

Sarmiento, Adolfo

Article

Seven lessons from the e-Peso pilot plan: The possibility of a Central Bank digital currency

Latin American Journal of Central Banking (LAJCB)

Provided in Cooperation with:

Center for Latin American Monetary Studies, Mexico City

Suggested Citation: Sarmiento, Adolfo (2022) : Seven lessons from the e-Peso pilot plan: The possibility of a Central Bank digital currency, Latin American Journal of Central Banking (LAJCB), ISSN 2666-1438, Elsevier, Amsterdam, Vol. 3, Iss. 2, pp. 1-7, <https://doi.org/10.1016/j.latcb.2022.100062>

This Version is available at:

<https://hdl.handle.net/10419/336348>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



<https://creativecommons.org/licenses/by-nc-nd/4.0/>

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Latin American Journal of Central Banking

journal homepage: www.elsevier.com/locate/latchb

Seven lessons from the e-Peso pilot plan: The possibility of a Central Bank Digital Currency [☆]



Adolfo Sarmiento

Central Bank of Uruguay, Banco Central del Uruguay, Diag Fabini 777, Montevideo 11100, Uruguay

ARTICLE INFO

JEL classifications:

E42
E58
G21

Keywords:

Central bank digital currency
CBDC
Central banking
Digital currency
Digital money
Payment systems

ABSTRACT

The decision to introduce a central bank digital currency (CBDC) is part of the new challenges that central banks are facing as technology keeps moving. The e-Peso pilot plan, implemented between 2017 and 2018, could provide some key findings for central banks. In this sense, we can learn seven lessons from the e-Peso pilot plan: (i) reputation is key for central banks' decision to introduce a CBDC; (ii) financial inclusion and cultural reasons are the main motivations; (iii) the technological solution as simple as possible; (iv) security aspects and traceable transfers are central for operational risk problems; (v) a token was a good solution for CBDC implementation; (vi) digital money was used for small payments and transfers; and (vii) CBDCs complement the existing means of payment. The conclusions highlight that CBDC choices are based not only on technical considerations but also on the cultural implications money use. The adoption of this new means of payment will be incremental but not reversible.

1. Introduction

New technologies are causing central banks challenges regarding means of payment developments and financial inclusion strategies. Nevertheless, new technologies are part of the instruments that central banks design to implement their policies, for example, blockchain technology to implement and share information with credit bureaus and big data to analyze price tendencies or digital assets as money.

There are many aspects to discuss regarding the introduction of Central Bank Digital Currency (CBDC), starting with the legal power, the technology available, and the added value to the existing means of payments. The answers to these questions vary by country, and depend on the development level of the economy, the depth of the financial system and even on cultural aspects.

The focus in this paper will be different from the previous consideration. From the perspective of a central bank, there is a mandate to issue money to the economy in order to fulfill the economic activity. Technology is one of the variables that can improve the effectiveness of this mandate. In the long story of paper money, new technologies have helped to improve use and security, so this is a new step that can complement physical banknotes.

Even though this focus is less disruptive than the ongoing research about CBDC, the main object is not to underline the supremacy of new technology, over the previous ways of issuing money. On the contrary, the focus is to understand in which sense this instrument can help central banks with the service they give to the population and to deal with the changes that new technologies impose on the payment system.

[☆] All the views expressed in this paper are the author's sole responsibility and do not represent the opinions of the institutions for which he works or is affiliated. For comments and fruitful discussion, I thank Jon Frost, Raphael Auer, Giulio Cornelli and Tara Rice from the Bank for International Settlements; John Kiff from the International Monetary Fund; Francisco Rivadeneyra from the Bank of Canada.

