

New and evolving financial technologies implications for monetary policy and financial stability in Latin America

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**NEW AND EVOLVING FINANCIAL TECHNOLOGIES:
IMPLICATIONS FOR MONETARY POLICY AND FINANCIAL STABILITY IN
LATIN AMERICA**

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1. Introduction

This paper provides a broad analytical overview of how technological changes are likely to affect the practice of central banking. While the advent of decentralized cryptocurrencies such as Bitcoin has dominated the headlines, a broader set of changes wrought by advances in technology are likely to eventually have a more profound and lasting impact on central banks.

While it is premature to speak of disruption of traditional concepts of central banking, it is worth considering if the looming changes to money, financial markets, and payments systems will have significant repercussions for the operation of central banks and their ability to deliver on key objectives such as low inflation and financial stability. New forms of money and new channels for moving funds within and between economies could also have implications for international capital flows and exchange rates, which are of particular relevance for emerging market central banks.

The paper touches on the relevant considerations (for monetary policy and financial stability) and catalogs the approaches that major central banks are taking towards three inter-related issues: central bank digital currencies (CBDC), nonofficial cryptocurrencies, and fintech, a term that encompasses new and evolving financial technologies. The objective of this paper is not to offer detailed policy prescriptions but to survey the issues that central banks will have to grapple with and describe how some of them are preparing for the looming changes. The potential implications for the international monetary system will also be addressed briefly.

The rapid rise of cryptocurrencies has elicited a range of responses from central banks and governments, from trying to co-opt the changes to their advantage to resisting certain developments for fear of endangering monetary and financial instability. For many central banks, the responses are driven by concerns about the rapidly declining usage of currency and the implications for both financial and macroeconomic stability if decentralized, privately-managed payment systems displace both cash and traditional payment systems managed by regulated financial institutions.

One response has been for central banks themselves to innovate in the means for producing money. At a basic level, CBDC are digital forms of central bank money. The scope of CBDC encompasses both retail and wholesale payments systems. Wholesale CBDC entail some efficiency improvements but not fundamental changes to the interbank payments system managed by central banks, since balances held by commercial banks at the central bank (reserves) are already in electronic form. Retail CBDC, which would be a digital complement to or substitute for physical cash, would be more of a revolutionary change. Retail CBDC can take one of two forms—either token-based or value-based. These have very different implications for monetary and other policies.

The motives for issuing retail CBDC range from broadening financial inclusion to increasing the efficiency and stability of payment systems. For instance, Sweden's Riksbank is actively exploring the issuance of an e-krona, a digital complement to cash, with the objective of "promoting a safe and efficient payment system." Other central banks that have already issued

or are considering issuing CBDC, especially those in developing economies, seem to put higher priority on giving households easier access to electronic payments systems.

A few key points that emerge from the discussion in this paper are as follows:

- There are many potential advantages to switching from physical to digital versions of central bank money, in terms of easing some constraints on traditional monetary policy and providing an official electronic payments system that all agents in an economy, not just financial institutions, have access to. The basic mechanics of monetary policy implementation will not be affected by a switch from physical currency to CBDCs. However, other technological changes that are likely to affect financial markets and institutions could have significant effects on monetary policy implementation and transmission.
- New financial technologies—including those underpinning nonofficial cryptocurrencies—herald broader access to the financial system, quicker and more easily verifiable settlement of transactions and payments, and lower transaction costs. Domestic and cross-border payment systems are on the threshold of major transformation, with significant gains in speed and lowering of transaction costs on the horizon. The efficiency gains in normal times from having decentralized payment and settlement systems needs to be balanced against their potential technological vulnerabilities and the repercussions of loss of confidence during periods of financial stress.
- Multiple payment systems could improve the stability of the overall payments mechanism in the economy and reduce the possibility of counterparty risk associated with the payment hubs themselves. However, multiple systems without official backing could be severely tested in times of crisis of confidence and serve as channels for risk transmission. Decentralized electronic payment systems are also exposed to technological vulnerabilities that could entail significant economic as well as financial damage. CBDCs could function as payment mechanisms that provide stability without necessarily limiting private fintech innovations or displacing privately managed payments systems.
- Financial institutions, especially banks, could face challenges to their business models, as new technologies facilitate the entry of institutions (or decentralized mechanisms) that can undertake financial intermediation and overcome information asymmetries. Banks will find it difficult to continue collecting economic rents on some activities that cross-subsidize other activities. The emergence of new institutions and mechanisms could improve financial intermediation but will pose significant challenges in terms of regulation and financial stability.
- New forms of money and new channels for moving funds within and between economies could also have implications for international capital flows, exchange rates, and the structure of the international monetary system. The proliferation of channels for cross-border capital flows will make it increasingly difficult for national authorities

to control these flows. Emerging market economies will face particular challenges in managing the volatility of capital flows and exchange rates, and could be subject to greater monetary policy spillovers and contagion effects.

The basic functions of central bank issued money might also be at the threshold of change. Fiat money now serves as a unit of account, medium of exchange, and store of value. With the advent of various forms of digital currencies, the functions of money can in principle be separated. While some nonofficial cryptocurrencies aspire to serve these multiple roles, the technology behind them could be the ultimate game-changer in terms of facilitating commercial and financial transactions by serving as a medium of exchange rather than as a store of value.

1.1. Latin America

After presenting the main analytical and policy considerations, this paper examines the implications of these changes specifically for central banking and financial regulatory policies in Latin America. Many countries in the region have historically been beset by high inflation, lack of central bank credibility, high degree of informality in economic activity, low levels of financial inclusion, and varying degrees of dollarization. These are related issues and partly reflect undisciplined fiscal policies, along with weak governance and political instability. Some countries in the region have tamed inflation and won some credibility for their central banks by adopting inflation targeting frameworks. But virtually every country in the region stands to benefit from making progress on dealing with the other aspects mentioned above.

The country-specific macroeconomic context, along with regulatory capacity, has relevance for determining whether a central bank should consider issuing CBDC. CBDC are unlikely to fare no better or worse than physical cash in terms of their acceptability as a medium of exchange and stable source of value. The value of a country's central bank money is ultimately tied to the credibility of the central bank that issues it and the state of macroeconomic policies in that country. Nevertheless, from other perspectives such as that of increasing financial inclusion and improving payment systems, there might be advantages to issuing CBDCs.

A passive approach to Fintech and CBDCs is not a viable option for Latin America. Some of the issues discussed in this paper, especially the implications of new cross-border payments systems for quicker and easier international flows of capital, are particularly relevant for countries in the region. These countries already have to deal with substantial capital flow and exchange rate volatility, partly related to spillovers of monetary and other policies from the U.S. and other advanced economies. These challenges could become greater if new payments systems and digital currencies increase both the volumes and fluctuations in cross-border capital flows and make capital controls less potent, adding to such volatility.

Similarly, while none of the G-3 central banks (Fed, ECB, Bank of Japan) have so far indicated plans to issue CBDCs, that prospect is one that countries in this region need to prepare for. Such a development, which could make it easier to hold and transact in major global currencies, could exacerbate the problem of dollarization that many countries in the

region are already grappling with. Indeed, shifts to electronic currencies would make it easier to use even currencies of smaller reserve currency economies other than the G-3 as mediums of exchange and stores of value if there remains little trust in domestic currencies. Moreover, while cryptocurrencies issued by large and financially powerful multinational corporations such as Amazon and Facebook might not gain traction in advanced economies with trusted fiat currencies, such financial innovations have the potential to displace domestic fiat currencies in Latin American economies. As indicated by Facebook's proposal to launch its cryptocurrency, Libra, in 2020 and the BIS's explicit support for CBDC, the advent of both official and unofficial digital currencies that have the potential to disrupt the viability of Latin American fiat currencies might happen relatively soon, leaving policymakers only limited time to prepare for these developments.¹

This paper also makes the case that Latin American central banks and regulatory authorities need to proactively manage the benefit-risk tradeoffs from innovations to financial technology rather than passively letting markets take their course. The new financial technologies could play a positive role in broadening financial inclusion, which remains low in many countries in the region, and in improving the intermediation of domestic savings into productive investments and also the efficiency of payments systems. This paper discusses the many constraints to Fintech development in the region and also potential financial stability risks if regulatory capacity falls behind technological developments.

It would be appropriate for countries in the region to approach these issues not just individually but also collectively. For instance, a coordinated approach could help incorporate Fintech into the broader agenda of regional financial market development, while also developing a strategy for allowing innovation in this area without endangering financial stability. It is striking that Fintech regulatory sandboxes, which many countries around the world see as a way of controlled experimentation with new financial technologies, are almost entirely absent from the region. There is clearly a role for an agency such as FLAR to coordinate the region's analytical and policy work on this topic. Such an effort would involve drawing on and synthesizing lessons from the academic literature and the experiences of other countries, and then developing precise policy recommendations and reflecting on how to apply them to the specific circumstances of individual countries in the region.

2. Definitions and Concepts

I begin with a brief overview of key concepts and definitions relevant for understanding how technological changes could affect the operation of financial markets and monetary policy.

2.1. Basics of Money

While the term *money* has no singular definition, it is popularly associated with currency banknotes and coins. Much of the popular discussion about digital currencies is related to a narrow concept of money. Monetary aggregates that are more relevant for evaluating the

¹ For the recent BIS endorsement of CBDC, see the statements by BIS General Manager Carstens in "Central Bank Plans to Create Digital Currencies Receive Backing," *Financial Times*, June 30, 2019.

stance and outcomes of monetary policy are broader and can be classified into two categories:²

- Outside money: Fiat (unbacked) money issued by a central bank (or government entity) or backed by an asset that is not in zero net supply in the private sector (e.g., gold).
- Inside money: An asset representing or backed by any form of private credit; circulates as medium of exchange; in net zero supply in private sector.

These two concepts could become blurred as unbacked money that is privately issued (or created by a non-governmental entity) competes with government-issued fiat currency. This raises a number of analytical issues about the different roles played by various forms of money, some of which will be explored later in this paper. It should also be noted that inside money, in the form of bank deposits, is arguably already mostly in electronic form.

Explaining the very existence of fiat money, which has no intrinsic value, poses theoretical challenges. There is an extensive and rich literature on models of money. Some of the early approaches to modeling money include putting money directly in the utility function (Sidrauski, 1967), cash-in advance models (Svensson, 1985), shopping-time models (Brock, 1990), and the turnpike model of spatially separated agents (Townsend, 1980). Search-theoretic models of money pioneered by Kiyotaki and Wright (1993) represent a major step forward in this literature. Kocherlakota (1998) makes an important contribution that highlights the specific role played by money in environments with incomplete information and limited commitment.

The relevance of these models to the present debate lies in identifying specific characteristics of central bank money that could be replicated or superseded by technological advances. For instance, Kocherlakota's formulation of money as embedding sufficient information about economic agents' credit histories could be replicated through Big Data and suitable information processing techniques.

Carstens (2018) highlights the key role of trust in central banks, arguing that "money is an indispensable social convention backed by an accountable institution within the State that enjoys public trust...Experience has also shown that to be credible, money requires institutional backup, which is best provided by a central bank." He goes on to say that money as a social institution requires a solution to the problem of a lack of trust. He says that "The tried, trusted, and resilient modern way to provide confidence in public money is the independent central bank. This means legal safeguards and agreed goals, i.e., clear monetary policy objectives, operational, instrument, and administrative independence, together with democratic accountability to ensure broad-based political support and legitimacy. While not fully immune from the temptation to cheat, central banks as an institution are hard to beat in terms of safeguarding society's economic and political interest in a stable currency."

² See Lagos (2006) for an exposition.

Similarly, when it comes to the creation of inside money, commercial banking is built on a foundation of trust, which is reinforced by regulatory processes overseen by government institutions. This issue of trust will play a key role as one critically surveys the evolving landscape of official and privately-issued digital currencies, and the competition between them.

2.2. The Changing Structure of Monetary Aggregates

The share of central bank money in overall monetary aggregates has declined in recent years in most economies. For instance, take Sweden, which has gained some attention as an economy that is fast moving towards becoming cashless. The ratio of currency (banknotes and coins) to the monetary aggregate M3, which includes currency as well as bank deposits of various maturities, fell from 7 percent in the early 2000s to 2 percent by 2016. A report from the Riksbank states that “the proportion of cash payments in the retail sector has fallen from close to 40 percent in 2010 to about 15 percent in 2016.”

The ratio of currency to M2—which typically includes currency as well as savings deposits, time deposits, and money market deposit accounts (although the precise definition varies from country to country)—ranges from close to 20 percent in Russia and Mexico, to about 10 percent in India, Japan, Kenya, and the U.S., to under 5 percent in China, the U.K., and the Euro zone. In recent years, the ratio of currency to M2 has fallen in a number of advanced and emerging market countries, indicating the declining importance of outside money even within this narrow monetary aggregate. Since 2003, the ratio of currency to M2 has fallen by 5 percentage points in China, 7 percentage points in India, and 3 percentage points in the Euro zone.³

The implications of these crude calculations of the low and declining importance of currency are two-fold. First, the typical notion of money needs to be extended to consider broader concepts of money that are more relevant for economic activity and monetary policy. Second, when considering how technological developments could affect monetary policy, it is essential to examine the potential implications of these developments for financial institutions that play a critical role in creating inside money.

2.3. Definitions

At the outset, it is worth laying out some relevant definitions for the purposes of the discussion in this paper and to clarify certain terms that are sometimes used interchangeably in popular discussions.

- *Fiat currency*: Currency issued by a national central bank, typically in the form of currency banknotes and coins (which will henceforth be referred to as *cash*). Generally

³ The ratio has held relatively steady in Japan, Switzerland, the U.K., and the U.S., all of which are, interestingly, reserve currency economies.

issued by a government entity, although can also be issued by private institutions under the authority of the government.⁴

- *Legal tender*: Form of payment that a creditor is legally obliged to accept from a debtor in order to extinguish a debt. Fiat currencies are typically legal tender. Not only must they be accepted as settlement for debt between private parties, but the government—which has the authority to levy taxes—can require that such tax obligations only be settled using the legal tender. Fiat currencies are, in principle and at least to a limited extent, backed by this authority of the government.
- *Digital currency*: Broad term that encompasses any form of currency that is not tangible.
- *Central Bank Digital Currencies*: Fiat currencies issued by central banks in place of, or as a complement to, physical currency (banknotes and coins).
- *Official cryptocurrencies*: Currencies issued by a government entity, using cryptographic technologies. This category could be considered a subset of CBDC.
- *Nonofficial cryptocurrencies*: Digital currencies that are virtual, typically not backed by a government, and do not constitute legal tender. Key characteristic is the ostensible anonymity of transactions conducted principally using blockchain technology (this aspect is similar to cash, but cryptocurrencies are easier to scale than cash and do not require physical transfers of currency notes). Cryptocurrencies can either be decentralized (wherein, for instance, any economic agent with enough computing power can verify transactions in return for a reward) or centralized (with verification undertaken by or limited to those approved by a central authority).⁵ Another relevant characteristic is whether the record of transactions is public or private (restricted to those who have permissioned access).
- *Fintech*: Broad term that refers to various technological developments that are relevant to financial markets. While there are many developments under this rubric that are not directly related to digital currencies, they could facilitate the use of such currencies since many of the relevant technologies, especially decentralized distributed ledgers, are relevant to both contexts.

These broad definitions need to be complemented by a range of other combinations of these underlying concepts, as well as some practical and legal considerations. The blockchain or Distributed Ledger Technology (DLT) underpinning Bitcoin allows for decentralized public verification of transactions and ensures immutability of those records. This technology clearly has applications beyond Bitcoin. A similar technological setup could be used to set up a

⁴ In Hong Kong, for instance, the Government, through the Hong Kong Monetary Authority has authorized three commercial banks (Bank of China (Hong Kong), HSBC, and Standard Chartered (Hong Kong)) to issue currency banknotes.

⁵ In practice, the degree of centralization is not a binary choice.

CBDC, although the nature of verification of transactions (by the central bank itself, by a set of authorized agents, or by miners who get rewarded for this process in some fashion) and whether the system allows for true anonymity would have to be decided by the central bank.

This points to an important difference between official and nonofficial digital currencies. A fiat currency in a decentralized distributed ledger would in effect be an IOU, which would have to be backed up by a payment system to transfer the underlying financial asset (the currency). By contrast, for a nonofficial cryptocurrency, the entry on the public ledger is itself the digital asset, which is not backed in any way. The status of official cryptocurrencies is ambiguous—in principle, such a cryptocurrency could be backed by the government; if this backing was credible, this would be similar to other official digital currencies with the potential for anonymity being the distinguishing characteristic relative to electronic money.

3. Central Bank Digital Currencies

CBDC are fiat currencies issued by central banks in digital form in place of, or as a complement to, physical currency (banknotes and coins). Commercial banks, through their accounts at the central bank, already have access to electronic central bank money. Even in the context of such digital central bank reserves, the concept of a CBDC might imply significant changes. This section will discuss in more detail various definitions of CBDC, the motives for central banks that have issued or are considering issuing them, and the forms that CBDC can take. The implications of CBDC for monetary and financial stability will be discussed later.

3.1. Definitions

Digital central bank money has already existed for a long time. Electronic balances held by commercial banks (and, occasionally, other financial institutions) at central banks, referred to as reserves, are used to facilitate payments and settlement through interbank payment systems managed by the central bank. Kumhof and Noone (2018) provide a useful definition of CBDC to distinguish it from reserves and cash. They define CBDC as electronic central bank money that (i) can be accessed more broadly than reserves, (ii) has functionality for retail transactions, (iii) can be interest bearing (with a rate different from that on reserves), and (iv) has a separate operational structure relative to other forms of central bank money.

