverty and hunger are concentrated (UN, 2020). These enormous fees contribute to the reason why 1.7 billion unbanked people are excluded from the banking system, as they are not an asset to the commercial banks (Demirgüç-Kunt et al., 2018). *"If you have ten dollars of disposable income every month, you are not a bank client. They will not be able to make any money on you*" (MN30). To be able to send or receive money electronically, you have to be part of the banking system, which costs quite a bit of money (MN5). To put the costs into perspective, an average transfer of $40 for migrants in Niger cost the equivalent to a household's grain consumption of one month (Aker, 2018). In addition, banks require ID to create an account because of KYC anti money laundering requirements. However, this creates barriers for people in poor regions to join the financial system, as the cost of verifiable documents is disproportionally high, costing as much one week of average income for an unbanked person to obtain an ID card (Kiva, 2020).
Research has shown that banking the unbanked not only increases equality, but can grow GDP by up to 6% (MN7; ADB 2020). Other research has also stressed the incredible importance of having a bank account. It massively contributes to the overall quality of life, as people are more

likely to use other financial services, invest in education, personal health and weather financial shocks. (The World Bank, 2020b). Thus, the unavailability of financial services billions of people face, speaks to Rasmus Nielsens earlier point about the current system being unfair. Today, people with less money pay more for financial services, to which Morten Nielsen concurs as he argues the transfer of money should not be an extremely expensive activity just because it has become electronic (MN2). *"Poverty should not be something that prevents you from having at least very basic financial services"* (MN29).

While financial inclusion is not a problem in Denmark, as 99% of the danish public is part of the financial system(SN3), financial advisor Søren Nielsen at The National Bank of Denmark concurs it is a big problem in poor regions of the world. The challenge in Denmark is different and not as apparent. According to Morten Nielsen, intermediaries like Nets charge transactions fees of 0.2% when using credit cards. *"That doesn't sound like a lot, but when you add it up, it's actually millions that supermarked chains pay every year. That's one of the core issues"* (MN2).

6.2.3 High barriers to entry

Another challenge in the current monetary system is the high barrier to entry for new entrants to penetrate the money market (SN11). The market can be defined as a two sided market, as both a sender and receiver is needed to perform a transaction (SN11). Thus, to penetrate the market, newcomers must build a complete network to attract both sides of the market. Globally three corporations currently dominate the payment processing market: UnionPay, Visa and Mastercard (Nilson, 2020). According to Søren Nielsen, due to the extreme network effects that reside in the payment market, these corporations can much easier reach many customers, which in turn also solidify their power (SN11). Monopoly-like circumstances such as the payment market can be challenging, as economic theory and a plethora of real world examples has shown monopolies cannot control their desire to raise prices (SN23). To offset some of these effects, the payment market is heavily regulated to allow for new entrants to compete on a more equal footing (SN11). However regulation can also be a hindrance to start-ups, as you need to apply for money licences and prove the underlying technology is safe, which makes it an uphill struggle for start-ups that employ new and less proven distributed ledger technology (MN12).

6.2.4 Money laundering

As mentioned, cash usage has in many regions been declining steadily in the last decades due to digitalisation of the monetary system. However, several challenges in today's monetary system still exist, as shadow economy, theft, robbery and money laundering to a lesser extent than previously persists with the use of cash (SN4). However, today financial crime is largely a digital phenomenon (RN16, SN6). This has also meant criminals have adapted and thought of new and clever ways to launder electronic money. Electronic money laundering is a widespread problem, as it is easier to launder large sums in comparison to cash for several reasons. As pointed out, transferring electronic money can require many intermediaries, which can make it impossible to trace the flow of money. Criminals use numerous accounts to wire money to different accounts, making it impossible to follow the money trail as soon as it disappears into another jurisdiction (MN31). Unlike cash, where tracking individual notes is possible due to serial numbers that make each note unique, electronic money lacks equivalent properties (RN17).

