



The Roles of Central Bank Digital Currency over Physical Currency

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Abstract

The technology and innovation are the keys used to unlocked impossible imaginations to become possible towards achieving unexpected individual and organizational desired objectives. This study focused on the roles of unprecedented phenomenon called central bank digital currency (CBDC) over physical currency. Initially, the total of 146 articles from various research databases ranging from the year 2018 to 2021 were downloaded. However, 35 articles were reviewed from the total articles downloaded and selected as the study sample size by meeting the title, abstract and contents criteria. Furthermore, the results of this study employed systematic literature review (SLR) to explain in details why CBDC should be chosen and how it supersede the traditional physical currency based on individual and organizational perspectives. The study assesses the roles of CBDC based on three parameters such as features, perceived benefits and challenges of both CBDC and Physical Currency. It also revealed that CBDC can replaces the use of physical currency depends only on how people, businesses perceive the features, benefits (better allocation, accessibility, interest bearing, convertibility and cost reduction) and possible challenges (reverse of the benefits) associated with CBDC compare to it counterpart.

Keywords CBDC, Physical Currency, Central Bank, Perceived Knowledge, Perceived Benefits, Challenges

INTRODUCTION

The role of ICT toward digitization of economic activities, financial transactions and enhancing businesses by enabling digital currency to plays an important role in business environments. Based on the current situation of business transactions where physical currency is predominant method of storing and settling of business transactions. The physical currencies are not reliable and ideal method of payment due to the instability of price value of physical currencies compare to other international currencies when it comes to crossboarder transactions (Saito & Iwamura, 2019). About 63 central banks globally participated in the survey from various jurisdictions (Barontini & Holden, 2019). Central bank is responsible to issues, maintains, monitors, and regulates the country's currencies. Being the Apex bank of a country's banks, some central banks are investigating the possibility of issuing digital currency which is called Central Bank Digital Currency (CBDC) as a future replacement of physical currency. Alternatively some central banks proposes different policies depending on the country such policies include: *digital currency*, *virtual currency* (Naheem, 2016), *e-money*, some *cashless* as a measure to tackle the political,



economic and financial instability which lead many countries into corruption, devaluation of currency, persistent increase in price of goods and services (Isah & Babalola, 2019).

Even cryptocurrencies such as *Bitcoin*, *Ethereum*, Facebook's *Diem*, *Corda*, *Fabric* and *Ripple* are competing for a spot in the cashless world, constantly reinventing themselves in the hope of offering more stable value, and quicker, cheaper settlement (Chapman, 2021; Lagarde, 2021; (Shao et al., 2021; Zhang & Huang, 2021). The sole aim of introducing digital currency is to reduce the volume of physical currency in circulation which in turn destabilizes socioeconomic development of a country (Barontini & Holden, 2019).

It is well-known fact that many people and businesses don't accept innovations especially the ones caused by technology. For instant, it used to happen during the emergence technological innovation such as Internet technology, robotics, artificial intelligent, mobile banking, management information system and cryptocurrency and so for digital currency. Mostly, people resist to change which result in early, mid, and late movers (adopters) in Roger's Innovation Diffusion Theory (IDT). And of course, there are some risks and benefits associated with early, mid and late movers which is called *movers' advantages* respectively (Rogers & Everett, 1983). Recently, the way customers have paid for goods and services has been undergoing fundamental change in recent years especially during the period of COVID-19 outbreak (Chapman 2021). Even though Lagarde (2017) stated that the change can appear daunting, destabilizing, and even threatening especially for technological change, which disrupts our habits, jobs, and social interactions. But the reason of this key change is to harness the benefits of technological change while managing the risks of acceptance the new and emerging technological charge. Furthermore, central banks are continuing to research on CBDCs.