A more technologically-oriented definition comes from Yao (2018), head of the Institute of Digital Money at the People's Bank of China (PBC). He has articulated China's vision of a CBDC, which he refers to as a digital fiat currency (DFC). He posits that DFC is “a credit-based currency in terms of value, a crypto-currency from a technical perspective, an algorithm-based currency in terms of implementation, and a smart currency in application scenarios.” Yao notes that DFC has two major advantages over private digital currencies—it is a more stable medium of exchange and unit of account, and it can play a role in credit creation and therefore has real economic impact. He argues that cryptographic technology, implemented through various encryption algorithms, is essential for security and credibility of

the DFC. Most importantly, Yao notes that DFC is not just a digital version of cash but that has the potential to make money “smarter.”

Bjerg (2017) lays out a broad definition of CBDC as electronic, universally accepted, central bank issued money and discusses three possible scenarios. In the first one, the CBDC serves as electronic cash, complementing cash and bank deposits and, thus, fulfilling the role of medium of exchange. The central bank would simultaneously fulfill the objectives of free convertibility and maintaining parity among CBDC, cash, and bank deposits. However, the central bank would lose monetary sovereignty in terms of designing interest-based monetary policy. In a second scenario, the CBDC would serve as universal reserve and fulfill the role of store of value, replacing cash. The central bank would maintain parity but not free convertibility between CBDC and bank deposits. In a third design, CBDC serves as sovereign account money and as the unit of account, potentially replacing bank deposits. In this scenario, the central bank takes the sole responsibility of creating and issuing money in the economy, maintaining free convertibility between CBDC and bank deposits. The central bank could effectively use monetary policy to create or destroy liquidity in the system based on the state of the economy.

Bordo and Levin (2017) present two designs for CBDC as a *medium of exchange*. In the first, the central bank circulates “CBDC tokens”, supported by distributed ledger technology for ownership verification and payment transactions. In the second, the central bank maintains “CBDC accounts” that facilitate electronic holding of funds for individuals and follow a simple debiting and crediting transaction protocol that is instantaneous and costless. The authors then explore three alternatives for a secure *store of value*. First, similar to paper currency, the central bank would issue CBDC with “constant nominal value” and earning zero interest. This would constrain the central bank from implementing a negative nominal interest rate. Second, the central bank would retain “stable real value” of CBDC through price level indexation of CBDC, which would also constrain policy at the zero lower bound. Third, the central bank would provide an interest-bearing CBDC where the interest rate would be positive in a growing and stable price economy. The authors argue that such a CBDC would serve as a stable *unit of account* with the help of flexible price-level targeting monetary policy.

The sampling of definitions above suggests that there is no clear consensus yet on the definition of a CBDC, with both conceptual and technological issues still being sorted out. Both of these sets of issues are tied in to the motivation for a central bank to issue a CBDC, which I turn to next.

3.2. Motivation

Why are central banks contemplating issuing CBDC? The motives appear to range from serving as a backstop to privately-managed payment systems to broadening financial inclusion. There are other ancillary benefits that could result from switching from paper currency to CBDC although these do not appear to be the key drivers influencing central bank decisions on this matter.⁶

⁶ See Fung and Halaburda (2016), Engert and Fung (2017), and Mancini-Griffoli et al. (2018) for additional perspectives on this issue.

In Sweden, an economy where the use of cash is fast disappearing, the central bank's consideration of retail CBDC, in the form of an e-krona, seems to be driven primarily by concerns about financial stability. The sharp decline in the use of cash for retail payments has occurred in tandem with a shift toward privately-managed payment systems and consolidation among a small number of commercial participants, payment services, and infrastructures. A recent Riksbank report notes that such concentration could "restrain competitiveness in the market and make society vulnerable. The development towards an almost cashless society also entails households having little opportunity to save and pay with risk-free central bank money, which could lead to a decline in the resilience of the payments system."

The report adds that "An e-krona would give the general public access to a digital complement to cash guaranteed by the state and several payment services suppliers could connect to the e-krona system...By functioning independently from the infrastructure used by the commercial bank system, the e-krona system could also make the payment system more robust in the event of disruptions to, for instance, the system for card payments."⁷

The Riksbank notes that an e-krona could alleviate the problem of concentration of the payments infrastructure and also its potential vulnerability to loss of confidence. The digital currency would be based on a separate infrastructure that would also be open to private agents willing to offer payment services linked to the e-krona. The general public would have access to the e-krona with both payment suppliers and fintech companies having access to the network. Thus, an e-krona system would promote competition, innovation, and financial stability.

Unlike in advanced economies such as Sweden, a primary motivation for emerging market economies to consider issuing CBDC seems to be related to financial inclusion. Take the case of Uruguay. The Uruguayan government approved a Financial Inclusion Law in 2014 in order to promote financial inclusion, which it had declared a major national priority. The law targeted universal access and was also intended to increase the formalization of the labor market and improve payment system efficiency. As part of this program, the central bank initiated a six-month pilot program in November 2017 to issue a legal tender digital currency, the e-peso. Similar motives seem to have been at play in the cases of countries such as Ecuador and Tunisia. In describing the Ecuador digital fiat currency experiment, which proved short-lived, Lara and Reis (2015) state that the initiative sought to [text translated from Spanish] "achieve financial inclusion for almost 60 percent of the population that did not have access in that time to financial services and provide a simpler, faster, and cheaper way for the population to make financial transactions."

3.3. Other Considerations

Paper currency is vulnerable to counterfeiting, a challenge that governments have faced since the very introduction of paper currency by the Tang Dynasty in China in the 7th century (Prasad, 2017). CBDCs could in principle reduce this risk, although the risk of electronic counterfeiting on an even more massive scale through hacking is a major concern for governments that intend to take this route.

⁷ See "The E-Krona Project's First Interim Report," Sveriges Riksbank, March 2018.

A potential advantage of a CBDC is that it would discourage illicit activity and rein in the shadow economy by reducing the anonymity of transactions now provided by the use of currency banknotes, a point made forcefully by Rogoff (2016), especially in the context of high-denomination banknotes. This would also affect tax revenues, both by bringing more activities out of the shadows and into the tax net and also by enhancing the government's ability to collect tax revenues more efficiently.

An argument in favor of preserving physical cash is that the level of access to the formal financial system is limited among poorer households. Hence, cash is crucial for financial intermediation and, in developing economies, even as a more secure form of savings. This argument is being undercut rapidly by technologies such as mobile banking and the falling cost of digital transactions. Moreover, the introduction of CBDCs does not necessarily entail the immediate elimination of physical cash. The two could co-exist during a transition period or even indefinitely.

Would the proliferation of digital currencies affect the seigniorage revenues that accrue to central banks when they issue cash? These revenues are the difference between the worth of the cash issued (in terms of goods and services it can procure) and the cost of producing and distributing it. The cost of printing paper currency and its lack of durability reduce direct seigniorage revenues. Hence, a CBDC could, all else unchanged, increase seigniorage revenues. However, the demand for central bank issued currency, either in physical or digital form, could be lower if it is displaced as a medium of exchange. Hence, the net effect on seigniorage revenues depends on how technological developments affect the demand for central bank money. In any event, seigniorage revenues tend to be modest for most central banks although, for those such as the Federal Reserve and ECB that issue major reserve currencies, the revenues are hardly trivial.

Ensuring compliance with AML/CFT regulations has been a major challenge for government authorities. The elimination of physical cash could assist in these efforts, although the likely shifting of illicit fund transfers to decentralized payment systems and intermediated through anonymous, decentralized cryptocurrencies could vitiate this progress. This is one reason why central banks might seriously consider issuing CBDCs so they can retain control of or at least oversight over payment systems that could as easily be used for illicit as for licit purposes.

These benefits come at the potential cost of loss of privacy in commercial transactions if these can be intermediated only through private or government-managed electronic payments systems. While various encryption technologies in principle allow users of retail CBDC to retain privacy, it is likely that these are subject to the same technological vulnerabilities as nonofficial cryptocurrencies, where privacy has been difficult to ensure. A government or central bank is of course under no legal obligation to provide the public with a means of exchange and payment that guarantees privacy, which is the case with cash. This highlights an important set of considerations, that are not purely economic or technological, that each society will have to ponder as it considers the displacement of cash with retail CBDC.

3.4. Types

At a basic level, there are two versions of CBDC--wholesale or retail. As noted earlier, wholesale CBDC would essentially be a technological improvement over existing digital reserves used by commercial banks, through their accounts at the central bank, for payments clearing and settlement. The Monetary Authority of Singapore, for instance, is developing a DLT-based wholesale CBDC that appears to provide some efficiency gains, as well as a liquidity saving mechanism, relative to the existing Real Time Gross Settlement (RTGS) system. Other jurisdictions such as the U.S. are largely emphasizing improvements to the existing RTGS rather than considering adopting DLT or other new technologies. Since bank reserves are already digital, wholesale CBDC would not constitute a significant conceptual advance.

By contrast, retail CBDC, which individual households and nonfinancial enterprises would have access to, represent a major conceptual as well as technological advance. Current conceptions of CBDC can be put in the following categories:

- *E-money*: A simple version of an electronic currency, wherein the central bank in effect manages a centralized payment system linked to electronic “wallets”. In some cases, this takes the form of specific amounts downloaded to a mobile phone app by designated financial institutions. The payment system could be managed using blockchain or other versions of distributed ledger technology to verify transactions, with the verification process managed by the central bank rather than through a decentralized mechanism.
- *Account-based CBDC*: In this incarnation, all agents in an economy would have access to central bank accounts, where the balances could be interest-bearing. The central bank would in effect become the manager of a sophisticated payments system that would also allow it, depending on the structure of this CBDC, to implement conventional and unconventional monetary policy in nonstandard ways and, in some respects, more effectively.
- *Official cryptocurrencies*: Cryptocurrencies issued by a government entity, although not considered the equivalent of fiat currency; could in principle count as legal tender if the government were to decree this. Logically, government cryptocurrencies would be centralized, with verification of transactions provided by the government itself or its appointed agents rather than through a decentralized verification mechanism. There is an open question if this provides true (and a time-consistent promise of) anonymity to transacting parties.

Of the options above, the first two are the ones under more serious consideration. The first option is easier to implement and, in combination with mobile phones that have become ubiquitous even in low-income economies, has significant potential to improve financial inclusion and reduce dependence on cash. The latter option is technologically and conceptually more complicated but has greater potential to be scaled up into a payments system that serves as a backup to the private payments infrastructure.

Yao (2018) lays out a more expansive version of CBDC. He points to experiments conducted by the PBC showing that the functionality of conditional payments embedded in DFC smart contracts could address the trust issue among counterparties and facilitate the synchronization between flows of funds and corresponding transactions. He argues that a digital commercial paper trading platform based on blockchain technology and a liquidity saving mechanism managed by smart contracts based on DFC's clearing and settlement functionalities can improve the efficiency of commercial transactions (Yao, 2017). In a retail DFC context, he asserts that a decentralized peer-to-peer payment system managed by the central bank can serve as the foundation for intelligent commercial applications that enhance efficiency and offer benefits to end-users. In other words, given the presence of private payment systems such as Alipay and WeChat that are already sophisticated, issuance of a CBDC to end users is necessary for building a better payment system, maintaining financial stability, and enhancing the central bank's authority. The alternative would be one where the central bank retreats to a role as "money wholesaler at [the] back-end."

3.5. Legal Tender

The legal status of a particular type of money is an important determinant of how widely accepted it is and what purposes it is used for. Fiat currencies issued by central banks have the status of legal tender. However, the definition of legal tender typically tends to be related to legal means of discharging debt obligations rather than retail or business-to-business transactions. In the U.S. for instance, the pertinent law states that: "United States coins and currency (including Federal reserve notes and circulating notes of Federal reserve banks and national banking associations), regardless of when coined or issued, are legal tender for all debts, public charges, taxes, and dues."⁸

In interpreting this statute, the U.S. Treasury notes this "...means that all United States money as identified above are a valid and legal offer of payment for debts when tendered to a creditor. There is, however, no Federal statute mandating that a private business, a person or an organization must accept currency or coins as for payment for goods and/or services. Private businesses are free to develop their own policies on whether or not to accept cash unless there is a State law which says otherwise." Other advanced country central banks such as the Bank of England and the ECB also make it clear that legal tender laws in their jurisdictions apply to the discharge of debt obligations but do not compel merchants to accept cash as payment for goods or services rendered.

Practices in emerging market countries vary. China's central banking law stipulates that "No entity or individual can refuse repayment of debt in RMB." However, the PBC has adopted a broader interpretation of the legal tender law, arguing that cash must be accepted in retail transactions as well.⁹ In 2018, the PBC undertook a nationwide campaign to identify cases of what it deemed "illegal cash refusal" by commercial enterprises.

⁸ The relevant text is in Section 31 U.S.C. 5103 of Public Law 89-81, referred to as the Coinage Act of 1965. <https://www.govinfo.gov/content/pkg/STATUTE-79/pdf/STATUTE-79-Pg254.pdf>

⁹ See http://www.npc.gov.cn/wxzl/wxzl/2000-12/05/content_4637.htm

In Latin American countries, both legislative frameworks and social norms differ across countries. In the case of Peru, for instance, banknotes and coins issued by the Banco Central de Reserva del Peru must by law be accepted for the payment of any obligation, public and private. The legal principle explicitly applies not only to the financial system but also to trade and the general population. The law states that no person or trade should refuse a banknote expressed in Soles and that a commercial establishment cannot refuse to accept cash or even any specific denominations.¹⁰

On the other hand, Uruguay, for instance, is among the countries that favor the use of electronic money and means of payment other than cash. The 2018 Financial Inclusion Law in fact stipulates that, for automobile purchases and real estate transactions that exceed a certain threshold (approximately \$5,000), payments must be done through electronic means, crossed bills of exchange (in the name of the acquirer) and common or deferred checks, crossed and “not to order”.¹¹ The use of other means of payment, including cash, could result in a fine equivalent to 25 percent of the amount paid or received incorrectly, with both parties to the transaction being jointly and severally liable. Such legislation, along with subsidies provided for the expansion of POS terminals and the reduction in bank charges on debit and credit cards, have led to a marked decline in the use of cash in Uruguay.

In short, legislation and government policies play a large role in determining the relative importance of physical versus electronic means of payment. Thus, any government contemplating issuing a CBDC will have to pay careful attention to the legal framework that underpins central bank money and its status relative to privately-managed payments systems and mediums of exchange.

3.6. Status

A number of central banks are at various stages of looking into the feasibility and desirability of issuing CBDC. This sub-section classifies major central banks into a few categories. Appendix A provides a detailed review of how selected advanced economy and emerging market central banks are approaching these issues, either based on policy documents or on statements and speeches by their senior officials.

- *Issued but no longer in operation:* In 2015, Ecuador introduced a centralized payment system backed by a digital currency but, since the system failed to attract a significant number of users or volume of payments, deactivated the system in

¹⁰ The two relevant articles in the Organic Law of the Central Bank of Peru are as follows: “Article 42: The issuance of banknotes and coins is the exclusive power of the State, which exercises it through the Bank (BCRP). Article 43: The banknotes and coins that the Bank puts into circulation are expressed in terms of the monetary unit of the Country and are of forced acceptance for the payment of any obligation, public or private” <http://www.bcrp.gob.pe/billetes-y-monedas/normas-sobre-tesoreria/art-2-y-42-al-45-de-la-ley-organica-del-bcrp.html>

¹¹ The text of the Financial Inclusion Law, issued by the Uruguay Ministry of Finance, can be found at: <https://www.mef.gub.uy/23936/1/mef/inclusion-financiera:-desde-abril-rigen-cambios-en-la-forma-de-pago-del-servicio-domestico-y-de-las-operaciones-sobre-bienes-inmuebles-vehiculos-y-de-montos-elevados.html#Ancla1>

April 2018. Uruguay conducted a six-month trial for an e-peso from November 2017 to April 2018. The trial was considered a success (this case is discussed in more detail below) but the next stage of the e-peso project is still under consideration.

- *In operation:* Tunisia issued the first CBDC, an e-Dinar designed as a virtual account, as early as 2010. It has now been superseded by a blockchain-based centralized digital currency (using the Monetas digital platform) that also functions as a payments system.
- *Preparation for implementation/groundwork in progress:* China has successfully tested a block-chain based digital notes transaction platform and is developing a digital currency known as the Digital Currency for Electronic Payment. A consortium of Japanese banks plans to introduce a digital currency (J Coin) in time for the 2020 Tokyo Olympics. This project has the approval of the Bank of Japan, which has indicated that it is not considering issuing a digital currency by itself. The Bank of Canada has a joint initiative with the national payment system operator to develop a DLT-based settlement asset for wholesale transactions (Project Jasper). The Monetary Authority of Singapore is developing a tokenized version of the Singapore dollar on an Ethereum-based blockchain (Project Ubin). Senegal intends to issue an electronic version of the eCFA that will co-exist with physical CFA. This will be issued by a regional bank and will not rely on blockchain technology.
- *Evaluating pros and cons, with no specific plans to issue digital currency:* None of the major advanced economy central banks have announced specific plans to issue CBDCs. Some officials of the Bank of Japan, Bank of Canada, Bank of England, European Central Bank, and the Federal Reserve have indicated they are evaluating the pros and cons of CBDCs, although none of them appear to be giving this serious consideration.

3.7. Case Study: Uruguay's E-peso¹²

In November 2017, Banco Central del Uruguay initiated a six-month pilot program to issue a legal tender digital currency, the e-peso. The program was seen as in effect creating an “electronic platform” for the Uruguayan peso. The pilot was intended to provide an assessment of the technical feasibility of the e-peso program in an environment in which

¹² This discussion about the e-peso program is based on conversations with officials from the central bank of Uruguay and materials provided by them. It should also be noted that retail payments in Uruguay have already been rapidly shifting away from cash. The Central Bank of Uruguay has developed an index of electronic means of payments in order to measure the evolution of the use of electronic means of payment in the Uruguayan retail market. This index compares the use of electronic payment instruments with traditional mechanisms, including ATM cash withdrawals and cheques. The index goes from 0 to 100, with the value 100 indicating that retail payments are entirely electronic. The index rose from 8 in 2010 to 38 in mid-2018. Uruguay also already has a high level of banking penetration, as indicated by the ratio of credit cards per cardholder, which stands at 2.86.

potential risks could be controlled. The pilot was designed such that, beyond the costs of setting up the system, there would be no marginal costs to either the central bank or final users of the e-peso.

