Department of *Political Science*

Master's Degree in International Relations, *major* Global Studies

Chair of Global Trade

The rise of digital money and the changing relationship between the private and public sectors

SUPERVISOR:

Prof. Franco Passacantando

CO-SUPERVISOR:

Prof.ssa Cristina Alaimo

CANDIDATE:

Carola Macagno

641472

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INTRODUCTION

A revolution is taking place in the financial system: innovations have not only led to extraordinary advances in the traditional payment services already widely used in our economies, but also to the emergence of new payment instruments[1]. As it happens for every novelty, many questions are surrounding the world of digital currencies. A heated debate on crypto-assets and stablecoins has triggered another one, aimed at considering the opportunity and the risks of central banks to issue their own digital currency, the Central Bank Digital Currency.
This topic, still unresolved in many respects, raises a number of questions: what will happen in the near future to our currencies? If central banks opt - as I am led to believe - to issue their own digital currency, what will happen to the payment instruments issued by the private sector? In other words, will there be cooperation or competition?

To arrive at a potential answer to these queries, I began with the very foundations. The first chapter opens with a historical description of money: with the aim of arriving at the latest evolution - linked to digitization - the main stages of its history are outlined, analyzing the changes that have taken place over the centuries and the three functions it has today. Attention is also given to the evolution of the relationship between the public and private sectors, that is, between commercial and central banks. Finally, the last section is devoted to the different types of electronic and digital money: although the terms are often used indistinctly, there are differences - which cannot be overlooked, given the subject under examination. In this last part, therefore, I analyze the different typologies[2].

The second chapter examines the impact of digital transformation on the financial system. Over the years, the use of cash has been decreasing, proving to be less and less suitable for payments in a digital age. Moreover, in the last two years, the pandemic has determined the acceleration of these trends. Covid-19 has been instrumental in that, by forcing citizens to use more frequently these alternative payment instruments to physical cash (at times when restrictions prevented people from

[1] First, it is important to provide some definitions that may be useful throughout the research:
The term payment instruments refers to all non-cash instruments (cards, credit transfers, direct debits and e-money) with which end users of payment systems transfer funds between accounts at banks or other financial institutions. (Definition provided by the ECB).
Currency, on the other hand, represents the portion of the national money supply, consisting of banknotes, paper money, and government-issued coins, that does not require endorsement in serving as a medium of exchange. (Definition provided by Britannica).

[2] Although my research does not intend to include the analysis of crypto-assets, as this is a topic that is increasingly talked about in the last period, I thought it was important to provide a brief analysis of the phenomenon, highlighting its main characteristics, the extent to which it is expanding, and the risks associated with it.

going to stores and therefore using cash), it has made them more aware of their practicality. Specifically, the chapter provides a view of what has happened worldwide and in the Euro-area, distinguishing the two periods (pre- and post-Covid). Then, the main positive aspects related to the expansion of digital payments are listed, with a focus on financial inclusion and lower costs. I also wanted to devote special attention to a case study, that of Satispay, a mobile payment platform that can be used by anyone with a bank account. The desire to mention and publicize this solution is a personal one, as it was created just a few kilometers from my hometown. Finally, the last section is dedicated to the consequences that digital payments may have on the current banking system since this is not immune to technological progress.

The third and fourth chapters are specular and represent the last fundamental step to get a well-rounded vision of the analyzed topic: they present, respectively, the two initiatives of the private sector and the central banks, namely stablecoin and CBDC. If in the third chapter there is an insight into Big Tech in the financial sector, the one dedicated to CBDC presents a brief overview of the main initiatives, with a focus on the Bahamas and Sweden. The archipelagic State launched its own digital currency, the Sand Dollar, in October 2020. Sweden, on the other hand, although still in the pilot phase of the e-Krona project, is significant for the strong decrease in the use of cash. In both chapters there is a detailed analysis of the main features and typologies. Making some comparisons between them, I have then analyzed the main advantages and disadvantages and concluded looking at their possible uses and implications in the financial system.

The fifth chapter is the conclusive one, which aims at providing an answer to the question at the base of this research. In order to postulate the probable future of money and the international monetary system, the chapter is divided into two parts: the first one deals with the more technical aspect, to understand the evolution of the relationships between private companies and central banks. Although competition seemed to be the prevailing scenario initially, there are many factors that suggest cooperation will occur in the future. In the second part, instead, I focused on China, Europe, and the United States. China is certainly ahead of the US and the EU in this field: this could have significant consequences, possibly changing the long-standing equilibrium in the international monetary system. However, these are hypotheses, still far from being realized: it is even difficult to imagine that the Chinese renminbi could overcome the primacy of the dollar.
Timing is crucial: if some countries lag behind others - or decide not to go ahead - the first-mover could have advantages and its currency could even establish itself in the markets of other countries. Obviously, however, this is a relatively new theme in which there are few confirmations and many

doubts. If the need for the financial system to adapt to the digital transformation is certain, the future of currency is still unclear.

CHAPTER 1

THE EVOLUTION OF MONEY: FROM BARTER TO DIGITAL CURRENCY

> *"Tutto ciò che è oggetto di scambio deve essere in qualche modo commensurabile. A questo scopo è stata inventata la moneta, che è divenuta una sorta di termine medio, dato che misura tutto.*
> *Misura sia l'eccesso sia il difetto e quindi anche quante scarpe siano uguali a una casa o a del cibo; quindi, è necessario che, come un architetto sta a un calzolaio, così questa precisa quantità di scarpe stia a una casa o a una certa quantità di cibo; se non vi è commensurabilità, non si possono avere né scambio né associazione. ... perciò la moneta è diventata un sostituto del bisogno per accordo comune e per questo ha il nome di moneta, perché non è per natura ma per convenzione e dipende da noi modificarla o porla fuori corso..."*
>
> (Aristotele, Etica Nicomachea, V, 1133)

In history, the introduction of money has allowed people to free themselves from any obligation linked to the exchange of a good or service, in the exact moment in which it is accepted. This is because money finalizes the agreement, becoming the property of whoever receives it and therefore ascertaining that the exchange has taken place. Over the years, as economies have become more and more complex, money has allowed for the more efficient allocation of goods and services in space and time. The technological changes that have occurred over the centuries have meant that some payment instruments and currencies, previously widely used, were replaced by new ones. Generally, at the basis of the transition from one monetary phase to the other, there is the problem of excessive rigidity of the form of money spread at that time. While on the one hand the demand for institutional change and innovation accumulates gradually, supply responds in a discontinuous manner. Thus, regime changes have usually occurred during periods of deflationary drifts and subsequent to crises,

which serve as catalysts to overcome the resistance of those benefiting from the status quo[3]. Certainly, however, technological evolution is not the only factor: people are only willing to accept a piece of paper, coins or electronic bits if they are aware that at any time in the future, another person will accept them. It is therefore fundamental that a currency preserves value over time, in order for it to be accepted and exchanged: the trust of citizens in monetary stability is an essential element for currency to be effectively considered a store of value and to be widely used as a form of payment in the economy. A second important requirement for acceptance is the financial stability[4] of the issuer, i.e., the actual availability of money. Although nowadays this is a remote possibility, in the past it was concrete: any payment with a cheque from a failed bank at the time of a collection was not accepted.

In the wake of increasing technological maturity and financial innovation, new payment systems and digital currencies issued by the private sector are rapidly spreading throughout the world. In addition, the Covid-19 pandemic has played a key role in highlighting the practicality of these new payment methods, particularly with respect to the distancing policies implemented by many - if not all - States. In this chapter, I will first analyze currency, briefly tracing its history and highlighting its main functions. Then I will focus on the relationship between the private and public sectors throughout the ages, analyzing the evolution of the relationship between commercial and central banks. Finally, I will point out the various typologies of digital and electronic money: the intention is to analyze the main features of e-money, cryptocurrencies, stablecoins and CBDCs, comparing them with each other.

1.1 WHY DO WE USE MONEY?

Currency is attributed by law the power to extinguish the obligation of the payer towards the creditor: for this reason, today, we talk about 'legal money'. In this regard, it is peculiar to notice that in ancient Greece, to indicate currency they used the word νόμισμα (nomisma), which derives from νόμος

[3] Passacantando F., "Central banks as 'Producers of confidence'. Curzio Giannini's contribution to the theory of central banking"- paper prepared for the conference entitled "Money and Monetary Institutions after the crisis", Banca d'Italia, Rome, December 2013

[4] According to the definition provided by the ECB, financial stability is the *"condition in which the financial system – which comprises financial intermediaries, markets and market infrastructures – is capable of withstanding shocks and the unravelling of financial imbalances".*
https://www.ecb.europa.eu/pub/financial-stability/html/index.en.html

(nomos), custom, habit, law. Going through the history of money means going through the evolution of the first financial instrument able to be accepted and recognized by the masses, attracting and conveying their trust first towards metals, then towards financial institutions and markets.
In ancient times, the first communities gave life to a system of exchanges - mostly bilateral - which was based on the method of barter. This model consisted of the exchange of different products between two or more parties according to the advantage that each good could bring to the other party; it took the name of the natural economy[5]. For the natural economy to be successful, three conditions were required: first, there must be a simultaneous need for the respective goods by the two parties, the so called "double coincidence of wants"; second, the presence of sufficient quantities of commodities to make the exchange; and third, the ability to equate the values of two different goods[6]. As communities developed, barter became an increasingly inefficient tool: parties were often forced to make long journeys and onerous transfers of goods in order to find an opportunity to carry out barter. In addition, not all goods could be transported and stored for long periods of time. Moreover, given the impossibility of attributing an objective value to goods, negotiations were often long and difficult. Thus, the need to find a means of payment capable of facilitating the exchange of increasingly complex realities began to spread among humans.

The first forms of currency were constituted by particular goods, such as salt, livestock, ivory, and metals - hence the name commodity money; they were goods with some characteristics in common: even if rare, they were available in sufficient quantities, they kept their value in time and were appreciated and recognized by everybody as valuable goods. Precious metals - in the form of ingots, nuggets, or powder - quickly became popular because they met the requirements listed above and, thanks to their small size, were easy to transport and store. A drawback, however, was the fact that whoever received the payment had to have a weight scale.
This disadvantage was overcome with the minting of precious metal coins: it was the Kings, Emperors and the Lords who produced their own coins; indeed, their face was generally impressed on one of the two sides. This marked the passage from commodity to representative currency[7]. Worldwide, a

[5] The natural economy is opposed to the monetary economy. According to the Enciclopedia Treccani, the first one is characterized by the self-consumption of the producers, by barter and, eventually, by the direct appropriation of a share of the products by who has some coercive power on the producers. Monetary economy is characterized by exchanges of currency against goods and vice versa, that is by purchases and sales, and it's just the systematic and continuous exchanges of this type that constitute the markets, where the contracting parties, at least at the time of bargaining, are free to buy or sell. https://www.treccani.it/enciclopedia/mercato_%28Enciclopedia-del-Novecento%29/

[6] Gallico G., "Dai metalli alle criptovalute: breve storia della moneta", Parentesi Storiche, March 2019

[7] https://www.ecb.europa.eu/explainers/tell-me-more/html/what_is_money.it.html

multitude of currencies were used at the same time. It was the minting - the image and the writings impressed on the metal - that represented the guarantee seal of the State (or better, of the Lord): this allowed the currency to be accepted as a means of payment, without having to be weighed or verified. The State, in turn, was paid for this service by retaining part of the gold that was brought to them in exchange for the coins - what is called the right of seigniorage[8]. The fact that the State centralized on itself the power to mint the coins implied that it was committed to guaranteeing the value. In this context, it is important to mention that the value of the coin must be universally recognized. There are two elements that allow this: intrinsic value and trust. The intrinsic value corresponds to the amount of precious metal used to mint the coin, and this correspondence acted as a guarantee for the counterparts of the exchange. The trust, instead, consists of the positive expectation that the value of the metal contained in the coin (intrinsic value) is equal to the value attributed to the coin itself by the market (nominal value, or extrinsic value). Until the Middle Ages, the monetary model was based on the monometallic system: coins were composed of a single metal, such as gold, silver, or copper. In this way, intrinsic value and nominal value were perfectly equivalent; trust, on the other side, was ensured by the fact that it was the State itself that minted the currency. During the early Middle Ages, instead, the institutions responsible for minting began to produce coins by mixing together precious metals. With this passage to the bimetallic system, the progressive detachment between intrinsic value and nominal value of the currency took place. The exchange rate depended on the amount of gold present in the individual coins: often Kings or Lords would reduce the amount of gold in the coins they issued, in order to extract more seigniorage profits to finance wars or other expenses. A problem with this system, however, was the difficulty in measuring the amount of gold in the currency: the reputation of the issuer, therefore, played a key role in certifying its value. The bimetallic system entered into crisis during the late Middle Ages, due to several factors, including the difficulties in extracting sufficient precious metals and the high costs associated with the transport of large quantities of currency[9]. If, under normal conditions, seigniorage represented a modest contribution to State finances, on many other occasions it was abused: States that could not cover their expenses made up for it by producing many coins containing only a part of the precious metal previously contained. Adding to the old coins, the number of coins in circulation increased: the same did not

[8] https://www.bancaditalia.it/compiti/emissione-euro/signoraggio/index.html?com.dotmarketing.htmlpage.language=102

[9] Gallico G., "Dai metalli alle criptovalute: breve storia della moneta", Parentesi Storiche, March 2019

happen to the goods on the market. This led, within a short time, to the loss of value of the coins - inflation occurred[10].

The next evolution is represented by banknotes. Paper money was born from the need for practicality, dictated by commercial development. The first banknotes, called "*note di banco*"[11], were made in the 14th century: first goldsmiths, and then bankers began to issue deposit receipts on paper in exchange for the gold coins that merchants gave them in custody. The paper money consisted of a document that guaranteed the right of the holder to withdraw this quantity of gold at any time. The nominal value was therefore equal to the intrinsic value of the precious metal deposited; the banknote, once issued, was freely exchanged and accepted according to the nominal value indicated on it. This system eliminated the costs of transporting coins, as it was sufficient to carry the documents issued by the banker and give them to his correspondent to obtain the precious metal. With the subsequent step, namely the creation of banknotes, a simple conventional sign that freed mankind from the need to produce large quantities of gold and silver, the potential for extracting a seigniorage profit also expanded; the reasons were on the one hand the minimal cost of production, and, on the other, the possibility of imposing an arbitrarily high value on paper banknotes. Since there were significant cases of abuse, after a complex institutional evolution, it was affirmed that the issuing of money should be done by institutions independent from governments, first by private banks, then by central banks. When issuance was assigned to private banks, they had to meet numerous obligations, including ensuring the convertibility of their notes into gold or silver at a rate set by law.

In addition, convertibility fostered the emergence of an international monetary system based on common rules. From the 18th century onwards, this resulted in the birth of the Gold Standard, a system that was initially adopted in the United Kingdom and later by other major world nations. Every country had to fix its currency in terms of units of gold and they were tied together by a system of fixed exchange rates: it was no longer possible to proceed with the printing of new money if not adequately covered by gold reserves. The relative quantity of gold between two currencies in the system was known as the parity. The growth of the economy was thus limited by the availability of gold resources and the Gold Standard system went into crisis at the beginning of the 20th century, showing all its limits during the First World War. In this period, it was realized that the convertibility

[10] It must be specified, however, that inflation does not arise because the coins have a lower gold content, but because they are issued in excessive quantity compared to the production of goods.
https://www.bancaditalia.it/compiti/emissione-euro/signoraggio/index.html?com.dotmarketing.htmlpage.language=102

[11] This Italian expression was used to define the receipt that first goldsmith and then banks issued when people gave them gold. Its name comes from the fact that it was generally signed on the goldsmith's desk.

obligation, conceived to guarantee the value of money, entailed strong risks for economic stability, because it imposed, in times of crisis, heavy monetary restrictions that exacerbated the crisis itself, rather than alleviating it[12]. The decline of the Gold Standard lasted for about thirty years: 1931 was the date that officially marked the end of the Gold Standard: from that moment, banknotes became a form of 'fiat money'. In 1944 - while the war was not yet over - 44 nations decided to meet in Bretton Woods[13], to create a new monetary order, the Gold Exchange Standard. The system - known as the par value system - was based on a scheme of fixed exchange rates between currencies, all pegged to the U.S. dollar, which was the only currency in turn guaranteed in terms of gold content. The commitment was to indicate the par value, namely the value at which the currency was going to be exchanged for dollar, and to maintain it within 1% on either side. Even this system, however, soon went into crisis. In order for the internationally held stocks of dollars to grow, the U.S. had to incur balance of payments deficits. Inevitably, U.S. official foreign liabilities had to exceed the growth of the country's gold reserves. As a result of economic difficulties, the US found itself no longer able to guarantee the convertibility of their currency in the precious metal and, because of pressing demands of conversion, it was forced to declare in 1971 the dollar inconvertible in gold. This fact is known as Triffin's dilemma[14]. Breaking the link between gold and the dollar destroyed a key component of the Bretton Woods Agreement; this decision marked the end of the monetary system linked to the value of gold reserves, giving to the trust in the markets, and in the national economies, a decisive role in pricing the value of a currency.

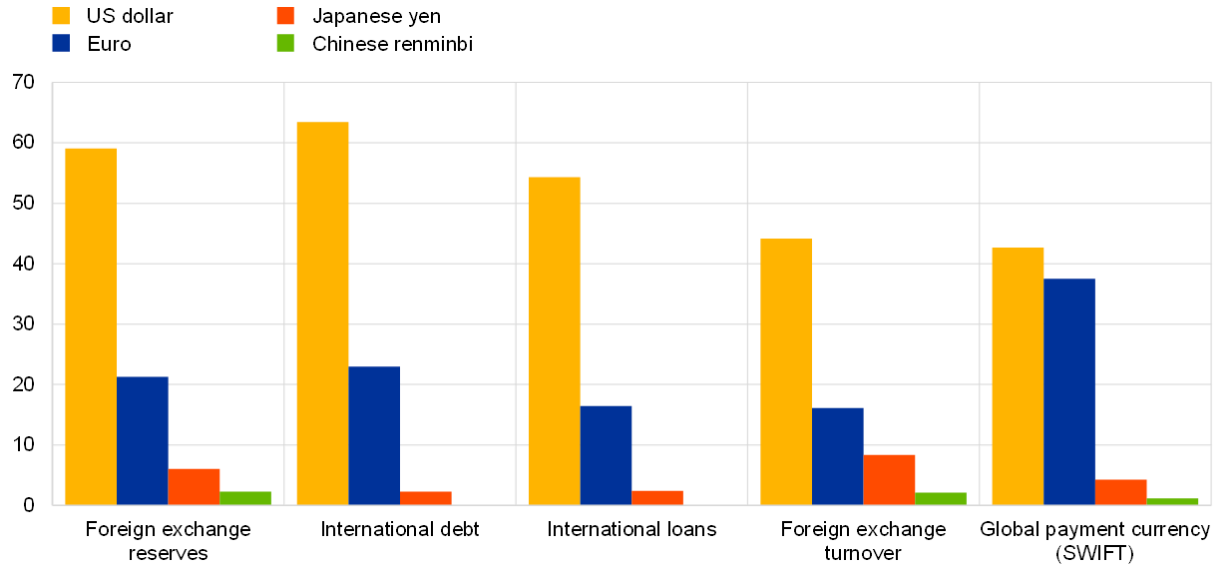
The system that came out of the monetary crisis of 1971, which is defined as floating exchange rates, still exists today: the value of a currency depends on the economies of the issuing States and on the trust that the market places in them. We have therefore reached the complete dematerialization of currency. According to United Nations, currently, there are 180 currencies worldwide.

[12] See note 7

[13] Conference of Bretton Woods: on July 1, 1944, delegates from 44 nations met at the secluded Mount Washington Hotel in Bretton Woods, New Hampshire to participate in what became known as the Bretton Woods Conference. This conference gave birth to the International Bank for Reconstruction and Development (IBRD) and the International Monetary Fund (IMF).

[14] Elimination of the US balance of payments deficits could create a global liquidity shortage. But if he United States did provide an unlimited supply of dollars, lubricating growth and trade, confidence in its commitment to convert them into gold would be eroded

Figure 1. Snapshot of the international monetary system



Source: 20th annual review of the international role of the euro, published by the ECB

According to the European Central Bank - which every year researches the international role of the euro - the dollar is the most important currency in the international monetary system, followed by the euro.

With digitization, we have witnessed a further development with the creation in 2009 of cryptocurrencies - a digital currency, completely decentralized and based on cryptography to complete transactions and produce money. Compared to traditional currencies, they do not have any kind of underlying economy: their value is due exclusively to the trust that the market reserves towards this instrument which, as I will analyze at the end of this chapter, is subject to extraordinary fluctuations.

In conclusion, the history of currency tells the evolution of an instrument that was initially tangible and quantifiable, then perfected to adapt to economic development and the changing needs of those who use it. Being a tool that adapts to times and needs, taking different forms, it is difficult to foresee its future; the only certainty remains the role of trust as the backbone of the monetary system. Currency will resist as a means of payment only as long as there is trust in markets, institutions, and currency itself.

The functions of money

Money is indispensable to the functioning of an economic system. Since it puts in relation different individuals, cultures and societies, products and services, ways of counting, and languages, it is an element of aggregation.

Moreover, it performs three fundamental economic functions: it can function as a unit of account, as a means of payment, and as a store of value. Each of these three roles has arisen to address a different economic challenge. The first function is unit of account: money provides a common measure of the value of exchanged goods and services. It is therefore the benchmark for comparing the value of very different products uniformly. Knowing the value or price of a good allows both the supplier and the buyer of the good to make decisions about how much of the good to supply and how much of the good to purchase. In a certain sense, it is like a common language.

The second one - means of payment - is undoubtedly the primary function that comes to mind when talking about money, which has become the medium of exchange to facilitate transitions. Without currency, all transactions would have to be conducted through barter, the oldest form of trade, which consists of the *"direct exchange of goods or services, without an intervening medium of exchange or money"*.[15] As I have already mentioned above[16], however, there were some problems behind barter, which could be overcome only thanks to the introduction of money, that serves as a means of payment accepted in all transactions.

As for the third function, namely that of store of value, to perform the function of means of payment, money must maintain its value over time. Indeed, money can transfer purchasing power from one period to another. Money is not the only store of value, nor is it the most efficient because it depreciates with inflation[17]. However, money issued by the central bank is more liquid than other stores of value because it is a legal tender, according to the law it must be accepted everywhere in the country of issue. This feature allows everyone to save money, i.e. defer consumption, and set aside a reserve for unforeseen expenses and future needs. This necessity arose from the fundamental inability of economic agents to coordinate and engage in future value transfers. A clear example can demonstrate this: a farmer, who must compensate employees for their labor, may not assure workers

[15] Definition provided by Britannica: https://www.britannica.com/topic/barter-trade

[16] See page 12

[17] Currency depreciation is a fall in the value of a currency in terms of its exchange rate versus other currencies. This implies that if prices increase from period x to period x+1, the amount of money needed to purchase a good in period x would not be sufficient to purchase the same good in period x+1.

of a share of the product after they have done their work; instead, paying them in money while they work would still allow them to purchase the products at a future date. Though, workers will only be incentivized to work if they believe that the money will retain its value in the future.

1.2 PUBLIC AND PRIVATE MONEY: THE DIVISION OF LABOR BETWEEN CENTRAL BANKS AND COMMERCIAL BANKS

Scholars have long debated whether money should be produced, transferred, and preserved in a State monopoly regime or whether it should be the result of a competitive market system, supervised and regulated by the State. Those who support the first solution believe that a single entity - the State - allows for uniformity and stability of the currency and minimization of transaction costs. Those who sustain the second option, on the other hand, believe that a currency produced under a monopoly creates distorted incentives for the issuer: the latter, taking advantage of its position, could decide to devalue its value in order to increase seigniorage profits; furthermore, in favor of the competitive market constituted by many issuers, they argue that information spreads more efficiently and that issuers are better able to know and assess the demand for currency by households and businesses; finally, according to them, regulation and public supervision are able to eliminate or correct the distortions and negative externalities that can occur in such a market[18].

For centuries banks have issued banknotes in a competitive environment. After having been the competence of the State, indeed, the power to issue money passed into the hands of private banks and then into those of central banks: this happened when it became clear that in periods of crisis, governments facing budget deficits ordered the creation of money; thus, the importance of entrusting this task to an independent institution was born. So, a slow evolution has led to the current situation, in which in each country there is only one central bank, that can be defined as the *"public institution that manages the currency of a country or group of countries and controls the money supply – literally, the amount of money in circulation"*[19]. To use the words of Italian historian and academic Carlo Cipolla, *"the origins of banking are lost in the mists of time. Not so those of central banks. Their history is condensed into the last three centuries of the modern-contemporary age. For all of them, it is possible to establish a precise date of birth"*[20].

[18] R. De Bonis, "La verità, vi prego, sulla moneta digitale di Banca Centrale", Nuova Antologia, 2020

[19] Definition provided by the ECB: https://www.ecb.europa.eu/explainers/tell-me/html/what-is-a-central-bank.en.html

[20] https://www.bancaditalia.it/chi-siamo/storia/index.html

"The basic thesis is that central banks are neither an historical accident, the fruit of changing political interests, nor the inevitable product of the instability and incompleteness of credit contracts, nor even a means of guaranteeing the price stability of money as a 'good'. The 'central bank' is the outcome of a gradual institutional evolution, the rationale of which resides in money's distinctive features compared with the other goods and services produced in the economic circuit."[21]

The fact that a precise date can be set for each central bank, however, must not be misleading. In fact, the Central Bank was not born as a complete and defined institution but is a body that developed over time progressively acquiring new and increasingly complex functions, tasks and physiognomy. In particular, in many cases, central banks were born from the transformation of a commercial bank, sometimes through a process of merger between several banks. It happened that a State invested in a "leading" bank to assume the nature of a central bank. Because of this past history as a commercial bank, for several years central banks continued to collect deposits and offer loans to the public. The Bank of Italy, for instance, although established in 1893, maintained its relationship with the public until 1936. Today, however, thanks to the establishment of the division of labor between central and commercial banks, this is no longer possible; on the contrary, it has become the main factor differentiating them from one another.

Today, central banks perform many tasks: first and foremost, they issue two forms of money, central bank reserves (only used by banks to make transactions) and circulating money (banknotes and coins); in addition, they often ensure that payment systems for banks and traded financial instruments function properly, they handle foreign reserves and inform the public about the overall economy. One of the main tools of any central bank is setting interest rates - the "cost of money" - as part of its monetary policy. Acting as a bank for commercial banks, it influences the flow of money and credit into the economy to achieve stable prices - one of its primary objectives. Finally, a central bank can act as a "lender of last resort," helping to keep the financial system stable. Commercial banks issue a third type of currency, bank account deposits. They have a direct link to the public: an individual or business can open an account and apply for a loan.

[21] Giannini, C., The Age of Central Banks, Edward Elgar, 2011, p. 3

The evolution of central banks

The origin and evolution of central banks cannot leave out of consideration the history of money: it must be interpreted as a response to a fundamental need, that of generating confidence in monetary instruments which, in the course of history, have progressively lost any direct or indirect relationship with an object of intrinsic value. As I analyzed above, there have been several transitions from one monetary phase to another, generally caused by the excessive rigidity of the form of money prevailing at the time.

Following the periodization suggested by Giannini in his book *"The Age of Central Banks"*, it is possible to identify three clear phases in the evolution of central banks, and a fourth, which is emerging. They mirror the evolution of payment technologies, analyzed in the first section of the chapter. The first phase coincides with the introduction of convertible banknotes, which appeared around the 18th century. At that time, central banks were mainly private institutions, in some cases in competition with each other. Often at that time, in times of war as well as peace, the risk of exception issuance materialized, forcing governments to suspend convertibility. To manage the problem of the collapse of confidence, many countries decided to create a central monopoly lack, introducing legislation to limit discretion in the management of paper money.

The second phase is marked by the development of bank money: it was introduced with the aim of overcoming the rigidities and restrictions of convertible banknotes. In the 19th and 20th centuries, there were frequent bank panics which revealed first the fragility of the technology based on convertible currency and then that of bank money. It became apparent that the ability to convert deposits into currency at a fixed predetermined value would make the system vulnerable to bank runs. At that time, first in the United States, attempts were made to develop voluntary and cooperative mechanisms to manage crises, relying on clearinghouses. However, these mechanisms proved ineffective in resolving financial crises. For the same reason listed above, i.e. to strengthen confidence in the system, the role of central banks was strengthened, transforming them from private to public institutions. New legislation was introduced to authorize them to act as lenders of last resort and in many cases to assign them responsibility for banking supervision.

Finally, the third phrase can be traced back to the 1970s, the time when the Gold Exchange Standard was definitively abandoned, and fiat money was developed. From that moment on, money that no longer had any gold link became widespread: this maximized the flexibility of money creation; during this period, central banks extended their course to open market operations. However, this increased

flexibility also had negative repercussions, namely the occurrence of possible abuses in the creation of money, arising from pressures to cover government expenditures or from those components of society that could take advantage of it. It is well known that there are two factors on which confidence in the current payment technology is based: first, that there is the stability of the value of the monetary instrument over time; second, that the credit risk associated with the bank deposit is minimized. Once again, central banks have had to address the challenge posed by the "need for confidence". In particular, it has been necessary to redefine their role with respect to the objectives of price and financial stability and strengthen the independence they must enjoy in pursuing them, within a system of institutional checks and balances. Many were concerned that a monetary system that lost its gold peg or a fixed exchange rate to a currency pegged to gold would be a serious threat to price stability. Indeed, this happened in the 1970s and 1980s, pushing most central banks to establish specific targets, firstly in terms of monetary aggregates that were thought to have a stable relationship with inflation, and subsequently in terms of inflation itself. This period also witnessed the definitive nationalization of central banks in most countries and the introduction of legislation enshrining the principle of the independence of central banks.

With the emergence of new forms of currency, produced by the private sector, we have undoubtedly entered a new phase of money. Likewise, this could mark the beginning of a fourth phase in the evolution of central banking, with a new wave of potentially far-reaching institutional reforms. Before analyzing the fourth, I will briefly list what the past institutional developments have been.

The first institutional step saw the increased engagement of central banks in interbank payments, to mitigate systemic risk. In other words, when bank money[22] is used - for example, a check - the exchange lags behind the settlement of the underlying obligation, which occurs only when the balance is actually transferred between accounts. In this interval, there are several risks, such as the possibility that the counterparty does not have sufficient funds or that its bank has defaulted. In the 1980s and 1990s, this became a priority for central banks, and their action has undoubtedly been successful.

The second development led to the emergence of a new function, the supervision of payment systems - a new and distinct, albeit connected to banking oversight. Thanks to new technologies, every payment can be settled instantly, a property that only commodity money or legal tender has. Some components of the banking industry resisted this, as they feared a loss of revenue or new competitive threats. Oversight of payment systems was developed to ensure that the new risks associated with the

[22] Payment by bank money is different from that by commodity money or banknotes: while the latter is an act that ends at the very moment it is executed, the former is a process consisting of several steps - including the exchange of documents certifying the buyer's obligation to pay, possibly the offsetting of payments of opposite sign and the final settlement in monetary base by the central bank.

use of technologies would be properly managed. In most countries, central bank action was supported by the introduction of new laws to contain the risk of abuse, fraud, or new forms of crime.

Finally, due to the increasing integration of financial markets, greater international cooperation has been established; this can be seen as the third institutional step. Standards and principles of "cooperative supervision" and common procedures for monitoring their implementation have been established. The highest degree of cooperation between central banks concerns foreign wholesale transactions, which are characterized by high settlement risk. A privately managed Continuous Linked Settlement (CLS) system has been created, overseen by what could be considered the most global college of central bank supervisors, with the Fed serving as the primary supervisor.

The fourth institutional development - caused by the growth of private currencies - could be even larger, since it could alter the monetary architecture. The risk is that a parallel payment system could develop, threatening the pyramid structure of payment systems[23] operated and regulated by central banks. For this reason, several years ago, Giannini gave the name 'pyramid under siege' to this phenomenon. Although riskier than those issued by the central bank, the new currencies could be very successful because they are more profitable.

> *"For if the central bank is not perceived by citizens as having a comparative advantage in generating trust such as to justify the greater costliness of the money it produces vis-à-vis alternative instruments, the very notion of central banking is impossible."*[24]

In conclusion, what is certain is that the financial system always needs to enjoy the trust of citizens. Every step in the evolution of central banks, in fact, goes towards this need: their ability is undoubtedly influenced by the controversial relationship they have always had with governments: on the one hand, this is the ultimate source of power and legitimacy, which allows the central bank to generate trust; at the same time, however, trust in the action of central banks depends on their autonomy from the powerful executive power and pressure groups that could take advantage of inflation or devaluation. Balancing these two needs has always been an important factor, enabling central banks to be confidence producers.

[23] Since the 1930s, the payment system can be effectively depicted in the form of a pyramid: at the base is the general public of consumers and firms; at a higher level is a set of specialized intermediaries, such as brokers and dealers, who operate in the monetary, financial and primary goods markets as intermediaries between buyers and sellers of goods. At the upper level there are interbank transfers, in which there can be three types of payment mechanisms. Finally, in all countries the function of settlement agent has been assumed by the central bank, which is at the top of the pyramid. For further information consult "Giannini, C., The Age of Central Banks, Edward Elgar, 2011", p. 265

[24] Giannini, C., The Age of Central Banks, Edward Elgar, 2011, p. 303

"The central bank produces an intangible but essential good- trust- of which capitalism (based as it is on a pyramid of paper if not merely electronic signals) has an immense need. We must not forget that trust, or its synonym 'confidence' derives from the Latin fides, meaning faith, which cannot be produced simply by contract. In fact, the legitimacy of central banks does not lie in their policy activism, or their ability to generate income or even, save in a very indirect sense, their efficiency. Rather ... it derives from competence, moderation, the long run approach, and the refusal to take on any tasks beyond their primary role. If, as I am sure, there is to be another phase in the development of central banking, it will spring from these values."[25]

1.3 TOWARDS A NEW PHASE OF MONEY: CLASSIFYING DIFFERENT TYPES OF DIGITAL AND ELECTRONIC MONEY

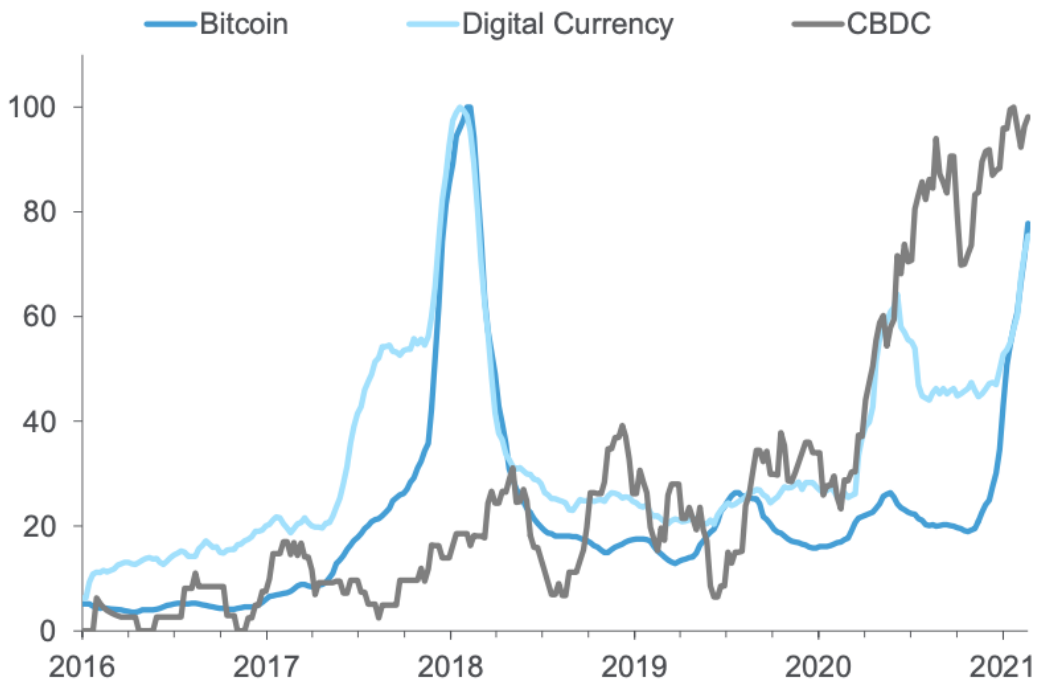
Though in everyday life digital money and electronic money are often used interchangeably - mainly to describe everything that is in a non-physical form - they are not the same thing. Nowadays, in the financial system, most of the money is in intangible, electronic, or digital format: this implies that it is fundamental to understand the difference, first of all, between digital and electronic money. Electronic money is simpler: it is *"linked to fiat, account-based, centralized, and permissioned"*[26]. Alipay and PayPal are well-known examples of e-money. By contrast, the term digital currency refers to any currency that is available exclusively in electronic form: it is *"tokenized and not account-based, it can be based on a centralized database or blockchain, and its value can be linked to fiat currency or set by supply and demand"*[27]. Central bank digital currencies, stablecoins, and cryptocurrencies are examples of digital currency.

[25] Giannini, C., The Age of Central Banks, Edward Elgar, 2011, p. 304

[26] Citi GPS, "Future of money. Crypto, CBDCs and 21st Century Cash", April 2021

[27] See note above (26)

Figure 2. Google Search Interest Over Time



Source: Google Trends
Notes: Interest over time represents search interest worldwide relative to the highest point on the chart for the given region and time. A value of 100 is the peak popularity for the term.

In this figure, we can see how global interest - and thus online made research - on "bitcoin", "digital currency", and "central bank digital currency" changed from 2016 to 2021. Specifically, while research for the terms "bitcoin" and "digital currency" experienced a spike as early as 2017 and 2018, interest in central bank initiatives has only increased in the last year. Indeed, while it is true that central banks have been investigating the topic for a while now, the tipping point came after Facebook announced its Libra project in the summer of 2019[28].

In this section, I will first analyze electronic money more in-depth; then, I will focus on digital money, highlighting the major distinctions between cryptocurrencies, stablecoins, and CBDCs[29].

[28] Serrate J.S., "Digital currencies, la nuova sfida delle banche centrali", Istituto per gli Studi di Politica Internazionale (ISPI), January 2021

[29] In this section, I will focus the analysis more on electronic money and cryptocurrencies, since there will be two chapters dedicated entirely to stablecoins and CBDCs.

1.3.1 E-MONEY

E-money - which stands for electronic money - is broadly defined as *"an electronic store of monetary value on a technical device that may be widely used for making payments to entities other than the e-money issuer"*[30]. Electronic money products can be either based on hardware or software, depending on the technology used to store the monetary value. In the first case, e-money is stored in a physical device, such as in the chip of a card. Monetary values are typically transferred via device readers that do not need real-time network connectivity to a remote server. On the other hand, software-based products employ specialized software that runs on common personal devices, such as personal computers or tablets. In this case, the personal device typically needs to establish an online connection with a remote server that controls the use of purchasing power. Moreover, some schemes combine both hardware and software features.

Analyzing the characteristics of electronic money, just like physical paper money, it has the main functions of store of value, medium of exchange and unit of account. The main feature is that the issuer is obliged to convert it into bank money at the request of the holder; to ensure that this happens, the issuer must have on its balance sheet a quantity of very liquid assets (meaning rapidly convertible into bank money, without loss of value) at least equal to the e-money it has issued. An example, widely used in Italy, are prepaid cards, on which we transfer funds by handing cash to the intermediary or moving them from one of our current accounts. E-money can be issued by banks, Post Offices and Electronic Money Institutions (ELMI)[31]. In Europe, ELMIs are subject to forms of regulation and supervision. However, the money they issue is not covered by insurance similar to that which exists for bank deposits; furthermore, they do not have access to central bank reserves and, therefore, the latter does not act as lender of last resort for them[32].

As I have already mentioned previously, all these electronic records are centralized - i.e., they are physically stored within the computer memory (or servers) of banks, the Post Office, central banks (for central bank reserves), and ELMIs. These subjects not only create these forms of currency but also store and transfer them.

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[30] https://www.ecb.europa.eu/stats/money_credit_banking/electronic_money/html/index.en.html

[31] According to the European Central Bank, Electronic Money Institution (ELMI) is *"a term used in EU legislation to designate credit institutions which are governed by a simplified regulatory regime because their activity is limited to the issuance of electronic money and the provision of financial and non-financial services closely related to the issuance of electronic money"*. https://www.ecb.europa.eu/services/glossary/html/act7e.en.html

[32] R. De Bonis, "La verità, vi prego, sulla moneta digitale di Banca Centrale", Nuova Antologia, 2020, p. 27

Electronic money has several advantages for the overall economy. Firstly, greater flexibility and convenience: transactions can be carried out from anywhere in the world, at any time, extremely easily. Thanks to electronic money the problems associated with the physical delivery of payments are eliminated. Moreover, payment by e-money takes place in a way that brings with it a type of instantaneousness that has not been experienced before in the economy: transactions can be completed in fractions of a second. Another reason why the use of electronic money is becoming increasingly popular is the storage of every transaction made. This makes it easier to track payments and also helps in making detailed spending reports, budgets, and so on. As a result, it increases security and helps prevent fraudulent activities and malpractices. Finally, it leads to a greater sense of security: to prevent the loss of personal information, often during online transactions strict verification measures are employed to ensure the full authenticity of the transaction.

