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CONSEQUENCES OF CBDCS, STABLECOINS AND ALTERNATIVE EMERGING PAYMENT SOLUTIONS ON THE MONEY ECOSYSTEM

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FOREWORD

In an era marked by unprecedented technological advancements and shifts in financial paradigms, the very concept of money is undergoing a transformation that challenges traditional norms and invites us to rethink our understanding of economic systems. As we stand on the cusp of this transformation, it becomes imperative to dissect, analyze, and anticipate the changes that are reshaping the money ecosystem. This article serves as a seminal work in that direction, offering a comprehensive exploration of the evolving landscape of digital currencies, including retail and wholesale Central Bank Digital Currencies (rCBDCs and wCBDCs), stablecoins, and cryptocurrencies.

The article delves into the complexities of a three-tier money ecosystem, a departure from the traditional two-tier system we have known. It introduces us to new forms of money and their issuers, setting the stage for a future where these digital assets could potentially coexist and even complement one another. But this future is not without its challenges and uncertainties. Regulatory frameworks, technological hurdles, and market dynamics all play a crucial role in determining the trajectory of these emerging forms of money.

What distinguishes this document is its nuanced perspective. It not only recognizes the transformative potential of emerging digital assets but also delves into the associated uncertainties and risks. The article comprehensively explores key factors, from the impact of regulatory frameworks to the necessity for compatibility between various monetary forms. It functions as both an informative guide and a catalyst for critical thinking, arming the reader with the insights needed to grasp new paradigms while questioning existing ones.

As someone deeply engaged in overseeing the integration of Distributed Ledger Technology (DLT) into conventional financial systems, I consider this document an essential asset. It resonates with my goals of rolling out a new DLT regime and offers vital insights for effective oversight and the assimilation of DLT into the traditional economic landscape.

In quoting Niels Bohr, the document aptly reminds us that ***"prediction is very difficult, especially if it's about the future."*** Yet, it takes the bold step of making educated conjectures about what the future could hold. It is this blend of caution and forward-thinking that makes this document a must-read for policymakers, financial experts, and anyone interested in the future of money and finance.

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MONIES, NEW MONIES, AND CHALLENGER MONIES

There are three commonly accepted forms of money. First, there is cash, a liability of the central bank in physical form, available to anyone. Second, reserves in the central bank's accounts, which are liabilities of the central bank in digital form, are available to financial institutions only. And third, commercial bank money, which is a digital liability of commercial banks in the form of deposits. These three, are forms of money that interoperate, i.e., that may be easily converted into another type of money.[1]

Retail payment solutions have pivoted around these three types of money. Debit cards, credit cards, checks, and electronic transfers, all are payment instruments that enable the user (e.g., an individual or a firm) to start a transaction that will affect the balances in commercial bank money and that will eventually involve an exchange of central bank money (cash or reserves) among commercial banks.

All this started to change in the aftermath of the global financial crisis that started around 2007. Renewed trust in computers and cryptography to free and protect the people, along with discontent with the traditional financial system, pushed a proposal for a new type of money, bitcoin, which was rolled out in 2009 by the now-famous pseudonym Satoshi Nakamoto.

Bitcoin aims at becoming a new form of money, namely *a peer-to-peer version of electronic cash*. Instead of trusting a central bank as the sole issuer of money and the financial system as its intermediary, bitcoin put forward a slowly and predictably issued (i.e., scarce) digital token with neither a backing asset nor issuer, with transactions being independently recorded in an encrypted, incremental, and distributed ledger (i.e., the blockchain). Bitcoin uses cryptographic proof instead of trust in the central bank and commercial banks as issuers of money. Instead of using financial institutions and infrastructures (e.g., central banks, commercial banks, payment services providers, and automated clearing houses), bitcoin allows users to hold the keys to their digital tokens and transact directly. As a peer-to-peer version of cash, the original purpose of bitcoin was to serve the three traditional functions of cash: store of value, medium of exchange, and unit of account.

1 For instance, an individual can easily convert her bank deposits (i.e., commercial bank money) into cash by withdrawing from an ATM or a banking office, and vice versa. Likewise, a bank can convert its reserves at the central bank into cash or into bank deposits at another commercial bank, and vice versa.

