Central Bank Digital Currency Models
A Short Review

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Abstract. This research paper explores the models and implications of central bank digital currency (CBDC) in four countries: China, Japan, the U.S., and Australia. The paper analyses the different design choices, governance structures, and technological challenges of CBDC development in each country. The paper also compares the progress and impact of CBDC on financial stability, privacy, and centralised control. The paper concludes that CBDCs have the potential to revolutionise digital payment systems and enhance the efficiency and security of transactions, but they also pose significant risks and trade-offs that need to be carefully addressed. The paper provides some recommendations for CBDC development and adoption, such as establishing comprehensive regulations, educating the public, and ensuring interoperability.

Keywords: CBDC · digital currency · cryptocurrency · blockchain · DLT

1 Introduction

Over the past two decades, groundbreaking technologies have revolutionised monetary and payment systems at an unparalleled rate. The advent of various digital currencies—ranging from mobile money to cryptocurrencies underpinned by distributed ledger technology and blockchain—has consistently tested the limits of existing domestic and international financial regulations. Moreover, the surge of unregulated crypto-digital currencies has unleashed a wave of fraud, theft, and hacking incidents, jeopardising the established financial frameworks overseen by national regulatory bodies such as central banks. To counter these challenges, especially those tied to the anonymity of traditional digital currencies, central banks across the globe are actively investigating the viability of launching state-sanctioned, centrally-backed digital currencies.

As Central Bank Digital Currency (CBDC) remains under active research and development, a standardised, conclusive definition is yet to exist [19]. However, it generally possesses three distinctive characteristics that set it apart from physical cash, electronic money, and traditional cryptocurrencies [8]. First, CBDC is issued by a central bank, representing a liability of that institution rather than a private financial entity, and it is expected to hold a value analogous to the fiat currency distributed by the same central bank. Second, CBDC is

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virtual, existing solely in digital form as opposed to a physical medium. Third, although CBDC may employ technologies like blockchain or distributed ledger technology for transaction and settlement processes, it remains under the centralised control and supervision of the issuing central bank.

Worldwide, various banking analyst reports and academic studies have delved into the pros and cons of CBDC [29]. On the upside, CBDCs offer advantages such as efficiency, convenience, safety, integrity, accessibility, settlement finality, and financial inclusion. Conversely, the risks often centre around the potential misuse of financial data and concerns regarding user privacy. Despite the evolving dialogue and research focusing on the financial and technological aspects of CBDC, there is a notable gap in legal and policy analysis concerning the regulation of information protection associated with CBDC.

The insights garnered from this paper will hold far-reaching implications for state-sponsored digital currencies in various jurisdictions. Particularly, when the advent of CBDCs introduces potential or significant risks to financial markets and individual privacy, a legal framework becomes imperative to confront these challenges and to offer viable solutions. Prior to delving into the practical and regulatory complexities of CBDCs, an essential preliminary step involves examining the available design options, as these choices will invariably influence the future regulatory landscape for CBDCs.

The main contributions of this paper are:

- Analyses CBDC models for four countries: China, Japan, the U.S., and Australia.
- Compares the CBDC progress, highlighting the factors that influence their development and adoption.
- Provides some recommendations for CBDC development and adoption.

2 Background

A large number of recent studies examine the dynamics of digital currency cryptocurrencies, CBDC and potential impact central banking monetary policy. policies [10,14,22]. This section give a brief background into digital payment, CBDC its design.

2.1 Digital Payment Systems

Digital payments, often referred to as electronic payment systems, involve the transfer of digital money between accounts through the use of digital payment technologies. These technologies encompass a wide range of methods to facilitate electronic transfers of funds. Advancements in technology, combined with increased access to digital devices and internet connectivity, have spurred the transformation toward digital payments.

In our conventional financial architecture, when central banks allocate credit to commercial banks, this allocation gets registered in the ledgers of these commercial banks as a credit from the central bank. This credit is not relayed directly to the individual bank customers. Instead, commercial banks draw upon this credit to disburse retail money to their clientele in the form of digital transactions and deposits. The digital funds reflected in the accounts of customers denote adjustments in their account balances and don't represent tangible cash. Conversely, tangible currency is the sole monetary format provided by central banks that consumers can directly possess and transact with.

The shift toward digital, cashless payments offers a plethora of advantages for consumers, enterprises, and governments alike. Not only are these payments swift, secure, and convenient, but they also diminish the overheads associated with cash management for banks and financial institutions. Both government bodies and financial institutions have been instrumental in championing the transition to digital cashless payment infrastructures.

Digital currency offers the dual advantages of rapid access to funds and unparalleled convenience for users. Furthermore, it provides governmental agencies and tax authorities with enhanced capabilities for tracking the flow of money, thereby aiding in the detection of tax evasion and money laundering activities.

2.2 CBDCs

CBDCs are digital currencies that are issued and overseen by a central bank. An immediate inquiry surfaces: With the prevailing money system predominantly digital, what differentiates a CBDC?. While a digital currency signifies a claim against an intermediary, a CBDC embodies a direct claim against the central bank [4]. This is in contrast to cryptocurrencies, which are shaped, transacted, and terminated via open protocols. In the case of CBDCs, their issuance and governance rest with the central bank, mirroring the operations of conventional fiat currency. Several central banks, in their exploration of CBDCs, emphasise the potential of these currencies to amplify financial inclusion, as highlighted in a report [17] by the Bank for International Settlements (BIS)[1].

