

CBDC Application Analysis and Prospects

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Abstract. With the increasing rise of digital currency, the central bank has begun to march into digital currency. This article reviews the research articles on CBDC to gain a deeper understanding of the research content and direction of CBDC. This article aims to review research on central bank digital currencies (CBDCs). Learn about the latest research directions on CBDC and evaluate the practical significance of CBDC and its contribution to the industry. According to the latest research, CBDC is defined as a means of payment equivalent to cash. The advantages and characteristics of using CBDC have also been proposed as the reasons why the central bank should issue them. The article also shows the relationship between CBDC and financial inclusion. Analysis of the current situation and prediction of the future development of CBDC, and some updated measures by regulators after the issuance of CBDC. The report has a certain contribution to what measures should be taken after the issuance of CBDC.

Keywords: CBDC; Financial inclusion; Digital finance; Monetary policy.

1. Introduction

The popularity of digital currencies such as Bitcoin is getting higher and higher. People begin to use cryptocurrencies for exchange and invest a lot in them. Due to the introduction of many funds, the price of cryptocurrencies has risen highly. The emergence of this situation may affect the entire financial and monetary system. So some countries announced the ban on digital currency instead of researching it. People have been gathering information about digital currencies for the past few years. With the gradual maturity of technology, people began to imagine why it is not possible to issue a more secure digital currency through the central bank. The term Central Bank Digital Currency (CBDC) appeared in front of people. In recent years, countries have strengthened the research and development process and competitiveness of central bank digital currency (CBDC). With the world's first CBDC-Sand Dollar launch in the Bahamas in 2020, monetary history has officially entered a new period. Digital currency has become very popular once it is launched. One of the important reasons is that CBDC, as a central bank liability, can be said to be risk-free and irrevocable [1]. RScoin model is the first CBDC model proposed. At present, research on RScoin model has achieved certain research results and has been developed relatively maturely. After classifying CBDC, the prototype system model of CBDC proposed by distributed ledger is relatively few and insufficient at present [2]. Therefore, this paper analyzes and summarizes this model.

The amount of CBDC research is on the rise as a whole, and global competition has become a trend. At the same time, there is also a cooperative alliance of significant countries for CBDC. In January 2020, the central banks of the European Union, Japan, Canada, the United Kingdom, Sweden, and Switzerland, and the Bank for International Settlements (BIS) jointly established a CBDC research group to evaluate various application scenarios and program options for CBDC. This article selects a specific direction (CBDC and inclusive finance) for data collection and analysis. Determine the connection between CBDC and inclusive finance. Based on the writings of Fáykiss and Ozili, the positive and negative factors are explained with different attitudes [3,4]. The development trend of the global digital financial industry is intensifying. In addition to technological research and development, how to give full play to the organization's transparency while ensuring the security of user privacy? How to steadily promote financial inclusion? And how to gain an advantage in the international market? These are issues worthy of discussion. Perhaps some hints can be obtained from the article by Liu [5]. Solving these problems is crucial to the development of CBDC. This article aims to collect research papers on CBDC and conduct a specific analysis of it. Help researchers

quickly understand the current development status. Based on this, New Research Directions will conduct subsequent research on CBDC.

This article aims to review the research on CBDC and provide people with more comprehensive information. The first is an evaluation of CBDC in general, and then the study of some characteristics of CBDC can offer a broad understanding of the specific impact of CBDC. It is also essential to put forward more effective management measures by combining the analysis of the current situation with the pros and cons of CBDC.