Bitcoin kick-started many other similar projects, which are now altogether commonly referred to as cryptos.[2] The crypto ecosystem has grown manifestly: as of January 2023, there are about 22,209 cryptos; a 24-hour trading volume of about U$ 27.3 billion; a market capitalization of circa U$ 0.8 trillion (with a U$ 2.8 trillion peak in November 2021)[3], with bitcoin contributing about 40 per cent of the market capitalization, followed by ethereum (19 per cent).[4]

However, the crypto ecosystem not only grew in the number of cryptos, trading volume, and market capitalization. The crypto ecosystem realized that its inherent volatility and weak interoperability with the fiat ecosystem posed serious problems to its growth. Then, from within the crypto ecosystem, stablecoins emerged as a digital ancillary solution to the volatility and interoperability problems.[5]

In their simplest form, stablecoins are blockchain-based privately-issued digital tokens that aim to maintain a stable value relative to an asset or pool of assets, either by asset-backing the tokens with money, securities or commodities or by actively intervening in the token supply and demand (i.e., algorithmic stablecoins)—thus, countering the cryptos volatility problem. Also, stablecoins enabled a way to circumvent the regulatory burden and inefficiencies of using fiat money to exit a crypto position. Later, agents from the crypto and fiat ecosystems realised that stablecoins—if stable–could work as payment instruments too, with great potential for efficient cross-border payments. In unstable economies with high inflation and depreciation (e.g., Argentina, Turkey, Venezuela), agents discovered that stablecoins could serve as stores of value too.

Today, it is rather straightforward to say that bitcoin and other cryptos do not fulfil any of the three traditional functions of money, thus they are not to be considered monies—at least from a classic viewpoint. First, albeit the periods of spectacular price increase, cryptos' wild volatility and extreme drawdowns make them a questionable store of value. Second, as a medium of exchange, cryptos acceptance is low and dubious.[6] Third, to the best of our knowledge, no crypto is generally used to value goods and services, record debts, or make everyday calculations. Interestingly, even where bitcoin has been introduced as legal tender (e.g., El Salvador), cryptos have been unable to fulfil the traditional functions of money.

Although neither bitcoin, other cryptos nor stablecoins can be considered as monies today, they could be considered as challenger forms of money—after all, they are trying to become new forms of money. Further, cryptos and stablecoins should also be regarded for their contribution to the evolution of money. It is most likely that the rise of cryptos and stablecoins has been one of two key factors in pushing forward a long-overdue revision of what we think money is and should be. The decline of cash as a medium of exchange is the other key factor. Both factors have pushed central banks to rethink money.

2 Originally, bitcoin and the similar projects that followed were referred to as cryptocurrencies. However, to avoid an equivocal reference to currencies and–indirectly–to money, we will refer to them as cryptos.

3 For comparison purposes, as of January 2023, the market capitalization of Apple is about U$ 2.1 trillion, with a U$ 2.9 trillion peak in December 2021.

4 Based on public data reported by Coinmarketcap.com, retrieved on January 5th, 2023. Data includes stablecoins—explained next.

5 It is common to refer to stablecoins as cryptos. Although they share a common origin, this is debatable because of the notorious differences between them. We keep both concepts apart to allow for a clearer discussion.

6 For instance, PYMNTS & BitPay (2022) report that (i) the crypto acceptance at many retailers is quite low, thus crypto holders have limited options when it comes to paying for purchases at many retailers, (ii) crypto is still a big retailer game, with smaller merchants less likely to accept crypto as a payment method, (iii) most purchases with crypto, about 93 per cent, are made with digital wallets such as PayPal and Venmo (i.e., non-native crypto wallets) that convert crypto into fiat prior to making a purchase. Regarding the latter, it is arguable that being forced to convert crypto into fiat before making a purchase isn´t true acceptance as medium of exchange; it is *countertrade* (Scott, 2022).

The outcome of this rethinking process is what we know as central bank digital currencies (CBDCs). CBDCs are digital versions of money issued by the central bank, available in two versions, wholesale (wCBDCs) and retail (rCBDCs). The fundamental difference between these two versions is that wholesale is available to financial institutions only, whereas retail is available to all agents in the economy.

Arguably, wCBDCs are not a new form of money. There is a current form of money that is a digital liability of the central bank available to financial institutions only: reserves in the central bank's accounts. The new case for wCBDCs has to do with (i) making reserves available to a broader set of legacy financial institutions (e.g., non-prime banks and non-banking financial institutions) and new entrants to the financial ecosystem (e.g., e-money institutions, fintechs, bigtechs), and (ii) expediting local and cross-border payments among financial institutions. Therefore, as reserves are already digital, wCBDCs represent a better way for financial institutions to use them, without any noticeable change for the public (Prasad, 2021).

