NATIONAL BANK OF RWANDA
BANKI NKURU Y'U RWANDA

RESEARCH PAPER ON
RWANDA CENTRAL BANK DIGITAL CURRENCY (CBDC)

IN PARTNERSHIP WITH

ACCESS TO FINANCE RWANDA

Contents

1. Executive Summary

This research paper summarizes the key findings of the Feasibility Study on Central Bank Digital Currency (CBDC) in Rwanda in terms of economic, functional, legal, and financial perspectives. It applies a quantitative analysis of opportunities, risks, and challenges to validate the feasibility of a CBDC in Rwanda. The paper also identifies a potential CBDC design and suggests a way forward.

The study analyzes 15 potential opportunities for a CBDC in Rwanda. Of these opportunities, four are identified as feasible, suitable and better positioned than alternative solutions. All other opportunities would also be addressed if a CBDC is introduced, but to a lesser extent as the four Sweet Spots, and they are therefore not considered primary motivators. Additionally, the Sweet Spots are based on stronger evidence and higher certainty of achievability than the other opportunities. The four identified Sweet Spots for CBDC, within the Rwandan context, are the following:

1. To increase resilience against possible network outages, power failures and natural disasters;
2. To improve innovation and competition;
3. To contribute to achieving the cashless economy national initiative over time;
4. To develop faster, cheaper, more transparent, and more inclusive cross-border remittances.

The risks that the study identifies with a high level of concern and few mitigation options are related to CBDC adoption by the public, financial service providers, and merchants. These risks should be carefully investigated throughout any next engagements, as the level of adoption are strict conditions for the Sweet Spots to be achieved.

The CBDC design that has been identified to address the Sweet Spots and mitigate the Pitfalls contains several principles. It is recommended to be a two-tier, universal, zero interest CBDC with partial pseudo-anonymity. It is advised that the National Bank of Rwanda (BNR) provides interoperability with existing payment systems and potential other CBDCs, while leaving remaining interoperability to the private sector. It is also advised that limits are imposed on holdings and transaction amounts. The compensation model should be defined through additional consultations with private sector stakeholders given its complexity and importance for CBDC adoption. At a technical level, the research recommends a token-based model, that supports online and offline transactions, with open programmability and a distributed database.

The legal analysis finds that a CBDC in Rwanda should have the same legal status as banknotes, but that there are conditions that prevent a straightforward

implementation of the status of CBDC as legal tender. The research also concludes that it would be preferable for the Central Bank Act to be updated to reflect a specific mandate to issue a CBDC. Such amendments would ensure certainty, clarity, and mitigate possible hurdles in making relevant and necessary changes to other laws in order to ensure a robust legal framework for CBDC. This is advised while understanding that the mandate of the BNR is currently broad.

To conclude, the research finds that there are opportunities for improvements in the payment landscape of Rwanda. The identified Sweet Spots are well-positioned to address these opportunities. However, there are conditions that prevent the study to conclude with a high level of confidence that Rwanda needs to introduce a CBDC in the immediate or short term. The primary condition, or Pitfall, is the topic of public adoption, which warrants the need for deep user research. How users would treat CBDC offering should therefore be carefully investigated prior to decision-making. For the medium-to-long term, the need for a CBDC could increasingly materialize for the BNR, given the trajectory of ongoing digitization in payments and the need for central bank money to continue playing the role of monetary anchor at the expanding digital economy where public money, i.e., cash, cannot have a role.

As a way forward, the research recommends to proceed iteratively and cautiously with multiple time-lined verification stages in terms of CBDC Proof of Concepts (PoC) and piloting. The identified Sweet Spots constitute a solid starting point for initiating formal CBDC experimentations in Rwanda. This process could also lead to identifying more opportunities and possibilities feeding back into the decision-making process as the BNR moves forward. Overall, continuing CBDC explorations would strategically position the BNR for a future CBDC launch as it would expand its institutional knowledge, skills and expertise in this important domain. It will also align the BNR with other central banks actively exploring CBDC in Africa and other regions of the world, so that it could engage with them at joint CBDC projects, for instance in experimenting cross border CBDC transactions.

2. Introduction

Central Bank Digital Currency (CBDC) is a digital form of a central bank-issued money. CBDC would be denominated in the same national unit of currency – Rwandan Franc - and serve as legal tender. It would be a direct liability of the National Bank of Rwanda (BNR), so it would be solely issued and centrally governed by the Central Bank. In addition, it would be exchangeable one to one (1:1) against other forms of currency, such as physical cash, deposit money (bank balances), and mobile money. Furthermore, it is expected to serve most of the existing purposes of money, for instance functioning as a store of value, means of payment, and unit of account. CBDC would have most of the features of cash. Because it is held in electronic form, it would additionally be usable in online or remote payment scenarios.

While CBDC uses cryptographic mechanisms similar to those utilized in many digital assets systems, to ensure secure and smooth operation of the protocol it differs from decentralized systems in that it would be under the central management of the BNR and can always be exchanged 1:1 for cash. As such, it would not be prone to volatility and reluctance of acceptance from merchants and businesses.

Although there is a consensus about the general nature of CBDC as outlined above, there are various possibilities for how it could be designed and implemented. These variations are largely dependent on the expected use cases, as well as technical and legal considerations and requirements.

Global research and development work on CBDCs is taking place on almost all continents today, from America and Europe to Australia and Africa. The 2021 BIS survey found that 90% of central banks were actively investigating CBDCs (that corresponds to 98 countries, representing over 90% of global GDP[i]), 62% were conducting PoCs and experimenting with the technology and design options, and 26% were deploying pilot projects[ii]. The survey also showed that 68% of central banks are expecting to issue a retail CBDC in the short term (1-3 years) or medium term (1-6 years).

In 2022, the BNR initiated a feasibility study regarding CBDC in Rwanda. This seeks to explore the rationale, use cases, opportunities, and risks of introducing CBDC, and to provide evidence-based recommendations on the feasibility of CBDC in Rwanda.

3. Methodology and objectives

The purpose of the Rwanda CBDC Feasibility Study is to validate the feasibility for CBDC in Rwanda. This task is reflected in detail in the Feasibility Study Report (in full) and summarized in this research paper. The study provides the key findings in terms of functional, technical, economic, legal, and financial perspectives. The study also sets out the way forward, along with further technical details regarding the potential design of a CBDC. The main issues covered and investigated in the Feasibility Study Report are:

- What opportunities does CBDC provide, and to what extent are those opportunities relevant to Rwanda?
- When compared to available alternatives, how appealing is CBDC as a policy option that makes use of these opportunities?
- What are the risks and challenges of issuing CBDC in Rwanda? How could they be mitigated or dealt with?
- What objectives and demands from various stakeholders should be taken into account while designing a CBDC? What impact would these have on the operations, system architecture, and design of the CBDC?
- What legislative considerations are necessary to support the issuance of CBDC in Rwanda's current legal framework?
- What future preparatory steps are necessary for the widespread implementation of CBDC?