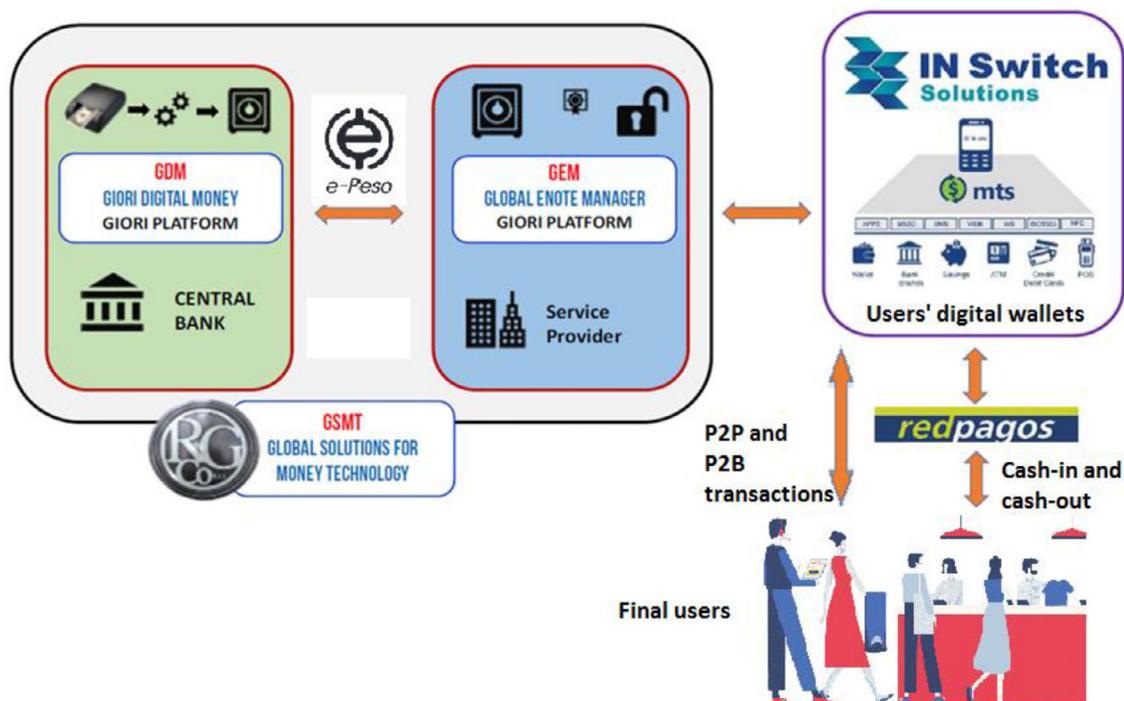
E-mail address: adolfos@bcu.gub.uy

<https://doi.org/10.1016/j.latchb.2022.100062>

Received 7 July 2021; Received in revised form 19 October 2021; Accepted 18 May 2022

Available online 5 June 2022

2666-1438/© 2022 The Author(s). Published by Elsevier B.V. on behalf of Center for Latin American Monetary Studies. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)



Graphic 1. Scheme of e-Peso pilot. Source: Central Bank of Uruguay.

Morales-Reséndiz et al. (2021) share how CBDC research is a relevant issue for financial innovation and for central banking. As part of a learning process, pilot plans play a role in proving and understanding the risks, as well as the lessons learned to deal with such risks. Particularly, reputational risk and cybersecurity risk are two of the major challenges when designing the CBDC. Furthermore, lessons about CBDC's technological options and financial consequences are relevant to how this new payment instrument will impact the payment ecosystem.

The lessons learned from the e-Peso pilot plan address the following objectives. Reputation is the key for central banks' decisions regarding CBDC. Financial inclusion and cultural reasons have to be included in the CBDC design process. In the era of technological irruptions, CBDC must keep the technological solution as simple as possible. Cybersecurity aspects and traceable transfers are central for operational risk problems, in the e-Peso pilot plan a token was a good solution for CBDC implementation, and digital money was used for small payments and transfers as a complement to existing means of payment. The conclusions highlight that CBDC choices are based not only on technical considerations but also on the cultural implications of using money.