The e-peso app could be downloaded onto mobile phones and charged up with desired amounts of the digital currency through licensed financial services providers to whom the central bank had transferred the e-pesos. At the end of the pilot, the e-pesos could be returned to the same group of financial services providers, which in turn would return them to the central bank for destruction.

The main characteristics of the system were that it provided instantaneous settlement, required only a mobile phone line, and was anonymous but traceable as transactions were intermediated through users' electronic wallets and the encrypted Global E-Note Manager (GEM). The system was seen as providing significant security improvements over cash since e-pesos are secured at GEM even if users lose their phones or their digital wallet passwords.

To make users more comfortable with e-pesos, the original plan was to allow users to be able to see the bills in their electronic wallets. This particular feature was ultimately not implemented. Still, the bills were unique and traceable, features seen as key to preventing double-spending and falsification. But these features also reduced the fungibility of the e-pesos and, while the GEM could automatically make change for a given transaction, this created some issues in terms of managing the stock of fixed denominations of electronic bills. At the end of the pilot, the e-pesos were withdrawn from circulation and extinguished. The pilot program was deemed a success in that there were no technical glitches and it appeared to have had a positive impact on financial inclusion. Both households and merchants that participated seem to have had positive reactions to the program.

3.8. Summary

Based on the discussion so far, the main potential benefits of a retail CBDC are as follows: (i) greater efficiency and speed, lower cost, and finality of transactions, (ii) broader tax base, reduced tax evasion, (iii) backstop to private sector managed payment systems, (iv) enhanced financial inclusion, and (v) higher seigniorage revenues. The risks include (i) technological vulnerabilities and (ii) loss of privacy in commercial transactions. The implications of CBDC for monetary policy and financial stability are in principle more important than these more technical considerations and will be discussed later in this paper. Before that, I turn to a consideration of how nonofficial cryptocurrencies are changing the landscape of finance and banking.

4. Nonofficial Cryptocurrencies

4.1. Origins and Viability

The frenzy around cryptocurrencies was set off by Bitcoin and the blockchain technology underlying it. Bitcoin was originally seen as a medium of exchange that would allow for

intermediation of transactions in a manner that obviated both traditional financial institutions and government control. The original paper laying out the philosophical basis for the Bitcoin architecture (Nakamoto, 2008) states that “A purely peer-to-peer version of electronic cash would allow online payments to be sent directly from one party to another without going through a financial institution.” The paper goes on to highlight that resolving the need for trust, which is inherent in a physical currency issued by a trusted third party such as a central bank, is key to any payments mechanism: “These costs and payment uncertainties can be avoided in person by using physical currency, but no mechanism exists to make payments over a communications channel without a trusted party. What is needed is an electronic payment system based on cryptographic proof instead of trust, allowing any two willing parties to transact directly with each other without the need for a trusted third party.” The logic underlying Bitcoin is that a form of decentralized consensus can replace trust, allowing for both verification of payments and finality of settlement without the intervention of a trusted party such as a government or commercial bank.

Nonofficial cryptocurrencies, which lack government or other backing, might appear to stand little chance of competing with fiat currencies in the long run. Moreover, with growing indications that cryptocurrencies such as Bitcoin do not truly guarantee anonymity, their roles as currencies rather than as just sophisticated payment systems have come under question. The market response has been the proliferation of cryptocurrencies that attempt to address one or more of these concerns. There are now close about 1400 cryptocurrencies that come in various flavors. Some of these are ostensibly backed in one form or another and are intended for a variety of purposes. For instance, the blockchain-based cryptocurrency Tether is in principle backed by and trades at par with the U.S. dollar (or, in its other incarnations, at par with other major currencies). Cryptocurrencies backed by a physical currency do not constitute new money creation and are in effect just a payments system. The value of some cryptocurrencies is backed by commodities or their prices are pegged to the prices of specific commodities.¹³

One of the initial attractions of nonofficial cryptocurrencies, and the reason for official concerns about them, was the anonymity they provided. Bitcoin and Ethereum, two popular cryptocurrencies, are in fact not anonymous since the amounts as well as source and destination addresses associated with each transaction are public information (this could allow the parties to any transaction to be traced). By contrast, Monero and ZCash are considered truly anonymous in the sense that none of this information associated with a particular transaction is publicly available. However, researchers have raised questions about the non-traceability of transactions even in these cases.¹⁴ These findings have implications for security risks associated with CBDCs and especially for official cryptocurrencies that might purport to provide anonymity in a digital environment.

¹³ The U.K.’s Royal Mint has issued a cryptocurrency backed by its gold holdings. For other gold- or commodity-backed currencies, the verification mechanism for the backing seems to rely on audits by major auditing firms. Concerns have been raised about whether Tether is in fact fully backed by dollars as claimed by the issuers, who indicate that their reserve holdings are published daily and subject to frequent professional audits.

¹⁴ See Miller (2017) and the discussion in Prasad (2018).

The proliferation of cryptocurrencies and their relationship to fiat currencies, whether physical or digital, is likely to ultimately hinge on how effectively each currency delivers on its intended functions. In this sense, by parceling out the various functions, the advent of cryptocurrencies has already changed the nature of money. Fiat money bundles together multiple functions as it serves as a unit of account, medium of exchange, and store of value. Now, with the advent of various forms of digital currencies, these functions can conceptually be separated. Moreover, whatever the future of cryptocurrencies, the DLT and related technologies underlying their creation could have major impacts in the realms of finance and central banking.

The potentially transformative potential of unofficial cryptocurrencies was recently highlighted by Facebook's announcement that it plans to issue a cryptocurrency called Libra in 2020 (see Box 1 for more details). Facebook envisions Libra as a digital currency that will be limited to serving as a medium of exchange and that will be fully backed by a reserve constituted of a basket of safe assets denominated in major hard currencies, an approach that is in some ways akin to the issuance of a currency under a currency board arrangement. According to Facebook, the goal is to create a more inclusive financial system as well as a more efficient and cheap payments system for both domestic and cross-border transactions. The fully-backed nature of Libra suggests that it will provide a stable store of value and will not have any monetary policy implications.

However, central bankers and other officials have expressed concerns that, if Libra does gain traction and in view of the enormous international network of Facebook members, there is the scope for the cryptocurrency to be delinked from the reserve and for Facebook to become an unregulated creator of money, with implications for both monetary policy in individual countries and cross-border liquidity flows. Given Facebook's enormous financial clout, it is even conceivable that any money that it issues could be seen as more trustworthy and stable in value, as well as likely to have wider international acceptance, than the fiat currencies of many developing and emerging market economies whose central banks suffer from lack of credibility. In the absence of regulation, Libra could also end up creating new conduits for both legitimate and illegitimate capital flows, adding to the problems of capital flow and exchange rate volatility already faced by many emerging market economies.

Box 1. Facebook's Libra: Concept and Design Issues

In June 2019, Facebook announced that it planned to launch a cryptocurrency named Libra in 2020. In what follows, the description of the concept and the currency is based on a white paper (Libra, 2019) and supporting documents provided by Facebook.

The ostensible mission of Libra, according to the white paper, is “a simple global currency and financial infrastructure that empowers billions of people by lowering of barriers to access and cost of capital for everyone and facilitate frictionless payments for more people...Libra is intended to be built on a secure, scalable, and reliable blockchain; will be backed by a reserve of assets designed to give it intrinsic value; and is governed by the independent Libra Association.”

Libra is designed to be a stable digital cryptocurrency that will be fully backed by a reserve of real assets and supported by a competitive network of exchanges buying and selling Libra. The reserve will consist of a collection of liquid, low-volatility assets, including bank deposits and government securities in currencies from stable and reputable central banks. This allows the size of the reserve to be easily adjusted as the amount of Libra in circulation expands or contracts. The reserve will not be actively managed and is to be held by a geographically distributed network of custodians with investment-grade credit rating to limit counterparty risk. Any returns from the reserve will finance the Libra association, with the remaining surplus to be paid out as dividends to early investors.

Libra will start as a permissioned blockchain, in which the Libra association grants access to run a validator node that verifies transactions. The aim is apparently to gradually move to a permissionless blockchain, in which anyone who meets the technical requirements can run a validator node. For now, “there isn't a proven solution that can deliver the scale, stability, and security needed to support billions of people and transactions across the globe through a permissionless network.” This is apparent from the evolution of Bitcoin, which has proven to be a costly (and volatile) medium of exchange as the underlying technology for verification of transactions and finality of settlement through public consensus has not proved scalable.

To sum up, Libra is a stable coin—a cryptocurrency that is backed by fiat currencies and is therefore expected to maintain its value. It has many of the desirable properties of cryptocurrencies: the ability to send money quickly, the security of cryptography, and the freedom to easily transmit funds across borders. The Libra association, which issues Libra coins, claims it does not intend to set monetary policy. Through interactions with authorized resellers, the association plans to automatically mint new coins when demand increases and destroys them when the demand contracts.

There are good reasons to be skeptical about the lofty objectives for Libra given that Facebook is a profit-driven, commercial organization that will ultimately seek to monetize the cryptocurrency in some form. Moreover, it is not obvious how and whether the issuance of Libra coins will be constrained in the future if the cryptocurrency does gain traction, thereby making it a competitor to existing fiat currencies. Libra is unlikely to dent the major reserve currencies but it could become a viable competitor to the fiat currencies issued by many other economies, especially those lack strong, independent, and credible central banks.

4.2. Regulation

The approaches of governments and central banks to permitting and/or regulating nonofficial cryptocurrencies span a wide spectrum, with individual countries often changing their positions in response to consumer demand and concerns about financial stability implications. Carstens (2018) argues that Bitcoin and other nonofficial cryptocurrencies are subject to some fundamental problems—debasement through forking, lack of trust, and inefficiency. While these problems should in principle undermine the utility of nonofficial cryptocurrencies, the question for financial regulators is whether there are implications for institutions that are in their regulatory ambit or if there are any other systemic implications that merit their intervention. As discussed in the previous section, the emergence of nonofficial cryptocurrencies backed by major corporations might require a new set of domestic as well as coordinated international regulatory responses.

Some of the major categories of regulatory responses are indicated below, with a more comprehensive overview of different countries' approaches to this issue listed in Appendix B.

- *Active regulation:* Canada and Japan have explicit laws concerning the trading and use of cryptocurrencies. The U.S. considers Bitcoin and other cryptocurrencies as financial assets that are subject to tax laws as well as regulations concerning anti-money laundering and combating of financing of terrorism (AML/CFT).
- *Soft/hard bans on cryptocurrencies:* India's central bank, the Reserve Bank of India (RBI), has not authorized any institution it regulates to trade in or conduct business using cryptocurrencies. In April 2018, the RBI prohibited banks, financial institutions, and other regulated entities from dealing in virtual currencies. Korea's regulators have taken a dim view of cryptocurrencies, although they have not banned them outright. China banned domestic Bitcoin exchanges when it was trying to restrict speculative capital outflows in 2017, and has subsequently blocked access to cryptocurrency exchanges. China has also banned domestic initial coin offerings (ICOs) and prohibited individuals and institutions from participating in them.
- *Passive tolerance:* A majority of countries are in this category, not banning cryptocurrencies but discouraging their use by financial institutions and, in many cases, not clarifying the legal status of such currencies even as means of payment.
- *Governments/central banks issuing their own cryptocurrencies:* Venezuela's government issued the first official cryptocurrency, the petro, in February 2018. In April 2018, Venezuela declared the petro to be legal tender. The petro's value is in principle backed by Venezuela's oil reserves and the cryptocurrency's issuance was intended to bolster public finances and evade financial sanctions imposed against Venezuela by the U.S. and other countries. Russia has indicated that it will issue a CryptoRuble, mainly for the latter reason. Estonia and the Republic of the Marshall Islands have announced plans to issue official cryptocurrencies.

In short, there is no unified approach to regulation (or tolerance) of cryptocurrencies. However, as indicated by a recent G-20 statement, many countries are concerned about the potential problems posed by cryptocurrencies, especially the avenues they may provide for evasion of taxes and AML/CFT regulations. The March 2018 communiqué of the G-20 finance ministers and central bank governors states that “Crypto-assets do...raise issues with respect to consumer and investor protection, market integrity, tax evasion, money laundering and terrorist financing. Crypto-assets lack the key attributes of sovereign currencies. At some point they could have financial stability implications.”

4.3. Implications for Financial Stability

The range of financial activities that are facilitated by cryptocurrencies and the potential for gaps in regulatory oversight as different regulators sort through jurisdictional issues is illustrated by the U.S. experience so far. The following summary is based on a recent CFTC document:¹⁵

U.S. law does not provide for direct, comprehensive Federal oversight of underlying Bitcoin or virtual currency spot markets. As a result, U.S. regulation of virtual currencies has evolved into a multifaceted, multi-regulatory approach:

- State banking regulators oversee certain U.S. and foreign virtual currency spot exchanges largely through state money transfer laws.
- The Internal Revenue Service (IRS) treats virtual currencies as property subject to capital gains tax.
- The Treasury’s Financial Crimes Enforcement Network (FinCEN) monitors Bitcoin and other virtual currency transfers for anti-money laundering purposes.
- The Securities and Exchange Commission (SEC) has the authority to oversee initial coin offerings (ICOs) since they typically involve the offer and sale of securities.
- The CFTC has declared virtual currencies to be a “commodity” subject to oversight under its authority under the Commodity Exchange Act (CEA).

The document notes that the CFTC has “taken action against unregistered Bitcoin futures exchanges (BitFinex), enforced the laws prohibiting wash trading and prearranged trades on a derivatives platform, issued proposed guidance on what is a derivative market and what is a spot market in the virtual currency context, issued warnings about valuations and volatility in spot virtual currency markets, and addressed a virtual currency Ponzi scheme.”

¹⁵ “CFTC Backgrounder on Oversight of and Approach to Virtual Currency Futures Markets” CFTC Public Affairs Office, January 2018.
https://www.cftc.gov/sites/default/files/idc/groups/public/%40customerprotection/documents/file/backgrounder_virtualcurrency01.pdf

The complexity of regulations when secondary markets are involved is illustrated by the case of Bitcoin derivatives. As the price of Bitcoin surged towards \$20,000 near the end of 2017, derivatives exchanges sensed an opportunity to exploit the interest in products for speculating on Bitcoin prices. In December 2017, the Chicago Mercantile Exchange Inc. (CME) and the CBOE Futures Exchange (CFE) self-certified new contracts for bitcoin futures products, and the Cantor Exchange (Cantor) self-certified a new contract for bitcoin binary options.¹⁶

The CFTC claims jurisdiction when a virtual currency is used in a derivatives contract (or if there is fraud or manipulation involving a virtual currency traded in interstate commerce). However, the CFTC noted that, so long as the self-certification by the derivatives exchanges adhered to certain guidelines, it had no authority to even hold public hearings or seek public input before the new products were launched. In responding to concerns about the new products adding to the Bitcoin hype (and price volatility), CFTC Chairman Giancorlo acknowledged that “Bitcoin...is a commodity unlike any the Commission has dealt with in the past.” The CFTC added that “In working with the Commission, CME, CFE and Cantor have set an appropriate standard for oversight over these bitcoin contracts given the CFTC’s limited statutory ability to oversee the cash market for bitcoin.”

As Bitcoin and other cryptocurrencies, along with the technologies underpinning them, start playing a bigger role in financial markets, issues of regulatory jurisdiction and the potential for regulatory gaps/arbitrage take on greater significance. This discussion raises some important concerns in the context of the fragmented, overlapping, and inconsistent regulatory framework for U.S. financial markets that may have played a role in the global financial crisis and remains largely unchanged to this day.

Nonofficial cryptocurrencies may also require greater coordination and harmonization of regulatory efforts across national regulators. While some cryptocurrency exchanges are nominally domiciled in specific countries, the nature of these virtual currencies makes it difficult to subject them to national rules and regulations, especially in terms of investor protection. U.S. Securities and Exchange Commission Chairman Jay Clayton summarized this in a cautionary statement to the public: “Please...recognize that these markets span national borders and that significant trading may occur on systems and platforms outside the United States. Your invested funds may quickly travel overseas without your knowledge. As a result, risks can be amplified, including the risk that market regulators, such as the SEC, may not be able to effectively pursue bad actors or recover funds.”

5. Implications of New Financial Technologies for Financial Institutions and Markets

Recent technological developments have implications for the structure of financial markets as well as for banks and other financial institutions.¹⁷ The biggest impact of the new financial

¹⁶ See <https://www.cftc.gov/PressRoom/PressReleases/pr7654-17>. The CFE and CME Bitcoin futures began trading in December 2017, the Cantor exchange product has not yet been launched.

¹⁷ The academic literature on the recent wave of Fintech developments is still quite limited. One prominent exception is a special issue of the *Review of Financial Studies* devoted entirely to this topic.

technologies is likely to be on payment systems. Payment systems can broadly be classified into three categories—retail, wholesale (interbank), and cross-border. Each of these categories is subject to disruptive change or, at any rate, substantial change that could affect the business models of institutions intermediating such payments.