This paper contains information intended to serve as groundwork for further decisions relating to the feasibility and potential design of a CBDC. Given the exploratory nature of the field, this will inevitably necessitate certain assumptions and conditions, which are listed throughout the paper. Going forward, it would be sensible to continue observing developments and re-evaluating opportunities, risks, and obstacles.

The Feasibility Study utilized the main outcomes of the previous phases of the analysis namely: Industry Analysis (Desk Research) and questionnaire responses from stakeholders in the Rwandan financial (Stakeholder Analysis).

The assessment of feasibility for CBDC in Rwanda is based on a quantitative analysis of opportunities, risks, and challenges in relation to CBDC. Where possible, the outputs are supported by concrete figures from data which have either been supplied by the BNR or found on other official sites of relevant organizations. The structure of the analysis is adapted from the World Economic Forum's CBDC Policy-Maker Toolki[1] and has been reconfigured to help identify the attractiveness of CBDC as a policy option in Rwanda, relative to alternative options. A more detailed description on the methodology can be found in the Feasibility Study Report.

[1] Central Bank Digital Currency Policy-Maker Toolkit | World Economic Forum (weforum.org)

4. Challenges of Rwanda's financial sector

Rwanda's financial sector has significantly modernized and expanded in recent years. The sector is becoming increasingly diversified, and is made up of a growing array of institutions: Banks, payment service providers (PSPs), microfinance institutions (savings and credit cooperatives (SACCOs), non-deposit-taking microfinance institutions (NDFIs), insurance companies, and pension funds.

Banking still makes up the largest part of the financial sector, accounting for 67.4% of total financial sector assets as at the end of June 2022, followed by the pension sector which makes up 16.7%. The insurance and microfinance sectors account for 9.2% and 5.8% respectively, while the remaining institutions – including foreign currency dealers, PSPs, and NDFIs – make up the remaining 0.9%.[2]

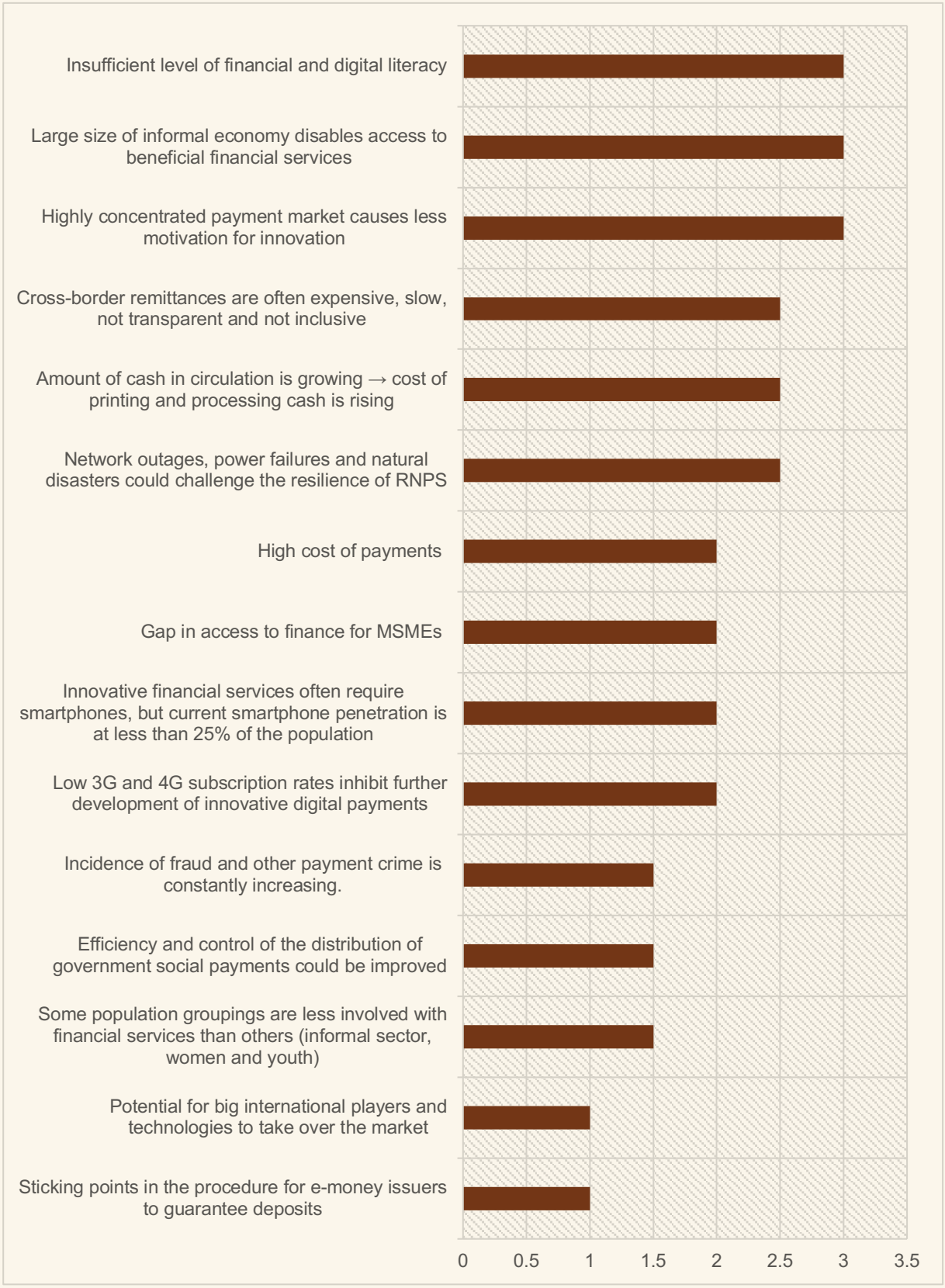
With the purpose of facilitating smooth interoperability between different financial institutions, the Rwanda National Payment System (RNPS) has been significantly improved over the past decade. Major achievements include the implementation of the Rwanda Integrated Payments Processing System (RIPPS) in 2011; its upgrade in 2020 to expand access to non-bank financial institutions and to operate around the clock; establishment of the central securities depositories; and the set-up of an inclusive instant payment system (RNDPS).

The modernization of RNPS is still in progress, and guided in accordance with strategic economic targets defined in the Rwanda Payment System Strategy. This envisages that the payment system facilitates a cashless economy by promoting e-payments; creates an enabling environment for product and service innovation which provides affordable, effective and relevant payment services to Rwandans; and drives financial inclusion to meet the country's goal of 100% of adults being financially included[3].