On the other hand, rCBDCs are a new form of money.[7] A rCBDC is akin to a digital version of cash, issued by the central bank and available to all agents in the economy. Interestingly, there isn't a single motivation but a collection of complementary motivations for central banks to design and roll out a rCBDC. The most common motivations aim at preserving monetary sovereignty–against the unwanted dominance of private forms of money[8]; financial inclusion; payment system efficiency and resilience; and financial stability. In this vein, based on conceptual as well as technological advance (Prasad, 2021), rCBDCs have become the fourth form of money.

Yet, there is a fifth form of money, neither issued by the central bank nor the commercial banks. Recently, electronic money institutions[9] have added a new form of money consisting of balances in non-banking institutions that are–fully–backed by cash and deposits with a commercial bank. This is the case with PayPal, Wise, Venmo, and M-Pesa, which allow users to make payments with their own-issued liabilities; with these solutions, a user can convert her cash or deposits into money in the balance in PayPal or M-Pesa to make payments, and can convert back that balance into bank deposits or cash again; that is, they are interoperable. These forms of money are widely accepted in the market they intend to serve, e.g., PayPal in online merchants, M-Pesa as mobile money in Kenya, Venmo as a mobile wallet in the United States, etc. Hence, e-money is not a challenger form of money anymore but the fifth (new) form of money.

7 Although rCBDCs are recognized as a new form of money, digital versions of cash were available to the general public several decades ago with a different name. That is the case of Avant, Bank of Finland's electronic cash system, which was rolled out in 1992 and discontinued in 2006. Avant is commonly recognized as the first rCBDC ever to exist, whose main motivation was *to replace coins and small denomination banknotes* (see Grym, 2020).

8 The dominance of private forms of money, local or foreign, could affect the ability of a central bank to influence the domestic economy through monetary policy and to act as a lender of last resort.

9 Directive 2009/110/EC of the European Parliament defines electronic money as "electronically [...] stored monetary value as represented by a claim on the issuer which is issued on receipt of funds for the purpose of making payment transactions [...] and which is accepted by a natural or legal person other than the electronic money issuer". Accordingly, an electronic money institution is a legal person that has been granted authorisation to issue electronic money. The key functional difference with commercial banks is that electronic money institutions can't take deposits and should not grant credit from the funds received or held for the purpose of issuing electronic money.

WHERE ARE WE NOW?

Recent news has unveiled interesting issues regarding the money ecosystem previously portrayed. First, countries that have rolled out rCBDCs or that are in pilot phases have reported low and slow adoption. That is the case of the Sand Dollar in the Bahamas (Walker, 2022), the e-Naira in Nigeria (Anthony, 2022, Osae-Brown, et al., 2022, Ree, 2023), and the e-Yuan in China (Feng, 2022, PYMNTS, 2022). This is a cautionary tale about how the adoption of new forms of money is not trivial, even if it is money issued by the central bank with legal tender status. Likewise, it is a call for designing rCBDCs with a convenient balance between the use case as a payment instrument (i.e., for consumers and merchants to use) and the central bank's motivations; otherwise, the adoption could be ill-fated from the start, with the central bank's reputation at risk. Also, it is evidence of the lack of a clear first-mover advantage when rolling out a rCBDC (see Isaacson, et al., 2022).

Second, stablecoins have proved to be not as stable as envisaged. The failure of TerraUSD, an algorithmic stablecoin that at its peak was the third in market capitalization after USDT (i.e., Tether) and USDC, called the attention of market participants to the shortfalls of this potential form of money when not adequately backed and to the contagion effects in the crypto ecosystem—in this case, in the form of the failure of a well-known crypto borrowing and lending platform, Celsius. Further, the failure of TerraUSD heightened the concerns about how stablecoins are backing their peg. As stablecoins are backed by an attested—yet not audited—mix of assets that includes, cash, deposits, securities, loans, and commodities[10], with their issuers lacking proper transparency and regulation, their ability to continuously keep the peg and to withstand runs is to some extent uncertain.