These developments have the potential to increase the efficiency and stability of financial markets but could also create new risks and amplify them in certain circumstances. The structures of financial markets and institutions will also be affected, with even the viability of some traditional institutions coming into question. In particular, commercial banks could face challenges to their business models as Fintech shifts the balance of power between traditional commercial banks and newer forms of intermediation by nonbank/nonfinancial institutions. The key challenge such developments pose for policymakers and regulators is how to balance the benefits of financial innovation with management of risks.

5.1. Payments Systems

The potential efficiency gains and welfare improvements from DLTs and other technologies underlying both CBDCs and cryptocurrencies could be significant. As the technology matures, it will confer a variety of benefits such as lower transaction costs as well as quicker and more easily verifiable settlement of transactions. It will become easier and cheaper to conduct even micro transactions using electronic payment systems. Such technologies can also help in broadening access to the formal financial system. An earlier fintech development, mobile banking, is already revolutionizing the very concept of banking in developing economies and giving much of the population—including rural and poor households—access to the formal financial system.

Many of these efficiency gains are related to improvements in payments systems, which have the potential to transform a variety of financial transactions. Both domestic and cross-border payments systems face disruption, with significant gains in speed and lowering of transaction costs on the horizon. Traditional messaging and payments/settlement systems across institutions (e.g., Fedwire and Clearing House Interbank Payments System (CHIPS) in the U.S., SWIFT for international transactions) could be displaced by cheaper and more efficient alternatives based on either decentralized or centralized monitoring. Payments systems and intermediaries such as Visa and Mastercard, which operate both within and across national borders, could also have their business models disrupted if their innovation does not keep pace.¹⁸

See Goldstein, Jiang, and Karolyi (2019) for a nice overview of that special issue and the issues raised by the research featured in it.

¹⁸ Klein (2019) provides a useful overview of innovations in retail payments systems in China. He summarizes these changes as follows: “Leapfrogging the card-based system, two new payment systems have come to dominate person-to-person, retail, and many business transactions. China’s new system is built on digital wallets, QR codes, and runs through their own big tech firms: Alipay running through Alibaba (China’s version of Amazon) and WeChat Pay running through Tencent (China’s version of Facebook).” He notes the potential these innovations have to disrupt traditional payments structures by creating new nexuses among consumers, businesses, and technology providers (rather than banks).

These changes have obvious positive welfare implications. The proliferation of payments systems could increase financial stability by creating multiple levels of redundancies, so that the technological (or other forms of) failure of one payment system would not be harmful to the system. However, there are important considerations that could worsen instability. As has become abundantly clear in multiple contexts, electronic systems have considerable technological vulnerabilities. These vulnerabilities, in addition to the lack of official backing, could expose these systems to crises of confidence. If this happens at a time when official payments systems have been sidelined as a result of competitive forces, there could be dire financial and macroeconomic consequences. Fragmentation and lack of oversight of payments systems could also lead to pooling of counterparty risk in the payment hubs, further increasing their fragility at times of financial stress.

An important decision facing policymakers in each country is what role the government should play in payments systems. One approach is to provide a unified and consistent regulatory framework that allows private sector payments services providers to compete and innovate. Another is where the government, through a CBDC or alternative approach, provides both wholesale and retail payments services.

In the U.S., the Federal Reserve provides a wholesale payments network (Fedwire) that co-exists with a private wholesale payments network operated by a consortium of large banks (CHIPS). The Fed has recently identified substantial operational and regulatory weaknesses in the U.S. payments system, both wholesale and retail, and is taking steps to rectify them (see Appendix C for details on the findings and recommendations of the Fed's Faster Payments Task Force). For instance, the Real Time Gross Settlement (RTGS) system operated by the Fed for wholesale payments is fast, efficient, and essentially free of charge to commercial banks. However, it has limited hours of operation that in turn hinder retail payments. Changing the RTGS system to a 24x7x365 operation and giving all agents in the economy access to the system would, in principle, substantially enhance payments system efficiency. The challenge, of course, is whether the RTGS can be scaled up to intermediate such a large volume of transactions. The Fed is clearly disinclined to provide such services that can be provided cheaply and efficiently by the private sector. Virtually every government will soon face similar issues about the desirable level of their involvement in national and cross-border payments systems.

5.2. Financial Institutions

As noted earlier, banks play a crucial role in the creation of money. Hence, changes to the financial system that affect the relative importance, or even the viability of, traditional banks have implications not just for financial markets but also for economic activity and monetary policy.

The traditional roles of banks—intermediating between savers and borrowers by offering deposits and loans—could be upended by more direct intermediation channels. Providing channels for maturity transformation and dealing with information asymmetries, traditionally the main issues that gave banks advantages over other financial institutions, could still affect whether commercial banks may be displaced or simply switch to different roles.

Commercial banks' traditional advantages can, however, no longer be taken for granted. For instance, relationship banking and other sources of information give banks an advantage over other financial institutions in dealing with information asymmetries between borrowers and lenders. However, as has already been demonstrated by Alibaba and Alipay in China, the use of big data and tracking of multiple attributes and economic activities of agents (including their purchase and payment histories) could provide even more effective credit scoring that reduces information asymmetries. Similarly, peer to peer lending and other direct intermediation channels between savers and borrowers, including online platforms such as LendingClub and LendingTree in the U.S., are being facilitated by new technologies.

These alternative channels of financial intermediation have passed the proof of concept stage, but whether they can be scaled up to the extent that they challenge commercial banks remains to be seen. Maturity transformation is an inherently risky activity for a financial institution and there may be a limit to which informal institutions can take on this task. At any rate, banks can no longer count on collecting economic rents on many intermediation activities that they had hitherto conducted inefficiently and charged high fees on, exploiting their oligopolistic power. Competitive pressures from nonbank institutions are likely to lead to a rapid erosion of such rents, which could increase financial pressures on banks that had been using profits on certain activities to cross-subsidize other activities.

The rise of new types of nonbank and informal financial institutions could help increase the efficiency of financial intermediation, including by creating new products for savers and borrowers.¹⁹ Whether these institutions will displace commercial banks or expand the channels of financial intermediation in an economy is not conclusive at this stage.²⁰ Moreover, the outcomes could be very different between advanced and developing economies, especially given the substantial differences between these two types of economies in terms of the levels of access of households and small businesses to banks and other traditional financial institutions. Nevertheless, as these institutions intrude on the business areas of traditional banks, they would also take on some of the financial fragilities associated with those activities. Hence, the structures of financial supervisory and regulatory frameworks will need to adapt since the risks might shift to the under-regulated parts of the financial system.

¹⁹ Fuster et al. (2019) note that FinTech lenders increased their market share of U.S. mortgage lending from 2 percent to 8 percent from 2010 to 2016. They report evidence that FinTech lenders process mortgage applications about 20 percent faster than other lenders, but this faster processing does not come at the cost of higher defaults. They conclude that technological innovation has improved the efficiency of financial intermediation in the U.S. mortgage market.

²⁰ Tang (2019) finds that, in the U.S., peer to peer lending is a substitute for bank lending in terms of serving infra-marginal bank borrowers yet complements bank lending with respect to small loans. He interprets these results as indicating that credit expansion resulting from peer to peer lending likely occurs only among borrowers who already have access to bank credit. Vallee and Zeng (2019) analyze U.S. marketplace lending, which relies on large-scale loan screening by investors rather than by commercial banks. They show that, in a theoretical setting, the participation of sophisticated investors in marketplace lending improves screening outcomes but also creates adverse selection. They then use data from two lending platforms in the U.S., LendingClub and Prosper, to show that these platforms maximize loan volume by trading off these two forces by choosing intermediate levels of platform pre-screening and information provision to investors.

5.3. Financial Market Regulation

The nature of regulation will change not just as new financial players emerge but also as the financial operations of existing players and the structures of financial markets are affected by the technological developments discussed in this paper.

One of the key changes wrought by technology is that the cost of information acquisition and dispersion is falling. This should in principle engender greater financial stability since asymmetric and incomplete information represent impediments to the smooth functioning of financial markets. However, a reduction in the cost of obtaining information, without commensurate improvements in reliable signal extraction mechanisms or the displacement of trusted signal interpreters, could actually lead to information overload. This in turn has the potential to generate information cascades that tend to worsen herding behavior and intensify contagion across financial markets. Bandwagon effects could intensify volatility in financial markets as more investors, including retail investors, can jump on more quickly and cheaply as they try to follow trends.

Informal financial institutions, which are outside the purview of regulators, could become increasingly important to the financial system. If the system does in fact efficiently disperse risk, then the outcome with a larger number of institutions due to the lower cost of entry might be a better one than present system. It has also been argued by some analysts that market discipline is often thwarted by government intervention or, worse, direct government involvement in the market. But will a decentralized system truly be subject to checks and balances in the absence of any oversight/regulation?

Decentralized payment processing and settlement systems could, in addition to increasing efficiency, level the playing field across small and large banks. The advantage of scale that large banks (and other large financial institutions) have would matter less as the costs of financial intermediation fall. However, regulators will need to be vigilant to avoid the risks of capture by large institutions. For instance, a set of large banks could set up a closed and centralized payment system that smaller banks do not have access to, making it harder for smaller banks that have access only to alternative decentralized systems to compete effectively.

Thus, while some aspects of financial regulation might become easier (because of better and quicker monitoring of digital transactions), the nature of financial regulation will have to keep pace with shifts in the structures of financial markets and institutions. While considerations such as too big to fail and the need for tighter regulatory standards for systemically important financial institutions have received prominence in recent regulatory reforms, future regulation might also need to ensure that big banks do not use their size to cartelize the financial system by setting up restricted access payment and settlement systems outside the purview of the central bank or other regulatory authority.

5.4. Fintech and Regulatory Sandboxes

The challenge for regulators is to find a balance between regulation and providing space for financial innovation that does not pose systemic stability risks. By definition this is a difficult balancing act since the full scope of benefits as well as the full scale of risks associated with a particular innovation might not be clear in the early stages.

A number of central banks, recognizing the potential benefits of new technologies, have tried to allow some experimentation under controlled circumstances. Regulatory sandboxes have proliferated as regulators try to take the measure of the new technologies and their potential without engendering systemic risks. The U.K. Financial Conduct Authority Regulatory notes that its sandbox “allows businesses to test innovative products, services, business models and delivery mechanisms in the real market, with real consumers.” The Monetary Authority of Singapore states that its regulatory sandbox enables financial institutions “...as well as FinTech players to experiment with innovative financial products or services in the production environment but within a well-defined space and duration. It shall also include appropriate safeguards to contain the consequences of failure and maintain the overall safety and soundness of the financial system.” The sandboxes allow regulators to observe the operation of new financial technologies as a precursor to designing suitable regulation as these activities scale up and move out of the sandboxes and into the broader financial system.

The list of countries that already have such financial regulatory sandboxes in operation includes a number of advanced and emerging market economies such as Australia, Canada, Denmark, Hong Kong, Malaysia, Thailand, Saudi Arabia, South Africa, Sweden, and the United Kingdom. The European Union recently set out proposals for an EU-wide regulatory sandbox. Appendix D provides an overview of the nature of Fintech regulatory sandboxes around the world, along with a brief selective assessment of how well these seem to be functioning.

The Federal Reserve has not initiated any proposals for such a sandbox or indicated any intention of doing so. Interestingly, in March 2018, Arizona enacted a new law establishing a fintech sandbox, making it the first U.S. state to do so.²¹ The program, managed by the Attorney General’s office, opened for applications in late 2018 and is slated to run through July 2028. Applicants will be able to serve up to 10,000 Arizonian customers, and will have two years for testing. The press release notes that, while the idea of a regulatory fintech sandbox is “being discussed at the federal level, Congress is moving at a glacial pace.”

While Fintech regulatory sandboxes are in operation in many parts of the world, including in many emerging market and developing economies, Latin America is conspicuous in its absence from the list. This could be the result of a cautious regulatory approach, combined with a lack of interest among potential Fintech operators. It would be worth investigating in more detail the reasons for this weak interest and then for governments in the region to consider sending positive signals about their openness to considering financial innovations. While it is certainly a viable strategy to learn from the experiences of other countries, the

²¹ The official press release is available at: <https://www.azag.gov/press-release/arizona-becomes-first-state-us-offer-fintech-regulatory-sandbox>.

evidence so far suggests that country-specific financial and other circumstances are crucial in designing and implementing Fintech innovations. Hence, there is a strong incentive for central banks and financial regulators in the region to consider ways to encourage and promote Fintech and other innovations that could improve financial inclusion and household welfare.

5.5. New Players

One intriguing prospect is that large nonbank financial institutions and nonfinancial corporations could become important players in financial markets, perhaps even issuing their own tokens/currencies. For instance, a company such as Amazon could conceivably issue electronic tokens for trading goods on its platform. The backing of such a large company could ensure the stability of its value and make it a viable medium of exchange, reducing the demand for central bank money for commercial transactions. Such digital tokens issued by well-known nonfinancial corporations, with Facebook being another example, could end up being seen as stores of value as well given the scale, apparent stability, and financial firepower that these corporations command. The major implications of such developments would not just be the reduction in the demand for central bank money as mediums of exchange or stores of value, but the consequences they would have for the business models of banks and other existing financial institutions. Although the potential effects are not obvious and need careful study, these developments could have implications for monetary policy transmission.

6. Challenges for Central Banks: Monetary Policy, Financial Stability

Central banks are likely to face technical and operational challenges to their core mandates or, at a minimum, will need to adapt to the evolving financial technologies.²² While these challenges are inter-related, it is useful to separate them for discussion purposes into those related to monetary policy implementation, the transmission of monetary policy, and financial stability.

6.1. Monetary Policy Implementation

One obvious question is whether CBDC will have an effect on monetary policy or other aspects of macroeconomic policies. Retail CBDC disseminated through electronic wallets would make it easier to implement monetary policy more effectively in two ways. First, the nominal zero lower bound, which became a binding constraint for traditional monetary policy in advanced economies during the worst of the global financial crisis, would no longer apply. The central bank could institute a negative nominal interest rate simply by reducing balances on these electronic wallets at a pre-announced rate. In an economy with physical cash, this should in principle not be possible since consumers (and firms) have the alternative of holding

²² See BIS, 2018, “Central Bank Digital Currencies,” Committee on Payments and Market Infrastructures, and Lael Brainard, 2018, “Cryptocurrencies, Digital Currencies, and Distributed Ledger Technologies: What Are We Learning?” Federal Reserve Board of Governors.

physical currency banknotes, a zero nominal interest rate instrument. In principle, negative nominal interest rates that would become feasible with certain forms of CBDC should encourage consumption by making it expensive for households to maintain cash positions.

Monetary policy could also be implemented through “helicopter drops” of money, once seen as just a theoretical possibility of increasing cash holdings in an economy in a non-distortionary fashion by making lumpsum transfers to all households. This would be easy to implement if all citizens in an economy had official electronic wallets and the government could transfer central bank money into (or out of) those wallets. Channels for injecting outside money into an economy quickly and efficiently become important in circumstances of weak economic activity or looming crises, when banks might slow down or even terminate the creation of outside money.

Thus, a central bank could substantially reduce deflationary risks by resorting to such measures in order to escape the liquidity trap that results when it runs out of room to use traditional monetary policy tools in a physical cash-based economy.

There is an important asymmetry in this context that could become even more consequential if outside money were to have only a small role in the overall money supply. In that case, if banks were expanding outside money rapidly at a time of strong economic activity with rising inflationary risks, the central bank’s ability to shrink electronic wallets holding CBDC might not do much to control the overall money supply. Although most advanced economy central banks now use price-based monetary policy measures (policy interest rates) rather than quantity-based monetary policy measures, this might be another reason for central banks to issue CBDCs rather than letting central bank money wither away if households were to use less and less cash.

There is, however, a flip-side to the ease with which a central bank can increase or decrease the supply of outside money. The ability to impose a haircut on CBDC holdings, or to increase them rapidly in case the government were to apply pressure on a central bank to monetize its budget deficit, could lead to substitution away from the CBDC. The reduction in nominal balances and the erosion in the real purchasing power of nominal balances through monetary injections would have similar effects—decreasing confidence in the currency as a safe asset that can hold its value, at least in nominal terms.

6.2. Monetary Policy Transmission

A number of banks and consortiums of banks are exploring the use of DLT for bilateral settlement of clearing balances without going through a trusted intermediary such as the central bank. DLTs, as discussed earlier, make it easier to track and verify transactions. If all participants in a closed pool can monitor such activities and if there is a permanent indelible transaction record that is tamper-proof, they may be able to use group monitoring as an alternative for a trusted central counterparty.

Will such developments dilute the ability of the central bank to affect interest rates in the economy through its control of very short-term policy interest rates (such as the discount rate

and the Fed funds rate in the U.S.)? This gets to the crux of the question about whether central banks can maintain their influence over aggregate demand and inflation even if they are sidelined from some of their traditional roles—issuing (outside) money and providing payment and settlement services for major financial institutions.

If banks and other major financial institutions do create such payments and settlement mechanisms among themselves (both bilaterally and across members in the group), and are also able to more effectively manage their liquidity positions and overnight balances, then settlement and liquidity management through the central bank might play a less important role. Of course, the ability to observe such transactions (or even to observe that such transactions are taking place between certain participants in the system) conveys important information that banks might not want to reveal to their competitors. Thus, competitive forces might limit the use of DLTs as an alternative for a trusted third party such as a central bank to provide settlement services while maintaining the confidentiality of those transactions. In short, significant technological as well as conceptual hurdles will need to be overcome before commercial banks sideline the central bank.

If these challenges are overcome, one possibility is that the central bank eventually becomes a liquidity provider of last resort in times of crises but, otherwise, commercial banks route their settlement and liquidity management operations through direct channels among themselves.

