

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

Adolfo Sarmiento¹

March, 2022

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 the actual and future answers to 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) keep 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 not only based on technical considerations but also on cultural implications of the use of money. The adoption of this new means of payment will be incremental but not reversible.

Keywords: central bank digital currency, CBDC, central banking, digital currency, digital money, payment systems

JEL classifications: E42, E58, G21

¹ All the views expressed in this paper are the sole responsibility of the author and do not represent the opinion of the institutions he works for or is affiliated to. For comments and fruitful discussion, I thank Jon Frost, Raphael Auer, Giulio Cornelli and Tara Rice from the Bank for International Settlements (BIS), John Kiff from the International Monetary Fund, Francisco Rivadeneyra from the Bank of Canada.

Introduction

New technologies are giving to central banks some new challenges about means of payments developments and financial inclusion strategies. Nevertheless, new technologies are part of the instruments that central banks design to implement their policies: some examples are blockchain technology to implement and share credit bureau, big data to analyze price tendencies or digital assets as money.

In the decision to introduce a Central Bank Digital Currency (CBDC) there are many aspects to discuss: starting with the legal power, the technology available and the added value to the existing means of payments, these are the first issues to consider. The answers to these questions change from country to country, and depend on the level of development of the economy, the depth of financial system and even on cultural aspects.

In this paper the focus 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 to complete the service they give to the population and at the same time to deal with the changes that new technologies impose on the payment system.

Morales-Reséndiz et. al. (2021) share experiences about CBDC research as a relevant issue for financial innovation and for central banking: as part of a learning process pilot plans play a role to prove and understand the risk that they are facing and the lessons learned to deal with risks. Particularly, reputational risk and cybersecurity risks are two of the major challenges in the CBDC designing approach. Also lessons about technological options and financial consequences of CBDC are relevant to go forward on how this new payment instrument affects the payment ecosystem.

The lessons learned from the e-Peso pilot plan address this objectives: reputation is key for central banks' decision on CBDC, financial inclusion and cultural reasons have to be included in the CBDC designing 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 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 not only based on technical considerations but also on cultural implications of the use of 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. For this propose the first part presents a

short description of the e-Peso pilot plan, the second part includes the lessons learned from this plan and finally the third part gives some conclusions and challenges for next steps.

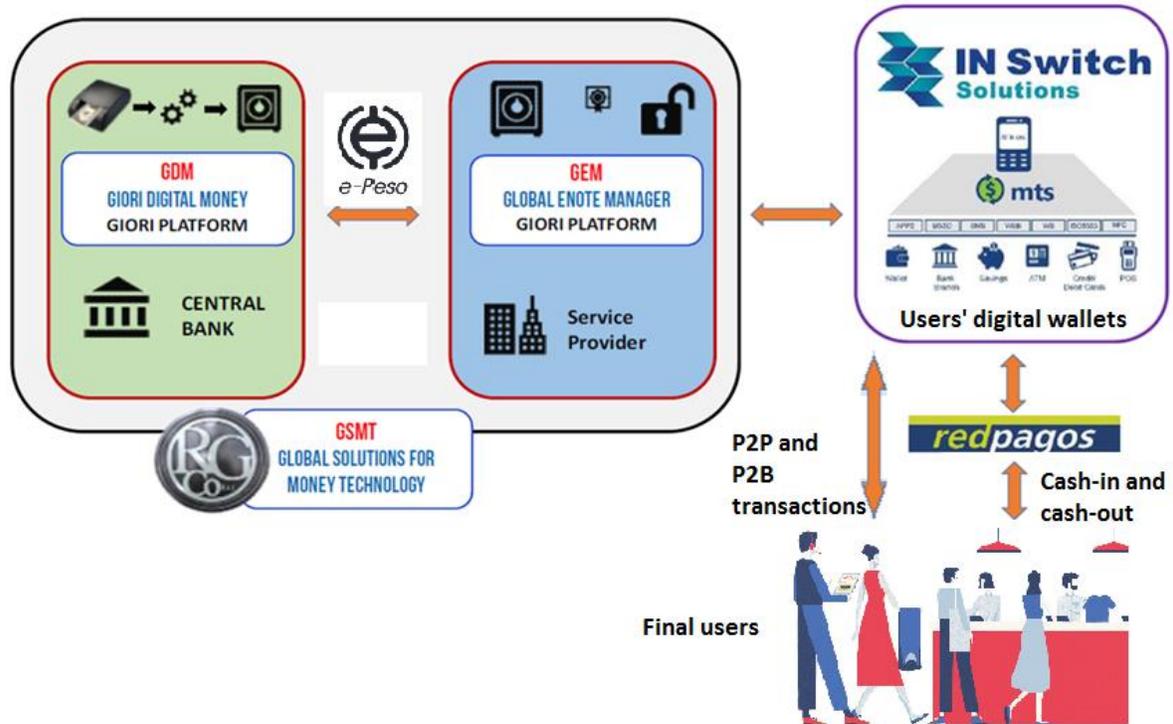
I. A description of the e-Peso pilot plan