At the same time, however, e-money has some disadvantages: first, to use this method of payment, some infrastructure is required - such as a computer or laptop, or a smartphone - and a stable internet connection. Also, the internet always brings with it the inevitability of possible security breaches and hacks. Sensitive personal information can be leaked, leading to fraud and money laundering. Online scams can easily be set up: by pretending to be a certain organization or bank, fraudsters can easily convince consumers to give their bank or credit card information. Despite the increase in security and the presence of authentication measures to combat online scams, they are still something to watch out for.

1.3.2 CRYPTOCURRENCY

For many years now, the payment system has become more and more electronic: a further technological-institutional step has occurred, with the advent of cryptocurrencies. Since 2009, the role cryptocurrencies play in society has changed greatly: they have gone from being little known - mostly niche technological curiosities - to rapidly spreading financial instruments that have become the subject of widespread public interest. Though there is no universal definition, the ECB Crypto-Assets Task Force[33] defined a crypto-asset as *"a new type of asset recorded in digital form and enabled by the use of cryptography that is not and does not represent a financial claim on, or a*

[33] The ECB began exploring crypto-asset trends back in 2011, publishing a first report in 2012 and a second in 2015. In light of the recent increase in market interest, in 2018 the ECB established the Internal Crypto-Assets Task Force (ICA-TF), to develop a common understanding of crypto-assets and assess their potential impact on some of its key areas of responsibility.

liability of, any identifiable entity"[34]. What differentiates them from other payment technologies is the lack of an underlying credit, making them highly volatile and speculative.

Starting with the analysis of the name itself, if we break down the word cryptocurrency, we see how the first part, 'crypto', means 'hidden' or 'secret' and reflects the secure technology used to record who owns what, and to make payments between users. The second part, however, tells us that they were invented with the intent of being electronic cash. Though, they are very different in the sense that there is no central bank nor government responsible for producing them or intervening in case of problems.

Typically, these electronic payment systems use public ledgers, which allow individuals to establish an account with an alias (known to the entire network) and an access code (known only to the account holder). When two parties agree to transfer cryptocurrency, the transaction takes place. Simply put, for those using this system, it works similar to payment authorization on any website that requires the individual to enter a username and password. Cryptocurrency platforms often use blockchain technology to validate changes to ledgers. Blockchain technology uses cryptographic protocols to prevent invalid alterations or manipulations of the public ledger: each time a change needs to be made, a member must validate the transaction, and a digital signature is used to do so. This allows even unknown people to make trades, as they trust the platform and its cryptographic protocols. In general, there are limits to the total amount of currency in the system: this is set by the creators of the cryptocurrency in order to create scarcity and thus maintain its value. People can also buy cryptocurrencies using official government-backed currencies or other cryptocurrencies.

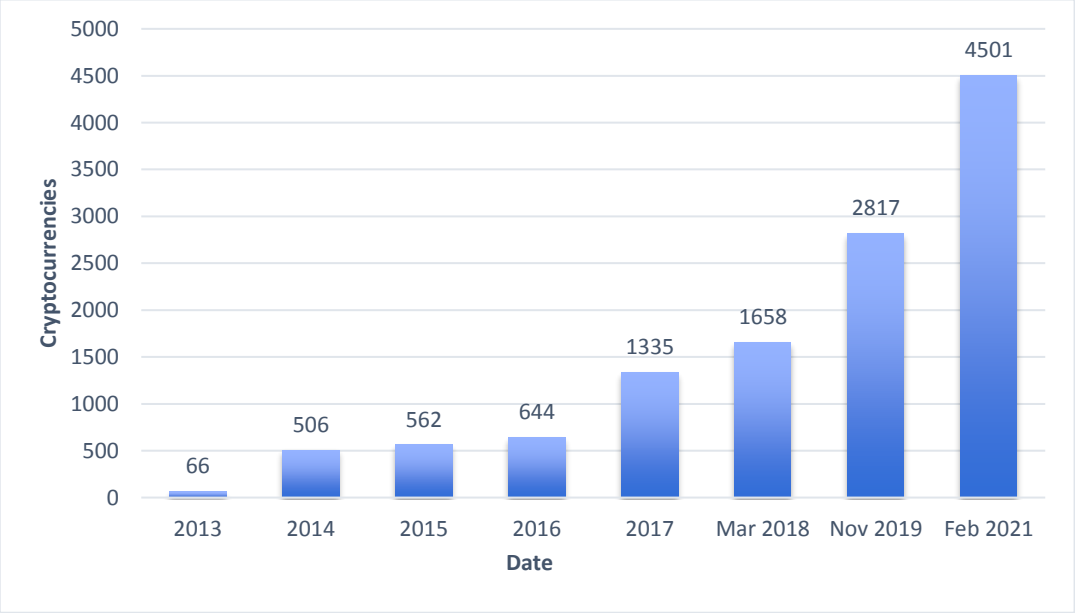
As it can be seen from the definition, when talking about cryptocurrencies, some argue that, in reality, it would be correct to call them crypto-assets as they are not able to perform the three traditional functions of money at the same time: medium of exchange, store of value and unit of account. Several features of cryptocurrencies undermine their ability to serve these three functions; technically, the role of medium of exchange is a rather trivial requirement: any asset - whether digital or physical - can be one, if it is purchased by someone for the purpose of later reselling it in exchange for another asset. In this regard, cryptocurrencies can fulfill this role. On the other hand, the problem arises when you want to see if an asset is a widely accepted medium of exchange: in this regard, digital currencies have a long way to go, particularly when compared to national currencies. Currently, a relatively small number of companies or individuals use or accept cryptocurrencies for payment. Often, most cryptocurrency purchases are made to later be held as an investment, rather than as payment for goods

[34] https://www.ecb.europa.eu/paym/intro/mip-online/2019/html/1906_crypto_assets.en.html

or services. Additionally, unlike currencies issued by central banks, cryptocurrencies are not legal tender, meaning that creditors are not legally required to accept them to settle debts. Another issue lies in trust: consumers and businesses may also be hesitant to place their trust in a decentralized computer network of pseudonymous participants; conversely, there is little motivation for them to be reluctant towards traditional payment methods. Moreover, the price volatility of cryptocurrencies suggests that they perform poorly as a unit of account and store of value. The term "price volatility" is used to describe the price fluctuations of a commodity and it is measured by the day-to-day percentage difference in the price of the commodity[35]. Volatility in the financial market refers to changes in the price of an asset.

According to a research conducted by Citi GPS, the number of cryptocurrencies available worldwide has increased significantly from 2013. At the beginning of 2021, there were over 4,000 privately issued cryptocurrencies: as the graph clearly shows, there has been a very strong rise over the past 8 years.

Figure 3. Quantity of cryptocurrencies worldwide from 2013 to 2021



Source: Author's calculation based on Statista data

However, not all cryptocurrencies in the world have a significant weight: in fact, it is estimated that the top 20 cryptocurrencies make up almost 90 percent of the total market. including Ethereum,

[35] https://www.eia.gov/naturalgas/weekly/archivenew_ngwu/2003/10_23/Volatility%2010-22-03.htm

Litecoin, and Ripple. However, Bitcoin, whose market share exceeds 50 percent, is the most famous one. Its birth dates back to late 2008, two months after the bankruptcy of Lehman Brothers. Bitcoin uses a system for electronic transactions in which the offering of new units and the validation of transfers of ownership of existing units is completely decentralized, without providing for any central server or authority.

Bitcoin

> *"A purely peer-to-peer version of electronic cash would allow online payments to be sent directly from one party to another without going through a financial institution. Digital signatures provide part of the solution, but the main benefits are lost if a trusted third party is still required to prevent double-spending. We propose a solution to the double-spending problem using a peer-to-peer network."*[36]
>
> *(Nakamoto, 2008)*

Bitcoin is the first cryptocurrency to be created and still the best known: it was created in 2008 by an unknown computer programmer - or a group - under the pseudonym Satoshi Nakamoto. Bitcoin is not a central bank liability, like cash in circulation; in addition, it is not legal tender, meaning that the State does not oblige to accept it in transactions and for debt repayment. As for other cryptocurrencies, there are no controls or guarantees by a central institute: it is accepted on a voluntary basis. The fact that it is not a monetary substitute, makes it different from the e-money. Whereas for legal money, trust is placed in the banks (the central one and the commercial ones), in this case, we refer to the cryptographic system, managed by individuals ideally placed on an equal footing.

The system works through the interaction between users: everyone can send bitcoins to another person who has a Bitcoin network address; complete anonymity is guaranteed because it is a simple combination of letters and numbers. A blockchain - a technology consisting of a decentralized ledger technology (DLT) - is used to transfer and validate the transfer of ownership of Bitcoin. There is a decentralized database that stores information about every transaction. When a payment is made via Bitcoin, it happens immediately; however, to be sure, you have to wait for the so-called "evidence". As a result, the payment can take anywhere from 10 minutes to 1 hour - which means it is slower than

[36] Nakamoto. S., "Bitcoin: A Peer-to-Peer Electronic Cash System", 2019

transactions in centralized electronic money systems where it only takes a few seconds. The person who receives bitcoins at his address does not need a program of internet connection-wallet[37]. On the contrary, it is necessary for the payer. Furthermore, there are users, called *miners*, who gather in certain places called "*mining pool*"[38], who are tasked with solving a cryptographic problem related to a block, so as to approve the transaction in question. This mining activity is about solving a complex mathematical problem related to a block of transactions, geared towards adding the transaction to the blockchain itself.

There is an inflexible algorithmic limitation of bitcoin issuance rate: in other words, the total number of bitcoins at any given time is limited. The algorithm was established by the person who devised this system and provides for slowing down the rate of issuance. The supply is regulated not by the trend in demand, but by this algorithm, that sets the quantity of new units to be introduced as a function of the passage of time: the total amount of bitcoins will not exceed 21 million. Their value, instead, is regulated by the demand and supply and it is always expressed in terms of traditional currencies.

Table 1. The number of bitcoins in circulation

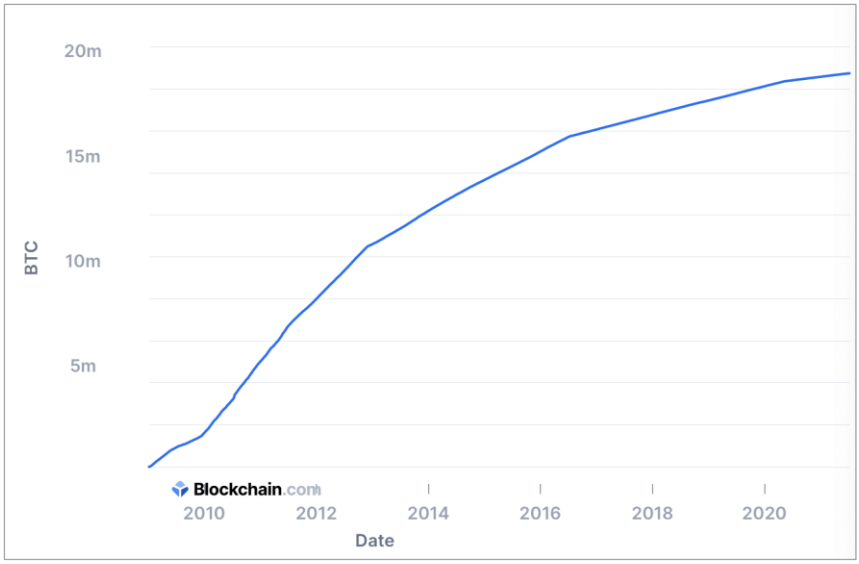
Data	Number of Bitcoin in circulation	Growth rate for year %
Jan. 2016	14.44 million	+ 10%
Jan. 2017	15.75 million	+ 9.1%
Jan. 2018	16.41 million	+ 4.2%
Jan. 2019	17.06 million	+ 4.0%
Jan. 2020	18.37 million	+ 3.9%
Jan. 2021	18.70 million	+ 3.7%

Source: Author's calculation based on data found in A. V. Vlasov, "The ecolution of e-money", European Research Studies Volume XX, Issue 1, 2017

[37] The purpose of the wallet is primarily to store the user's private keys-which allow spending balances associated with the corresponding addresses. The actual bitcoin balances are stored in the blockchain which is constantly updated by the bitcoin network even when the user is offline. In turn, the wallet, updates itself when the user is online, validating all the blocks that occurred while being offline.

[38] *"A mining pool is a group of miners who share their computing power over a network and get rewarded based on the amount of power each contributes as opposed to whether or not the pool finds a block".* Definition provided by https://www.blockchain.com/pools

Figure 4. Total circulating bitcoins from 2009 to 2021

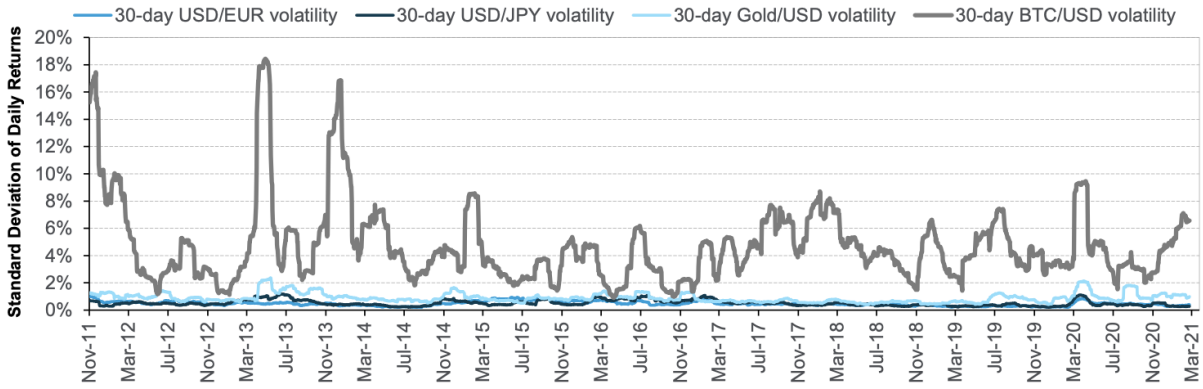


Source: Blockchain.com
https://www.blockchain.com/charts/total-bitcoins

Both the table and graph show how the number of bitcoins is increasing over time, though at a decreasing rate. Once 10.5 million units were reached, the issuance rate decreased by half; after 15,750,000 were issued, the rate decreased by two times, and so on.

An additional factor that must always be taken into account when talking about cryptocurrencies and therefore bitcoin is volatility.

Figure 5. Volatility of Bitcoin vs Gold vs Fiat Currency



Source: Citi GPS: Global Perspective & Solutions, "Future of money. Crypto, CBDCs and 21st Century Cash", April 2021

According to some research conducted by Citigroup, the average volatility of Bitcoin (in dollar terms) is about 5%, compared to that of major currencies (USD/EUR, USD/JPY) which is 0.5%, and gold, which is at 1%. In this regard, it is worthy to mention that although these is no liability of any issuer, Bitcoin is often likened to a commodity like gold; even the term miners - mentioned above - is reminiscent of gold miners. However, there is a clear distinction between the two in terms of volatility. Despite the high volatility - which makes it unattractive as a unit of account, as a medium of exchange, and a very risky store of value - Bitcoin is the first crypto-assets to become legal tender in a country. In this regard, it is worth mentioning what happened recently: on September 7th, 2021, in El Salvador, Bitcoin became legal tender alongside the dollar, the national currency. This is the first and only (so far) country to have made this choice: according to President Nyib Bukele, this cryptocurrency has the ability to give a boost to the country's economy; moreover, in a State where the number of unbanked people is high, it can have a positive impact on financial inclusion. By becoming law, economic operators and businesses are obliged to accept cryptocurrency and must display all prices of products and services in both dollars and digital currency. Citizens can use bitcoin via an app, receiving a gift of a sum of bitcoin (equivalent to $30). However, on the first day, this app had some problems. People around the world are waiting to see the implications of this singular choice.

1.3.3 STABLECOIN

Although stablecoins are a relatively recent payment innovation, it has already been the subject of much debate. Stablecoins are digital units of value designed to minimize fluctuations in their price against a reference currency or basket of currencies[39]. The main characteristic, which differentiates them from cryptos, is the fact that they cannot be subject to extreme price volatility, since they own to their peg. This can be perceived from the name itself, which in the first part refers to the fact that they are 'stable'. Indeed, we can say that the market started to issue them, mainly in response to the excessive volatility of so-called cryptocurrencies. Like Bitcoin, these private digital currencies exploit a DLT technology[40] to transfer and validate the transfer of ownership of individual units but,

[39] Definition provided by the ECB:
https://www.ecb.europa.eu/press/key/date/2020/html/ecb.sp201104~7908460f0d.en.html

[40] The term DLT refers to an instrument that serves to record the ownership of, for example, money or financial assets, real estate, etc. Distributed ledgers are a database of transactions distributed across a network of many computers, and therefore not held at a central node. Usually, all members of the network can read the information and, depending on their permissions, can also add to it.

unlike Bitcoin, they are generally issued by identified private entities, financial or otherwise. The stablecoins are born with the explicit objective of maintaining the value of the instrument stable over time, linking it to that of financial or real assets with a relatively stable value (asset-linked stablecoins) or using algorithms that regulate the supply according to the trend of demand (algorithmic stablecoins). In the case of asset-linked stablecoins, the quality and liquidity of the assets held by the issuer against the crypto-assets issued generate a trade-off for the issuer itself: the greater the degree of liquidity and stability, the lower the return on these assets and, therefore, the seigniorage profit; but at the same time, the easier it is to convert stablecoins into the currency in which the assets are defined, the greater the trust in them. The most commonly collateralized stablecoins are those linked to fiat currencies such as the dollar, euro, and pound.

It is possible to make a brief comparison between stablecoins and cryptocurrencies and e-money: in addition to the volatility factor, stablecoins differ from the former in that they tend to be backed by a single base and work more in a centralized model. In fact, while decentralized cryptocurrencies do not have a central repository, stablecoins have an equal or greater asset base to rely on. Moreover, stablecoins can eventually transact faster than classic cryptocurrencies.

As for stablecoins, while there are several similarities with fiat currencies, there are also some points of distinction: they are privately issued and are not automatically linked in the regulatory framework with central bank money.

Among stablecoins, the proposal that has undoubtedly attracted the most attention is that of Libra, put forward by Mark Zuckerberg, co-founder, chairman and CEO of Facebook. Libra's first white paper came out in June 2019: it was immediately taken by the G7, in October of the same year, which highlighted the risks of the instrument - that can be both social and economic in nature; firstly, there could be misuse of personal information (which can jeopardize privacy); secondly, the spread of foreign-owned stablecoins could make the European payments market dependent on technologies developed, managed and regulated elsewhere. This could result in a more difficult traceability of payments, in the context of the fight against money laundering, terrorist financing and tax evasion. These risks are compounded by others, affecting the monetary and financial system. Indeed, concerning Facebook, that is a global technology and information company, Libra's potential global deployment has a strong comparative advantage over other companies in collecting and analyzing customer data; this raised many questions about the possible effects it would have on monetary sovereignty, financial and payments system stability, and monetary policy effectiveness (as well as

The most common type of DTL is called "blockchain", referring to the fact that transactions are grouped into blocks and these are joined together in chronological order to form a chain, protected by complex mathematical algorithms that aim to ensure the integrity and security of the data.

consumer protection and the fight against money laundering and financial crime). In April 2020 came Libra's response, via a second white paper. Recently, the European Commission and the G7 countries have reiterated the argument that private cryptocurrencies, if authorized, can only be issued on the basis of strong regulation, clearly stating what the obligations are for issuers in terms of protection of users and society as a whole, security and stability of the economic and financial system.

In conclusion, private stablecoins aim to provide an alternative form of risk-free digital unit that is not limited to commercial banks but could be used directly by consumers. This means that, should this payment instrument become widely used, the function performed by the commercial banks themselves would be eliminated: in fact, if a buyer can transfer widely accepted and risk-free stablecoins immediately and directly to a seller, the work performed by commercial banks as a payment service mechanism is no longer necessary.

1.3.4 CENTRAL BANK DIGITAL CURRENCY

A Central Bank Digital Currency (CBDC) is a liability of the central bank, denominated in the official unit of account, which serves both as a digital means of payment and a store of value[41]. CBDC is different from cash, since it is in digital form. Moreover, it is also different from existing forms of cashless payment instruments utilized by consumers - for example, credit transfers, card payments, and e-money - because it represents direct credit to a central bank, not a liability of a private financial institution. Finally, the fact that it is risk-free credit also makes it different from cryptocurrencies or other private digital tokens.

While the benevolent disinterest of central banks was justifiable at first, it has not been a viable option for a few years now: in 2009, the emergence of bitcoins did not cause much concern in the sector, as officials referred to cryptocurrencies as crypto-assets, to highlight their generation's weakness as a medium of exchange. With the more recent advent of stablecoins, however, the situation has changed: the Libra project launched by Facebook in the summer of 2019 revealed that global digital platforms could develop their own currencies and integrated payment systems. It was this initiative that alarmed central banks around the world, which began to consider the massive adoption of these tools.

[41] F. Passacantando, “Could a digital currency strengthen the euro?”, 2021

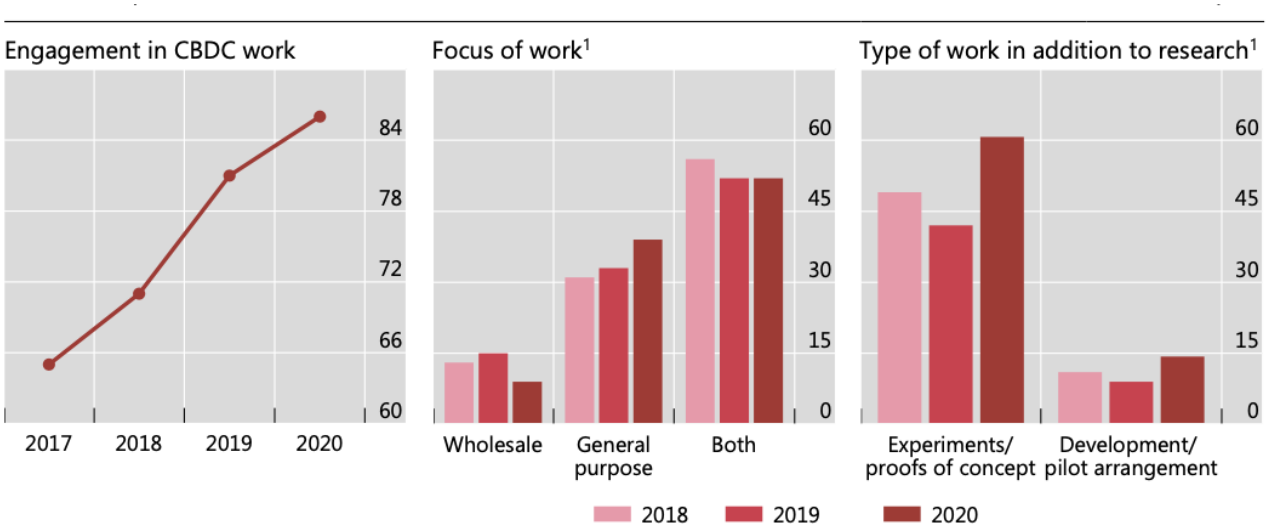
According to a recent Bank for International Settlements (BIS) survey[42], 86% of central banks are now studying the benefits and the risks of CBDCs: it represents an increase of about one-third over the past four years. Among them, some have already started a testing phase. In addition, in October 2020, the Central Bank of The Bahamas - after a successful pilot project launched in 2019 on the Exuma island conglomerate (a 365-island district) - launched the world's first nationwide CBDC, the Sand Dollar.

Listing briefly and broadly the main characteristics, it is a digital instrument: this implies that it is easily scalable and without storage costs; it is a hybrid instrument, in the sense that it is both a financial asset and a means of payment - since it is remunerated. Thus, like cash, it provides immediate liquidity services, but it can also be potentially used as investment, such as bonds or term deposits. In addition, CBDC is secure and can be traded internationally. Since a detailed analysis of CBDCs will occur in chapter four, in this section I simply introduce an initial and fundamental distinction: if we understand CBDC as a digital equivalent of cash for use by end users - and thus by people such as households and businesses - we are talking about a "retail" CBDC. This would be a new option for the general public to hold money. In contrast to retail CBDC, "wholesale" CBDC targets a different group of eligible users. It is designed for limited access by financial institutions and is similar to existing central bank reserve and settlement accounts. As a result, it is intended for the settlement of large interbank payments or to provide central bank money to settle transactions of tokenized digital financial assets in new infrastructures.

Referring to Figure 6, the first graph highlights how much central banks' interest in this topic has changed in recent years. The two charts to the right are more specific: in 2019, about 10% of central banks surveyed were intent on focusing on creating a solely wholesale CBDC; over 45% were considering both (wholesale and general purpose). As can be seen in the third chart, in 2020, about 60% of central banks among those included in the research were conducting experiments or proofs of concept, while 14% had moved to development and pilot agreements. These trends include large differences across jurisdictions and types of economies.

[42] Boar C. and Wehrli A., "Ready, steady, go? – Results of the third BIS survey on central bank digital currency" BIS Papers No 114, January 2021

Figure 6. Central banks' work on CBDC



Source: BIS Papers No 14
Note that these figures refer to data from the survey conducted in 2020, to which 65 central banks responded.

There are different reasons that push central banks in advanced and emerging market economies to consider issuing a CBDC: for the former, the main motivation is its use as a means of payment. A digital currency issued by central banks could in fact manage the decline in the use of cash, ensuring access to central bank money and protecting consumer welfare. For emerging economies, on the other hand, the top priority seems to be financial inclusiveness: in these States, in fact, there is a high percentage of non-bankers, even among those who have mobile devices and an internet connection. One example is the central bank of the Bahamas, which has already launched the Sand Dollar in order to benefit from the lower cost of digital logistics compared to conventional cash management in an archipelago composed of a multitude of islands. Similarly, countries that are highly exposed to natural disasters could also benefit from greater financial resilience by adopting a central bank digital currency.

To conclude, while there are many benefits of CBDCs, they are not without their dangers. On the one side, they could reduce transaction costs, increase financial inclusion, accelerate domestic and cross-border payments, affect the effectiveness of monetary policy, facilitate direct fiscal transfers, and promote innovation through new services and functionality[43]. On the other side, however, the risks relate to the possibility of triggering banking disintermediation and the assault on branches if not

[43] Serrate J. S., "Digital currencies, la nuova sfida delle banche centrali", Istituto per gli Studi di Politica Internazionale (ISPI), January 2021

properly configured. What is certain is that central bank digital currencies would not only have domestic macroeconomic and financial implications for the issuing economy, but also for the rest of the world. For this reason - and others that I will analyze in detail later[44] - the study that central banks are carrying out on this issue will still require time and effort.

[44] See chapter 4

CHAPTER 2

THE IMPACT OF DIGITAL TRANSFORMATION ON THE FINANCIAL SYSTEM

Digital Transformation (DX) is *"about adopting disruptive technologies to increase productivity, value creation, and social welfare"*[45]. Technological progress has been transforming many of our daily activities into digital versions for decades now. Just think of letters, now turned into emails, and postcards, now turned into digital photographs, sent through a phone with greetings attached. With these examples, it immediately becomes apparent how digital transformation has led to a reduction in time and space - thus increasing efficiency: the estimated number of letters sent worldwide in a year is roughly equal to the number of emails sent in a single day[46]. Indeed, the digitization process goes hand in hand with people's need for immediacy, transforming both the world around them and their behavior and culture. Likewise, digitization has also been prominent in the financial system, especially in payment services.

Over time, payment instruments have evolved significantly; however, core elements for their success have remained essentially the same: convenience and security. The former implies that payments are easy to use, fast, and widely accepted; security, on the other hand, requires that risk be minimal, both economically and financially, as well as socially. Digital transformation is raising the bar on convenience and security. While it is true that cash is the instrument that is directly accessible to all, has the characteristic of immediacy, is universally accepted, and guarantees privacy and security, it is not suitable for payments in a digital context - such as that represented by e-commerce. Especially with the growth of e-commerce[47] and connected lifestyles, people are increasingly demanding immediacy and coordination between payments and digital services. At the same time, however, it is critical to ensure security and privacy, two elements that people are concerned about in every aspect of their lives - especially when it comes to their money. At present, there are many existing payment

[45] Ebert C. and Cabral Duarte C.H., "Digital Transformation", IEEE Software, July 2018

[46] Panetta F., "21st century cash: Central banking, technological innovation and digital currencies"- SUERF/BAFFI CAREFIN Centre Conference 'Do we need central bank digital currencies? Economics, technology and psychology', August 2018

[47] A UNCTAD report released on May the 3rd estimates that the dramatic increase in e-commerce due to restrictions imposed to address COVID-19 has raised the share of online retail sales in total retail sales from 16 % to 19 % in 2020. https://unctad.org/system/files/official-document/tn_unctad_ict4d18_en.pdf

instruments: in addition to cash, there are cards (debit and credit), credit transfers, direct debits, and electronic money - instruments with which end users of payment systems transfer funds between accounts at banks or other financial institutions. Making a first general distinction, we can say that, at least in Europe, in-person transactions are mostly conducted with cash and cards; remote purchases are dominated by cards and electronic payments; bills are generally paid with direct debits and credit transfers.[48]

In addition, the outbreak of the pandemic in 2019 has impacted every aspect of the lives of citizens around the world; equally, the health crisis has had a clear impact on the financial sector: it has accelerated some existing trends; in recent years there has been a steady increase in digital payments, e-commerce, and a decrease in the use of cash; while it is still difficult to predict what the trends will be in the future once the pandemic is over, the overall trajectory of these trends has certainly received a major boost over the past two years. Overall, the crisis is compressing the value of half a decade's worth of changes into less than a year - and in areas that are typically slow to evolve: customer behavior, business models, and payment operating models[49].

The first section will focus on the evolution of cash use and digital payments in recent years, analyzing first the global context and then the Eurozone. Moreover, a specific section will be devoted to a more detailed analysis of the trends following the public health crisis triggered by Covid-19. In the second section, I will explore what the benefits of digital payments are, focusing on two key aspects, financial inclusion and reduced cash costs. The third paragraph will be dedicated to a case study, that of Satispay, a mobile payment platform independent from credit and debit cards, which can be used by anyone with a bank account. Finally, in the last paragraph, I will list the main implications of digital payments on the banking system, analyzing the main challenges it faces.

2.1 TRENDS IN CASH AND DIGITAL PAYMENTS

Digitization certainly plays a key role in financial life; the payments horizon is constantly evolving: while serving as the backbone for the economies of every State, payments are revolutionizing themselves so as not to fall behind the times.

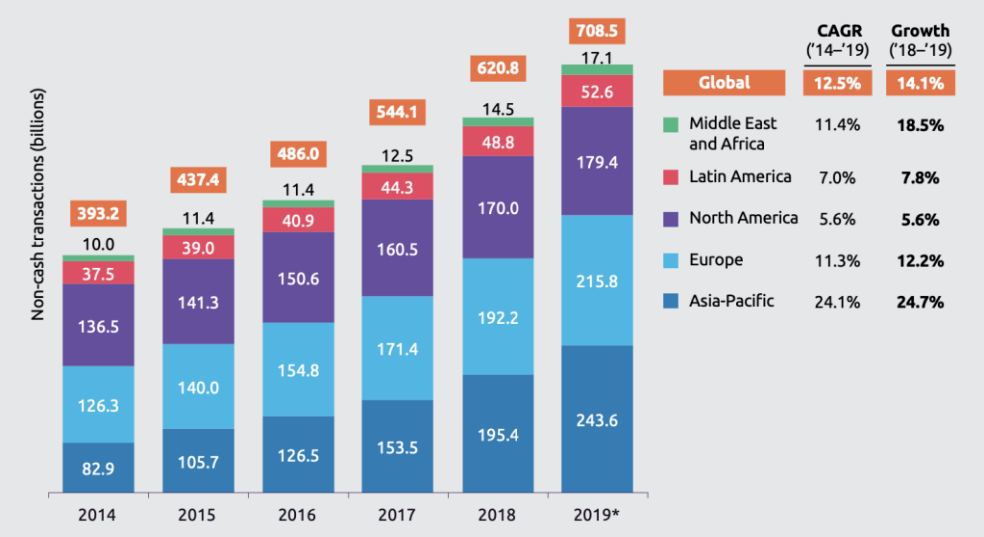
There are many studies analyzing changes in payment preferences among individuals: in 2020, Capgemini produced a report, in which an analysis up to 2019 emerges. Globally, the volume of non-

[48] https://www.ecb.europa.eu/press/key/date/2020/html/ecb.sp201127~a781c4e0fc.en.html

[49] McKinsey & Company, "The 2020 McKinsey Global Payments Report", October 2020

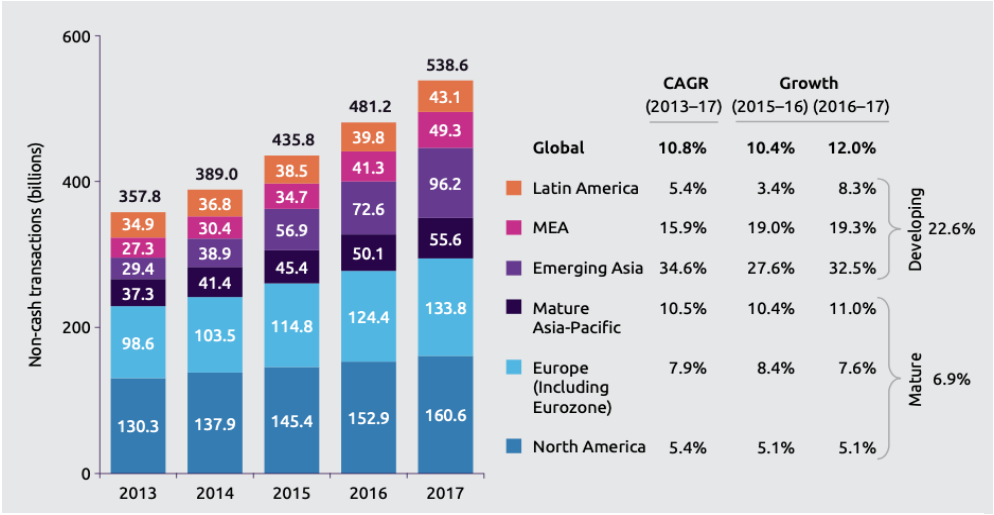
cash transactions increased by 14.1% between 2018 and 2019, reaching a total of 708.5 billion transactions. This is the highest growth ace in the last decade[50]. Looking at previous data from World Payments Report 2019, indeed, non-cash transaction volumes had grown 10.4 % between 2015 and 2016 and 12 % between 2016 and 2017, reaching a total of 539 billion globally.

Figure 7. Global non-cash transaction (in billions), by region, 2014-2019



Source: Capgemini, World Payments Report, 2020

Figure 8. Global non-cash transactions (in billions), by region, 2013-2017[51]



Source: Capgemini, World Payments Report, 2019

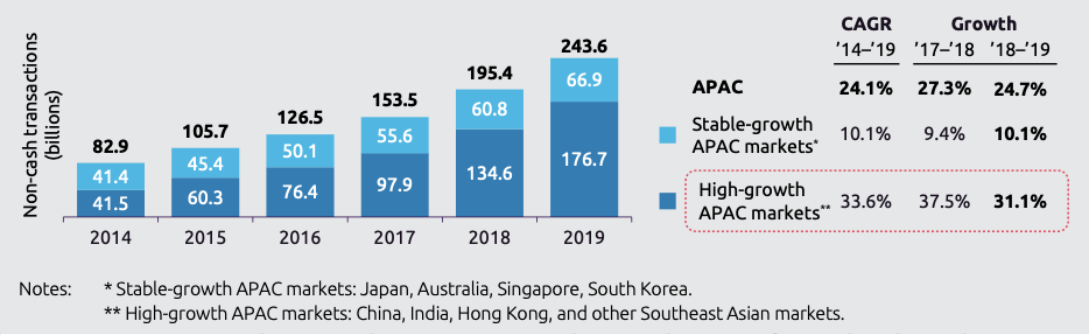
[50] Capgemini, "World Payments Report", 2020, p. 23

[51] Some numbers may differ from data published in WPR 2020 due to data changed at the source and re-categorization of some geographies in 2020.

As can be seen from the first graph (Figure 7), the geographic area that experienced the greatest increase in non-cash transactions from 2018 to 2019 - with a growth of almost 25% - is Asia-Pacific: in 2019, the total transactions made in this area reached the figure of 243.6 billion, compared to a total of 195.4 billion in the previous year. The same was true even for the period before, in which Emerging Asia[52] was driving growth, with a rate of 27.6% in 2015-2016 and 32.5% in 2016-2017. According to the research, the factors that have led to this high increase are the rise in the popularity of smartphones, the boom in e-commerce, the thriving adoption of digital wallets and innovations, especially mobile payments and QR-codes. In the second position, there is the Middle East and Africa, whose growth rate between 2018 and 2019 was 18.5 %, reaching a total non-cash transaction of 17.1 billion. In the previous period (2016-2017), MEA States grew at a higher rate of 19.3%. Europe holds third place, growing 12.2% between 2018 and 2019, up from 2017-2018 (7.6%). European States are followed respectively by Latin America (7.8%) and North America (5.6%). The former experienced a slightly lower growth rate than 2016-2017 while North America marginally climbed (in previous years it was at 5.1%).

In addition, regarding the Asia-Pacific region, it is possible to analyze in further detail which States are currently leading the way: China, India, and other SE Asian markets. There, the growth in non-cash transaction volume reached a rate of 37.5% between 2017 and 2018 and 31.1% between 2018 and 2019. The gap with the other States belonging to the same region, referred to as Stable-growth APAC markets (i.e. Japan, Australia, Singapore, and South Korea) is high: in these, the growth that occurred from 2017 to 2018 and from 2018 to 2019 is 9.4% and 10.1%, respectively.

Figure 9. Non-cash transactions in countries of the Asia-Pacific Region

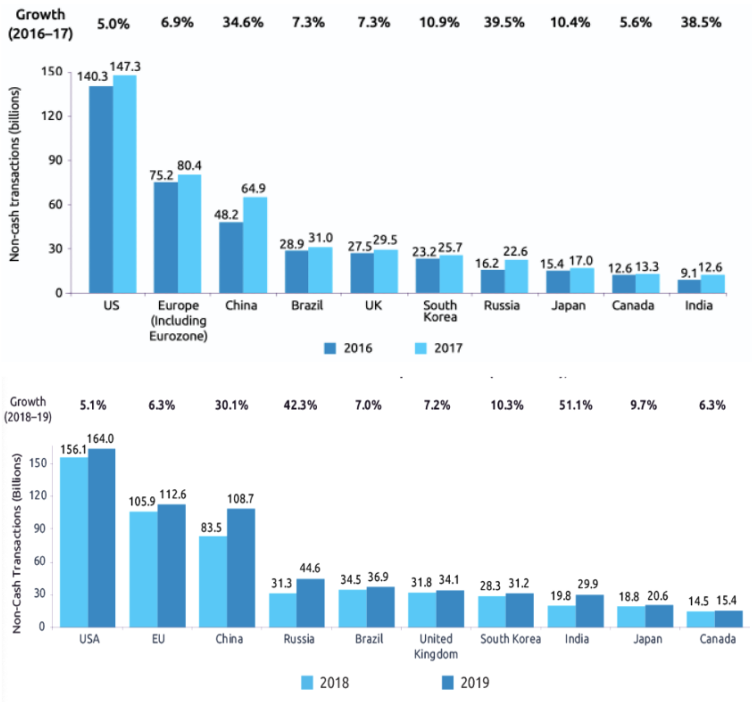


Source: Capgemini, World Payments Report, 2020

[52] Emerging Asia included China, Hong Kong, India, and other Asian markets (including Malaysia, Thailand, Indonesia, Philippines, Taiwan, Pakistan, Sri Lanka, and Bangladesh).

The high-growth APAC markets are on the cusp of a non-cash payments revolution, driven by the hugely successful adoption of mobile payments. In China, the number of people using their phones to make payments reached the amount of 852.52 million as of December 2020[53].