A related issue is whether nonbank and informal financial institutions are less sensitive to policy interest rate changes than traditional commercial banks. If these institutions do not rely on wholesale funding and have other ways of intermediating between savers and borrowers, then the central bank might face significant challenges to the effectiveness of monetary policy transmission. This might also prove to be only a long-term challenge for advanced economies if and when the relative importance of traditional commercial banks declines, although in developing economies informal financial institutions already play a significant role. Despite the proliferation of nonbank financial institutions and more direct intermediation channels, it is far from obvious that these can be scaled up such that they displace (rather than erode the prominence of) commercial banks. The relative sensitivity of the nonbank financial sector to changes in policy interest rates and other operational tools of monetary policy needs further study as the structures of financial systems undergo changes that could significantly affect the implementation and transmission of monetary policy.

6.3. Financial Stability

The challenges for financial stability come mainly from innovations that could displace existing financial institutions, lead to concentration of payments systems, and accentuate technological vulnerabilities. For emerging market economies, the expansion of conduits for cross-border financial flows with greater efficiency and lower costs could be a double-edged sword, making it easier for them to integrate into global financial markets but at the risk of higher capital flow and exchange rate volatility. Such volatility has often caused significant stresses for corporate and sovereign balance sheets in these economies.

One of the key challenges facing central banks is how to reduce the vulnerability of privately-managed retail and wholesale payments systems. While these systems may lead to substantial efficiency gains, a major concern is the vulnerability of the entire network of payment systems at times of financial market stress that results in an increase in (perceived or actual) counterparty risk. Cash or electronic payments systems managed by a central bank would provide a backstop in such cases, but that also comes with the risk that the flight to safer payments systems could lead to an escalation of even minor episodes of loss of confidence into major disruptions to private payment systems. Balancing such risks will be an important and difficult challenge.

Regulatory policy will need to evolve rapidly in order to evaluate and regulate both institution-specific and systemic risk generated by financial sector activities of nonbank financial institutions and nonfinancial corporations. With Fintech firms and even regular commercial enterprises playing a larger role in various aspects of financial intermediation, the regulatory architecture could soon develop lacunae that affect financial stability in times of macroeconomic stress. One interesting example is that of Alibaba in China, a consortium that was not only enabling e-commerce but conducting a slew of financial transactions including provision of short-term credit to retailers and buyers that were using its platform. The consortium did not come under the purview of the banking regulator since it did not take retail deposits. The consortium recently applied for and received a banking license, but there are other providers of financial services that seem to be poorly covered by the existing regulatory framework.

Another aspect of financial stability is related to crisis management, particularly in the context of changes to financial market structures. For instance, liquidity injections to smooth over periods of financial market stress would be harder if nonbank financial institutions not directly connected to the central bank became more important players than commercial banks.

6.4. Selective Review of Academic Literature

The academic literature has only recently begun to grapple with the implications of CBDC as well as Fintech more broadly for monetary policy. Some authors argue that a CBDC will not in any material way affect the implementation of monetary policy, although there could be other macroeconomic effects. The conclusions, as indicated by the limited and selective survey below, depend to a great extent on the model structure and the manner in which the CBDC is introduced into the economy.

Barrdear and Kumhof (2016) develop a DSGE model with multiple sectors and several nominal and real rigidities to understand the effect of introduction of CBDC. These authors suggest that infusing CBDC into an economy could result in substantial steady state output gains of nearly 30 percent. This effect persists if the central bank issues a large amount of CBDC against government bonds.

Andolfatto (2018) studies the implications of CBDC in an overlapping generation model with a monopolistic banking sector. In this model, the introduction of interest-bearing CBDC increases the market deposit rate, leads to an expansion of the deposit base, and reduces bank

profits. This is because competition from the CBDC causes banks to raise deposit rates. However, the CBDC has no effect in terms of bank lending activity and lending rates. Although the introduction of the interest-bearing CBDC increases financial inclusion, diminishing the demand for physical cash, it does not disintermediate banks.

Bordo and Levin (2019) consider how digital cash could bolster the effectiveness of monetary policy. They lay out some steps for implementing digital cash via public-private partnerships between the central bank and supervised financial institutions. They conclude that digital cash could significantly enhance the stability of the financial system.

Mishra and Prasad (2019) develop a simple general equilibrium model that highlights the trade-offs between physical and electronic forms of fiat currency issued by central banks. The key differences between these two forms of central bank-issued outside money include transaction costs (lower for CBDC), possibilities for tax evasion (higher for cash, but with a positive probability of being caught and penalized), and nominal rates of return (zero for cash; potentially positive or negative for CBDC). They show the conditions under which cash and CBDC can co-exist and also show how different combinations of government policies, such as the level of taxes and the penalty for being caught undertaking tax evasion, can influence the relative holdings of cash and CBDC. The model provides a framework that can eventually be extended to evaluate conditions under which different forms of government-backed and privately-issued currencies can coexist, conditional on the attributes of each of those currencies and also government policies.

While this burgeoning literature has provided some useful insights for designing and evaluating the implications of CBDC, a great deal of work clearly remains to be done in fleshing out the monetary policy and financial stability implications of CBDC.

7. Implications for the International Monetary System

The advent of CBDC and cryptocurrencies could have implications over the long run for certain aspects of the international monetary system, but these are not likely to be revolutionary. Some changes could occur even earlier, although their effects on global finance will mostly be limited to the structure of financial markets themselves.

One of the major benefits of improved electronic payment and settlement systems that would go with the proliferation of digital currencies is the increase in speed and security of transactions, along with a reduction in their costs. This would mark a substantial improvement for settlement of trade-related transactions as well as remittances. Even cross-border settlement of other types of financial transactions could benefit from these developments. DLTs offer the potential for reliable tracking of different stages of trade and financial transactions, reducing one of the frictions associated with such transactions. Such changes might simply increase the efficiency and lower the cost of transactions routed through banks and other traditional financial institutions rather than displacing such institutions.

International payment messaging systems such as SWIFT are vulnerable to being replaced by alternatives that have the benefits of security and verifiability, but at a lower cost. SWIFT has the major initial advantage of a standardized communication protocol but it is difficult to imagine that that advantage is sufficient as a business model. Indeed, many countries such as China and Russia are setting up their own payment systems so as to reduce their reliance on foreign payment systems and also as a gateway to the international payment system. In other words, such countries could conceivably link their payment systems, routing bilateral international transactions through their own payment systems rather than relying on SWIFT and the payment systems that use it for messaging. For instance, China's Cross-Border Interbank Payment System (CIPS), which commenced operations in 2015, offers clearing and settlement services for cross-border payments in renminbi. CIPS has the capacity for easier integration with other national payments systems. While it currently uses SWIFT as the messaging channel, CIPS could eventually serve as a more comprehensive system that includes messaging services using an alternative protocol.

A longer term and perhaps less likely outcome is the advent of cryptocurrencies, or at least decentralized payment systems, that function as mediums of exchange in international transactions. This would in effect create new channels for cross-border capital flows that are more difficult for a government to control through either macroprudential regulations or explicit capital controls.

7.1. Capital Controls and Exchange Rates

Financial globalization has increased as a result of greater pressures for capital to flow across national borders, in search of either or both yield and safety, and the spread of financial institutions with a global footprint. This has led to rising de facto financial openness of all economies, including emerging market economies such as China and India that maintain de jure capital controls. In the case of China, for instance, its large banks now have a global presence and provide channels for moving money into and out of the country more easily than when the operations of these banks were mostly domestic. In addition, rising trade volumes have created opportunities for evading capital controls through trade misinvoicing.

New channels for transmitting payments across borders more quickly and cheaply are likely to make it more difficult to regulate and control capital flows. Such changes are hardly imminent since cross-border payment systems are still in their infancy. But China's recent experience provides a cautionary tale. When the government was trying to control capital outflows in 2015-2016 in order to manage depreciation pressures on the renminbi, Bitcoin demand emanating from China surged. It is not possible to establish a clear connection between these developments, but there was enough circumstantial evidence to lead the government to ban Bitcoin trading in order to tamp down on capital flight through this channel.

7.2. Financial and Real Spillovers

Both banks and nonbank financial institutions could expand the geographical scope of their operations across national borders using the new technologies. This entails new challenges for supervision and regulation. One complication is the lack of clarity about the domicile of

informal financial institutions and the geographical locus of the supervisory authority of national regulators. The second is the potential accentuation of cross-border financial stability risks as more institutions operate across national borders. Some of these challenges could be overcome by the greater transparency of transactions if they are conducted using a public DLT or if the regulator has access to the relevant private ledgers.

New channels for capital flows could also transmit financial market volatility more rapidly across countries. This is a particular concern for emerging market economies that are already subject to whiplash effects on account of conventional and unconventional monetary policy actions of the major advanced economy central banks, particularly the U.S. In other words, the availability of more efficient conduits for cross-border capital flows could intensify global financial cycles and all the domestic policy complications that result from them.²³

7.3. The Dollar's Role as Dominant Reserve Currency

The demand for Bitcoin as a store of value rather than as a medium of exchange has stoked discussion about whether such cryptocurrencies could challenge that role of traditional reserve currencies. It is more likely that, as the underlying technologies become more stable and as more efficient verification mechanisms are developed, such decentralized nonofficial cryptocurrencies will start playing a bigger role as mediums of exchange. Even that proposition is a tenuous one given the high levels of price volatility experienced by such currencies recently. Nevertheless, this shift could occur over time as the utilitarian functions of cryptocurrencies and the underlying payment verification and transfer systems take precedence over the speculative interest in them.

The decline in transaction costs and easier settlement of transactions across currency pairs could have a more direct and immediate impact—a decline in the role of vehicle currencies such as the U.S. dollar that are used to intermediate transactions across pairs of other currencies. The dominance of the dollar as a vehicle currency, followed by the euro, is related to the depth and liquidity of most currency pairs with the dollar (and the euro), which reduces the associated transaction costs. This dominance is unlikely to persist and could even result in an erosion of the dollar's role as a unit of account. For instance, the denomination of all oil contracts in dollars could easily give away to denomination and settlement of contracts for oil and other commodities in other currencies, perhaps even emerging market currencies such as the renminbi.

Notwithstanding any such changes, the role of reserve currencies as stores of value are not likely to be affected.²⁴ Safe financial assets—assets that are perceived as maintaining most of

²³ Rey (2013) makes the case for a global financial cycle in capital flows, asset prices, and credit growth, and the constraints this imposes on emerging market economies' monetary policy independence.

²⁴ Gopinath and Stein (2018) offer a different perspective, arguing that the dollar's dominance is largely the *result* of its prominence as a medium of exchange. This suggests that the two roles are tied together and that a decline in the dollar's medium of exchange function in international transactions could weaken its dominant reserve currency status. By contrast, Prasad (2014, 2016) makes the case for continued dollar dominance as the reserve currency even if its importance as unit of account or

their principal value even in terms of extreme national or global financial stress—have many attributes that cannot be matched by nonofficial cryptocurrencies.

The key technical attributes include liquidity and depth of the relevant financial instruments denominated in these currencies, such as U.S. Treasuries. More importantly, both domestic and foreign investors tend to place their trust in such currencies during times of financial crisis since they are backed by a powerful institutional framework.²⁵ The elements of such a framework include an institutionalized system of checks and balances, the rule of law, and a trusted central bank. These elements provide a security blanket to investors that the value of those investments will be largely protected and that investors, both domestic and foreign, will be treated fairly.

While reserve currencies might not be challenged as stores of value, digital versions of extant reserve currencies and improved cross-border transaction channels could intensify competition among reserve currencies themselves. In short, the finance-related technological developments that are on the horizon portend important changes to domestic and international financial markets but a revolution in the international monetary system is not quite on the cards for the foreseeable future.

8. Implications for Latin America

There is a stark divergence among Latin American countries in their embrace of and approach to both new financial technologies and CBDCs. In some respects, a few countries in the region have been at the forefront of adopting the new financial technologies. Ecuador and Uruguay were among the first countries to issue, in a limited form, token-based CBDC while Venezuela issued the first official cryptocurrency. Of these, only the Uruguay e-peso experiment has proved viable. More broadly, it appears that Latin American governments and central banks have taken a somewhat passive approach to preparing for the advent of new financial technologies, including harnessing the potential benefits of Fintech innovations.

This section presents some arguments as to why central banks in the region should seriously consider the adoption of CBDC. However, the ability of CBDCs to gain traction might be constrained by macroeconomic and structural issues in the region. Still, at a minimum there is an opportunity to harness the benefits of new financial technologies to improve the equality of financial intermediation as well as other economic outcomes among Latin American countries. Moreover, there is a risk that a passive approach to the digitalization of money, while it picks up pace elsewhere in the world, could work to the disadvantage of countries in the region over the long run.

medium of exchange in international finance should decline, particularly with the advent of the Chinese renminbi and given some of the factors discussed in this paper that would reduce the need for a vehicle currency in international trade transactions.

²⁵ See Prasad (2014).

8.1. Overview of Modes of Payment and Payments Systems Prevalent in Latin America

Latin American countries have a heterogeneous set of monetary and exchange rate regimes. Brazil, Colombia, and Mexico have in recent years experienced relatively moderate inflation anchored by inflation targeting regimes and (mostly) flexible or loosely-managed exchange rates. Others such as Argentina and Venezuela face high inflation or hyperinflation, with central banks that have limited credibility due to fiscal dominance and lack of independence from direct political intervention in their operational decision-making. Many countries in the region—including Bolivia, Costa Rica, Ecuador, Paraguay, Peru, and Uruguay—are partially or fully dollarized, again reflecting historical monetary instability and limited central bank credibility. Some of these countries—including Costa Rica, Paraguay, and Peru—pursue inflation targeting while others such as Bolivia target monetary aggregates.

Cash still remains dominant in many Latin American emerging market economies, a striking contrast with middle-income countries in other parts of the world that are increasingly shifting towards electronic forms of payment for retail transactions rather than using cash. On average, the share of currency in M2 for the countries in the region was 17.6 percent in 2017 (see Table 1), with a number of economies such as Argentina, Bolivia, Ecuador, and Paraguay reporting ratios above 25 percent. The average share of currency in M2 declined by only two percentage points from 2004 to 2017, a much smaller decline than that experienced by middle-income emerging market economies in many other parts of the world (see Prasad, 2018). Meanwhile, the average ratio of currency to nominal GDP in the region in fact rose from 3.3 percent in 2001 to 7 percent in 2017.²⁶

An interesting case study for Colombia reinforces the point about how important cash remains in Latin America. Arango-Arango, Suárez-Ariza, and Garrido-Mejía (2018) report the results from a survey conducted by the Banco de la República in collaboration with private firms. The survey was aimed at the general public and small traders in the country's five main cities: Barranquilla, Bogotá, Bucaramanga, Cali, and Medellín. The study concludes that even urban consumers who have a high degree of access to electronic payments instruments still make 97 percent of their payments in cash, mainly due to the limited acceptance of such instruments in their daily transactions. The reluctance of small businesses to accept electronic payments is due to their perceptions of the cost involved and the prospect of higher tax burdens. Electronic payments account for only about 30 percent of even higher-value transactions (roughly above \$470) and about 12 percent of the total value of all transactions.

²⁶ The regional averages referred to in this section are unweighted, cross-sectional averages.

Table 1. Some Financial Statistics for Selected Latin American Countries

	Currency to M2 (in percent)		Currency to GDP (in percent)		Wholesale payments (ratio to GDP)		Size of informal economy (percent of GDP)	
	2004	2017	2001	2017	2006	2017	2004	2015
Argentina	36.8	32.6	3.1	6.7	2.6	4.3	24.3	25.0
Bolivia	59.0	36.0	4.3	15.6	1.2	2.2	66.7	62.3
Brazil	8.9	7.2	2.5	3.1	41.0	52.0	37.3	37.6
Chile	5.2	5.2	2.4	3.7	9.3	16.3	16.9	16.7
Colombia	16.0	14.0	2.9	5.5	12.0	14.8	35.3	33.3
Costa Rica	11.0	5.0	2.8	2.7	1.9	1.7	24.0	24.5
Ecuador	25.0	46.0	6.2	14.4	0.1	1.0	33.8	33.6
Mexico	13.6	18.4	3.2	7.0	11.0	11.3	29.8	31.7
Paraguay	38.0	26.0	4.7	7.8	---	1.8	36.3	34.5
Peru	7.8	9.6	2.9	6.8	2.6	4.7	53.5	52.4
Uruguay	5.0	6.0	2.3	3.3	0.2	1.8	40.7	20.4
Venezuela	12.0	5.0	2.6	---	---	---	36.2	33.8
Average	19.9	17.6	3.3	7.0	8.2	10.2	36.2	33.8

Notes: Data provided by central banks and compiled by FLAR. Estimates of size of informal economy are from Medina and Schneider (2018). Averages shown are simple cross-sectional averages for countries for which data were available for relevant variable.

The statistics reported in Table 1 are buttressed by a review of the levels of financial inclusion in the region. In Table 2, drawing on the World Bank's Findex Database, I present some data on basic aspects of financial inclusion and also some measures of access specifically related to digital payment and banking technologies. The table shows data for 2017. Based on a broad measure of financial inclusion—having an account at a financial institution—on average only 57 percent of adults in Latin American countries have direct access to the formal financial system. The ratio is below 50 percent in Argentina, Colombia, Mexico, and Peru, while it is 70 percent or higher in Brazil, Chile, and Venezuela. Even among adults who have such an account, only a small proportion use the internet or mobile phones to conduct financial transactions through that account.

The average shares of adults with a debit card and a credit card are 43 percent and 20 percent, respectively, suggesting that electronic means of payment are still not used by large swaths of the populations in these countries. There is again a wide discrepancy among regional economies. For instance, the proportion of adults with a credit card is 10 percent or lower in Bolivia, Ecuador, and Mexico, while it is 30 percent or higher in Chile and Uruguay. On average, only about 40 percent of adults in Latin American countries report having used any

form of digital payment over the past year. The share is higher than 50 percent in only three economies—Chile, Uruguay, and Venezuela.