Alongside with strategic achievements, the study identified fifteen challenges for the financial and payment systems in Rwanda. These challenges have been used in further analysis to validate potential opportunities for CBDC and alternative options. Depending on each challenge's importance and relevance, based on independent expert assessment, it was given a score from 1 to 3 (see graph below).

[2] BNR`s Annual financial stability report. July 2021-June 2022.
[3] Rwanda Payment System Strategy. Towards a cashless Rwanda | 2018-2024.

Challenge Scoring



5. Sweet Spots for CBDC in Rwanda

Based on the assessment of the current payments landscape in Rwanda, the study has identified fifteen CBDC opportunities where each opportunity corresponds with one of the fifteen challenges (please, see Appendix 1). Among them there are four Sweet Spots, which are considered to be CBDC opportunities with high potential benefits and limited alternative choices to obtain similar advantages. The identified Sweet Spots are:

1. Increase resilience against possible network outages, power failures and natural disasters;
2. Improve innovation and competition;
3. Contribute to achieving the cashless economy national initiative over time;
4. Develop faster, cheaper, more transparent, and more inclusive cross-border remittances.

Below, we review the reasoning behind these CBDC motivations.

1. Increase resilience against possible network outages, power failures and natural disasters

The overall value of retail electronic payment to GDP in Rwanda increased by 16.4 % in 2021-2022 to reach 111.9%. The value of mobile money transactions increased by 140% from RWF 917 billion to RWF 381 billion.[4] The growth of electronic payments and concentration of mobile money balances at telecom providers constitutes high levels of risks to the resilience of cashless payments.

Another aspect motivating enhancing the resilience of the RNDPS is estimating the expected impact when a power outage occurs. The BNR has invested in modernizing the RIPPS and introducing RNDPS. According to the BNR, although the volume of transfers remained the same from 2020/2021 to 2021/2022, the value has increased by 23% to reach 9.3 billion RWF. The BNR annual report also cited that "The overall value of retail e-payment to GDP increased by 16.4% during the period under review to reach 111.9%." As more payments become digital, the ramifications and consequences of a network outage could be significant on the economy.

Though power outages are still occurring in Rwanda, over recent years they have lessened in frequency and duration due to investments in the country's power infrastructure. Nonetheless, like many countries in the region, Rwanda faces difficulties ensuring a stable and reliable electricity supply, particularly in rural

[4] BNR Annual Report 2021/2022.

areas[5]. This can be troublesome for payment systems in Rwanda, as outages have the potential to disrupt electronic transactions and cause inconvenience for customers who rely on cashless methods of payments. This impacts businesses and individuals who depend on a reliable power supply for their daily operations, and may also affect the overall growth and development of the country's economy.

The design of CBDC should take the occurrences of power outages into consideration, and plan for failover systems that can ensure continuity of service. The extent to which power outages affect CBDC systems would depend on the specific design and implementation of the system.

One of the possible features of a CBDC solution is the capability to conduct secure consecutive offline payments in which both the payer and payee are offline, with no mobile network, no Internet connection and – to a limited extent – even without power supply. This is enabled by the possible design of CBDC as a bearer instrument (tokens), allowing for the immediate transfer of value without the need to process the transaction through clearing and settlement systems. However, this will greatly depend on the CBDC implementation model (account- vs. token-based).

Generally speaking, the lower the technical requirements for a CBDC payment, the more resilient the ecosystem gets.[6] For example, many countries have near-universal 2G coverage (as opposed to 4G), which means that Mobile Money payments that work through USSD codes have a competitive edge over e-money solutions that require higher bandwidth. An offline-capable CBDC implementation could do away even with 2G coverage, if transactions can – for a limited number of transactions – be settled directly between participants through Bluetooth or NFC; communication technologies that are not reliant on Internet connectivity.

In the current cashless payments landscape in Rwanda, consumers and merchants broadly have two choices: Either they use mobile money, which requires 2G connectivity but only offers basic payment features; or they use smartphone apps, which have a broader range of features but require 3G or 4G connectivity to work. The challenge is that there is currently no cashless payment instrument that can work completely offline, i.e. even without 2G cellular coverage, nor are there advanced features available that work on low bandwidth. The mobile network operators (MNOs) have indicated that their innovation strategies are geared toward raising subscription levels for 3G and 4G services. This approach enables them to increase their customer base. This is a sound economic strategy,

[5] Shyirambere, G. et al. (2021). Study of Assessing the Stability of Rwanda's Power System from Big Data Based on Power Generation.

[6] Three lessons from Project Sand Dollar, OMFIF, 2020.

given that MNOs are for-profit corporations. However, the cost of data subscriptions remains high, with the 4G price per gigabyte an average of 13 times the price of 3G. Furthermore, upfront costs for 3G/4G-enabled devices (POS terminals and/or smartphones) may prove prohibitive to the goal of raising subscription levels. The public sector might step in to address this gap in the market by developing payment solutions that offer features beyond simple payments, and which are inexpensive to access and use.

Resilience against electricity outages is harder to achieve because any electronic payment instrument requires power to operate. For example, payments involving a smart card can only be executed with a power supply, e.g. through NFC.[7] Fortunately, battery-powered card readers (including smartphones equipped with merchant apps) can alleviate this problem.

Optimizing a CBDC for resilience also aids in accessibility goals. Especially for underprivileged and underserved groups, 4G and/or power requirements may pose relatively larger challenges than for the rest of the population. Taking a consumer-centric approach is therefore crucial in CBDC design.

2. Improve innovation and competition

This CBDC Sweet Spot partially refers to solving present day challenges (insufficient level of competition) but also to future potential opportunities of the accelerating digital economy.

Cashless payment channels in Rwanda are currently largely dominated by mobile money, which accounts for 70% of the total transfers in 2022, dwarfing banking services cashless channels across card-based payments, Internet banking, and mobile banking. Combined mobile and card-based POS payments account for 27% of total transfers while the rest of the channels account for no more than 3% of cashless payments only, an extremely low percentage reflecting an acute disequilibrium at the cashless payment channels in favor of mobile money[8].

There is currently little competition in mobile money payments. Two major operators – MTN and Airtel – are dominating the sector and the national payment system[9]. The operators recently signed an agreement allowing subscribers across these two telecom providers transfer funds without additional costs.

The mobile money ecosystem on the one hand provides accessibility and relative ease of use. On the other hand, the duopolistic model within the ecosystem

[7] There are smart cards with batteries; however, such models are more costly, thus circumventing accessibility in other ways.
[8] BNR Annual Report 2021/2022
[9] ibid

comes at the expense of high fees for users and merchants (e.g., payment fees of 0.5 % for merchants[10]).

Regulators can implement different anticompetitive practices to regulate fees in the payments sphere. Such practices might vary from consultations and agreements with the market participants to the involvement of anti-monopoly authorities and regulatory requirements of lowering fees. In case of Rwanda, the questions of costs of payments are discussed during careful consultations between regulators and EMIs.