2. Introduction of CBDC and some related content

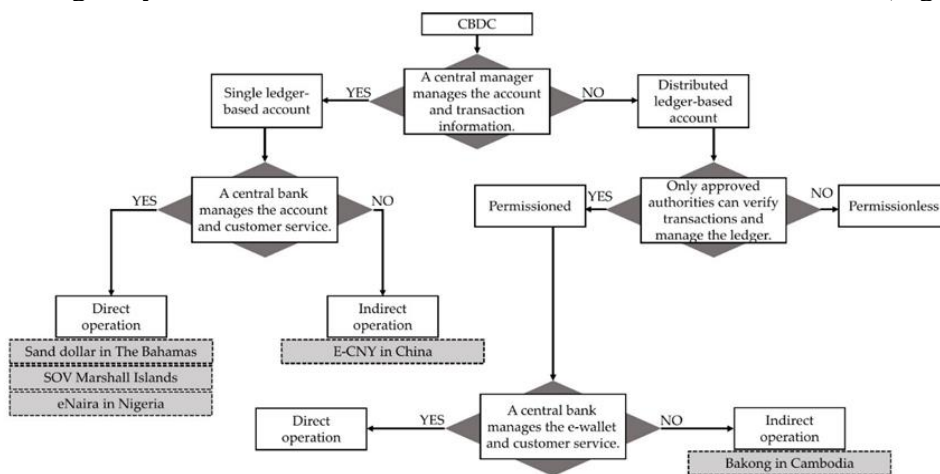
2.1 The definition of CBDC

So far, there is no unified definition of CBDC. In general, CBDC is defined as a digital liability in the central bank that the public can widely use. In a 2019 report by Orla & Sabrina, CBDC was defined as a new form of digital capital issued by central banks. At the same time, CBDC is closely linked to digital currency and blockchain technology. Kumhof and Noone expanded the scope of CBDC to the balance or storage held by commercial banks and other financial institutions in the central bank [6]. CBDC define as an accessible electronic currency of a central bank. This form of payment has more room for independent operation than ordinary physical payment. Ozili said that the Central bank digital currency is a legal tender in digital form [7]. CBDC represents a liability of the central bank [1].

To sum up, CBDC is a legal payment method with government approval, just like cash. The difference with cash is physical, one in physical form, the other in digital form.

2.2 The forms of CBDC

Countries will take various forms of CBDC systems according to different purposes. It is divided into the single-ledger-based system and the distributed-ledger-based system. Under a single-ledger-based system, with a central bank and other government agencies to manage, this can have a unified management system. Under this system, there will also be a difference between the central bank and the management account. In the distributed-ledger-based system (the exact opposite of a single-ledger-based system), the shared management of multiple parties ensures the transparency of operations and reduces the possibility of digital attacks. CBDC implements identity verification for users based on undisclosed distributed accounts in order to operate. Permissioned CBDCs are more efficient than permissionless ones, but there is still no solution to problems such as financial opacity. In the permissioned CBDC system, the direct CBDC is directly managed by the central bank; the brief CBDC is to delegate management power to intermediary agencies, and the intermediary agencies are managed by the central bank. This is a CBDC in various forms Like (Fig.1) [8].



Note: The gray boxes represent only CBDCs that are currently in use.

Fig. 1 Different forms of the CBDC systems [8]

2.3 The equations of CBDC

CBDC can be displayed not only by the concept but also in equations. RSCoin, the first CBDC research framework jointly proposed by the Bank of England and the University of London, provides a blockchain-based grouping structure to ensure the central bank's currency supply and combines the advantages of distributed accounting. Issues such as currency issuance, regulation, etc., are not discussed [9]. So, some scholars have developed a formula to define distributed accounts to make the formula more accurate. Yao improved the distributed ledger technology based on the People's Bank of China's legal digital currency prototype system. Yao proposed a visual model [2]. The prototype system explores CBDC expressions that support extensible features in a cryptographic form, and its formal model can be expressed as

$$\text{EXP}_{\text{CBDC}} = \text{Sign}(\text{Crypto}(\text{ATTR})) \quad (1)$$

$$\text{ATTR} \in \{\text{id, value, owner, issuer, Extset}\} \quad (2)$$

EXP (CBDC) represents the expression of CBDC (Eq. (1)), ATTR represents the attribute set contained in the expression (Eq. (2)), Crypto represents the encryption operation on the element of the attribute set, and Sign represents the signature operation on the expression. This property Set includes the essential user identification ID, owner information, issuer information, and an extensible property set called EXT Set.