In November 2017 the Central Bank of Uruguay (CBU) began a pilot plan to test an e-Peso. The initial analysis inside the CBU focuses on three aspects: 1) Legal framework: The CBU legal power was sufficient for the 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: Successful testing of the system's component (e-Peso production, digital vault, digital wallets, transactional system, infrastructures, etc.) and business continuity.

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 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: 1st stage: Starting with industry consultation and public communication, the CBU issued \$20,000,000 Uruguayan pesos in digital (e-Peso), transferring to virtual vault and then transferring to *RedPagos* first \$7,000,000 e-Pesos. 2nd stage: Starts November 2017 for 6 months, voluntary participants with ANTEL mobile phones install 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. 3rd stage: Cash-out process through *RedPagos*, then returning of e-Pesos to the CBU for destruction and evaluation of the Pilot and decision on future steps.

Graphic 1: Scheme of e-Peso pilot



Source: Central Bank of Uruguay

The main characteristics for the pilot design were: All the operations have instant settlement, and do 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 are secured at GEM even if users lose their phones or password of digital wallet. The unique, traceable bills prevent double-spending and falsification. The digital bills difficult complete fungibility but GEM may change automatically.

The platform acted as a registry of the banknotes' ownership, and there was a digital wallet in each mobile phone to do transactions, so it didn't need 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 including the banks and other financial institutions.

Also in Morales-Reséndiz et. al. (2021) there is a description of e-Peso pilot plan and a comparison to others CBDC retail projects.

A final comment on the description aspects is the interaction with other means of payments. From a payment ecosystem perspective future e-Peso pilots implies a strong impulse to consolidate electronic means of payments, from the moment that the CBDC could be part of every e-wallet it becomes a universal validation of the whole ecosystem.

II. Seven lessons from the e-Peso pilot plan

1. Reputation: the stem of the money flower

The money flower Venn diagram presented in Bech et al (2017) and Barontini et al (2019) introduces a taxonomy of money following four properties: issuer, form, accessibility and technology. This diagram is very useful to rethink the previous situation to CBDC possibility, which is when the ‘issuer’ petal was absent. Cash was out of that flower of three petals, cash was in the stem of the flower with central banks issuing money to feed the flower. From this perspective it is important to analyze the motivations that have some central banks to considering issuing digital currency. This is a new petal or a new way to feed the flower.

The main motivations for general purpose digital currency that would be a complement to cash are to create a stronger framework for the payment system, accessible, competitive and efficient. It also improves financial inclusion and reduces the operational costs of cash.

The strength of the infrastructure of payments is exposed to the fragilities of security and access. In a world where technology increases the scope of the means of payment, aspects like the corporate governance of the issuer turn to be crucial to assure that this means completely fulfill its functions. This corporate governance dimension is a key challenge for central banks that have the final role of issuing money for the whole 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, and also AML/CFT risks. Going to the money flower scheme, part of the elements to feed the stem are KYC controls. This element is crucial to understand other design decisions because this aspect is central on 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 a decision on central banks’ reputation and their power to preserve the confidence of society in (digital) means of payment. So central banks in considering CBDC are considering whether it will improve or worsen their reputation and confidence in money. This reputation will be the stem of the flower and will allow the new petal to grow or not.