Nevertheless, stablecoins' growth and potential to be used as a medium of exchange and store of value under certain conditions are unambiguous. In this vein, stablecoins that are properly backed by fiat money may be regarded as the sixth form of (challenger) money, close to the fifth form of money, i.e, e-money. After all, as highlighted by Scott (2022), stablecoins and e-money are much the same because they both are backed with central bank's and commercial banks' money, yet stablecoins operate based on distributed ledger technology and use other backing assets (e.g., commodities) too. Interestingly, even the

10 For instance, based on public information available in https://tether.to/en/transparency/#reports as of January 1st, 2023, USDT backing relies on cash, cash equivalents, short-term deposits, commercial paper (82.45%); secured loans (9.02%); corporate bonds, funds, and precious metals (4.69%); and other investments (3.85%). Regarding the first category, 70.71% correspond to US Treasuries; 12.66% to Money Market Funds; and 10.83% to cash and bank deposits.

issuers of stablecoins publicly highlight their close relation to fiat money while they avoid any explicit relation to cryptos.[11]

Third, more than a decade after its inception, bitcoin has not reached the status of a credible form of money or challenger money, i.e., the promised peer-to-peer version of electronic cash. The aspiration of turning a scarce decentralized digital token system into a monetary system has proven to be elusive. Instead of a medium of exchange, people put their savings in bitcoin and investors bet on its price (Prasad, 2021). Trading bitcoin for capital gains has made the view of bitcoin as an investment[12] prevalent within the crypto community; also, outside the crypto community, bitcoin and alike are nothing but tokens that are traded as goods within the standard monetary system (see Scott, 2022). There are neither signs of nor reasons for a reversal in this trend.[13] For bitcoin or another crypto to turn into the envisaged monetary system, the entire monetary ecosystem would need to find that the main existing central banks' monies have failed and are not to be trusted as the backing of the other forms of money. After both recent severe quantitative easing and quantitative tightening periods, there is no evidence of such an apocalyptic fate for the existing monetary system. On the contrary, even with high inflation, scarcity has been a negligible reason for cryptos to become the mainstay of the monetary system, even in unstable economies with high inflation and/or depreciation—where the public prefers to use other countries' monies instead.[14] What is more, not even where bitcoin has been given legal tender status (e.g., El Salvador), is used as money. All in all, to date, evidence points out that central bank money will continue to be the mainstay of the money ecosystem—whereas cryptos will play no role.

Therefore, besides the traditional three forms of money, rCBDCs and electronic money are new forms of money, whereas stablecoins remain a well-positioned challenger form of money. For the foreseeable future, cryptos will remain tokens traded as goods in the monetary system, with no credible potential to become a form of money or challenger money.

As rCBDCs and stablecoins are the most recent entrants to the money ecosystem, they are in the spotlight. The most interesting question is whether the stablecoins and rCBDCs are going to coexist or compete. Are they complementary or substitute forms of money? How will rCBDCs and stablecoins reshape the money ecosystem?

THE THREE-TIER, SIX-MONEY ECOSYSTEM

In our view, rCBDCs and stablecoins' complementary nature suggests that coexistence as forms of money is the most likely outcome, whereas cryptos' features force them to remain outside the money ecosystem. And there are good reasons for these conjectures.

11 For instance, the description of USDT (retrieved from https://tether.to/en/ on January 10, 2023) states that "Tether is a blockchain-enabled platform designed to facilitate the use of fiat currencies in a digital manner". When describing what USDT is, there is no mention of cryptos or the crypto ecosystem—just to fiat money.

12 Panetta (2022) argues that, in fact, cryptos are a gamble disguised as an investment asset.

13 In the case of bitcoin, not only the investment view is prevalent, but several well-known problems deter it from becoming a means of exchange, such as lack of speed and scalability (now being addressed with Lightning Network, a third-party solution); wild price volatility; volatile fees; lack of security and consumer protection; requiring some degree of expertise to be able to onboard and manage the holdings, unless using exchanges–which have been under the spotlight permanently (e.g., Mt.Gox, FTX).

14 Interestingly, high inflation worldwide has coincided with sharp decreases in the price of bitcoin and most cryptos. From a conceptual viewpoint of bitcoin, not only the price should have increased but its role as first-tier money should have materialized. Yet, as with any other asset traded in the standard monetary system, as liquidity decreased, bitcoin prices plummeted.

The three-tier depiction of the money ecosystem (see Diagram 1) can help us understand how the different forms of money and challenger money interact nowadays. In a subsequent section, we will evaluate, from a qualitative viewpoint, how this three-tier depiction could evolve to accommodate these new entrants to the money ecosystem while increasing the efficiency and safety of the payment system.