2.4 The motivation and advantages of CBDC

The motivation and advantages of CBDC issuance are also expressed in the literature. After the financial crisis in 2008, CBDC can maintain the stability and security of funds, and the cryptocurrencies in it do not rely on the traditional banking system and government control [10]. When the economy is in turmoil, it can better guarantee the value of money. CBDCs would complement cash in general enterprises' operations [11]. At the same time, when CBDC is widely used, it will reduce the demand for cash, significantly reduce the working process, improve the working efficiency, and also reduce production and operating costs.

3. CBDC and financial inclusion

This section will discuss recent hot research topics on CBDC, CBDC and financial inclusion is one of it. As discussed in the previous section, financial inclusion is also one of the purposes of issuing CBDC. Financial inclusion is about essential financial services that improve their benefits by enabling more unbanked people to go through the regular financial process [12]. Financial inclusion has another meaning: how households and businesses access and use formal financial services [13]. There is no way for the country to ensure the economic development status quo in every region, so even in developed countries, there is much room for improvement in financial inclusion. As the world's largest economy, the United States has an advanced financial infrastructure and a wide range of services. Nevertheless, as of 2019, 5.4% of households did not have a bank account [14].

While improving financial inclusion is a long and arduous task, it seems imperative that more people gain access to essential financial benefits as the global economy slows due to the impact of the COVID-19 pandemic.

The article by Fáykiss directly affirms that CBDC is an opportunity to support digital financial inclusion in the current environment [3]. However, in Ozili's article, the pros and cons are examined in a neutral way [4]. CBDC can promote the digitization of the blockchain in the economy, and the extensive use of CBDC by companies may increase the economic connections among other businesses of the company. Some supporters believe that CBDC will expand the development of the digital economy. With the continuous development of technology, the digital economy is in an increasingly important position. CBDC will link different fields and strengthen the content of

economic globalization. Features to improve payment efficiency and security were also proposed in the previous section, which would guarantee the finality of the settlement.

On the contrary, CBDC must rely on devices such as the Internet. This will be a massive threshold for some developing countries, where people do not have the money to buy expensive digital equipment. At the same time, in some areas with lower education levels, many digital illiterates still do not understand the digital economy. Despite these reasons, some argue that a non-interest-bearing CBDC would hinder financial inclusion. And lack of regulatory requirements. Whether or not CBDC increases inclusivity depends on how the CBDC model unfolds.

Murakami and his team judge welfare through a model of introducing CBDC into financial inclusion [15]. They compare the benefits of different families to analyze. This function compares the ergodic mean of welfare for the banked household (BHH), unbanked household (UHH), and a synthetic aggregate household (AGG) by analyzing the benefits of financial inclusion through the provision of CBDCs.

$$\mathbb{W}^j = F(\text{Var}(\bar{C}^j), \text{Var}(\bar{L}^j)), j = \{h, u\} \tag{3}$$

$$\mathbb{W}^{agg} = \Gamma_h \mathbb{W}^h + \Gamma_u \mathbb{W}^u \tag{4}$$

By introducing CBDC into the model (Eq. (3)(4)), the relative welfare benefits of each representative household of the baseline pension economy with CBDC relative to the pension economy without CBDC are plotted. It can be seen that the welfare benefits of UHH expand significantly with pension or process fluctuations. But BHH has no higher promotion (Fig.2).

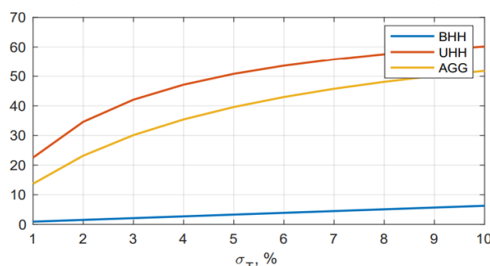


Fig. 2 Relative welfare and endowment volatility [15]

(Note:The relative welfare return graph of the economy with CBDC and the economy without CBDC takes the representative BHH, UHH, and total household as variables to increase the variance in the pension shock process.)