The share of adults with a mobile money account is in single digits for most countries. In general, there have been only modest increases in the indicators shown here over the last few years (the Findex database has data for 2011 and 2014, in addition to 2017). Thus, both in terms of financial inclusion and digitization of payments, there is considerable room for progress in Latin American economies.

Table 2. Measures of Financial Inclusion and Digital Access in Latin America
(percent of adult population)

	Account at financial institution	Used mobile phone or internet to access a/c	Debit card	Credit card	Made digital payments in past year	Mobile money account
Argentina	49	21	41	24	32	2
Bolivia	54	12	28	7	33	7
Brazil	70	18	59	27	46	5
Chile	74	34	60	30	56	19
Colombia	46	16	26	14	29	5
Costa Rica	68	26	52	14	46	--
Ecuador	51	9	28	9	22	3
Mexico	37	15	25	10	23	6
Peru	43	10	28	12	25	3
Uruguay	64	25	56	41	53	--
Venezuela	73	40	66	29	65	11

Notes: Data were obtained from the World Bank's Global Findex Database. Data shown in the table are for 2017 and were not available for Paraguay. Adult population refers to individuals aged 15 years or older. The second column indicates what proportion of households *with* accounts used mobile phones or the internet to access their accounts.

One intriguing question that arises from reviewing the data in these two tables is what the relationship and direction of causality is between the level of financial inclusion and degree of informality of economic activity in a country. At a first glance, it appears that there is a negative (unconditional) cross-sectional relationship between the two variables. Countries with higher levels of financial inclusion have lower levels of informality. Even if this relationship were to hold up in more formal statistical analysis, the issue of causality is difficult to disentangle since there could in fact be alternative factors that account for both of

them. Indeed, it is likely that these phenomena, as well as that of dollarization, have common origins. For instance, a high tax burden creates incentives for shifting economic activity into the informal sector, shrinking the tax base and often leading governments to resort to monetary financing of public deficits. This can result in high and variable inflation, which in turn affects the stability of the value of the official medium of exchange, can in turn lead to dollarization. Thus, macroeconomic policies ultimately are key determinants of the multiple phenomena discussed here.

8.2. Some Lessons for Latin American Economies

What role could a CBDC play in addressing some of the issues that have been identified above in Latin American economies? A CBDC can help in improving financial inclusion and in reducing the extent of economic activity that escapes the formal tax net. It could also serve as a low-cost and efficient digital payments system for retail transactions. But the ability of a CBDC to promote these objectives will still depend on the quality and stability of macroeconomic policies. For instance, a broadening of the tax base would have a significant positive impact only if it led to a reduction in tax rates rather than simply an increase in government expenditures. Similarly, if fiscal dominance and other factors kept expectations of inflation at high levels, then availability of a digital version of the domestic fiat currency would not by itself reduce dollarization.

From the perspective of Latin American economies, the costs and benefits of CBDC are largely tied to the credibility of the central banks issuing them. The notion that a central bank could attain greater credibility for an electronic version of its fiat currency relative to cash is not tenable. The value and acceptability of both forms of central bank money, whether cash or digital, are fundamentally tied to a central bank's credibility, which in turn is a function of the independence of the central bank and other policies in the economy, especially fiscal policy.

There are a number of factors that could inhibit the introduction and widespread acceptability of CBDC in Latin American countries. As noted earlier, many economies in the region are dollarized to some extent, if not fully. Countries such as Brazil, Chile, and Colombia have successfully used inflation targeting regimes to deal with the region's historical scourge of high inflation, but the region as a whole still faces the problems of fiscal dominance and political threats to central bank independence and credibility.

While many Latin American economies have attained the status of middle-income or even upper middle-income economies, the region is still characterized by a high degree of informality in economic and financial activities, with consequent implications for the tax base, financial regulation, and management of illicit commercial activities. Medina and Schneider (2018) estimate that, among all the regions in the world, the share of informal economic activities, conducted mostly using cash, is highest in Sub-Saharan Africa and Latin America. These authors find that the average share of the shadow economy in the total economy is more than one-third for countries in the region. In some economies in the region—including Bolivia, Guatemala, Honduras, and Peru—the share is as above 50 percent. For the countries represented in Table 1 (last panel), the average ratio was 33.8 percent in 2015, down only marginally from 36.2 percent in 2004. Even discounting the precision of

these estimates, it is clear that the shadow economy accounts for a substantial share of overall economic activity in these countries.

Introduction of a CBDC under all of these circumstances could face significant limitations. In particular, digital versions of money issued by a central bank that lacks credibility will not inherently be more widely accepted than paper currency. Still, as the experiment in Uruguay indicates, CBDC can be seen as a tool to achieve other objectives such as financial inclusion and improvements in the retail payments system. It would in any event be advisable for central banks in the region to undertake analysis of how the new financial technologies could affect financial institutions and markets in their countries, and proactively manage the benefit-risk tradeoffs from such innovations rather than passively letting markets take their course.²⁷

An additional consideration for central banks in the region relates to the volatility of capital flows and, by extension, exchange rates. Latin American countries, which have traditionally had more open capital accounts (at least in de facto if not in de jure terms) than emerging market economies in other parts of the world, have experienced boom-bust cycles in capital inflows. The development of new cross-border payments systems and other channels that facilitate capital flows could benefit the region in many ways. Remittances and inward investment flows could increase, with the costs of such transactions falling, and the settlement and verification of transactions becoming quicker and more efficient. More broadly, foreign capital could help boost investment and growth in these economies if domestic markets effectively funnel this capital into productive investment opportunities.

However, these benefits of reduced frictions on cross-border capital flows come with the attendant risks of capital flow surges as well as sudden stops or reversals of capital inflows. The emergence of new and more efficient conduits for cross-border financial flows could intensify the spillovers of conventional and unconventional monetary policy actions of the major advanced economy central banks, especially the U.S. Federal Reserve. The intensification of financial cycles would not only engender more capital flow and exchange rate volatility, but could also constrain monetary policy independence, even for central banks that practice inflation targeting backed up by flexible exchange rates.

8.3. Summary

At this stage of the discussion, it is worth taking stock of the tradeoffs associated with issuing a CBDC and what the policy implications could be for Latin American countries.

The main benefits of a retail CBDC can be summarized as follows:

- Greater efficiency and speed, lower cost, and finality of transactions
- Broader tax base, reduced tax evasion
- Easing of zero lower bound constraint on monetary policy

²⁷ Camara et al. (2018) discuss various options for CBDC in Latin American countries. They note that an “unidentified” retail CBDC that provides anonymity could improve financial inclusion but also increase the informality of economic activity in the region. They argue that an identified CBDC would reduce informality but could lead to a substitution away from domestic fiat currencies, in either physical or digital form, toward nonofficial cryptocurrencies and foreign currencies.

- Easier to engineer nondistortionary helicopter drops or withdrawals of central bank money (without relying on fiscal transfers)
- Backstop to private sector managed payment systems, avoiding breakdown of payments systems at a time of crisis of confidence and rise in counterparty risk

Some of these benefits are less relevant for Latin America. For instance, given the high levels of inflation and high nominal interest rates among many countries in the region, the zero lower bound on interest rates is hardly a relevant constraint on monetary policy.

The potential risks of issuing a CBDC include:

- Disintermediation of the banking system
- Financial risks due to lack of regulatory expertise and capacity
- Government involvement in activities such as payments that can be cheaply and efficiently be managed by the private sector could limit innovation
- Loss of privacy in commercial transactions
- Technological vulnerabilities

This discussion implies that, as is happening in other countries that are considering issuing CBDC, a societal consensus will have to be developed about the loss of privacy implied by the shift to purely digital forms of money and payments systems.

Thus, each country will have to take into account its specific circumstance and initial conditions before deciding whether the potential benefits of introducing a CBDC outweigh the possible costs. Even if the benefits of issuing a CBDC outweigh the costs, a number of factors could complicate the introduction and widespread adoption of CBDC. These include:

- Dollarization (which usually implies perceived instability in the value of the domestic currency, deterring its use even as a medium of exchange)
- High inflation, unstable monetary policy
- Weak central bank credibility
- High degree of informality in economic and financial activities
- Technological/technical constraints

8.4. Policy Recommendations

The discussion to this point suggests some policy implications for Latin American central banks and financial regulators to consider in regard to the new and evolving financial landscape. Based on the characteristics highlighted above, a multi-track approach with the following elements could be useful for the region:

- First, initiate consideration of approaches taken by countries around the world, such as Fintech regulatory sandboxes (currently largely absent from the region, as can be seen in Appendix D). This will allow regional economies to harness new technologies that have the potential to improve financial inclusion, efficiency of payments, and, ultimately, household welfare.

- Second, improve interbank payments systems, which are already largely electronic as elsewhere in the world, but could be improved through the use of technologies such as Blockchain. Token-based wholesale CBDC using permissioned distributed ledger technologies have passed proof-of-concept tests in many countries and seem to have good potential with limited risks. At a minimum, there is scope for adopting enhancements to RTGS systems, a more modest approach that the U.S. has adopted.
- Third, proactively consider the development of retail CBDC as this could play a useful role in broadening financial inclusion, serving as a backstop for privately-managed payments systems, reducing informality of economic activity, and broadening the tax base. Eventual replacement of physical cash with CBDC could also help in disrupting financial flows related to illegitimate economic activities and in dealing with AML-CFT issues. Uruguay's experience with a simple version of e-money that involves a mobile phone app would be a useful starting point to consider as it is easier to implement and would deliver many of the benefits of a more sophisticated account-based CBDC.²⁸

These three steps could be sequenced, depending on the technical and policy capabilities as well as initial conditions of each country, although there is a case to be made for at least initiating analytical work on each of them simultaneously as these initiatives could reinforce each other. Moreover, coordination at the regional level could be helpful in sharing knowledge and developing a regional approach to these issues. In particular, this would help tie in broader objectives such as financial market development and financial integration at both the national and regional levels. A regional institution such as FLAR that is familiar with economic and financial market circumstances in the region could play a useful catalytic role in drawing upon and synthesizing the small but growing body of relevant academic and policy literatures, as well as in incorporating lessons from experiences of other countries that are farther along in all of these areas.

The risk of a premature call to action in terms of advocating for the issuance of CBDC in the region needs to be balanced against the risk of a passive approach that has its own risks. If other countries, especially the major reserve currency economies, move forward with digital currency initiatives, the problem of dollarization that is endemic to the Latin American region could worsen rapidly. Similarly, payments systems could migrate outside these countries and outside the locus of national regulatory authorities, creating its own set of vulnerabilities.

It will also be important to undertake a critical review of regulatory capacity in the region since, for all its benefits, financial innovations can also bring new risks. Regulatory systems need to be flexible enough to accommodate financial innovations while keeping under control

²⁸ A transitional step that could be considered by a highly dollarized economy would be to explicitly link the CBDC to the dollar, analogous to the dollar-backed nonofficial cryptocurrency Tether (discussed in Section 4.1 above). This could facilitate adoption of the CBDC by ensuring the stability of its value. The CBDC could then eventually be delinked from the dollar. However, unless the country in question adopts sound policies during the transition, this strategy might end up resulting in both short-run loss of monetary policy autonomy and long-run collapse of demand for the CBDC if and when it were to be delinked.

institution-specific as well as systemic risks. Other countries' experiences can be useful in this context as well. For instance, in China the off-balance sheet financial products issued by formal financial institutions such as banks has generated concerns about off-balance sheet risks ultimately feeding into banking system risks. Regulatory sandboxes are one way to manage these risks while leaving space for innovation.

Such a coordinated analytical effort could also be helpful for investigating some basic questions. For instance, it is reasonable to expect that there would be substantial latent demand in the region for efficient retail payment services. So one question to be confronted is whether the lack of payments innovations in the region is constrained by regulatory issues, technological constraints, or other factors such as concerns about the willingness of consumers and merchants to adopt such payments systems. Disentangling these factors is essential for designing financial regulatory sandboxes in a manner that is attuned to specific circumstances in the region.

The potential benefits of undertaking such initiatives could be significant for this region given various initial conditions documented above. Digitalization of payments systems would not only have a positive effect on the efficiency of retail payments but also improve financial inclusion, reduce informality in economic activity, broaden the tax base, enhance financial intermediation, and help clamp down on illegal commerce.

Certain financial innovations that go beyond payments systems, including lending platforms that are expanding rapidly in both advanced and emerging market economies, could have additional benefits. Financial systems in the region remain largely bank dominated, which results in small and medium enterprises finding it difficult to get credit due to collateral constraints and absence of credit histories. Fintech platforms could help finance entrepreneurial activities, with obvious benefits in terms of providing a boost to economic activity and employment growth.²⁹

Finally, it is worth reiterating a key point. Fintech innovations and a shift towards digital versions of fiat currencies need to be supported by a strong foundation, which includes sound macroeconomic and structural policies, along with good regulatory frameworks. Merely switching to a digital version of a fiat currency with no changes in underlying policies will hardly increase that currency's traction as a medium of exchange and store of value.

²⁹ An interesting example from China is that of MyBank, a private commercial bank that is largely owned by Ant Financial. MyBank is a licensed online bank that raises funding almost entirely through the interbank market. By mid-2017, it had made mostly small loans (with an average amount of about \$1,200) to about 3 million SMEs, which have traditionally found it difficult to get financing through the formal financial system. The total lending portfolio at this time stood at roughly \$14 billion. Ant Financial uses information gathered from transactions data generated by small businesses using its platform and then deploys artificial intelligence tools to create credit scores for those businesses that then underlie its lending decisions (Zeng, 2018). Its loan default rates have so far been around 1 percent, which is below the NPL ratios of traditional brick and mortar commercial banks, despite having a loan portfolio concentrated on SMEs that are inherently riskier than state owned enterprises.

9. Concluding Remarks

Central banks around the world, including those in Latin America, face important decisions in the coming years about whether to resist new financial technologies, passively accept private sector-led innovations, or embrace the potential efficiency gains the new technologies offer.

Given the extensive demand for more efficient payment services at the retail, wholesale, and cross-border levels, private sector-led financial innovations could lead to significant welfare gains for households and corporations. In this respect, the key challenge for central banks and financial regulators is how to balance financial innovation with risk management. A passive approach to these developments could risk limiting financial innovation, with the potential risk of the payment systems shifting outside national borders and therefore outside domestic regulatory jurisdictions.

A related question faced by Latin American central banks is whether to issue digital versions of their fiat currencies. The potential benefits of CBDC include lower transaction costs, easier verification and settlement of payments through sophisticated financial technology, reduced information asymmetries, and elimination of the nominal zero lower bound on policy interest rates. In addition, well-designed retail CBDC can also broaden financial inclusion, a particular priority for developing economies, and serve as a backstop to the infrastructure of privately-managed payments systems.

However, the issuance of CBDC will not in any way mask underlying weaknesses in central bank credibility or other issues such as fiscal dominance that affect the value of cash. In other words, digital central bank money is only as strong and credible as the central bank that issues it. In considering a shift to digital forms of retail central bank money, it is important to keep in mind that the transitional risks could be higher in the absence of stable macroeconomic and structural policies, including sound regulatory frameworks that are agile enough to be able to recognize and deal with financial risks created by new types of financial intermediaries.

It should also be recognized, notwithstanding the potential benefits, there are many unanswered questions about how the new financial technologies could affect the structure of financial institutions and markets. Questions also abound about whether retail CBDC will in any significant way affect monetary policy implementation and transmission. These uncertainties suggest a cautious approach to embracing the concept of CBDC but not shunning it altogether.

One interesting point to note is that small advanced economies—such as Canada, Singapore, and Sweden—along with developing economies such as China seem to be taking the lead in pushing forward with exploration and development of digital versions of their fiat currencies. By contrast, the issuers of the major reserve currencies—the BOJ, ECB, and the Federal Reserve—have taken more neutral positions, with their officials arguing that while there are some merits to the new financial technologies, these institutions are not considering any changes to the format of the central bank money that they issue. It would be a game changer if any of the G-3 central banks were to begin seriously exploring the possibility of issuing CBDC. Latin American countries, particularly those that suffer from a high degree of

dollarization, might find such developments particularly challenging as they could further erode the demand for money, either physical or digital, issued by national central banks in the region.

In fact, such challenges to domestic fiat currencies might be more imminent than previously thought, now that major multinational social and commercial platforms such as Amazon and Facebook are developing their own digital tokens. Given the easy access that Latin American households have to these platforms and the enormous financial and commercial clout that such corporations have, cryptocurrencies such as Facebook's Libra could further reduce the domestic demand for fiat currencies, both as mediums of exchange and stores of value.

Latin American central banks and governments may be left with little choice but to proactively develop a strategy that helps harness the benefits of the developments discussed in this paper. Some caution is certainly warranted in light of economic and political constraints in the region. Still, an active approach could help improve the benefit-risk tradeoffs of new financial technologies, while a passive approach increases longer-term risks and delays the potential benefits that economies in the region stand to gain.