In this sense, this paper constitutes a cartography of the aspects that central banks consider in the configuration of a digital currency pilot plan. The first part presents a short description of the e-Peso pilot plan; the second part includes the lessons learned from this plan; and the third part provides some conclusions and challenges for next steps.

2. A description of the e-Peso pilot plan

In November 2017, the Central Bank of Uruguay (CBU) began a pilot plan to test an e-Peso. The initial analysis inside the CBU focused on three aspects. (1) Legal framework: The CBU legal power was sufficient for issuing electronic bills as a complement of paper bills. (2) Security: Cyber and information risks have been reasonably mitigated, and other risks (e.g. financial and reputation) have been reasonably hedged. (3) Technology: The system's components (e.g., e-Peso production, digital vault, digital wallets, transactional system, infrastructures, etc.) and business continuity were successfully tested.

The pilot lasted six months, and after April 2018, the digital currency was destroyed. The total issuance was limited to 20 million Uruguayan pesos (670,000 US dollars). The pilot was token-based; cell phones from ANTEL, a public communications company, were available but limited to 10,000 mobile phone users. The e-wallets were also limited to 30,000 Uruguayan pesos (1,000 US dollars) for each user and 200,000 Uruguayan pesos for each registered business. The e-Peso could be used for payments in registered stores and for peer-to-peer transfers among registered users (see Graphic 1).

The pilot was developed in three stages. In the first stage, beginning with industry consultation and public communication, the CBU issued 20 million Uruguayan pesos digitally (e-Peso), which were transferred to a virtual vault and then transferred to the first 7 million e-Pesos to redpagos. In the second stage beginning November 2017 for 6 months, voluntary participants with ANTEL mobile phones installed the e-Peso app (digital wallet) and do the cash-in through redpagos (incentives to the first 1000). There were random, monthly, monetary incentives for active users, and making transactions with e-Pesos was allowed until April 2018. In the third stage,

a cash-out process through redpagos occurred, which allowed the e-Pesos to be returned to the CBU for destruction and evaluation of the pilot, and decisions on future steps.

The main characteristics for the pilot design were as follow. All the operations had instant settlements, and did not require internet connection (just a mobile phone line). The operations were anonymous but traceable with the users' wallets (developed by IN Switch) and encrypted Global E-note Manager (GEM developed by Giori Company).

The e-Pesos were secured at GEM even if users lost their phones or digital wallet password. The unique, traceable bills prevent double-spending and falsification. The digital bills fungibility is difficult, but GEM may change automatically.

The platform acted as a registry of the banknotes' ownership. Each mobile phone contained a digital wallet in each mobile phone to complete transactions, negating the need for a wi-fi connection.

After the destruction of all the digital currency, there was an evaluation phase. There is still no decision about a second pilot through banks and other financial institutions.

[Morales-Reséndiz et al. \(2021\)](#) describing an e-Peso pilot plan, comparing it to other CBDC retail projects.

From a payment ecosystem perspective, future e-Peso pilots imply a strong impulse to consolidate electronic means of payments; from the moment the CBDC is part of every e-wallet, it becomes a universal validation of the whole ecosystem.

3. Seven lessons from the e-Peso pilot plan

3.1. Reputation: the stem of the money flower

The money flower Venn diagram presented by [Bech et al. \(2017\)](#) and [Barontini et al. \(2019\)](#) introduced a taxonomy of money following four properties: issuer, form, accessibility, and technology. This diagram is useful when reconsidering the previous situation of a possible CBDC, for which the 'issuer' petal was absent. Cash was not in the flower's three petals, cash was in the flower's stem with central banks issuing money to feed the flower. From this perspective it is important to analyze the motivations of some central banks to consider issuing digital currency. This is a new petal or a new way to feed the flower.

The main motivations for a general purpose digital currency to complement cash include a stronger framework for the payment system, accessibility, competitiveness, and efficiency. Digital currency would also improve financial inclusion and reduce the operational costs of cash ([Alvez et al., 2018](#)).