The researchers then plotted the relative welfare gains for representative households versus the proportion of bank savings population gains (Fig. 3). The benefits of CBDC fall in BHH. When BHH=1, inclusive finance has no benefits. In summary, CBDC benefits are higher in areas with low financial inclusion and a low proportion of bank accounts.

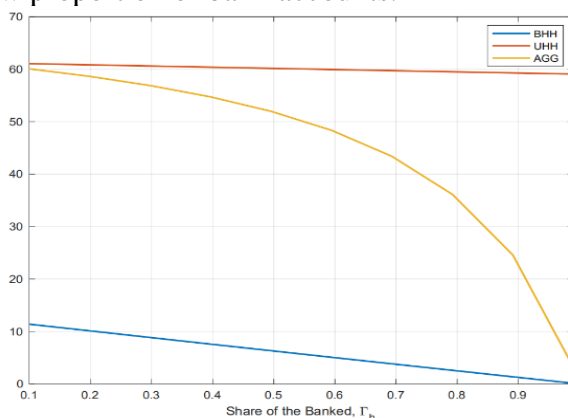


Fig. 3 Relative welfare and banked population [15]

4. Future development of CBDC

This section will describe the future development of CBDC.

With the continuous development of technology, the world is entering a new digital age. Central banks have always used cash as a means of payment, but we use cash less and less often. Perhaps in the near future, a cashless society will be realized. The financial system must also keep pace with the times and constantly update the digital structural system. All countries are studying the CBDC model structure. A series of problems accompany this bright future financial and monetary system. Before CBDC is widely used, how would it affect the existing cash currency system? What will be the cooperation of CBDC in the cross-border payment market? Furthermore, how will the government departments of various countries supervise? Summarize as follows:

The enormous advantages of CBDC in terms of cost and efficiency will make CBDC an essential position in cross-border payments in the future. The increasing globalization of the economy has prompted various countries to study CBDC. CBDC will improve the cross-border payment system and ultimately break the situation between countries. The current cross-border payment adopts the correspondent bank model, which passes through multiple intermediary companies, and the policy efficiency of each country is different, including various hidden costs. However, CBDC will effectively solve the above problems, reduce payment costs and increase payment efficiency [5]. Under the technical background of CBDC, countries will promote financial development and strengthen cooperation among countries by strengthening basic research on CBDC. Song and Liu [16] believe that the gradual promotion of CBDC will "ensure financial stability. At the same time, we must also enhance financial inclusion. The new currency proposed by the central bank will continue to achieve public policy goals. The central bank needs to control risks. Mitigate the impact on the existing system within a controllable range. "Innovation regulation" will become the theme of future CBDC competition [17]. In this context, technological innovation and the construction of structural systems are important for CBDC Factors. The "innovation supervision" of various countries will be linked with the supervision of central banks. The transparency of CBDC makes a country's supervision of CBDC will be affected in many ways.

As an emerging monetary system, there is still much room for improvement in privacy and regulatory issues. The development of CBDC will promote the improvement of laws and regulations in various countries, and the current infrastructure needs to be built based on future national policies. CBDC can neither be wholly anonymous nor completely transparent. Countries need to balance CBDC and residents' privacy security. At the same time, the policies and regulations of different countries are different. To carry out step-in services, countries need to communicate further and strengthen supervision.

5. Conclusion

This article reviews the basic definition and characteristics of CBDC, derives its relevance to inclusive finance, and finally predicts the future opportunities and challenges of CBDC. First of all, most of the literature agrees that both CBDC and cash are legal means of payment and are also liabilities of the central bank. At the same time, the motivation for CBDC issuance and the basic features of CBDC are studied. The CBDC is classified and divided into two parts. Afterward, Researchers affirmed the positive impact of CBDC on promoting inclusive finance. According to the introduced model, it is further judged that CBDC is more profitable than cash. Finally, some ideas are put forward in the face of the current reality of intense cooperation and competition. This paper shortens the time for researchers to read the latest research content and find relevant content more conveniently. Make some contributions to the new direction of CBDC research.

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