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 on the menu of instruments 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 the 2014 Financial Inclusion Law was passed by Congress. The consideration of a digital currency issued by the central bank was seen at first sight 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 to limit CBDC to small amounts for each user is the strategy to fulfill cash use without harming other instruments. The e-peso pilot plan results shows this issue was completely fulfilled by the pilot, mainly small payments were issued during the six months and also peer to peer payments were released².

Departing from a totally different situation the aim the Swedish Riksbank in the research of e-Krona is almost the same. Financial inclusion is not a big problem for Sweden but the decline in the use of cash is the 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.

One way or another, even sometime digital currencies are considered a substitute to cash, it may be considered as 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 the use of it 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 explaining how the central bank can complete money options for the whole society and how all can benefit from this.

3. Technology: the simpler the better

The importance of Distributed Ledger Technology (DLT) has been growing by the hand of cryptocurrencies and other financial instruments, so it was natural to see it as a way of implementing CBDC. Furthermore, in the starting discussion of digital currencies there was a general confusion with blockchain technology and the e-Peso pilot plan.

Technology has been changing faster than expected and DLT applied to many problems of information sharing has been a cornerstone for new solutions to old problems. But 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

² See Graph 2 in Lesson 6 about the use of money to illuminate this aspect.

connection (just a mobile phone line). The platform is anonymous but traceable, users had digital wallets and security was designed for those who lose their phones or the password of their digital wallet. 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 privilege the well extended use of mobile phones in Uruguay. The results were positive without any technical incident. Even if in the next stages of a pilot banks 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 under control. The results of e-Peso pilot shows that no connections or transmission of operations problems were reported, so the network supported pretty good the pilot

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

CBDCs can be seen as a digital version of printing physical cash. Each e-Peso digital note includes an identification (ID) serial number so these digital notes could be traced back to a specific user, and each time that an operation was done the digital notes could be spread in smaller denomination notes with their own ID serial number. 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 and at the same time the cash out took more than two months after the pilot ended and all the digital currency was finally destroyed.

In the questions to answer there is still 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. Even though, it is sensitive who and how manages all this information and how works the legal system around it. As the Big Brother in George Orwell's dystopian novel 1984, wherein the leader of Oceania was watching everything,

this new power have pros and cons for the use of money and challenge the legal framework.

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 ways³. The verification process to test a genuine token, and that the e-Peso is not duplicated, was proven successfully. The mobile wallet app had no failed operations and in all cases the users could do payments without delay or inconvenience. This design not only was interesting for those parts of the population with limited access to bank accounts, it was also used for small payments, mostly related to everyday needs.

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

Interoperability was an important issue in the design process, modular approach to introduce the rest of the agents of the payment ecosystem is a very important part of this solution. Even though the banking system was not part of the pilot, they followed its development and from their perspective the interaction of the e-Peso with other electronic means of payments is perfectible achievable. Even the inclusion of the e-Peso in many other e-wallets that some banks already offer is a way to interact with the CBDC.