In essence, a CBDC is conceived as a digital counterpart aiming to emulate the foundational functions of physical currency [29]. It aspires to ensure universal access, function as legal tender, and its provenance can be easily traced. A CBDC is structured to fulfill quintessential monetary functions, serving as a unit of account, a medium for exchange, and a reservoir for value.

The discourse around CBDCs often gravitates towards their potential to act as digital cash, encapsulating features that support peer-to-peer transactions and operations without the need for online connectivity. The objective is to digitally encapsulate the attributes of tangible cash, ensuring it is amenable for regular transactions and remains accessible, even in the absence of internet connectivity. However, the exact design and operational nuances of CBDCs can diverge, contingent on the stipulations and choices of the individual central banks.

[1] https://www.bis.org/about/bisih/topics/cbdc.htm.

Conceiving CBDCs as digital equivalents to physical cash, such as tendering a banknote or coin [6]. A meticulously crafted CBDC is not just a digital facsimile of a nation's currency; it has the potential to serve multifarious policy aims. The design of CBDCs is not to replace but to coexist alongside tangible currency, offering an alternative underpinned by the merits of digital evolution. While retaining many attributes of traditional tender, like stability and universal acceptance within its territory, CBDCs can proffer benefits like streamlined transactions, cost-effectiveness, and fortified security provisions.

2.3 Navigating the Emergence of CBDCs

For centuries, people have relied on paper currency, making the shift to digital currency a challenging transition, especially for older generations. The currency system is fundamentally built on trust, and if the public lacks confidence in CBDC, it remains merely a string of meaningless digits. The question then arises: what underpins this new technology? Is it the central banks, the government, or perhaps mathematical algorithms? Trust is the bedrock, but skepticism exists about whether machines can establish this trust. Additionally, the regulatory framework for CBDCs is still in its infancy, lacking comprehensive laws to protect digital assets. Even governmental authorities are uncertain about the repercussions of CBDC issuance. On a practical note, widespread acceptance is also hampered by the lack of merchant facilities that accept CBDCs, akin to promoting electric vehicles without providing enough charging stations.

CBDCs are experiencing a surge in popularity globally, emerging as a prominent digital payment system. An increasing number of people are opting to use digital payment methods to enhance the convenience of transactions. According to Jones [7], the objective of a CBDC is to serve as 'a digital claim on the central bank, accessible to the wider public.' As trust between the public and central banks solidifies, CBDCs have the potential to revolutionise our economy. Moreover, they could address numerous challenges in the current global economic system and offer improved control over inflation rates.

According to Náñez Alonso [21], 'CBDC is an electronic variant of cash issued by a central bank, which combines cryptography and digital ledger technology to offer this digital money.' This statement aptly encapsulates the ideal vision for central digital currency. Nonetheless, several challenges must be addressed before the full realisation of the CBDC system can occur. One primary issue is the integration of new technologies; there exists a segment of the population that does not yet utilise smartphones or any digital devices. Transitioning from a reliance on physical assets to adopting digital assets is not straightforward; altering people's mindsets and fostering trust in the new system is a time-intensive process. As Peterson notes [24], individual choice will play a crucial role in the acceptance of new digital currency despite the remarkable technology it employs. Another significant hurdle is the current inadequacy of regulations and infrastructure surrounding digital currency [11]; this can potentially allow individuals to exploit the system, thereby creating risks for the general public. The existing

support for CBDCs is insufficient, posing threats to financial stability. Furthermore, digitally illiterate individuals may require assistance from physical human agents, necessitating direct communication with a real person to address their queries [24].

2.4 CBDC Design

There are two prominent types of CBDC designs being developed. The first is based on DLT, and the second operates under central control [9].

DLT-based CBDCs draw upon the concept of decentralised cryptocurrencies, addressing the illegitimacy issues associated with complete anonymity by incorporating validation by authorised verifiers. DLT-related design currencies stand distinct from electronic currencies based on a trusted central payment system. Compared to a centralised intermediary payment system, the DLT design of CBDCs could facilitate business transactions and financial services due to its accessibility, resilience, and transparency. However, a CBDC with a DLT design is not without risks. The evolving DLTs may bring operational and security risks and potential disruptions to the current monetary regulation. For instance, the multiple nodes of a DLT can create additional entry points for malicious intruders, cryptographic tools might experience security breaches, and existing regulations may not be robust enough to confirm the rights and obligations of involved parties. Additionally, non-central bank parties involved in a DLT-based CBDC might partake in various CBDC transactions without sufficient security measures, akin to a country's central bank, leading to additional financial risks.

A centralised model of CBDC design, where the central bank has exclusive control over the digital currency, poses several concerns that warrant careful consideration. One glaring issue is that this model may raise serious privacy concerns, as the central entity monitors and records all transactions, possibly compromising the confidentiality of users' financial activities. Moreover, innovation may be stifled due to a lack of competitive atmosphere encouraging the development of new features and improvements. The centralised structure might also breed bureaucratic inefficiencies, slowing down necessary adaptations to evolving market conditions and possibly leading to mismanagement or abuse of authority. Thus, a well-thought-out approach addressing aspects like security, privacy, and scalability is imperative when contemplating a centralised CBDC design.

3 CBDC Models

3.1 China

According to Wang [28], the e-CNY, also known as the digital yuan — China's CBDC, is poised to be a formidable player both on the domestic and global stage, bolstered significantly by substantial backing from the Chinese government, akin to its fiat currency. The e-CNY operates on a two-tier system, supplemented with auxiliary layers to facilitate service delivery to end-users. This

digital currency is characterised by features like proficient circulation management, seamless interoperability, and a flexible exchange and wallet ecosystem. Remarkably, these features are accessible to both Chinese residents and foreign visitors in China [28] (Fig. 1).

