

# Chapter 8

## The Future of Money or Quest for Good Money



### 8.1 Introduction

We live in the fourth industrial revolution, based on the Internet and digital technology. Our society is in the process of digital transformation (DX). Naturally the future of money depends on this process.

What is the main feature of the digital society? Looking back at human history after the first industrialization in the eighteenth century in Europe, we see that society began engaging in a lifestyle of mass production and mass consumption. Many products were standardized so that many people enjoyed the same quality of goods and services. These changes improved the standard of living and the quality of life to a large extent in the nineteenth and twentieth centuries. Consequently, the global population exploded after the nineteenth century. At the beginning of the twenty-first century, however, economic and population growth declined gradually in advanced countries. The fourth industrial revolution has emerged as both a consequence of and a compensation for the trend as well.

My diagnosis for the sluggish economy is that our economic statistics or indicators are still based on the twentieth century's modes of production and consumption, while the reality is shifting rapidly to the twenty-first century's lifestyle, i.e., an individualistic pattern of production and consumption. Economists and politicians still talk about Gross Domestic Product (GDP), but many experts recognize, due to digital technology, that we can pay more attention to the living conditions of individuals in detail. If the individual quality of life or the standard of living improves, the slow GDP growth may not matter. At the moment, while we recognize the GDP is no longer a useful indicator of the economy, we have not transformed our social infrastructures to collect individual information automatically and to use or analyze it properly. This is the current situation.

It is quite clear that we need to reach a social consensus on how to collect digital information, how to use it socially, and where to store it. At the moment, each company collects and uses information as they like. The government collects individual information and statistics for administrative and policy-making purposes on

the basis of the individual ministry or governmental department. Academic institutions such as universities and research institutes also collect information and statistics for their research purposes. It is time to share information and statistics socially, to allow the agents (the government, the company, the individual researcher, etc.) to use them openly and to store them safely. In the fourth industrial revolution, data play a central role, and all infrastructures and analytical tools are focused to facilitate data analysis. The future role of money will find its place in the digital society accordingly.

## 8.2 Cryptocurrency or Cryptoassets

Bitcoin arrived as a mega surprise to financial market experts. This cryptocurrency does not require any office staff, money issuance agents, or central settlement office. It is conducted almost automatically as written in the protocol in January 2009. Until now (as of January 2022), Bitcoin has been issued mechanically without any serious disturbance. I can imagine that many hackers and experts have tried to intervene and hack the Bitcoin system, but they have failed so far.

From the early days, most economists around me have argued that Bitcoin is a private token without any real asset backing (i.e., private fiat money) and without any representative agent (i.e., no economic entity), and that Bitcoin itself contains only a line of cryptography, nothing else. If people take Bitcoin as a 100% bubble, the Bitcoin market would have collapsed earlier. But in reality, after 13 years on, Bitcoin is still producing new Bitcoin and many people are mining it every minute. Furthermore, a country like El Salvador approves Bitcoin as legal tender. How can we explain this? At least some people believe in the intrinsic value of Bitcoin (e.g., mining costs), no matter how its price fluctuates.<sup>1</sup> Some countries buy Bitcoins for the purpose of hedging against the major currencies, especially against the U.S. dollar. In fact, the group of people who innovate with Bitcoin simply practice issuing cryptocurrency in cyberspace. They do not do any financial trading (borrowing and extending loans) and hedging using Bitcoins, and Bitcoin has no link with the legal tender, so there is no risk of default against the Bitcoin ecosystem itself.

As opposed to an autonomous Bitcoin, some people want to issue so-called stablecoin, which is a collateral-backed cryptocurrency. They say that Bitcoin or Ether is too volatile to be used as a medium of exchange. It sounds odd because not many people hold Bitcoin or Ether for the purpose of its being a medium of exchange in daily shopping. People are holding Bitcoins for the sake of a store of value in the long-run. In addition, those who are interested in stablecoins also do not intend to

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<sup>1</sup> As of January 2022, more than 8,000 cryptocurrencies have been issued. Most of them have no record of trading. As the basic protocol of Bitcoin is available and many textbooks on cryptocurrency are published, it is quite easy to issue new cryptocurrency. But it is difficult to add fundamentally new features to the original Bitcoin protocol. The Bitcoin's intrinsic value rests in its decentralized autonomous organization structure. This is indeed a very innovative idea and it attracts many supporters among Internet users and others.

use it as a medium of exchange but as a financial asset. In other words, financial market investors hesitate to invest in Bitcoins because of no collateral backing, but they may be happy with stablecoins because of its collateral backing.