The strength of the payment infrastructure is exposed to the fragilities of security and access. In a world where technology increases the scope of the means of payment, aspects such as the user's corporate governance, become crucial to assure that this means completely fulfills its functions. This corporate governance dimension is a key challenge for central banks that have the final role of issuing money for the entire population, preserving the strength of payments. The other side of this challenge is the interest of central banks in reducing risks associated with physical currency management, as well as AML/CFT risks. Regarding the money flower scheme, KYC controls are part of the elements to feed the stem. This element is crucial for understanding other design decisions because this aspect is central to reputation.

Reputational risk is part of the key discussion on central banks' corporate governance. The decision to introduce a CBDC pilot plan, beyond the existing uncertainties about the development of technology and cyber risk, will be based on central banks' reputation and their power to preserve society's confidence in (digital) means of payment. Thus, when considering CBDC, central banks are determining whether it will improve or worsen their reputations and confidence in money. This reputation will be the flower's stem and will facilitate the new petal's growth.

3.2. Motivation: from financial inclusion to cultural dimensions

In the international experience, CBDC motivations differ, but financial inclusion and cultural factors are often key. When financial inclusion policies were introduced in many countries with underdeveloped financial systems, CBDC was not an option to improve limited inclusion, see [Arauz et al. \(2021\)](#) on Ecuador's CBDC case. The promotion of electronic payments, automated teller machines (ATM), and points-of-sale (POS) terminals increased in Uruguay after Congress passed the 2014 Financial Inclusion Law. The consideration of a digital currency issued by the central bank was first seen as competition with private electronic means of payments. This was part of the motivation to research the use of cash. The use of cash for small payments is the rule, and limiting CBDC to small amounts for each user is the strategy to fulfill cash use without harming other instruments. The results shows this issue was completely fulfilled by the e-peso pilot plan, mainly small payments were issued during the six months, and peer-to-peer payments were released¹.

The Swedish Riksbank's aim in researching the e-Krona is almost the same. Financial inclusion is not a big problem for Sweden, but the decline in the use of cash is a motivation to issue a digital currency. The elderly and other vulnerable groups who may have access only to cash may need an electronic means of payment issued by the Riksbank ([Armeliuss et al., 2018](#); [Sveriges Riksbank 2018](#)).

One way or another, even when digital currency is considered a substitute to cash; it may also be considered a complement to cash. The use of cash is still there, not only for financial inclusion purposes but also for cultural reasons. The elderly and those with little financial education see some added value in cash, so the change in use will be slow and must meet various prerequisites: it must be simple, accessible, and trustworthy. Moreover, this change may be part of a financial education program for all stakeholders that explains how the central bank can complete money options for the whole society and how all can benefit.

¹ See [Graph 2](#) in Lesson 6 about the use of money to illuminate this aspect.

3.3. Technology: the simpler the better

The importance of distributed ledger technology (DLT) has grown because of cryptocurrencies and other financial instruments, so it was natural to see it as a way of implementing CBDC. Furthermore, in early discussions of digital currencies, there was a general confusion with blockchain technology and the e-Peso pilot plan.

Technology has changed faster than expected, and application of DLT to many problems of information sharing has been a cornerstone for new solutions to old problems. However, this was not the way the e-Peso pilot plan chose to manage the electronic platform to issue money. The platform function is a register of the ownership of the digital banknotes linked to a telephone number without DLT. Instant settlement does not require an internet connection (just a mobile phone line). The platform was anonymous but traceable; users had digital wallets; and security was designed for those who lost their phones or digital wallet password. The bills were unique and traceable to prevent double-spending and falsification.