6.2.5 Summary of analysis: Part 2

To answer the research subquestion “(2) *What are the challenges in the current monetary system?”*, data from the interviews were analysed. The analysis revealed several challenges regarding the current monetary system. 1) The capability of central banks to control the money supply is being marginalized, as commercial banks create money through the issuance of loans. Critics like Rasmus Nielsen argue commercial banks do not have the best interest of society at heart, as they focus on short-term profits. 2) The current financial system invites unnecessary risk, which ultimately shifts to the consumer. 3) A high number of intermediaries in the banking system creates complexity which adds to the risk and transfer speed. 4) The monetary system is unfair, as high remittance fees are most costly for the poorest. 5) Financial inclusion is low in certain regions, as being part of the financial system is costly in some regions. 6) High barriers to entry make it hard for new entrants to penetrate the money market. 7) Digital money laundering is increasingly difficult to track, partly due to the lack of technological consensus in the banking system.

6.3 Analysis: Part 3

To answer the third subquestion, (3) *“How can new types of money possibly address these challenges?”,* the subsequent codification of the data collected from the four interviews highlighted possible ways the previously identified challenges of the current monetary system could be addressed.

6.3.1 Addressing the challenges - CBDC

To address the challenge of central banks' marginalized control of the money supply, Rasmus Nielsen of Gode Penge suggests to reform the current monetary system by separating money creation and lending. The commercial banks would still be able to issue loans, but without adding to the money supply by doing so. For the National Bank of Denmark to regain control of the money supply, the creation of money should be monopolized under the control of the National Bank of Denmark and to include both physical and digital forms of money (Nielsen, 2020). This would ensure that a public and independent institution such as a Central Bank could control the money supply independently of political motives or commercial bank interest of profit maximization. "*I believe there are good reasons to have an independent Central Bank and to have the creation of money outside the hands of politicians*" - Rasmus Nielsen (Gode Penge, RN7). Furthermore, he suggests that each private citizen and business would be allocated an account at the National Bank of Denmark, which would be used to pay out salaries, public and social benefits and to collect debt and taxes. For this initiative to succeed, Rasmus Nielsen believes money created by the National Bank of Denmark should be the only legal tender, as it would reduce systemic risk by removing legal tender as a function of electronic money (Gode Penge, 2020), which would also ensure a high degree of acceptability.

“If governments started introducing CBDCs I think certainly a lot of people will adopt it quite willingly” - *Mads Clemmensen* (MC16). Furthermore, it would ensure private alternatives of money such as Libra cannot undermine the monopoly of money creation. A CBDC would counter intrusive private digital currency initiatives who pose a threat to the monetary system (MC24). Søren Nielsen of the National Bank of Denmark concurs: *“We have an interest in keeping the monetary system in hands of the nation, so that it doesn’t serve the purpose of*

foreign powers or profit optimization" - Søren Nielsen (SN9). To facilitate this massive reformation, Central Banks would have to issue either electronic fiat money or a CBDC. Rasmus Nielsen believes a CBDC could be used as a monetary solution to address the many challenges described. By creating a digital representation of money in form of a CBDC controlled by the central bank, the supply of money could be controlled by an independent body whose primary goal is to act in the best interest of society (Gode Penge, 2020), which would also increase the effectiveness of the monetary system and enhance the tools of monetary policy (Zhang, 2020). A CBDC would for instance make it possible to distribute money to citizens without the need of a third party such as commercial banks (RN5). Depending on the design of the CBDC, it could allow characteristics of programmable money such as immutability, self-enforcement and distribution to be utilized to secure and automate payment processes. CBDCs would strengthen the fight against corruption and money laundering, as it would be easier to trace transactions far more effectively by designing the CBDC to include a digital serial number (PwC, 2019). While the analysis of introducing a CBDC is viewed in the lens of the danish monetary system, the arguments could also be applied to other regions of the world. As mentioned, financial inclusivity is not a considerable challenge in Denmark as 99% of the public is part of the financial system(SN3), but poses a real problem in other regions of the world. Introducing a CBDC could be a way to bank the unbanked and increase financial inclusivity by enabling access to core financial services, in which transactions would be more efficient with a near instantaneous settlement at potentially drastically reduced transaction costs. Søren Nielsen concurs as he believes a CBDC could help address some of the challenges regarding cross border payments if it is designed as a european CBDC. On top of that it could allow governments to quickly distribute emergency funds in the case of a crisis (MC17).