Yet there is no evidence of a widespread or general move to expand this research into experimentation and pilot arrangements. However, a few central banks with sufficient motivation are proceeding to pilot various designs (Boar et al., 2020). Over all, prior to the development of bank cards, automated teller machine (ATM), point of sale (POS), Internet and mobile banking for bill, salary payments, and disbursements played a similar physical currency replacement role (International Monetary Fund, n.d, pp.1). Based on the facts claimed in the prior studies, this study aims to highlights role of CBDC over physical currency by provides s between the two in terms of features, perceived benefits and challenges.

It is well known scenarios that people buy and sell goods and render services and made payments using their phones or computer related devices (e-commerce or e-business). Apart from credit and debit cards there are some payment system applications such as Google Pay, Apple Pay, PayPal, or one of the growing number of other payment system apps on the market. Nowadays, mobile phones provide users with numerous opportunity to make payment via e-wallets and e-money solutions (Isah & Babalola, 2019). Moreover, younger people seem to prefer to pay for goods and services using mobile payment solutions rather than credit or debit cards (Bilotta, 2021).

As the CBDC have become a subject of great concern by the central banks in which many researchers have begun to theorized its economic implications (Chapman, 2021). The



concept of CBDC is not new in most developed countries but still new with regards to developing countries perspective. Eventually, the concept has been defined by various scholars based on their respective monetary policy and background. Saito and Iwamura, (2019) defined CBDC as any electronic, fiat liability of a central bank that can be used to settle payments or as a store of value. Lagarde (2017) described CBDC as the digital cash that are used to represents physical cash already in use. The means of payments are changing in exponential pace. In addition to changes in how payments are made, likewise the type of money in use could be also changed. Davoodalhosseini (2021) also described CBDC as the money issued by the central bank in electronic form and universally accessible to settle the payment for goods and services. Evidently, the research by Barontini and Holden (2019) highlight the four key properties of physical currency as: *issuer* (central bank or not), *form* (digital or physical), *accessibility* (widely or restricted), and then *technology* (enabling IT physical resource and non-physical). While based on this study CBDC on the other hand inherits some feature of physical currency but in virtual form. These features include: *issuer* (central bank), *accessibility* (everywhere with internet network provide by network service providers), *acceptability* (gradually increases), *technology* (enabling IT physical resource and non-physical), *form* (digital not physical), *convertibility* (changing one digital currency into another kind of digital or physical one). Moreover, the CBDC as one of the digital cryptocurrency based on Blockchain technology pioneered by Bitcoin which usage is no longer restricted to limited purposes (Fadhil & Syed, 2019).

The CBDC is also a hybrid instrument that is used for both payment and considers as financial asset but in digital form. CBDC is a digital instrument that is easily scalable and has no storage costs, unlike a physical instrument like cash (Ferrari et al., 2020). While physical cash is a free, nearly anonymous payment tool provided by central banks, which now hope to update it to provide a public payment instrument with similar attributes that can also be used for digital payments (Chorzempa, 2021). It revealed that CBDC will be the primary tool in the future digital economy, and countries that are conversant with the technology will have a competitive advantage (Kuo et al., 2021).

Bitcoin Ethereum and other forms of digital currencies or cryptocurrencies are powered by blockchain technology. Bitcoin has no physical representation like bills and coins and which is not issued or backed by any government or private corporation. Its value is determined by different factors, but the most important one is demand for it. When people buy Bitcoins its value increases; conversely, when people sell Bitcoins, it decreases. For this reason, its value tends to fluctuate a great deal (Bilotta, 2021).

Payment services provided by the private sector can effectively address the defects of fiat money. Therefore, central banks yield the authority of currency issuance to the private sector and allow it to issue currency backed by bank deposits or electronic money to build a payment system with wide coverage and diverse payment models (Qian, 2019). However, Ozili (2021) identified risks include digital illiteracy, increased propensity for cyber-attacks, data theft, and the changing role of banks in a full-fledged CBDC economy. Policy makers should harness the benefits of CBDC, and develop a regulatory framework for digital assets. And when implement it will help to address some of the risks associated with CBDC.