In comparison to existing policy tools, CBDC could be a simpler – or additional – tool to enhance competition policy, because it would provide an alternative low-cost payment instrument for customers and merchants. CBDC allows use in payment systems for online transactions and peer-to-peer transfers but offers the same level of safety as cash (because Central Banks cannot default on their nominal obligations). A CBDC should be priced to achieve the objective of a universally accessible and low-cost means of payment.[11] This competition would help bring down the level of fees charged by EMIs and card schemes.

The trend of economy digitalization brings a new generation of use cases, for example, micro- and machine to machine payments in the Internet of Things (IoT) or programmable payments. A duopolistic model within the mobile money ecosystem means less motivation to introduce innovative payments. Higher monopoly power means higher opportunity costs, so less incentive to innovate.[12]

According to Bank of Canada's considerations[13], a CBDC could contribute to a competitive and vibrant digital economy in two ways:

- CBDC could increase welfare relative to the status quo by enabling new markets, providers, use cases, and applications;
- CBDC could mitigate welfare losses by limiting abuses of market power and avoiding coordination failures in payments and new markets such as in smart contracts (programs designed to automatically execute a transaction between two parties or more when one or several pre-determined conditions are satisfied).

One way in which a CBDC can foster innovation in the digital economy is by supporting programmable payments. The public sector in Rwanda could

[10] https://www.mtn.co.rw/momo-tariff/
[11] The Positive Case for a CBDC. Bank of Canada Staff Discussion Paper/Document d'analyse du personnel — 2021-11.
[12] Monopoly and the Incentive to Innovate. When Adoption Involves Switchover Disruptions. Federal Reserve Bank of Minneapolis.
[13] The Positive Case for a CBDC. Bank of Canada Staff Discussion Paper/Document d'analyse du personnel — 2021-11.

leverage the CBDC infrastructure as a payment rail to disburse stimulus and other government-to-person transfers (G2P) more efficiently.[14]

Note that there is a distinction between programmable money and programmable payments, which imply different design and implementation trade-offs.[15] Programmable money is designed with built-in rules that constrain the holder. These rules could mean that money expires after a fixed date or its use is restricted to a certain set of goods. This would affect digital currency acceptance and has obvious legal implications. Programmable payments, on the other hand, enable automatic transfers to be carried out or blocked when pre-determined conditions are met. These could include daily spending limits or recurring payments, similar to direct debits and standing orders. Programmability features could bring numerous benefits, enabling new workflows, processes, and digital business models without affecting the properties of the currency itself.

CBDC could be designed as a platform open to private payment service providers. This model should ensure low barriers of entry for new firms seeking to offer new payment services. The CBDC platform could provide an API layer on top of core CBDC systems and facilitate the CBDC developer and ecosystem community to access the platform and drive innovation on top of it, which increases competition on the market.

3. Contribute to achieving the cashless economy national initiative over time

Despite the great disruptions of economic activities caused by the COVID19 pandemic, cash in circulation continued to increase consistently during the period June 2019 – June 2022[16] where the currency out of banks under M1 of the Monetary survey showed the following progression:

June	2019	2020	2021	2022
Cash in circulation in RWF million	201,276	229,729	253,725	304,990
% increase		14.14%	10.45%	20.21%

Given these figures, the total increase of cash in circulation for the period June 2019 – June 2022 was 51.53%. This might also suggest that the digital payments options, including mobile money, were not as effective in deceasing demand for

[14] S. Allen, S. Capkun, I. Eyal, G. Fanti, B. Ford, J. Grimmelmann, A. Juels, K. Kostiainen, S. Meiklejohn, A. Miller, E. Prasad, K. Wüst und F. Zhang, „Design choices for Central Bank Digital Currency: Policy and technical considerations," Global Economy and Development at Brookings, 2020.
[15] Alexander Lee, "What is programmable money?", 2021.
[16] BNR Annual Report 2021/2022.

cash and hence did not effectively contribute to achieving Rwanda's cashless economy goals. Yet, the survey by Finscope (2020) indicated that only 58% of mobile account holders transacted at least three or more times on a monthly basis, 23% transacted once or twice a month and 17% transacted less often[17]. This shows that the metric of mobile money subscriptions does not necessarily reflect usability.

The BNR Annual report also indicates that "The value of cash withdrawals to GDP through counters, ATM and agents decreased from 84% in June 2021 to 72% in June 2022". Nonetheless, a prevailing 72% is still high and reflects a continued high demand for cash across its various distribution channels.

Additionally, and according to the BNR Annual report 2021/2022, total cash deposits increased by 70.23% while cash withdrawals increased by 70.02%. The report also indicates that the value of cash in circulation increased by 18.84% while cash processing increased by 79.53%. Such figures reflect increases in cash processing costs. This not only reflects high incurred costs in cash processing but also confirms that in case of a CBDC introduction, such machinery, systems, and safe storage spaces will not be involved in the CBDC ecosystem given its digital nature.

The cost of cash printing, minting, and processing amounted USD 30,199,673 in 2018-2022 and is estimated to increase by USD 5,141,578 in the next five years. On top of these cost-bearing components, the Central Bank might need to handle charges for agency fees or additional costs, like overheads for cash management, and administration costs for tenders. In addition, destruction costs of worn-out banknotes require significant investment in destruction machines and come with associated operational and administrative costs.

Activities	Cost (USD) in last 5 years	Estimated cost (USD) for next 5 years
Printing & Minting	29,021,282.94	32,000,000
ISCO Cash Processing (counting and sorting)	-	1,400,000
Maintenance fees for machines	1,178,390	1,941,251
Total	30,199,673	35,341,251

[17] FinScope Rwanda Survey 2020.

It is worth mentioning that due to high cash usage, the BNR also needs to heavily invest in its cash management infrastructure, which further adds to costs. Cash management additionally incurs costs for the entire stakeholder chain.

For commercial banks the main cost elements comes from logistics, such as the transfer of cash between the Central Bank and its branches as well as transit between its branches, or ATM provisioning and servicing. According to a study by McKinsey, the cost of cash can represent up to 5-10% of operating costs for banks[18].

Although it is too early to estimate CBDC costs, for example in terms of implementation, education, and promotion, it is expected that introducing a CBDC could significantly reduce the amount of cash in circulation and associated costs for all stakeholders as CBDC adoption increases with time. The amount of cash in circulation would be reduced in the medium to long term aligned with BNR time-lined CBDC road map. A CBDC would be a digital alternative to cash, offering immediate settlement and direct availability of funds.

The exact cost and price model of a CBDC should be further studied in separate research closer to decision-making. It is clear though that maintenance of the CBDC system and potential transaction-based fees should not and will not exceed the costs of managing cash, at least given that CBDC is digital as compared to physical cash requiring a physical ecosystem of machinery and space.