Unlike Bitcoins, stablecoins seem to be designed to attract the financial market participants.<sup>2</sup> The team of stablecoin makers emphasize the stability of its value against the U.S. dollar. Needless to say, the U.S. dollar is fluctuating against other major currencies. Stability is all relative. The other aspect to draw your attention is that the U.S. dollar exchange rate volatility is definitely more stable than that of the Bitcoin and U.S. dollar exchange rate. But the Bitcoin price has gone up more than 60 times in the past 5 years. Which is more attractive for investors?

### 8.3 Central Bank Digital Currency

There is no doubt that central bankers around the world were jarred by the announcement of Libra (the global digital currency now called Diem) by Facebook (now called Meta). All of sudden, central bankers start discussing central bank digital currency (CBDC) after Facebook's announcement on June 18, 2019. The stated goal behind Libra (Diem) is to create a global currency for the billions of people, both individuals and businesses, without access to traditional financial services and capital. It was the launch of a cryptocurrency with a potentially disruptive effect on the financial industry by a big platformer. Recently, the Diem project has faced setbacks from the regulators (FRB and the U.S. Congress). Meta in fact has withdrawn from this project. This news must reduce the pressure on the central bank community to create CBDC urgently.

The major countries' central banks—namely, Bank of Canada, Bank of England, Bank of Japan, European Central Bank, Federal Reserve, Sveriges Riksbank and Swiss National Bank, and the Bank for International Settlements—started a joint project of studying CBDC in January 2020.

They emphasize its merits in (1) technological efficiency, (2) financial inclusion, (3) prevention of money laundering, tax evasion and criminal activities, (4) safety and robustness of payment system, (5) reduction of cash transaction costs, and (6) improving cross-border payments. The risks would be in (1) suppressing private sector innovation, (2) centralization, and (3) bank disintermediation.

At the moment, the major central banks conduct research and experiments for CBDC feasibilities. They exchange views at BIS, IMF, and the like. They also monitor the private digital currencies carefully as they did for Libra (Diem). They have not reached any decisions as to when they will introduce CBDC. As we saw in Chap. 5, the private sector has already introduced electronic money and they are used intensively

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<sup>2</sup> I personally feel that stablecoin is like the Monkees in the 1960s, the U.S. counterpart of the Beatles from Britain. The U.S. show business industry created the Monkees and achieved some success. But in terms of impact on the music world, there could be no comparison: In the cryptocurrency world, Bitcoin is definitely the Beatles.

in Japan. Unless substantial innovations in the digital currency are found, the Bank of Japan may not have a strong motivation to introduce CBDC soon.

However, it is important to design the digital currency with the private sector and the other central banks across the world, so that new CBDC framework facilitates the future coordination, for example, in cross-border payments. Furthermore, the Bank of Japan should take the initiative in building an open access public database in the digital era whether it is used for CBDC or not.

## 8.4 Back to the Basics

### 8.4.1 One-Yen Coins

When a country issues new money, what does an individual care about? First of all, the design of notes and coins secondly, security against counterfeits; thirdly, the amount/number of issues and, fourthly, when to issue.

I would like to introduce a story of the one-yen coin in 1955. Ten years after the end of the Second World War, Japan was recovering from the damages and losses that occurred during the war. The postwar hyperinflation had settled down and new construction of infrastructure building across the nation had just begun from the early 1950s. The government of Japan decided to issue new one-yen coins and called for a design competition publicly for the first time. Out of 2,581 applications, the surface (head) design of young tree by Masami Nakamura (Kyoto) and the back (tail) design of 1 by Toshio Takashima (Osaka) were selected. The Ministry of Finance commented on the selected design of an anonymous young tree as the symbol of new growth in Japan and as anonymity applying for everyone in society. This new issue of one-yen coin was a very symbolic event; this is the only coin design selected through an open competition. We felt that everyone in society had stood up from the ashes and decided to walk along our road together. The one-yen coin story does not stop here, however.

Not many people recognize that a one-yen coin, the minimum denomination of Japanese money, weight 1 g and its radius is 1 cm. It is literally the basic unit of measurement on earth. Let me explain how we reach the *metre* and *gram* standard.

The history of the meter starts with the scientific revolution initiated by Nicolaus Copernicus. Scientists looked for measures that were universal and based on natural phenomena. With the French Revolution in 1789, a new unit of length, the meter, was introduced on October 7, 1790. It was defined as one ten-millionth of the shortest distance from the North Pole to the equator passing through Paris. This measurement of one meter is based on the size/distance of the earth which all human beings inhabit. It is also based on the decimal system (10 mm = 1 cm, 100 cm = 1 m, 1,000 m = 1 km, etc.).