METHODOLOGY

The purpose of this study is to analyze and synthesize the role of CBDC over physical currency providing adequate s based on features, perceived benefits and possible challenges that could be derived from its adoption and usage. As stated earlier that this study initially gathered about 146 articles out of which 35 articles were selected as the study sample size based on the titles and contents criteria. These articles were sourced from four different research databases from the year 2017 to 2021 (see figure 1). The results were analyzed and synthesized based on the role of CBDC over physical currency with regards to its features, benefits and challenges.

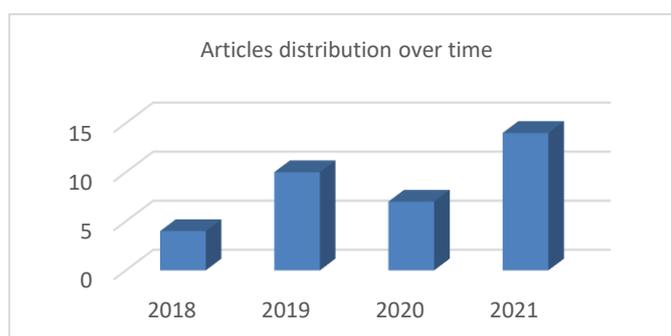


Figure 1: Articles distribution over time

RESULTS AND DISCUSSIONS

This section contains the detail information about the role of CBDC over physical currency by providing sufficient s between the two in terms of features, benefits and challenges.

The role of CBDC over physical currency based on features

The information contain in table 1 illustrated some features of CBDC which differentiate it from physical currency. There is no doubt in the existence of real dichotomy between the CBDC and physical currency. Firstly, the CBDC as a store of value and its value as a means of payments especially when it comes to economy where the physical currency (bearing no interest) is issued and compares with the result of CBDC's (interest-bearing) payment effects over interest-free-cash. Secondly, where interest-bearing CBDC with an otherwise-identical economy where CBDC lacks the transaction-cost mitigating effects (Chapman, 2021). Even though, this terminology (CBDC) is somehow misleading, as the traditional currency has some physical form either as paper notes or metal coins (Shen & Hou, 2021). (Williamson, 2021) distinguished between the benefits of physical currency and CBDC as substitute of physical currency with regards to interest as central bank pays interest on CBDC not on physical currency. The use of CBDC is designed to accept in a wider array of transactions than physical currency.



The role of CBDC over physical currency based on perceived benefits

This study synthesizes and analyzes the result based on the s between CBDC and Physical Currency in the light of features, perceived benefits and challenges. Shen & Hou (2021) once explained that the reserves and deposits are digitally the same with digital currency. For instance, reserves refer to the deposits of commercial banks and other financial institutions stored in the central banks so as to protect both the customers and the financial institutions from being insolvency. As a general obligations or rules all financial institutions have to keep certain percentage of the deposits collected from various depositors as a reserves into central bank as a guarantee (banks' financial backup). However, the deposits, and reserves are not different from CBDC as the two were also enable inter-bank settlement in terms of digitization. Deposits and reserves perform the same function as digitally stored on the account balance of financial institutions (Fernández & Olga, 2019). Both CBDC, deposits and reserves are digitized without any physical forms and all can be accessible through the use of computer-related devices.

Whereas the use of physical currency requires a direct physical contact between two or more parties in order to exchange value, however, CBDC dodges the need for any financial institution such as a bank to intermediate the transaction, although several digital intermediary services (by digital device and internet) may be used in order to facilitate the transaction (Naheem, 2016). There are a lot of benefits that can be derived from using CBDC. Firstly, it explained that for customers; CBDC reduces transaction costs directly. Secondly, it allows reduction in the policy rate which is only applicable on the depositors and in turn it bust income levels increase the profits of the bank and reduces the expected cost of capital related fine. Finally, for government it reduces the stock of debts in the hands of the public and therefore reduces the government lending rates which reduces the needs for distortionary taxation (Chapman, 2021).