Considering the commitment of the BNR and the Ministry of Finance and Economic Planning (MINECOFIN) to encourage all residents of Rwanda to use electronic payments and to move towards a cashless society, it could be a strategic priority for the BNR to decrease the amount of cash in circulation. A CBDC could drive the objective of at least achieving a cash-lite society. Less cash in circulation could bring down the burgeoning cost burden on the Central Bank and the entire stakeholder chain. It could contribute to increasing the proportion of the formal economy in the country, which could also translate into larger tax and government revenues. Again, it would be difficult to provide exact numbers or even numeric estimates given the early stage of BNR's current CBDC exploration. Nonetheless, it is possible to establish these arguments and potential conclusions as they are directly deduced from the hypothesis of considering CBDC as a form of digital cash.

These findings were further confirmed by a BIS paper issued in 2022 surveying CBDC in Africa[19], were it found that "Another possible motivation for issuing a CBDC is the cost savings from less cash in circulation. Cost reductions relate to the printing, transportation and storage of banknotes and coins. The potential for savings is greater in economies where cash circulation remains high, as in Africa.

[18] Fintech in Africa: The end of the beginning. McKinsey. August 30, 2022 | Report.
[19] Central bank digital currencies in Africa (bis.org)

For African central banks, reducing cash distribution costs is indeed a much more important motivation (48% of responses) than for other EMEs."

The increments of cost savings from a reduced cash in circulation as a result of introducing CBDC is time bound. Many Central Banks around the world have multiyear PoC and piloting plans, which will be followed by a time-lined staged soft launch preceding the full launch. It will then take time for CBDC adoption to reach the levels of a reflected decrease of cash in circulation. Such adoption will also depend on the BNR policy regarding CBDC design in terms of onboarding requirements (KYC), and the possible caps on holdings and limits of transactions placed on a CBDC wallet at least at the initial stages of a CBDC soft launch. Given all these time bound factors, coupled with the BNR's early stage of CBDC exploration, it would be difficult to provide solid expectations in terms of number estimates. This is the prevailing case internationally, where no CBDC feasibility study, even those issued by leading international financial institutions and funds, could lay down such predictions at a CBDC feasibility study.

4. Develop faster, cheaper, more transparent, and more inclusive cross-border remittances

Cross-border payments are those where the payer and payee reside in different jurisdictions. The payer and payee can be debited and credited in different currencies, but this is not a necessary condition. There are several use cases where cross-border payments are deployed: among others, remittances, tourism, and cross-border retail investments[20].

According to the brief prepared by the Global Knowledge Partnership on Migration and Development for the World Bank[21], remittance inflow saw a strong gain in sub-Saharan Africa (14.1%) of approximately US$49 billion, in 2021, following an 8.1% decline in 2020. In 2022, the volume of remittances to sub-Saharan Africa would increase by 7.1%.

Sub-Saharan Africa remains the costliest developing region to which remittances are sent. For example, the fee for sending $200 in remittances from Tanzania to neighboring Uganda would cost the Ugandan migrant 29.7%. Sending remittances from Tanzania to Rwanda is among the top-3 most expensive corridors[22].

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[20] Financial inclusion across borders with retail Central Bank Digital Currencies. Whitepaper by G+D.
[21] Migration and Development Brief 36 – A War in a Pandemic: Implications of the Ukraine crisis and COVID-19 on global governance of migration and remittance flows, May 2022. KNOMAD, the Global Knowledge Partnership on Migration and Development for the World Bank.
[22] ibid

International migrants represent 0.7% of Rwanda's population[23]. Most come from neighboring countries: the Democratic Republic of Congo (43%), Tanzania (31%), Burundi (14%), Uganda (11%) and other African countries (1%)[24]. Internal migrants represent 11.5% of the population in Rwanda[25]. Despite this relatively small percentage of migrants, around 3.2 million (45%) adults in Rwanda have either sent money to and/or received money from people living elsewhere. The most common mechanism used to transfer money is through formal electronic channels. Though, there are still those who received money in cash or through a relative or in person.

The abovementioned countries are partner states of the East African community. The establishment of the East African Monetary Union is an important stage in the process of the community's regional integration allowing the partner states to progressively converge their currencies into a single currency.

Currently, to perform retail transactions outside of Rwanda's borders, RNDPS is connected to regional and global payment platforms through Rswitch, MasterCard and Visa to allow electronic transactions. Cross-border mobile transfers are emerging through bi-connections between MNOs or via regional mobile money hubs (MFS Africa and Thunes).

Retail cross-border CBDC would help alleviate high price and existing frictions. In search of an optimal solution for such interactions, different approaches to CBDC`s interoperability can be considered:

1. An interlinked model proposed by BIS[26] can potentially be considered under the conditions of the East African Monetary Union, where the administering Central Bank would take the role of the "common service" provider, allowing domestic CBDCs to transact with each other with no need to become direct participants in each of them. Or, bilateral arrangements can be established with an intermediary for each one.

   A common CBDC within the East African Monetary Union issued by one administering (East African Central Bank) or several national Central Banks would simplify this model due to the absence of currency conversion. The CBDC could be backed by the assets of the participating Central Banks. The share of currency backing could be determined based on foreign trade, GDP figures of the participating countries, or other applicable indicators. Since foreign exchange might be one of the largest economic challenges for establishing cross-border CBDC corridors among countries, a single currency-based CBDC could more

[23] Rwanda Household Survey2019/2020.
[24] Third Integrated Household Living Conditions Survey.
[25] Rwanda Household Survey2019/2020.
[26] Options for access to and interoperability of CBDCs for cross-border payments, Report to the G20, July 2022.

effectively bridge the cumbersome access to the global foreign exchange markets.

2. Another important area of discussion is the development of common standards for domestic CBDCs. It would allow private sector participants accessing foreign CBDC systems, either directly or indirectly, to proceed with cross-border payments. To confirm, a common regional digital currency would make such tasks easier to implement.

3. The development of economic interlinkages and cooperation between countries in the form of monetary unions opens additional opportunities for discussions of a common CBDC platform, for international payments and remittances in the region.

   Though, there is no retail cross-border CBDC in production to confirm its efficiency against available alternatives on the market, various CBDC cross-border projects provided important outcomes. For instance, project Icebreaker[27] (Bank of Israel, Norges Bank, Sveriges Riksbank) confirmed the feasibility of connecting different CBDCs using a hub-and-spoke solution (interlinkage model). BIS lead project mBridge[28] (Bank of Thailand, Hong Kong Monetary Authority, People's Bank of China, Central Bank of the United Arab Emirates) indicated that cost savings with CBDCs in cross-border payments could reach almost 50% compared with traditional banking infrastructures. Project Jasper-Ubin[29] (Bank of Canada, Monetary Authority of Singapore) confirmed the feasibility of cross-border, cross-currency, cross-platform atomic transactions without the need for a third party. Project Inthanon-LionRock[30] (Bank of Thailand, Hong Kong Monetary Authority) showed that cost reduction can be achieved by deploying smart contracts and an algorithmic liquidity saving.