The design was established to have the simplest solution to manage the digital currency. DLT was not needed at this stage of the pilot, and a token-based system was elected over an account-based form to take advantage of the extended use of mobile phones in Uruguay. The results were positive without any technical incident. Even if in the next stages of a pilot bank could be included, the technological solution must stay as simple as possible because the operation of the system and the cyber risk concerns must be controlled. The e-Peso pilot results show that no connections or transmission of operations problems were reported, thus the network supported the pilot well.

3.4. Operational risk: 'printing money' and Big Brother

CBDC can be seen as a digital version of printing physical cash. Each e-Peso digital note includes an identification (ID) serial number so that the digital notes could be traced back to a specific user, and each time an operation is completed, the digital notes can be spread in smaller denomination notes with their own ID serial numbers. This process has two important implications; (i) each digital note includes security aspects, and (ii) the use of each note can be traced from one wallet to another. This identification and monitoring model is one important way to mitigate operational risk from double-spending and falsification.

A CBDC pilot plan implies designing a clear and controlled life cycle for digital currency. The whole process of cash in, circulation, and cash out and the permanent control over the amount of currency circulating are crucial from the operational point of view. The e-Peso pilot outsourced this process with clear responsibilities and permanent control over each step. Identifying the requirements in the CBDC circulation process was central to the success of the pilot. All the system's components were tested: e-Peso production, digital vaults, digital wallets, transactional system, infrastructures, and business continuity. The cash-in process was faster than expected, but the cash out took more than two months after the pilot ended and all the digital currency was finally destroyed.

There are still questions about the privacy of ownership and information of transactions. The legitimation process satisfied all the preferences for privacy. Even though the system has all the information, the third-party anonymity hides identities from all transaction participants. Nevertheless, it is sensitive to who manages all this information and how the legal system works around it. As with the Big Brother in George Orwell's dystopian novel 1984, wherein the leader of Oceania was watching everything, this new power has pros and cons for the use of money and challenges the legal framework.

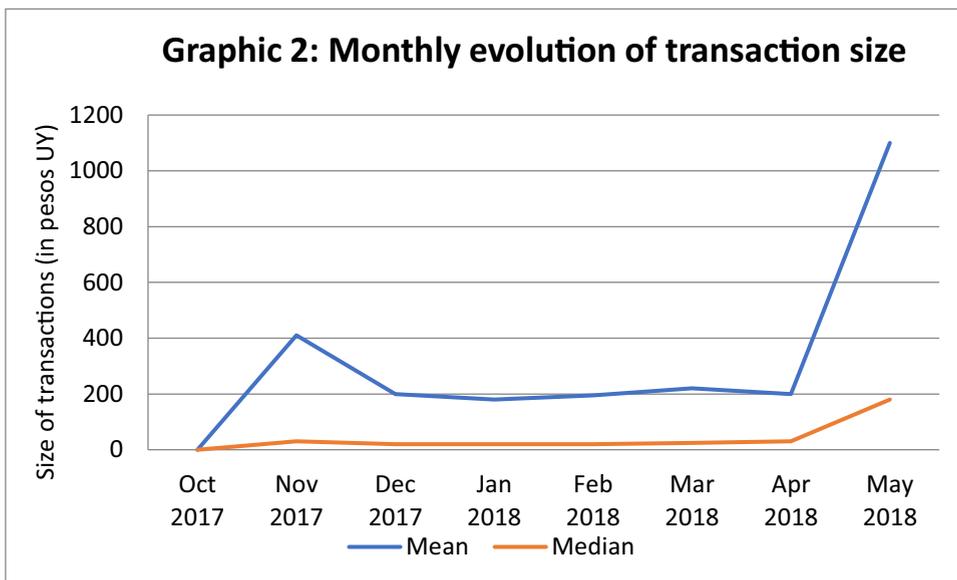
3.5. Tokens as a solution

The design decision of a token-based CBDC that involves the transfer of a token directly between wallets has worked properly in many ways². The verification process to test a genuine token, ensuring that the e-Peso was not duplicated, was proven successfully. The mobile wallet app had no failed operations, and in all cases, the users could make payments without delay or inconvenience. This design was interesting for those parts of the population with limited access to bank accounts, and was used for small payments mostly related to everyday needs.