6.3.2 Addressing the challenges - Aryze

Aryze is a financial platform that facilitates the movement of money across the world in a very efficient database structure at near-zero cost (MN26). To address the identified challenges, Aryze provides a type of private CBDC by using permissioned distributed ledger technology, which is a distributed database system (MN14;MN21). This means Aryze's tokens, called Ryze inherents programmable money characteristics such as *self-enforcing and immutable* which is utilized to create a safer and smarter type of money. For instance can two persons create a

digital contract that self-enforces once certain agreed upon conditions are fulfilled. Because of the underlying technology, data in the ledger can be trusted to not be manipulated as it cannot be edited, unless accessed by a strict and independent third party only used for special cases like court orders (MN33).

By using a full-reserve banking system, each outstanding Aryze token is backed up by accounts at Central Banks around the world (MN37), which ensures there is no credit risk associated with the tokens. The solution is then to leverage the tokens to create financial services (MN23).

Because of the design, Aryze are able to follow every single transaction which can alleviate money laundering issues and help authorities. *"For every 100 hash dealers in Copenhagen there will always be just one or two exit points to the dealing network. If we see a significant concentration of money coming into a single place, we will know that and we can then follow the money back to say where it originates from. In other words, if someone in Greece or Ukraine receives a thousand transactions a week from different sources in Europe we will know and see it. We will be able to track it and red light it and report to the authorities."* - Morten Nielsen (MN32). Morten Nielsen believes there is a clear demand for programmable money, but in order for Ryze tokens to achieve acceptability they must command strong network effects by attracting users, or else they will have developed an innovative service that no one uses (MN20). To do this they are using a B2B2C business model, by creating alliances with branch organizations such as ISOBRO, who represent fundraising organizations such as Red Cross, Doctors Without Borders and UNICEF or global corporations such as Maersk. Following this strategy will make it easier for Aryze to offer their services to the unbanked of the world and increase financial inclusion. Unlike banks, Aryze uses a matrix approach where the less money a person holds and the less transactions the person conducts, the less Aryze needs to know about the person in terms of KYC documentation, which reduces the barriers to join the platform. *"if you are a Philippine sailor that works for Maersk, then we have a KYC process where Maersk can onboard you as part of their network for salary payments."* - Morten Nielsen (MN45). Because the amount of money the sailor would remit back home would be relatively low, KYC regulations are not as strict. As the volume of transactions grows, additional information will be required in a combination of national IDs and biometrics. The costs of an international money transfer using the Aryze network is near-zero, as they charge less than 1% (MN24), which is considerable less than the global average of 6.67%. Opposite existing and

possibly future systems, the Aryze platform removes the need for intermediaries as the same network is run across the world regardless of which currency is used to deposit (MN43). *"I think that not even in the Nordics we would ever agree which platform to use for a digital currency."* - Morten Nielsen (MN46).

6.3.3 Summary of analysis: Part 3

To answer the third subquestion, (3) *"How can new types of money possibly address these challenges?"* The analysis highlighted two possible solutions to how the previously identified challenges of the current monetary system could be addressed.

The first solution suggests reforming the current monetary system by separating money creation and lending. By allocating the responsibility of money creation to the Central Bank, the monetary supply can be controlled with the introduction of a CBDC. A CBDC could increase the effectiveness of the monetary system and make it possible to distribute and collect money without the use of intermediaries. Furthermore, a CBDC could introduce characteristics of programmable money such as anti-money laundering properties of money, in the form of serial numbers, enhanced security and automation processes.

The second solution is developed by the start-up Aryze who provides a private type of CBDC.

By providing a full-reserve banking system, they are able to minimize risks as each token is backed by central bank money. The underlying technology makes it possible to track transactions, making it easier to detect illicit activities. Furthermore, Aryze has created alliances with strategic partners to onboard users and increase the network effects. Additionally Aryze is able to help bank the unbanked by offering lenient identification requirements and near-zero transaction fees.

6.4 What is the future of money?

The future of money is uncertain, but lessons learned from history and the understanding of current trends and projects can deduce a probable direction for future money. The history of money showed authorities such as kings or states play a central role in the development of money and that convenience as a characteristic proved to be of utmost importance for its success as a medium of exchange.