Figure 10. Number of non-cash transactions in the top 10 markets (in billions), 2016-2017 and 2018-2019



Source: Capgemini, WPR 2019 and 2020

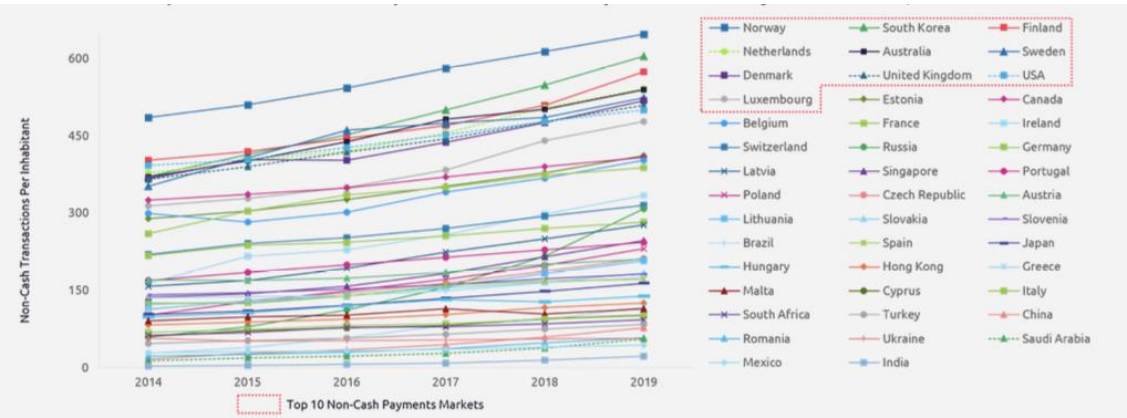
Looking at the top 10 non-cash transaction markets, the U.S. continues to head the list, with China, India, and Russia quickly closing in. The well-established U.S. non-cash payments landscape, which features a maturity in bank account penetration and payment instrument use (4.45 cards per capita)[54], helped the market maintain its leading position. China has maintained the same position as in previous years, although volumes have increased significantly - making the divergence with Europe minimal. Russia climbed some positions: its non-payment volume surpassed Brazil's in 2019, with a growth rate of 42%, driven mainly by the adoption of the domestic payment system (Mir)[55]. The same goes for India, which surpassed Japan and Canada, registering the highest growth - nearly 51%.

[53] https://www.statista.com/statistics/278487/number-of-mobile-payment-users-in-china/

[54] J.P.Morgan, "E-commerce Payments Trends: United States", 2020

[55] In 2015 there were some initiatives by the Central Bank of Russian Federation to implement a new national card system. Up to 2019, more than 56 million Mir cards were issued, make up more than 20 percent of Russia's bank card market. Russia created its own card payment system in 2014 because it feared U.S. and European sanctions against some Russian banks and businesspeople over the annexation of Crimea could block transactions made with US based Mastercard and Visa. https://www.reuters.com/article/us-russia-cards-idUSKCN1RV0KZ

Figure 11. Number of non-cash transactions per inhabitant, 2014-2019



Source: Capgemini, World Payments Report, 2020

Finally, when relating the number of non-cash transactions to the number of inhabitants in individual States, Norway is number one (and has been since 2014). In recent years, however, South Korea and Finland are quickly catching up: they have large banking populations and a well-developed payment ecosystem. It is significant to note that among the top 10 countries (outlined in red), 5 are part of the European Union. In the next section, I will look in more detail at how the payment habits of people in the Eurozone have changed in recent years.

Euro area

In 2019, the European Central Bank conducted a Study on the payment attitudes of consumers in the euro area (SPACE)[56]. In order to get the full picture, SPACE investigated consumers' use of cash and non-cash payment instruments, first analyzing individuals' purchases at physical points of sale (POS) and peer-to-peer (P2P) payments, then payments made remotely (for online purchases, phone and postal orders, bill payments, and recurring payments). A previous study - whose name is the Use of cash by households in the euro area (SUCH)[57] - was conducted in 2016, thus allowing a comparison

[56] SPACE fieldwork was conducted in 2019. Between mid-March 2019 and mid-December 2019, 41,155 respondents in 17 euro area countries reported their transactions in one-day payment diaries. The payment diaries of 2,061 respondents in Germany and 22,103 respondents in the Netherlands collected in the context of national surveys in 2017 and 2019 respectively were included in the SPACE analysis where possible. While payment diary data for Germany stem from 2017, the Deutsche Bundesbank collected some survey data in 2019 in parallel to the ECB survey. https://www.ecb.europa.eu/pub/pdf/other/ecb.spacereport202012~bb2038bbb6.en.pdf#page=22

[57] SUCH has been conducted in all euro area countries, except in Germany and the Netherlands, where the corresponding central banks have been carrying out similar payment diary surveys. Nevertheless, to the extent possible, the results of those countries have been integrated to present the results for the whole euro area. The ECB's SUCH survey was conducted from October to November 2015 and from January to July 2016. It involved 65,281 respondents who kept a

between the two different years. According to the results, cash is still the most popular payment method in countries that have adopted the euro as their official currency, albeit to varying degrees in different States. However, as a result of technological advances in the financial sector, non-cash transitions are steadily increasing.

The term POS stands for Point of Sale (it can also be referred to as POP, Point of Purchase) and indicates the physical area of a store where customers can pay for theirs purchases - thus completing the retail transaction[58]. The term P2P stands for person-to-person or peer-to-peer and refers to payments made between two individuals[59]. It is estimated that in 2019, the entire population in the euro area aged 18 and above made 160 billion POS and P2P payments, for a total value of € 4,082 billion[60]. To these must be added the online spending made by consumers, which amounted to 12 billion in the same year, for a total of € 834 billion[61]. As is clearly demonstrated in Table 2, cash was the most widely used instrument in POS and P2P payments, both in terms of numbers and value. In the second-place stand cards, followed by other instruments, which include bank cheques, credit transfers, and direct debts. As for online purchases - shown in Table 3 - the most commonly used means of payment were cards (debit and credit). Consumers in the Eurozone have made 6 billion card transitions, for a value of € 396. In addition, 3 billion payments were made using e-payment solutions (e.g. PayPal) and 1 billion via credit transfer.

diary to write down all the payments and cash withdrawals or replenishments that they carried out during the course of a single day. A subset of 28,099 respondents was also invited to complete a questionnaire in order to collect information on consumers' access to payment instruments, their payment behavior and to analyze these results together with the reported transactions. The total number of survey participants for the whole euro area, including Germany and the Netherlands, was 92,080, reporting a total of 198,600 payments.
https://www.ecb.europa.eu/pub/pdf/scpops/ecb.op201.en.pdf

[58] ECB (2020): Point-of-sale payments include those payments made at supermarkets, restaurants, bars, cafés, small shops for day-to-day items, petrol stations, street or market selling points, shops selling durable goods, vending or ticketing machines, venues for culture, sports or entertainment, offices of public authorities, and hotels or similar, as well as for services outside the home (e.g. hairdressers, dry cleaning, bicycle repair) and at other physical locations.

[59] ECB (2020): Person-to-person payments include all payments made between two individuals, e.g. payments for services in and around the house, charitable donations and other P2P payments such as pocket money, gifts, repayments of shared restaurant bills, as well as payments at a flea market, in a church and to street artists.

[60] ECB (2020), Study on the payments attitudes of consumer in the euro area (SPACE), p. 17

[61] ECB (2020), Study on the payments attitudes of consumer in the euro area (SPACE), p. 34

Table 2. Number and value of POS and P2P payments in the euro area in 2019

	Number of transactions (in billions)	Value of transactions (in € billions)
All payment instruments	160	4,082
POS	151	3,686
P2P	9	397
Cash	116	1,971
POS	109	1,722
P2P	8	249
Cards	38	1,667
POS	38	1,633
P2P	0.5	34
Others	5	445
POS	4	331
P2P	1	114

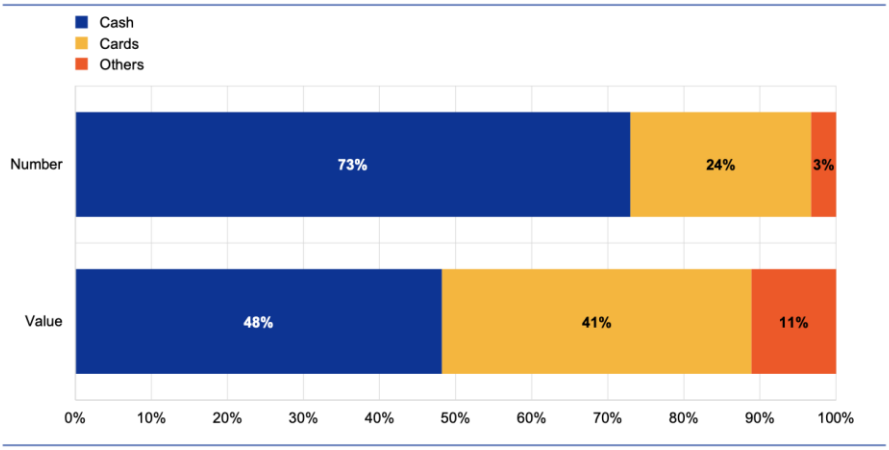
Source: Author's calculation based on ECB data provided in ECB (2020), Study on the payments attitudes of consumer in the euro area (SPACE), p. 17

Table 3. Number and value of online purchases in 2019

	Number of transactions (in billions)	Value of transactions (in € billions)
All payment instruments	12	834
Cash	0	22
Cards	6	396
E-payment solutions	3	194
Credit transfers	1	143
Others	1	78

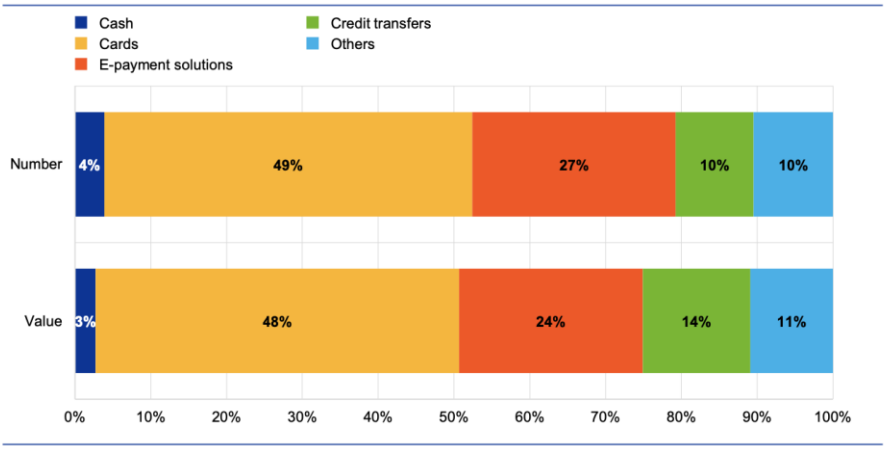
Source: Author's calculation based on ECB data provided in ECB (2020), Study on the payments attitudes of consumer in the euro area (SPACE), p. 17

Figure 12. Share of payment instruments at the POS and P2P in 2019



Source: ECB, SPACE Report (2020)

Figure 13. Share of payment instruments used for online purchases in 2019[62]



Source: ECB, SPACE Report (2020)

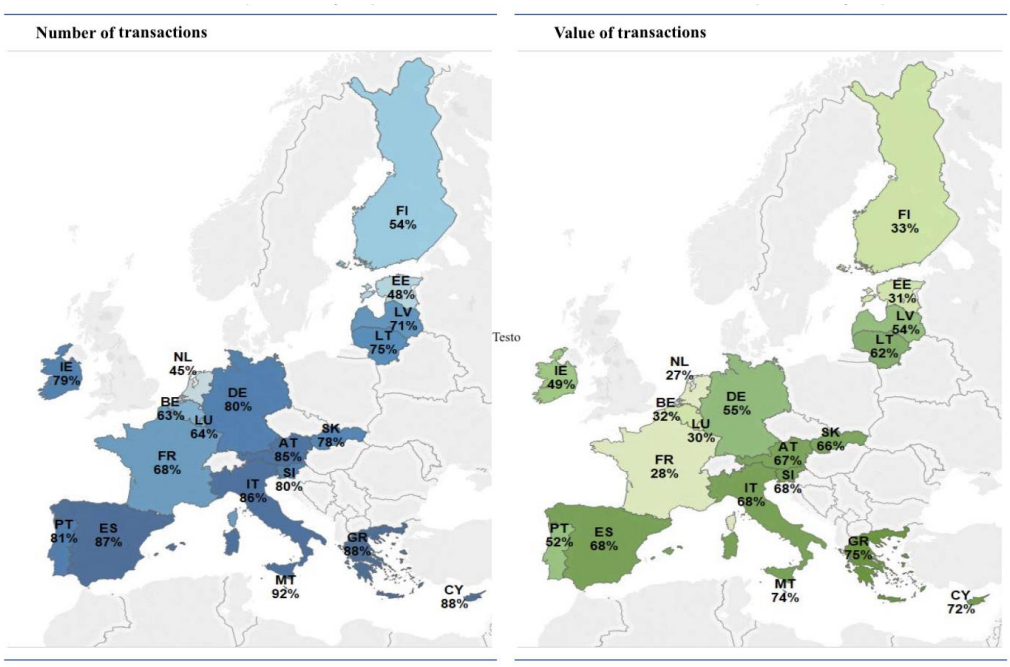
Figures 12 and 13 graphically represent what has been reported in the tables above: they give a clear and immediate overview of the different shares of payment instruments. In 2019, the two most used tools for POS and P2P payments were cash and cards, with a share of 73% and 24%, respectively. While the percentages between the two tools differ greatly when it comes to the number of transactions, it is different when looking at the value. In fact, while the number of cash transitions was very high, it represents a much lower percentage in terms of value, at just 48%. On the contrary, the percentage in terms of the value of credit cards was higher than the quantity, amounting to 41%.

[62] Note that SPACE also reports numbers and values on bill payments divided by payment instrument; for personal choice, for the purpose of comparison with POS and P2P payments, I decided to focus only on online purchases.

As for online spending, shown in Figure 13, card payments accounted for 49%. This was followed by e-payment, which accounted for 27% of all online payments. The lowest percentage was represented by cash payments. Unlike the graph representing payments at POS and P2P, in this case, there is not a big difference between the payment instruments in terms of number and value: on the contrary, the percentages are very similar.

In addition, it may be worthwhile to make a comparison with 2016 data, at least in terms of cash usage in the various Eurozone States. While cash was still largely the most widely used medium in 2019, there was a decrease when compared to 2016. According to data provided by the SUCH study regarding payments made at the point of sale, the share of cash dropped nearly 6 percentage points, from 78.9% to 73%[63].

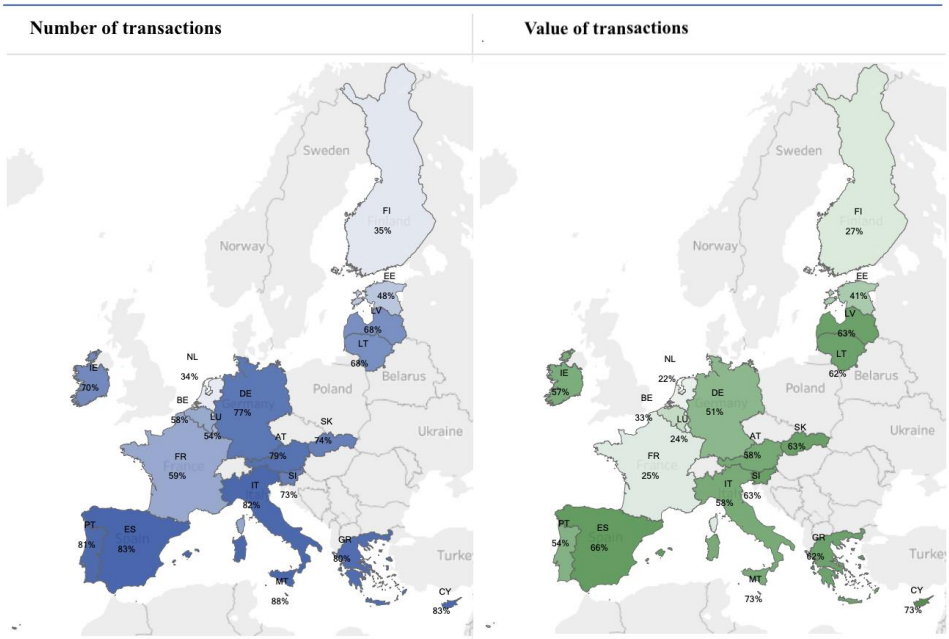
Figure 14. Cash payments: number and value of transactions in 2016



Source: ECB, SUCH Report (2017)

[63] ECB (2020), "Study on the payments attitudes of consumer in the euro area (SPACE)", p. 18

Figure 15. Cash payments: number and value of transactions in 2019



Source: ECB, SPACE Report (2020)

Looking at the two maps, we can see that, in terms of numbers, the use of cash was more widespread in the southern countries of the euro area: in 2016, the countries with the highest number of cash transactions were by order Malta (92%), Cyprus and Greece (88%), Spain (87%), Italy (86%) and Portugal (81%); these countries were followed by Germany and Slovenia, with 80%. 2019 saw a decrease in percentages in almost every country: the States that still exceeded 80% of the number of transactions made in cash were Malta (88%), Cyprus and Spain (83%), Italy (82%), Portugal (81%) and Greece (80%). Conversely, both in 2016 and 2019, the countries that had the lowest shares - between 45% and 54% of all POS payments - were the Netherlands, Estonia and Finland. In terms of the value of payments made, in all countries and in both years the share of cash was much lower than in terms of the number of payments. In 2016, the countries with the highest share were Greece (75%), Malta (74%), and Cyprus (72%); three years later, only Malta and Cyprus remained with a share above 70%. In contrast, the lowest percentage was recorded in Benelux countries and France, which was also confirmed in 2019.

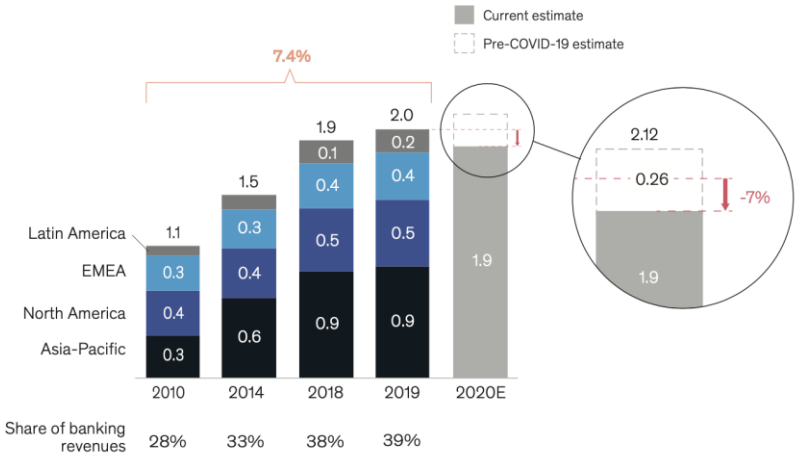
Finally, comparing the two years, it can be seen that, in terms of numbers, the State that experienced the greatest decrease in the use of cash was Finland, dropping from 54% to 35% (-19 percentage points). This country is followed by the Netherlands, Luxembourg (-10 p.p.), France and Ireland (-9 p.p.). In terms of value, the greatest falls were achieved in Greece (- 13 p.p.), Italy (- 10 p.p.), and Austria (- 9 p.p.). In this regard, a slight increase was seen in three countries: in Estonia - from 31% to 41%, in Latvia - from 54% to 63%, and in Ireland - from 49% to 57%.

2.1.1 THE IMPACT OF COVID-19

The Covid-19 pandemic has accelerated the transformation of the financial services industry worldwide. While the changes were already in the public eye before the outbreak of the healthcare crisis, the latter has highlighted how, in the future, the possibility of a global cashless society is actually quite realistic. During the lockdowns imposed by governments in the past two years, many people have adopted digital behaviors, accelerating the proliferation of mobile-first digital economies and making cash even less relevant to daily life than it already was (although in less developed economies, cash remains essential)[64]. Overall, the crisis is compressing the value of half a decade of change into less than a year[65].

As for the payments industry, according to data reported in the 2020 McKinsey Global Payments Report, global revenues declined 22% in the first six months of 2020, compared to the same period in 2019.

Figure 16. Global payments revenue, $ trillion



Source: The 2020 McKinsey Global Payments Report (2020)

Since Covid-19 became a global pandemic, many governments have established closures, with different types of restrictions. As a result, there was an immediate reduction in discretionary spending and a severe demand-side shock. In addition, there has been a decline in the use of cash, as there has been a consumer shift from point of sale to digital commerce. The data shows that overall, for retail, there has not been a decline but rather a shift in purchasing behavior[66]: all forms of peer-to-peer and

[64] PwC, "Charting a course amid evolution and revolution", 2021

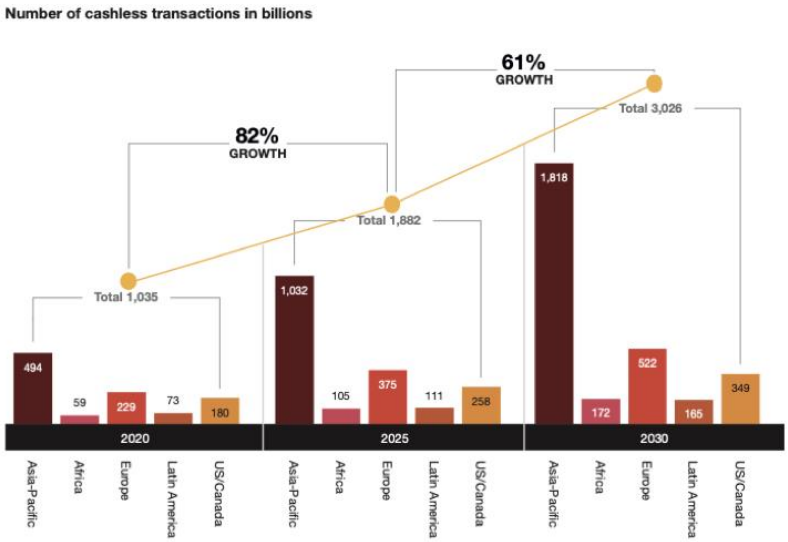
[65] McKinsey & Company, The 2020 McKinsey Global Payments Report (2020), p. 2

[66] McKinsey & Company, The 2020 McKinsey Global Payments Report (2020), p. 5

consumer-to-business electronic payments have been incentivized. Moving on to look at different digital payment tools, the use of debit cards has increased in many regions, mostly at the expense of cash; it has been different for credit cards: for example, in Australia the share of credit cards to card spending fell by five percentage points between February and June 2020, in favor of debit cards. In Asia, while credit cards have remained strong in their support of e-commerce and POS payments, alternative payments (such as instant and mobile instruments) have seen very high growth.
In addition, the pandemic has caused the shift from physical to virtual banks to accelerate: banks in several geographies are closing branches, as are ATMs. In Australia, the four major banks have removed 2,150 ATM terminals and closed 175 branches since June[67]. While the pandemic initially put a damper on cross-border e-commerce volumes, already in the second quarter, the data is positive: UPS and PayPal, for example, reported double-digit growth in cross-border shipping volumes and the value of goods sold.

The question is, what will happen in the future? According to an analysis conducted by PwC, while total global cashless payments amounted to 1.035 billion in 2020, this number is expected to increase more than 80% by 2025, reaching almost 1.9 tn; in 2030, the prediction is even that the number will triple compared to 2020, reaching a total of 3.026 billion[68].

Figure 17. Cashless transaction volume, 2020, 2025 and 2030



Source: Pwc, Charting a course amid evolution and revolution, 2021

[67] McKinsey & Company, "The 2020 McKinsey Global Payments Report" (2020), p. 6

[68] PwC, "Charting a course amid evolution and revolution", 2021

As the graph shows, the area of the world that will experience the greatest growth will be Asia-Pacific: the volume of cashless transactions in this area will grow 109% in the first 5 years and 76% from 2025 to 2030. In second place is the African continent, with growth first of 78%, then 64%. Europe, in third place, will see cashless transaction growth of 64% and 39%, followed by Latin America and the United States, and Canada.

Euro area

By the end of 2020, the value of banknotes in circulation in the euro area reached €1,435 billion, an annual increase of €142 billion or 11%[69]. This is the largest increase since the global financial crisis of 2008: many people in Europe - as indeed happens in turbulent times - reacted to the outbreak of the pandemic by storing cash. The fact that the increase in cash in circulation coincides with a period when cash payments have been significantly reduced has led the European Central Bank (ECB) to speak of *the paradox of banknotes*; it refers to an increase in the demand for banknotes at the same time as the use of cash for transactions is decreasing. Cash, in fact, in addition to being a means of payment, is an important store of value. According to data provided by the ECB, even before the pandemic, the total amount of cash that was actually used to pay amounted to only 20-22%. The remainder was either used as a store of value (between 28 and 50%) or belonged to entities residing outside the Eurozone (between 30 and 50%). This means that in the presence of negative interest rates and other insecurity, banknotes can be more convenient than bank money. I will now look at how people's preferences for payment methods have changed.

Besides the two studies conducted in 2019 and 2016, an additional survey was conducted by the ECB in July 2020 to probe how the pandemic has affected cash usage across all euro area States (IMPACT survey[70]). In fact, while the increase in non-cash transactions is a phenomenon that has been expanding for a few years now, it appears to have accelerated more in the past two years. Among

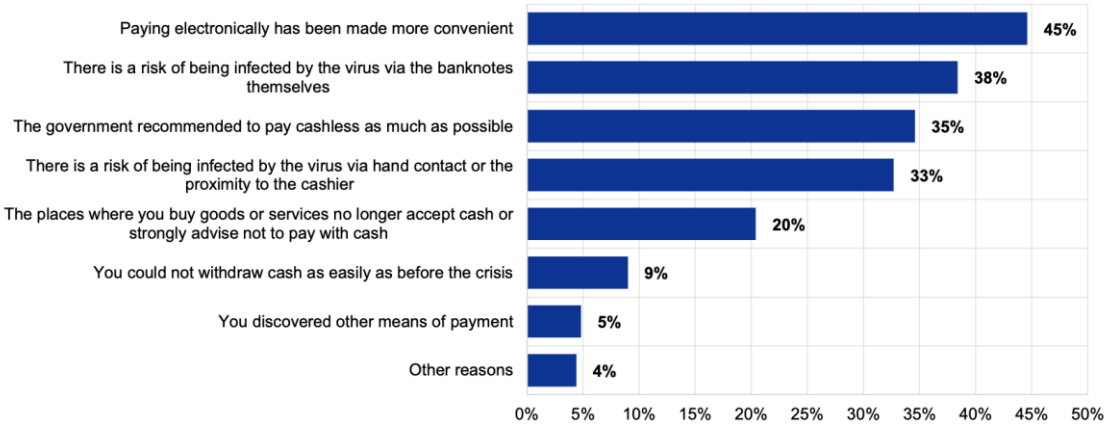
[69] Zamora-Pérez A., "The paradox of banknotes: understanding the demand for cash beyond transactional use", ECB Economic Bulletin, Issue 2/2021

[70] The survey was conducted online in most countries, except in Malta and Cyprus where it was conducted by telephone. The target for the sample size was to achieve 1,000 interviews in each country, except in Malta, Cyprus and Luxembourg where it was 500. A total of 17,779 persons were interviewed in the last two weeks of July. The outcomes of the two surveys (SPACE and IMPACT) cannot be directly compared as the type of survey and the methodologies differ. Nevertheless, IMPACT gives a view of possible changes in the payment attitude of consumers and their payment behavior in the euro area countries.

participants, it emerged that 40% have used less cash since the start of Covid-19; it further emerged that, among these, nearly 90% said they would continue on this path even once the pandemic ended - among them, 46% were certain while 41% assumed it was a probability.

A study was done to assess what were the reasons behind consumers' choices to use non-cash payment methods. The reason most often cited was the changes made in electronic payments, which were made more convenient during the pandemic: for example, with respect to contactless payments, the threshold for which the cardholder must enter their personal identification number (PIN) for payment authorization was increased. Other reasons lie in the fear of contracting the virus through banknotes, hand-to-hand contact, or proximity to the seller. In addition, although in a fairly small percentage, in some cases people have experimented and discovered new payment methods.

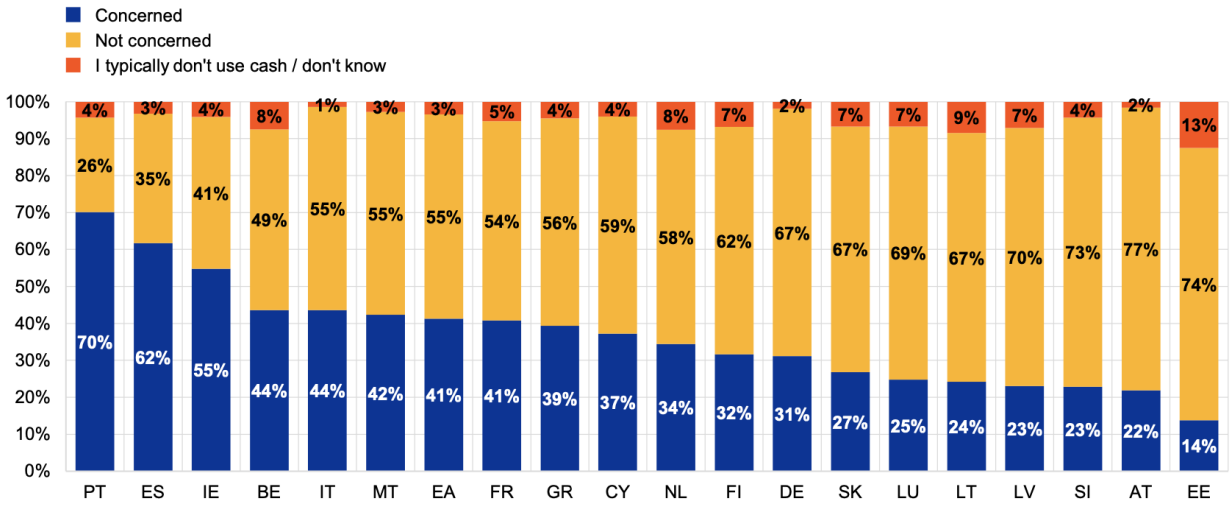
Figure 18. Reasons for changing payment behavior during Covid-19



Source: ECB, SPACE Report (2020)

Clearly, results vary from country to country, depending not only on the different measures put in place by the respective governments but also on the habits and preferences of citizens, recommendations, and existing infrastructure. Indeed, taking for instance the fear of being infected by the virus through banknotes, the perception changes considerably depending on the country; observing the graph below - Figure 19 - the impression is that the concern was lower in the northern countries of the Eurozone. The countries in which concern is highest are Portugal, Spain, and Ireland, followed by Belgium and Italy. On the other side of the graph, instead, are the Baltic countries, Slovenia and Austria, where worry is low. Furthermore, it is curious to note that whereas in Portugal the percentage of citizens who were worried at the time of the survey was 74% and those who were not worried was 26%, in Estonia the two values are reversed.

Figure 19. Concerns about getting Covid-19 when touching banknotes or coins



Source: ECB, SPACE Report (2020)

To conclude, although it is still difficult to predict what will happen at the end of the pandemic and how much it will impact payment habits, the results show that the pandemic has accelerated a phenomenon that was already developing: the decline in the use of cash in countries that use the euro.

2.2 PROS OF DIGITAL PAYMENTS

The fact that in recent years digital payments have been increasing to such an extent - taking away year after year from the overall cash payments - has a clear reason: they bring many benefits. A first obvious advantage is the speed of digital payments: especially when it comes to significant amounts, they make it possible to avoid counting cash, the checking by cashiers of its validity and the placement of it in the cash register sections; this implies a reduction in terms of time as queues are reduced accordingly. This is not only an advantage over cash, but also over another payment instrument such as the cheque, which requires even more steps, and consequently more time. Another benefit - which at first glance may seem trivial - is the convenience at a material level for the consumer, who does not need to carry around cash: in the case of digital payment, it is sufficient to carry the credit/debit card or, more simply, the smartphone, from which to make the transition in complete safety. In this regard, digital payments are even safer: first of all, they reduce to zero the risk of losing cash and minimize the risk of being robbed (a danger that concerns both the consumer and the merchant). Thanks to the high levels of security imposed on both card and smartphone payments, people can remedy loss, in many cases without suffering a loss of money. In addition, studies have shown that

delivering payments through digital channels rather increases transparency - thereby reducing the issue of tax evasion - and reduces corruption[71].

Digital payments have two other merits that, being more complex and less intuitive, require a more thorough and separate analysis: financial inclusion and reduced cash costs.

Financial inclusion

Beginning with the definition given by the World Bank, financial inclusion means that *"individuals and businesses have access to useful and affordable financial products and services that meet their needs - transactions, payments, savings, credit, and insurance - delivered in a responsible and sustainable way"*[72]. This issue is of fundamental importance: although it is not explicitly listed in the 17 Sustainable Development Goals[73] (SDGs), it is a key factor in the achievement of many of them. In fact, it is a key element in reducing poverty and increasing prosperity. As research by CGAP[74] (Consultative Group to Assist the Poor) has shown, many of the big global challenges are related to the financial lives of low-income people: this is also true for all essential services, which at first might seem disconnected from the financial inclusivity aspect. For example, achieving universal access to clean water - one of the 17 SDGs - simultaneously involves finding a way for millions of people living in poverty to pay for the costs associated with having water in their homes. According to their analysis, there are ways in which digital finance can address these development challenges. The digitization of payments plays a key role in expanding financial inclusion - especially in emerging countries - becoming an opportunity for businesses and governments.

Financial exclusion is certainly costly for people, as it has a significant impact on their lives, preventing them from investing in their future and making them vulnerable to external factors (as they lack collateral); it is also costly for States with high numbers of people or, as it impedes economic

[71] Demirguc-Kunt A., Klapper L., Singer D., Ansar S. and Hess J., "The Global Findex Database 2017: Measuring financial inclusion and the fintech revolution", the World Bank

[72] https://www.worldbank.org/en/topic/financialinclusion/overview#1

[73] The 17 SDGs make up the 2030 Agenda for Sustainable Development-adopted by all members of the United Nations- and refer to different areas of social, economic, and environmental development that must be considered in an integrated manner. They are: no poverty; zero hunger; good health and well-being; quality education; gender equality; clean water and sanitation; affordable and clean energy; decent work and economic growth; industry, innovation and infrastructure; reduced inequalities; sustainable cities and communities; responsible consumption and production; climate action; life below water; life on land; peace, justice and strong institutions; partnership for the goals.

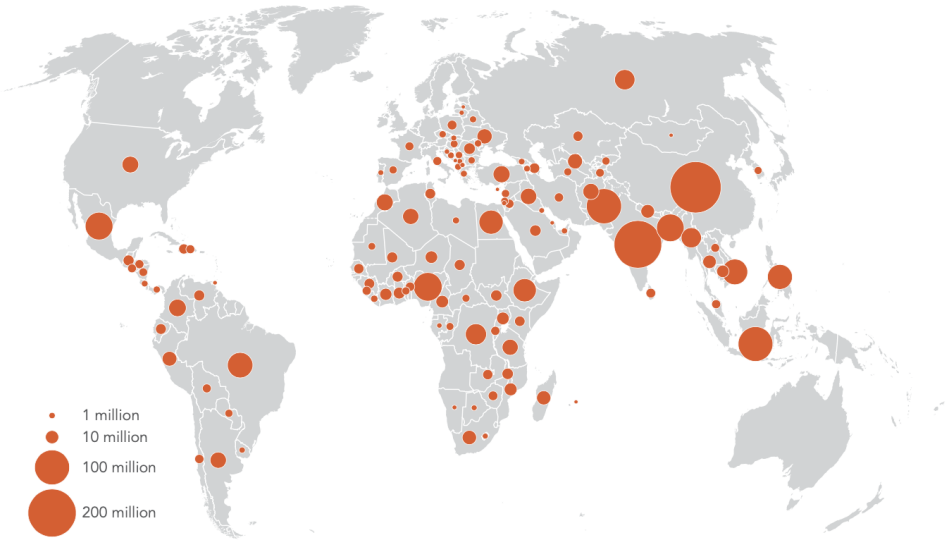
[74] CGAP is a global partnership of more than 30 leading development organizations that works to advance the lives of poor people through financial inclusion. Using action-oriented research, they test, learn and share knowledge intended to help build inclusive and responsible financial systems that move people out of poverty, protect their economic gains and advance broader development goals. https://www.cgap.org/about

growth and development. Generally, financial inclusion is measured by checking how many people own and use formal financial products.

According to the Oxford dictionary, the term unbanked refers to all people who *"do not have access to the services of a bank or similar financial organization"*. Worldwide, there are approximately 1.7 billion unbanked people[75]. When compared to 2014, when the total was 2 billion, it can be said that financial inclusion is increasing globally, accelerated by cell phones and internet access.

In high-income economies, the number of people with accounts is nearly universal (94% of adults have an account[76]): still, just looking at Europe, where the total number of unbanked people is estimated to be close to 40 million, it becomes clear that this is a worldwide problem. Certainly, however, the majority of unbanked adults are in developing economies. As can be seen from the map (Figure 20), China has the largest number of unbanked adults, followed by India[77], Pakistan, and Indonesia. These 4 States - whose numbers of unbanked people are 225, 190, 100, and 95 million, respectively - along with 3 others, namely Nigeria, Mexico, and Bangladesh, reach nearly 50% of the world's unbanked population.

Figure 20. Worldwide adults without an account, 2017



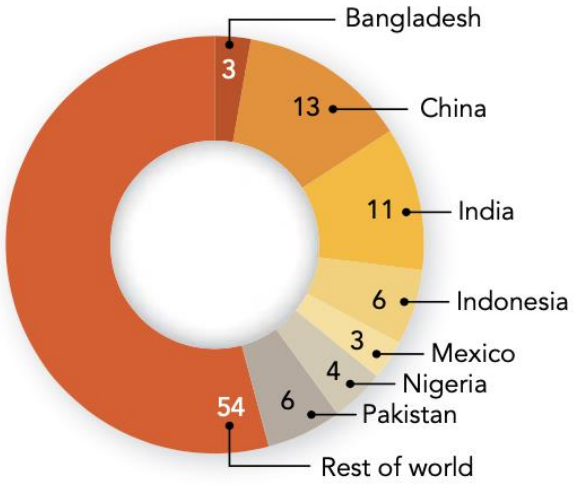
Source: The Global Findex database 2017

[75] Demirguc-Kunt A., Klapper L., Singer D., Ansar S. and Hess J., "The Global Findex Database 2017: Measuring financial inclusion and the fintech revolution", the World Bank, p. 35
The data used in the analysis refers to the year 2017, as it is the latest available on the web up to this moment. In fact, the last research done by the World Bank dates back to this paper, published in 2018.

[76] Demirguc-Kunt A., Klapper L., Singer D., Ansar S. and Hess J., "The Global Findex Database 2017: Measuring financial inclusion and the fintech revolution", the World Bank, p. 18

[77] It should be noted that China and India have relatively large numbers of current accounts; however, they claim large shares of the world's unbanked population due to their size.

Figure 21. Adults without an account by economy (%), 2017

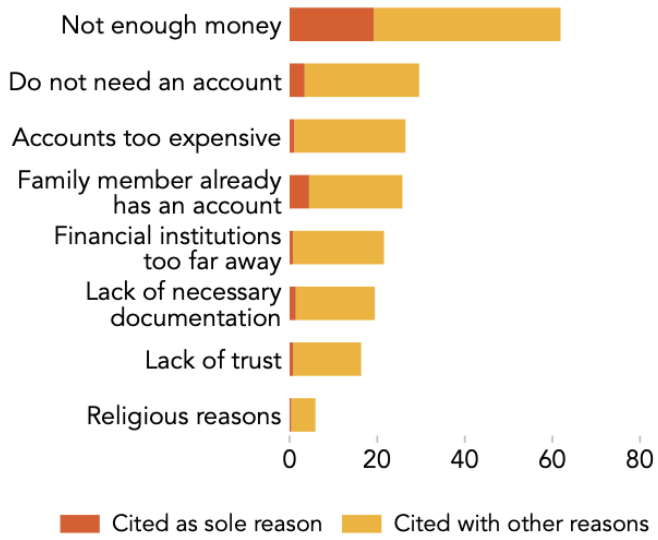


Source: The Global Findex database 2017

The research goes further by analyzing which segments of the population are most susceptible to financial exclusion. Specifically, women are overrepresented among the world's unbanked (not just in developing countries): they account for 56% of all unbanked adults globally. Moreover, unbanked adults - including both men and women - tend to be concentrated among the poorest households. Globally, about a quarter of unbanked adults live in the poorest 20 percent of households within their economy[78]. In fact, if one considers the reasons why 31% of the world's population is unbanked, the most frequent one is the lack of money: almost two-thirds of people without a financial institution account consider this to be the main reason; for one-third, moreover, it is the only reason. This figure can easily be linked to the third reason, which is the fact that accounts are too expensive. A few believe they do not need an account, in some cases because there is already someone in the household who does. Other reasons include the distance from financial institutions, lack of necessary documentation, lack of trust; finally, a small percentage (6%) of people do not have an account for religious reasons. Looking at the reasons why people do not open an account with a financial institution is also critical to finding future solutions.