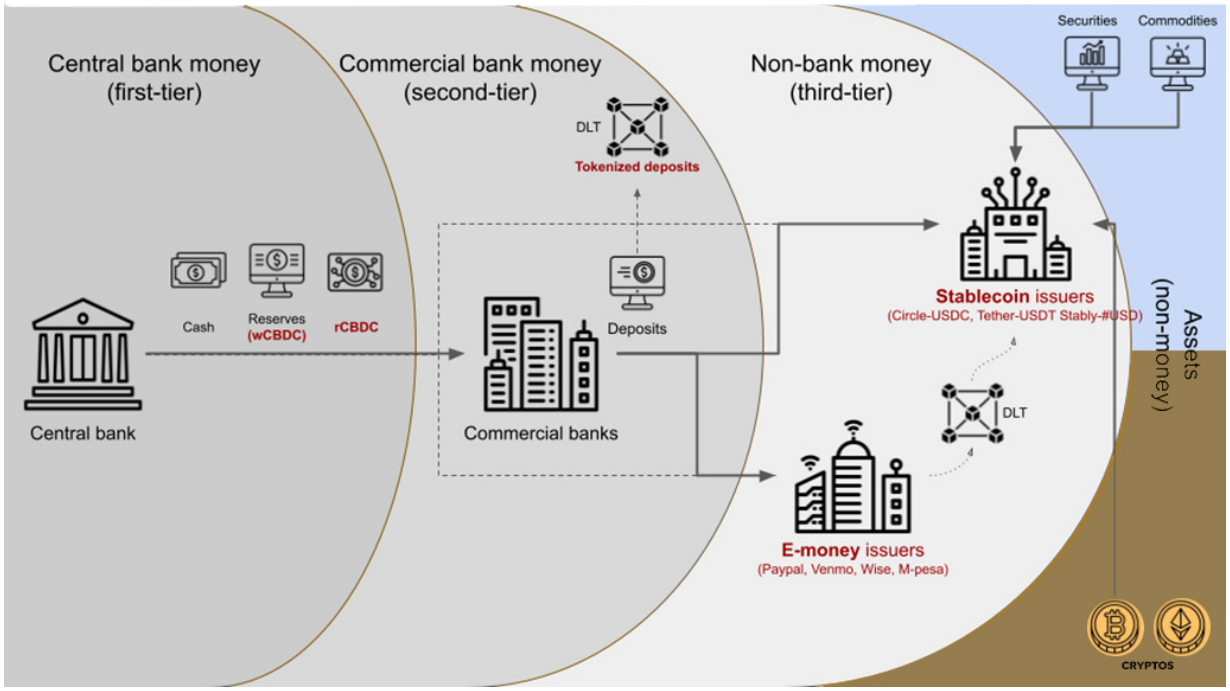

Diagram 1. A three-tier money system. Arrows represent backing relations from the issuer to the holder of the liability; dashed arrows represent backing relations yet to be explored; dotted arrows correspond to an equivalence based on the use of a particular technology (i.e., stablecoins differing from e-money issuers by using DLT instead of centralized systems). The central bank money (i.e., cash, reserves, rCBDC) is first-tier money. Commercial bank money (i.e., deposits), which is–partially–backed with central bank money, is second-tier money, along with tokenized deposits (i.e. digital representations of bank deposits that are traded on a DLT system). Money issued by e-money issuers, which is fully backed with bank deposits, is third-tier money. Also, stablecoins, backed with bank deposits, cash, and assets, are third-tier money. Cryptos remain tokens traded as goods or assets without serving as backing in the money system—thus, they are outside the three-tier money system. Source: authors' design.

In the first tier of Diagram 1, the central bank issues three different liabilities, namely cash, reserves (the primitive form of wCBDC), and rCBDC. Today, commercial banks, in the second tier, hold cash and reserves to back the deposits (i.e. commercial bank money) and a new form of money that is being discussed nowadays: tokenized bank deposits (i.e. digital representations of bank deposits that are traded on a DLT system)[15]. In the future, as explained below, we expect rCBDC to be available for backing bank deposits too.

Deposits issued by commercial banks in the second tier, along with cash, are used by stablecoin issuers and e-money issuers to back their issuance of third-tier money; only stablecoins use securities and commodities to back their liabilities too. To the best of our knowledge, stablecoins issuers and e-money issuers are not allowed to access reserves at the central bank, whereas it is unclear whether they will be able to hold rCBDCs as they are introduced into the system. As we explain below, there are good reasons for money issuers in the third tier to access and hold reserves, rCBDCs and wCBDCs.