Current trends suggest that cash usage is declining as a result of more convenient options. Søren Nielsen agrees cash usage will continue to decline in the future, but won't disappear in the foreseeable future as cash still plays a role for mainly elder demographics as a store of value, in gift giving or as allowance (SN18). Mads Clemmensen somewhat concurs, as he argues cash could be too impractical to use in a relatively near future and we eventually will change into a cashless society. *"I think ultimately it might solve itself, because people will eventually adapt or the old generation will die off"* - Mads Clemmensen (MC10). Morten Nielsen believes payment methods will change (MN41). On the road to becoming fully cashless, he is sure blockchain technology will play a huge role in the financial industry, as financial services will become cloud based SaaS (Software as a Service) that can be accessed by using digital platforms to apply for loans, mortgages or to invest (MN40).
Clemmensen concurs as he argues we will be better at making user-friendly digital ways to spend and manage your money (MC11). However, current analogue payment systems of the commercial banks won't disappear in the next 10-20 years (MN28). *"We can't just dismiss banks the way they are and the infrastructure that they have created over the last hundred years"* - Morten Nielsen (MN28). Clemmensen argues CBDCs will likely be implemented in the future as it will give central banks greater monetary control (MC15). Morten Nielsen predicts CBDCs will happen in a limited edition, which will be used to pay out salaries and social services but not in the form of central bank digital currency that is available for businesses (MC39). While Søren Nielsen does not believe it is necessary to implement a CBDC in Denmark at the moment, he is sure CBDCs will be happening in some capacity in the near future, maybe in a european version (SN19; SN20).

Morten Nielsen believes a centralised platform such as Aryze will disrupt the future monetary system, as he finds it unlikely that countries or commercial banks can agree to use the same technology (MN44). *"Is it going to be American technology, is it going to be Chinese technology? Let them fight that for the next 25 years and meanwhile we create a platform that is supported tomorrow"* - Morten Nielsen (MN44). Clemmensen agrees that for commercial banks to cooperate and create a new and more efficient payment network with less intermediaries would be a very difficult undertaking (MC7). *"It takes years to get a bunch of banks to agree on anything especially when we are talking on a global scale where we suddenly have hundreds of*

different legal jurisdictions" - Mads Clemmensen (MC8). Søren Nielsen does not see mass adoption of cryptocurrencies happen, as he points to issues such as exchange rates and price volatility (SN21). However, he predicts programmable money to play a bigger role in the future monetary system, as it can make payment processes more agile (SN22). Rasmus Nielsen predicts future payment solutions will be integrated into existing banking systems, and also find it unlikely that decentralized cryptocurrencies such as Bitcoin will succeed to reach mass adoption (RN13). He believes we are at the forefront of a currency war between the US and China, where states will make alliances with private platforms like Facebook or Alipay to supply and distribute CBDCs via their centralised networks (RN11). All four respondents believe the future monetary system to be less complex and more inclusive at a global scale.

7.0 Discussion

7.1 Challenges concerning new types of money

One potential problem all four respondents mentioned was the risk of bank runs if a CBDC was to be introduced (SN2; MC14; RN6; MN38). If a crisis is underway, households and businesses could potentially in a rush of desperation shift their bank deposits into a risk-free CBDC. *"It's like when the country closes because of Corona and everybody runs to the store to buy toilet paper even though they are told it will also be available on the shelves the next day. People nevertheless buy three extra packages"* - Søren Nielsen (SN2). A bank run without a CBDC would take time as people would have to line up at an ATM, whereas with a CBDC it could happen much faster as the transfer would be instantaneous. This would not only be a problem for the commercial banks, but for society as a whole as people would lose confidence in the financial system, which could result in damaging economic consequences.

Another second potential problem could be if the public stores money at the central bank, commercial banks would have less deposit funding, meaning they would have less ability to provide credit and lending to the economy (MC14; RN14). If the central bank would facilitate a lot of the transactions in place of commercial banks, commercial banks would earn less revenue on profit and would have to find new revenue paths to be able to offer the same financial services (MC14).

In the case of central banks monopolizing the creation of money, critics believe a centralized approach would result in increased state surveillance. While this might be the case, Rasmus Nielsen would rather be monitored by a state than a private entity (Gode Penge, 2020). Søren Nielsen rejects the idea that the creation of money should be monopolized to central banks. He argues the current system is tried and tested and works well, as commercial banks are experts at calculating credit ratings and providing financial services (SN13).