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Appendix A. Central Bank Digital Currencies

1. CBDC Status: Issued

Country	Digital Fiat Currency	Details	Current Status
Ecuador	Dinero electrónico	Dinero electrónico (“electronic money”) was a mobile payment service in Ecuador where the central bank provided the underlying accounts to the public. Citizens could open an account by downloading an app, registering their national identity number, and answering security questions. People could deposit or withdraw money by going to designated transaction centers. https://www.bis.org/publ/qtrpdf/r_qt1709f.htm	The state system failed to attract a significant number of users or volume of payments, so users were unable to withdraw their funds and the system was closed in April 2018. https://seekingalpha.com/article/4159982-ecuador-central-bank-electronic-money-come-gone-e-2014minus-2018
Tunisia	e-Dinar	The e-Dinar is a digital wallet service from the Tunisian Post, launched in 2000 as part of the government’s e-Tijara initiative. It is designed as a virtual account that is debited on one hand by the sum of digital transactions and credited on the other by the value of recharge cards, by transfer from another virtual account or by deduction from a postal account or another e-Dinar account. http://www.certification.tn/en/content/e-dinar-tunisian-post https://coinjournal.net/tunisia-postal-services-teams-blockchain-startup-national-payment-platform/	In October 2015, the Tunisian Post launched blockchain experimentations in partnership with a startup to migrate e-Dinars into a blockchain-based system. https://www.uneca.org/sites/default/files/ima-chain_technology_in_africa_draft_report_19_2017-final_edited.pdf Experimentation with blockchain-based e-Dinar in October 2015. The project claimed in 2016 that 600,000 customers would soon be transitioned to the new system. https://futurism.com/tunisia-puts-nations-currency-blockchain/

			No evidence of a full-scale migration of the eCFA blockchain could be found.
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2. CBDC Status: Announced

Country	Digital Fiat Currency	Details	Current Status
Senegal	eCFA	<p>The currency is designed to operate alongside the African Financial Community (CFA) franc. It will be issued by the regional bank Banque Régionale de Marché (BRM) and will be used by countries in the West African Economic and Monetary Union, according to a statement from the BRM. The physical technology is a digital currency production engine described as “a pyramidal structure with a tiny slot at the top.” Each central bank will have its own engine, locked in a vault and kept offline. It will only be operational when the central bank wants to use it.</p> <p>https://qz.com/872876/fintech-senegal-is-launched-the-ecfa-digital-currency/</p>	<p>In November 2016, Senegal announced that eCFA distribution would begin soon.</p> <p>https://www.ecurrency.net/static/news/20161116-senegal-release_BRM_translated.pdf</p>

3. Official Cryptocurrency Status: Issued

Country	Digital Fiat Currency	Details	Current Status
Venezuela	Petro	<p>The Petro is a sovereign crypto asset backed by oil reserves, issued by the Venezuelan state and open to direct participation of citizens. http://www.elpetro.gob.ve/index-en.html#about</p> <p>In April 2018, the Venezuelan government declared the petro to be a legal tender, with government institutions given 120 days to start accepting it as such. https://www.bloomberg.com/news/articles/2018-04-12/venezuela-says-government-bodies-must-soon-accept-cryptocurrency</p>	<p>The Petro was first offered in presale in February 2018. Following the launch, President Nicolás Maduro said proceeds had reached US\$735 million. The actual sale of the cryptocurrency began a month later, and Maduro claims this has raised US\$1 billion to date. There is no evidence of these proceeds. https://oilprice.com/Latest-Energy-News/World-News/Venezuelan-Parliament-Finally-Approves-Backed-Cryptocurrency.html</p>

4. Official Cryptocurrency Status: Announced, Not Yet Issued

Country	Digital Fiat Currency	Details	Current Status
Estonia	Estcoin	<p>Estonia has plans to launch its own crypto token, the Estcoin, which would be a digital token that would not fluctuate in value. The Estcoin is part of a larger plan—the e-Residency program—for establishing Estonia as a global “haven” for initial coin offerings. http://incorporate.ee/news/estonia-to-become-a-global-ico-hub/?gclid=EAIaIQobChMI2rrgnoG12gIVjzqBCh0KawWVEAAYASAAEgLf6PD_BwE</p>	<p>In December 2017, Estonia’s e-Residency program announced a proposal to launch the Estcoin via an initial coin offering. The coin has yet not been launched. https://medium.com/e-residency-blog/were-planning-to-launch-estcoin-and-that-s-only-the-start-310aba7f3790</p>

shall ds	Sovereign (SOV)	<p>The Sovereign (SOV) is a cryptocurrency to be issued by the government of the Republic of the Marshall Islands (R.M.I.). It will constitute legal tender. Neema, an Israeli startup, is developing the technology to support SOV and will oversee both the presale and the coin offerings.</p> <p>https://futurism.com/marshall-islands-crypto-official-currency/</p>	<p>In February 2018, the R.M.I. passed a law ap the launch of SOV. The nation plans to distri SOV via an initial coin offering. SOV supply capped at 24 million tokens, with that number in reference to the R.M.I.'s 24 municipalities</p> <p>https://futurism.com/marshall-islands-crypto-currency/</p>
ia	CryptoRuble	<p>The CryptoRuble is not associated with a mining process. All transactions will be recorded via blockchain and verified by a centralized government authority. In September 2018, the Bank of Russia conducted an experimental ICO on existing infrastructure and found it to be technically viable but legally uncertain.</p> <p>https://arxiv.org/ftp/arxiv/papers/1801/1801.05760.pdf</p> <p>https://cryptocrimson.com/russia-ico/</p>	<p>Launch of CryptoRuble is delayed to mid-20</p> <p>https://cointelegraph.com/news/is-cryptorubl-launch-set-for-mid-2019-says-russian-blockc-association</p>

5. CBDC Status: Considering or Experimenting

5.1 Countries Experimenting With and Open to CBDC

Country	Digital Fiat Currency	Details
China	DCEP (retail)	<p>The People's Bank of China (PBC) established its Digital Currency Research Institute in 2017, and has been actively developing prototypes related to blockchain-based digital currency. In September 2018, it announced a trial blockchain platform of trade finance in collaboration with several commercial banks. https://www.coindesk.com/chinas-central-bank-opens-new-digital-currency-research-institute/ https://m.21jingji.com/article/20180904/herald/2d66ef9b438cab86aef580dcf177bdea.html (Chinese)</p> <p>Yao Qian, director of the Digital Currency Research Institute, wrote in a 2017 report that a digital currency could be integrated into the existing banking system, with commercial banks operating digital wallets for the central bank's currency. https://www.technologyreview.com/s/608088/chinas-central-bank-has-begun-cautiously-testing-digital-currency/</p> <p>The PBC is currently developing a digital currency known as the DCEP, or Digital Currency (for Electronic Payment), according to a 2018 report from the Beijing Youth Daily. https://www.ethnews.com/pboc-governor-digital-currency-could-replace-cash-in-china http://news.ifeng.com/a/20180309/56592674_0.shtml (Chinese)</p> <p>In January 2018, PBC vice governor Fan Yifei stated in an op-ed that DCEP is aimed at replacing M0 rather than M1 or M2. To avoid shocks to the financial sector, individuals would hold accounts at commercial banks rather than at the central bank. https://www.yicai.com/news/5395409.html</p>
Sweden	e-krona (retail)	<p>The Riksbank is investigating whether it would be possible to issue a digital complement to cash in krona, and whether such a complement could support the Riksbank in the task of promoting a safe and efficient payment system. The decision on issuing a digital fiat currency will be made by 2019. http://www.riksbank.se/en/Financial-stability/Payments/Does-Sweden-need-the-e-krona/Reports</p>

Uruguay	e-Peso (retail)	In November 2017, the Central Bank of Uruguay began a pilot program for digital currency and electronic wallets using a mobile phone-based app. The project was concluded in April 2018 and was a success as there were no technical glitches, and consumers and merchants who used the e-Peso reported positive experiences. The digital currency was deactivated after the trial. Further trials are anticipated in the future but no specifics or dates have been announced. https://www.bis.org/publ/bppdf/bispap101.pdf
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5.2 Countries Experimenting With But With No Near Term Plan for CBDC

Bahamas	N/A	In June 2018, the Minister of Finance of the Bahamas announced that the central bank would soon introduce a pilot digital currency program. No further details available. https://bit.ly/2Jv14yy
Brazil	N/A (wholesale)	The Central Bank of Brazil is now developing proofs-of-concept on four different platforms—Ethereum, JPMorgan’s Quorum, and Hyperledger Fabric alongside Corda. https://www.coindesk.com/immature-no-longer-brazils-central-bank-is-ramping-up-its-blockchain From September 2016 to January 2017, the central bank experimented with different DLT platforms as a backup for the interbank settlement system. The report found it was hard to achieve privacy with the chosen platforms, but also acknowledged the potential of other innovative solutions. https://www.bcb.gov.br/htms/public/microcredito/Distributed_ledger_technical_research_in_Central_bank_of_Brazil.pdf
Canada	CADcoin (wholesale)	Project Jasper – the Bank of Canada’s DLT experiment – is a joint initiative with national payment system operator Payments Canada, leading Canadian banks, and the R3 technology consortium. The project has used CADcoin, a DLT-based settlement asset, to create and test two proof-of-concept wholesale payment systems. http://www.bankofcanada.ca/wp-content/uploads/2017/07/fintech-collaboration-vital-unlock-prospects In May 2018, Payments Canada announced that the project found instantaneous clearing and settlement of securities feasible with DLT. https://www.payments.ca/about-us/news/payments-canada-bank-canada-tmx-group-accenture-and-ocbc-demonstrate-feasibility

		<p>Bank of Canada and Payments Canada have also partnered with the Monetary Authority of Singapore to work on a cross-border, cross-currency settlement system, which combines Project Jasper and Singapore's Project Ubin.</p> <p>https://www.bankofcanada.ca/research/digital-currencies-and-fintech/fintech-experiments-and-p</p>
ern ibbean	N/A	<p>The Eastern Caribbean Central Bank, in partnership with Bitt Inc., is planning a pilot project to test blockchain technology within the region's member countries (Anguilla, Antigua and Barbuda, the Commonwealth of Dominica, Grenada, Montserrat, St. Kitts and Nevis, Saint Lucia, and St. Vincent and the Grenadines).</p> <p>https://www.coindesk.com/eastern-caribbean-central-bank-pilot-bitt-blockchain-tech/</p>
European on	N/A (wholesale)	<p>The ECB has published the findings from the second phase of "Project Stella," which is a joint research initiative run by the BoJ and the ECB. The project serves the sole purpose of assessing whether some functionalities of existing payment systems could be safely and efficiently run with a DLT application, focusing on hands-on testing only. The areas of cost efficiency, market integration, and oversight are for future study. The first phase of Project Stella has found that DLT-based solutions could meet the performance needs of a Real-Time Gross Settlement (RTGS) system.</p> <p>https://www.boj.or.jp/en/announcements/release_2017/data/rel170906a1.pdf</p> <p>In March 2018, a report on the second phase of Project Stella was published. The project finds that delivery-versus-payment (DvP) securities settlement systems can be constructed with DLT under the current design. https://www.boj.or.jp/en/announcements/release_2018/data/rel180327a1.pdf</p> <p>In May 2018, Benoît Cœuré, member of the Executive Board of the ECB acknowledged the benefits of a CBDC but said "the technology is still immature, costly to maintain, and possibly prone to vulnerabilities".</p> <p>https://www.ecb.europa.eu/press/key/date/2018/html/ecb.sp180514_4.en.html</p> <p>In Sep 2018, Mario Draghi reaffirms the ECB has no plan to issue digital currency.</p> <p>https://uk.reuters.com/article/uk-ecb-bitcoin/ecb-has-no-plan-to-issue-digital-currency-draghi-idUKKCN1LU1J0?rpc=401&</p>
g Kong	N/A (wholesale)	<p>In March 2017, the Hong Kong Monetary Authority (HKMA) launched a research and a proof-of-concept work on CBDC in collaboration with the three note-issuing banks in Hong Kong, along</p>

		<p>Hong Kong Interbank Clearing Limited and the R3 consortium (which is setting up a DLT called for financial transactions), to explore the potential of DLT.</p> <p>http://www.legco.gov.hk/yr16-17/english/panels/fa/papers/fa20170418cb1-777-3-e.pdf</p> <p>In 2017, the HKMA carried out proof of concept work with several banks and industry players on application of DLT to trade finance, digital identity management, and mortgage loan application with positive results.</p> <p>http://www.hkma.gov.hk/media/eng/doc/key-functions/financial-infrastructure/infrastructure/20171024e1.pdf</p> <p>http://www.hkma.gov.hk/media/eng/doc/key-functions/financial-infrastructure/infrastructure/20171025e1a1.pdf</p>
a	N/A (retail)	<p>The Reserve Bank of India (RBI), the country's central bank, has spoken about its ongoing cryptocurrency research, hinting at its role as a future digital alternative to the rupee. RBI executive director Sudarshan Sen said in September 2017, "Right now, we have a group of people who are at fiat cryptocurrencies. Something that is an alternative to the Indian rupee."</p> <p>https://www.coindesk.com/indian-central-bank-studies-fiat-cryptocurrency-for-digital-rupee/</p> <p>In January 2019, there were unconfirmed reports that CBDC plans had been shelved.</p> <p>https://cointelegraph.com/news/india-media-reports-central-bank-has-postponed-crypto-rupee-pl</p>
nesia	N/A (retail)	<p>PayPro Indonesia has partnered with eCurrency Mint Limited to provide eCurrency's digital fiat currency solution in Indonesia.</p> <p>https://www.businesswire.com/news/home/20171018006021/en/Indonesia-Takes-Steps-Digital-Currency-Solution</p> <p>Bank Indonesia official Susiarto Dewi said that trials of the digital rupiah would be conducted in an effort to improve the efficiency of the payment system. Susiarto added that the calculation of the circulated digital money would also be based on the current currency system, and would take into account the inflation rate. Officials said the trials were projected to be completed by 2020.</p> <p>http://www.thejakartapost.com/news/2018/01/29/bank-indonesia-considers-issuing-digital-rupiah</p> <p>http://www.thejakartapost.com/news/2018/02/01/digital-rupiah-study-to-be-completed-in-2020-l</p>
g Kong	N/A (wholesale)	<p>In March 2017, the Hong Kong Monetary Authority (HKMA) launched a research and a proof-of-concept work on CBDC in collaboration with the three note-issuing banks in Hong Kong, along with Hong Kong Interbank Clearing Limited and the R3 consortium (which is setting up a DLT called for financial transactions), to explore the potential of DLT.</p>

		http://www.legco.gov.hk/yr16-17/english/panels/fa/papers/fa20170418cb1-777-3-e.pdf In 2017, the HKMA carried out proof of concept work with several banks and industry players on the application of DLT to trade finance, digital identity management and mortgage loan applications with positive results. http://www.hkma.gov.hk/media/eng/doc/key-functions/financial-infrastructure/infrastructure/20171024e1.pdf http://www.hkma.gov.hk/media/eng/doc/key-functions/financial-infrastructure/infrastructure/20171025e1a1.pdf
n	MUFG Coin (wholesale)	The Bank of Japan (BoJ), Japan's central bank, sees no need to mint a retail digital currency. https://www.bloomberg.com/news/articles/2018-01-28/japanese-don-t-need-digital-currency-as-love-cash-boj-says The BoJ is conducting a joint research initiative ("Project Stella") with the European Central Bank (ECB) to assess the applicability of DLT solutions in the area of financial market infrastructures.
an	N/A (retail)	In a recent statement, the governor of the Bank of Lebanon, Riad Salameh, stated that the central bank plans to introduce its own digital currency. The digital currency would be issued by the Bank of Lebanon (BDL) in the next few years. https://themerikle.com/lebanon-to-issue-its-own-digital-currency/
erlands	DNBcoin (wholesale)	In 2015, De Nederlandsche Bank, the central bank of the Netherlands, started experimenting with a digital cryptocurrency (DNBcoin). However, the central bank has stated that DNBcoin is restricted to internal testing purposes and that it will not be put into circulation. In June 2018, a blog post of DNB reported that DLT solutions tested in the last few years failed to meet the high demands made of financial market infrastructures (FMIs). https://www.dnb.nl/binaries/Speech%20Ron%20Berndsen_tcm46-342846.pdf https://www.dnb.nl/en/news/news-and-archive/DNBulletin2018/dnb376502.jsp#
apore	N/A (wholesale)	The Monetary Authority of Singapore (MAS), along with the R3 consortium and a group of financial institutions, launched Project Ubin in November 2016 to test interbank payments using DLT. After two phases, MAS announced in October 2017 the successful development of software prototypes of different models for decentralized interbank payments and settlement with liquidity savings mechanisms. Future phases may study settlement of securities and cross border payments with DLT. http://www.mas.gov.sg/Singapore-Financial-Centre/Smart-Financial-Centre/Project-Ubin.aspx

South Africa	N/A (wholesale)	In February 2018, the South African Reserve Bank (SARB) revealed a fintech program that will prioritize a project dubbed “Khokha” to explore a proof-of-concept using the blockchain technology. The project focused on build a proof-of-concept (PoC) wholesale payment system for interbank settlement using a token based system. A report published in June 2018 claimed success in processing typical volume of national payments in less than two hours with confidentiality and finality. https://www.coindesk.com/south-africas-central-bank-eyes-jpmorgan-blockchain-tech/
Thailand	Project Inthanon (wholesale)	In June 2018, Bank of Thailand (BoT) governor Veerathai Santiprabhob revealed “Project Inthanon” which the Bank of Thailand and commercial banks would co-develop a new way of conducting interbank settlement using wholesale CBDC. The primary goal is not immediate adoption, but exploration of potentials and implications. In August 2018, the BoT announced phase 1 of ‘Project Inthanon’ in collaboration with R3 Corda and other commercial banks to develop a proof-of-concept prototype for domestic wholesale fund transfer. https://www.bis.org/review/r180606g.pdf https://www.bot.or.th/Thai/PressandSpeeches/Press/News2561/n5461e.pdf

5.3 Countries Explicitly Not Considering CDBC in Short Term

Australia	N/A	The Reserve Bank of Australia has no immediate plans to issue an electronic form of Australian banknotes. However, the bank is continuing to look at the pros and cons of issuing a digital currency. http://www.rba.gov.au/speeches/2017/pdf/sp-gov-2017-12-13.pdf https://www.rba.gov.au/speeches/2018/sp-so-2018-06-26.html#fn9
Denmark	N/A	In December 2017, the central bank of Denmark stated in a research paper that “central bank digital currency would not be an improvement of the existing payment solutions in Denmark”. http://www.nationalbanken.dk/en/publications/Pages/2017/12/Central-bank-digital-currency-in-Denmark.aspx
Israel	N/A	The Bank of Israel started to examine implications of CBDC in 2017. In November 2018, the central bank team published a comprehensive report, which does not support issuing CBDC in the near future. https://www.boi.org.il/en/NewsAndPublications/PressReleases/Documents/Digital%20currency

and	N/A	In June 2018, Reserve Bank of New Zealand Deputy Governor Geoff Bascand evaluated the pros and cons of CBDC in a speech and concluded that “at this stage it is yet to be seen that a central bank digital currency will bring conclusive benefits”. https://www.rbnz.govt.nz/research-and-publications/speeches/2018/speech2018-06-25
h Korea	N/A	The Bank of Korea (BoK), South Korea’s central bank, launched a cryptocurrency task force to study the technology’s effects on the financial system in January 2018. The taskforce also studied CBDC. It concluded, in January 2019, that there was no short-term need to issue CBDC. https://www.coindesk.com/koreas-central-bank-forms-task-force-to-study-cryptocurrency-impacts/ http://www.koreaherald.com/view.php?ud=20190129000553
	N/A	The Bank of England does not currently plan to issue a CBDC. However, the bank is undertaking extensive research to better understand the implications of CBDC. https://www.bankofengland.co.uk/research/digital-currencies
A	N/A	New York Fed President William Dudley said that the Fed is beginning to explore whether it could issue its own digital currency. https://www.wsj.com/articles/dudley-says-fed-has-started-thinking-about-official-digital-currency-1511968465 San Francisco Federal Reserve President John Williams (and now New York Fed President) said in November 2017 that “Right now the Federal Reserve is not developing its own digital currency.” https://cointelegraph.com/news/us-federal-reserve-has-no-plans-to-introduce-digital-currencies-san-francisco-fed-president Fed governor Lael Brainard said in May 2018 that “there is no compelling demonstrated need for a widely issued digital currency”. She also cited cybersecurity concerns and potential effects of CBDC on the financial system. https://www.federalreserve.gov/newsevents/speech/brainard20180515a.htm

Appendix B. Selected Countries' Approaches to Cryptocurrencies

This appendix provides an overview of how selected countries are regulating various aspects of cryptocurrencies.