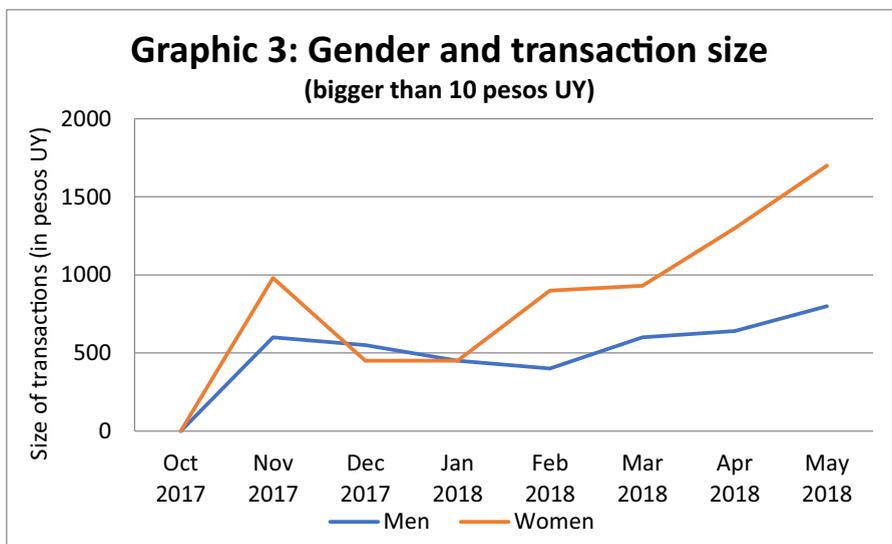
All the evidence of the e-Peso pilot plan shows that the mobile phone was a helpful instrument to implement a token-based CBDC without other intermediaries involved in the implementation, and it appears to be an easy way to interact with CBDC. Even if a hybrid system is considered, in further steps the token will be a necessary condition of the design to assure universal implementation.

Interoperability was an important issue in the design process, as a modular approach to introduce the rest of the agents of the payment ecosystem is a necessary part of this solution. Even though the banking system was not part of the pilot, it followed the plan's development, and from the banking system's perspective, the interaction of the e-Peso with other electronic means of payments

² In the IMF taxonomy, the e-Peso pilot plan may be considered as account based instead of token based. Following Charles Kahn, one of the inventors of the taxonomy has wondered whether the taxonomy is useful for digital currency: "This dichotomy necessarily represents something of an idealization, and there are some important types of systems (e.g., debit cards) that arguably do not fall so neatly into either of these camps." (Kahn, C. et al., 2009). There are technological (DLT versus centralization) and legal considerations (ownerships) to characterize the digital currency denomination, some recent studies highlight this point: "Research on CBDC often draws a fundamental distinction between account-based and token-based architecture. At the end-user, functional level, the distinction is not as clear. Furthermore, there is no universally accepted definition of a token. It may therefore be preferable to avoid framing the scope of a CBDC in terms of notions of accounts and tokens. To maximize flexibility, any policy or legislative definitions should be technology-neutral (e.g., by using terms like "value in electronic form")." (Shah, D. et al., 2020). The Bank of Canada continues to look for what it calls a "universal access device". (Miedema, J. et al., 2020).



Graphic 2. Monthly evolution of transaction size.



Graphic 3. Gender and transaction size (bigger than 10 pesos UY).

is perfectly achievable. The inclusion of the e-Peso in many other e-wallets that some banks already offer is a way to interact with the CBDC.

3.6. The use of money: small payments and transfers

One important result of the e-Peso pilot plan was to consider the way that digital currency is used. Some results are shown in [Graphics 2 and 3](#):

[Graphic 2](#) shows the size of transactions, showing that most were for small payments and transfers. Transfers between peers with e-Pesos were very common during the pilot period. The quantity of operations rose with the learning process of users. Transfers between peers with e-Pesos were very common during the implementation period.