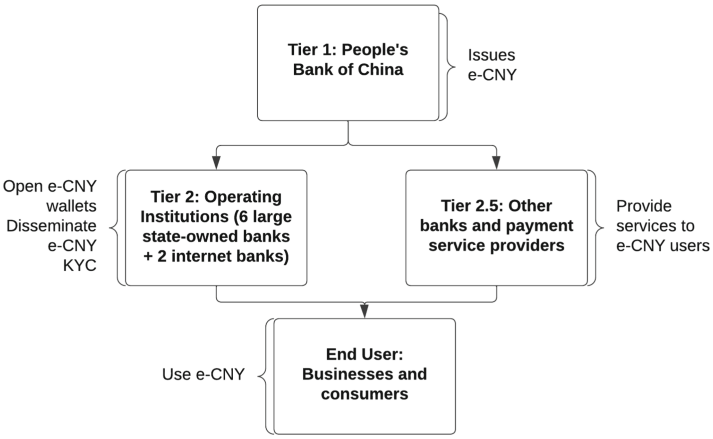

Fig. 1. The e-CNY structure [5].

The structure of e-CNY is centralised, under the central government's stringent oversight. At the core of this structure is the People's Bank of China (PBOC), which occupies the first tier, responsible for dispensing e-CNY to the second-tier entities. These second-tier institutions comprise six prominent state-owned banks and two leading internet banks in China, tasked with the role of initiating e-CNY wallets or accounts for the general populace. The state-owned banks enlisted in this endeavour are the Bank of China (BOC), China Construction Bank (CCB), Industrial and Commercial Bank of China (ICBC), Agricultural Bank of China (ABC), Bank of Communications (BOCOM), and the Postal Savings Bank of China (PSBC), complemented by the internet banking giants, WeBank (associated with Weixin Pay) and MYbank (affiliated with Alipay) [30]. These institutions function as conduits, channelling the service down to other commercial banks, enterprises, consumers, and payment service providers, thereby facilitating a seamless flow of transactions within the ecosystem. To illustrate, individuals can readily convert conventional CNY to e-CNY or digital yuan via these state banks. The converted currency can then be safely stored in an e-CNY wallet, empowering users to execute transactions or procure goods from providers integrated with the e-CNY network.

3.2 Japan

The Bank of Japan, as the nation's central bank, is responsible for issuing the Yen, Japan's fiat currency, to the public. It is also likely to be the institution behind the issuance of Japan's CBDC, commonly referred to as the digital yen. The Bank of Japan has already taken several significant steps towards this end. It published a CBDC paper in November 2020, followed by the release of the Proof of Concept Phase 1 in December 2021 and Phase 2 in May 2022[2]. Further, it has scheduled a Pilot Program for May 2023 and aims for an official issuance by February 2026, according to available data [1]. These developments indicate that the Bank of Japan is on a phased trajectory to introduce the digital yen by 2026, following extensive testing and public piloting of the CBDC scheme.

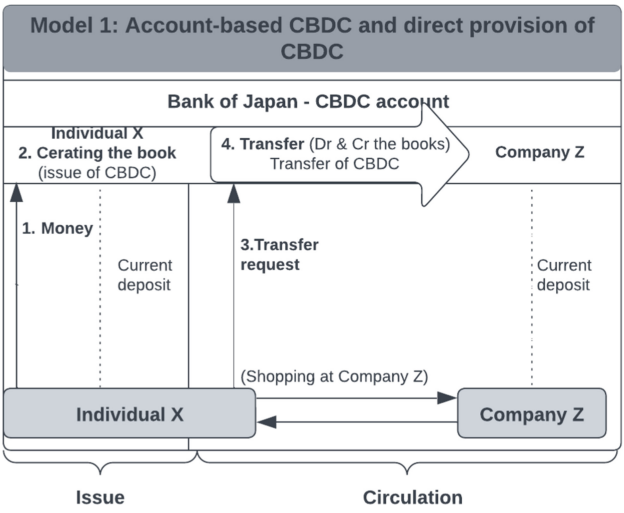

Fig. 2. Model 1 – Account-based CBDC with direct provision [13]

Masayoshi Amamiya, the Deputy Governor of the Bank of Japan, has outlined two primary forms of CBDC. The first is an *account-based CBDC*, where individuals and firms open accounts directly with the central bank and utilise these for transfers. The second form is a *token-based CBDC*, which involves users storing CBDC on smartphone applications or IC cards and transferring value for payments [2]. Figure 2 and Fig. 3 provide further details on these account-based CBDC structures, categorised into direct and indirect provisions. In the direct account model, an individual—referred to as X can transfer CBDC directly from their own digital wallet or account to a Company Z. Conversely, the indirect account model involves an Intermediating Institution Y. In this model, individual X first transfers yen to Institution Y, which then converts it into digital yen.

[2] https://www.boj.or.jp/en/paym/digital/index.htm.