   The idea here is that issuing CBDC could potentially position the BNR in a favorable situation in case it considered in the future (near or distant) to engage with other Central Banks in the region or even internationally at joint CBDC cross-border projects. It would be hard to argue that CBDC could not play a role in Rwandan remittances given the current high costs and the international momentum in this direction.

[27] Project Icebreaker: Breaking new paths in cross-border retail CBDC payments (bis.org)
[28] Connecting economies through CBDC (bis.org)
[29] Jasper-Ubin-Design-Paper.pdf (mas.gov.sg)
[30] Project Inthanon-LionRock (hkma.gov.hk)

6. Pitfalls for CBDC in Rwanda

In total, the research has identified twelve risks arising from the issuing and implementation of CBDC in Rwanda that warrant careful consideration by the BNR. The Pitfalls, which are risks characterized by a high level of concern and few options to mitigate them, are described in this section.

1. CBDC adoption by the public

In the absence of a practical pilot it is hard to define CBDC's attractiveness and potential uptake by Rwandan people. As such it is also difficult to predict the number of citizens who might become CBDC users in the event of a decision to nationally implement a digital currency.

The payment habits of people in Rwanda are largely dominated by mobile payments. In 2022 the number of funds transfers made via mobile payments increased by 60%, from 23 million to 382 million. In value, transfers via mobile payments increased by 61% from RWF 5,208 billion to RWF 8,409 billion, compared to 2021[31].

Hence, shifting existing consumer habits to an innovative instrument such as CBDC would require additional investments to its promotion and education. CBDC should be clearly articulated and explained to people in a simple manner (even now, many adults in Rwanda have felt or experienced a lack of transparency from financial service providers, including lack of clear information on financial products and services).[32]

Mitigating the risk of low adoption is a complex matter. CBDC should provide a frictionless[33] user experience by combining the best of both private and public currency worlds. Alternatively, the CBDC user experience could mimic mobile money. This requires careful balancing, since the BNR should not be seen as a competitor to EMIs.

Without greater interoperability, it will likely be more expensive and difficult for individuals and businesses to adopt CBDC in ways that lead to the reduction of the use of cash.

Government incentives towards G2P and P2G payments can be a benefit for CBDC compared to alternative instruments. Other motivations could be: effective compensation model where FSPs/MNOs would benefit from the effect of scale,

[31] Monetary policy and financial stability statement. March 2023.
[32] FinScope Rwanda Survey 2020.
[33] The meaning of this word relates to the amount of actions that a user must perform to access a CBDC Wallet.

step-by-step motivation of merchants to accept CBDC. Such steps should be thought-through and defined in a CBDC adoption strategy.

2. CBDC adoption by financial service providers and merchants

The implementation of any innovative product on the market must happen gradually, and needs to be supported with effort and financial investments. Some companies, including Google, make these investments by giving out money for users to spend on installing and using new mobile applications.

The payment market in Rwanda is dominated by mobile payments. MNOs have invested significant work and money, particularly into developing the infrastructure so that USSD would become the most common electronic payment method.

Comparing December 2021 and December 2022, the number of mobile POS increased by 211% from 45,739 to 142,351. This increase is due to awareness campaigns and facilitation in merchant onboarding process. The number of mobile payment agents increased by 21%, from 124,373 to 150,767 agents[34].

An appropriate business model needs to be found to mitigate this risk, and it must also include new revenue streams and address who bears the cost of implementation. However, it is important to understand that the concept of retail CBDC as digital cash, free of charge for the end-user, disincentivizes financial service providers from contributing to a solution.

Merchants could be an entry point for CBDC adoption. To support this, they should be incentivized to accept payments even without high user adoption.

Cooperation between the private and public sector might be necessary, for instance with involvement of financial service providers in the distribution of government funds.

[34] Monetary policy and financial stability statement. March 2023.

7. CBDC design considerations

In order to evaluate the potential introduction of CBDC in Rwanda, consideration needs to be given to how the CBDC ecosystem should be designed. There are various aspects that need to be taken into account for this purpose. This section provides an overview of the recommended characteristics, and lists available alternatives.

1. High-level characteristics

Distribution model

Recommended	Alternatives
Two-tier indirect	One-tier or two-tier synthetic

There is almost universal agreement in literature and in practice that the two-tier distribution model is favorable to the one-tier model, mainly because it has a lower likelihood of disrupting the existing financial system. Financial Service Providers would take on a similar role as today in terms of the distribution of cash. Based on the responses from the Stakeholder Analysis, there is also a preference towards the BNR as the sole issuer of CBDC, which is why the indirect model is preferrable. From a legal perspective, the BNR extending access to the CBDC ecosystem to non-bank firms should be considered.

Accessibility

Recommended	Alternatives
Universal accessibility	Limited accessibility

Lack of universal access will stifle adoption of a CBDC because it introduces artificial barriers to its use. However, universal access does not need to be fully implemented right from the beginning; instead opting for a gradual approach. This would help with gathering experience, and slowly expand the access. In particular, following a gradual approach also addresses the disadvantage that non-residents may use CBDC outside of the country: Initially, providing local identity documents could be required for obtaining a CBDC wallet. Later, non-residents could be onboarded with wallets that have limited features, such as lower spending limits. If problems arise from foreign use, these policies can be adapted later.

Privacy

Recommended	Alternatives
Partial pseudo-anonymity	Full anonymity, pseudo-anonymity, or full transparency

Neither full anonymity nor full transparency are seriously considered by Central Banks in their CBDC projects. While the former poses too many fraud risks, the latter would hinder adoption, especially in privacy-conscious environments. The Stakeholder Analysis has shown that there is a significant interest in privacy, combined with the desire to build innovative use cases that may require private data. A compromise can be struck through partial pseudo-anonymity, where privacy levels can be configured appropriately. Another cornerstone of this approach is consumer choice, where any consumer can choose to provide more data to access more advanced services beyond simple payments. Still, this approach guarantees privacy for honest users while simultaneously giving tools to investigate money laundering (AML) and combating the financing of terrorism (CFT).

Interest

Recommended	Alternatives
Zero interest	Interest-bearing, tiered interest, or negative interest (only)

Even though the Stakeholder Analysis showed some favorable responses towards interest, the potential negative impacts on monetary stability and intermediation leads us to the clear conclusion that a cash-like, zero interest CBDC is the preferred approach. This is the position taken by many Central Banks. Others take the view that, although there is no intention to renumerate CBDC at this time, the door should be left open for the possibility to pay interest in the future.