[78] Demirguc-Kunt A., Klapper L., Singer D., Ansar S. and Hess J., "The Global Findex Database 2017: Measuring financial inclusion and the fintech revolution", the World Bank, p. 36

Figure 22. Main reasons why adults do not have a financial institution account, 2017



Source: The Global Findex database 2017

In this regard, a key role in driving financial inclusion can be played by the internet and mobiles, which have already initiated a new generation of financial services that do not require sophisticated devices. Obviously, however, adequate infrastructure is key: on the one hand, physical infrastructure, such as electricity and mobile networks; and on the other, financial infrastructure, including both an adequate payments system and a physical network to provide payments to all corners of the economy. While cards (debit/credit) are the most widely used tool among digital payments in many developed economies, people in most developing economies do not have cards. As World Bank research shows, however, many do have a mobile phone and internet access, two tools that could enable these economies to take advantage of mobile payments - thus incrementing financial inclusion. Looking at the data, globally, there are about 1.1 billion unbanked adults who have a phone: that is about two-thirds of all those without an account. As for internet connection, the share of people who own both a phone and a connection is lower (25%) - with a large difference across developing economies. These are two tools that would overcome some of the barriers that unbanked adults claim underlie their inability to access financial services: first, it could be helpful for those who cite high costs as a reason for not having an account with a financial institution. In fact, digital financial services would reduce the distance between financial institutions and people, lowering their costs.

Furthermore, FinTech companies are also trying to drive financial inclusion by trying to make getting a bank account more accessible: since among the reasons expressed by the unbanked there is the lack

of the necessary documents, some are experimenting with new technologies - such as biometric authentication, including through fingerprints and iris - to overcome this obstacle[79].

A more effective approach could be to give citizens who do not have an account with a bank or institution access to digital payment instruments that do not depend on traditional bank accounts - in this regard, hypothetical coins issued by central banks could be a key turning point[80].

There is also a more pragmatic approach to helping unbanked users digitize their money without necessarily having a bank account. Mexico is a clear example: only 37% of adults have a bank account and people working in the informal sectors receive their salaries in cash; this implies that they cannot use all the payment options that require an alternative instrument to cash (e-commerce); this has prompted merchants in Mexico to adopt an alternative, hybrid solution that allows customers to buy online but pay in cash via a voucher that is sent at the end of the online purchase and must be printed and taken to a local store. The transaction is completed within 24 hours and when the payment is successfully processed, the status of an order will change to paid and users will receive their product[81].

In conclusion, digital payment services can offer financial inclusion, but they can also inhibit it[82]. Therefore, it is crucial to move in the right direction so that the new technologies available to humans can benefit even the most disadvantaged sectors of the world's population.

Reduction of the cost of cash

Digital payments have another great advantage, that of eliminating the many costs associated with cash: for States, managing banknotes and coins is not free; on the contrary, they have to bear several costs, which are related to materials, machinery used for production, storage and distribution[83].

To give an idea of the production and associated costs of the currency, I looked at data in the United States and Europe. In America, currency paper is made of 75% cotton and 25% linen - this gives American currency its distinct look. For denominations of $5 and above, the security thread and vertical or numerical watermark are incorporated into the paper from the initial moment of production. For the $100 bill, a 6mm wide 3D security ribbon is woven into the paper - adding a very

[79] Evstratov K., "How technology can help unbanked access e-commerce", World Economic Forum, May 2021

[80] This issue will be further analyzed in chapter 4, dedicated to CBDCs

[81] Evstratov K., "How technology can help unbanked access e-commerce", World Economic Forum, May 2021

[82] Bostic R., Bower S., Shy O., Wall L. and Washington J., "Shifting the Focus: Digital Payments and the Path to Financial Inclusion", Federal Reserve Bank of Atlanta, No. 2'-1, 2020

[83] Volpe C., "Banconote e monete in euro: quanto costa produrle", Starting Finance, August 2020

advanced level of security to the bill. All bills use green ink on the back and other ink colors on the front - all specially formulated and blended by the Bureau of Engraving and Printing (BEP)[84]. The latter each year receives an order from the Federal Reserve Board, which is responsible for determining the likely demand for new currency. The BEP produces the currency and charges the cost to the Board. For example, the currency operating budget in 2021 is $1,095.8 million[85]. The table below is based on the 2021 Currency Budget[86] data and shows the costs of producing the bills: it can be seen that, when put in relation to their value, the costs become very significant for small denomination banknotes.

Table 4. Printing costs for banknotes in the US

Denomination	Printing costs
$1 and $2	6.2 cents per note
$5	10.8 cents per note
$10	10.8 cents per note
$20	11.2 cents per note
$50	11.0 cents per note
$100	14.0 cents per note

Source: Board of Governors of the Federal Reserve System; https://www.federalreserve.gov/faqs/currency_12771.htm

As for annual coin production, it is determined by the U.S. Mint. As the table below shows (Table 5), in some cases the cost exceeds the face value: this is the case of the penny (one-cent) and nickel (five-cent).

[84] https://www.moneyfactory.gov/hmimpaperandink.html

[85] https://www.federalreserve.gov/faqs/currency_12771.htm

[86] Board of Governors of the Federal Reserve System, "2021 Currency Budget", Division of Reserve Bank Operations and Payment Systems

Table 5. Unit cost of producing and distributing coins by denomination

2020	One-Cent	Five-Cent	Dime	Quarter-Dollar	Half-Dollar
Cost of Goods Sold	$0.0151	$0.0653	$0.0326	$0.0760	$0.2500
Selling, General & Administrative	$0.0022	$0.0080	$0.0042	$0.0091	$-
Distribution to FRB	$0.0003	$0.0009	$0.0005	$0.0011	$-
Total Unit cost	$0.0176	$0.0742	$0.0373	$0.0862	$0.2500

Source: United States Mint, 2020 Annual Report

In Europe, both the ECB and the National Central Banks (NCBs) of the euro area - according to the rules and principles established in the Eurosystem - are entitled to issue euro banknotes (in practice, only the NCBs materially provide for the issuance and withdrawal of euro banknotes). For reasons of efficiency, the printing of banknotes is divided among the different NCBs. The ECB allocates production volumes to a number of NCBs, which then provide a precise share of the total annual production for one or more denominations[87].

Table 6. Banknotes production in euro area countries, 2021 and 2022

2021

Denomination	Quantity (in millions of banknotes)	Value (€ millions)	NCBs commissioning production
€5	973.8	4,869.1	BE, ES, AT, PT
€10	1,176.1	11,761.2	DE, GR
€20	1,403.6	28,071.2	DE, EE, IE, FR, IT, CY, LU, MT, NL, SI, SK, FI
€50	1,951.4	97,572.0	DE, ES, FR, IT, LV, LT
€100	-	-	
€200	335.0	67,000.0	DE, AT
€500	-	-	
TOTAL	5,839.9	209,273.5	

2022

Denomination	Quantity (in millions of banknotes)	Value (€ millions)	NCBs commissioning production
€5	316.0	1,580.0	FR
€10	918.0	9,180.0	BE, DE, GR, AT
€20	1,215.0	24,300.0	BE, FR, IT, PT
€50	2,767.0	138,350.0	DE, EE, IE, ES, FR, IT, CY, LV, LT, LU, MT, NL, SI, SK, FI
€100	420.0	42,000.0	DE
€200	452.0	90,400.0	DE
€500	-	-	
TOTAL	6,088.0	305,810.0	

Source: ECB

Banknotes are composed of cotton fiber, to which is added a watermark, a metal foil, and a security thread (a thread on which there is a code). The last three components are essential to quickly and safely verify the authenticity of the cash. Since cotton is the material used for production, the cost of production varies according to fluctuations in the price of the raw material and, to a lesser extent,

[87] https://www.ecb.europa.eu/euro/intro/production/html/index.it.html

other materials. To print banknotes, the cost varies between 6 and 18 cents, varying between different bill denominations[88].

As for the coins, they are managed and produced by the NCBs and the State Mints, within the limits accepted by the ECB. As for America, similarly in Europe there have often been discussions related to the pieces of 1, 2 and 5 cents. These, in fact, have a production cost higher than their monetary value: a 1-cent coin costs about 4.5 cents, a 2-cent coin about 5.2, and a 5-cent coin about 5.7. Even in this case, the expense is not fixed but it can change according to the price fluctuations of the necessary materials. Minting 10-cent coins costs the State 5 cents; the 20-cent coin costs 7 cents; finally, the 1- and 2-euro pieces require 18 and 25 cents per unit, respectively.

In addition, there are certain costs for individuals who use cash as well: besides the possibility of being robbed or losing money and spending different amounts of time in lines at ATMs or waiting for slow transitions at a retailer's checkout, being that cash currently earns essentially no interest means that it is a non-productive investment vehicle. Moreover, when a citizen wants to deposit cash in a checking account, he or she often has to pay a fee: this is because most banks either charge conventional checking accounts or impose minimum deposit requirements - or both - to support cash-related costs.

In conclusion, the costs of handling cash, which are due to its physical nature, would disappear or at least decrease in a digital world.

2.3 SATISPAY: A CASE STUDY

With the rapid growth of the global economy, mobile phones have become a commodity that an individual cannot live without - and so has the internet. This incremental need has driven the rapid growth of the mobile payments market, a trend that - given changing lifestyles, everyday commerce, and the expansion of online retailing - is expected to continue in the future. Today, mobile payment is a consolidated payment method in many countries around the world.

Starting from the Asian world, in China the digital payments market is very fragmented, but the most used platforms are all traceable to Chinese companies: a large part of the collections take place mainly with Alipay and WeChat Pay. According to the Statista Global Consumer Survey of July 2020, they have been used at least once in the previous 12 months by 97% and 87% of respondents respectively[89].

[88] Volpe C., "Banconote e monete in euro: quanto costa produrle", Starting Finance, August 2020

[89] Axerve, "Alipay e i sistemi di pagamento per il mercato cinese", May 2021

Compared to other parts of the world, particularly China, the U.S. is far behind in mobile payment adoption[90] - a fact that, at first glance, may seem odd considering the prevalence of smartphones in America; however, according to data provided by eMarketer, the U.S. mobile payments market has increased 41% from $69.8 billion in 2018 to $98.8 billion in 2019[91].

As far as Italy is concerned, in 2019 there was an increase in use for both proximity payments (made at the point of sale via mobile devices) and payments outside the physical store; in particular, the former saw a real explosion in Mobile Proximity Payment in 2019: almost €1.83 billion was transacted via smartphones inside stores[92]. Currently, there are several apps on the market: among them, it is worth mentioning PayPal, Apple Pay, Google Pay, Amazon Pay, and Satispay.

Satispay

The idea of creating a way to use smartphones to easily and conveniently perform many payment activities - and not only - was born in 2013 thanks to entrepreneur Alberto Dalmasso and computer scientist Dario Brignone, two young minds from a town in Piedmont, Cuneo.

> *"In early 2012, along with Dario Brignone, we began to question why you could do anything with a smartphone with extreme comfort and convenience, except pay. We used to have our credit cards rejected for small payments and considered a waste of time withdrawing money from ATMs or searching for pennies when we had to give money back to a friend to split a bill or the cost of the soccer field".*[93]
>
> Alberto Dalmasso - Founder & CEO at Satispay

At the end of 2013 Satispay was founded and, after less than two years, the mobile application was launched. Satispay is a digital, cashless payment service that allows consumers to pay and send money without using credit cards or reloading ATMs[94]. In fact, Satispay takes money directly from

[90] Rooney K., "Mobile payments have barely caught on in the US, despite the rise of smartphone", CNBC, August 2019

[91] Kohan S.E., "Fueled by increased consumer comfort, Mobile Payments in the US will exceed $130 Billion in 2020", Forbes, 2020

[92] Asaro I., "Pagamenti Contactless: definizione, limite e mercato in Italia", Osservatori.net, June 2020

[93] Nicolucci A., "Satispay, una Silicon Valley a due passi dal «Dòmm»", Banca Finanza, March 2017

[94] Satispay can be used by 18 years old users with a bank account or prepaid card with an IBAN code, if they support SEPA Direct Debit.

the bank account and only an internet connection is needed to make payments at affiliated stores or send money to other users. The app is completely independent of traditional payment circuits[95] and can be downloaded from the App Store, Google Play and AppGallery.[96]

Registration is very simple and can be done either directly from the app or via the website. Once installed, to create an account, the person must enter his personal information, the IBAN of the associated bank account, a scan of an ID, and a photo taken with the computer's webcam or the front camera of the smartphone. Then, Satispay takes care of processing the information in order to check that everything is compliant to proceed with account activation (if not, additional information is requested). The customer must also choose a five-digit PIN that allows him to enter the app each time it is opened. Once the account is activated, in order to benefit from the services offered by the company, the user has to set a weekly budget, i.e. the amount of money he or she wants to have on his account on a weekly basis. This figure can be modified later, via the appropriate section present in the app. By receiving or sending money during the week, the balance increases or decreases accordingly - though, the budget remains the same. At the beginning of each week, the balance will return to the budget level. This means that if at the end of the week Satispay balance is lower than the budget, then the difference will be automatically transferred from the user's bank account to Satispay. On the other hand, if the balance is higher than the budget, then the extra money will be transferred from the Satispay account to the bank account. If no transitions are made and the balance is equal to the budget, then no recharge is made[97]. The maximum budget that can be set on the app is € 200[98]; however, there is the possibility - for active users, who regularly use the app and have already made a number of payments - to send a request by filling out an online form, to request to increase it. Each request is evaluated individually.

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[95] They decided not use credit/debit cards and stayed independent from a specific bank or network operator to provide a new system that is smart for users and cheaper for businesses; https://www.satispay.com/en-it/

[96] https://support.satispay.com/en/articles/what-is-satispay

[97] A numerical example can help to understand how this system works: assuming that the user decides to set a weekly budget of €200, this is the maximum total amount of spending he/she can do by paying with the app. If during the week the total amount spent by the user is 30€, at the end of the week the budget will be 170€. In order to bring the budget to 200€, at the beginning of the week 30€ is withdrawn from the current account. If, on the contrary, during the week the user receives money and therefore has an available balance higher than the set budget, for example 250€, at the beginning of the week 50€ will be transferred to the bank account. Finally, if the user does not make or receive any payment during the week and the budget is still 200€, no operation will be carried out.

[98] The choice of setting limits is not of a technical or legal nature: it lies rather in the initial desire of the founders to test people's habits and offer a weekly ceiling in line with the management of small weekly expenses.

As far as the services offered are concerned, besides the possibility to make payments at affiliated businesses - including both in-store[99] and online shopping - it is possible to exchange money with all the people who have an account on Satispay; users can also make payments to the public administration with the pagoPA system[100], pay postal bills and car taxes, make top-ups for phones, use the app as a digital wallet and create special gift bags for important events. In addition, the *Delivery and Takeaway*[101] function has recently been implemented, which allows customers to find affiliated take-away stores, keep in touch with them by phone to make reservations and finally pay with the app).

Moreover, there is the *Cards* service, which allows you to save your fidelity barcode cards directly in the App, simply by scanning them. This is another way that benefits and facilitates the consumer at the time of purchase, making payments faster and smarter. Finally, thanks to the *Savings* service[102], people can create their digital Money Box: once the person chooses a savings method from several options, the app will set aside money. Moving money in and out of the piggy bank is completely free and can be done at any time.

In addition to analyzing the services and benefits that consumers have, it is also important to examine the side of businesses that decide to enter the world of Satispay. A company that decides to activate Satispay Business can accept cashless payments. The merchant's first benefit is that the system eliminates the risk of being stolen or paid with counterfeit cash. To receive payment, it is only necessary for customers to press "send" on their smartphones. In addition, by adhering to the *Cashback Network* program, the merchant can reach more customers - thus increasing the store's visibility - or retain existing ones; in fact, it provides a small percentage of reimbursement on the

[99] Thanks to the geolocation system, Satispay discovers the location of the user and shows him the technical card of the store. It is also possible to go to "Stores", select the merchant you want to pay or scan the QR code on the cashier of the store. Then it is only a matter of entering the amount and sending it; the merchant receives the payment notification in a few seconds and can accept or reject it. Once accepted, Satispay transfers the amount of money from the user's account to the merchant's, thus ending the transaction. https://support.satispay.com/en/articles/in-store-payments

[100] pagoPA is a system of electronic payments designed to make any payment to the Public Administration simpler, safer and more transparent. pagoPA is not a site to pay, but a new way to make payments to the Public Administration in a standardized way, through participating Payment Service Providers (PSP). Payments can be made directly on the site or on the mobile application of the Public Administration or through both physical and online channels of banks and other Payment Service Providers (PSP). https://www.pagopa.gov.it/it/pagopa/

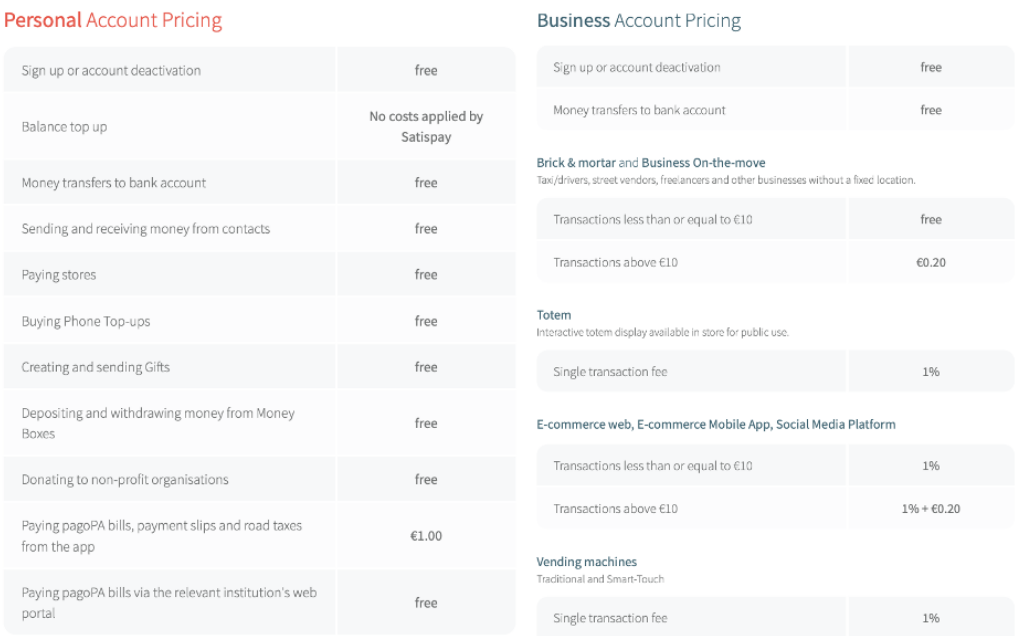
[101] You can place your order by tapping the store's logo and calling the phone number that appears by pressing the Contact button. Once you have placed the order via phone, you'll receive a payment request from the store; by accepting the payment, your order is confirmed. You can then comfortably await your delivery at home or go pick up your takeaway order; https://support.satispay.com/en/articles/delivery-and-takeaway

[102] https://support.satispay.com/en/articles/savings
The different savings options are: 1. Spare Change- every purchase will be rounded to the nearest euro and cents will be added to the piggy bank; 2. Cashback- where money refunded in purchases is put into the piggy bank; 3. Periodic- a fixed amount is automatically set aside periodically.

amount spent. Whether or not to activate this functionality is a decision that is directly up to the merchant; the cost for the service is a monthly fee of € 20 and there are three types: first, the *Classic Cashback*, where a fixed percentage of refund is established on each purchase; second, a *First Purchase Cashback*, where the partial refund is activated only for the first sale; third, *Incremental Cashback*, where the amount returned increases in proportion to the number of purchases in that store. It is even possible to combine the First Purchase Cashback with one of the other two[103].

As for the cost aspects, Satispay guarantees an almost free service: for both private customers and merchants, there are no activation costs. Thanks to the fact that the payment system is completely independent of traditional circuits, intermediaries have been eliminated, allowing Satispay to increase efficiency while reducing costs. As you can see in Figure 23, no costs are applied to the private customer, except for payment of services for the Public Administration, car tax, and payments slips- which cost €1 if you pay through the app. For merchants, the free service is granted only for micro-payments, that is those up to €10; there is instead a fixed commission of €0.20 for transitions over €10. As for e-commerce, there is a 1% fee up to 10€ and 1% plus 0.20€ for amounts above the 10€ threshold.

Figure 23. Satispay cost scheme



Personal Account Pricing

Sign up or account deactivation	free
Balance top up	No costs applied by Satispay
Money transfers to bank account	free
Sending and receiving money from contacts	free
Paying stores	free
Buying Phone Top-ups	free
Creating and sending Gifts	free
Depositing and withdrawing money from Money Boxes	free
Donating to non-profit organisations	free
Paying pagoPA bills, payment slips and road taxes from the app	€1.00
Paying pagoPA bills via the relevant institution's web portal	free

Business Account Pricing

Sign up or account deactivation	free
Money transfers to bank account	free

Brick & mortar and **Business On-the-move**
Taxi/drivers, street vendors, freelancers and other businesses without a fixed location.

Transactions less than or equal to €10	free
Transactions above €10	€0.20

Totem
Interactive totem display available in store for public use.

Single transaction fee	1%

E-commerce web, E-commerce Mobile App, Social Media Platform

Transactions less than or equal to €10	1%
Transactions above €10	1% + €0.20

Vending machines
Traditional and Smart-Touch

Single transaction fee	1%

Source: Satispay

[103] https://support.satispay.com/en/articles/cashback-network

These figures are convenient for merchants, especially when compared to the fees they have to pay when paying with traditional credit and debit cards.
According to an analysis provided by the *Osservatorio Credito Confcommercio* based on data from the Bank of Italy, 67% of businesses consider the acceptance of credit and debit cards to be "not advantageous": the first reason for dissatisfaction (95%) is linked to management costs and commissions. This has prompted about half of the merchants to turn to their bank to negotiate a reduction in commissions: more than half, however, have not received satisfaction; three merchants out of four believe that it is essential to reduce costs if one wants to increase the use of cards to the detriment of cash; finally, a smaller number of people (23%) ask that installation and management costs be reduced[104].

Despite the fact that the pandemic has led to the closure of many businesses, offices, and services, Satispay has confirmed its role as a leader in the market transition to electronic payments also in 2020. During this period, in fact, it has proven to be an important ally for citizens who have approached digital payments; it has also been an important tool for merchants, as it has managed in record time to offer alternative services - such as the *Delivery and Takeaway* service (previously reviewed), created to support small merchants in maintaining business despite the forced slowdown. The research "*Innovative Payments- from choice to necessity*"[105] carried out in 2021 by the School of Management of Politecnico di Milano revealed significant changes in the purchasing and payment habits of citizens, who rewarded payment systems that were simple, fast and offered security of distance. In 2020, payment via smartphone has experienced great popularity: the transit volume exceeds € 3.4 billion, an increase of more than 80% compared to 2019. Within the category, the volume transacted through non-NFC systems (that is, not connected to the traditional credit card model), stands at €500 million in 2020, an increment of 32% over the previous year. Of this, around 60% - equivalent to around €300 million - went through Satispay: a number of payments amounting to 20 million were made, representing 67% of the total payments in the segment under review[106].

[104] Data provided by Confcommercio, "Pagamenti digitali e cashback", October 2020

[105] https://www.osservatori.net/it/eventi/on-demand/convegni/convegno-risultati-osservatorio-innovative-payments-convegno

[106] Riccio S., "Il boom dei pagamenti digitali spinge le fintech italiane: numeri record per Nexi, Satispay e Hype", La Stampa, 11/03/2021
https://www.lastampa.it/topnews/economia-finanza/2021/03/11/news/il-boom-dei-pagamenti-digitali-spinge-le-fintech-italiane-numeri-record-per-nexi-satispay-e-hype-1.40013757

The outstanding performance of Satispay, however, was not limited to in-store payments: analyzing the total volume of payments - therefore including besides in-store payments, online payments and services such as P2P, phone top-ups, utility bills, pagoPA, car taxes - it grew by 81% compared to 2019, from €323 million to €585 million total transacted as of December 31, 2020. Despite the lockdowns, the data highlights the company's strong growth, reporting a 58% increase in volume and a 60% increase in the number of payments compared to 2019[107].

Year after year Satispay demonstrates the strength of the alternative payment model to the traditional ones; recently, it has been f included in the category of Digital Wallet that ARK Investment[108]. As shown in figure 24, in the annual report *Big Ideas 2021*, Satispay is included among the 6 European companies in the Digital Wallet segment; it is interesting to note that it is included among the 32 companies at a global level, and of those in Europe, it is the only Italian company.

Figure 24. Worldwide Digital Wallets

Source: AKR Invest, Big Ideas 2021

[107] Financial Trend Analysis, "Satispay, veicolato il 67% dei pagamenti mobile non NFC nel 2020", Trend online, 11/03/2021

[108] Riccio S., "Il boom dei pagamenti digitali spinge le fintech italiane: numeri record per Nexi, Satispay e Hype", La Stampa, 11/03/2021

2.4 THE IMPLICATION OF ELECTRONIC PAYMENTS ON BANKS

The banking sector is not immune to the digital revolution: technological progress and the digitization of payments have had a significant effect on the financial sector, bringing numerous developments to banks as well. Thanks to technologies, new customer contact mechanisms and offerings have been enriched. Artificial Intelligence[109], Machine Learning[110], Blockchain[111] and the Internet of Things[112] are redefining the boundaries and the very nature of financial services.

Recently, new non-banking players, such as digital champions (e.g., Google, Amazon, Facebook, Apple, etc.) and fintech, have entered the competitive arena of the sector (particularly in the payment services business).

Two services that have emerged over the past three decades and are becoming increasingly popular are internet banking[113] and mobile banking: the former is an electronic payment system that allows customers of a bank or other financial institution to carry out a range of financial transactions through the website; on the other hand, mobile banking is when transactions are carried out via a smartphone or tablet. These services offer customers a number of benefits, primarily in terms of time and space: according to data reported by Statista[114], the total number of users using online and mobile banking in 2020 amounted to 1.9 billion worldwide. Furthermore, online and mobile banking usage is estimated to increase steadily between 2020 and 2024, reaching 2.5 billion, with the Asian market leading the way. The Far East and China already accounted for more than 800 million active online banking users in 2020 - estimated to reach nearly a billion by 2024. reach 2.5 billion by 2024.

[109] Definition of Artificial Intelligence: the theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages. https://www.oxfordreference.com/view/10.1093/oi/authority.20110803095426960

[110] Definition of Machine Learning: a branch of artificial intelligence (AI) and computer science which focuses on the use of data and algorithms to imitate the way that humans learn, gradually improving its accuracy. https://www.ibm.com/cloud/learn/machine-learning

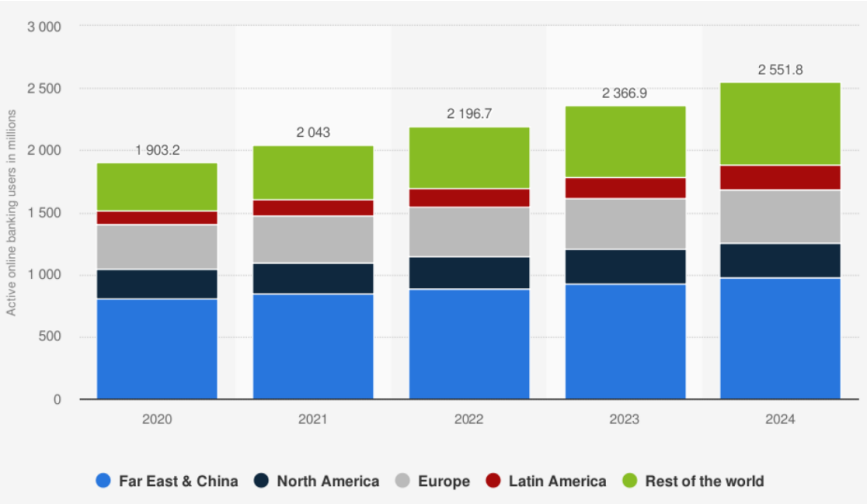
[111] Definition of Blockchain: Blockchain is a shared, immutable ledger that facilitates the process of recording transactions and tracking assets in a business network. https://www.ibm.com/topics/what-is-blockchain

[112] Definition of Internet of Things: it refers to a distributed network connecting physical objects that are capable of sensing or acting on their environment and able to communicate with each other, other machines or computers. https://www.europarl.europa.eu/RegData/etudes/BRIE/2015/557012/EPRS_BRI(2015)557012_EN.pdf

[113] It is also known as online banking, web banking or home banking.

[114] The data is based on a survey conducted by Juniper Research in March 2021

Figure 25. Number of active online banking users in 2020, with forecasts from 2021 to 2024, by regions (in millions)



Source: Statista, 2021

Moreover, in recent years, especially in the United States, a phenomenon that could create major financial risks (attacking the bank's core business) is exploding, the so-called Buy Now, Pay Later (BNPL). According to some data, 1 out of 3 Americans uses this payment tool and the number rises to more than half if we consider the 34-44 age group[115].

The way it works is very easy: buyers can buy an asset by getting a short, interest-free loan. There are three intertwining factors that have caused this phenomenon to surge in the last period: investors like fintech companies making the loans; consumers enjoy receiving credit on which they don't have to pay interest; and finally, merchants love this tool because it allows them to increase sales. However, this can be a dangerous instrument: first of all, it could encourage buyers to overextend themselves; the loans are unsecured so there is nothing stopping a person from racking up balances with more services. Furthermore, while there are no interest rates, in most cases there are fees charged if a person does not make the payment on time. Even in this case, the crush on BNPL has led the banking sector to scramble to find alternative services: several banks have launched or are evaluating BNLP services with different business models: a first method - though leading to reduced earnings for banks - is to lease their balances to BNPL firms[116]. A second method can be to integrate installments into credit cards: in fact, there are many banks that already allow installment payments - albeit including interest

[115] McIntyre A., "Buy Now, Regret it Later? The hype of BNPL and its impact on consumers, banks and merchants", Forbes, Feb. 2021

[116] An example of is Cross River Bank, which has used this method, outsourcing the financing capacity to Affirm.

rates. Other solutions may be to buy a BNPL company or create a partnership to offer BNPL solutions[117].

So, if initially the approach of financial institutions towards fintech was defensive, now they are progressively moving towards a collaborative approach, even on the topic of blockchain. One example of collaboration between banks and fintech is the experience of R3, a technology company that specializes in creating blockchain for the financial world, which has attracted the attention of major industry players and created a consortium of more than 70 institutions, including Barclays, BBVA, Credit Suisse, but also UniCredit, Intesa Sanpaolo and Banca Mediolanum, with the aim of developing shared solutions for leveraging blockchain technology in the banking world[118].

In any case, new payment systems and currencies issued by the private sector have led to numerous challenges for banks and financial institutions more generally. First, there are some clear implications of electronic and digital money on monetary policy[119]: a primary risk for banks concerns the diminution of central bank control over the money supply; indeed, central banks conduct monetary policy by regulating the supply of money, generally through open market operations[120] - with the aim of steering short-term interest rates, which in turn influence long-term rates and overall economic activity. Of course, a possible decrease in their role depends on the degree of substitution; the explanation is that currency in circulation is part of the monetary aggregates: if the use of cash decreases, it will be difficult for the central bank to measure the monetary aggregates and control the money supply. A solution to this problem can be found in regulation, in the sense that it can be envisaged to impose some limitations on the use of e-money.
A further problem associated with the rise of electronic money concerns the consequent reduced need to print cash: this has a significant impact on central bank revenues. Seigniorage is the term for all income derived from the issuance of money. For central banks, seigniorage income can be defined as the interest stream generated by assets held against bills in circulation or, more generally, against the

[117] There is one example: Barclays, a British international bank, has decided to partner with Amount to bring a BNPL solution to market.

[118] KPMG, "Digital banking. L'evoluzione delle aspettative dei clienti tra rivoluzione digitale, sfide regolamentari e nuovi competitor", 2018

[119] Popovska-Kamnar, Neda, "The use of electronic money and its impact on monetary policy", Journal of Contemporary Economic and Business Issues, ISSN 1857-9108, 2014

[120] For instance, a central bank may reduce the supply of money by selling government bonds, thereby taking money from commercial banks. https://www.imf.org/en/About/Factsheets/Sheets/2016/08/01/16/20/Monetary-Policy-and-Central-Banking

monetary base[121]. To understand the impact of digital currencies, we need to start with their creation: at the beginning, the value of the digital currency is zero, and only once trading of the digital currency for sovereign currency begins will there be a positive market price or exchange rate. As it gains popularity, various asset substitutions take place: people reduce their cash holdings and start making some payments with digital currency. In addition, individuals may choose to hold fewer bonds, seeing digital currency as a new asset class. As overall deposits shrink, banks' demand for central bank deposits could also decline, leading to a smaller central bank balance sheet and therefore less seigniorage[122].

Concerning digital currencies, as I analyzed in the previous chapter, traditional banks are reluctant towards cryptocurrencies, arguing that their inherent risks outweigh their potential benefits. This stems primarily from the decentralized nature of cryptocurrencies and their volatility: they were created with the intention of providing an alternative to traditional banking infrastructure; this allows users to transfer funds quickly and without having to pay transaction fees; this itself represents a challenge for financial institutions.

However, there is a way that banks can cope with the cryptocurrency market, without being left behind but rather by changing their thinking about it. In July, the Office of the Comptroller of the Currency (OCC)[123] stated that banks and savings associations could provide cryptocurrency custody services for customers, including holding unique cryptographic keys associated with access to private wallets[124]. At the same time, banks could be an asset, aiding the entry of new, inexperienced cryptocurrency investors and militating the security concerns of cryptocurrency holders.

The transformation of the payments system has clearly raised some concerns, as reflected in a speech by Fabio Panetta - a member of the ECB's executive board - in which he said that *"We need to make sure our currency is fit for the future"*[125]. In this sense, CBDCs could represent a major turning point

[121] https://www.bancaditalia.it/compiti/emissione-euro/signoraggio/index.html?com.dotmarketing.htmlpage.language=102

[122] Heller D., "The implications of Digital Currencies for Monetary Policy", Policy department economic and scientific policy, 2017

[123] The OCC is an independent bureau of the U.S. Department of the Treasury. It charters, regulates, and supervises all national banks, federal savings associations, and federal branches and agencies of foreign banks- ensuring that they operate in a safe and sound manner, provide fair access to financial services, treat customers fairly, and comply with applicable laws and regulations.

[124] Scicchitano M., "How Cryptocurrencies May Impact the Banking Industry", Wolf &Co

[125] Panetta F., "We must be prepared to issue a digital euro", ECB Blog, October 2020 https://www.ecb.europa.eu/press/blog/date/2020/html/ecb.blog201002~12ab1c06b5.en.html

towards digital for central banks: they could become a complementary means of payment, serving as a catalyst for continued innovation and competition in payments, finance and commerce in general[126]. Given the common interest of central banks (in discussing the possibility of issuing CBDCs) in promoting innovation and efficiency but without harming the central bank mandate, a precondition for the issuance of CBDCs is that its design does not disintermediate commercial banks or lead to greater volatility in their funding sources. While these are possible risks that central banks do not feel like ruling out, there are certainly some useful tools to address digital runs and the potential for disintermediation - including limits on the size of CBDCs, or variable interest rates that discourage users from holding very large stakes.

In conclusion, banks could and should move from seeing digital innovations on the payment front as competitors to possible partners; they can provide each other with mutual benefits: by increasing levels of collateral and security, banks can simultaneously benefit from the technology underpinning new digital tools that can streamline processes and bring the banking industry to a greater level of efficiency and innovation.

[126] Carstens A., "Digital currencies and the future of the monetary system", Hoover Institution policy seminar, January 2021 https://www.bis.org/speeches/sp210127.pdf

CHAPTER 3

STABLECOIN: A PRIVATE SECTOR INITIATIVE

Financial service providers and technology companies have been working for a few years now on stablecoins, a type of digital asset that uses stabilization mechanisms to minimize price fluctuations. It was born subsequently to cryptocurrencies which, as I briefly mentioned in the first chapter[127], present the problem of volatility. Unlike the latter, therefore, stablecoins are much more stable, since their values are generally anchored to other assets, be they fiat currencies or assets. This key feature allows stablecoins to enjoy the advantages of cryptocurrencies - such as transparency, security and privacy - while overcoming the limitation of pronounced and unpredictable variations. This has led to a growth in demand for stablecoins in recent years: specifically, according to research conducted by CB Insights, by the end of 2020, the total value of stablecoin assets exceeded $ 20 billion, showing growth of just under 300% year-to-year[128].

This growth, coupled with the fact that at least 200 stablecoins have either been released to date or are in development globally, leads to talk of a "stablecoin invasion"[129]. Furthermore, after the New York State Department of Financial Services approved and regulated two stablecoins pegged in dollars, financial services incumbents are also eyeing the opportunity - JPMorgan, for example, has piloted and launched its own stablecoin.

Since stablecoins are private sector initiatives, before covering the more technical aspects, I will give a brief overview of Big Tech in the financial sector, with a focus on the main companies that have decided - or are expected to happen in the future - to enter the financial sector by minting their own digital currency; Facebook is undoubtedly the key example: enjoying a worldwide network, this can lead to countless benefits. Next, in the second section, I will analyze the main characteristics and types of stablecoins: in fact, there is not only one general type of stablecoin; analyzing the main aspects of each one is fundamental to have a clear vision of the implications they can have. The third section will be dedicated to the main advantages and disadvantages of this digital currency: whereas some argue that they may have the ability to make payments faster and cheaper and support financial

[127] See Chapter 1, Section 1.3.2

[128] CB Insights Research, “What Are Stablecoins?”, February 2021
https://www.cbinsights.com/research/report/what-are-stablecoins/

[129] See note above (128)

inclusion, there are still many challenges they raise - in the areas of security, customer protection, financial and monetary stability risks, to name a few. Therefore, the fourth and last part will address the potential use of stablecoins, their implications and regulation. Regulation needs to adapt quickly to assess and contain the risks of stablecoins and to address those challenges to the economy, consumers, and the financial system.

3.1 THE ENTRY OF BIG TECH IN THE DIGITAL CURRENCY MARKET

Recently, we have seen the entry of big tech companies into the financial sector, primarily the payments market. According to a survey carried out by the European System of Central Banks, in 2020 there were over 200 new initiatives in the field of payments (a third of which could be attributed to companies in the process of start-up)[130]. However, it must be pointed out that, as shown by an analysis conducted by the Bank for International Settlements, this is not the core business of Big Tech[131]. Indeed, while fintech companies are set up to deal mainly in financial services, large technology companies provide financial services as part of a much broader set of activities. The table below (Table 7) shows the main offerings in the financial sector of some of the most prominent Big Techs in the world. These services are offered sometimes in competition with traditional financial institutions sometimes in partnership.

Table 7. Financial service offerings by big tech companies

Big tech	Main business	Banking%	Credit provision	Payments	Crowd-funding	Asset management	Insurance
Google	Internet search/advertising	✓*		✓			
Apple	Tech/producing hardware			✓			
Facebook	Social media/advertising			✓			
Amazon	E-commerce/online retail		✓	✓	✓		✓
Alibaba (Ant Group)	E-commerce/online retail	✓	✓	✓	✓	✓	✓
Baidu (Du Xiaoman)	Internet search/advertising	✓	✓	✓	✓	✓	✓
JD.com (JD Digits)	E-commerce/online retail	✓	✓	✓	✓	✓	✓
Tencent	Tech/gaming and messaging	✓	✓	✓	✓	✓	✓
NTT Docomo	Mobile communications	✓	✓	✓	✓		
Rakuten	E-commerce/online retail	✓		✓		✓	✓
Mercado Libre	E-commerce/online retail		✓	✓		✓	

✓ Provision of financial service through big tech entity and/or in partnership with financial institutions outside big tech group in at least one jurisdiction. ✓* Launch expected in 2021. % The core activity of an entity engaged in banking is taking deposits, though regulations vary across countries.

Source: FSI, 2021

[130] https://www.ecb.europa.eu/press/key/date/2020/html/ecb.sp201104~7908460f0d.it.html

[131] According to BIS, the core business of big tech is represented by technology information and consulting services, which make up 46% of their total revenues. Revenues related to their financial activities still remain a small percentage at 11%.

These large multinational technology companies have multiple advantages: first, due to the strong market positioning they possess in their core businesses, they have comparative advantages that allow them to achieve economies of scale more easily and quickly; second, they have a number of strategic characteristics, including significant technological capability and financial liquidity. In addition, these companies seek to offer an ecosystem of products and services, which are highly connected to each other. This allows global tech giants to have the ability to leverage network effects, taking advantage of the vast number of customers they have, to further expand into international markets.

The first strategic moves (that are undoubtedly the most well-known ones) in this field concerned the payments system: in particular, several companies launched online and mobile solutions (such as PayPal and Alipay), which in turn consolidated e-commerce activities - allowing them to lower the costs of payment transaction on the one hand and facilitate the collection of information on consumer purchasing behavior on the other. There are three main reasons for these companies to enter the payments market: it is a segment that is not subject to a strict regulatory framework, does not require a banking license and does not impose stringent requirements on its balance sheet[132]. In addition to payment services, some Big Tech has gone further, aiming to offer lending services. While the interest rates offered might be higher than average, these players manage to capture a portion of the market because they can rely on more effective moral hazard mitigation and credit risk assessment mechanisms[133]. In addition, Big Tech can also leverage network effects to expand into the insurance, asset management and investment markets.