The CBDC was introduced as a financial innovation also as alternative payment method for customers as it ensure financial efficiency by providing secured, faster, and cheaper transactions. Moreover, its use as a universal medium of exchanges challenging the traditional dominion of central bank in currency issuance (Fadhil & Syed, 2019).

Table 1: between Central Bank Digital Currency and Physical Currency

Factors	Central Bank Digital Currency	Physical Currency
Accessibility	Virtually accessible using phones and other computer-related devices anytime from everywhere	Physically accessible by visiting bank, ATM, POS's locations
Mobility	Simple	Heavy and risky
Security	More secured as PIN will be used to authenticate the owner	It requires physical protection and so for the holders
Acceptability	Low	High



Processing Cost	Moderate	High
Risk	Low	High
Agent	Exists	Exists
Issuer	Direct from the Central Banks	Form the Central bank through the Commercial Banks
Uses	Payments	Payments
Intermediation	Not exists	Exists
Physical form	Not exists	Exists
Technological Requirements	Account holder's computer-related devices, Internet services, etc.	Account holders and Banks' computer-related devices, Internet services, etc.
Skills	It requires adequate skills and knowledge	It requires little skills and knowledge since fund can be access physically

Better Allocation

Using CBDC ensures *better allocation of digital currency*. Customers would be encourage to use CBDC instead of physical currency in order to achieve better allocations or reduce the cash inflation to have less distorted allocation for cash and also save on CBDC carrying cost with condition that if the cost of carrying CBDC is too small enough, then only CBDC will be used as the best option. However, if the CBDC is too costly, then the economic welfare under the coexistence of the two may be dominated by either CBDC or physical currency in which only one of the two will be used because under co-existence the agents or customers may use the physical currency as a way to escape from the applicable tax. Therefore, the co-existence may lead to underutilization of CBDC, which has attractive feature of bearing interest, in turn the choice of coexistence is more likely to be optimal, Davoodalhosseini (2021). Taking the CBDC interest rate away from zero causes welfare losses as it creates price distortions of choice between these two payment instruments (Agur et al., 2021).

Accessibility

Accessibility is another important aspect of CBDC (Meaning et al., 2018) feature of CBDC may be universal or restricted to limited subset of economic agents for any or limited purpose. Bjerg (2017) also described that CBDC could be universally accessible.

Interest Bearing

Interest bearing is another important aspect of CBDC Davoodalhosseini (2021); Meaning et al., (2018), it pays adjustable interest rate (Kumhof & Noone, 2021). This finding of (Agur et al., 2021) provides an economic counterweight to the political economy considerations that may otherwise drive central banks to opt for a noninterest bearing CBDC, such as concerns about the possibility of negative rates on publicly accessible central bank



liabilities (Mancini-griffoli et al., 2018). The blockchain technology and cryptocurrencies in financial sector (banking and other business-related sectors) of economy are the most significant examples of CBDC. Subsequently, the findings of study of Kulkarni & Patil, (2020) using technology, organization and environment model revealed that perceived compatibility, relative advantage, perceived security, firm scope, top management, consumer readiness, competitive pressure and government policies are blockchain technology adoption driver whereas perceived cost is a significant inhibitor for blockchain technology adoption and so for CBDC.

Convertibility

Convertibility is another important aspect of CBDC. Base on the features of CBDC is as similar as possible to cash but in digital form and therefore it is convertible to cash and or reserves on demand (Fernández & Olga, 2019; Zhang & Huang, 2021). Kumhof and Noone (2021) revealed that CBDC and reserves are distinct and not guaranteed to be directly convertible into each other at the CB, likewise the no guaranteed convertibility of banks' deposits into CBDC at commercial banks.

Cost Reduction

The CBDCs offer an opportunity for dramatic *cost reductions*, which may translate into faster and less expensive transactions, for instance in remittances. CBDC motivates and promotes safety, robustness and efficiency of payments reduce issuing cost and increase transaction convenience (Zhang & Huang, 2021).