Interoperability

Recommended	Alternatives
With existing payment solutions (by BNR), other CBDCs	New token-based instruments, privately-issued currencies and stable coins, smart contracts, or partial interoperability. Alternatives are recommended to be provided by the market.

This level of interoperability should be provided by the BNR to ensure smooth conversion with bank accounts and mobile money, which are the payment rails that are currently dominating the market. An insular CBDC solution would not provide the necessary incentives for people to adopt it. CBDC could be interconnected with Rwanda National Digital Payment System (RNDPS) / eKash, utilizing this interoperable, inclusive, and instant payment system connecting to banks, MFIs, SACCOs, EMIs.

In terms of interoperability with other CBDCs, we cannot make a comprehensive conclusion since there is currently a lack of relevant CBDCs in the region to interoperate with. However, to ensure future interoperability, it is important that a CBDC is designed with the prospects of interoperability with CBDCs of other jurisdictions,

Additionally, interoperability with smart contracts and token-based instruments (or stable coins, once the legislation on virtual assets is in place) should be provided by the private sector, since there is a high degree of customization required due to the sheer number of platforms with different technologies. Care should be taken regarding the regulatory framework, such as limits (see also the following section).

Limits

Recommended	Alternatives
Limited (amount, time, other conditions)	Unlimited

Due to a combination of factors (prevention of fraud and maintaining financial stability), it is advisable to institute limits on CBDC holdings of individuals and businesses' holdings. A particularly appealing option comprises both amount and spending limits: A restricted amount prevents uncontrolled flow from deposit money to CBDC, while spending limits on the receiving side would combat money laundering. Businesses that require higher limits can have them lifted and/or increased by providing documents and/or submitting to higher scrutiny for taxation.

Compensation model: transaction costs and fees

Recommended	Options
To be defined through stakeholder consultations	Free, Free for certain transaction amounts only, or fees on every CBDC transaction

The BNR should conduct extensive rounds of joint consultations and discussions with relevant national payment system stakeholders as the potential compensation model is a local market specific, multisided, and multilayered matter. Such joint discussions are highly recommended to conduct thorough analysis of the proposed CBDC cost sharing arrangements and fee structure within the general understanding that CBDC is a digital version of cash and hence a public good being distributed and operated within the same intermediated architecture.

The discussions should be also guided by the principal of "Do no Harm". The participants would reach agreement on the target level of CBDC adoption that would not undermine the national payment system and its stakeholders. At the same time, it should include an accepted CBDC fee structure that would encourage both merchant and end user. It should be defined not only how and when the private sector stakeholders could potentially recover the costs incurred in CBDC infrastructure, but to what extent and how the public sector can incentivize CBDC adoption. During stakeholder consultations with payment industry representatives, the incentive that was identified as most important was the possibility to provide value-added services on the CBDC platform.

One more aspect is that a CBDC fee structure should be viewed as a CBDC incentive scheme directly impacting its adoption. For instance, merchant fee for CBDC could be set lower than at the existing alternatives and basic payment operations up to a certain amount to be free of charge for end-users. Another guiding aspect is that CBDC could be considered as an additional venue for merchant and end user onboarding for intermediaries. Hence, compensation could be realized from the spectrum of fee-based financial services that would be offered with and on top of CBDC.

Ultimately the compensation model depends on the overall CBDC strategy of the Central Bank. Is the intention to make CBDC a dominant payment instrument in the country or should it rather be a fall back solution to ensure there is still a public payment instrument as a competition to commercial offerings? Is it intended to protect existing players in the payment industry together with their current business model or should a CBDC ecosystem enable innovation? Should the compensation model foster Fintechs to create new innovations, new products and services on top of a CBDC ecosystem? Based on this overall strategy a compensation model could be designed to support these goals of the Central Bank.

2. Technological considerations

Foundational technology

Recommended	Alternatives
Distributed database	Distributed Ledger Technology (DLT), or Hybrid

Even though there is a high level of enthusiasm regarding DLT and ongoing research into more performant implementations, a distributed database is considered as the only mature technology to achieve production-grade performance. Resilience concerns can be adequately addressed through the distribution of the database across datacenters. It should be noted that the choice of a distributed database does not rule out programmability.

CBDC model

Recommended	Alternatives
Token-based	Account-based or hybrid

To facilitate offline payments with instant settlement and to reduce potential governance complexity of a hybrid approach, a token-based solution is considered. Since the CBDC should be universal, and therefore also be accessible by feature phones, the requirement is that the token-based solution should cater for an account-like setup in which users can transact from their online wallets through feature phones.

Availability

Recommended	Alternatives
Both online and offline transactions	Online only

CBDC, just like cash, should be available to everyone, everywhere, anytime as a publicly provided good by the BNR. In a situation where the Internet connection is unavailable for an extended period of time or where there is no access to electricity caused by a power outage, a mere online CBDC application would reach its operational limits. By providing a solution that can operate in both online mode (i.e., with Internet connection) and offline mode (i.e., both payer and payee are not connected to the network), the resilience of the entire system can be improved.

Online CBDC transactions can be cleared and settled instantly between the payer and payee and recorded as settled in the Central Bank ledger.

Offline transactions for token-based CBDC will clear and settle instantly as the token passes from the payer to the payee.

There are several form factors (both support online and offline transactions) that have been proposed on the market or are currently being developed:

1. Smart cards: CBDC tokens can be stored offline on a smart card with a contact or contactless chip. Such smart cards can be used for transactions with compatible POS terminals, without Internet or cellular connectivity.
2. Secure Elements on SIM cards or devices (embedded Secure Elements): CBDC tokens can be stored on the secure elements available on SIM cards or integrated on devices. To enable those devices, respective MNOs and device vendors need to be involved or mandated to support CBDC tokens on the devices. Storing on the secure elements enables the user to either make online or offline payments.
3. Smartphones, which can run an application to grant user access to hosted wallets or ledgers (online). It does not require a secure element inside it as long as there is connectivity to the ledger or hosted wallet platform.
4. Feature phones, whose integration may be achieved by the implementation of USSD messaging to the online hosted wallet systems. This would require both cellular connectivity and a stable connection to the wallet server. Further, potentially existing feature phones can house SIM cards with CBDC tokens which support both mobile connectivity and secure storage/ operations of CBDC tokens – therefore allowing both online and offline CBDC transactions.

Programmability

Recommended	Alternatives
Open	Limited

The advantages of open programmability, which facilitates value-added innovative products and services, are expected to outweigh the arguments of privacy and security. Proceeding with an open level of programmability is tentatively considered; however, further user research should be undertaken to accurately assess the impact on user adoption of such configurations. Caution arises because of security risks and privacy concerns, also because it is unclear at this time what additional risks such programmability brings into the ecosystem and to end users. Further research is recommended.