The weight measurement of *gram* is also based on the meter. It was defined in 1795, such that the absolute weight of a volume of pure water equal to the cube of

the hundredth part of a meter ( $1 \text{ cm}^3$ ), and at the temperature of  $4^\circ \text{C}$  at which water reaches its maximum density. Of course, the measurement of a gram is also based on the decimal system, such that  $1,000 \text{ g} = 1 \text{ kg}$ ,  $1,000 \text{ kg} = 1 \text{ ton}$ .

Water is essential material for human beings. Without water, no one can survive on earth. The decision made by the French National Convention to use pure water as the base of weight standard was accepted globally. There is nothing more natural than pure water. Many countries adopted the meter–gram measurement standard in the nineteenth century. Japan did so in 1885. As far as I know, accuracy in measurement of length and weight has improved as scientific technology advances,<sup>3</sup> but the fundamental idea of meter and gram based on the size of the earth remains. A one-yen coin, very small in value and size, reflects the basic unit of meter–gram standard, sharing the same measurement across the globe. Needless to say, the Japanese yen did not intend to be a global currency but was simply a local currency with a modest hope of being accepted and used by earthlings, as Japan was scheduled to join the United Nations in December 1956. I hope the Bank of Japan’s CBDC, if issued, will inherit the spirit of the one-yen coin.

### 8.4.2 *Communication and Money*

Marshall McLuhan (Media) says that money is a communication medium that conveys the idea of value.

In days past, we visited local retail shops for daily consumption. At the shop, the buyer and the seller would exchange information and make sure the quality of the goods and their price were decent. McMillan (2002, pp. 5–6) argues:

What characterizes a market transaction? Decision-making autonomy is key. Participation in the exchange is voluntary; both buyer and seller are able to veto any deal. They are separate entities. Controlling their own resources, the participants in a market, in deciding how those resources are to be used, are not obliged to follow others’ order. They are free to make decisions—to buy, to sell, to exert effort, to invest—that reflect their own preferences. Their choices are not completely free, though: they are constrained by the extent of their resources and by the rules of the marketplace.

In order to make our decision autonomous, we need sufficient communication between buyer and seller, and for both sides to fully understand what the buyer wants and what the seller has, then decide to buy or not to buy. The role of the marketplace or the bazaar is to reduce and, desirably, eliminate information asymmetry between buyer and seller by means of repeated trading and reputation among the market participants.

In the digital era, can we conduct the same density of face-to-face communications at the bazaar? Do we know the companies or the products listed in shopping pages of

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<sup>3</sup> Nowadays the *meter* is the International System of Units (SI) of length. It is defined as the length of the path travelled by light in a vacuum during a time interval of  $1/299792458$  of a second. In short, now the unit of length is measured in terms of a time (more precisely the speed of light) because time can be measured more accurately than length.

Amazon? I think information asymmetry has been widened in recent years, and that creates many mismatches not only in the goods market, but also the labor market, even in the marriage market.

From the goods market, we hear a lot of clothes and foods are discarded and burned. From the labor market, many workers quit job frequently, never obtain high skills, and remain peripheral positions in society. From the marriage market, the divorce rate has risen, whatever the reasons may be. In Japan, more peculiar things are happening. That is, 25.7% of men and 16.4% of women stayed single until age 50 in 2021. About one-fourth of men have no chance to get married, so no wonder the population declines.

I do not think all these mismatches are due to lack of communication and mutual understanding, but maybe due to money. Indeed, money is involved in all market transactions. Messages in money convey some implications or interpretations from the other side, as McLuhan said.

It may be a time to reinvent the bazaar, as John McMillan proposed. One way to reinvent market communication is to build the open access database. McMillan (2002, p. 46) said,

Buyers are empowered by anything that makes it easier for them to acquire information. Any market innovation that lowers search costs, such as the advent of electronic commerce, makes markets more efficient. People waste less time and money on search. Better matches of buyer and seller are formed, and pricing becomes more competitive, to the buyer's advantage.

In the digital era, innovation with respect to the digital currency has something to do with information and the database. In a broad sense, it is to do with communication. Think about the fact that we pay with digital currency through the Internet as we send e-mail from our smartphone, and that we usually install its wallet on our phone. Now the digital currency becomes literally a part of our communication tool.