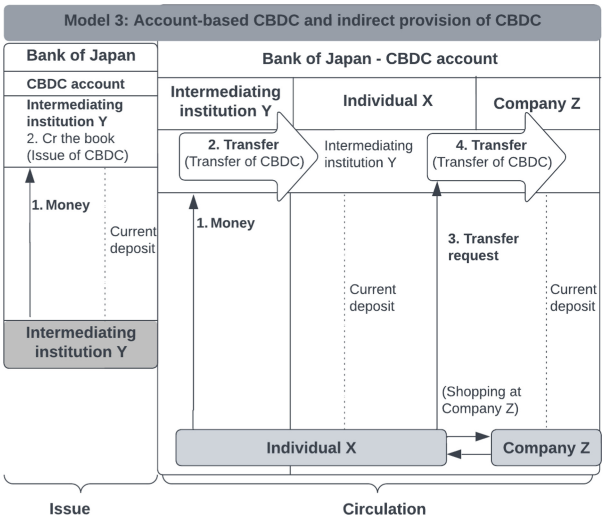

Fig. 3. Model 3 – Account-based CBDC with indirect provision [13]

Subsequently, individual X can transfer this digital yen to Company Z. In this scenario, Institution Y serves as a currency exchange entity, adding an extra layer of conversion from yen to digital yen.

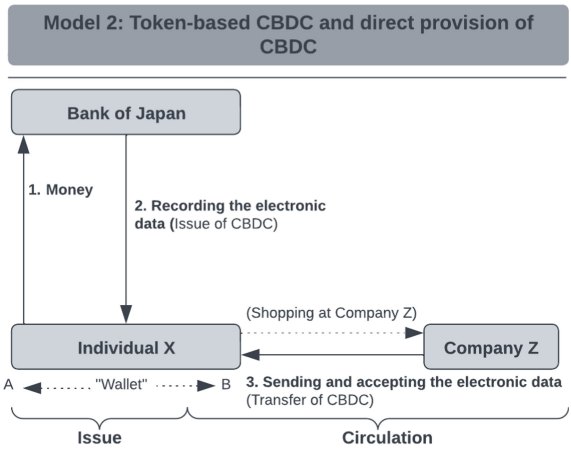

Fig. 4. Model 2 – Token-based CBDC with direct provision [13]

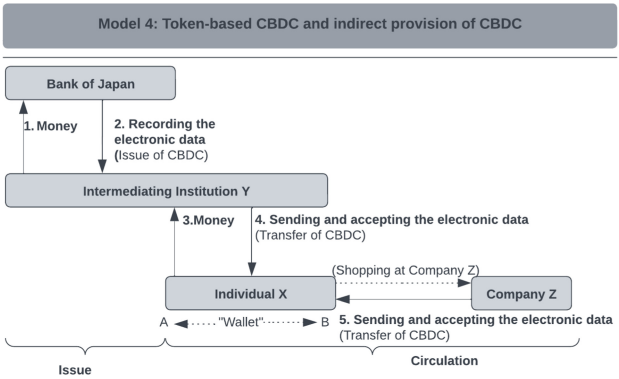

Fig. 5. Model 4 – Token-based CBDC with indirect provision [13]

Figure 4 and Fig. 5 provide the token-based CBDC mechanisms, differentiating between direct and indirect provisions. In the direct token method, users can transfer CBDC using either their ID card or smartphone. Upon receiving the electronic token data from the user's ID card or smartphone, the Bank of Japan can validate the transaction and initiate the CBDC transfer to Company Z. The indirect token method operates similarly, but includes an additional layer: Intermediating Institution Y. This entity decrypts the electronic data before forwarding it to the Bank of Japan. Once the Bank of Japan receives and approves this data, Intermediating Institution Y is authorised to proceed with the CBDC transfer to Company Z.

3.3 United States

In 2022, the Biden administration set forth a plan to delve into CBDCs, aiming to mitigate fraud and enhance security [15]. Federal Reserve Chair, Jerome H. Powell, emphasised that the creation of a CBDC involves addressing monetary policy, financial stability, consumer protection, and privacy issues [12]. The intention is clear: the U.S. wants to introduce a CBDC for its citizens, but it must first address public concerns, regulatory challenges, and potential data breaches. Without resolving these hurdles, the path to launching digital dollars remains uncertain.

Figure 6 provides a high-level view of the approval and issuance of CBDC tokens. Before reserve banks can issue a CBDC, the proposal would first need to be approved by the Board of Governors. It would then be submitted to Congress for further review. Congress would then debate the merits and potential drawbacks of the initiative before deciding if reserve banks can proceed with issuing the CBDC to the public. Once approved, the CBDC would go through the process of being issued to commercial banks, service providers, and ultimately, to customers. It is important to highlight that states may differ in their perspectives or timelines concerning the CBDC. Thereafter, consumers can opt for

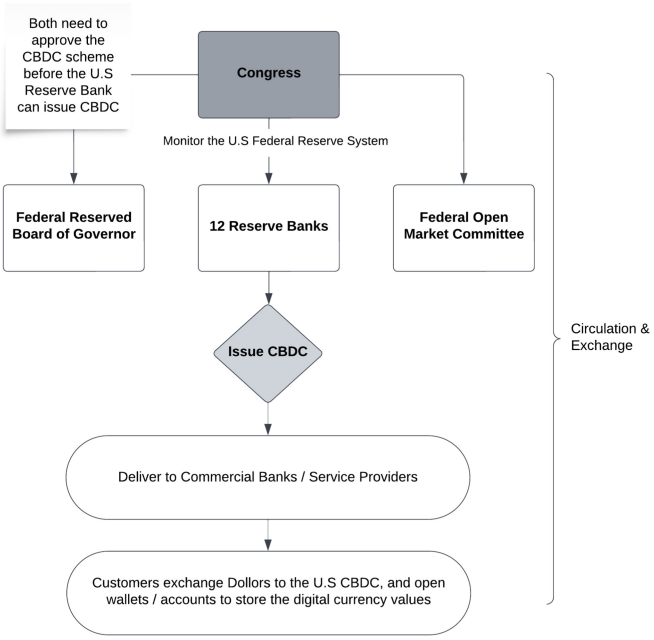

Fig. 6. U.S. CBDC Model

digital wallets via these banks, facilitating the conversion of physical dollars into their digital counterparts.