In this context, it is relevant to mention the case of *Amazon*, which is attacking financial services from every angle: from payments and loans to insurance and checking accounts. All of the financial services Amazon is targeting are aimed at supporting its main goal: increasing participation in the Amazon ecosystem. The tools, in fact, aim on the one hand to increase the number of merchants, allowing each to sell more, on the other hand, to increase the number of customers, leading them to spend more. At the base, there is the attempt to eliminate any friction at the base of purchases and sales. So, while it cannot really be said that Amazon is building the next generation bank, it is, in a sense, creating a bank for itself[134]. In recent years Amazon has invested heavily in payments infrastructure and services: the primary goal is to make payments more efficient and frictionless for

[132] Biotta, Botti, "La finanza big tech tra efficienza e scelte di mercato", 2020

[133] See note above (132)

[134] CB Insights Research, "Everything you need to know about what Amazon is doing in Financial Services", April 2021

consumers. The first product, Pay with Amazon, was launched back in 2007; today, after 14 years, Amazon Pay exists: a digital wallet for customers and a payments network for both online and brick-and-mortar merchants and shoppers[135]. Amazon's innovative strategies in this area have gone further, even in terms of payments at the point of sale: in September 2020, for example, Amazon One was launched, which allows people to pay using the palm of their hand[136]. In the same period, a method of paying for gasoline at different locations using a voice command was launched.
As for savings, back in 2017, Amazon Cash was launched, which allows people to deposit cash without any fee into an online account by simply showing a barcode or their phone number associated with their Amazon account at participating stores. Similarly, the company is committed to allowing people to use e-commerce even in realities where there is no possibility of making payments online.
As for lending, in 2016, Jeff Bezos expressed his willingness to expand Amazon Lending, initially launched in 2011 to help small businesses finance and sell more goods on Amazon. Some innovations involve Amazon's consumer lending, offering benefits to anyone with Amazon Prime cards. Finally, the company has shown interest in marketplaces and insurance products: in 2016, Amazon Protect was introduced[137]. Some rumors suggest that, in the likely recent future, Amazon will take a step further in the direction of digital currencies.

Going back to the big techs' advantages in the payment market, the global scale of their business allows them to be ideally positioned to offer cross-border payment services, which today are still characterized by low quality and high costs. Stablecoins were born in this context: they would have the ability to be used by big techs to offer payment services both domestically and internationally. In this regard, it is worth analyzing in detail the case of Facebook, which has gone even further than the other realities, launching the Libra project in 2019.

Facebook

Following the example of China, after seeing the success of WeChat, Facebook has tried to enter the online payments market through the WhatsApp pay application. This is a global project, started in

[135] CB Insights Research, "Everything you need to know about what Amazon is doing in Financial Services", April 2021

[136] Customers first have to register to use this service by inserting a payment card into an Amazon One device and scanning one or both of their palms. Once registered, they enter and leave stores by placing their hand above a sensor at the entrance. Smart cameras and shelf sensors detect products customers take. The system then automatically charges customers as they leave the store.

[137] It is a white-label service in the UK that provides accidental and theft insurance on consumer goods; it has then expanded to other countries.

Brazil and destined to expand to other countries. It is a developed on two channels, the business channel and the private channel, allowing the exchange of money both through people and people and companies[138]. Besides this project, however, in recent years there has been much talk about Facebook for its proposal to launch a digital currency.

On June 18th, 2019, Mark Zuckerberg - president and CEO of Facebook Inc. - announced that the company itself would have released in early 2020 its own digital currency, called Libra (now Diem). The project, the currency itself, and transactions involving it were to be cryptographically managed and entrusted to the Libra Association (now Diem Association), which was an organization that included companies primarily from the payments, technology, and telecommunications industries. At the time of its founding, it had 28 members. Currently, the members are 26[139]: 8 have left (including big financial companies, such as eBay, Mastercard, PayPal and Visa) and 6 new members (including a payment systems company, an e-commerce company, a cryptocurrency brokerage firm and some venture capitals) have joined.

As stated in the first White Paper published in 2019, the primary goal was to provide access to financial services around the world, particularly in underdeveloped countries - creating *"immense economic opportunities."*[140] Looking at the more technical aspects, initially, the digital currency was to be pegged to a basket of low-volatility assets, consisting of bank deposits and short-term government bonds. The mechanism involved members of the Libra Association purchasing low volatility assets to put in the Diem reserve and then providing potential owners or users with the virtual equivalent of the Diem at the existing exchange rate. A prerequisite for the assets to be purchased was to be from "stable countries", and to be denominated in U.S. dollars, euros, British pounds or yen. Specifically, in September 2019 Facebook announced that the reserve would consist of 50% USD, 18% EUR, 14% JPY, 11% GBP and 7% SGD[141]. Along with the digital currency, a digital wallet had been launched, called Calibra (now Novi). Through this, the owners of Libra would have been able to carry out the different functions (saving, buying and sending Diem). Regarding

[138] Biagio S., "Arriva WhatsApp Pay: servizio già attivo in Brasile, presto anche in Italia, il Sole 24 Ore, June 2020

[139] The current members of Diem Association are: Anchorage, Andreessen Horowitz, Blockchain Capital, Breakthrough Initiatives, Checkout.com, Coinbase, Creative Destruction Lab, Novi, Farfetch, Heifer International, Iliad, Kiva, Lyft, Mercy Corps, Paradigm, PayU, Ribbit Capital, Shopify, Slow Ventures, Spotify, Temasek, Thrive Capital, Uber, Union Square Ventures, Women's World, Banking and, Xapo. https://www.diem.com/en-us/about-us/

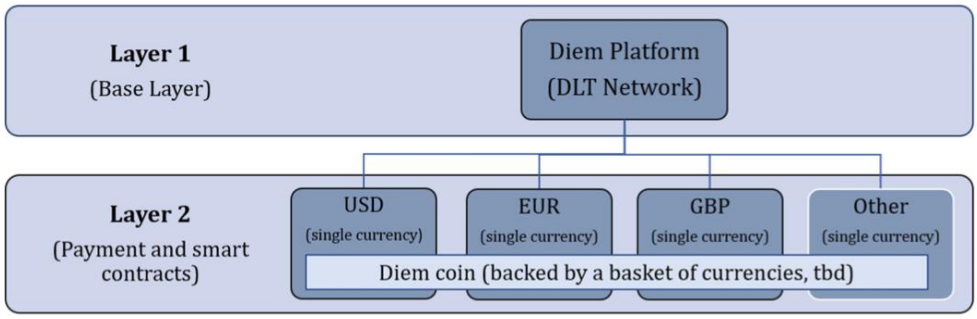
[140] Rrustemi J. and Tuchschmid N.S., "Facebook's Digital Currency Venture "Diem": the new Frontier ... or a Galaxy far, far away?", TIM Review Dec. 2020

[141] See note above (140)

private information, during a speech, David Marcus[142] made it clear that account information would never be shared with third parties without consumer consent, nor used to improve ad targeting on behalf of Facebook or third parties.

The proposal for this "global stablecoin", however, immediately sparked multiple criticisms from central banks and other authorities on a global scale, which had raised specters of financial instability, erosion of monetary policy control, privacy risks, and money laundering scandals. After intense dialogue with regulators, the Libra Association released a new proposal, called Libra 2.0, on April 16th, 2020. The re-issued White Paper presented four main changes, aimed at address regulatory concerns: a. the offering also of single-currency stablecoins; b. the improvement of the security of the Libra payment system; c. the renunciation of the future transition to a permissionless system; d. the construction of strong protections into the design of the Libra Reserve[143]. Since, a key concern was that the multi-currency Libra Coin (LBR) could interfere with monetary sovereignty and policy, the major change was the offering - in addition to the multi-currency coin - of single-currency stablecoins, e.g. Diem USD, Diem EUR, Diem GBP: they will be available to customers and will be backed by securities denominated in the specific currencies, so as not to interfere with the monetary sovereignty of those countries.

Figure 26. The Diem 2.0 architecture



Source: J. Rrustemi and N. S. Tuchschmid (2020)

In this second White Paper, they also specified that they will not provide loans from their reserves but will potentially turn to third parties to offer these services through the Diem network, thus reducing the risks that the Diem association could pose to central banks[144].

[142] David Marcus is an American entrepreneur: he is the co-creator and a board member of Diem.

[143] https://www.diem.com/en-us/white-paper/#cover-letter

[144] Rrustemi J. and Tuchschmid N.S., "Facebook's Digital Currency Venture "Diem": the new Frontier ... or a Galaxy far, far away?", TIM Review Dec. 2020

As already stated above, in 2020, the project was modified, and the digital currency was named Diem, managed by the Diem Association: the rebranding is certainly a step towards the imminent launch of the currency. Although there are still no precise indications about the date, according to what CNBC reported, by the end of 2021 at the latest Diem will be launched with a pilot project.

To conclude, numerous articles that have come out over the past few years are evidence that Facebook probably won't be the only company looking to make its own digital currency. As twins Tyler and Cameron Winklevoss claimed back in 2019, within a couple of years every Faang - the acronym referring to the 5 prominent American technology companies, Facebook, Amazon, Apple, Netflix and Google (Alphabet) - will have its own virtual currency[145]. These projects will have an enormous influence on the balance of the financial world, even to the point of changing it.

3.2 FEATURES

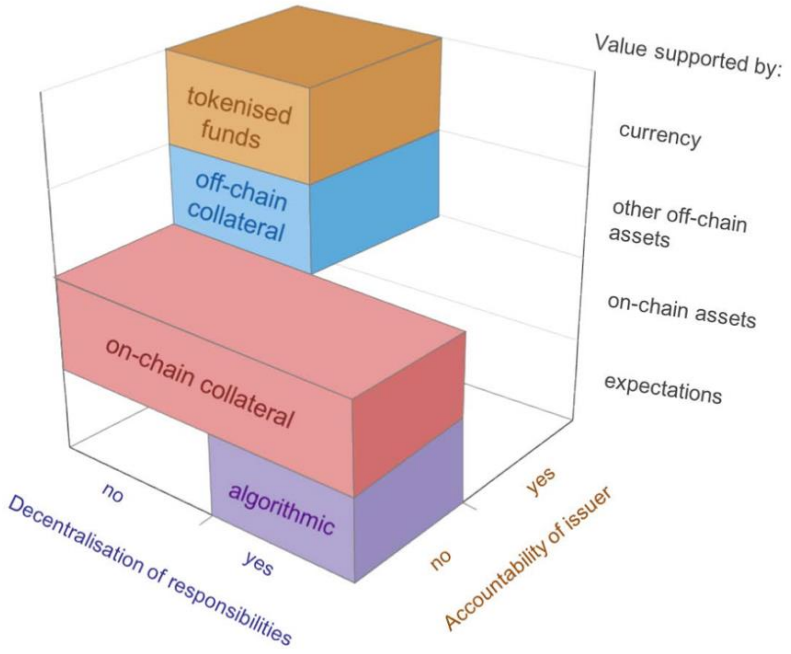
A stablecoin can be defined as a cryptocurrency that *"aims to maintain a stable value relative to a specific asset, or a pool or basket of assets"*[146].
Analyzing which are the main characteristics of stablecoins is fundamental to understand which can be their uses and consequently the advantages and disadvantages that can derive from them. There is no single type of stablecoin: they can be distinguished into 4 distinct categories based on the different stabilization mechanisms that act as a guarantor of the value of the assets, which can be fiat money - in one currency or a basket of different currencies - bonds and commodities, crypto-assets or users' expectations of future purchasing power[147].
The following image (Figure 27) represents what has been called by the ECB the 'crypto-cube'; it gives a clear understanding of the types of stablecoins, divided on the basis of three criteria: a. the existence/absence of an issuer (right horizontal axis); b. the centralization/decentralization of decision-making responsibilities (left horizontal axis); c. what underpins the value of the stablecoin (vertical axis).

[145] Biagio S., "Dopo Libra arriva 'Google Coin'? I piani di Big Tech sulle criptovalute, il Sole 24 Ore, July 2019

[146] Arner D., Auer R. and Frost J., "Stablecoins: risks, potential and regulation", BIS Working Papers, No 905, Nov. 2020

[147] ECB Report, "Stablecoins, no coins- but are they stable?", IN FOCUS, Issue no 3, Nov. 2019

Figure 27. The crypto-cube: classification of stablecoins



Source: ECB (2019)

The first one can be defined as *"tokenized funds"* or *"fiat-collateralized stablecoins"*: these are stablecoins backed by funds - specifically commercial money, electronic money or central bank money - that an issuer or custodian holds in custody; this implies that it is committed to guaranteeing at any time the possibility of tokenized funds being tokenized in full. Most of these stablecoins are backed by fiat currencies such as the dollar, euro, and British pound, generally at a 1:1 ratio, meaning that 1 stablecoin equals 1 unit of currency. The fact that it is pegged to a fiat currency means that for every stablecoin that exists, there must be a fiat currency held in a bank account to back it up. If an individual wants to take back the cash at the expense of stablecoins, there must be an entity that guarantees the exchange by taking the amount of fiat currency from their reserve and handing it over to the individual; the equivalent stablecoins, once the cash exchange occurs, are destroyed or taken out of circulation.

An example of this is Tether (USDT), which was one of the first stablecoins to be created, enjoying first-mover advantage as a result. Tether was issued by Tether Ltd. in Hong Kong in 2014 and has its own unit of account, called USDT, that guarantees a 1:1 conversion ratio with the U.S. dollar. The company has several functions: it is in charge of issuing the stablecoin, holding the assets placed in reserve and managing the integration with wallets and exchanges according to the existing blockchain

system. The currency's dependence on the dollar constitutes a significant limitation: while theoretically there is no hard limit to the total supply of USDT because it belongs to a private company (and thus its issuance is only limited by Tether's policies), since Tether claims that every single USDT should be backed by one US dollar, the amount of tokens is limited by the company's actual cash reserves. As of September 2020, there were more than 14.4 billion USDT tokens in circulation, which in turn were backed by $14.6 billion in assets, as reported by Tether[148]. Lately, however, some controversy has arisen regarding this stablecoin, in particular some suspicions that Tether has issued more USDT than is actually supported by the dollar reserves[149].

Another stablecoin pegged to the dollar is USD Coin (USDC); it is managed by a consortium that includes cryptofinance company Circle and exchange Coinbase. In order to avoid any doubts about the actual dollar reserves that support the USDC offering, a report containing the data is published every month.
There are numerous other stablecoins that are anchored in traditional currencies: in Europe, for example, the EURS token[150] of the tokenization platform Stasis is backed by the euro. In Singapore, the stablecoin XSGD[151] was recently launched, which is backed by the Singapore dollar at a 1:1 ratio.

The second type is called *"off-chain collateralized stablecoins"* or *"commodity-collateralized stablecoins"*: even in this case, the value of the digital currency is pegged to an underlying asset, which, however, is a tangible good or a bond. The most common commodity to be collateralized is gold - however, in some cases oil, real estate, and various precious metals also serve as backing for the currency. As with the first type of stablecoin, a custodian is required to hold these assets so that the stablecoin holder can make an exchange at any time. In this case, moreover, there is the possibility that the assets revalue over time, increasing the incentive of the person to hold this type of digital

[148] https://coinmarketcap.com/it/currencies/tether/

[149] See Section 3.3

[150] Produced by STASIS, EURS was developed to tokenize the traditional fiat asset, the Euro. EURS mirrors the value of the Euro on the blockchain and is said to be supported by liquidity assurance mechanisms combining the benefits of a global fiat with the transparency, immutability and efficiency of the blockchain. All tokens are fully backed by 1:1 collateral reserves. The company aims to promote transparency by providing daily statements from account providers along with weekly verifications and quarterly audits by a top 5 global accounting firm.
https://coinmarketcap.com/it/currencies/stasis-euro/

[151] XSGD is the fully collateralized Singapore Dollar stablecoin, powered by open-source blockchain protocols. All Xfers issued SGD-backed stablecoins have 1:1 parity with Singapore Dollar.
https://coinmarketcap.com/it/currencies/xsgd/

currency. This can be a strength but also a weakness since, compared to the first type guaranteed by a fiat currency, its value is less stable.

An example is Digix Gold (DGX): as you can imagine from the name, it is backed by gold, with a ratio of 1 DGX per 1 gram of gold. The precious asset is stored in a vault in Singapore and is checked every 3 months to ensure transparency: holders of this currency can redeem the ingots by simply going to pick them up at the vault. The creators of DGX claim to have *"democratized access to gold"*[152].

In some cases, it is not just one metal that supports the value of the stablecoin but a mixture, as in the case of Tiberius Coin (TCX)[153] - where there is a combination of 7 precious metals commonly used in technology hardware.

"On-chain collateralized stablecoins" or *"crypto-collateralized stablecoins*" is a third type of stablecoin: in this case, it is the crypto-assets that support the digital currency; this means that, since they are registered in a decentralized way, there is no need for either an issuer or a custodian - everything is conducted on the blockchain. In order to reduce the volatility risks typical of regular cryptocurrencies, these stablecoins are often over-collateralized: this allows them to be able to absorb significant fluctuations. For example, in order to get a number of stablecoins, a person need to deposit at least twice as many cryptocurrencies, so stablecoins are guaranteed to be 200%. One advantage they have is the fact that they enjoy more liquidity, which means they can be converted quickly and cheaply into their underlying asset. However, this type of stablecoin remains very complex, which has had - and still has - a bearing on its popularity.

One example is Dai[154], backed by units of Ether, a crypto-asset on the Ethereum blockchain.

[152] CB Insights Research, "What Are Stablecoins?", Feb 2021

[153] Tiberius Crypto AG created TiberiusCoin (TCX) to serve as a fungible digital asset based on a "basket," or supply, of precious metals. In September 2018 it was announced that the company would begin an initial coin offering. According to the company's CEO, Giuseppe Rapallo, the starting price of TCX will be set at $0.70, and sold based on Swiss trade laws

[154] DAI is an Ethereum-based stablecoin whose issuance and development is managed by the Maker Protocol and the MakerDAO decentralized autonomous organization. The price of DAI is soft-pegged to the U.S. dollar and is collateralized by a mix of other cryptocurrencies that are deposited into smart-contract vaults every time new DAI is minted. One of the defining features of DAI is that it wasn't created by any single person or a small group of co-founders. Instead, the development of the software that powers it and the issuance of new tokens is governed by the MakerDAO and Maker Protocol. MakerDAO is a decentralized autonomous organization — a kind of company that runs itself in a decentralized manner via the use of smart contracts
https://coinmarketcap.com/it/currencies/multi-collateral-dai/

Finally, there are the *"algorithmic stablecoins"* or *"non-collateralized stablecoins"*, supported only by the users' expectations about the future purchasing power of their holdings; the fact that they are not supported by anything material may seem contradictory, given the very definition of this type of digital currency; in reality, however, the underlying concept is the one that is valid today for the currencies we use daily - euros are used basically because people trust their value. Again, there is no need for a custodian, no need for an issuer and the operation is totally decentralized. To control the supply of stablecoins is used an algorithmically governed support (hence the name by which they are defined): when demand increases, new stablecoins are created to reduce the price to the normal level; when, on the contrary, the supply is greater than demand, stablecoins are purchased. This implies that prices remain stable, as they are driven by market supply and demand. It is the most decentralized and independent form as it is not tied to any other asset. For them to be successful, it is essential that there is continuous growth, and the risk is that, in the event of a crash, there are no guarantees of being able to convert these algorithmic stablecoins back into money, thus losing the entire amount.
One example was NuBits, one of the oldest algorithmic stablecoins, operational since 2014. While it has been able to overcome temporary price fluctuations over the years, even recovering after a big loss of confidence in 2016, the same cannot be said to have happened after 2018.
An active example of non-collateralized stablecoin is Ampleforth[155], AMPL. The supply of AMPL is adjusted on a daily basis based on demand.

The table below (Table 8) summarizes what has been said so far, as it contains the main characteristics of each type of stablecoin.

[155] Ampleforth was founded by Evan Kuo, an experienced product manager and serial entrepreneur that holds a Bachelor of Science (BS) from UC Berkeley. Ampleforth is an Ethereum-based cryptocurrency with an algorithmically adjusted circulating supply. When the protocol detects that the price of AMPL is too high, it increases the circulating supply, whereas the supply is decreased if the price is too low. This automatic supply adjustment process is known as a "rebase" and occurs once each day, with a positive rebase if the price goes above $1.06, and a negative rebase if it is below $0.96. https://coinmarketcap.com/it/currencies/ampleforth/

Table 8. Summary table of stablecoin characteristics

	issued on the receipt of:	"collateralised" by:	redeemable at:
Tokenised funds	funds (i.e. cash, deposits or electronic money)	funds and/or close substitutes (i.e. secure, low-risk, liquid assets [12])	market value of the collateral at the time of redemption or face value of the stablecoin
Off-chain collateralised stablecoin	assets held through an accountable entity (e.g. securities, commodities, or crypto-assets in custody with an intermediary)	assets held through an accountable entity (e.g. securities, commodities, or crypto-assets in custody with an intermediary)	market value of the collateral at the time of redemption
On-chain collateralised stablecoin	crypto-assets held directly on the distributed ledger	crypto-assets held directly on the distributed ledger	market value of the collateral at the time of redemption
Algorithmic stablecoins	crypto-assets or given away for free	no collateral – value of stablecoin is based purely on the expectation of its future market value	not redeemable

Source: ECB, Occasional Paper, 2020

Besides this classification, a distinction can be made by looking at the geographic scope: the so called global stablecoins *"encompass multiple jurisdictions in terms of their users, the entities comprising the arrangement, and the composition of the collateral"*[156]. In fact, being that some stablecoins are sponsored by large tech or financial companies, it implies that these digital currencies have the potential to scale quickly to reach a global footprint, thanks to their large existing customer base, which is cross-border. With Facebook's announcement of its Libra project, the private stablecoin was taken to an entirely different level than any previous cryptocurrency or stablecoin: in fact, it was the first global stablecoin proposal backed by a group of companies and aimed at retail payments[157]. It could be a tool used by hundreds of millions of retail customers in a very short period of time. Global stablecoins, given their scale, could bring a number of benefits - particularly in the context of cross-border transfers - but they also raise substantial issues for monetary and financial authorities.

Current status of stablecoins

Although it is a phenomenon that has been present for a few years now, in recent years there has been an increasing number of stablecoin initiatives, especially since 2018. As reported by a study carried out in 2020 by the European Central Bank, last year there were 50 different types of stablecoins traded

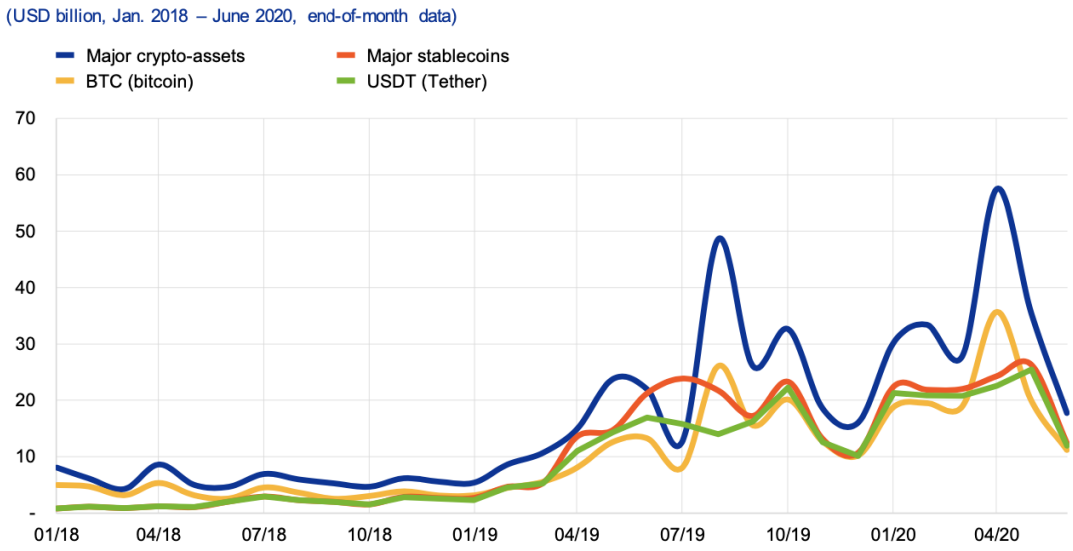
[156] ECB, "Stablecoins: Implications for monetary policy, financial stability, market infrastructures and payments, and banking supervision in the euro area", Occasional Paper Series, No 247/Sep. 2020, p. 7

[157] Arner D., Auer R. and Frost J., "Stablecoins: risks, potential and regulation", BIS Working Papers, No 905, Nov. 2020

on crypto-asset trading platforms. About 40% of them had been launched in 2018 while 16% started trading only last year. In terms of types, it is estimated that the majority of stablecoins are pegged to a fiat currency, followed by on-chain collateral and algorithm.

The chart below (Figure 28) shows the exchange volumes of both major crypto-assets (blue line) and stablecoin (orange line), carrying the main one for both cases: bitcoin for the former (represented by the yellow line) and tether for the latter (green line). Stablecoin trading volumes showed significant increases in spring 2019, driven by the release of the initial Libra white paper. Then, in early 2020, there was a decline, leading to lower volumes. Finally, with the outbreak of the pandemic and turmoil in the financial and cryptocurrency markets, there was a renewed increase between January and April 2020.

Figure 28. Trading volumes, 2018-2020

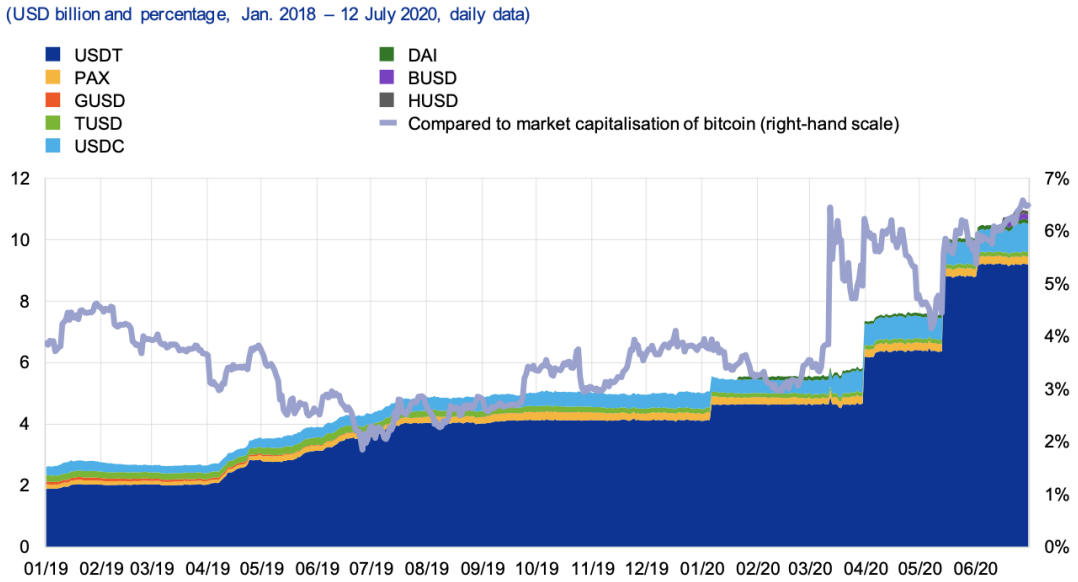


Source: ECB, Occasional Paper, 2020

Looking at the market capitalization[158] of the major stablecoins, depicted in the graph below (Figure 29), it represents a fraction (6.5%), of that of bitcoins; however, in 2020 it increased multiple times, driven by a growing stablecoin supply, nearly tripling for Gemini USD and more than doubling for Tether, USD Coin, and DAI since the beginning of 2020.

[158] Within the blockchain industry, the term market capitalization (or market cap) refers to a metric that measures the relative size of a cryptocurrency. It is calculated by multiplying the current market price of a particular coin or token with the total number of coins in circulation.
Market Cap = Current Price x Circulating Supply
https://academy.binance.com/en/glossary/market-capitalization

Figure 29. Market capitalization, 2019-2020



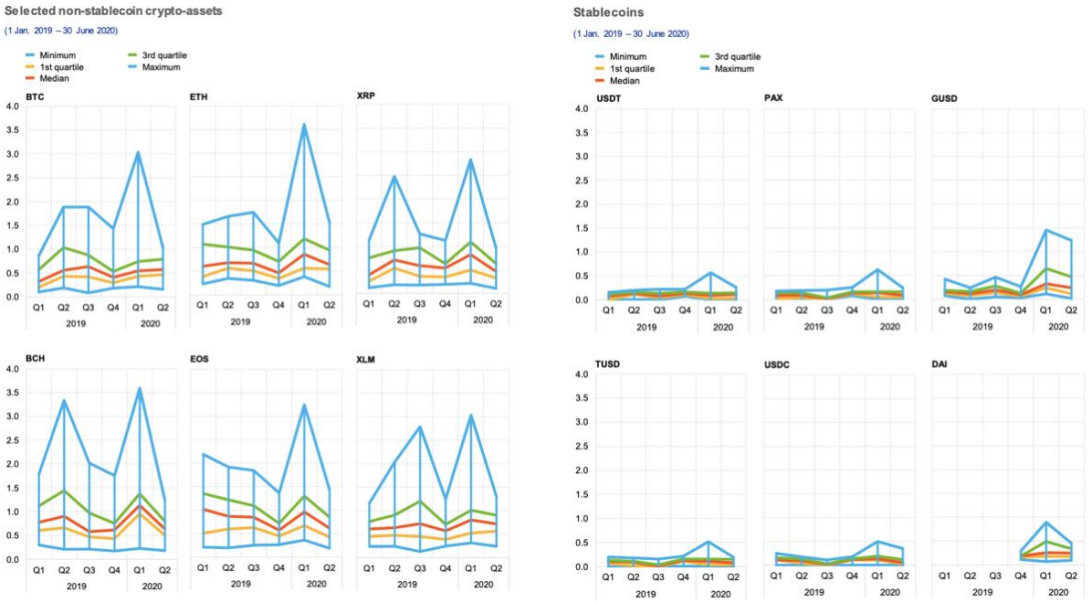
Source: ECB, Occasional Paper, 2020

3.3 PROS AND CONS

Advantages

There are several advantages that can push people to approach the world of stablecoins: first of all, as I have repeatedly said, they differ from crypto-assets in that they are not subject to extreme price volatility. This can be easily seen from the images below (Figure 30), which compares the price variation of some cryptocurrencies with that of some stablecoins, between 2019 and 2020. While we can see right away that the price volatility of stablecoins is clearly less pronounced, it must also be said that this also varies between different stablecoins, depending on the types. The tokenized funds show the lowest volatility. From the graph we can also see that in the first quarter of 2020 there was a peak for both cryptocurrencies and stablecoins: the latter, however, have since experienced a decrease in price volatility that is lower than the former. This factor is very important and represents a significant component in the possible competition between different stablecoins: the more stable ones will undoubtedly present advantages, which will allow them to have the upper hand over the others.

Figure 30. Price volatility of crypto-assets and stablecoins[159]



Source: ECB, Occasional Paper, 2020

Added to this benefit, there are all those typically associated with cryptocurrencies, including transparency, security, immutability, digital wallets, fast transactions, low fees and privacy - without losing the guarantees of trust and stability that come with the use of fiat currency.

As for global stablecoins, they have the advantage of allowing money to move from one part of the world to another easily, quickly and securely: this would benefit people and industries around the world who need to make international payments quickly and securely; migrants who need to send money to their families in the homeland; and businesses who need to pay suppliers overseas, economically and efficiently.

Disadvantages

In addition to the many advantages listed above, however, stablecoins have some limitations, which differ depending on the type. Starting with stablecoins backed by fiat currency, they are centralized and therefore managed by a single entity. This implies that there must be a constant trust in the activity

[159] For the graph of crypto-assets, the following were selected: Bitcoin (BTC), Ethereum (ETH), Ripple (XRP), Bitcoin Cash (BCH), Eos (EOS), and Stellar (XLM). The following were selected for the stablecoin chart: Tether (USDT), Paxos Standard (PAX), Gemini dollar (GUSD), True USD (TUSD), USD Coin (USDC), and Dai (DAI).

supported by the entity and in particular that there is a correspondence between the number of stablecoins and the currency on which it is based. Tether is an emblematic example in this case: in April 2019, extensive studies of the money available to the company and its division at the operational level showed that the coverage of each coin was not respected; instead of having $1 for each USDT issued, there was an average of about $0.75. This was a serious episode as trust in the system is a necessary prerequisite for its functioning and stability. Earlier this year, it was really proven that the world's most popular stablecoin was not always fully backed by US dollars: Tether, along with iFinex, Bitfinex, had to pay an $18.5 million penalty. This is a demonstration that laws should be respected: moreover, the discussion of a bill presented by the Democratic party is going on in the US House that goes in the direction of requiring stablecoins to maintain 1: 1 reserves against dollars at the Federal Reserve[160]. Indeed, one way to solve this first problem could be the introduction of regular third-party audits, which would ensure transparency - consequently keeping the reputation of fiat-collateralized stablecoins high.

A second problem with tokenized stablecoins is that tokenized funds are subject to all the regulations that fiat currencies are subject to, which compromises the potential effectiveness of the digital asset. For example, the stablecoin launched by Facebook promised a stablecoin that was backed by several global fiat currencies, allowing it to broaden its appeal and usefulness. However, the numerous regulatory criticisms it received meant that the multi-currency project had to be abandoned.

As for the second type - namely those backed by commodities - when a person decides to change stablecoins to get the commodity back, this can involve a number of costs and timeframes that are also high. Not to mention the possibility that the underlying asset - be it a currency or an asset - not only does not gain value over time but loses it.

Crypto-asset-anchored stablecoins have the problem of being more vulnerable to price instability than the first two types. As much as in many cases we try to implement mechanisms to absorb fluctuations, when the crypto takes a deep nosedive, consequently the same will happen to the stablecoin. Being the most complex form, together with the non-collateralized one, the risk that something could go in the wrong direction is higher and consequently the trust in the asset, which in itself should be stable, is lost.

[160] Ursino G., "Provate le accuse sul Tether: stop all'attività di Bitfinex (ma solo nello Stato di New York), il Sole 24 Ore, February 2021

3.4 POTENTIAL USES AND IMPLICATIONS

Potential uses

There are several potential uses for stablecoins in the real world: first, they could be used as an everyday currency, with the added advantage of being digital - and therefore legally supported and secure. This would mean using (probably via smartphone) a digital wallet containing stablecoins to pay for any good or service. In addition to benefits in the domestic market, the use of stablecoins as a daily currency would allow to improve and make more efficient payments abroad as they do not require a conversion between different fiat currencies: a person living on the other side of the globe, in a country with a different currency, could receive stablecoins (backed in euros) from a European citizen, without having to convert them; this is a rather significant reduction in commission costs. As with other digital currencies, stablecoins lend themselves to being a universal medium of exchange for e-commerce. Furthermore, they could be used for alternative loan issuance, reaching a high number of people who normally do not have the possibilities and/or capabilities to receive loans from banks. In addition, stablecoins also enable the use of financial smart contracts: these are self-executing contracts that exist on a blockchain network, without the need for a third party; as they are automatic transactions that are transparent, traceable, and irreversible, they are ideal for many salary payments[161], rents and subscriptions. A further use of stablecoins could relate to migrants, who often find themselves having to send remittances to their families, often through companies such as Western Union: not only does this make the process slower but it is also expensive, causing a large portion of savings to be lost that go into commissions. Stablecoins can solve this problem, thanks to fast transactions and low commissions and the fact that there is no risk, as in the case of normal cryptocurrencies, that they lose part of their value. Finally, as for stablecoins pegged to a fiat currency, they could act as a protection from local currency crashes: indeed, people could quickly exchange their declining currency holdings into a stable currency.

[161] An employer can set up a smart contract that automatically transfers stablecoins to their employees at the end of each month, for example. This is especially beneficial for companies that have employees all over the world, as it reduces the exorbitant fees and day-long process of transferring and exchanging fiat currency, for example, from a bank account in New York to a Chinese bank account. Using stablecoins, this process could take minutes and require only a small fraction of the usual transaction fees.

Implications

At the moment, since there is limited evidence that stablecoins are used for payments outside of the crypto-asset market[162], the implications for economic development and monetary policy may still be negligible. However, given the exponential growth of this digital currency in the last period, there is a possibility that things will change in the future. In fact, according to a study carried out by the European Central Bank, there are three possible scenarios in the future[163]: the first one assigns stablecoins an ancillary function to cryptocurrencies, which would allow cryptocurrency revenues to be secured in less volatile assets; this would represent a continuation of the current state of the market. The second and third scenarios, on the other hand, imply an evolution and assume that stablecoins become a new payment method or an alternative store of value, respectively. Depending on the different scenarios and the different types of stablecoins being considered, there are different risks.

The risks related to stablecoins are of both social and economic nature. The first one is related to privacy, which could be jeopardized by a data driven business model; in fact, there is the possibility that information could be misused for commercial or other purposes. Second, the possible deployment of this type of digital currency on behalf of foreign operators could pose a risk to the domestic market - for example, the European market - making it dependent on technologies that are developed, managed and regulated elsewhere. This would have an impact on the traceability of payments which, by becoming more complex, could increase money laundering and other major crimes such as terrorist financing and tax evasion. In an extreme scenario, for the Eurosystem, dependence on foreign operators could also imply the inability of the payments system to sustain the market and the single currency.

A further risk concerns the monetary system: stablecoins generally allow conversion into fiat currency. The methods of conversion, however, differ from those for bank deposits or electronic money: in the former, the credibility of convertibility is based on the deposit insurance regime, financial regulations and prudential supervision; the value of electronic money is protected instead

[162] In this case, stablecoins can be said to have an ancillary function to cryptocurrencies: since they fail to gain enough security among users to become a new payment method, they could remain tied to the crypto-asset market (as has been the case so far). In other words, it is what we described in the previous section, talking about "on-chain collateralized stablecoins" or "crypto-collateralized stablecoins".
ECB, "Stablecoins: Implications for monetary policy, financial stability, market infrastructures and payments, and banking supervision in the euro area", Occasional Paper Series, No 247/Sep. 2020

[163] See note above (162)

by the obligation to deposit client funds with third parties[164]. However, the same mechanisms do not apply to stablecoins, which could be vulnerable to the risk of runs. These runs could occur if users lose confidence in the issuer, realize that collateral assets are losing value - thus calling into question the value of the stablecoin - or if an adverse event occurs (such as a cyber-attack on the system or theft from the wallet). In addition, the need to address redemptions could lead the issuer of the stablecoin to liquidate the collateral assets, triggering contagion effects throughout the financial system.

In terms of financial stability, there are numerous risks emanating from the private stablecoin sector: in addition to the traditional risks of "too big to fail" and "too connected to fail," some risks relate to the transmission of monetary policy and the banking sector - including the central bank's role as lender of last resort. Because of its global reach - or at least the ease with which a normal stablecoin can become one - there are potential financial stability issues as well, particularly market integrity, consumer protection, and risks of anti-competitive behavior and restrictions on innovation.

Assuming stablecoins become an alternative store of value, there would be some implications for the transmission of monetary policy: large purchases in safe assets by stablecoin issuers could change the availability of risk-free assets and alter the level and volatility of real interest rates, which could have undesirable effects on monetary policy or financial conditions[165]. Moreover, significant use could affect the stability and funding cost of bank deposits, posing challenges to banks' intermediation capacity. Linked to the implication on banks, a use of stablecoins as a payment method could also reduce banks' fee income by intertwining their profitability. The same holds true for central banks, which in turn could lose seigniorage, i.e., the profits they make from interest on the money they lend, or from returns on the assets they buy.

Since there are many risks and consequently concerns surrounding stablecoins, authorities around the world are working to develop regulatory systems and measures. There are numerous initiatives and events where approaches to cryptocurrencies and stablecoins are discussed internationally. Regarding the latter, it is important to make an initial distinction between stablecoins in general and those defined as global, which pose a number of greater risks to financial stability, monetary policy transmission, and monetary sovereignty.

Starting with the former, regulation should first and foremost provide for an appropriate registration or licensing regime that allows for adequate disclosure and monitoring. Since the cross-border

[164] https://www.ecb.europa.eu/press/key/date/2020/html/ecb.sp201104~7908460f0d.it.html

[165] See note above

potential is high in the case of stablecoins, it is nevertheless important that the authorities provide for systems whereby information can be easily exchanged. Although the risks of this type of stablecoin are minor, the hypothesis that it may become global must be taken into consideration. Therefore, a solution could be the one proposed by the EU, differentiated on the basis of the underlying structure - thus differentiating the regulatory requirements for e-money stablecoins, asset-backed stablecoins and 'significant stablecoins' (which is the definition provided by the EU, to indicate global stablecoins). As stablecoins raise regulatory and supervisory concerns - especially in relation to market integrity and consumer/investor protection - a number of international organizations (including the G20 and FATF) have already turned their attention to the issues of money laundering and terrorist financing. These are the same concerns that exist for crypto-assets, with the addition that in this case there are additional investor protection concerns given the link between the asset and the fiat currency (or other assets that generally serve as its collateral). In the absence of regulation, stablecoin issuers can earn a profit by investing in higher yielding or illiquid assets, or lending funds or assets, while paying low or no interest to stablecoin holders[166]. This is why regulatory and supervisory tools are critical. This is even more true with respect to global stablecoins where tools already applied in the past such as supervisory colleges - now applied to cross-border banks - could be used; alternatively, cooperative approaches between public and private participants could arise. In addition, there will be a need for more informal means of cooperation-multilateral memoranda of understanding and memoranda of understanding, international standards, and specific regulatory treatment. What remains a major challenge is identifying those global stablecoins, given the speed with which big tech can act in the sector, leveraging their size and technological capabilities.