The roles of CBDC over currency based on financial transactions

The CBDC and physical currency are different entities under a single roof. Digital currency can easily be used as a tool for financial crime control; therefore, there is needs to determine a regulatory body and formulate regulatory rules to enable it secured end-to-end transactions (Yanchao, 2021). The end-to-end security of CBDC is provided by blockchain technology, it plays an important role by increasing the transaction volume and total and total volume in the exchange of transaction (Altan et al., 2019), CBDC ensure efficient financial settlement (payment), ensure end-to-end secured transaction using cryptocurrency powered by blockchain technology (Zhang & Huang, 2021; Nelson, 2018). In respect to physical currency, financial institutions captured complete customers's transactions including transaction records, and this model has effectively promoted the transformation of the regulatory model from understanding customers to understanding data. And finally to the formation of the data-centered regulatory model (Yanchao, 2021).

However, digital currency is characterized by decentralization, with data distributed and stored at each node and no concept of a central database. Even digital currency exchange is only used as a trading place that users can opt into rather than as the necessary trading place of the centralized model. As a result, data on digital currency exchange are still local rather than global, resulting in a reverse development model in which all countries regulating digital currency move from understanding data to understanding customers (Yanchao,



2021). The findings of Isah and Babalola (2019) revealed that cashless economic policy impacted positively on financial inclusiveness. Therefore, consistent effort must be maintained to ensure that cashless policy is expanded to reach the entire populace of the country to advance economic activities and consequently improve economic growth.

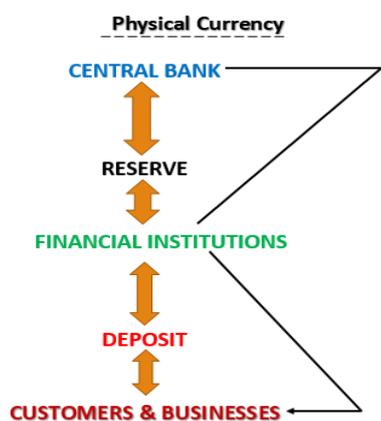


Figure 2: Transaction of Physical

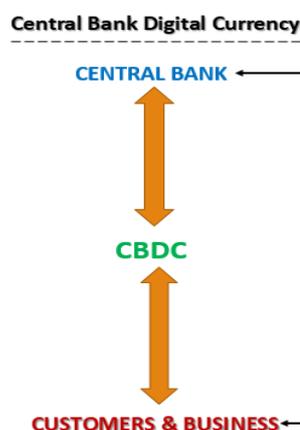


Figure 3: Transaction of CBDC

Many countries around the globe are busy on improving legislation on digital currency. China's financial management departments are highly concerned about legislation for and application of digital currency, and are committed to building a complete and scientific legal system for digital currency (Yanchao, 2021). Regardless of whether digital currency is deemed to be an ordinary commodity (an asset) or a currency, it cannot readily be judged using ideas of right or wrong (Nelson, 2018). In determining the legal attributes of digital currency and making laws for it, it is necessary to deal with the following three relationships: firstly the relationship between currency attributes and commodity attributes, secondly the relationship between centralism and decentralism, thirdly the relationship between traditional fiat currency and the new digital currency (Yanchao, 2021).

With the gradual development of the practice of digital currency issuance by the central banks, it is necessary to further sum up the law of benign interaction between traditional fiat currency and digital currency (Yanchao, 2021). As stated earlier that the coexistence of CBDC and physical currency may lead to underutilization of CBDC, which has attractive feature of bearing interest, in turn the choice of coexistence is more likely to be optimal (Davoodalhosseini 2021). However, taking the CBDC interest rate away from zero causes welfare losses as it creates price distortions of choice between these two payment instruments (Agur et al., 2021).