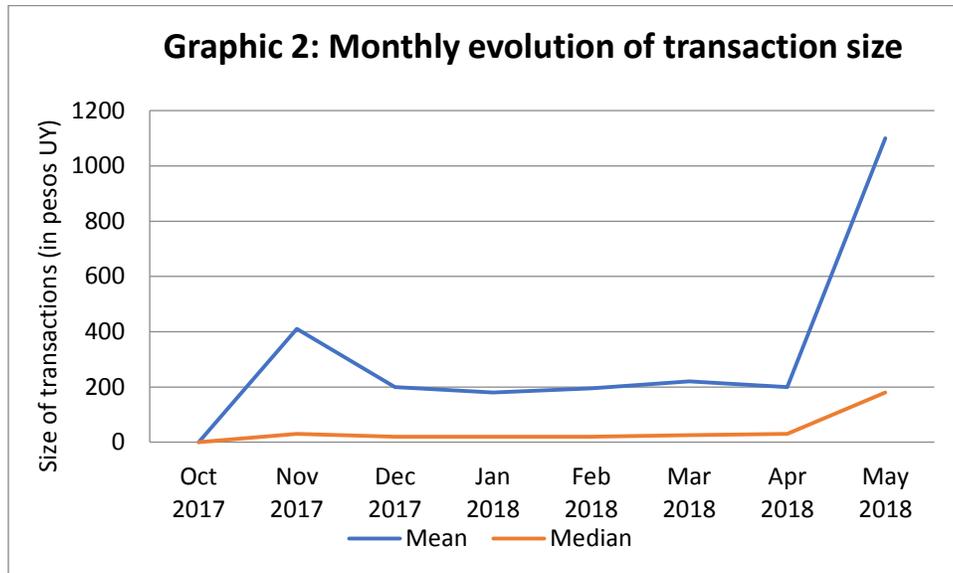
6. The use of money: small payments and transfers

³ 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 out loud 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)).

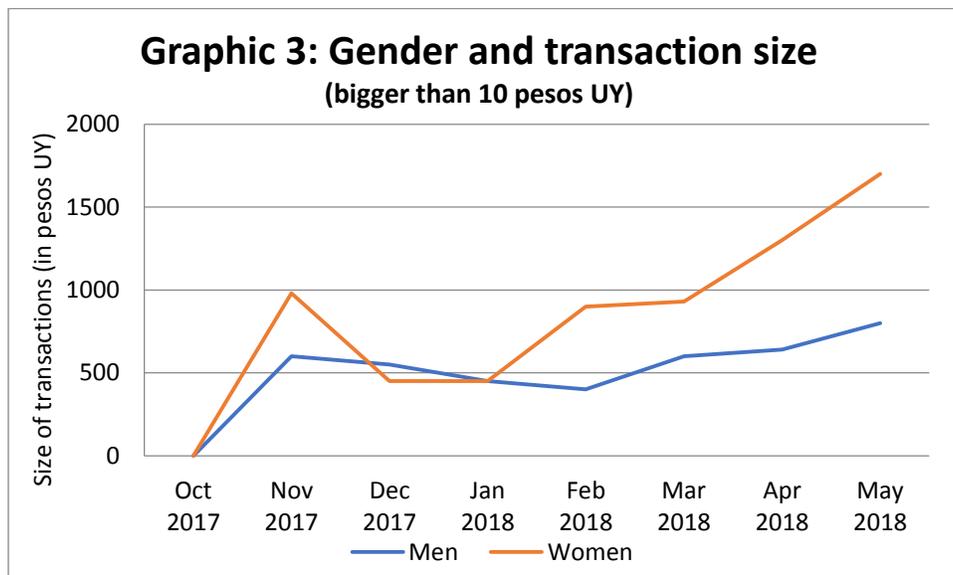
There are technological (DLT versus centralization) and legal considerations (ownerships) to characterize the digital currency denomination, even more some recent studies highlight this point: “Research on CBDC often draws a fundamental distinction between account-based and token-based architecture. 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)).

Anyways, the Bank of Canada keep on looking for what they call a “universal access device”. (Miedema, J. et al (2020)).

One important result of the e-Peso pilot plan was to consider the way that digital currency is used. Some results are shown in this graphics:



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 through the pilot period. The quantity of operations rose with the learning process of users. Transfers between peers with e-Pesos were very common throughout the implementation period.



Another issue is the cultural use of money: nearly all the participants use 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 gender approach, Graphic 3 shows that both women and men used the e-Peso in the pilot. Women did made transactions as the get 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 transactions.

All this information are part of the evidence of the use of CBDC as a valid instrument for small payments, that represents one of the use of cash not only in countries with low financial inclusion but also in those with developed financial systems that seeks for the universalization of electronic means of payment. If the CBDC is accessible and simple it could be use by everyone, on the contrary you can only use this for special payments and for sophisticated users. Arauz et. al. (2021) mentions the “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 it is important how it is introduced in the payment ecosystem and how it affects the existing means of payments, and this is consider in the final lesson.