15 Discussions about tokenized bank deposits are rather recent. See German Banking Industry Committee (2022) and Oliver Wyman and J.P.Morgan Chase & Co. (2023).

Finally, neither used as money nor used to back any form of money in this three-tier system, cryptos are portrayed in Diagram 1 as assets. This is consistent with Scott (2022), who highlights that bitcoin (and alike) fail to operate as money and are being absorbed as goods to be traded within the standard monetary system. Two interesting observations about cryptos' failure to become a form of money or challenger money are worth stating. First, it is their lack of backing that makes cryptos stand little chance of competing with fiat currencies in the long run (Prasad, 2021) and offer no clear benefits to society (Panetta, 2022). Second, paradoxically, stablecoins, a subproduct of the crypto ecosystem, are closer to money than bitcoin and alike precisely because they are issued by an institution and backed by first and second-tier monies[16].

WHERE ARE WE HEADING? COEXISTENCE AND COMPETITION

As rCBDCs and stablecoins enter the money ecosystem, they will both accommodate and find their niche among users. We expect monies in the second and third tiers to specialize and compete based on the use cases that fit their features the best; after all, although it is rather difficult for the users (i.e., consumers and merchants) to differentiate among distinct forms of digital money, each one of them has features that make them stand among the others from a user perspective.

We expect cash and rCBDCs to have generic and complementary use cases for the public, coexisting with other forms of money. Regarding rCBDCs, a group of central banks and the Bank for International Settlements have agreed on three common foundational principles for CBDC issuance, where the second is *coexistence*, in the form of complementarity with other forms of central bank money and the coexistence with second-tier money.[17]

On the other hand, within the issuers of money, we foresee coexistence conveying a positive outcome: a safer payment ecosystem. As we expect wCBDCs and rCBDCs to be accessible

16 Algorithmic stablecoins are excluded deliberately as they have no backing and have proven not to be stable enough.

17 The central banks are Bank of Canada, European Central Bank, Bank of Japan, Sveriges Riksbank, Swiss National Bank, Bank of England, and Board of Governors Federal Reserve System. The other two principles are *do no harm* (i.e., supporting the fulfilment of public policy objectives and not interfering with or impeding a central bank's ability to carry out its mandate for monetary and financial stability) and *innovation and efficiency*.

to a broader set of banking institutions, payments system providers, e-money issuers, and stablecoins issuers, the introduction of CBDCs could have a positive impact on the quality of assets that back the second and third tiers of the ecosystem. Because regulation requires money issuers to differentiate among distinct forms of money in the ecosystem, competition is unlikely, e.g., the risky nature of stablecoins vis a vis rCBDCs will make the former unfeasible as money to back commercial bank money and e-money. Therefore, access to a broader set of first-tier money and adequate regulation and supervision of new and challenger forms of money, could make the payment ecosystem safer.

Safer coexistence by broader access to first-tier money

It is clear that rCBDCs and wCBDCs are monies. Similar to cash, it is expected that rCBDCs would be available to households, firms, government, and financial institutions, whereas wCBDCs would be available to financial institutions, payment system providers, e-money issuers, and stablecoins issuers. As in Diagram 1, akin to the other types of central bank money, rCBDCs and wCBDCs could also serve as part of the backing of the second and third tiers. This ability will depend on how rCBDCs holdings are regulated, wCBDCs access is conferred, and to the extent that cash continues its steady decline.

For the second tier, regulation will likely allow commercial banks to hold rCBDCs to, for instance, serve customers' requests to top up their rCBDC wallets—as commercial banks also hold cash to serve customers' requests to withdraw via ATMs— or as commercial banks convert merchants' rCBDCs to deposits. As such, those rCBDCs holdings could also serve commercial banks to comply with reserve requirements and liquidity ratios, which is a function that third-tier monies are unlikely to perform as they convey higher counterparty, market, and liquidity risks.

Similarly, rCBDCs could serve to back e-money in the third tier, allowing e-money issuers to hold central bank digital liabilities directly–with no counterparty risk vis a vis commercial bank deposits. Furthermore, instead of or in addition to holding cash, stablecoins issuers could hold rCBDCs to back their pegs. Also, as stablecoins become regulated, it is most likely that regulation will require high-quality reserves, in the form of information-insensitive securities (see Gorton and Metrick, 2010), with first-tier money as a natural choice. This is also consistent with considering systemically important stablecoins issuers as financial market infrastructures, which would allow them to settle transactions in a stablecoin only if credit and liquidity risks make it *an acceptable alternative to the use of central bank money* (see CPMI-BIS & IOSCO, 2022). Thus, depending on how regulation evolves, we find rCBDCs and wCBDCs could make stablecoins and e-money safer, making the entire money ecosystem safer as well.