In conclusion, stablecoins initially evolved in response to the critical issues that emerged with respect to crypto-assets, which were too volatile to perform all the functions of a traditional money (particularly that of store of value and unit of account). Stablecoins, being anchored to an asset - typically a fiat currency - act as a bridge between DLT and the coins themselves. If successful, they could become a medium capable of simplifying and enabling new forms of exchange in the digital economy, even challenging current means of payment, such as cards and e-wallets. However, since there are many risks associated with it (although not imminent given the use that is being made of it), many debates about this new digital currency have emerged among central banks and authorities worldwide. In particular, for some years now, central banks have been evaluating the possibility of

[166] ECB, "Stablecoins: Implications for monetary policy, financial stability, market infrastructures and payments, and banking supervision in the euro area", Occasional Paper Series, No 247/Sep. 2020

playing an active role in the digital transformation by issuing their own digital currencies - the so-called Central Bank Digital Currency (CBDC), which I will discuss in the next chapter.

CHAPTER 4

CENTRAL BANKS' INITIATIVES IN ISSUING DIGITAL CURRENCIES: CBDC

> *"Central banks cannot ignore these developments. Over many centuries, the sovereign has provided its own currency to citizens as a symbol of stability, safety and trust. Providing money as a public good is central to the mission of central banks. Given the digital transformation under way, which has the potential to transform the payments landscape and even the entire financial system, central banks must be bold and keep up with the pace of change."*
>
> Fabio Panetta[167]

The involvement of central banks in the matter of issuing electronic money is a relatively recent phenomenon. It is important to stress that the so-called Central Bank Digital Currencies have nothing to do with private crypto assets (e.g., bitcoins). They are a currency in all respects like cash, governed by the same rules and laws; therefore, they could become a payment alternative, in digital format. Several factors have triggered this discussion: first, the emergence of new forms of technology in the financial sector; second, the decline in the use of cash in many countries; third, the entry into the financial services sector of new (private) players willing to develop their own currencies and payment systems, able to spread very quickly thanks to the huge user base of these companies. In particular, this last concern has played a key role, making the initial benevolent disinterest of central banks towards digital currencies a no longer viable option[168]. Moreover, central banks around the world are delving into evaluations of issuing their own digital currency for a defensive motive: they are aware that the advantages China could have by moving first in this field cannot be underestimated. While it is true that the digital yuan is unlikely to become popular in the US and Europe, it is likely to do so in Asia or Africa - where the network of trade with China is already extensive. Moreover, the Middle Kingdom could become a leader capable of exporting the technologies behind digital currencies around the world. Looking more broadly at different regions of the world, it can be seen that there

[167] Panetta F., "Preparing for the euro's digital future", the ECB Blog, July 2021 https://www.ecb.europa.eu/press/blog/date/2021/html/ecb.blog210714~6bfc156386.en.html

[168] Serrate J. S., "Digital currencies, la nuova sfida delle banche centrali", Istituto per gli Studi di Politica Internazionale (ISPI), January 2021

are several reasons why the world's central banks have been considering issuing their own digital currencies: for some countries, it is a way to ensure that central banks continue to play the role of currency issuers, overcoming the dangers that could emerge with the progressive disappearance of cash. For other States - primarily from developing economies - financial inclusion[169] and the reduction of the costs[170] of digital logistics compared to conventional cash management seem to be top priorities.

In this chapter I will analyze the main characteristics of CBDCs and the different types that may emerge from the combination of these: there is not, in fact, a single model of currencies issued by central banks but can be distinguished four main scenarios. Currently, the main questions are related to the fact that it must be traceable or ensure anonymity (as happens with physical cash). In the second section, the focus will be on the advantages and disadvantages of this type of digital currency: on the one hand, they could indeed reduce transaction costs, increase financial inclusion, accelerate domestic and cross-border payments, affect the effectiveness of the monetary policy, and promote innovation; at the same time, however, the idea of developing CBDCs has raised several questions mainly related to the role of central banks, the direct access to bank liabilities by users, the structure that banking intermediation should have in such a scenario, as well as to financial stability. In addition, as a cross-border effect, currency substitution and loss of control over monetary policy could occur. Then, I will analyze the potential uses of CBDC and the implications that might emerge from them. Exploring the pros and cons of this digital currency and determining which is the most appropriate form is not only a matter for central banks but also for the political sphere, as the choice touches the heart of personal freedom and modern liberal democracy. Finally, the last part will be devoted to an analysis of the main initiatives currently undertaken by central banks around the world: the focus will be on two initiatives in particular, that of the Bahamas, where the Sand Dollar began operating in October 2020, and that of Sweden, which has begun testing e-krona, a token-based-CBDC that uses blockchain technology. Ultimately, it can be said that just as increasing competition from the private sector has

[169] As we have seen in previous chapters, digital currencies- among them CBDCs- could improve access to digital payments for unbanked consumers, which is a non-negligible fraction of the population not only in developing countries but also in highly developed countries. Whether this potential benefit will truly materialize depends on the reasons why these groups are unbanked-such as the cost of banking, remoteness, and lack of digital literacy-and needs further research.

Just to cite a few figures, even in high-income countries like the US, UK, France and Spain (where one might mistakenly think that financial inclusion is almost universal), the share of the population without a bank account is between 4 and 7%. A similar figure is recorded in Italy (7%).

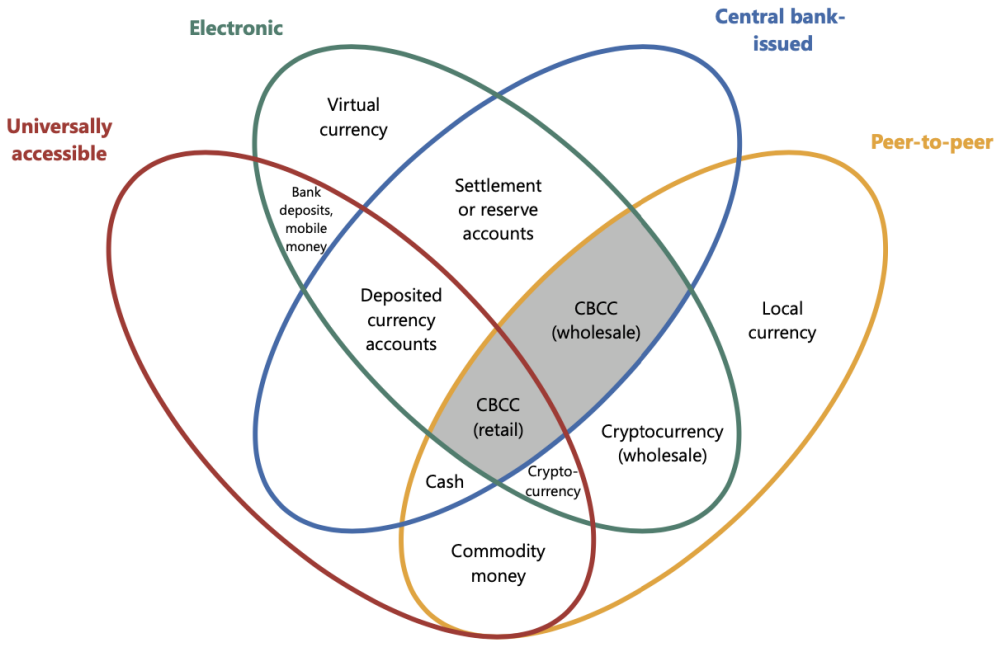
[170] CBDCs could help save the high costs associated with physical cash handling: in EU countries, this is estimated to amount to at least 1/2% of GDP. In addition, further costs of physical cash relate to storage: these are estimated to be in the range of 0.5-1% of stored value; in contrast, the storage costs of CBDCs are quite negligible.
Data provided by Gnan E. and Masciandaro D., "Do we need Central Bank Digital Currency? Economics, Technology and Institutions", SUERF, 2018

prompted central banks to take an interest in the subject, the initial moves by some central banks in this area have also increased the incentives of other central banks to follow. In fact, there is more than just a national issue at stake: the implications will also be strong at the international level. This last issue will be analyzed in detail in the next chapter.

4.1 FEATURES AND VARIANTS

In recent decades, the monetary architecture has been undergoing numerous changes: therefore, a new taxonomy for all forms of money is needed. According to a study produced by BIS, this should be produced based on the interaction of four characteristics: accessibility, issuer, form, and technology.

Figure 31. A taxonomy of money



Source: BIS (2017), "Central bank cryptocurrencies"

Currently, central bank money exists physically in the form of banknotes and coins and digitally in the form of reserves held by financial institutions (they can access them for wholesale transactions). CBDC, therefore, represents a new form of central bank money. According to the definition provided by the Bank for International Settlements, a Central Bank Digital Currency is *"central bank-issued*

digital money denominated in the national unit of account, and it represents a liability of the central bank"[171]. According to the Bank of England, this digital currency

> (i) can be accessed more broadly than reserves, (ii) potentially has much greater functionality for retail transactions than cash, (iii) has a separate operational structure to other forms of central bank money, allowing it to potentially serve a different core purpose, and (iv) can be interest bearing, under realistic assumptions paying a rate that would be different to the rate on reserves[172].

Making a brief comparison with other payment instruments, it can be said that CBDC is different from cash in that it is in digital form; unlike other non-cash payment instruments (such as card payments, credit transfers, and e-money) it represents a direct claim on central banks. Finally, it is also different from cryptocurrencies and other private digital currencies due to its riskless claim.

Before moving on to analyze and explain in detail what are all the different properties to consider when talking about CBDC, I list below four possible scenarios that were presented a few years ago in a research done by Fernandez de Liz[173]. This categorization, although in some respects it may seem abstract and sometimes outdated, will be useful in the following section, where I will analyze the pros and cons of the different types of CBDCs. The first typology is *a non-yield-bearing CBDC with restricted access and full identification*: in this case, all the data of the institutions which own and use the currency are available and only a limited number of subjects can access to it. The advantage of this typology is the refinement of the efficiency of the wholesale money market. The second type is *a non-yield bearing CBDC with universal access and anonymity*: it differs from the first one in that it has universal access (meaning that anyone can hold the currency), and it is anonymous. This variant could take the place of physical cash, presenting some additional advantages, including lower costs. In this case, we can suppose that this electronic currency also reflects the three roles covered by the physical one: object of exchange, unit of account and store of value. The only noteworthy difference is the possibility for payments with this currency be fractioned in multiple formats (just like in the case of bitcoins and bank money). The third typology presented is *a yield-bearing CBDC with universal access and anonymity*: what differentiates it from the previous scenario is precisely its ability to generate interest payments. With the addition of this feature, central banks may be able to

[171] Boar C. and Wehrli A., "Ready, steady, go? – Results of the third BIS survey on central bank digital currency", BIS Papers No 114, January 2021

[172] Kumhof M., Noone C., "Central Bank Digital Currencies — Design Principles and Balance Sheet Implications", Bank of England Staff Working Papers, No. 725, May 2018, p. 4

[173] Gnan E. and Masciandaro D., "Do we need Central Bank Digital Currency? Economics, Technology and Institutions", SUERF, 2018

change the nominal value of the entire amount of CBDCs issued. It is a disruptive scenario that could help central banks move beyond the zero lower bound[174] on interest rates. The fourth and last scenario described in the research is *a non-yield bearing CBDC with universal access and full identification*: this form of CBDC would also lead to an upheaval of the banking systems we know today, involving a transition phase that can also be painful. In this latter hypothesis, we consider a CBDC that maintains all the characteristics of physical money with one difference: the loss of anonymity. Considering this feature, the CBDC would look more like a current account currency. This type of currency could be used to deposit money directly to CBs, thus delineating an account-based currency rather than a token-based one. This is a feature that would make the use and holding of this kind of currency more secure, allowing central authorities to identify the holders and to whom transfers are made.

Actually, these are only some of the possibilities that can be obtained from the different combination of characteristics of the digital currency: therefore, since there is no single model of CBDC, it is important to examine more generally the different features that it may present.
The first design decision concerns the degree of access: the currency issued by central banks could be either accessible to all individuals in the economy or limited to certain subjects. In this regard, the first distinction is between *'retail CBDC'* (also called *'general-purpose CBDC'*) or *'wholesale CBDC'*. In the former case, all persons would be allowed to hold CBDCs; on the contrary, in the second scenario, CBDCs can only be accessed by certain economic actors, for interbank payments and securities transactions. This would not differ markedly from what is already happening today, as national banks can already do fast transactions with each other, using the Real-Time Gross Settlement (RTGS) system[175]. As reported by Nicola Bilotta and Fabrizio Botti[176], things would change significantly if *"a wholesale CBDC system supported cross-border transactions"*: this would allow

[174] The Zero Lower Bound refers to the belief that interest rates cannot be lowered beyond zero. By manipulating the interest rate, central banks can meet their fiscal objectives: the principle is that during a recession, banks lower the interest rate (to promote investment); conversely, during a boom, it is raised (to control prices). Central banks believed that the interest rate was bound from the bottom to 0, meaning the lowest interest rate the central bank could set in the economy was 0%. Following the 2008 recession, however, even zero interest rates apparently could not stimulate investment and recovery.

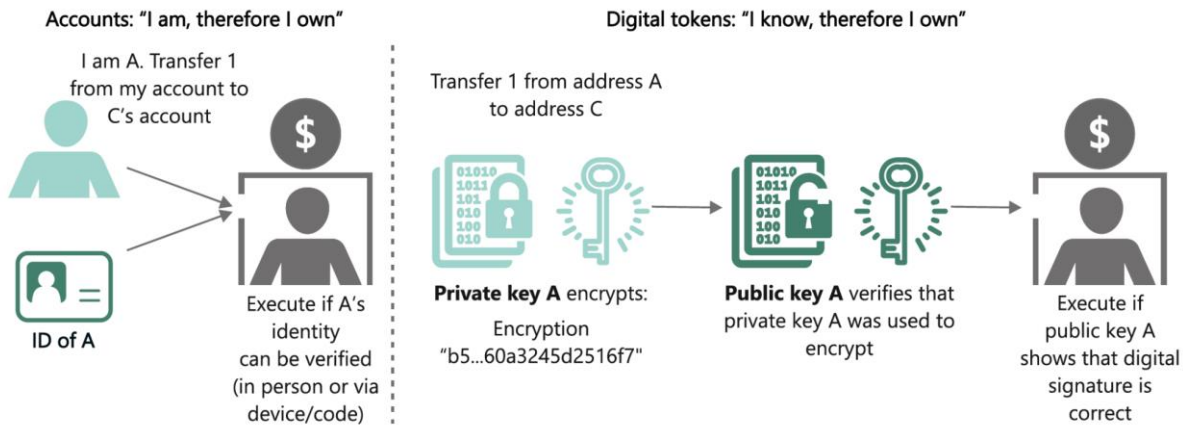
[175] Real-Time Gross Settlement (RTGS): The RTGS system is a "tiered" system and requires strict control by central banks, which must immediately verify the availability of money in the hands of the various commercial banks included in it. In order to reduce the workload and consequently the costs, it was decided to allow only Tier1 banks to open settlement accounts with the CBs; the remaining institutions must turn to the latter in order to make transfers with the central banks, which will take place indirectly. In the Eurozone, the system used is called the Trans-European Automated Real-time Gross Settlement Express Transfer System, or TARGET2.

[176] Bilotta N. and Botti F. (eds), "The (Near) Future of Central Bank Digital Currencies. Risks and Opportunities for the Global Economy and Society", Peter Lang, 2021

foreign institutions to hold and transact with CBDCs, reducing transaction times and costs- and thus improving the current interbank payments infrastructure. The same reasoning applies to retail CBDCs, which could improve the efficiency of cross-border retail payments.

A second differentiation (which is common to all electronic money, whether issued by privates or institutions) concerns the different verification required for a transaction to be executed: it can be *account-based* or *token-based*. In general, the distinction is that an account-based system requires verification of the identity of the payer, while a token-based system requires verification of the validity of the object used to pay[177]. The latter verification of authenticity is similar to that which is performed for cash. The image below (Figure 32) graphically illustrates the difference between the two CBDCs. In the former, an intermediary verifies the identity of the account holder for transactions; ownership of these CBDCs would be tied to an identity and transactions authorized through identification. In the second, credits would be honored based on proven knowledge, such as a digital signature.

Figure 32. Account-based access compared with Token-based access



Source: Citi GPS (2021)

As many central banks are hypothesizing the realization of a CBDC that is complementary to cash, there is a study by the Sveriges Riksbank[178] that analyzed how the distinction between tokens and accounts is irrelevant in order to create a CBDC that has properties similar to cash: to overcome the problem of double-spending, in fact, all CBDC payments must involve a remote ledger. While this is obvious for account-based CBDCs, it is not so for token-based ones, which deserve more detailed

[177] Garratt R., Lee M., Malone B. and Martin A., "Token- or Account-Based? A digital Currency Can Be Both", Liberty Street Economics, Federal Reserve Bank of New York, August 2020

[178] Armelius H., Claussen C.A., and Hull I., "On the possibility of a cash-like CBDC", Sveriges Riksbank, Payments Department and Research Division, February 2021

attention. The latter can be stored remotely or on local devices. In the first case, there are three alternatives: CBDC tokens can be stored on accounts or wallets, on a network of computers or servers (thus on a ledger that is on the network), or on a device that is in a known physical location (this scenario may be reminiscent of storing cash in a bank box, for example). As for local storage - for example, on mobile phones - this method would allow tokens to be exchanged from one device to another without a third party involved and in offline mode as well. However, in this specific case, there would be the problem of double spending - for which a token can be replicated several times and spent as many. Currently then, the only possibility is that there are one or more parties involved or a DLT with a ledger, where transactions are recorded. In fact, tokens can only function as money if their authenticity can be verified[179].

This issue is linked to that of anonymity: since an account-based system - unlike the token-based one - necessarily implies knowledge of the owners of the current accounts in which the coins are deposited, there are repercussions at macroeconomic, political, and security levels. For example, an account-based system, which cannot guarantee completely anonymous transactions, would require central banks to manage large numbers of retail and corporate accounts; this could increase the risk of disintermediation of existing financial institutions. With the ultimate goal of maximizing the benefits while minimizing the negative effects, some central banks have proposed a hybrid system in which token-based CBDCs are integrated into a closed architecture of certified accounts.

Another aspect to consider is that of interest, i.e., whether or not these currencies can generate interest payments. If this were to happen, the central banks would maintain the possibility of modifying the interest rates applied according to the economic phase in which the system finds itself. The possibility of setting heterogeneous rates based on defined characteristics could be considered interesting: one could think of rates that differ according to the subject holding the CBDCs (the holder being resident or non-resident) or according to the amount of money held. The Bahamas, with the launch of the Sand Dollar, decided to opt for a zero-interest rate. If a positive interest rate on the CBDC were to be expected, banks would have to increase interest rates on deposits in order for these to remain competitive. In this regard, it is interesting to mention what is being hypothesized in the Euro zone when it comes to digital currencies: tiering would be applied to the universal current account with the ECB[180]. This implies that up to a certain threshold, the sums deposited in this account would be

[179] This concept lies at the heart of currency: in order for it to serve as a medium of exchange, it is essential that there be certainty that it will be accepted for further exchange in the future. If it is easier to check the validity of banknotes, this is not so in the case of digital tokens where counterfeiting is quite easy, either by creating false ones, or by creating copies of those already issued by the central bank.

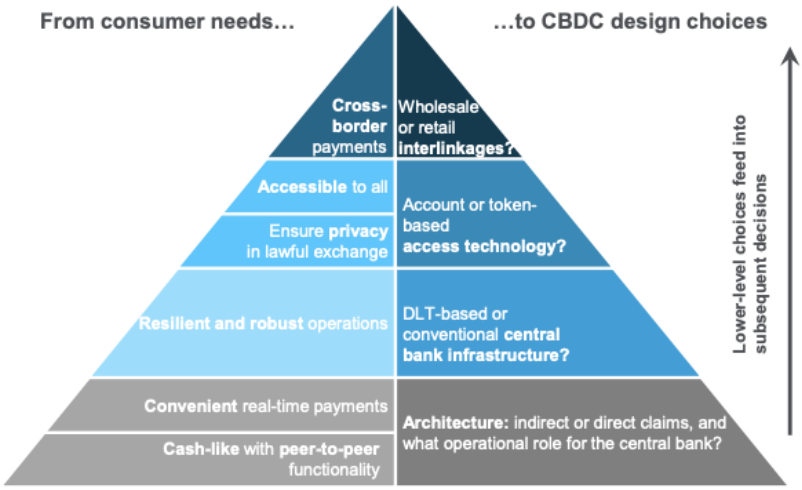
[180] Minenna M., "Proteggere le banche dall'avvento delle valute digitali: si può fare", Il Sole 24 Ore, July 2020

remunerated at a rate of 0%; above the threshold, however, deposits in digital euros at the ECB could be penalized by a negative rate (hypothetically increasing). A further question facing central banks is whether they will have to issue a CBDC as a new liability backed by other assets or bonds (thus expanding their balance sheets) or replace existing liabilities - cash or reserves - with a CBDC.
There is also the question related to the distribution of CBDCs: the hypotheses are, on the one hand, that central banks distribute currencies directly; on the other hand, that they delegate the task to specific intermediaries (probably financial institutions). If the first scenario would produce a high degree of disintermediation, increasing the role - and therefore the power - of central banks, the second scenario would reduce the precision of monetary policies dictated by the central bank. The first hypothesis, however, is now almost completely abandoned as no central bank could really take on the direct relationship with millions of end users.
Finally, the last feature concerns the possibility of introducing limits to the use of CBDCs. Some argue that such a scenario could be a violation of personal freedom to spend; actually, if one analyzes the current alternative payment instruments to cash, one can easily see that even credit cards or some smartphone payment instruments (including Satispay) have these restrictions. Since these currencies are complementary to cash, the freedom to spend would always be maintained, using different tools. The pro of imposing limitations is to avoid banking disintermediation; the drawback, on the other hand, is that people might prefer to use instruments that have looser limitations. This is the line the European Union is taking: the option being considered is to limit the amount of digital euros that individual users can hold, thus preventing large transfers of bank deposits into the central bank[181].

To conclude, what might be the best way to choose which type of CBDC to issue? According to studies carried out by the BIS, there is no single type globally, but it depends on the State itself. Anyway, one approach is to use the CBDC pyramid (Figure 33) by first identifying consumer needs (on the left side of the pyramid); second, evaluating what the technical design trade-offs are (on the right side of the pyramid), and finally, arriving at identifying design choices. Some of the key elements are: architecture, infrastructure, access and retail and wholesale interconnections.

[181] Panetta F., "Evolution or revolution? The impact of a digital euro on the financial system", Speech at a Bruegel online seminar, February 2021

Figure 33. The CBDC Pyramid



Source: Citi GPS (2021)

There is a hierarchy in the pyramid: the lower layers represent design choices, which in turn feed into the decisions of the upper levels[182]. Starting from the bottom, the *architecture* aims to investigate what the roles of the central bank and private intermediaries should be in the issuance and management of CBDCs. In this regard, a distinction based on different structures of legal claims and records kept by the central bank can be made. First, direct CBDCs, in which the central bank directly offers retail services; the CBDC is a direct claim on the central bank, which holds the record of all transactions. The second option is the hybrid CBDC: the central bank still holds the central ledger with all transactions, but it is the intermediaries that handle retail payments. Third, the intermediated CBDC, very similar to the previous model, whose only difference is that the central bank owns only a wholesale ledger. Finally, indirect (or synthetic) CBDC, a payment system operated by intermediaries. The second layer concerns the *infrastructure*: it can be based on a centralized database or a DLT. *Access* determines the way in which users can access the CBDC and therefore refer to the distinction analyzed previously, account or token-based CBDC. On top of the pyramid there is the distinction between *"retail" and "wholesale" CBDC* and its accessibility for residents and non-residents.

[182] Auer R., Cornelli G., and Frost J., "Rise of the central bank digital currencies: drivers, approaches and technologies", BIS Working Papers, No 880, August 2020

4.2 PROS AND CONS

Before analyzing more in detail the advantages and disadvantages of different CBDC variants, let's see which are the general ones, which characterize all the versions of currencies issued by central banks. First of all, unlike cryptocurrencies - which operate in a decentralized manner - a CBDC is issued and controlled by the Central Bank. This allows it to be a currency that can offer many merits, including faster and cheaper transactions - with a high level of security. A CBDC would provide public access to legal tender if cash is phased out. As we have seen at length, the use of cash is shrinking more and more due to the technological innovations that have taken place in the last decades in the payments system; although it is still a remote hypothesis (which will probably not occur in the short term), cash could one day disappear, due to its negative externalities: in addition to the onerous costs, it is by nature difficult to track, which means that it is an attractive medium for tax evasion, money laundering, and illegal transactions. On a related note, the cost associated with issuing CBDC is lower than that of cash, as there are no charges for the costs of production, storage, transportation, and disposal. Moreover, the advantage of CBDCs would not only be over cash but also over other cryptocurrencies, as it is issued by the central bank and thus would enjoy stability and trust.

A further benefit of CBDCs is related to financial inclusion, which is fundamental to reduce global poverty: they could allow access to digital payments to millions of unbanked families; without the need to have a bank account, but with the only requirement to have internet access, these users could access current payment instruments at a very low or even zero cost. In emerging and backward countries, this innovation could facilitate the joint achievement of financial and humanitarian standards deemed minimal in more advanced economies, while also making trade and interaction with the economies of those countries easier.

In addition, a CBDC could improve the efficiency and security of both retail and wholesale payment systems, both domestically and abroad. Transactions addressed to individuals residing in another country can sometimes be costly and time-consuming; in contrast, digital currency payments can be sent almost instantaneously from a sender to a recipient at a significantly lower cost than international bank transfers. Studies show that CBDC could also improve counterparty credit risk for cross-border interbank payments and settlements: in fact, there are limitations to the systems currently used, due to time lags for inter-jurisdictional payments, during which counterparties are exposed to credit and settlement risk from their correspondents[183].

[183] Ward O. and Rochemont S., "Understanding Central Bank Digital Currencies (CBDC)", Institute and Faculty of Actuaries, March 2019

Finally, due to the introduction of a new currency, competition in the payment instrument landscape could increase; one of the biggest advantages here is the lack of intermediary involvement: this implies that CBDCs could play a crucial role in increasing settlement speed along with support for real-time payments[184]. It must be added, however, that the benefits that could be derived from the issuance of CBDCs could be limited should private electronic currencies spread rapidly, finding wide acceptance among individuals.

In addition to these many pros, however, several cons cannot be overlooked. One disadvantage of CBDCs is the strong control that the government would have over the blockchain network within which the digital currency would operate. Having control not only over banknotes but also over the digital currencies they issue, central banks would gain more power, monitoring not only the issuance of money but also the preferences of consumers (thus depriving them of their privacy). However, we have to consider that the alternative is the private digital currency: the point is therefore to understand if people prefer to lose privacy in favor of big private companies (for example, Facebook and Amazon) or central banks.

A further drawback is related to the disintermediation of commercial banks, which could occur if people started moving money from bank accounts to CBDC. Should this happen, banks would necessarily have to offer higher interest rates on bank deposits - in order for these to remain competitive - and thus, as a consequence, increase the cost of loans or decrease their volume. However, a distinction must be made between structural and crisis disintermediation: in fact, the former could even be almost desirable[185]: first, it is assumed that not all types of deposits could be subject to this shift; second, banks could enrich the available payment services and the offer of financial products. If this transfer from bank deposits to digital currency were to take place in times of crisis, instead, it would have different repercussions. It is a possibility that currently exists for high value deposits[186] (and would be extended to a wider audience if it also included digital currencies). This circumstance would represent a new source of instability for the economic system, as it would threaten to cause the collapse of several institutions currently operating and on which many people's savings depend. As I have previously mentioned, one solution proposed by the ECB to this problem would be the introduction of limits to the use of the digital euro or a variable remuneration.

[184] Geroni D., "Pros and Cons of Central Bank Digital Currency", February 2021 https://101blockchains.com/central-bank-digital-currency-pros-and-cons/

[185] Passacantando F., "Could a digital currency strengthen the euro?", Luiss SEP, Policy Brief 9/2021, May 2021

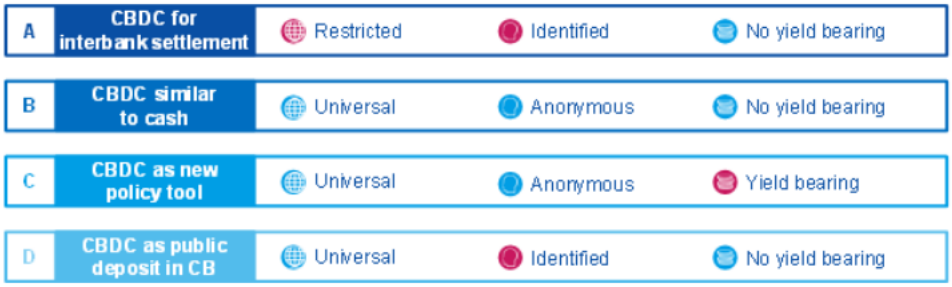
[186] They can be converted into treasury bills or other low-risk assets.

Finally, an aspect that is often considered marginally but cannot be set aside concerns a reputational risk for the central bank: if cyber-attacks or human error were to occur - with a strong repercussion on the currency issued by the banks - this could reflect negatively on the central bank, which could lose credibility.

Pros and cons of different types of CBDCs

The types of CBDCs I listed and analyzed in the previous section[187] are very different from each other and therefore have different advantages and disadvantages, which are worth considering individually.

Figure 34. Different variants and uses of CBDC



Source: BBVA Research (No 19/04)

The first option we have discussed is a non-interest-bearing CBDC, in which identification is complete and access is limited. It is therefore assumed that this new digital currency will complement the existing one and will be available to all credit institutions, i.e. top-tier banks, lower-tier banks and non-banks that manage large amounts of money. Since its access is limited, it is referred to as wholesale CBDC, which could have the benefit of further increasing the efficiency of wholesale payment systems: in fact, the current RTGS infrastructure, although secure and reliable, is very expensive from the point of view of collateral consumption[188]. Another area that could benefit from this type of CBDC concerns cross-border payment systems. Though, this is a common benefit of cryptocurrencies (which offer a great opportunity for significant cost reduction and consequently reduced transaction timing and economics) and so it is not yet clear whether CBDCs will be able to compete with them, since the former are based on domestic payment systems.

[187] See Section 4.1

[188] De Lis F. and Gouveia O., "Central Bank digital currencies: features, options, pros and cons", BBVA Research, Working Paper No 19/04

As for yield-free CBDC, with universal access and anonymity, it could become an alternative to cash. In this case, the benefits are primarily related to reducing the huge costs associated with physical money. This is not only costly in terms of production, replacement, and necessary infrastructure but it also has disadvantages related to the possibility of theft or loss. As a result, CBDCs have the advantage of offering a more efficient alternative to P2P payments.
The main disadvantage of this type of currency, however, lies in the anonymity: if anonymity is an inherent feature in banknotes, it would be a choice in the case of CBDCs; in this case, the central banks themselves would issue an anonymous digital currency, which could become a channel for illegal payments and criminal activities.

The third variant involves an interest-bearing CBDC, with universal access and anonymity: this would open new possibilities for monetary policy, with reference to the zero lower bound on interest rates. This issue has emerged in recent crises; however, the existence of cash, which has a fixed nominal value, places a limit on the scope of negative interest rates[189]; if this were to happen, in fact, arbitrage would lead to the accumulation of cash. Similarly, CBDCs could extend the territory of negative interest rates only in the event that physical cash was eliminated completely (or at least limited to very small denominations). Moreover, this would require the introduction of capital controls to prevent people, faced with the introduction of negative interest rates on domestic cash, from resorting to foreign currency. The key question then becomes whether the Central Bank, an independent entity whose primary objective is to ensure price stability, would have the legitimacy to impose such measures that straddle the line between monetary and financial policy.

The last variant envisions an account-based CBDC with no interest and universal access. This option results in individuals being able to open a checking account with the central bank. Those who support this option argue by claiming that this would reduce the frequency and cost of banking crises[190]. The loss of anonymity has the primary benefit of targeting tax evaders and those who engage in illicit activities. At the same time, however, the loss of anonymity by CBDCs could make them less attractive than physical cash, constituting a limitation to the shift to a society focused on transactions

[189] De Lis F. and Gouveia O., "Central Bank digital currencies: features, options, pros and cons", BBVA Research, Working Paper No 19/04

[190] See note above
Those who support this view argue that crises are *"a consequence of banks' fractional reserves and their role as deposit providers with a fixed face value on their liability side and as credit providers with a variable and uncertain value on their asset side"*. The technology would offer *"the ability to separate the generation of deposits from the provision of credit, radically transforming the role of banks and central banks"*.

through digital payments. If we consider the use of this currency as a store of value, we can say that the increase in its security could lead to an increase in demand: the identification of the owner and the dematerialization of the currency allow for greater traceability of the same, consequently blocking any illicit movements of money. Finally, considering the case of deposits with the CB, consumers will have lower maintenance costs and custody will be more secure than in the case of deposits with commercial banks.
However, it is difficult (if not impossible) to define with certainty whether or not this scenario is preferable to the previous ones: this depends on a combination of several factors.

To conclude, the fact that there is no one CBDC that includes all the advantages but that there are different types that have some pros and other cons means that central banks must devote a lot of time and resources to evaluating the different hypotheses and creating a digital currency system that is truly effective.

4.3 POTENTIAL USES AND IMPLICATIONS

The different types of CBDC imply a different use of currency and therefore can lead to effects that are different from one another. The hypothesis in which the CBDC would be wholesale- thus causing some changes in the operation of wholesale payment systems- would have less significant repercussions. The other alternatives analyzed, on the contrary, can be more overwhelming: the introduction of CBDC as a means of payment could modify people's habits; in some cases, moreover, it would even lead to a modification of the economy and the financial system.

Starting with the possible uses of CBDC, it could serve the function of a means of payment: it would become an additional digital tool for making payments, increasing the degree of competition in the industry. This is an area where there is already a great deal of choice as there are several ways in which a digital payment can be made - via credit and debit cards, using your phone, computer, or smartphone, or via the service offered by banks (online banking), that allows for bank transfers without having to travel locally.

As I listed at the beginning of the first chapter, another function of money is that of store of value: CBDCs could perform this function, at a lower cost than cash: being fully dematerialized, storage

costs would be very low or zero - thus becoming a rather convenient method of storing liquid wealth. It would also have unique features: CBDCs would be free of credit and liquidity risk. This could have an implication for the banking system; being preferable to other instruments generally used to store wealth, such as bank deposits, the move to CBDCs could lead to a funding gap in the banking system. The greatest impact of this scenario is on commercial banks: the introduction of CBDC would lead to a decrease in deposits as a safer alternative to the classic one would be available (since there is a greater protection required). In extreme conditions, the decline in deposits could translate into the rush to digital banking. The size of the banking system would be drastically reduced, which in turn would translate into less possibility for banks to lend to their clients, thus reducing the aggregate credit of the entire economy. According to some studies, however, the effects would not necessarily be disruptive for banks[191]: first, not all deposits could be transferred to the central bank (probably only demand deposits[192]); second, there are some services that banks can offer, unlike CBDCs, such as access to credit and payment services; third, banks could increase their reliance on wholesale funding. In addition, there will still be clients wishing to use classic bank deposits. However, this type of customer will be more risk averse, as they would renounce the possibility offered by central institutions of using a safe deposit. So, commercial banks will be in a position to increase the range of services offered to clients, competing directly with investment banks and mutual funds. However, the fact remains that the banks' business model would be affected.
Of course, the extent to which these effects occur will depend on how successful CBDCs are; this, in turn, will depend on the specific characteristics that central banks decide to give the currency. Risks and benefits are two sides of the same coin, which central banks are and will continue to assess carefully: they need to be aware that, while some features of the currency will maximize the benefits, the risks will never be completely eliminated.

In terms of the impact on monetary policy (and thus how central banks use balance sheets to control interest rates), the issuance of CBDCs should not be significant. Given that CBDCs are not designed to replace cash, the size and composition of the central bank's balance sheet should not change significantly; instead, it could change if *"non-residents move a portion of their portfolios into the domestic CBDC or if the public moves their funds from commercial bank deposits to the CBDC"*[193].

[191] Panetta F., "21st century cash: central banking, technological innovation and digital currencies", in Gnan E. and Masciandaro D., "Do we need Central Bank Digital Currency? Economics, Technology and Institutions", SUERF, 2018

[192] By definition, a demand deposit account (DDA) is *"a bank account from which deposited funds can be withdrawn at any time, without advance notice. DDA accounts can pay interest on the deposited funds but aren't required to"*.

[193] Passacantando F., "Could a digital currency strengthen the euro?", Luiss SEP, Policy Brief 9/2021, May 2021

In this case, there would be changes in central bank lending and investment policies, which would have institutional repercussions. One possibility is that the central bank would use the additional funds to increase lending to banks, creating a few problems: first, there could be a decrease in quality in the collateral that banks would offer to the central bank (which is normally high). Also, central bank lending policies would change.

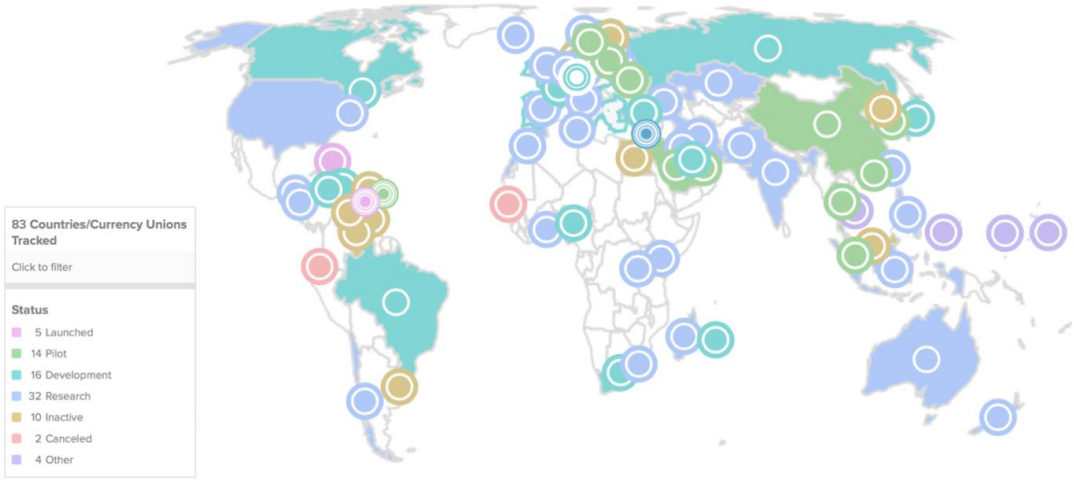
In addition, as far as implications related to the use of this digital currency issued by central banks are concerned, the first is related to the storage of information in the case of transactions that take place digitally: unlike large private providers - which accumulate data, monetizing the information they collect - central banks are not profit-oriented. However, it could be an element in supporting a more robust monetary and financial system. In addition, it could be a method for central banks to combat tax evasion and money laundering by decreasing the size of the informal economy. It could also reduce the information asymmetry that exists when central banks have to decide on monetary policy intervention.

What would have a significant impact on the financial system is if large private companies were to gain centrality in the economy, coming into conflict with the ground of central banks, which have always been in charge of issuing and supervising the issuance of money. Even greater are the concerns if one considers that the private providers could be the Big Techs that enjoy large network effects; monetary circulation could be influenced by two factors that give benefit to these giants: the credibility of the issuer and the degree of acceptance; the fact that they enjoy high notoriety (brand recognition) is a point to their advantage. The effects on the financial system could be disruptive, going so far as to make the State and the central banks themselves dependent on private providers. In fact, if the use of fiat currency were to decline significantly, the optimal policy of the central bank would depend on the policy of the e-money issuer; this could seriously weaken the transmission of monetary policy and limit the ability of the central bank to act as lender of last resort. By issuing its own digital currency, this danger could be averted.

4.4 CURRENT MAJOR CENTRAL BANK INITIATIVES

Data provided by the Atlantic Council[194] regarding CBDCs shows that, currently, 81 countries (representing over 90% of the world's GDP) are exploring the world of central bank-issued currencies. There has been a boom in the past year.

Figure 35. The status of CBDC projects around the world



Source: Atlantic Council

If one considers the four major central banks - namely the US Federal Reserve, the European Central Bank, the Bank of Japan, and the Bank of England - the US is further behind. China, on the other hand, is racing ahead: during the upcoming Winter Olympics (February 2022), visitors who provide passport information to the People's Bank of China will be allowed to use the digital yuan. As the map above shows, five States have already introduced a digital currency: the Bahamas and four States belonging to the Eastern Caribbean Central Bank (Saint Kitts and Nevis, Antigua and Barbuda, Saint Lucia, Grenada). In addition, 14 other States - including Sweden, China, and South Korea - are now in the pilot stage, preparing for a possible future launch.