7. Complement versus competition

Last but not least, CBDC pilot plans have raised several warnings about competition within the banking sector. The first issue to discuss is if compete with bank deposits and the importance of higher deposit rates to remain competitive. Even more, CBDC can compete with payment service providers 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 to have in the e-wallet. That is consistent with the international discussion (see e.g. Bindseil (2020) and Kumhof and Noone (2018)). So, the main use of e-Pesos is the same as cash, to do small payments and not to compete with other means of payments or at least, no to compete in a different way than cash does

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

III. Conclusions

CBDC is a challenge for central banks and policy makers. To learn about CBDC possibilities and explore the potential use of money implementing pilot plans and research is the way to fulfill this issue, giving new chances to the population in everyday life. To design, implement, and share lessons from CBDC pilots seems to do in the right direction as a global answer to this challenge.

Reputational risk and cybersecurity risks are two of the major aspects that central bank are facing to solve how to approach to design a CBDC. All the pilot plans that are ongoing allow central banks to test different solutions but them also open new questions about how the whole payment system will get into 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 seeing 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 caps, among others. All the research that central banks are doing will enrich the experience and lessons learned from each process will give us 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 step by incremental but not reversible. This implies that research on CBDC must not only concern on technical issues but also in 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, so 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 highlights the acceleration in shift toward the digital payments, including CBDCs. The search for contactless means of payments will be part of the agenda of any central bank involved in a safer and more accessible payment system.

BIBLIOGRAPHY

- Adrian, T., and T. Mancini-Griffoli. 2019. "The Rise of Digital Money," IMF Fintech Note 19/01.
- Agur, I., A. Ari, and G. Dell'Ariccia. 2019. "Central Bank Digital Currencies: Design Tradeoffs and Implications." IMF Working Paper WP/19/252, International Monetary Fund, Washington, DC.
- Alvez, M., R. Lluberás and J. Ponce. 2018. "The Cost of Using Cash and Checks in Uruguay," Unpublished mimeo.
- Arauz, A., R. Garratt, D. F. Ramos, (2021), "Dinero Electrónico: The rise and fall of Ecuador's central bank digital currency", *Latin American Journal of Central Banking*, Volume 2, Issue 2, 2021.
- Armelius, H., P. Boel, C.A. Claussen and M. Nessén. 2018. "The e-Krona and the Macroeconomy," *Sveriges Riksbank Economic Review*, Third Quarter.
- Auer R. and R Böhme. 2020. "The technology of retail central bank digital currency", *BIS Quarterly Review*, March, pp 85–100.
- Auer R., G. Cornelli and J. Frost. 2020a. Covid-19, cash, and the future of payments. *Bulletin 3*, Bank for International Settlements.
- Auer R., G. Cornelli and J . Frost 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 of Canada and Monetary Authority of Singapore (BoC/MAS). 2019. "How Do Hashed Time-Locked Contracts (HTLC) for Cross-Border Payments Work?" Annex to "Central Banks of Canada and Singapore Conduct Successful Experiment for Cross-Border Payments Using Distributed Ledger Technology" Joint Press Release, May 2.
- Bank for International Settlements (BIS). 2018. "Central Bank Digital Currencies," *Committee on Payments and Market Infrastructures*, Basel: Bank for International Settlements.
- Barontini, C. and H. Holden. 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. and W. Roberds. 2009. "Why Pay? An Introduction to Payments Economics," *Journal of Financial Intermediation*, 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., J. Ponce, P. Picardo, A. Velasco, B. Chen, L. Sanz, G. Guiborg, B. Segendorff, J. L. Vasquez, J. Arroyo, I. Aguirre, N. Haynes, N. Panton, M. Griffiths, C. Pieterz, A. Hodge, "Implementing a retail CBDC: Lessons learned and key insights", *Latin American Journal of Central Banking*, Volume 2, Issue 1, 2021.

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.