A fourth concern mentioned is a phenomenon known as dollarization. If citizens of a nation start to use a foreign CBDC as a medium of exchange because of attractive characteristics such as low transaction costs, high convenience and high acceptability it could become an issue as it undermines the nations own currency (SN8).

As mentioned the money market is two sided, which could pose a problem for Aryze if they are not able to attract enough users to their platform. One of roadblocks according to Morten Nielsen is the amount regulatory hurdles needed to be surpassed to integrate to the existing banking infrastructure. *"If you decide to live in Connecticut and you want to move money to an analogue bank account of your family member in Florida, we need to be able to facilitate that transaction. And that requires integration into the banking world"*. - Morten Nielsen (MN27).

7.2 Which characteristics should define future money?

A flawless digital currency is probably an unattainable idea, but some of the identified characteristics could improve the utilities in the design of future programmable money. Below follows a suggestion of which characteristics an ideal currency should possess.

First of all, a great currency should possess the traditional functions of money, ***medium of exchange****,* ***unit of account*** *and* ***imperfect store of value***. The value of the currency should decline slowly over time, as it affects the economy negatively if money does not circulate fast because people are less inclined to use it in the hopes of its value appreciating. It should be ***fungible*** so some tokens do not have a lower perceived value than others, it should be ***durable*** which in a digital setting would involve a safe and ***secure*** IT infrastructure and design. It should be ***divisible*** and easy to send (***portable****)*. ***Cognizable*** to make it easy to perceive value and globally ***accepted*** as payment. In an ideal world, it could also be used globally to pay off taxes and debt *(****legal tender****),* although highly unlikely. It should be ***convenient*** and ***fast*** to use.

Furthermore the currency should be easily accessible via digital user friendly platforms void of intermediaries and cost near-zero to use (***Inclusive****, **no or few intermediaries** required* and ***low transaction cost***). The currency should also be ***trackable***, to allow government authorities to stop illicit activities. Additionally the currency should have inherent characteristics of programmable money (***Immutable, self-enforcing****)* if technically possible to allow for technical flexibility. Lastly, it should be digital and thus pose ***no health risk***. Characteristics such as *anonymity*, *trust*, *transparency* and *centralization* is a question of ideology and could be both argued as essentiel or needless.

8.0 Reflection

The purpose of this thesis was to explore the future of money in three steps. The first step was to summarize the history of money in order to extract lessons learned from the past. As countless books and articles have been written about the subject, the information was easily accessible. The characteristics of money were identified throughout the whole thesis process by reading literature and from performing interviews. The data from the interviews was an effective way to extract hyped up characteristics such as inclusiveness and anonymity. The second step was to analyse the challenges in the current monetary system. Interview guides were created on the basis of the literature review, and evolved over time as data was collected and analysed, which allowed the ongoing process to focus on the most relevant issues and solutions. The third step created coherence between the three steps, as it analysed and evaluated how new types of money, in the form of CBDC and Aryze, and which characteristics identified from step one could address the challenges identified in step two. Lastly the future of money was assessed on the basis of all three steps to answer the main research question.

8.1 Trustworthiness of research

In contrast to quantitative research, it can be difficult to test for validity and reliability when using methods that are qualitative of nature. Quality criterias utilized for quantitative research such as objectivity, reliability, generalizability and validity are not fitting to judge the quality of qualitative research. As a replacement, it is recommended to carry out an examination of trustworthiness

when performing qualitative research, in order to establish that the findings can be trusted (Lincoln & Guba, 1985; Seale, 1999; Korstjens & Moser, 2017). Trustworthiness is categorized into four subcategories: *Credibility*, *Transferability*, *Dependability* and *Confirmability*.

8.1.1 Credibility

The credibility of the thesis is high, as primary data was collected from reputable experts that represent different money market actors. To achieve method triangulation, a clear option could be to combine the primary interview data, the secondary data in the shape of researched scientific articles and statistics with primary survey data to obtain a both deep and broad range of data. A survey could have allowed for more respondents to evaluate money characteristics, which could lead to a higher credibility. Had more than a single researcher codified and analyzed the data, the investigator triangulation would also have been stronger. Lastly, if the respondents had taken part in the analysis phase by feeding back data, interpretations and conclusions it could have strengthened the data if it was confirmed from where it was originally extracted, which ultimately would have increased the credibility of the thesis.