Another issue is the cultural use of money. Nearly all the participants used the e-Peso in the same way, which was not surprising because the voluntary participants were familiar with electronic means of payments.

With respect of the gender approach, [Graphic 3](#) shows that women and men used the e-Peso in the pilot. Women made transactions as they became familiar with the e-Peso. At the end of the pilot plan, women's transactions were twice as large, considering the

payments that were allowed by the pilot that may be caused by household transactions. In the case of peer to peer payments, there was a small difference between men and women.

All of this information is evidence of the CBDC's use, as a valid instrument for small payments, which represents use of cash not only in countries with low financial inclusion but also in those with developed financial systems that seek a universalization of electronic means of payment. If the CBDC is accessible and simple, it could be used by everyone; but if not, it could only be used for special payments and sophisticated users. Arauz et al. (2021) mentioned "electronic soup" as the only thing they could buy with CBDC in Ecuador as a reason for a failed experience.

As the CBDC is a valid instrument, how it is introduced in the payment ecosystem and how it affects the existing means of payments are important, which is considered in the final lesson.

3.7. Complement versus competition

Finally, CBDC pilot plans have raised several warnings about competition within the banking sector. The first issue to discuss is if CBDC competes with bank deposits and the importance of higher deposit rates to remain competitive. Furthermore, CBDC can compete with payment service providers, thus questioning disintermediation.

Although it would take some time for CBDC to be widely used, one very important issue in the e-Peso pilot plan was to impose a limit on the amount of e-money in the e-wallet. That was consistent with the international discussion (see, e.g., Bindseil, 2020 and Kumhof and Noone, 2018). The main use of e-Pesos is the same as cash, to make small payments and not to compete with other means of payments or, at least, not to compete in a different way than cash does.

From another point of view, CBDC is encouraging potential new services and can improve the efficiency of the means of payments.

4. Conclusions

CBDC is a challenge for central banks and policy makers (Bank for International Settlements (BIS), 2018; Adrian and Mancini-Griffoli, 2019; Carstens, 2019; International Telecommunication Union (ITU) 2019). Implementing pilot plans and research are ways to learn about CBDC's possibilities and to explore the potential use, giving new chances to the population in everyday life. To design (Agur et al., 2019), implement, and share lessons from CBDC pilots seems the right direction for a global answer to this challenge.

Reputational risk and cybersecurity risks are two of the major aspects that central bank are facing to design a CBDC. All the ongoing pilot plans allow central banks to test different solutions, but they open new questions about how the whole payment system will implement the new financial instrument.

The e-Peso pilot plan was disruptive not only for the simplicity of its design but also for showing that tokens and centralized computational solutions can be part of the final CBDC decision.

In terms of process, this can only be seen as a first step in a global approach that aims to reduce the risks from a cost-efficiency point of view. Other central banks are taking different design decisions: DLT solutions, account-based CBDCs, and differential interest rates rather than hard limits, among others. The research by central banks will enrich the experience, and lessons learned from each process will give more information for better decisions.

Future steps in the research arena will involve the role of private sector intermediaries in the process, especially banks. Possible private sector participation in CBDC architecture is analyzed in "CBDC Pyramid" (Auer and Böhme, 2020; Auer et al, 2020b).

Finally, a central bank's CBDC choice should be based not only on technical considerations but also in cultural dimensions of the use of money. This implies a holistic assessment of the payment environment and a clear understanding of the cultural implications of a change that will be incremental but not reversible. This implies that research on CBDC must not only concern technical issues but also idiosyncratic aspects: economy organization, historical aspects, and even social implications of money are part of the many faces of a CBDC project.