### **8.4.3 Democracy and the Internet**

Alexis de Tocqueville (1835) describes the principle of the sovereignty of the people of America as

[T]here [in the United States] society governs itself for itself. All power centers in its bosom, and scarcely an individual is to be met with who would venture to conceive or, still less, to express the idea of seeking it elsewhere. The nation participates in the making of the laws by the choice of its legislators, and in the execution of them by the choice of the agents of the executive government; it may almost be said to govern itself, so feeble and so restricted is the share left to the administration, so little do the authorities forget their popular origin and the power from which they emanate. The people reign in the American political world as the Deity does in the universe, they are the cause and the aim of all things; everything comes from them, and everything is absorbed in them. (Tocqueville, 1835. *Democracy in America*, Vol.1, Chap, IV, "The Principle of the Sovereignty of the People of America")

This is how democracy in modern times started. The founding fathers built an autonomous democratic society in 1776. About 250 years later, U.S. society is

divided badly between two groups of people. If this is a result of the Internet or social networking services (SNS), how we can fix it? Or if all useful digital tools tear apart an autonomous democratic society, should we control them? This problem emerges from a mixture of deterioration of democracy, social division by digital technology, and differences in socioeconomic conditions among regions and across occupations.

Tirole (2021) challenges the issues related to social division by digital technology. He tries to compare the bright side of data use in a more civilized society and the dark side of digital dystopia. He concludes it is important to understand the channels through which a dystopic society might come about, so as to better design legal and constitutional safeguards.

In this book, I take the position that our society is being transformed by digital technology, that we need to set up some basic frameworks for the digital currency, and that the open access database on the individual and economic entity must be constructed for the purposes of policy making and business uses (the digital currency is one of them).

As Tirole suggests, the autocratic regime might use the database for the sake of controlling or oppressing people. We must pay full attention to such a possibility. On top of that, the open access database should have a blockchain-like nature so that even the government cannot revise the data.

All democratic societies face a similar problem of political instability of the ruling regime, probably due to fluctuation of political voters. Some politicians, media, and intellectuals might express positive views about autocratic regimes and its efficient policy operations. I would recommend them reading Hayek (1944).

## 8.5 What is the Future of Money?

We use the Internet nearly all the time. It is natural to design a new digital currency that can be used online without involving an unnecessary third party. Recall that we can buy things through Amazon and pay by credit card, electronic money, or net banking; and we can sell goods on market platformers and receive sales payments (revenues) through various methods. Transaction fees or handling costs with a third party are a part of security in payments. Of course, we can reduce transaction fees or monitoring costs via Internet technology or artificial intelligence with P2P transactions. However, not all transactions are P2P, the roles of financial intermediaries and transaction settlement remain. We would rather think of other directions of its use for the future of money.

### 8.5.1 *Expansion of the Boundary of Numbers and Matching*

As we saw in Chaps. 2 and 3, cash is based on natural number denominations such as 1 dollar, 5 dollars, 10 dollars, 20 dollars, 50 dollars, and 100 dollars. On the accounting (book) base, we can consider a negative integer, a rational number (fraction;  $n/m$ ). In economic theory, the maximum boundary of numbers is the real number, including irrational numbers such as  $\pi$ ,  $e$ , and  $\sqrt{2}$ . Pricing and payment settlement normally use natural numbers.

Digital money can use a much wider range of numbers such as the complex numbers, quaternion (4-elements complex numbers), or octonion (8-element complex numbers). All these mathematical concepts of numbers can be handled by computers, as in a digital money wallet.<sup>4</sup>

As an aside, a bit is a binary digit, the smallest increment of data on a computer. A bit can hold only one of two values: 0 or 1, corresponding to the electrical values of “off” or “on”, respectively. As bits are so small, you rarely work with information one bit at a time. Bits are usually assembled into a group of eight to form a byte (i.e., 8 bits = 1 byte;  $2^8 = 256$  patterns of information). A byte contains enough information to store a single ASCII character, like “h”. A kilobyte (KB) is 1,024 bytes ( $=2^{10}$ ), not one thousand bytes as might be expected, because computers use binary (base two) math, instead of a decimal (base ten) system.<sup>5</sup>

We have not explored enough as to what we can do with digital information technology. Many economic and social decisions are made on the tradition of the analog world. We often discuss the digital transformation (DX) which is supposed to change our lifestyle fundamentally. It seems that only a small fraction of companies or organizations go through digital transformation, whereas a vast majority of companies and organizations remain unchanged and do not know which way to go.

How can digital currency be used in new era? Take an example from food consumption. With advances in biological knowledge, we are quite familiar with allergic reactions to food ingredients. We are also sensitive to contents of foods in terms of health (e.g., in diabetes) and increased awareness of obesity. Sometimes, allergic reactions cause death. Those who are sensitive to food contents pay close attention to dangerous ingredients. Nevertheless, food poisoning and allergic reactions occur all the time. This is because food producers may not fully explain the contents and ingredients of their products to their customers and may not list all the ingredients in the packages of their products. School meals may cause allergic reactions and food poisoning among school children because of lack of attention of allergy-causing materials and food conditions by school cooks. All these problems

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<sup>4</sup> Mathematics using these complex numbers goes beyond the scope of this book.