3.4 Australia

The Reserve Bank of Australia (RBA) is cooperating with the Digital Finance Cooperative Research Centre (DFCRC) to investigate the economic benefits that CBDC can bring to Australia; a few projects outlining the use cases, benefits and limitations of Australia CBDC have become popular among the researchers [27].

Australia, in particular, is at an interesting juncture in the CBDC landscape. The nation has primarily been focusing on the research and exploratory phase, delving deep into understanding the implications, benefits, and challenges of launching its own CBDC. Recognising the profound impact such a currency can have on its economy and society at large, Australian policymakers believe that it's crucial to involve the broader community in this conversation. There is a pressing need for more public discussions, seminars, and speeches to not only educate the masses about CBDCs but also to gauge their perspective and draw their attention to the potential transformation in the financial realm.

As depicted in Fig. 7, an overview of the Australian CBDC model is presented. At the core of this model, the central banks play a pivotal role by issuing CBDCs to commercial banks. These commercial banks, having vast experience and infrastructure in handling retail financial services, are then responsible for all

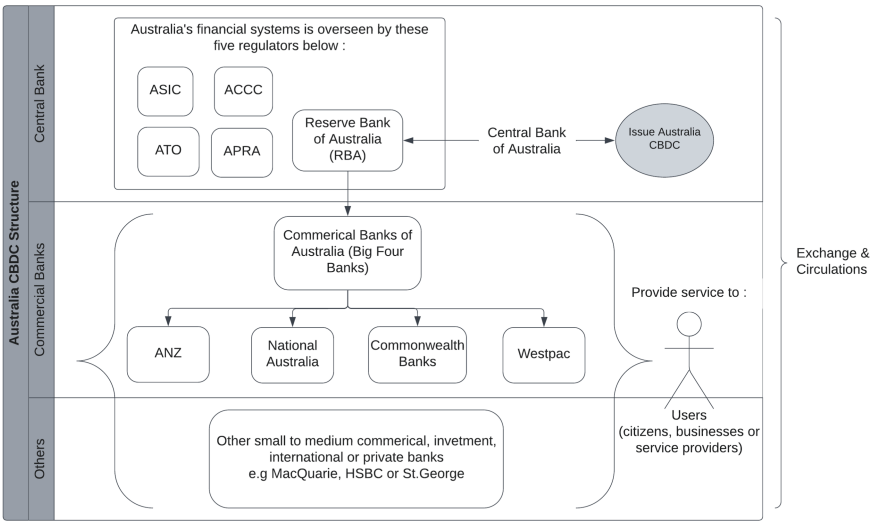

Fig. 7. Australian CBDC Model

user-facing services associated with the CBDC. This two-tiered approach ensures that while the integrity and authenticity of the digital currency are maintained by the central authority, the distribution, and transactional services are managed by institutions that are closely integrated with the end-users.

3.5 Discussions

Due to its centralised governance model, China has the capacity to promote its CBDC, known as e-CNY, on a broad scale. This enables an extensive scope for trials and experiments, facilitating data collection that could inform improvements to the existing financial system. Notably, significant resources have been allocated for CBDC research and pilot programs, signalling a strong intent to bring e-CNY into mainstream usage in the near future. While public opinion on the stability and acceptance of CBDCs may vary, the government's commitment to its implementation suggests that any reservations will likely be carefully considered as part of its ongoing development strategy.

In the context of a decentralised financial system, Japan's approach to CBDC development appears to involve multiple layers of governance, including both central and local authorities. The Bank of Japan has set timelines, with a goal of introducing a digital yen by 2026. Public consultation and expert input are being sought to inform the selection of the most beneficial CBDC model for the country. Various options are presented for stakeholder consideration, and local governments can share their viewpoints with the central authority. This collaborative and consultative approach may contribute to a more thorough preparatory phase, potentially mitigating challenges that could arise during later implementation stages.

In the United States, the financial system and cultural attitudes toward finance add layers of complexity to the development and adoption of a CBDC. Public concerns around data privacy are notable, and no absolute guarantee of data security exists. Moreover, the governance structure in the U.S. is decentralised, with varying relationships between the central and state governments. This could present challenges in reaching a consensus among diverse parties with differing interests, especially when it comes to advancing CBDC initiatives.

In Australia, the governance system is also decentralised, allowing state governments considerable autonomy in certain regulatory matters. As a result, more developed states might be quicker to experiment with CBDCs, while more remote states could lag in adoption. Although public discourse on digital currencies has been relatively limited, likely due to media focus on cryptocurrencies, increasing research and public discussion are anticipated to elevate awareness. While there may be some resistance to adopting new financial technologies, given Australia's generally cautious approach to change, the long-term benefits to the financial system could prompt earlier trials and eventual adoption of a CBDC.

In a centralised governance structure, the development and deployment of a CBDC may progress more quickly. This is because decision-making could be more streamlined and efficient. On the other hand, a decentralised governance approach might lead to a more robust and well-considered digital currency in the long term. While strong government support could be an asset during the initial stages of launching a digital currency, the ultimate success of the currency depends on its long-term impact on the economy and its acceptance by the public. If the digital currency proves beneficial, it will likely gain widespread acceptance. However, if it proves to be detrimental, there may be negative repercussions, potentially undermining public trust and adoption.