Consequently, it is apparent that stablecoins and rCBDCs do not compete for commercial banks' and e-money issuers' attention; simply put, rCBDCs and wCBDCs perform some functions that stablecoins can't. And, given the decrease in transactional use of cash, rCBDCs could be a true complement to physical central bank money that commercial banks will be more willing to distribute to the public and use for their business as usual.[18]

18 As stated before, the decrease in transactional use of cash is one of the main reasons for central banks to roll out rCBDCs, which are a source of concern for commercial banks–who fear that rCBDCs could cause deposit migration, narrower profit margins, and runs. Interestingly, as suggested by Scott (2022), commercial banks and other private payment system providers were spearheading cashless and cash-free initiatives worldwide.

Specialization by focusing on distinct use cases

The role of rCBDCs is not limited to backing monies in the second and third tiers. The end-user case for rCBDCs is the public, namely households (consumers) and firms (merchants). As it is rather difficult for the public to differentiate monies by their function in the three-tier ecosystem[19], the issuers will face an interesting challenge to position their forms of money. If rCBDCs allow anonymity for low-value transactions, this could attract users who value privacy and that do not trust private forms of money that could try to monetize or share their data. If the public values a banking institution as the usual all-around provider of a broad set of financial solutions (e.g., payments, credit, savings, investments), deposits could be a smart choice. If cross-border payments, interoperability with the crypto ecosystem, and store of value in inflationary countries matter, stablecoins could be the preferred form of money. If multi-currency balances, online payments, social payments, shared payments, micro-investments in financial assets and cryptos are valued, e-money could be an interesting choice of money. That is, the competition among rCBDCs, stablecoins, and e-money for the end-users could foster specialization and innovation.

In this vein, the existence of several forms of money could result in the specialization of money around the classical functions of money, i.e., store of value, medium of exchange, and unit of account. Most likely, third-tier monies will focus on the medium of exchange function. Stablecoins and e-monies will compete for the end-users that are looking for better (i.e., faster, cheaper, more flexible and advanced) payment solutions; in the case of stablecoins, smart contracts and cross-border payments could be differentiating factors, whereas ease of use is perhaps the immediate attraction of e-money.

rCBDCs and commercial bank money will continue to serve as mediums of exchange, but they will have tough competition as stablecoins and e-money face lower entrance barriers, whereas fintechs and big techs further disrupt with their unique ability to reach end-users, i.e., conquering the last mile of the retail payments chain. Interestingly, the decreasing use of cash as a payment instrument, the low adoption of rCBDCs wherever they have been rolled out or piloted, and the urge to increase financial inclusion despite the longlived efforts to bank the unbanked could be signals of what central banks and commercial banks will face when trying to remain relevant vis a vis new forms of money.

Regarding the store of value function, as all forms of money in the three-tier system are denominated in the unit of account of the economy, the competition will come in the form of remuneration. Cash is the lower bound of remuneration–unless negative interest rates are enforced. Most probably, rCBDCs will mimic cash as a non-remunerated (or low remuneration) form of money; otherwise, as feared by commercial banks and central banks, deposit migration to rCBDCs could impact banks' business as usual and, eventually, affect financial stability.[20] On the other hand, private forms of money in the second and third tiers will be able to compete by means of remunerating their users' funds—increasing the challenges for cash and rCBDCs to remain relevant among consumers and merchants. As aforementioned, due to their cross-border nature, stablecoins also provide a store of value function to people in countries with poor monetary records, which is a particularly important factor for other forms of money in those countries as stablecoins could push for a de facto dollarization of the economy—a direct threat to monetary sovereignty.

Only central bank-issued money will be the all-around form of money, fulfilling the three classical functions, namely store of value, medium of exchange, and unit of account. However,

19 That is, when a consumer faces the decision to use a balance in a mobile wallet, it is most likely that her decision won't be affected by where each form of money is in the three-tier ecosystem in Diagram 1 or who the issuer is.