3. Policy design

Governance

The governance of the CBDC relates to the roles and responsibilities of each stakeholder within the CBDC ecosystem. This section does not provide different options. Instead, it provides an overall recommended model on roles and responsibilities.

The discussion points below undertake to cover the key aspects of establishing and governing a CBDC system, so that the roles and responsibilities could be considered from the wide range of:

- Designing, building, and operating the infrastructure.
- Leading, coordinating, participating in, or supervising the framework.
- Increasing the economic activity and maintaining financial stability and trust.

Maintaining financial stability and trust is a responsibility of the Central Bank. However, the other points could be outsourced, or partnerships with technology service providers could be established in a hybrid/federated model.

Finally, the Central Bank should make sure that it has appropriate resources and tools in place to monitor market signals, scheme enforcement and updating, to conduct supervision, to establish controls and technical maintenance.

The proposed governance model presents the roles and responsibilities in the CBDC ecosystem based on the currently existing two-tier banking system, and undertakes to build on the strengths and experience of each stakeholder. However, it should be noted that these functions can be rearranged relatively flexibly based on the decision of the Central Bank and the cooperation with the private and public sector. It could be argued that the suggested setup should minimize the invasiveness of the CBDC infrastructure to the currently existing payment system. A detailed overview of the proposed governance can be found in the Feasibility Study Report.

Legal

Recommended	Alternatives
Full legal tender	Limited legal tender

Legal implications of a CBDC raise a number of questions in Monetary, Central Bank, and Payment Systems Laws. Some of the most significant examples are if CBDC should be considered as an existing monetary unit and a currency.

Given the current challenges of digital literacy, especially in rural areas, and the requirement to have technical infrastructure, it is not clear if the law can oblige the general public to accept CBDC. Therefore, the conditions that need to be in place to implement a CBDC as legal tender need to be carefully identified and

should be included in the legal definition of CBDC, potentially as 'conditional legal tender'.

The Feasibility Study concludes that CBDC in Rwanda should ideally have the same legal tender status as banknotes, with the specific note of the aforementioned conditions. For the purpose of risk management and the mitigation of AML and disintermediation risk, it is suggested that the BNR considers holding- and transaction limits for CBDC. Also, it should further consider alternate limits in the case that CBDC can be used for offline payments.

8. Conclusion and way forward

The feasibility study finds that there are opportunities for improvements in the payments landscape of Rwanda. The identified Sweet Spots are well-positioned to address these opportunities. There are conditions that prevent the study to conclude yet with a high level of confidence that Rwanda needs to introduce a CBDC in the immediate or short term.

The primary condition, or Pitfall, is the topic of public adoption, which warrants the need for deep user research. How users would treat an offering of CBDC should therefore be carefully investigated prior to decision-making. For the medium-to-long term, the need for a CBDC could increasingly materialize for the BNR, given the trajectory of ongoing digitization in payments and the need for central bank money to continue being a monetary anchor at such a digitized economy.

As a way forward with further investigation, the research recommends to proceed iteratively and cautiously with multiple time-lined verification stages in terms of CBDC PoCs and piloting. The identified Sweet Spots constitute a solid starting point for initiating formal CBDC experimentations in Rwanda. This process could also lead to identifying more opportunities and possibilities feeding back into the decision-making process as the BNR moves forward. Overall, continuing CBDC explorations would strategically position the BNR for a future CBDC launch as it would expand its institutional knowledge, skills and expertise in this important domain. It will also align the BNR with other central banks actively exploring CBDC in Africa and other regions of the world, so that it could engage with them at joint CBDC projects, for instance in experimenting cross border CBDC transactions.

Overall, continuing the engagement with CBDC e.g., with a PoC, pilot or other experimentation levels would generate various benefits for the BNR in terms of building the knowledge base, skills, and experiences in this new but rapidly evolving domain. This would strategically position the BNR in a favorable condition in terms of readiness, in the case that a decision to go forward with CBDC in the future is made. It is within this context that Central Banks around the world have been extensively exploring CBDC at various levels of experimentations for many years without necessarily linking such experimentations with the immediate need of reaching a final decision of whether to launch it in the short term.

As a next step after this feasibility study, user education and research should be conducted to validate whether a theoretical CBDC, according to the proposed design, addresses user needs and would be actively used as a complement or substitute to existing payment methods. Sequentially, or potentially iteratively as part of the same project, a PoC could be conducted to explore identified use cases.

After drawing conclusions from the user research and use case exploration the National Bank of Rwanda should decide whether to continue the CBDC exploration in the form of a pilot, or if the exploration should be paused or ended. If continued, only after a successful pilot should the BNR decide whether to issue a production level CBDC.

Appendix 1

Scoring of CBDC opportunities versus alternative options[35]

Opportunity		CBDC		Alternative option		CBDC overall	Challenge significance
		Suitability	Feasibility	Suitability	Feasibility		
1	Increase resilience against possible network outages, power failures and natural disasters	2	2	2	1	0.5	2.5
2	Improve innovation and competition	2	3	2	2	0.5	3
3	Contribute to achieving the cashless economy national initiative across time	2	2.5	1.5	2	0.5	2.5
4	Develop faster, cheaper, more transparent and more inclusive cross-border remittances	2.5	2.5	2	2	0.5	2.5
5	Enhance financial inclusion by expanding access to formal financial services and empowering everyone to participate in the digital economy, even people without a bank account / mobile wallet, a mobile network, or access to a smartphone	2	2	1	3	0	3
6	Develop payment solutions not reliant on 3G and 4G networks	2	3	2	1	1	2
7	Widely deploy low-cost affordable devices for payments, such as smart cards and feature phones	2	3	2	3	0	2

[35] More details can be found at the Feasibility Study and its appendices.

Opportunity		CBDC		Alternative option		CBDC overall	Challenge significance
		Suitability	Feasibility	Suitability	Feasibility		
8	Further support MSME financing through SACCOs and MFIs	3	3	3	2	0.5	2
9	Increase levels of financial and digital literacy	1	1	2	2	-1	3
10	Widely deploy simple-to-understand and easy-to-use payments	3	3	2	3	0.5	1.5
11	Reduce costs of digital payments on the market	2	1	2	1	0	2
12	Enhance the efficiency of the mobile money ecosystem	2	2	2	1	0.5	1
13	Enhance the efficiency of government payments	2	2.5	2	1.5	0.5	1.5
14	Maintain monetary sovereignty and address the risk of unregulated privately issued digital "currencies" or virtual assets	2	2	1.5	2	0.25	1
15	Develop safeguards against frequent incidences of fraud	1	1	1	1	0	1.5

[36] Atlantic Council CBDC Tracker.
[37] Gaining momentum – Results of the 2021 BIS survey on central bank digital currencies. BIS Papers No 125. May 2022.

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