4 Observations on CBDC Dynamics

For the widespread adoption of CBDC, comprehensive regulations are essential to ensure the rights and protections of digital currency users. Without safeguarding digital assets under legal frameworks, it becomes challenging to encourage the public to embrace this new form of currency. For instance, the existence of fraudulent cryptocurrency platforms raises concerns about reliability [8]. Similarly, without governing regulations for CBDCs, it is difficult to control the spread of misinformation or establish authoritative assessments of various digital currencies. Additionally, the government should actively promote the deployment of authorised payment terminals that support CBDC transactions, thereby expanding the number of outlets where customers can use digital currency.

Addressing and changing public perceptions about CBDC is crucial for its successful implementation. Government bodies have a role to play in educating the public on what this new technology means for society. Training sessions and complimentary CBDC cards for trial use could help familiarise people with the system. Misinformation is another challenge; some media outlets have misconstrued the essence of CBDC, sowing confusion and scepticism among the public.

Failure to correct these misconceptions can lead to increased doubt and hesitancy to adopt this groundbreaking technology. Therefore, engaging in educational initiatives that inform the public about the real objectives, features, and long-term benefits of CBDCs for the economy.

In the following sections, we explore the multifaceted nature of CBDCs, touching upon technological advancements, financial stability implications, privacy considerations, and the intricacies of centralised oversight.

4.1 Technological Advancement

In an era characterised by swift technological innovations, the financial services landscape is undergoing transformative changes, with central banks at the forefront of this evolution. Recognising the pivotal role of technology in shaping consumer expectations, central banks globally are keen on integrating these advancements into their operational transition strategies from physical to digital money. Esteemed institutions, from the People's Bank of China (PBOC) to the Reserve Bank of Australia (RBA) and the US Federal Reserve, are now actively exploring or implementing CBDCs, marking a significant milestone in the realm of digital finance. Several compelling drivers underscore this interest: the global shift away from cash, especially magnified during the pandemic; the rising prominence of private digital assets; the opportunity for central banks to reestablish themselves as pioneers in financial innovation; and the aspiration to exert granular control over globalised payment systems for regional stability.

Diving deeper into national trajectories, China's financial landscape, already revolutionised by platforms like Alipay and WeChat, is poised for further evolution with the anticipated rollout of the digital yuan. Japan has been increasingly warming up to mobile payments since the Tokyo 2020 Olympics, signifying this shift and hinting at the potential of a digital Yen in the future. In the U.S., the ascent of digital wallets, such as *Apple Pay* and *Android Pay*, and the broadening embrace of digital payments indicate the ripe landscape for a possible U.S. CBDC. Meanwhile, Australia, already witnessing a surge in electronic transactions and innovations like the 2018 *New Payments Platform* [23,25], is exploring the nation's commitment to financial technological progress. In sum, the convergence of technology and finance is an observable trend and a strategic imperative for central banks worldwide.

4.2 Financial Stability

The rise of digital currencies, most notably led by Bitcoin [20] and further bolstered by the recognition of stablecoins, has urged central banks worldwide to contemplate the inception of their CBDCs. This move seeks to retain their significance and ensure they remain pivotal in the international monetary spectrum. An underlying concern for central banks is the potential undermining of their monetary policy influence if decentralised cryptocurrencies gain vast acceptance, which may lead to financial instability and fraud. Despite its historical

dominance, physical paper currency is fraught with logistical challenges, primarily due to its need for physical transference between entities. CBDCs aim to eliminate such logistical burdens as they are account-based digital entities [16]. Traditional banks can sometimes be impeded from promptly furnishing funds to their clients during financial adversities. However, CBDCs, necessitating fewer secure assets, ensure the financial landscape remains robust, thus fostering stability [3]. Moreover, CBDCs, due to their inherent traceability, act as a defence against illicit financial undertakings, such as money laundering. This ensures that each transaction is scrutinised, enabling oversight bodies to discern and act upon any anomalous transactions that could threaten financial stability.

4.3 Privacy

Privacy is a paramount concern in the development of CBDC, with the central challenge being to balance individual privacy rights against the transparency mandates of anti-money laundering (AML) regulations. Privacy risks in current CBDC models can be distilled into four main categories: loss of regulatory control, loss of anonymity, loss of individual control, and loss of liberty [26]. As we delve deeper, we will examine how different countries, including China, Japan, the U.S.A., and Australia, address these privacy risks in their CBDC approaches.

In China, privacy is not considered a major concern by most citizens; instead, it is seen as a reality to be accepted. Given the centralised nature of China's economic and political systems, many of its citizens have faith in their government and are ready to prioritise the welfare of the majority over individual rights. Because of this political and cultural backdrop, Chinese citizens are likely to adapt to changes even if those entail some breaches of privacy. Fan Yifei, the Deputy Governor of the People's Bank of China, has remarked that while Central Bank Digital Currency (CBDC) transactions without third-party anonymity could jeopardise personal data and privacy, complete third-party anonymity might foster illicit activities, including tax evasion and terrorist financing [31]. A prevailing sentiment in China is that if an individual has not committed any wrongdoing, they should not be apprehensive about potential privacy intrusions or increased oversight, as they have nothing to hide. Conversely, these privacy issues are of significant concern to Western and other developed nations, placing pressure on the Chinese government to address the privacy aspects of the digital yuan on the global stage. To gain international trust, the Chinese government must vouch for the integrity of Chinese laws and assure foreigners that their privacy will be upheld within its legal framework. Achieving this will be demanding. If the Chinese government wishes to globalise the digital yuan, they must introduce more comprehensive privacy measures and demonstrate greater transparency in their policy decisions.