The COVID-19 pandemic has represented a new challenge for the use of money and for physical contact, and this situation may accelerate the issuance of a CBDC. Bank for International Settlements Bulletin 3 (Auer et al, 2020a) downplayed the importance of COVID-19 transmission through cash but highlighted the acceleration in the shift toward digital payments, including CBDCs. The search for contactless means of payment will be part of the agenda of any central bank involved in a safer and more accessible payment system.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

- Adrian, T., and T. Mancini-Griffoli. 2019. "The Rise of Digital Money," IMF Fintech Note 19/01.
- Agur, I., Ari, A., Dell'Ariccia, G., 2019. Central Bank Digital Currencies: Design Tradeoffs and Implications." IMF Working Paper WP/19/252. International Monetary Fund, Washington, DC.
- Alvez, M., R. Lluberas and J. Ponce. 2018. "The Cost of Using Cash and Checks in Uruguay," Unpublished mimeo.
- Arauz, A., Garratt, R., Ramos, D.F., 2021. Dinero Electrónico: The rise and fall of Ecuador's central bank digital currency. Latin Am. J. Central Banking 2 (2), 2021.
- Armelius, H., Boel, P., Clausen, C.A., Nessén, M., 2018. The e-Krona and the Macroeconomy. Sveriges Riksbank Economic Review Third Quarter.
- Auer, R., Böhme, R, 2020. The technology of retail central bank digital currency. BIS Quarterly Review (March) 85–100.

- Auer, R., Cornelli, G., Frost, J., 2020a. Covid-19, cash, and the future of payments. Bulletin 3, Bank for International Settlements.
- Auer, R., Cornelli, G., Frost, J., 2020b. Rise of the central bank digital currencies: drivers, approaches and technologies. BIS Working Papers No 880. Monetary and Economic Department. Bank for International Settlements.
- Bank for International Settlements (BIS), 2018. Central Bank Digital Currencies," Committee on Payments and Market Infrastructures. Bank for International Settlements, Basel.
- Barontini, C., Holden, H., 2019. Proceeding with caution – a survey on central bank digital currency. BIS Papers No 101. Monetary and Economic Department, Bank for International Settlements.
- Bech, M. and R. Garratt. 2017. Central bank cryptocurrencies. BIS Quarterly Review, Bank of International Settlements. September 17.
- Bindsedil, U. 2020. Tiered CBDC and the financial system. European Central Bank. Working Paper 2351.
- Carstens, A. 2019. "The future of money and payments." Speech at the Central Bank of Ireland. March 22.
- International Telecommunication Union (ITU). 2019. "Method for Achieving the Required Security Assurance Level for Protecting Digital Currency including Digital Fiat Currency with High Confidence," ITU Digital Fiat Currency Focus Group Security Working Group Deliverable, June. (<https://www.itu.int/en/ITU-T/focusgroups/dfc/Pages/default.aspx>).
- Kahn, C.M., Roberds, W., 2009. Why Pay? An introduction to payments economics. J. Financial Intermed. 18 (1).
- Kumhof, M. and C. Noone. 2018. Central Bank Digital Currencies: Design principles and balance sheet implications. Staff Working Paper 275. Bank of England.
- Miedema J., C. Minwalla, M. Warren, D. Shah. 2020. "Designing a CBDC for universal access". Staff Analytical Note 2020-10, June 2020
- Morales-Resendiz, R., Ponce, J., Picardo, P., Velasco, A., Chen, B., Sanz, L., Guiborg, G., Segendorff, B., Vasquez, J.L., Arroyo, J., Aguirre, I., Haynes, N., Panton, N., Griffiths, M., Pieterz, C., Hodge, A., 2021. Implementing a retail CBDC: Lessons learned and key insights. Latin Am. J. Central Banking 1 (2).
- Shah, D., R. Arora, H. Du, S. Darbha, J. Miedema, and C. Minwalla. 2020. "Technology Approach for a CBDC," Bank of Canada Staff Analytical Note 2020-6.
- Sveriges Riksbank. 2018. The Riksbank E-Krona Project: Report 2.