Possible Challenges of CBDC and physical currency

Unlike physical currency, there are some crossborder challenges in CBDC such as policy, implementation, scalability, cross-chain interoperability (Zhang & Huang, 2021), acceptability, convertibility (Fernández & Olga, 2019; Yanchao, 2021). Cryptocurrencies as enabler of CBDC offer an opportunity for dramatic cost reductions, which may translate into faster and less expensive transactions, for instance in remittances. But it is unclear whether



CBDCs may compete with cryptocurrencies in this, being based on national payment systems. Central Banks may, however, have incentives to develop interconnected payments systems for cross-border transactions if threatened by the competition of cryptocurrencies (Fernández & Olga, 2019). With regards to monetary policy issues associated with digital currencies, no digital currency seem likely to come into sufficiently widespread use to complicate the control bank's ability to moderate the business cycle and control inflation (Nelson, 2018).

The s between the CBDC and physical currency is one of the biggest concern that this study intent to address. Inadequate public awareness about the different functions of CBDC over physical currency counterpart lead to its slow implementation in most of the developing countries. (Williamson, 2021) still claimed that CBDC is good payment system, despite the fact that even when central bank replaces physical currency with CBDC will automatically reduce the functions and roles of other financial institutions in the eyes of the customers. There are some of cash related challenges faced by different central banks around the globe. Some central banks reported a high reliance on cash and are motivated by reducing costs and improving know-your- customer and countering-the-financing-of-terrorism arrangements. While some central banks have the opposite challenge such as low or declining use of cash for payments motivates research into a CBDC that would maintain public access to central bank money. Boar et al. (2020). At this early stage, when CBDCs are still in the laboratory, central banks may want to at least keep an eye on the inclusion of an adjustable CBDC interest rate, weighing its benefits against possible political economy costs (Agur et al., 2021).

The emergence of digital currency essentially represents a confrontation between a non-centralist intellectual movement and the centralist model with its long-term consolidation. We must acknowledge that digital currency, based as it is on the principle of decentralization, can remedy many of the shortcomings of centralism such as lack of credit, the center's high maintenance costs, inflation caused by excess issuance of currency, etc (Nelson, 2018).

Digital currencies such as Bitcoins, and Ethereum and others are probability the simplest methods of payment compare to other traditional methods. However, Saito and Iwamura (2019) these currencies are not ideal as methods of payment because of instability of their market prices. Their prices tend to go up in the long term, and to fluctuate widely in the short term. For this reason many people are incentivized to hoard those currencies, and would want to avoid risks of losing values by using them for payment. Stability of their market prices needs to be achieved if these currencies are intended to be used as monetary media instead of as investment products.

Despite the fact that there are a lot of advantages that can be drive from using CBDC, on the other hand there are still doubts over whether it is really worthy of adoption as two serious issues were identified as disruption caused by the CBDC. These issues include: firstly, disintermediation of financial institutions, where customers and businesses are allow to open accounts directly with the central banks and in return this direct transaction between the customers and the central banks would automatically reduce the amount of deposits that



supposed to be kept in other financial institutions (commercial banks). Consequently, this reduces the amount of physical currency supply in the financial institutions, which ultimately affects and drive the financial institutions out of the market. Secondly, CBDC may cause in re-using the old payment (physical currency) system after implementing CBDC during financial crisis, as it can affect both payment systems the central banks may come to a situation where governments decide regulate the amount of physical currencies in circulation to stabilize the economy during inflation (Shen & Hou, 2021).

Moreover, the study of Naheem (2016); Engert and Fung (2017) explained that the digital currency uses a direct peer-to-peer system in order to exchange value, which bypasses the need for any formal financial institution such as a bank; although several digital intermediary services may be used in order to facilitate the transaction. Davoodalhosseini (2021) explained that for the agents to utilize the benefits of using both CBDC and physical currency at the same time, the cash inflation must be strictly positive despite the fact that when both two of the payments system are available it may seem feasible to implement a negative cash inflation rate through an open market operation. Though, the negative cash inflation would induce users to switch from CBDC to cash, as the return of using cash will be higher than using CBDC, thus the agents do not need to incur the cost of carrying the CBDC. Therefore, since the CBDC would not be used, the central bank could not conduct an open market operation under negative cash inflation. Although the cost of transaction and charges seems to be an issue to the users of cashless policy, financial inclusion remains a relevant factor that can be used to track economic activities, free money, sharp practices in government agencies and intergovernmental expenses (Isah & Babalola, 2019).