20 Features such as tiered remuneration schemes and caps on balances or transactions, could deter deposit migration when rCBDCs are remunerated.

most importantly, the central bank-issued money would be the only one able to fulfil the unit of account function; it is the money issued by the central bank the one that sets the standard unit of measurement of goods and services, with all other forms of money adhering to the standard.[21]

FINAL REMARKS

In this article, we depict the money ecosystem and discuss how the entrance of rCBDCs, wCBDCs, stablecoins, and cryptos could reshape it in the not-so-distant future. Regarding our depiction, we find that we have transitioned from the traditional two-tier money ecosystem of the central bank and commercial banks' monies to a three-tier one, with e-money and stablecoins issuers as new and challenger forms of money, respectively. Today, cryptos remain outside the money ecosystem, incapable of entering the existing one or establishing one of their own.

About how the shape of the ecosystem could change, we acknowledge our limitations to foresee the future but provide a somewhat likely outcome of the entrance of rCBDCs, wCBDCs, and stablecoins from two viewpoints: first, as money to be used by the public and second, as money to be used among the issuers of money. Based on the main known features of each type of money in the three-tier ecosystem and their corresponding issuers, we conjecture that we should expect competition and specialization with respect to the end-users of money (consumers and merchants); we expect competition for niches will foster specialization and innovation, with limited space for *cannibalism* between different types of money.

On the other hand, we conjecture that we should expect the coexistence of different types of money within the issuers of money. Within the three tiers of the money ecosystem, money issuers can't choose freely among the different types of money because each one of them has particular features that determine its role in the ecosystem. For instance, we neither expect commercial banks to use stablecoins as reserves nor expect e-money issuers to be allowed to back e-money with stablecoins. As there is some sort of regulatory pecking order for money according to their position in the three-tier ecosystem, coexistence due to complementarity is the most likely outcome. Interestingly, the entrance of rCBDCs and

21 In the case of bitcoin and alike, not adhering to the standard makes them an unsuitable medium of exchange; they can't have a stable value compared with the unit of account in which goods and services are priced. On the other hand, this is why stablecoins are closer to money than cryptos.

wCDBCs could strengthen the money ecosystem if issuers in the second and third tiers are allowed to hold them to back their monies.

Nobel laureate in Physics Niels Bohr is usually quoted as saying "prediction is very difficult, especially if it's about the future". Hence, there are several known uncertainties that we should acknowledge. First, regulation will be the key to how the entrance of rCBDCs, wCBDCs, and stablecoins reshape the money ecosystem.[22] For instance, if stablecoins become regulated, they will likely be required to use cash, rCBDCs and wCBDCs as the foundations of their pegs. As highlighted by Panetta (2022), in the absence of a risk-free anchor with digital central bank money, stablecoins represent an overambitious attempt to create a risk-free digital asset backed by risky assets. Thus, if stablecoins are not required to use central bank money as the foundation of their pegs, a scenario in which stablecoins turn from a challenger form of money into a new form of money becomes less likely as it would be more difficult for them to become mainstream amid questions about their ability to back the peg under normal and stress scenarios.

Second, one defining feature among the monies in the first and second tiers is interoperability, i.e., they may be easily converted into another. We have not addressed the interoperability with monies in the third tier. Interoperability of e-money and stablecoins with other forms of money in the first and second tiers is necessary for them to work as money. Today, e-money and commercial bank money interoperate, but interoperability with rCBDCs is unknown—yet likely. Stablecoins interoperability today is, to the best of our knowledge, limited. Most importantly, interoperability could create incentives for end-users to hold and use several forms of money simultaneously as they could access different features without worrying about how to convert one form of money into another. Alternatively, private money issuers could try to offer several forms of money, e.g., a commercial bank issuing stablecoins and e-money; this an interesting and rather likely scenario that depends on how regulation will tackle the vertical integration along the three-tier money ecosystem.

Third, as mentioned previously, stablecoins have proved to be not as stable as envisaged. We can't rule out that lack of regulation and transparency could end in the demise of stablecoins as challenger forms of money. This does not mean that stablecoins will fail, but that they could have a marginal position in the money ecosystem—closer to that of cryptos today. Yet, the stablecoin industry failing amid the questions about the level, quality, and transparency of the pegs, amid the contagion from the crypto market and the failures in the crypto industry can't be ruled out either.

Finally, we acknowledge there are unknown sources of uncertainty that could derail our expectations manifestly. Yet, this is an interesting opportunity to make an educated guess about how the money ecosystem is being reshaped.

22 Regulating cryptos could help them to enter the money ecosystem too. However, this would be contrary to their original motivations.

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IMPACT OF CBDCS, STABLECOINS, AND NEW PAYMENT SOLUTIONS ON MONEY ECOSYSTEM

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