<sup>5</sup> Quantum computing will handle the basic quantum information unit as a *quantum bit* (qubit), which can take any numbers between 0 and 1—say 0.6 or 0.1—whereas the classic binary bit takes only 0 or 1. There is an idea of quantum money that is a proposal for creating banknotes by using quantum physics. This idea is still premature because the quantum bank notes require storing the quantum states in a quantum memory. Quantum memories can currently store quantum states only for a very short time.



can be substantially reduced by means of digital information requirements on foods and other health-related items.

An example is to make an information tag with a QR code in which price, ingredients, history of cooking, origins of food materials, and nutritional contents, among others, are listed. Consumers use a smartphone application (in the digital currency wallet) to read the QR code, to analyze food information, and to decide to buy or not to buy. In so doing, consumers are better able to avoid buying unsuitable foods.

This type of automatic selection of consumption goods is not restricted to foods but other items such as alcohol, tobacco, and gambling. This smart digital currency wallet can also examine individual items or components in insurance contracts, as with life (non-life), car, or property and then selects the insurance contract that is exactly what the buyer wants.

The future of money in this context requires a wider set of information including the price, other characteristics, and production information. To put it differently, in the digital era, we need to build a large database for each individual. It could be a actual database in the cloud or a virtual database in which all information is located separately and is assembled as required. Digital money uses a part of this individual database for purchasing decisions and payment purposes.

Individual consumers have to provide private information about bank accounts, health conditions, allergy-sensitive items, individual preferences. The smart digital currency wallet has access to the individual information. With this arrangement, the smart wallet can select consumption goods by matching two-sided information. In a sense, the digital currency communicates with goods and services and makes machine-aided personal decisions.

This idea originally comes from Hahn (1971). He defines named goods as well as anonymous goods that distinguish a given physical good at a particular time and place owned by an agent from the same good when it is being bought by another agent. This distinction allows Hahn to discuss households facing a sequence of budget constraints and the possibility of there being no unique set of discount rates applicable to all households. Sen (1976) employs the term “named good” in a different context. He defines commodity  $j$  going to person  $i$  will be called a “named good”,  $ij$ , the amount of which is denoted by  $x_{ij}$ . Sen (1976) proposes the measurement of real national income. The meaning of the same commodity differs from person to person. This concept later led to Sen’s capability approach (Sen, 1987). Our discussion of consumer goods with price and characteristic information matched with an individual digital currency wallet is a natural extension of Hahn and Sen’s concept of named goods in the digital economy.

### **8.5.2 Expansion of Time Dimension**

Another extension would add the time dimension to digital currency. In fact, the Bank of Japan 10,000-yen notes have an eight- or nine-digit serial number that indicates where and when they are issued. Coins explicitly indicate the issue-year

on their surface. If a cash dispenser is equipped with a sophisticated serial number scanner, we can handle individual cash differently. Early days in the beginning of twentieth century, the idea to put a time-stamp on the bank notes was discussed by Gesell (1918). At that time, a sophisticated-enough cash dispenser was not available, so that Gesell said that the owner of bank notes periodically would have to buy and affix stamps to the backs of bank notes to maintain their value. This would be equivalent to imposing a negative interest rate on cash or to levying a tax on cash holdings. This idea attracted much attention from eminent economists like Irving Fisher and John Maynard Keynes. They believed at first that this idea could be a tool for fighting deflation. In the end, they rejected Gesell's idea as impractical.<sup>6</sup>

Digital currency now can easily accommodate a negative interest rate as long as the database accepts the time-dimensional information. This is directly related to monetary policy. Needless to say, the effectiveness of monetary policy depends on how cash remains in use.

In addition to the monetary policy issue, a company accountant can access information about production flows such that how the final goods are produced with intermediary goods and raw materials, how much value is added in each production stage, and how much value-added taxes are paid in the upstream (invoice record), so that the company can decide the price of a product. This makes the production process transparent.

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<sup>6</sup> Rogoff (2016) discusses the possibility and merit of abolishing paper money. In so doing, he elaborates the way to impose a negative interest rate on cash. He mainly discusses how to handle individual notes with magnetic strips or radio-frequency identification chips to manage interest rates or stamp duty, but he did not discuss the digital currency wallet as we have done here.

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