CONCLUSION

To conclude, the adoption and usage of CBDC as a replacement of physical currency depends on how people and business entities understand the features (see table1), perceived benefits (better allocation, accessibility, interest bearing, convertibility, cost reduction) that could be derived from using it and the corresponding challenges (all these benefits on the other hand turned to its challenges, 4.4) that should be known for preventive measures. Moreover, the roles of CBDC based on financial transactions were well explained as the best option compare to physical currency transactions. The research and usage of CBDC is now becoming popular around the globe. But developing countries are yet to accept the use of this new and emerging technological innovation as a means of payment (see appendix).

RECOMMENDATIONS

The study also observed and recommended that considering the facts that adequate awareness about CBDC features, perceived benefits and challenges and other types of cryptocurrencies such as Bitcoin, Facebook's Diem, etc. need to be done as the matter of necessity. Unveiling the roles of CBDC over physical currency based on its features, benefits and challenges would definitely promote the acceptance and usage of CBDC around the globe especially in developing countries.



Theoretical Contributions

- i) Firstly, this study contributes immensely to the body of knowledge with regards to dissemination of adequate information about CBDC features, perceived benefits and challenges across individuals, businesses or other corporate bodies, and policy makers or regulatory agencies.
- ii) Secondly, this study bridges the gaps left by prior studies in which most of them focused on its adoption and effects based on financial transaction domains. Without focusing on its roles CBDCs over traditional physical currencies.
- iii) Finally, this study it is first of kind that focus on providing information reach on CBDC and physical currency.

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APPENDIX: Table 2: Articles Distribution based on Author(s), Country(ies), Journals and Theme

SN	Author(s) and Year	Title	Country (ies)	Source	Source Theme
1	(Davoodalhosseini, 2021)	Central bank digital currency and monetary policy	Canada	Journal of Economic Dynamics & Control	Central bank digital currency
2	(Agur et al., 2021)	Designing Central Bank Digital Currencies		Journal of Monetary Economics	Central Bank Digital Currencies
3	(Ji & Shen, 2021)	Introduction to the special issue on digital currency	China	China Economic Journal	Digital Currency
4	(Chorzempa, 2021)	China, the United States, and central bank digital currencies: how important is it to be first?	China	China Economic Journal	Central bank digital currency
5	(Yanchao, 2021)	On the Legal Attributes of Digital Currency	China	Social Sciences in China	Digital Currency
6	(Zhang & Huang, 2021)	Blockchain and central bank digital currency	China	ICT Express	Blockchain and digital currency
7	(Kumhof & Noone, 2021)	Central bank digital currencies: Design principles for financial stability	UK and Australia	Economic Analysis and Policy	CBDCs
8	(Chapman, 2021)	Discussion of “The macroeconomics of central bank digital currencies”	Canada	Journal of Economic Dynamics and Control	Central bank digital currency
9	(Shen & Hou, 2021)	China’s central bank digital currency and its impacts on	China	Computer Law & Security Review:	Central bank digital currency



		monetary policy and payment competition: Game changer or regulatory toolkit?		The International Journal of Technology Law and Practice	
10	(Williamson, 2021)	Central bank digital currency and flight to safety	Canada	Journal of Economic Dynamics and Control	Central bank digital currency
11	(Shao et al., 2021)	Research on venture capital based on information, entropy, BP network and CVaR model of digital currency in Yangtze River Delta	China	Procedia Computer Science	International Conference on Identification, Information and Knowledge in the internet of Things, 2020
12	(Li & Huang, 2021)	The genesis, design and implications of China's central bank digital currency	China	China Economic Journal	China's central bank digital currency
13	(Kuo et al., 2021)	A global perspective on central bank digital currency	China	China Economic Journal	central bank digital currency
14	(Tong & Jiayou, 2021)	A study of the economic impact of central bank digital currency under global competition	China	China Economic Journal	the economic impact of central bank digital currency under global competition
15	(Balvers & McDonald, 2020)	Designing a Global Digital Currency	Canada	Journal of International Money and Finance	Global Digital Currency
16	(Boar et al., 2020)	Impending arrival – a sequel to the survey on central bank digital currency	International	Bank for International Settlements	central bank digital currency
17	(Ferrari et al., 2020)	Central bank digital currency	European	European Central Bank	Central bank digital currency