In Japan, the Bank of Japan is keen on striking a balance between preventing financial crimes and ensuring privacy in relation to the digital Yen. The bank has suggested incorporating advanced cryptography to ensure commercial banks cannot access information across different CBDC accounts, even if users hold multiple ones [18]. While the digital Yen is still in its developmental stages,

many local citizens might be unaware of the intricacies behind the initiative. Nevertheless, prominent Japanese firms have partnered with the Japan CBDC pilot programs, pushing forward its development. These firms are vocal about user data management concerns and calling on the government for enhanced privacy measures. Given its status as the world's third-largest economy, there is significant international interest in Japan's CBDC rollout and the data protection technologies it will adopt.

In the US, the topic of privacy with respect to CBDC is a subject of intense debate. Many Americans question their government's ability to safeguard data protection adequately. The digital nature of CBDC records every transaction, amassing vast amounts of personal, financial, and locational data. Each digital dollar spent is tied to an individual, and a significant portion of the population is uneasy about the government tracking their purchases or even believing the government should not have the authority to do so. From the government's viewpoint, it might be seen as a necessary trade-off: while the CBDC enhances digital currency's capabilities, it might also mean individuals relinquishing some control over their data, similar to what is done with artificial intelligence, robotics, and automation. Amid the tension between the US government and its citizens, there is a pressing need for a thorough discourse to address and delineate the privacy implications, configurations, and protections surrounding CBDC.

In Australia, there is growing concern regarding how central banks handle user data. Many CBDC users anticipate a degree of anonymity for their transaction details. Individuals do not need to verify their identity with physical cash, but with CBDC, the situation is the opposite. Using Distributed Ledger Technology (DLT), the Australian government can track payment histories and geographical locations. If the relevant entities mishandle this sensitive data or inadvertently disclose it, the repercussions for society could be significant. This is a primary reason many Australians are calling for a robust privacy framework before the introduction of CBDC. While the e-AUD, or Australian CBDC, may not become a dominant global currency, its development will still draw attention. International businesses with ties to Australia will be keen to observe how the Australian government addresses privacy concerns associated with CBDC.

4.4 Centralised Control

Although decentralisation is a foundational characteristic of blockchain and was a primary feature of cryptocurrency's inception, central banks are leaning toward a centralised approach with the introduction of CBDCs.

In China, the Central Bank will exercise oversight over the CBDC, ensuring it can supervise, monitor, and trace its operations to mitigate financial crimes [31]. Unlike decentralized crypto assets, CBDCs are centralized, giving greater control to central banks and making them more secure and dependable digital payments. Central banks aim to maintain controlled anonymity to swiftly address illicit or unusual transactions. The introduction of CBDCs might diminish the population's interest in crypto assets, which are viewed as less secure

by the Chinese government. This centralized approach to CBDC is intended to safeguard citizens' assets and fortify financial stability.

In Japan, a CBDC operates as electronic coins or accounts, fully backed by the government's credibility. Its ownership and denomination are tracked through a ledger that maintains a record of issuances and transactions. The Bank of Japan intends to maintain control over the CBDC, ensuring the technological viability of its three ledger designs: shared account-based, centralized token-based, and centralized account-based[3]. With its pilot program launched in April 2023, Japan aims for mainstream adoption of the digital currency to benefit local businesses by optimizing their payment systems. This centralized digital currency, endorsed by the Bank of Japan, fosters confidence among local enterprises and attracts international companies to support the digital Yen.

In the US, the allure of issuing a centralized digital currency to regain control over its decentralized financial system is significant. Many cryptocurrencies launched in the US lack robust financial backing, and some have misled countless investors with false promises. Unfortunately, current regulations offer limited oversight over these crypto assets and their issuers, leaving many investors vulnerable. Given the lack of transparency from some unregulated digital asset platforms, it becomes imperative for the US government to introduce its centralized digital currency, the CBDC, to safeguard its citizens' digital assets and exert more control over the digital financial landscape.

In Australia, the rollout of the CBDC is still pending due to challenges identified during the research phase. The private sector views the CBDC as not a replacement for digital payments but an adjunct[4]. While both the Australian government and the RBA recognise the benefits of introducing a CBDC, securing consensus within the nation's decentralised governance and financial systems is challenging. Centralised oversight of the CBDC could enable the RBA to better analyse interest rates, as digital currency backed by Distributed Ledger Technology (DLT) offers valuable transaction data, potentially leading to more accurate financial reporting than the current system allows. However, the formal acceptance of the CBDC in Australia might be a few years away, necessitating greater media emphasis on its significance.

5 Conclusion

This paper explores the models and implications of central bank digital currency (CBDC) in four countries: China, Japan, the U.S., and Australia. It analyses the different design choices, governance structures, and technological challenges of CBDC development in each country. It also compares the progress and impact of CBDC on financial stability, privacy, and centrality in control. The paper finds that CBDCs have the potential to revolutionise digital payment systems and enhance the efficiency and security of transactions but also pose significant risks

[3] https://www.lexology.com/library/detail.aspx?g=43ebd953-5327-4edc-9940-e193f7a6b04e.