8.1.2 Transferability

The transferability of the findings are average as a single phenomenon was explored which makes it difficult to apply the findings to other topics. However, individual parts of the analysis such as Part 1 and Part 2 could be used as a starting point in other research areas to explore certain characteristics or existing challenges in more depth.

8.1.3 Dependability

The dependability is strong, as academic standards were followed to the best of my ability. All collected data is accounted for in the appendix and the use of references was frequently used. I believe it is likely similar conclusions would be found following the same research process if the data was extracted from the same sources. To test this, I could have asked a qualitative researcher to review and examine my research process as well as the data analysis in depth to ensure my findings could be repeated. Other experts might have different opinions or experiences which could lead to different conclusions. This is one of the risks you must accept when utilizing qualitative methods.

8.1.4 Confirmability

The confirmability of the findings is found to be decent. While there is an obvious bias from each individual interview as the respondents represent different market actors and the research revolves around the future, the four different respondents were selected to increase the neutrality of the findings.

8.2 Beneficiaries

The beneficiaries of this study on the future of money could be both fintech start-ups and regulators. Fintech start-ups could use the findings from this study as a starting point when building new money-related products or services. Regulators could gain a deeper understanding of the current status of digital money, which technologies, trends and market actors are driving the transformation of money, as well as which characteristics of money are worth special consideration in the design of future money.

8.3 Limitations

The identified challenges in the current monetary system varies greatly from region to region. These challenges are in some regions immense, where in others are of no real concern. As such it is difficult to assess and conclude the full extent of the problem from a global perspective and thus makes it hard to generalize the findings. Furthermore, the challenges could be elaborated in much more detail if the research was designed to focus on both local and global challenges. Another limitation is the use of inductive reasoning, as a conclusion can be invalidated, but never proven. As specified by Fusch & Ness (2015), failure to reach data saturation impacts the quality of research and hampers the validity of the content. To achieve higher data saturation I would have had to collect data from many more money market actors or add additional sources of relevant and reliable secondary data.

8.4 Future research

As this thesis is very much analysed from a macrosociological perspective, it could be fascinating to explore how the individual is affected by new types of money, especially in

countries where the public relies on remittances. Another possibility would be to explore other new types of money that could solve the identified challenges.

9.0 Conclusion

The purpose of the thesis was to explore *The Future of Money* as well as the three research sub questions from both a danish and international perspective.

The first part of the empirical analysis regarded the history of money and the existing characteristics of money. Here, it was found that the money has evolved over time to conform to societal needs. Furthermore certain characteristics of money such as convenience and central authority was found to be an important influence in the widespread use of different types of money. Secondly, Mankiw's (2016) definition of money was expanded to as assets plus payment systems to fit contemporary types of money. Thirdly, a model to illustrate the different types of money was developed. Lastly, 30 characteristics of money were found and analysed in the context of four different types of currencies: cash, electronic money, CBDC and cryptocurrencies.

The second part of the empirical analysis identified the challenges in the current monetary system. The analysis found seven different challenges existing in the current monetary system: 1) The marginalization of central bank's ability to control the money supply, 2) Systemic risks, 3) High number of intermediaries, 4) Unfairness, 5) Low financial inclusion in some regions, 6) High barriers to entry in the money market, 7) Digital money laundering.

The third part examined how new types of money could address the seven challenges in the shape of a publicly issued CBDC and the danish start-up company Aryze and its platform. Several empirically based suggestions were proposed such as the separation of money creation and lending, allocating full control of the creation of money to the central bank via a CBDC, which would increase system effectiveness, fairness, inclusion, security, automation, tracking and distribution. The Aryze solution was found to be able to reduce systemic risks by introducing a full reserve banking system that drastically increases financial inclusion via reduced KYC processes and near-zero fees. Furthermore, the platform was found to be able to detect illicit activities.

Lastly, The Future of Money was analysed and discussed. Cash will continue to decline until society eventually becomes cashless in 10-20 years. Blockchain technology and programmable money will play a larger role in the future monetary system. CBDCs will likely be implemented in the near future, which will grant central banks more control of the money supply - however not in Denmark for the foreseeable future. Centralized platforms such as Facebook or Alipay will be used in cooperation with states to distribute digital forms of money in efficient ways. Money will in the future be less complex and more inclusive at a global scale.

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