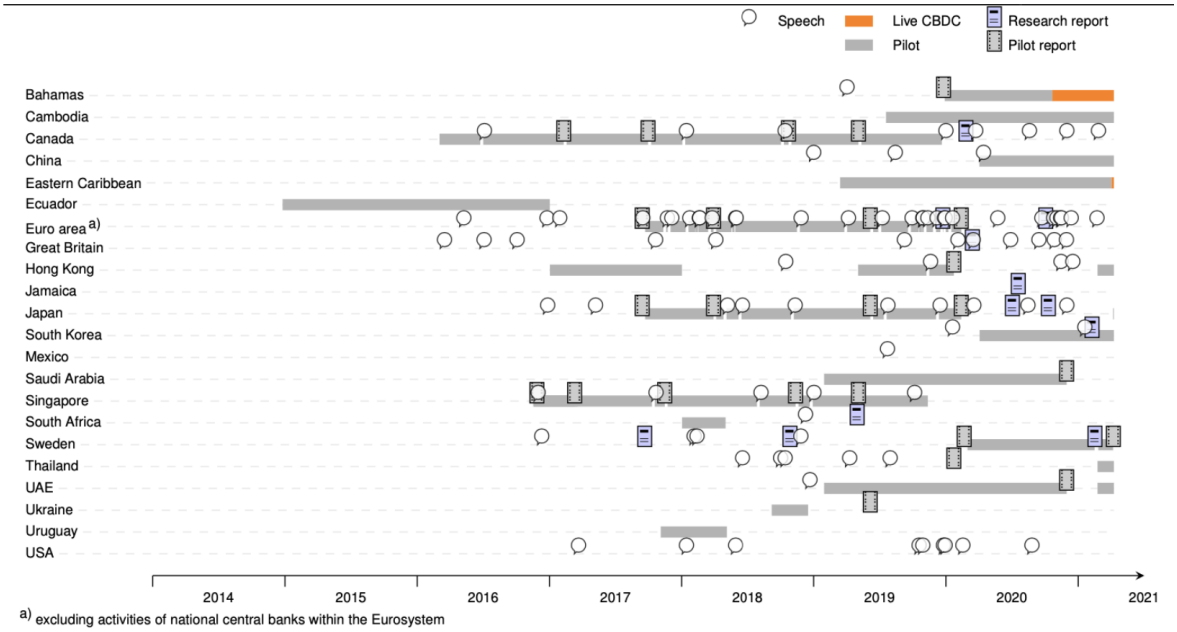
In January 2020, the BIS also conducted a survey on CBDCs[195], involving 65 central banks (representing 72% of the world's population and 91% of global output): it showed that 86% of the

[194] https://www.atlanticcouncil.org/cbdctracker/

[195] Boar C. and Wehrli A., "Ready, steady, go? – Results of the third BIS survey on central bank digital currency", BIS Papers No 114, January 2021

countries surveyed were working on a CBDC, exploring its benefits and drawbacks; again, it is significant to note how interest in this topic has increased within 3 years: in 2017, only 65% were working on these digital currencies. The few countries that have not yet joined the research are small and generally have more pressing priorities. Among these central banks, most are working on both wholesale and retail CBDCs[196].

Figure 36. Timeline of central bank activities on CBDC



Source: BIS (2021)

The world's major central banks are accelerating their studies and projects: meanwhile, two retail CBDCs are already in use. The first in chronological order was the Central Bank of The Bahamas: in December 2019, the Sand Dollar project was launched on the island of Exuma; later, in October 2020, the digital currency was launched throughout the country. This is by far the first central bank digital currency in the world that has passed the pilot phase. It was immediately made available to all Bahamian citizens unlike the integration with the commercial banking system which was subject to a gradual rollout (now almost complete). The other digital currency to be recently launched is the DCash: the Eastern Caribbean Central Bank (ECCB)[197] started developing the project in 2019 and,

[196] See Chapter 1, Figure 6 (Central banks' work on CBDC)

[197] The Eastern Caribbean Central Bank (ECCB) was established in October 1983 and it is the monetary authority of a group of 8 island economies: Anguilla, Antigua and Barbuda, Commonwealth of Dominica, Grenada, Montserrat, St Kitts, Saint Lucia and St Vincent and the Grenadines.

in March 2021 it was launched in 4[198] of its 8 member States. With the issuance of this CBDC, the Eastern Caribbean became the first central bank in the monetary union to issue digital money. The inhabitants of these islands can have the currency available on their cell phones and use it via the app (DCash App) or at participating financial institutions. The figure below shows the main features of the two CBDCs.

Figure 37. CBDC features launched in 5 States

Source: Atlantic Council

In the following, I will examine in more detail the projects of two countries, the Bahamas and Sweden. As I have already mentioned, the former has already launched its own digital currency, the Sand Dollar. The latter, on the other hand, is still in the pilot phase of the e-Krona project; the decision to select this State among many has at its base the strong decrease in the use of cash in the country.

The Bahamas: Sand Dollar[199]

The Central Bank of The Bahamas has been engaged in efforts to modernize the State's payment systems for many years now. In the late 1990s, a study was commissioned to identify the options available to the archipelago to enable the country's payment systems to reach international standards and ensure the development of all sectors of the economy.

[198] The four States in which the DCash was launched are: Saint Kitts and Nevis, Antigua and Barbuda, Saint Lucia and Grenada.

[199] Information about the digital currency issued by the central bank of The Bahamas was taken from the following site: https://www.sanddollar.bs

The Sand Dollar project is a recent part of The Bahamas Payment Systems Modernization Initiative (PSMI)[200]. The goals behind the project were: access to digital payment services by the entire population; full entry of all micro, small and medium-sized enterprises into the digital sphere; universal access to deposit account maintenance banking services; and strengthen controls over anti-money laundering and other illicit activities associated with the use of cash. Notably, when the Governor of the Central Bank of the Bahamas recounted the motivations, he stated that the main objective of the innovation was financial inclusion: in an area where the conformation of the territory makes it difficult and above all expensive to use traditional forms of payment, the introduction of a CBDC would play a key role in improving the efficiency of transactions[201].

Before the pilot phase could begin, the Central Bank sought a technology solutions provider to design and implement digital fiat: indeed, given the nature of the archipelago and the infrastructural challenges of digital service delivery, it was important to choose a robust solution. After receiving many proposals, the choice fell on NZIA Limited, and in May 2019 the partnership was signed - representing a starting point in the implementation of the project.
The first pilot project was launched in December 2019 in Exuma: the choice to start in this area the testing phase has reasons in its geography: this includes Great Exuma and other surrounding islets, making it an excellent representative sample of the largest archipelago. In the same year, a study on financial inclusion and access was conducted in this area. The results showed that access to bank accounts by residents was high (93%); two-thirds of these accounts receive deposits that come from salaries and 15% pension payments. Reasons for not using accounts were lack of trust in institutions or inconvenience of reaching a bank. Further data demonstrated that 96% of residents owned mobile devices - among them, 40% use them for some online payments (bills or online banking transactions). A few months later, in February 2020, the project was expanded to Abaco. Finally, on October 20th, 2020, the Sand Dollar was permanently launched throughout the Bahamas, becoming the central bank's first publicly available digital currency. The potential risks of disintermediation associated with the issuance of digital currency are controlled by the very design of this retail CBDC: users can hold determined amounts of Sand Dollar. The CBDC is not anonymous but the CBOB oversees the

[200] In 2003, the National Payments Council (NPC) was established to lead The Bahamas Payment Systems Modernization Initiative (PSMI); this also began to collaborate with the government and public corporations that are important players in payment systems. Further steps occurred in the years that followed: in 2004, the Central Bank invested directly in the launch of the Bahamas Interbank Settlement System - the Real-Time Gross Settlement (RTGS) system for large-value payments between clearing banks; subsequently, it spearheaded efforts to establish the Bahamas Automated Clearing House (BACH) for electronic settlement of small-value retail payments. This has produced numerous benefits, improving the efficiency and speed of domestic payments.

[201] De Bonis R., "La verità, vi prego, sulla moneta digitale di Banca Centrale", Nuova Antologia, 2020

circulation of digital currency daily, considering the measures necessary to ensure privacy and usability[202]. As for other features of the digital currency, the sand dollar does not pay interest and cannot be held non-domestically[203]. However, nationwide, it can be used for all wholesale and retail transactions. The Sand Dollar can be used 24/7/365 in disconnected environments and bears very low transaction fees[204].

Sweden: e-Krona[205]

The use of cash in Sweden has declined greatly over the years, with some studies showing that the country could become a cashless society as early as 2023[206]. A key role has undoubtedly been played by technological development, which over the years has provided various digital payment services. The central bank of Sweden - the Riksbank - has been pursuing since 2019 the project on digital currency, to address the problem of the decline in the use of cash: the e-krona would thus be a digital complement to cash. One principle that has been established and is fundamental is that the Swedish krona always has the same value, regardless of the form it is in (and therefore whether it is physical cash, an account balance, or a digital e-krona).

The first characteristic of the e-krona is that it is a token-based CBDC; therefore, it has some features in common with physical cash: first, only the Swedish central bank can create and issue the digital currency; therefore, there is a digital certificate that proves its issuance by the Riksbank (consequently, the State guarantees the value of the e-krona). Each token is therefore uniquely identifiable and has a specific value, as it contains an e-kronor number. To access and make payments with the Swedish CBDC, you must have a digital wallet that must be linked to a payment instrument (e.g., in the form of an app or card). The main difference with cash is that while cash can be exchanged without having to involve a third party, the same is not true for e-kronor. Moreover, the token can only be used once: once used, it is recorded as consumed and the e-kronor used in the transaction

[202] Morales-Resendiz R., Ponce J., Picardo P. et al. "Implementing a retail CBDC: Lessons learned and key insights" Latin American Journal of Central Banking 2 (2021)

[203] The Bahamian CBDC is for domestic use only and prohibited from acceptance by non-domestic payees.

[204] Bharathan, V., "Central Bank Digital Currency: The First Nationwide CBDC In the World Has Been Launched By The Bahamas", Forbes, 21 October 2020

[205] Information about the pilot phase 1 of the CBDC issued by the Central Bank of Sweden was taken from the following report: Sveriges Riksbank, "E-krona pilot Phase 1", April 2021

[206] Whateley L., "Sweden leads way to a cashless future", The Sunday Times, June 2021

takes a new form. In other words, the total amount of e-kronor in circulation that can be traced back to the Riksbank will remain the same, but the e-kronor will be represented by new tokens. As far as the distribution of e-kronor is concerned, in pilot phase 1, it was done in a similar way to what happens with cash. The network in which the currency circulates is private and decentralized (DLT), based on the Corda platform of the company R3. Transactions are not recorded in a central database but rather at the network participants who are involved in the buying and selling.
As far as the authenticity of the currency is concerned, as we said before, the credibility of e-krona lies in themselves and in the info that guarantees that they have been issued by the Riksbank, uniquely. If for cash the recognition is made easy by some tools and the possibility of counterfeiting is made difficult by others, the authenticity of digital currencies must be confirmed within the network. This control is performed by a special function, which is called a notary node[207].
As far as the way storage of the tokens with the e-kronor are concerned, there are several alternatives. In the pilot phase 1, the tokens were stored in secure digital vaults, at the participant to which the user is connected and not on the payment instrument: what is stored in the digital wallet connected to the device is the private key that enables the use of the e-kronor. This setup means that only the user has the right to execute transactions. A second scenario sees both the token and the transaction information as well as the private key stored in the payment instrument. The last one, on the contrary, involves all parties being stored in the network in the participant's node (this is a hypothesis that can be compared to the account balance with a connected payment instrument).

So, Sweden has concluded pilot phase 1: further analysis is needed, however, since the DLT and token-based solution is a new technology. After this first phase, the Riksbank has decided to extend the agreement with Accenture to continue evaluating the possibility of issuing this digital currency. There are some areas of interest that will be deepened in this second phase: the e-krona will be tested in retail payments; moreover, the possibility to make off-line payments will be tested: in the first phase, in fact, the central bank has produced only a theoretical analysis, which will now be put into practice. Finally, given the desire to make the e-krona usable in everyday purchases in stores, integration with the terminals of existing points of sale will be tested.

Still, there is not a final decision on whether to issue or not an e-krona.

[207] In summary, I show how a transaction can occur between user A and user B. Suppose A wants to transfer 70 e-kronor to B; A has a token that contains 100 e-kronor in a digital safe at his participant. First, A sends a request to his participant, who in turn checks that there are sufficient funds. The notary node checks that A's token has not been used before; it then records it as consumed and the transaction is approved. The participant of A creates two new tokens, one of 30 and one of 70 e-kronor, and distributes them to the safe of A and the safe of B, respectively. Finally, the participant of B verifies that the 70 e-kronor token is authentic and stores it in the digital safe.

CHAPTER 5

THE FUTURE OF MONEY AND ITS GEOPOLITICAL IMPLICATIONS

Digitization deserves attention: the digital age - featuring blockchain and decentralized ledgers, smart contracts, artificial intelligence, the promise of big data, and other innovations under development - suggests that there will be a radical change in the financial architecture. After taking a close look at the effects that digital transformation is playing in the financial arena and describing the two main innovations in the field of payments - namely stablecoins and CBDC - the purpose of this chapter is to analyze the likely future implications. Specifically, since there are two aspects on which I want to focus, I decided to formally divide the chapter into two parts: the first aimed at assessing the future scenarios of the monetary system; the second devoted to geopolitical aspects related to the introduction of CBDCs in the world.

Nowadays, worldwide, there is a system in which private and public sectors coexist in different areas: even at the level of payments there is a balance in which, the money that is privately issued by banks, telecommunications or specialized payments companies is based on the money that is publicly issued by central banks. In other words, private money is always convertible into public money, which is safe and liquid. With the emergence of new technologies and new payment instruments, it is normal and proper to ask how the monetary system will evolve: if central banks start producing digital currency, what will happen to that issued by the private sector? In other words, will there be competition or cooperation between the two sectors? According to some scholars - and I agree with their supposition - both hypotheses are possible, but the second one is desirable. I am convinced that central banks are unlikely to give up their sovereignty in the financial sector but that they cannot fail to admit that a cooperative effort with the private sector could lead to numerous benefits, providing a solution to the problem of having a relationship with a myriad of final customers and benefiting from competition.

As for the geopolitical implications of issuing a digital currency, the project launched by China that includes the "state blockchain" and the "digital yuan" has opened up doubts about the US ability to maintain leadership in the monetary sphere in the future. In this regard, after an initial brief description of the projects of China, Europe and the United States, I will analyze what are the plausible implications both on the balance that there is currently between the three nations and on emerging countries.

PART I

THE FUTURE OF MONEY: PRIVATE AND/OR PUBLIC?

5.1 PRIVATE AND PUBLIC MONEY

Starting with some definitions, private currencies are *"units of value issued by a private organization (such as a corporation or nonprofit enterprise) to act as an alternative to a national or fiat currency, which would otherwise be the standard unit of value in a country. As a result, these are not legal tenders"*[208]. Private money is instead the term often used to *"describe a loan or equity contribution to a company or investor by a private organization or individual"*[209]. Among private money it is worth mentioning bank (or scriptural) money: it is issued by banks and, even if it is not legal tender, it is accepted by everybody because it is convertible in legal money. Transfers, checks, debits, payment cards etc., tare all instruments that can be used to transfer bank money. Basically, the bank debits the debtor's account and credits the creditor's one, without there being a transfer of legal money[210]. These are opposed by fiat currencies, *"government-issued currency"*[211]. Thus, the government is not the only entity that has the authority to issue money[212]: citizens and businesses can also do so; this has often happened throughout history: in the United States, for example, in 1800 much of the country's paper currency consisted of banknotes issued by private banks[213]. Generally, private money needed to fill problems that existed in currencies issued by the public sector such as the lack of a payment instrument to make small purchases - sometimes in distant locations or circumstances of financial panic. A significant case involving currencies issued by the private sector was that of mining and logging companies: their location in remote areas far from banks stimulated

[208] https://www.investopedia.com/terms/p/private-currency.asp

[209] Olson S., "Private Money", REtipster, https://retipster.com/terms/private-money/

[210] In essence, one hundred euros in a bank account can be exchanged for a one-hundred-euro bill, which is a legal tender, accepted to settle debts. Behind this very simple mechanism, in reality, lie complex underpinnings, including sound regulation, government protections (deposit insurance and lender of last resort), and partial or full coverage of central bank reserves.

[211] https://www.investopedia.com/terms/f/fiatmoney.asp

[212] This can also be deduced from the standard definition of money, i.e. a commodity accepted by general consent as a medium of economic exchange.
The definition is provided by Britannica: https://www.britannica.com/topic/money

[213] Champ B., "Private Money in our Past, Present, and Future", Federal Reserve Bank of Cleveland, 2007

the idea of these companies issuing their own money - commonly known as scrip[214]. Similarly, during financial crises, such as the Great Depression, citizens flocked to banks to try to convert deposits into currency; banks were forced to suspend payments temporarily - often resulting in a shortage of cash, making it difficult to make payments. Again, the response was generally to issue private money in the form of scrip, generally used in the local area. In essence, currency with no intrinsic value is a form of debt and therefore can be issued by everyone, but confidence in the currency and its ability to circulate depend on public intervention to provide direct services or regulation.

In general, that type of money sought to solve liquidity problems that official, government-provided money did not satisfy. Anyway, although it can be said that private money has been useful in many circumstances over the centuries, often having beneficial effects, its use has also caused problems; in many cases, it was unsuccessful for one main reason: individuals lacked confidence in the issuer's ability to redeem it for fiat currency, goods or services in the future. In addition, in many cases, it was limited to restricted geographic areas and did not circulate widely; this can be linked to a problem of recognizability, i.e., the fact that you cannot be sure of the value if you do not know the issuer. A third and final point related to private currency concerns the ease of redemption: money that is difficult to redeem cannot be easily accepted.

Analyzing what happens nowadays, we can say that at the base of the current monetary system there are certainly central banks, which have the task of issuing money. However, cash is confronted on a daily basis - and to an increasing extent - with other payment instruments, generally created by companies belonging to the private sector. The fact that these two very different sectors have succeeded and succeed in coexisting is due to a precise reason: there is a fundamental symbiotic relationship, according to which people have always the possibility to redeem private money at a fixed nominal value in central bank money[215]. Behind this mechanism, which may seem trivial, there are complex underpinnings, such as robust regulation, careful oversight, and government protections.

With advances in technology and computing, electronic money has increasingly crept into the payment habits of citizens. Until about a decade ago, these were simple new ways to make payments.

[214] By definition, scrip is a private substitute for currency. Broadly, it refers to any kind of substitutional currency that replaces legal tender. It is a certificate that represents something of value, but it has no intrinsic value. https://financial-dictionary.thefreedictionary.com/Scrip

[215] Adrian T. and Mancini-Griffoli T., "Public and private money can coexist in the digital age", Cato Journal, Vol. 41, No. 2, 2021

With the introduction of stablecoins, however, things could change, and people could find themselves using a currency that is issued by the private sector. The latter presents significant advantages for innovation, convenience and ease; however, these private money have not yet taken over as they do not guarantee two typical characteristics of central bank money, stability and efficiency.
For its part, indeed, the public sector, namely the central bank, has the advantage of ensuring stability[216], issuing a money that is secure, but greater difficulty in adapting to ongoing technological change: managing the balance between stability and innovation is not an easy task. On the contrary, it can be said that a negative correlation exists between the two: more of one element generally implies less of the other. Therefore, while a system in which only private currencies can exist would be too risky, a system in which only central bank-issued currencies are present would be likely to lose important innovations - or take much longer to modernize. Actually, assuming that central banks even decide to go issue CBDCs, the big advantage of them over private digital currency is the ability to combine some of the benefits of digital currency while still nurturing the support of the existing financial system and the ability to shape regulation. At the same time, however, there are major challenges that suggest that the private sector is unlikely to be completely sidelined.

What needs to be analyzed is how the current relationship between the public and private sectors will change, and thus how their complementarity is assumed to shift.

5.2 COOPERATION OR COMPETITION?

Central banks - and especially bank money - have more and more competitors. However, considering first crypto-assets (such as, for example, bitcoins), it is unlikely that they can become real challenger of central banks, at least in the short-term: first, because size matters and both the total market capitalization and the number of transactions in cryptocurrencies is almost insignificant compared to sovereign currencies. Their biggest problem relates to volatility[217], which raises great doubts in users about their ability to serve as a medium of exchange and store of value. Moreover, there are some environmental problems: although they are virtual currencies, it has been shown by some studies that

[216] The first role of the central bank is to ensure price stability; at the same time, it makes a valuable contribution in controlling financial stability - not least because, in the event of disruptions there would also be repercussions on price stability, as the two are linked. So, the central bank regulates the amount of money in circulation to ensure a nation's economy remains stable and efficient, using tools such as interest rates, printing money and setting bank reserve requirements.

[217] The value of a cryptocurrency can vary a lot in one day, from 10-20% to even 100-200%.

their impact on the environment is negative. According to the *Cambridge Bitcoin Electricity Consumption Index*, at the end of July 2019, the average electricity consumption of bitcoins amounted to 60 terawatt hours - to understand the magnitude, it was higher than that of Switzerland, Qatar or Greece[218]. In this regard, there have already been several projects so that the ecological footprint of blockchain can be reduced and thus considerably decrease the amount of energy required for mining operations. At least as far as volatility is concerned, however, stablecoins were born to address and solve this problem. The private sector has been the first to prove itself ready to follow the momentum of digital transformation: it was the first to launch into the financial system a digital currency. At the same time, the immediacy with which central banks all over the world - first and foremost the Chinese one - have responded to Facebook's proposal to issue a stablecoin called Diem is a proof that they too are aware of it. At first, this made people think of possible competition, i.e. the risk that the private sector could take away one of their main functions from the central banks prompted them to get involved. However, it remains to be analyzed how this issue may evolve.

The debate over who should be the main issuer of money between central banks and private entities has always been very broad. On the one hand, some argue that only the former should have this role, as issuing private money could generate instability and transfer seigniorage revenues to private individuals. Conversely, other people are against the issuance of a CBDC, as they believe it could have negative implications for growth and threaten financial stability.

Several years ago, in 1976, Friedrich Hayek published the book *"The Denationalization of money"*, in which the author addressed the issue of private currencies: his proposal was the opening of money issuance to market forces, abolishing government monopolies[219]. For years, this proposal was considered more of a curiosity than a possibility to be put into practice. In fact, a problem of a monetary balance based on private money could hardly lead to the primary objective of central banks, price stability. Indeed, if an entrepreneur were in charge of issuing cash, it is understandable to expect that he might seek to maximize the real value of seigniorage, and thus his own profit. This implies that Hayek's basic idea, that a competition between private currencies could lead to a stable medium of exchange, was wrong: with the private entity, there is not necessarily a correlation between quality of money issued and price stability. In addition, according to some critics, a private money system

[218] Ithurbide P., "FX wars, currency wars & money wars. Fiat Money vs- Cryptocurrencies. Private vs. Public digital currencies…", Amundi, Disucssion Paper No. 44, January 2020

[219] Fernandez-Villaverde J., "On the economics of currency competition", VoxEU, CEPR Policy Portal, August 2017 https://voxeu.org/article/competition-between-government-money-and-cryptocurrencies

would not be able to provide the socially optimal quantity of money even in equilibrium with stable prices - because *"entrepreneurs do not internalize, by minting additional tokens, the pecuniary externalities they create in the market with trading frictions at the core of all essential money models"*[220]. Thus, it can be argued that, generally, a private money system will not provide price stability, will be prone to episodes of inflation, and will provide a suboptimal amount of money.

In addition, sovereign States have taken several centuries to arrive at the current financial structure and therefore it is difficult to think that they will allow the private sector to appropriate it. Furthermore, although central banks are fully aware of the advantages that large private companies have in terms of technological capabilities and attraction, they also know that they are unlikely to know how (or want) to manage accounts for millions of citizens. For this reason, some degree of cooperation between the two is not only possible, but desirable. The level of cooperation will likely vary by country.

In December 2019, researches conducted a study that showed how cooperation between the public and private sectors in the area of currency is very important: in this scenario, it is possible to minimize the risks of private currency, while maximizing the advantages it has in terms of technology. In this regard, it is important to introduce the concept of *synthetic Central Bank Digital Currency* (sCBDC), first presented by Adrian and Mancini-Graffoli. According to the definition provided by the International Monetary Fund, *"a synthetic CBDC is essentially a public-private partnership that encourages competition between eMoney providers and preserves comparative advantages. The private sector concentrates on innovation, interface design, and client management. And the public sector remains focused on underpinning trust"*[221]. In other words, the main difference that exists between a CBDC and an sCBDC is the entity that maintains contact with the client: in the former case, it is the central bank; in the latter, it is the private company. There are three main reasons why the sCBDC option is preferable.

First, both the initial and maintenance costs are lower: in fact, the costs associated with issuing a CBDC are high as it combines expertise in different fields. Not only initial technical knowledge is required for the actual creation of the digital currency, but skills in customer management and monitoring, regulatory and data management are essential. However, should the decision be made to

[220] See note above (219)

[221] IMF, "Stablecoins, Central Bank Digital Currencies, and Cross-Border Payments: A New Look at the International Monetary System", IMF-Swiss National Bank Conference, Zurich, May 2019

issue an sCBDC, most of the costs would be in the hands of private entities. Central banks, on the other hand, would only need to offer settlement services and access to reserves to stablecoin issuers. This would overcome a key problem faced by many central banks, related to their lack of maturity in the technology field.

Second, this scenario would lead to better regulations to control private stablecoin issuers: the debate regarding the regulatory framework needed to prevent abuses of monetary power with private issuance of a digital currency is quite complex. In the case of a sCBDC, this would be easier. This is a case very reminiscent of "narrow banks"[222], which take customer deposits and invest the proceeds in interest-bearing reserves at the central bank. If private issuers act in this way, then there is no risk of managing stablecoin reserves in a way that digital currencies are secured; In addition, regarding the use of private data, there may be high security standards imposed on private entities, for example, allowing only those who meet these requirements to access central bank reserves. Finally, it should not be forgotten that a sCBDC allows for competition in the payments industry, which in turn leads to the possibility of promoting innovation.

A final advantage is related to the issue of the reputation of central banks: by involving the private sector, this risk would be lower. As I have previously said, the central bank has the priority of guaranteeing price stability and, in doing so, the reputation it enjoys is fundamental. The possibility of failure in financial oversight can have serious consequences both at the level of people's confidence in the financial system and at the level of central banks (with significant consequences at the level of monetary policy). A CBDC would require some tasks that are not in the primary mandate of the central bank; being involved in these can lead to doubts and concerns among people, who would begin to wonder about the ability of central banks to continue to fully perform their primary duty. Not to mention the very real possibility of fraud, technical problems or cyber-attacks, which would carry even more weight. This leads to the assertion that it makes more than sense to free the Central Banks from these risks, entrusting them to private companies.

To conclude, the future of currencies issued by central banks is still to be defined: not only we do not know the characteristics that the different CBDCs will have, but we do not even know with certainty whether the central banks of the different countries that are evaluating the option, will choose to take this path or not. However, it is important that in the assessment, central banks are not faced with the choice between issuing their own digital currency or encouraging that of the private sector, but that

[222] Narrow banks are also called safe banks: the huge advantage of these institutions is that they are immune to runs, bankruptcies and financial crises, as they only hold liquid and safe government securities (and currency). In addition to this, stablecoin issuers also bring technological advantages and innovation to digital currency issuance, from which central banks can profit.

they consider the possibility of cooperating with the latter: the benefits that could result are numerous. By minimizing the risks associated with private entities - such as data protection and transparency - a sCBDC would enable a more stable version of the classic currency issued by central banks. This can happen if central banks make certain design choices and update their regulatory framework. In this respect, it is important to note that the CBDC model that is gaining momentum is the two-tier model, in which central banks "coin" CBDCs and leave them to the private sector, which is responsible for distributing them. This system, therefore, provides for extensive collaboration between the two sectors, drawing on the strengths of both. Looking to the future, this is the system that would need the least invasive technology, in the sense that it would allow adaptation to the new needs related to digitization - and thus a digital currency - while maintaining the two-tier monetary system, in which the private sector plays an important role[223]; open and competitive markets would be ensured, which are necessary to improve economic efficiency[224]: it can therefore be assumed that the two-tier architecture is the most viable solution.

[223] Auer R. and Böhme R., "Central bank digital currency: the quest for minimally invasive technology", BIS Working Papers, No. 948, June 2021

[224] According to a corollary of the free market, the part of finance related to the customer should be left to the private sector.

PART II

GEOPOLITICAL IMPLICATIONS

Concerning CBDCs, I have already extensively analyzed in the previous chapter the characteristics, advantages and disadvantages they can present. Moreover, in the last section I have analyzed two main projects - the first one already in use, in the Bahamas, the second one under experimentation, in Sweden. In this chapter, the analysis wants to go one step further, to analyze what the consequences of issuing a digital currency may be among three major economies - China, Europe and the United States. To this end, in the first section I will briefly examine the three digital currency projects, explaining at what point the various States are in the choice to issue a digital currency, the main features (when already defined) and the advantages and disadvantages that may arise. The last section, instead, will be devoted to a more detailed analysis of the consequences that there may be in the current monetary system at the global level, both among the three great powers, and on emerging countries. Indeed, just as we talked about competition between public and private payment instruments, with the issuance of CBDCs from central banks around the world, competition will also be greater between different States. The fact of being the first country to issue central bank digital currency can be an advantage not only in the possibility of overtaking other digital payment instruments - including stablecoins - but also in internationalizing its currency. In this sense, unlike the U.S. and Europe, by securing the first-mover position in issuing a digital currency, China may have an advantage at the geo-strategic level. It should not be forgotten that it is the second largest economy in the world and the largest exporter: for this reason, there are many interests in ousting the dollar from being the reference point of the monetary system. The Middle Kingdom seems to have been clear for some time now about the need to equip itself with two technologies that *"risk becoming decisive cyber weapons in the competition with the US: the "state blockchain"*[225] *and the digital yuan"*[226]. There are three objectives at the basis of these projects: first, to surpass the dollar as the currency used for international trade; second, to increase Chinese penetration in developing countries (mainly in Asia and Africa); and third, to use the mechanisms of these technologies to increase control over citizens, going so far as to orient their purchasing criteria. Already with the announcement of the *Made in China 2025* plan, Beijing was taking a big step: the objectives were, on the one hand, to

[225] In October 2019, the Chinese government released its own Blockchain Service Networks (Ben), followed after 6 months by the start of domestic commercialization of the service and after another 4 months by the launch of the international version. The Chinese blockchain is chaired by several entities that are led by the State Information Center of China (Sic). An important feature is that the Chinese blockchain is "permissioned" and lacks the features of decentralization and transparency.

[226] Frenzia Maxia M. "Blockchain statale e yuan digitale: "game changer" di Pechino nella competizione imperiale con gli Usa?", Istituto Affari Internazionali, 2020

transform the country from a producer of low-cost, low-tech goods to a producer of goods and services with a high technological capacity; on the other, to promote infrastructures linked to transport between China and Europe. The digital yuan project goes even further, hypothetically allowing the Chinese great power to compete with America in the infosphere.

5.3 CBDC PROJECTS IN CHINA, EUROPE AND USA

Throughout history, having a strong currency internationally has facilitated countries to extend their power by projecting their sphere of influence. Financial and political power are strongly intertwined[227]. Digital currency issued by central banks may represent a new land of challenge. Below I outline the main points of the three projects, namely the digital yuan (China), the digital euro (Europe), and the digital dollar.

Digital yuan

In terms of issuing a CBDC, China is certainly a step ahead of Europe and the United States. It has been several years now - specifically since 2014 - that the People's Bank of China (PBoC) has created a team of experts to analyze the technical and regulatory requirements for establishing a digital currency. In addition, its own Digital Currency Research Institute was established in 2017. Finally, China launched the pilot program in 2020, winning the lead in this respect. According to the PBoC's deputy governor, up to last year, the number of digital wallets opened for individuals would amount to 113,300 while those for companies would total 8,859. Between April and August alone, transactions would have touched a value of 1.1 billion renminbi (total 3.1 million transactions)[228]. Some reports show that digital yuan has been trialed in four cities - Shenzhen[229], Suzhou, Chengdu, Xiong'an - and in some commercial entities[230]. Coming soon, the trial will expand to Beijing, Tianjin

[227] Amighini A., "Cina: il renminbi alla conquista dei mercati globali", Istituto per gli Studi di Politica Internazionale (ISPI), 2021
https://www.ispionline.it/it/pubblicazione/cina-il-renminbi-alla-conquista-dei-mercati-globali-30235

[228] The data were provided during the Sibos 2020 meeting.

[229] To accelerate testing of the pilot phase, the Chinese government has "gifted" 50,000 citizens in the Shenzhen district with 200 digital yuan to spend in more than 3,300 stores enabled to receive digital payments

[230] Devonshire-Ellis C. and Wong D., "When Can I Buy, Use, and Trade China's Digital Yuan?", May 2021

(in Hebei province), and as part of the Greater Bay Area project; finally, there will be the use of this currency in the 2022 Winter Olympics[231].

The project launched by the PBoC is named Digital Currency/Electronic Payments (DCEP); as the title suggests, the main purpose is *"to create an electronic mode for payments that is sanctioned as legal tender by the Chinese government"*[232]. The central bank is therefore behind the project and the exchange rate against fiat RMB is 1:1. In China, cash is now an uncommon means of payment, and this additional initiative aims to replace it completely - without altering the amount of money in circulation. Interest-free, it is a token-based CBDC, operating on two levels: first, the PBoC distributes the currency to intermediaries[233] and payment services[234]. In turn, intermediaries play the role of distributing the currency to individuals. As far as the distribution of the yuan is concerned, Fan Yifei - deputy governor of the PBoC - stated that, unlike the central bank, commercial banks already have the infrastructure to distribute the DCEP and therefore they will take care of it.
One of the points worth noting is the fact that there is no need to have a bank account (despite the fact that these can be converted to digital currency): this has a bearing on financial inclusion. Finally, the technology will also allow payments to be made offline, thanks to technology with near field communication (NFC) capabilities.

In addition to the general benefits we have already listed for CBDCs in the last chapter - namely the reduction in the cost of issuing paper money and the risks associated with it[235], greater efficiency in financial transactions, regaining power over private payment services, promoting financial inclusion for unbanked citizens in small towns and rural areas - the digital yuan can improve financial digitization and innovation, and thus productivity. The central bank and government will be able to supervise money flows and financial activities more closely: this is positive as it can lead to greater ease in the fight against tax evasion, fraud, money laundering, and all other illicit activities; at the

[231] Frenzia Maxia M. "Blockchain statale e yuan digitale: "game changer" di Pechino nella competizione imperiale con gli Usa?", Istituto Affari Internazionali, 2020

[232] Knoerich J., "China's New Digital Currency: Implications for Renminbi Internationalization and the US Dollar", in The (Near) Future of Central Bank Digital Currencies, 2021, p. 146

[233] The PBoC will distributes digital yuan to China's four major state-owned commercial banks, namely Bank of China, Industrial and Commercial Bank of China, China Construction Bank, and Agricultural Bank of China.

[234] Such as Alibaba's Alipay, Tencent's WeChat Pay, and China UnionPay.

[235] Among the risk, there are the ease of counterfeiting, losing it, and using it for illicit purposes, given its anonymity.

same time, however, it could mean greater State control over citizens[236]. The issuance of a DCEP also has an important international implication: it can facilitate the circulation of RMB, potentially challenging the superiority of the U.S. dollar; it could also give China an advantage over currencies issued by private companies, such as the Facebook project - which poses a threat to the State. I will discuss these implications in the next section.

While the benefits are different, we must consider the fact that there are some risks for China in establishing itself as the first major power to issue digital currency: besides the possibility that the DCEP could attack the role of commercial banks - a hypothesis probably averted by the two-tier approach - problems could arise for the functioning of the economy and the financial system; the fact of being the first-mover could even accentuate the consequences while providing an advantage for other States (which could take a cue from the mistakes made by China).

Digital euro

The European Central Bank (ECB) is also analyzing the proposal to issue the digital euro. Specifically, in 2020, it decided to establish a high-level task force to deal with this issue and, in October 2020, it published the first report[237] analyzing various aspects related to the issuance of the digital euro; 9 months later - in July 2021 - following further analysis and initial experiments that produced positive results, the Eurosystem decided to launch the project.

> *"Our work aims to ensure that in the digital age citizens and firms continue to have access to the safest form of money, central bank money."*
>
> Christine Lagarde

Starting from the main results that emerged from the 2020 report, it should first of all be said that the digital euro would not have the objective of replacing cash but of flanking it, becoming an additional

[236] In the case of the Chinese project to issue CBDCs, we talk about "controllable anonymity": it refers to a system in which all payments remain anonymous but are nevertheless verified by data analysis tools to identify possible malfeasance. In other words, the central bank can observe and monitor transactions taking place while the transacting parties remain private. Still the PBoC can analyze transactions to monitor possible crimes. Indeed, as explained by Mu Changchun- director of the Digital Currency Research Institute at the PBoC- a completely anonymous digital yuan is not feasible for security reasons.

[237] ECB, “Report on a digital euro”, October 2020

tool to those already present. The elements that have pushed Europe to move on this issue are the need to support the digitalization of the economy, to create a new instrument of public money that can cope with both the reduction in the use of payments and the expansion of the private sector in this area, and to anticipate the adoption of foreign currencies. In addition, a digital euro could allow for greater control of monetary policy should the central bank decide to set the rate of return on the digital currency - thereby directly influencing the consumption and investment choices of households and businesses. A risk that could emerge from the issue of the CBDC is that of disintermediation of the payments system, in which the ECB could acquire greater value at the expense of the commercial banks. This is a risk of critical importance for the EU: since businesses (especially SMEs, which form the bulk of the industrial sector in many member countries) are highly dependent on bank intermediation, it deserves appropriate consideration[238]. Particular attention was paid to this aspect in the report: the idea is to create an interesting means of payment while avoiding its use as a form of investment. Two solutions to this problem could be either the imposition of a maximum limit of digital euros or the application of differentiated interest rates; finally, in the ECB's vision, the other financial institutions would continue to play a role by providing services linked to the user's operations.

In the months following the issue of the report, many experiments were conducted in four areas: technology for a digital euro (digital euro ledger), privacy and combating money laundering, limits to the circulation of the digital euro, access by end-users in the absence of an Internet connection and facilitating inclusiveness with appropriate devices[239]. The fact that no particular problems have been identified in these areas has led the ECB to opt for the experimental phase, but it must be stressed that this does not necessarily mean that a digital euro will be issued: in fact, the final decision will be taken only after the conclusion of this experimental phase, which has a duration of 24 months and will focus mainly on technical aspects about the characteristics and distribution.

The digital euro eventually issued by the European Central Bank will undoubtedly have to meet the needs of the citizens, while ensuring security and avoiding problems in terms of financial stability

[238] F. Passacantando, "Could a digital currency strengthen the euro?", 2021
In addition, it should be noted that-as explained in this paper- risks of instability should not be underestimated, not least because "when they materialize in the euro area they result in fragmentation of banking markets along national borders. Whether the CBDC would exacerbate these risks requires further analysis, but at the same time it would not be easy to design measures to mitigate them (such as variable interest rates on the CBDC), measures whose impact would be very different from country to country".

[239] ECB, "Eurosystem launches digital euro project", 2021:
https://www.ecb.europa.eu/press/pr/date/2021/html/ecb.pr210714~d99198ea23.en.html

and monetary policy. In the analysis phase of the project will be involved a series of experts who will be in charge of outlining prototypes, according to the needs of users. The form of digital currency that will emerge from these studies must be efficient, accessible and risk-free. In addition, the EU regulatory framework will be analyzed in detail and possible changes that may be needed. Finally, the impacts that the currency will have on the market will be assessed - always with the ultimate goal of finding a solution that can both guarantee privacy and avoid risks for citizens, intermediaries and the economy as a whole. Should this project be taken forward and the digital euro become a part of a larger project in which the Capital Markets Union and the Banking Union are reformed, this could even have a major impact on the internationalization of our currency.

Digital dollar

As for the U.S., there is not much to say about a digital dollar (also called Fedcoin) yet, as they are still in the early stages of evaluations and no decision has yet been made: lawmakers, Treasury Department officials, and the Fed to date have not chosen to launch a digital currency, let alone worked out possible methods by which it could interact with the current payment system. In this regard, however, reassurance to banks came from Federal Reserve Chairman Jerome Powell, who suggested that, should they proceed in the direction of issuing a digital dollar, it would be integrated into payment systems alongside cash and other forms of money. Theoretically, a Fed-backed digital dollar could function like cash and could allow citizens to exchange money that would be in a Fed-backed wallet outside of the private banking system.
So, if it is also important for the United States to keep up with the times and digitization, analyzing the risks and benefits that a currency can bring to the country, Americans are against rushing any study that is conducted in this regard.