[4] https://www.rba.gov.au/media-releases/2023/mr-23-21.html.

and trade-offs that need to be carefully addressed. The paper provides some recommendations for CBDC development and adoption, such as establishing comprehensive regulations, educating the public, and ensuring interoperability. The paper acknowledges the limitations of its scope and methodology and suggests further research on the legal, social, and economic aspects of CBDCs.

References

1. Alisha, C.: Snapshot: which countries have made the most progress on CBDCS so far in 2023. Econographics, Atlantic Councill (2019)
2. Amamiya, M.: Should the bank of japan issue a digital currency. In: Speech at a Reuters Newsmaker Event in Tokyo, Speech, Tokyo (5 July 2019)
3. Andolfatto, D.: Assessing the impact of central bank digital currency on private banks. Federal Reserve Bank of ST. Tech. Rep., Louis Working Paper 2018–026C (2018)
4. Auer, R., Böhme, R.: CBDC architectures, the financial system, and the central bank of the future. VoxEU. org-CEPR's Policy Portal (2020)
5. Bank, D.: Digital yuan: what is it and how does it work? (2021). https://www.db.com/news/detail/20210714-digital-yuan-what-is-it-and-how-does-it-work
6. Bindseil, U.: Tiered CBDC and the financial system. Available at SSRN 3513422 (2020)
7. Brad, J.: The economics of a central bank digital currency in Australia (2022). https://www.rba.gov.au/speeches/2022/sp-ag-2022-12-08.html
8. Carney, M.: The future of money. In: Scottish Economics Conference. Edinburgh University, Edinburgh (2018)
9. Cheng, P.: Decoding the rise of central bank digital currency in china: designs, problems, and prospects. J. Bank. Regul. **24**(2), 156–170 (2023)
10. Davoodalhosseini, M., Rivadeneyra, F., Zhu, Y.: CBDC and monetary policy. Tech. rep, Bank of Canada (2020)
11. Duffie, D.: Digital currencies and fast payment systems: disruption is coming. In: Asian Monetary Forum, May, Mimeo (2019)
12. Government, F.R.: Federal reserve chair jerome h. powell outlines the federal reserve's response to technological advances driving rapid change in the global payments landscape (2021). https://www.federalreserve.gov/newsevents/pressreleases/other20210520b.htm
13. Kenji, H., Hiroyuki, T., C.M.T.Y: Summary of the report of the study group on legal issues regarding central bank digital currency (2019). https://www.boj.or.jp/en/research/wps_rev/lab/lab19e03.htm
14. Jagtiani, J., Papaioannou, M., Tsetsekos, G., Dolson, E., Milo, D.: Cryptocurrencies: regulatory perspectives and implications for investors. In: The Palgrave Handbook of Technological Finance, pp. 161–186 (2021)
15. Jim, P.: White house considers creating a digital dollar (investopedia) (2022). https://www.investopedia.com/inside-the-new-white-house-framework-for-regulating-digital-assets-6674517
16. Kim, Y.S., Kwon, O.: Central bank digital currency and financial stability. Bank of Korea WP 6 (2019)
17. Kosse, A., Mattei, I.: Making headway-results of the 2022 BIS survey on central bank digital currencies and crypto. BIS Papers (2023)

18. Kshetri, N., Loukoianova, E.: Data privacy considerations for central bank digital currencies in asia-pacific countries. Computer **55**(03), 95–100 (2022)
19. Kumhof, M., Noone, C.: Central bank digital currencies-design principles and balance sheet implications (2018)
20. Nakamoto, S.: Bitcoin: a peer-to-peer electronic cash system. Decentralized Business Review (2008)
21. Náñez Alonso, S.L., Jorge-Vazquez, J., Reier Forradellas, R.F.: Central banks digital currency: detection of optimal countries for the implementation of a CBDC and the implication for payment industry open innovation. J. Open Innov. Technol. Market Complex. **7**(1) (2021). https://www.mdpi.com/2199-8531/7/1/72
22. Niepelt, D.: Monetary policy with reserves and CBDC: optimality, equivalence, and politics (2020)
23. NPP: NPP roadmap October 2022 (2022). https://tinyurl.com/2p9pn2y8. Accessed 30 July 2023
24. Ozili, P.K.: CBDC, fintech and cryptocurrency for financial inclusion and financial stability. In: Digital Policy, Regulation and Governance (ahead-of-print) (2022)
25. RBA. Strategic review of innovation in the payments system: conclusions (2012). https://www.rba.gov.au/payments-and-infrastructure/payments-system-regulation/past-regulatory-reviews/strategic-review-of-innovation-in-the-payments-system/. Accessed 02 July 2023
26. Rennie, E., Steele, S.: Privacy and emergency payments in a pandemic: how to think about privacy and a central bank digital currency. Law Technol. Hum. **3**(1), 6–17 (2021)
27. ReserveBankofAustralia. Research project exploring use cases for CBDC (2023). https://www.rba.gov.au/media-releases/2023/mr-23-06.html
28. Wang, H.: China's approach to central bank digital currency: selectively reshaping international financial order? Univ. Pennsylvania Asian Law Rev. **18**(1), 77 (2022)
29. Ward, O., Rochemont, S.: Understanding central bank digital currencies (CBDC). In: Institute and Faculty of Actuaries, pp. 1–52 (2019)
30. Xu, J.: Developments and implications of central bank digital currency: the case of china e-CNY. Asian Econ. Policy Rev. **17**(2), 235–250 (2022)
31. Yifei, F.: Some thoughts on CBDC operations in china. centralbanking.com. (1 April 2020)