		in an open economy			
18	(Kyriazis, 2020)	Herding behaviour in digital currency markets : An integrated survey and empirical estimation	Greece	Heliyon	digital currency
19	(Duque, 2020)	State involvement in cryptocurrencies. A potential world money?	Japan	The Japanese Political Economy	Cryptocurrency
20	(Ogbonna & Virtus, 2020)	Cashless Policy and the Nigerian Economy : A Disaggregated Approach	Nigeria	International Journal of Humanities Social Sciences and Education (IJHSSE)	Cashless Policy
21	(Bindseil & Bindseil, 2020)	Central Bank Digital Currency : Financial System Implications and Control	European	International Journal of Political Economy	Central Bank Digital Currency
22	(Altan et al., 2019)	Digital currency forecasting with chaotic meta-heuristic bio-inspired signal processing techniques	Turkey, Italy and Canada	Chaos , Solitons and Fractals	Digital currency
23	(Qian, 2019)	Central Bank Digital Currency: optimization of the currency system and its issuance design	China	China Economic Journal	Central Bank Digital Currency
24	(Isah & Babalola, 2019)	Impact of Cashless Economic Policy and Financial Inclusiveness in Nigeria : An	Nigeria	Amity Journal of Economics	Cashless Policy



		Empirical Investigation			
25	(Saito & Iwamura, 2019)	How to Make a Digital Currency on a Blockchain Stable	Japan		Digital Currency and Blockchain
26	(Barontini & Holden, 2019)	Proceeding with caution – a survey on central bank digital currency	International	Bank for International Settlements	Central Bank Digital Currency
27	(Naheem, 2019)	Exploring the links between AML , digital currencies and Blockchain technology	Germany	AML, Digital Currencies and Blockchain Technology	AML, Digital Currencies and Blockchain Technology
28	(Yazid & Zulhuda, 2019)	Cryptocurrencies and Anti-money Laundering Laws: The Need for an Integrated Approach	Malaysia	Emerging Issues in Islamic Finance Law and Practice	Cryptocurrencies and Anti-money Laundering Laws (Chapter 14
29	(Fadhil & Syed, 2019)	Regulating Digital Currency: Taming the Unruly	Malaysia	Emerging Issues in Islamic Finance Law and Practice	Digital Currency (Chapter 15
30	(Dow & Dow, 2019)	Monetary Reform, Central Banks, and Digital Currencies	United Kingdom	International Journal of Political Economy	Monetary Reform on Central Banks and Digital Currencies
31	(Costantini & Costantini, 2019)	Cryptocurrencies: Will Machines Replace Your Banker?	USA	International Journal of Political Economy	Cryptocurrencies
32	(Nelson, 2018)	Financial stability and monetary policy issues associated with digital currencies	USA	Journal of Economics and Business	Financial stability and monetary policy
33	(Hong et al., 2018)	Crowding Out in a Dual Currency Regime? Digital	Korea	Emerging Markets Finance and Trade	Digital versus Fiat Currency



		versus Fiat Currency			
34	(Mancini-griffoli et al., 2018)	Casting Light on Central Bank Digital Currency	International	I M F Staff Discussion Note	Central Bank Digital Currency
35	(Meaning et al., 2018)	Broadening narrow money: monetary policy with a central bank digital currency	England	Bank of England	Digital Currency and Monetary Policy