> *"If we were able to create a well-designed interface to a central bank digital currency, we could do for the transfer of value what the internet did for the transfer of information, which is create a platform for innovation,"*
>
> Neha Narula[240]

[240] Nover S., "The Fed's digital dollar could bring millions into the digital economy", Quartz, July 2021 https://qz.com/2031646/what-is-a-digital-dollar-and-how-does-it-work/

According to Robert Bench, vice president of the Boston Fed, the potential of a digital dollar is immense; however, so are the challenges - including *"anticipating the needs of the U.S. payment system 15 years down the road, to distilling copious amounts of technical knowledge for prototype design"*.[241]

As for the main benefits associated with the U.S. CBDC, it would make it easier and cheaper to transfer money abroad and speed up money transfers between the government and citizens; it could prevent private-sector monopolies on digital currencies that could affect privacy; and it is a project that could help many Americans who do not have access to the banking system: according to a 2019 study, there are 7.1 million U.S. families who are unbanked (i.e., 5.4%); should we assume that cash would stop being used, these people would be excluded because they do not have a checking or savings account with a bank or a credit union.

On the downside, in America, the privacy factor - along with security - is a priority: it is one of the issues Americans seem to be most concerned about, namely the strong control that a Fedcoin could have over its citizens.

Currently, however, the studies continue and, according to some early statements, the team of the Boston Fed and researchers from the Massachusetts Institute of Technology (MIT)[242] are simultaneously working on the digital currency platform (which does not assume any change in the current monetary system) and developing tests and experiments to understand the existing options of public and private digital currency. In any case, the Fed has already determined that if it proceeds, it will only do so with the support of Congress.

Further research is therefore expected from the Federal Reserve Bank of Boston and MIT: since 2020 they have been engaged in the analysis of digital currency that is fast, secure, resilient, and privacy - preserving - and thus capable of supporting the world's largest economy.

[241] Lindsay J., "Boston Fed exploring the tech, benefits and tradeoffs of a digital dollar". Federal Reserve Bank of Boston, 2020

[242] The project the Fed and the Massachusetts Institute of Technology are working on is called the Hamilton Project and is led by Neha Narula.

5.4 HOW DIGITAL CURRENCY WILL RE-ESTABLISH THE INTERNATIONAL MONETARY ORDER

A process to internationalize the renminbi has been underway in China for several years now: this process began in 2009, in the wake of the financial crisis, as China was among the peripheral countries that suffered significant damage, as opposed to the United States in which, thanks to the currency's hegemony, a monetary policy was used to protect itself more effectively from the economic fallout. Since then, many measures have been taken in this regard: in 2016, the numerous efforts led to a first result, as the RMB was included in the Special Drawing Rights (SDR) basket, which is an international reserve asset created by the International Monetary Fund (IMF). This step allowed it to stand alongside other currencies whose importance is recognized globally (i.e., the dollar, euro, pound, and yen). Thus, the global use of the currency expanded: however, this came to a halt in 2015 when, due to the collapse of Chinese stock markets[243], the government took the forced-choice to devalue the RMB. To prevent further depreciation of the currency, other measures - such as capital controls - came into play. The most damaging consequence has been a reduction in international confidence in the Chinese currency, which has put the brakes on a process of expansion that has been underway for several years - sometimes even going backward.

5.4.1 IMPACT ON US - EUROPE - CHINA EQUILIBRIUM

To understand the impact that the issuance of a Chinese digital currency may have on the international monetary system, I will start with some data. The figure below (Figure 38) shows 2019 and 2020 values for three important factors that are considered when assessing the level of currency internationalization: global payments, foreign exchange market activity, and foreign exchange reserves. In all of them, China presents very low percentages, below 5%, which brings it to the last place, not only after the United States and Europe but also Great Britain and Japan. This is a clear

[243] The collapse of Chinese stock market in 2015: China's stock market turbulence began with the bursting of the stock market bubble on June 12th, 2015. Prior to this date, China's stock market had risen by about 150% in one year: the value of many stocks increased at an incredible rate; however, at the same time, the country's growth slowed down a lot compared to other years. One of the reasons was that many people started investing in the stock market for the first time - in most cases they were inexperienced people using borrowed money. Despite some government-mandated requirements on this aspect, people found a variety of ways to circumvent them. After the Chinese authorities began to become alarmed by rising stock prices, there was an announcement about a new limit on the total amount of margin lending that stockbrokers could do. This triggered the market to fall in mid-June.
Information provided by: https://www.indrastra.com/2017/10/Understanding-Causes-of-China-s-Stock-Market-Crash-2015-003-10-2017-0016.html?m=1

sign that, despite being the world's second largest economy and the largest trading nation, there is still a long way to go on the internationalization of its currency.

Figure 38. Global utilization of the RMB in comparison to $, €, £ and ¥

Currency	Share of global payments June 2020, % (Rank)	Share of foreign exchange market turnover April 2019, % (Rank)	Share of allocated foreign exchange reserves 1Q2020, % (Rank)
USD	40.33 (1)	88.3 (1)	61.99 (1)
EUR	34.10 (2)	32.3 (2)	20.05 (2)
GBP	7.08 (3)	12.8 (4)	4.43 (4)
JPY	3.74 (4)	16.8 (3)	5.70 (3)
CNY	**1.76 (5)**	**4.3 (8)**	**2.02 (5)**

Source: The (Near) Future of Central Bank Digital Currencies

At the top of the list are the dollar and the euro; the high percentages in the various factors demonstrate a first fundamental point for this analysis: China - with its currency - is still a long way from being able to take their place. In fact, these are two currencies that are widely rooted in the international financial architecture and are unlikely to cease to be so, despite China's progress is indisputable.
It must also be taken into account that the Chinese capital account remains among the least open in the world and its financial markets among the most restricted to foreign participants[244]. These are aspects that do not allow the RMB to show its true potential. For the renminbi to truly internationalize, it is important that it circulates at a higher rate or that capital outflows increase - the latter would in turn require higher capital account convertibility, lifting restrictions on capital inflows and outflows, and ongoing opening of Chinese financial markets to foreign participation. This scenario is unlikely to occur in the short term as it would imply less control by the government, which fears there could be repercussions on the financial system, with possible capital flight. Add to all these factors, the ongoing pandemic makes it even less likely that the government will adopt financial reforms in this direction. For the world to have greater confidence in China's currency, in fact, greater confidence in market mechanisms would be needed, reducing intervention by Beijing.

[244] Bilotta N. and Botti F. (eds), "The (Near) Future of Central Bank Digital Currencies. Risks and Opportunities for the Global Economy and Society", Peter Lang, 2021, p. 155

This premise is fundamental in order to be able to evaluate what the scenarios surrounding the introduction of the DCEP are: there has certainly been a great deal of progress in terms of the internationalization of the renminbi, but there are still many unfavorable points. It is not yet clear how widespread the digital currency will be, and thus whether it will spread only at a national level or whether it will become widely used beyond national borders: in the second case, the digital yuan would be another element in the plan started several years ago to internationalize the RMB. As a result, a very strong renminbi would help increase China's ability to play a key role on the international chessboard, potentially going so far as to challenge the primacy of the dollar globally. This is a hypothesis that, given the initial premises, is very far from being able to come true.

What can objectively happen with the issuance of DCEP by the PBoC is that companies that import and export from the country will perceive it as a method that can simplify transactions, decreasing costs and exchange rate risks; for this reason, it could be affirmed in place of the US dollar, which is currently the intermediate currency. In fact, at present, it is advantageous to use the dollar as the intermediary currency, even in cases where there would still be the possibility of exchanging the currency directly into RMB.
Moreover, it is a payment instrument that could easily spread to those who have frequent dealings with China - I am referring not only to countries in Asia or along the Belt and Road[245] but also to all those that host large numbers of Chinese tourists year-round.

It can therefore be said almost certainly that the DCEP will increase the level of internationalization of Chinese fiat currency, expanding global payments in local currency. Theoretically, indeed, the DCEP has the potential to shift the global payments system in China's favor: since many companies trade internationally with the country, the opportunity to reduce costs and improve transaction efficiency could have far-reaching consequences. This is all the more so given China's primacy in exports. China's digital currency could be a success at the international level as it could allow bypassing the Society for Worldwide Interbank Financial Telecommunication (SWIFT) payment system - whose governance can be considered Western-centric; although there are possible solutions already able to reduce the time, the system that is still used is very old and has high costs.

[245] The Belt and Road Initiative (BRI): it is a long-term transcontinental policy and investment program that aims to expand the infrastructure and accelerate the economic integration of countries along the route of the historic Silk Road. The initiative was introduced in 2013 and until 2016 was known as OBOR - One Belt One Road. The main objective is to promote the connectivity of the Asian, European and African continents and their adjacent seas by establishing and strengthening partnerships between countries. According to the Belt and Road portal, 71 countries currently participate in the initiative.
https://www.beltroad-initiative.com/belt-and-road/

However, it does not yet have the potential to challenge the dollar (or the euro) as a reserve and investment currency. For one to even imagine a change in the current monetary system, with the renminbi overtaking the dollar, these two aspects must also strengthen. To do so, however, the Beijing government must start thinking about reforms and liberalization of the financial system.
However, this innovation is unlikely to affect investment decisions, which will continue to depend on the fundamentals of the Chinese financial system. Even moving first on the issuance of a digital currency would therefore not allow China to gloss over the need for financial reforms, capital account liberalization, and a more flexible exchange rate. On the contrary, these aspects may be necessary to allow the digital currency to become an effective method of payment abroad.

5.4.2 IMPACT ON EMERGING COUNTRIES

Assuming this will be possible from the technology underlying the DCEP, the currency issued by China's central bank could also be used by individuals from other countries: this could be particularly attractive in developing countries, where local currencies are often unstable and financial infrastructure underdeveloped. In this sense, the Digital Yuan could become a real alternative to the country's own currency. In conjunction with the tracing of the "the Silk Road", especially in poor and developing countries, Chinese capital is used to finance businesses; in these areas, Beijing also directly finances roads, ports, power plants, and bank branches[246]. However, this development has not been accompanied by the emergence of telecommunications-related infrastructure. Despite the fact that these are very poor countries, the investments coming from China are helping a not insignificant development: according to some analyses, the US think tank Brookings foresees that in the next 10 years, these investments could represent an outlet market for Chinese goods of one billion people and 2.5 billion dollars (in particular 2.1 trillion by 2025 and 2.5 trillion by 2030)[247]. These are important numbers, and if they were to be truly confirmed, they could represent a solution to the dangerous contraction of the trade surplus. In this regard, digital currency represents an incredible opportunity not only in terms of financial inclusion but also for the strategy of the Middle Kingdom: remember that, among the 1.7 billion people who are unbanked, two-thirds have a mobile phone. The majority of potential consumers in these areas of the world own a smartphone that is Chinese - in

[246] Frenzia Maxia M. "Blockchain statale e yuan digitale: "game changer" di Pechino nella competizione imperiale con gli Usa?", Istituto Affari Internazionali, 2020

[247] See note above

many cases down-provided with pre-installed apps that can enable the use of WeChat Pay, Alipay, or a hypothetical payment app for digital currencies issued by the central bank.

According to some data, cross-border payment traffic with China in RMB is increasing in both Asian and African countries: suffice it to say that, in Africa, the value of yuan-denominated payments rose 123% between 2016 and 2019[248]; some Chinese electronic payment companies - such as Ant Financial and Tencent - are playing a key role in many developing countries in Africa and beyond. Similarly, China UnionPay already has a vast global presence: these are elements that could subsequently encourage the spread of DCEP in these areas, which are already accustomed to it.

In addition, the factor of the loans that China has granted to the African continent must be considered: between 2000 and 2018, the sum reached the figure of $148 billion. In some countries, including Sudan, Ethiopia, Kenya, Angola, and Nigeria, the "debt trap"[249] has already been triggered. This could be a way for Beijing to encourage the use of digital renminbi in these countries. This last aspect, however, should be analyzed very cautiously because, in fact, there are discordant opinions of scholars: according to some, in fact, the costs of such behavior would be higher than the benefits. Furthermore, there are also those who believe that China, in most insolvency situations, has opted for negotiated solutions.

In conclusion, it is not yet clear what will happen in the immediate future and what will be the consequences of the issuance of DCEPs in China and other countries around the world. As of now, the US dollar looks likely to remain the chosen medium when it comes to international economic transactions. China's aspirations, although externally they seem to be oriented not to frighten but rather to narrate concord, are of a high level. Theoretically, should the project truly benefit from first-mover advantages, it could lead to important implications. It must also be taken into consideration that, although the USA and Europe are currently at a disadvantage, this may soon no longer be the case: in fact, the central banks of these countries are also evaluating and launching their own projects in this field. The area where it could gain the most support remains the developing world.

[248] See note above (246)

[249] A debt trap can be explained as a situation in which consumers or business entities accumulate debt to achieve a goal, but ultimately, they create additional financial difficulties. Getting out of this circumstance can be extremely difficult and take a lot of time and effort. Sometimes, the only way out of the trap is bankruptcy. Especially on the Western side there are concerns about Chinese loans, which are seen as geostrategic and coordinated tactics in which African countries are indebted in order to gain control over key assets. In fact, they assert that Chinese loans are secured by strategically important assets-from mineral resources to port projects-and the debt is deliberately used to leverage or extract strategic advantages from poor indebted countries-including asset seizures-when they are unable to meet their debt obligations.

CONCLUSION

The future of digital currencies is still uncertain: it is too early to determine who will be the winner. One of the main reasons behind the discussion of CBDCs is to prevent a few private currencies from dominating the payments system. The fear, at least until these days, is not so much about cryptocurrencies, which have the inherent problem of being too volatile, as it is about stablecoins that are issued by large companies. So, what is important to analyze is, what will happen to the historical relationship between the public and private sectors when it comes to payment? Nowadays, private and public coexist in different areas, including in the financial system. However, the emergence of digital currencies could be a factor of clash; on the contrary, there are some theses demonstrating that a cooperation between the two could bring numerous benefits.

The recent news of El Salvador, the first country to formally adopt bitcoin - the world's most popular crypto-asset - as legal tender alongside the dollar has further accelerated the debate. On the first day of the launch, there were some problems related to the functioning of the Chivo app, in which citizens can sign up with a national ID in order to start making transactions using bitcoin. Currently, therefore, supporters and critics around the world are sticking to the screen to assess how this experiment will play out. This episode could give a further launch not only to crypto-assets but also to stablecoins which are considered preferable as they are non-volatile. In my opinion, central banks will hardly be able to leave their sovereignty in the field of money in the hands of big private companies, but they will also not be able to ignore their competitive advantage in innovation and technology. A cooperative strategy could be the winning solution, capable of maximizing the benefits and reducing the risks of the two sectors taken individually.

As far as CBDCs are concerned, there is another issue that deserves some attention, which is geopolitical in nature. China will undoubtedly have a first-mover advantage, benefitting from its large population and the familiarity of its citizens to use digital technologies. Indeed, these two factors give it an edge in the testing phase of DCEP. In addition, there is less concern related to privacy in China, which is a major obstacle in other countries. The digital yuan will play a key role in the internationalization of the Chinese currency (already started several years ago): how far this project will go also depends on factors outside of China. Throughout history, powers have learnt that having a strong international currency could have positive consequences in extending their power and sphere of influence. Though, looking at the data relating to the current level of internationalization of the renminbi, it can be seen that the Chinese currency is still far from catching up with the dollar or the

euro. If we look at the share of global payments, foreign exchange market assets and foreign exchange reserves, China has percentages below 5% (1.76%, 4.3% and 2.02% respectively). In the United States the shares are 40.33%, 88.3% and 61.99% respectively; in Europe 34.10%, 32.3% and 20.05%. Between the two powers and China are Great Britain and Japan. Indeed, the dollar and the euro are currencies that have been rooted in the financial architecture for years. Moreover, there are numerous other aspects that would need to be reformed in order for the currency to gain more prominence outside of China itself. In addition, it must be admitted that China's main adversary, the United States, has on its side the advantage of being a strong FinTech power: this could allow the Americans, who are still far behind in launching a CBDC, to quickly catch up with the Middle Kingdom in the digital currencies' era. Even Europe is considering issuing its own digital euro: after an initial evaluation report, it decided to launch the project in July 2021 (although this does not necessarily mean that the ECB will eventually issue its own CBDC): the project, if it is accompanied by a broad reform effort (including the Capital Markets Union and the Banking Union) can play a key role in strengthening the European currency on a global level. As a result, first-mover advantages could be overcome quickly. What could more realistically happen is an influence of China on developing countries: countries with unstable local currencies and poor financial structures could decide to use a CBDC, probably the Chinese one, if it were to actually be accessible first. Furthermore, China has numerous trade relationships with many developing economies.

The decisions that will be made and the initiatives that will emerge in the coming months will be key to understanding what the future of the money will be.

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ABSTRACT

Introduction

Digitization innovations - like blockchain and decentralized ledgers, artificial intelligence, the management of big data - are revolutionizing financial architecture. Innovations have not only led to advances in traditional payment services but also to the emergence of new payment instruments. As happens with any novelty, many questions surround the world of digital currencies. A heated debate about cryptocurrencies and stablecoins has triggered another one about CBDCs. This topic, still unresolved in many ways, raises several questions: what will happen in the near future to money? Specifically, how will the relationship between the public and private sectors evolve and what will be the impact on the current monetary system? To arrive at a potential answer, I started from the very beginning, analyzing the history of money, the evolution of the relationship between central banks and commercial banks, and the impact of digital transformation on the financial system. Moreover, I focused my attention on stablecoins and CBDCs, studying in a specular way their characteristics, advantages, disadvantages and implications. This allowed me to have a holistic perspective, which allowed me to outline possible future scenarios, explaining which ones would be preferable.

Chapter 1
THE EVOLUTION OF MONEY: FROM BARTER TO DIGITAL CURRENCY

Throughout history, money has facilitated the exchange of goods and services. Besides being an element of aggregation, money functions as a unit of account, means of payment, and store of value. Today we talk about 'legal tender', as by law money has the power to extinguish the obligation of the payer towards the creditor; in ancient Greece, to indicate money was used the word νόμισμα (nomisma), which derives from νόμος (nomos), i.e., law, custom. Tracing its history means tracing the evolution of the first financial instrument capable of being accepted and recognized by the masses. After a first phase in which exchanges were based on the barter, humans began to feel the need to find a more efficient means: if at the beginning particular goods were traded - hence the name commodity money - then precious metals became established, first in the form of ingots or nuggets, then minted and transformed into coins. Initially, the monetary model was based on the monometallic system but, during the early Middle Ages, institutions began to produce coins by mixing precious metals: thus, the separation between intrinsic and nominal value occurred; consequently, the reputation of the issuer, which certified the value, became fundamental. The next evolution is represented by the banknote: the first *note di banco* were made in the 14th century and were deposit receipts issued by goldsmiths (later bankers) in exchange for gold coins that merchants gave them in custody. The need for convertibility over the years favored the birth of an international monetary

system, based on common rules: in the 18th century the Gold Standard was born; each country had to fix its currency in terms of gold units, and they were linked together by a system of fixed exchange rates. This system ended in 1931. Since then, banknotes became a form of 'fiat money'. In 1944, 44 nations decided to initiate the Gold Exchange Standard, based on a system of fixed exchange rates between currencies, anchored to the dollar, which was the only guaranteed currency in terms of gold. It ended in 1971, with the United States declaring the end to the conversion of the dollar into gold. The system that emerged from the 1971 currency crisis, defined as the floating exchange rate, still exists today. In 2009, with cryptocurrencies, the last phase of currency history began.

For centuries, banks have dealt with issuing banknotes in a competitive environment: a slow evolution has led to the current situation in which the central bank is responsible for managing money and controlling its supply. However, it was not born as a defined institution: it has developed over time - often from the transformation of commercial banks - progressively acquiring new and increasingly complex functions. Because of its former nature, for many years it continued to collect deposits and offer loans to the public. For example, the Bank of Italy, founded in 1893, maintained its relationship with the public until 1936. Today this is no longer possible: commercial and central banks have well-defined roles. Following the periodization indicated by Giannini (*The Age of Central Banks*), three phases in the evolution of central banks and a fourth, emerging, can be identified. The first coincides with the introduction of convertible banknotes: at the time, central banks were private institutions; the second phase is marked by the development of bank money: in that period, the role of central banks expanded, and they were transformed into public institutions. New legislation was introduced to authorize them to act as lenders of last resort and in many cases to assign them responsibility for banking supervision. Finally, the third step can be traced back to the 1970s, when fiat money was developed: this period saw the definitive nationalization of central banks and the introduction of legislation that enshrined their independence. With the emergence of new forms of money, produced by the private sector, we have entered a new phase of money, which could mark the beginning of a fourth phase in the evolution of central banks. In this case, the institutional development could be greater, going so far as to alter the monetary architecture. The risk that a parallel payment system might develop was already evident to Giannini, who called the phenomenon 'pyramid under siege'. He argued that *"if the central bank is not perceived by citizens as having a comparative advantage in generating trust such as to justify the greater costliness of the money it produces vis-à-vis alternative instruments, the very notion of central banking is impossible"* (Giannini C., 2011).

New forms of money can be distinguished between e-money and digital money. The term e-money refers to an electronic deposit of monetary value on a device. It can be hardware or software-based. The issuer (banks, post offices, or Electronic Money Institutions) is obliged to convert e-money into bank money when the owner requests it: the former, therefore, must have a very liquid amount of assets on its balance sheet, at least equal to the amount of e-money issued. It is a more flexible and convenient currency, allowing instant payments, and storage of each transaction - consequently, increasing security. However, it requires equipment and a stable internet connection, which in turn, brings the possibility of security breaches and hacking. Digital money, on the other hand, includes cryptocurrencies, stablecoins, and CBDCs. While there is no universal definition of cryptocurrency, the ECB has defined a crypto-asset as *"a new type of asset recorded in digital form and enabled by the use of cryptography that is not and does not represent a financial claim on, or a liability of, any identifiable entity"* (ECB, 2019). There is no central bank or government responsible for production or intervention in case of problems. Cryptocurrency does not perform the three traditional functions of money: it is not yet a widely accepted medium of exchange. Moreover, due to price volatility, it performs poorly as unit of account and store of value. However, the number of cryptocurrencies available worldwide has increased significantly since 2013 and by 2021 amounted to over 4,000. Though, not all of them carry the same weight: the most important one is Bitcoin, created in 2008 by an unknown computer programmer. Anonymity is guaranteed and a blockchain is used for transactions. The supply of bitcoins is regulated by an algorithm that determines the number of new units to be introduced. Stablecoins emerged later: their value is made stable by linking them to financial or real assets or by using algorithms. These private digital currencies also leverage a DLT technology but, unlike Bitcoin, are issued by identified private entities. Among stablecoins, the proposal that has undoubtedly attracted the most attention is that of Facebook in 2019. It has alarmed central banks around the world, that have begun to consider issuing a CBDC, which is the digital version of cash. According to a recent BIS survey, 86% of central banks are studying the benefits and risks of CBDCs. In October 2020, the Central Bank of the Bahamas launched the world's first nationwide CBDC, the Sand Dollar. Stablecoin and CBDCs are analyzed in detail in Chapters 3 and 4, respectively.

Chapter 2
THE IMPACT OF DIGITAL TRANSFORMATION ON THE FINANCIAL SYSTEM

Technological advances have transformed many of our daily activities into digital versions: even payment tools have evolved, following the rise of e-commerce and people's demand for immediacy. As regards cash, according to the Capgemini 2020 report, globally, non-cash transaction volume

increased by 14.1% between 2018 and 2019. The geographic area that has experienced the greatest growth is Asia-Pacific: in particular, China, India, and other SE Asian markets are leading the way. The US is still the market that does the most non-cash transactions, but China, India, and Russia are quickly catching up. As for the Eurozone, cash is still the most popular payment instrument - claiming first place in POS and P2P payments (followed by cards). For online payments, on the other hand, the use of cards is in the first place. However, despite the widespread use of cash, there was a 6-percentage drop from 2016 (from 78.9% to 73%), with a significant geographic difference: southern countries prefer cash to northern ones. The outbreak of Covid-19 has accelerated this trend: overall, the crisis is compressing the value of change by half a decade in less than a year. Some analyses even show that the number of global cashless payments is expected to increase by more than 80% by 2025. In the Eurozone - according to an ECB survey conducted in July 2020, 40% of respondents used less cash and 90% of them said they would continue on this path, even once the pandemic is over. Of course, results vary from country to country, depending not only on the different measures put in place by their respective governments but also on citizens' habits and preferences, recommendations, and existing infrastructure. There are many benefits of digital payments: in addition to increasing speed, material convenience, security, and transparency, they have positive impacts on financial inclusion and reduction of cash-related costs. Worldwide, there are approximately 1.7 billion unbanked people. Digitization of payments can play a key role in expanding financial inclusion: first, through the internet and mobile phones; in fact, while people in developing countries do not have cards, about 1.1 billion unbanked adults have a phone. One solution could be to create payment tools that do not depend on traditional bank accounts. FinTech companies are also trying to drive financial inclusion by making bank accounts more accessible. In Mexico, a hybrid solution has been proposed: allowing customers to buy online but pay in cash (at a local store) via a voucher. Digital payments have the other major advantage of eliminating the many costs associated with cash: for States, handling bills and coins is not free; they have to incur several costs, which are related to materials, machinery used for production, storage, and distribution. Finally, there are also costs to individuals who use cash: in addition to the possibility of being robbed or losing money and standing in line at ATMs or cash registers, money currently produces essentially no interest and is, therefore, a non-productive investment vehicle. In addition, when a citizen wants to deposit cash in a checking account, they often have to pay a fee.

In 2019, Italy saw an increase in payments made via mobile devices: among the various apps on the market, there is Satispay, founded in 2013 in Cuneo by Alberto Dalmasso and Dario Brignone. In this chapter I decided to devote special attention to this case study. It is a digital, cashless payment

service that allows consumers to pay and send money without using credit cards or reloading ATMs. The money is withdrawn from the bank account and all that is needed is an internet connection to make payments at participating stores or send money to other users. The services offered are many and new services have recently been added, such as Delivery and Takeaway and the Cards service. Even companies can enter the world of Satispay, taking advantage of the many benefits: for example, thanks to the Cashback Network program, the merchant can reach more customers. As far as costs are concerned, Satispay guarantees an almost free service. In 2020, Satispay confirmed its leadership in the market transition to electronic payments. Last year, the volume transacted via smartphones in Italy experienced an increase of more than 80% compared to 2019. Within the category, the volume transacted through non-NFC systems, saw a 32% increase, of which approximately 60% went through Satispay.

The banking industry is not immune to the digital revolution; in the last three decades, two services have emerged - internet banking and mobile banking - that offer customers many advantages: according to Statista data, 1.9 billion users were using these services in 2020; this amount is expected to increase steadily between 2020 and 2024, to 2.5 billion. In addition, in response to the Buy Now, Pay Later phenomenon - prevalent especially in the US - the banking industry is launching or considering BNLP services with different business models. So, if initially the approach of financial institutions towards Fintech was defensive, now they are gradually moving towards a collaborative approach. This can also be seen in the world of cryptocurrencies, which were created to provide an alternative to the traditional banking infrastructure. However, the Office of the Comptroller of the Currency (OCC) has stated that banks and savings associations could collaborate, for example by providing cryptocurrency custody services for customers, including holding unique cryptographic keys associated with access to private wallets. In any case, new payment systems and currencies issued by the private sector bring numerous challenges for banks and financial institutions more generally. A primary risk for banks relates to a decrease in central bank control over the money supply; because currency in circulation is part of the monetary aggregates, if the use of cash decreases, it will be difficult for the central bank to measure monetary aggregates and control the money supply. An additional problem relates to the resulting reduced need to print cash, which has a significant impact on central bank revenues (seigniorage).

Chapter 3
STABLECOIN: A PRIVATE SECTOR INITIATIVE

Stablecoin is *"a cryptocurrency that aims to maintain a stable value against a specific asset, or pool or basket of assets"* (BIS, 2020). While not their core business, Big Tech companies have recently entered the financial sector, primarily the payments market as they enjoy several advantages: first, comparative advantages that allow them to achieve economies of scale more easily and quickly; second, they have significant technological capability and financial liquidity. In addition, they can leverage network effects, taking advantage of the vast number of customers. Among the many are Amazon and Facebook: the former is attacking financial services from every angle, from payments and loans to insurance and checking accounts. It is even predicted that it will soon take a step in the direction of digital currencies. Facebook, on the other hand, is already known for its intention to issue a stablecoin (Libra, now Diem). The proposal immediately triggered multiple criticisms from central banks and other authorities on a global scale - which led Facebook to rethink some of the stablecoin's features: it is expected that, by the end of 2021 at the latest, Diem will be launched with a pilot project.

There is not a single type of stablecoin but 4 different categories, based on the different stabilization mechanisms that act as a guarantor of value. The first - "fiat-collateralized stablecoin" - is a stablecoin backed by fiat money (usually dollar, euro, or pound), that an issuer or custodian holds in custody. An example of this is Tether (USDT), one of the first stablecoins to be created in 2014. The second type - "commodity-collateralized stablecoin" - involves the value of the digital currency being pegged to a tangible asset or bond. The most common commodity to be collateralized is gold. An example is Digix Gold (DGX): the ratio is 1 DGX per 1 gram of gold. In some cases, there is a blend to support the value of the stablecoin. The third type is the "crypto-collateralized stablecoin": the crypto-assets support the digital currency. To reduce the volatility risks typical of regular cryptocurrencies, these stablecoins are often over-collateralized. One example is Dai, backed by units of Ether. Finally, there is the "algorithmic stablecoin," backed only by users' expectations of the future purchasing power of their holdings; although it may seem contradictory, the underlying concept is the one that applies today to the currencies we use on a daily basis - an increase in demand implies the creation of new stablecoins to reduce the price and vice versa. An example of this is Ampleforth, AMPL. In addition to this classification, looking at the geographic scope, there is the so-called global stablecoin.

As for the pros of stablecoins, in addition to not being subject to extreme price volatility, they enjoy the benefits typically associated with cryptocurrencies, including transparency, security, immutability, digital wallets, fast transactions, low fees, and privacy. Global stablecoin would allow

money to move from one part of the world to another easily, quickly, and securely. On the other hand, they have some limitations. Stablecoins backed by fiat currency - being managed by a single entity - require consistent confidence in the activity backed by the entity, and in particular that there is a match between the number of stablecoins and the currency on which it is based. In addition, tokenized funds are subject to all the regulations that fiat currencies are subject to, which undermines the potential effectiveness of the digital asset. Stablecoins backed by commodities, on the other hand, can involve some costs and timeframes when deciding to convert them into assets. In addition, the underlying asset can lose value over time. Finally, crypto-asset stablecoins are more unstable.

There are several potential uses for stablecoins in the real world: in addition to being used as an everyday currency, they could be used for alternative loan issuance. In addition, stablecoins also enable the use of financial smart contracts. Even migrants could use this digital currency to send remittances to their families (due to fast transactions and low fees). Stablecoins are now primarily used in the cryptocurrency market: so, the implications for economic development and monetary policy may still be negligible. However, given their exponential growth, things may change. The risks associated with stablecoins are both social and economic: first, privacy could be compromised, and information could be misused for commercial purposes. Second, any deployment of this type of digital currency on behalf of foreign operators could pose a risk to the domestic market, making it dependent on technologies that are developed, managed, and regulated elsewhere. This would impact payment traceability, which could increase money laundering and other major crimes. An additional risk relates to the monetary system: stablecoins generally allow for conversion to fiat currency, though with different methods. In the case of stablecoins, runs could occur if users lose confidence in the issuer, e.g., they realize that collateral assets are losing value, or if an adverse event occurs; the need to deal with redemptions could lead the stablecoin issuer to liquidate collateral assets, triggering contagion effects throughout the financial system. Assuming stablecoins become an alternative store of value, there would be some implications for the transmission of monetary policy: significant use could affect the stability and funding cost of bank deposits, posing challenges to banks' intermediation capacity. Central banks could also be affected, losing seigniorage.

Chapter 4
CENTRAL BANK'S INITIATIVES IN ISSUING DIGITAL CURRENCIES: CBDC

CBDC is defined as *"central bank-issued digital money denominated in the national unit of account, and it represents a liability of the central bank"* (BIS, 2021). Several factors have triggered the discussion on this topic: first, the emergence of new forms of technology in the financial sector;

second, the decline in the use of cash in many countries; third, the entry into the financial services sector of new private players willing to develop their currencies and payment systems. Moreover, there is a defensive motive: countries are aware that the advantages China could have by moving first in this field cannot be underestimated. There is no single model of CBDC: it can have several characteristics. The first design decision involves the degree of access: it can be a 'retail CBDC' - i.e., accessible to all individuals in the economy - or 'wholesale CBDC'- namely limited to certain subjects. A second differentiation concerns the different verification required for a transaction to be executed: it can be account-based or token-based. The former requires verification of the identity of the payer, while the latter requires verification of the validity of the object used to pay. However, a recent study by the Sveriges Riksbank showed that the distinction between tokens and accounts is irrelevant to create a CBDC that has properties similar to cash: to overcome the problem of double-spending, all CBDC payments must involve a remote ledger. Another issue to consider is interest, i.e., whether or not these currencies can generate interest payments. There is also the question regarding the distribution of CBDCs and thus whether it will be central banks or specific intermediaries that distribute the currencies. Finally, the last feature concerns the possibility of introducing limits on their use. In order to figure out the best type of CBDC to issue, countries could use the CBDC pyramid approach, first identifying consumer needs and then evaluating technical design tradeoffs.

Because CBDC is issued and controlled by central banks, it offers many benefits, including reduced cash costs, faster and cheaper transactions (both domestically and abroad), and a higher level of security. It also has the advantage of fostering financial inclusion, which is critical to reducing global poverty. Finally, competition in the payment instrument landscape could increase. However, some cons cannot be overlooked: one disadvantage of CBDCs is the strong control the government would have over the blockchain network within which the digital currency would operate. CBs would gain more power, controlling not only the issuance of money but also consumer preferences. An additional disadvantage is related to the disintermediation of commercial banks, which could occur if people started moving money from bank accounts to CBDCs.

In addition to its function as a means of payment, CBDC could perform the function of a store of value, at a lower cost than cash: being fully dematerialized, storage costs would be very low or zero. CBDC would be free of credit and liquidity risk. This would impact commercial banks, leading to a decline in deposits. Under extreme conditions, the decline in deposits could translate into a rush to digital banking. According to some studies, however, the effects would not necessarily be disruptive

for banks: first, not all deposits could be transferred to the central bank; second, there are some services that banks can offer, unlike CBDCs, such as access to credit and payment services; and third, banks could increase their reliance on wholesale funding. In terms of impact on monetary policy, the issuance of CBDCs should not be significant. Because CBDCs are not designed to replace cash, the size and composition of the central bank's balance sheet should not change significantly - unless non-residents are allowed to move some of their investments into domestic CBDCs. This could cause changes in lending and investment policies.

Looking at current initiatives by major central banks around the world, five States have already introduced a digital currency - the Bahamas and four States belonging to the Eastern Caribbean Central Bank. Another 14 States - including Sweden and China - are now in the pilot phase. As for the Bahamas, after many years of efforts to modernize the State's payment systems, the CBOB launched the Sand Dollar in October 2020. Due to the conformation of the territory - which makes it difficult and expensive to use traditional means of payment - the main goal was financial inclusion. It is a retail CBDC: users can hold certain amounts of Sand Dollar and the CBOB oversees the circulation of the digital currency daily. It pays no interest and cannot be held non-domestically. The currency can be used 24/7/365 in disconnected environments and has very low transaction fees. Sweden is another emblematic case: the use of cash in this country has declined significantly, leading some to believe that it could become a cashless society as early as 2023. Since 2019 Sweden's central bank has been running the project on the e-krona, which is now in the pilot phase. It is token-based: each token is uniquely identifiable and has a specific value, as it contains an e-kronor number. The network in which the currency circulates is private and decentralized (DLT). Still, there is no final decision on whether or not to issue an e-krona.

Chapter 5
THE FUTURE OF MONEY AND ITS GEOPOLITICAL IMPLICATIONS

In the world, money that is privately issued by banks, telecommunications, or companies specializing in payments coexists with money that is publicly issued by central banks. Throughout history, private money was generally needed to fill the problems that existed in coins issued by the public sector, such as the lack of a payment instrument to make small purchases or to make transactions in distant places, or in circumstances of financial panic. Often, therefore, the private entities issued money in the form of scrip. Nowadays, at the base of the current monetary system there are central banks - which have the task of issuing money - and other banks - which issue private money, that can be redeemed at a fixed value in central bank money. However, cash is confronted daily - and to an

increasing extent - with other payment instruments: with the introduction of stablecoins, things could change, and people could find themselves using a currency that is issued by the private sector. How will the relationship between the public and private sectors change? According to research conducted in 2019, cooperation between the public and private sectors in the area of currency is very important: in this scenario, it is possible to minimize the risks of private currency while maximizing the advantages it has in terms of technology. Adrian and Mancini-Griffoli introduced the concept of the Central Bank Synthetic Digital Currency (sCBDC): it is *"a public-private partnership that encourages competition among e-money providers and preserves comparative advantages. The private sector focuses on innovation, interface design, and customer management. And the public sector remains focused on sustaining trust"* (IMF, 2019). In other words, the main difference that exists between a CBDC and an sCBDC is the entity that maintains contact with the customer: in the former case, it is the central bank; in the latter, it is the private company. The advantages are numerous: first, the reduction in initial and maintenance costs. Second, it would be easier to establish regulations to control private issuers of stablecoins: regarding the use of private data, high security standards can be imposed on private entities. In addition, an sCBDC allows for competition in the payments industry. Finally, by involving the private sector, this risk of CBs of incurring a bad reputation would be lower.

Just as we talked about the competition between public and private payment instruments, with the issuance of CBDCs by central banks around the world, competition will also be between States. Whoever issues the CBDC first may have an advantage not only towards other digital payment instruments but also in the internationalization of their currency. In this sense, China - the world's second largest economy - may have a geo-strategic advantage. The People's Bank of China (PBoC) has been working on digital currency since 2014. The project is called Digital Currency/Electronic Payments (DCEP): with an exchange rate against RMB fiat of 1:1, it is a token-based, interest-free CBDC that operates on two levels (so it involves both the central bank and intermediaries). It has significant weight on inclusion, as there is no need to have a bank account and, thanks to technology with near field communication (NFC) capabilities, payments can be made offline. Europe is a step further behind: the European Central Bank is in the research phase: in 2020, it decided to set up a high-level task force to address the issue: after the report published in October 2020, in July this year it decided to launch the project. However, this does not mean that the digital euro will certainly be issued. Finally, there are the United States, which are still in the early stages of evaluation; no decision has been made yet: not only has it not been decided whether to launch a digital currency, but the possible methods by which it could interact with the current payment system have not been analyzed

either. Currently, some developments are expected: the Boston Fed team and researchers from the Massachusetts Institute of Technology (MIT) are simultaneously working on the digital currency platform and developing tests and experiments to understand the existing options.

To understand the impact that China's currency can have on the current international system, it is important to look at the level of internationalization (global payment shares, foreign exchange market activity, foreign exchange reserves) of the three currencies: all three of China's values are less than 5%, unlike the United States which is over 40% and Europe over 20%. This shows that the Chinese currency is still a long way from catching up with the dollar or the euro and thus having an impact on the international balance. In addition, several other aspects would need to be reformed for the RMB to gain more prominence outside the country: it would be important for it to circulate at a higher rate or for capital outflows to increase. China's digital currency, however, could be used by individuals from other countries, impacting emerging countries: in developing countries, where local currencies are often unstable and financial infrastructure is underdeveloped, using the digital yen could become an option. Some data show that cross-border payment traffic with China in RMB is increasing in both Asian and African countries. In addition, in conjunction with the "Silk Road", especially in poor and developing countries, Chinese capital is being used to finance businesses; according to some analyses, over the next 10 years, these investments could represent 1 billion people and $2.5 billion outlet market for Chinese goods. In addition, most potential consumers in these areas of the world own a smartphone that is Chinese - in many cases down stocked with pre-installed apps that can enable the use of WeChat Pay, Alipay, or a hypothetical central bank-issued digital currency payment app. The fact that these areas are already accustomed to strong relationships with China could encourage the spread of DCEP.

Conclusion

When it comes to the relationship between the public and private sectors, they now coexist in several areas, including finance. The recent news of El Salvador, which was the first to adopt bitcoin as a legal tender alongside the dollar, could trigger a chain reaction not only in other cryptocurrencies but also in stablecoins. However, it can be said that the choice of CBs to collaborate with private entities could lead to numerous benefits. As far as geopolitical implications are concerned, China looks like it will have the first-mover advantages. However, although the digital yuan will play a key role in the internationalization of the Chinese currency, it is unlikely to catch up with the dollar or euro. What might more realistically happen is the influence of China on developing countries. Anyway, to evaluate the future of money, we must wait for the decisions that will be made in the coming months.