Australia

Tax: In August 2014, the Australian Taxation Office issued a notice stating that transacting with Bitcoin is akin to a barter arrangement, with similar tax consequences. Those using digital currency for investment or business purposes may be subject to capital gains tax when they dispose of digital currency and individuals will be charged goods and services tax when they buy digital currency. Moreover, businesses providing an exchange service, buying and selling digital currency, or mining Bitcoin, would be subject to income tax on the profits.

AML/CFT: In December 2016, the Attorney-General's Department issued a consultation paper, suggesting that the AML/CTF (sic) (Anti-Money Laundering/Counter Terrorist Financing) Act should be amended to ensure that digital currencies are comprehensively captured by AML/CTF regulation. Starting in April 2018, all businesses providing digital currency exchange services fall under new AML/CFT laws, which require them to keep records of customer identification and transactions, and to report transactions over a specified threshold value.

ICO: The Australian Securities & Investments Commission states on its website that the legal status of an ICO depends on the circumstances of the ICO. In some cases, the ICO will only be subject to the general law and the Australian consumer laws regarding the offer of services or products. In other cases, the ICO may be subject to the Corporations Act.

<https://www.ato.gov.au/misc/downloads/pdf/qc42159.pdf>

<https://www.ag.gov.au/Consultations/Documents/AML-CTF/Regulating-digital-currencies-under-Australias-aml-ctf-regime.pdf>

<http://asic.gov.au/regulatory-resources/digital-transformation/initial-coin-offerings/#legal>

<http://www.austrac.gov.au/new-requirements-digital-currency-exchange-providers>

Brazil

Bill 2303 of 2015, which is still awaiting approval, was proposed to provide for the inclusion of virtual currencies into the framework of anti-money laundering regulation. In October 2017, the Securities and Exchange Commission of Brazil (CVM) issued a statement saying that securities offered through ICOs cannot be legally traded on virtual currency exchanges, since the latter are not authorized by the CVM to provide securities trading platforms in Brazil. According to the CVM, no ICO has been registered or exempted from registration in Brazil. In November 2017, the central bank of Brazil issued a notice stating that it does not regulate or supervise operations with virtual currencies.

http://www.cvm.gov.br/subportal_ingles/menu/international/ico_statement.html

<https://www.bcb.gov.br/ingles/norms/Virtual-currencies-Communique-31379-English.pdf>

<http://www.camara.gov.br/proposicoesWeb/fichadetramitacao?idProposicao=1555470>

Canada

Tax: Canada Revenue Agency stated in 2013 that the rules for barter transactions apply to digital currency transactions. Therefore, the value of the goods or services purchased using digital currency must be included in the seller's income for tax purposes. The amount to be included would be the value of the goods or services in Canadian dollars. It also stated that digital currency can be bought and sold like a commodity. Any resulting gains or losses could constitute be taxable income or capital gains for the taxpayer.

AML/CFT: In June 2014, Canada passed Bill C-31. This new law defines virtual currencies, including Bitcoin, as "money service business", which will be subject to the record keeping, verification procedures, suspicious transaction reporting, and registration requirements under the framework of Canada's Proceeds of Crime (Money Laundering) and Terrorist Financing Act.

Exchanges and ICOs: In August 2017, Canadian Securities Administrators (CSA) issued a notice stating that if a cryptocurrency exchange is doing business in a domestic jurisdiction, it must apply to that jurisdiction's securities regulatory authority for recognition or an exemption from recognition. To date, no cryptocurrency exchange has been recognized in any jurisdiction of Canada or exempted from recognition. The notice also states that cryptocurrency offerings fall under Canadian laws regulating securities and derivatives.

http://www.osc.gov.on.ca/documents/en/Securities-Category4/csa_20170824_cryptocurrency-offerings.pdf

<https://www.canada.ca/en/revenue-agency/news/newsroom/fact-sheets/fact-sheets-2013/what-you-should-know-about-digital-currency.html>

<http://www.parl.ca/DocumentViewer/en/41-2/bill/C-31/royal-assent/page-29#1>

http://www.osc.gov.on.ca/en/SecuritiesLaw_csa_20170824_cryptocurrency-offerings.htm

China

In December 2013, the People's Bank of China (PBC) issued a notice stating that Bitcoin is not a currency issued by the government and that it should not be circulated on the market as currency. This notice prohibited all financial institutions from using Bitcoin to price commodities or services, buying in or selling out of Bitcoin, and providing services related to Bitcoin. The notice required websites that provide a platform for Bitcoin transactions to be archived at the telecommunication administration.

In September 2017, the PBC issued a notice banning all cryptocurrency trading, defining Initial Coin Offerings as illegal activities, and banning all ICO activities in China. The notice prohibited all domestic exchanges from providing services related to cryptocurrency trading. This notice also prohibited all financial institutions and non-bank payment institutions from involvement, directly or indirectly, in any kind of ICO activities. In January 2018, the PBC issued a notice that prohibited all banks and their branches from providing any service for cryptocurrency trading and prevented any payment service being used for cryptocurrency trading.

<http://www.pbc.gov.cn/goutongjiaoliu/113456/113469/2804576/index.html>
<http://www.pbc.gov.cn/goutongjiaoliu/113456/113469/3374222/index.html>
<http://www.waizi.org.cn/doc/30165.html>

European Union

The European Central Bank (ECB) states that it is not the ECB's responsibility to ban or regulate Bitcoin or other cryptocurrencies but, given the lack of consumer protection, it is important for consumers to exercise caution.

Tax: In October 2015, the Court of Justice of the European Union decided that the exchange of traditional currencies for units of Bitcoin and other virtual currencies is exempt from VAT.

Exchanges and platforms: In May 2016, the European Commission submitted a proposal for a Directive that aims to extend the scope of Directive (EU) 2015/849 so as to include virtual currency exchange platforms and custodian wallet providers. This new Directive also requires member states to ensure that providers of exchange services between virtual currencies and fiat currencies as well as custodian wallet providers are licensed or registered. In February 2017, the European Parliament passed a new Directive that makes virtual currency exchange platforms and custodian wallet providers subject to some of the same reporting obligations as traditional financial services providers.

ICOs: In November 2017, the European Securities and Markets Authority (ESMA) stated that firms involved in ICOs should comply with relevant EU legislation of securities. In April 2018, the European Parliament supported an agreement reached in the previous year by the council to prevent money laundering. The latest update to the EU's Anti-Money Laundering Directive provides for public access to information on real owners of firms, and customer verification for virtual currencies.

<https://www.ecb.europa.eu/explainers/tell-me/html/what-is-bitcoin.en.html>
<http://curia.europa.eu/jcms/upload/docs/application/pdf/2015-10/cp150128en.pdf>
<https://bit.ly/2VVP6QV>
https://www.esma.europa.eu/sites/default/files/library/esma50-157-828_ico_statement_firms.pdf
<https://bit.ly/2qIuLxt>

Hong Kong

In March 2015, the Financial Services and the Treasury Bureau of Hong Kong issued a press release stating that Hong Kong does not have any targeted regulatory measures for virtual commodities specifically in terms of their safety or soundness, and the trading platforms or operators of such commodities. That said, the existing laws provide for sanctions against unlawful acts, such as money laundering, terrorist financing, fraud, pyramid schemes, and cyber-crimes, whether or not these virtual commodities are involved.

ICOs: In September 2017, Hong Kong’s Securities and Futures Commission (SFC) issued a statement saying that, depending on the facts and circumstances of an ICO, digital tokens that are offered or sold may be “securities” as defined in the Securities and Futures Ordinance (SFO), and subject to the securities laws of Hong Kong.

Exchanges and platforms: In December 2017, the SFC issued a circular stating that an entity is required to have an appropriate license or authorization from the SFC if it provides any business services that relate to Bitcoin futures contracts or cryptocurrency-related investment products and constitute a “regulated activity as defined in the SFO.

<http://www.info.gov.hk/gia/general/201503/25/P201503250463.htm>
<https://bit.ly/2xu0ELR>
<http://www.sfc.hk/edistributionWeb/gateway/EN/news-and-announcements/news/doc?refNo=18PR13>

India

In December 2017, the Reserve Bank of India (RBI) clarified that no license/authorization was given to any entity/company to operate or deal with Bitcoin or any virtual currencies. The Indian government also established an Inter-Disciplinary Committee to investigate and better understand matters related to cryptocurrencies. In April 2018, the RBI issued a statement saying it had decided, with immediate effect, that entities regulated by the RBI shall neither deal with nor provide services to any individual or business entities dealing with or settling virtual currencies. In effect, this means that banks, financial institutions, and other regulated entities are prohibited from dealing in virtual currencies or in facilitating such transactions.

<http://pib.nic.in/newsite/PrintRelease.aspx?relid=160923>
<https://rbi.org.in/scripts/PublicationsView.aspx?Id=18085>
<https://rbi.org.in/Scripts/NotificationUser.aspx?Id=11243&Mode=0>

Japan

Tax: In April 2014, the National Tax Agency of Japan issued a notice saying that the profit gained by an individual using Bitcoin would be classified as “miscellaneous income” and subject to income tax. Japan approved its Virtual Currency Act in March 2017 to subject digital currency exchanges to several added regulatory requirements. The new law defines Bitcoin and other virtual currencies as a form of payment, not a legally-recognized currency. Bitcoin will continue to be treated as an asset unless there are future revisions or directives to Japanese tax law.

ICOs: In October 2017, the Financial Services Agency of Japan issued a notice stating that, depending on the mechanism of an ICO, it is subject to regulation such as fund settlement law and financial product trading law.

<http://www.fsa.go.jp/news/28/ginkou/20170324-1.html>

<http://www.nta.go.jp/taxes/shiraberu/taxanswer/shotoku/1524.htm>
https://www.fsa.go.jp/policy/virtual_currency/06.pdf

Russia

Tax: In October 2016, the Russian Federal Tax Service issued a letter stating that operations related to the purchase or sale of cryptocurrency should be treated in a manner similar to that of transactions with foreign currencies.

Exchanges and platforms: In January 2018, the Bank of Russia published draft laws entitled “On Digital Financial Assets” and “On Alternative Ways to Attract Investment”, which suggest that cryptocurrency exchange operators have to be legally incorporated and meet the requirements of federal laws on stock markets and organized trading. Moreover, exchange of cryptocurrencies and tokens for other cryptocurrencies, rubles, and foreign currencies is allowed only via Russia-based exchanges. In May 2018, Russia’s parliament, the State Duma, approved the first readings of a new law on digital financial assets. The second readings were scheduled for March/April 2019. Legislators asserted that the bill would come into effect in October 2019 if passed.

<https://www.cbr.ru/eng/press/event/?id=1629>
<http://base.garant.ru/71584452/>
<http://sozd.parliament.gov.ru/bill/419059-7>
<https://cryptonews.com/news/russia-sets-new-crypto-law-deadline-3400.htm>

Singapore

Tax: The Inland Revenue Authority of Singapore (IRAS) states that profits derived by businesses that mine and trade virtual currencies in exchange for money are subject to tax. Businesses that buy virtual currencies for long-term investment purposes may enjoy a capital gain from the disposal of these virtual currencies.

AML/CFT: In March 2014, the Monetary Authority of Singapore (MAS) issued a statement, saying that it would regulate virtual currency intermediaries in Singapore to address potential money laundering and terrorist financing (ML/TF) risks. To address this, MAS would introduce regulations to require virtual currency intermediaries that buy, sell or facilitate the exchange of virtual currencies for real currencies to verify the identities of their customers and report suspicious transactions to the Suspicious Transaction Reporting Office.

In February 2018, MAS issued a notice indicating that there was no strong case to ban cryptocurrency trading in Singapore. However, all suspicious transaction reports, including those involving cryptocurrencies and digital tokens, which are commonly known as initial coin offerings (ICOs), are analyzed by the Suspicious Transaction Reporting Office (STRO). Where there are indications of an offence, STRO will refer the matter to the enforcement agencies, such as IRAS for possible tax crimes and the Commercial Affairs Department (a department of the Singapore Police Force) for possible money laundering.

ICOs: In August 2017, MAS clarified that ICOs would fall under the Securities and Futures Act, which involves registration and licensing requirements on both issuers of tokens and exchange platforms. In February 2018, a senior official of MAS said that additional investor protection measures were being considered.

<http://www.mas.gov.sg/news-and-publications/Parliamentary-Replies/2018/Reply-to-Parliamentary-Question-on-banning-the-trading-of-bitcoin-currency-or-cryptocurrency.aspx>
<https://www.iras.gov.sg/irashome/Businesses/Companies/Working-out-Corporate-Income-Taxes/Specific-topics/Income-Tax-Treatment-of-Virtual-Currencies/>
<https://bit.ly/2WANSrb>
<https://bit.ly/2ufgaJ3>
<https://bit.ly/2zBaAaI>
<https://bit.ly/30cMVYE>

South Africa

In September 2014, the National Treasury of South Africa issued a notice stating that virtual currencies are not defined as securities in terms of the 2012 Financial Markets Act (Act No. 19 of 2012). The regulatory standards that apply to the trading of securities therefore do not apply to virtual currencies. In December 2014, the South African Reserve Bank issued a position paper on virtual currencies, stating that it does not oversee, supervise or regulate the virtual currency (VC) landscape, systems or intermediaries for effectiveness, soundness, integrity or robustness. Consequently, any and all activities related to the acquisition, trading or use of VCs (particularly Decentralized Convertible Virtual Currencies) are performed at the end-user's sole and independent risk and the user has no recourse to the Bank. In April 2018, the South African Revenue Service (SARS) issued a media release stating that it would continue to apply normal income tax rules to cryptocurrencies and expected affected taxpayers to declare cryptocurrency gains or losses as part of their taxable income.

http://www.treasury.gov.za/comm_media/press/2014/2014091801%20-%20User%20Alert%20Virtual%20currencies.pdf
<https://bit.ly/2VUIcLP>
<https://bit.ly/2GBKdWk>

Sweden

In June 2014, the Swedish Central Bank issued a report saying that, while Bitcoin issuance is unregulated, Swedish companies offering exchange services for Bitcoin are regulated primarily through the Payment Service Act, which sets forth the rights and obligations of both the payment intermediary and the payment service users.

Tax: In April 2014, the Swedish Tax Agency issued a statement to the effect that the sale of Bitcoin is subject to capital gains tax under the provisions on Other Assets. In April 2015, the

Agency issued another statement saying that mining of Bitcoin and other cryptocurrencies would be subject to income tax.

ICOs: In November 2017, Swedish regulatory authority Finansinspektionen (FI) warned investors of risks associated with ICOs, which are unregulated for the time being.

<https://bit.ly/2JdqM77>

<https://www.skatteverket.se/privat/skatter/vardepapper/andratillgangar/kryptovalutor>

<https://www4.skatteverket.se/rattsligvagledning/338713.html>

<https://www.fi.se/sv/publicerat/nyheter/2017/varning-for-risker-med-initial-coin-offerings/>

United Kingdom

Tax: The U.K. HM Revenue & Customs issued a policy paper in March 2014 stating that income received from Bitcoin mining activities would generally be outside the scope of VAT. However, the general rules on foreign exchange and loan relationships apply to the tax treatment of virtual currencies.

AML/CFT: In March 2015, HM Treasury issued a report stating that the government intended to apply anti-money laundering regulation to digital currency exchanges in the U.K. to support innovation and prevent criminal use.

ICOs: In December 2017, the U.K. Financial Conduct Authority issued a notice warning of the risks of Initial Coin Offerings. The notice indicated that while many ICOs fell outside the regulated space, depending on how they are structured some ICOs may involve regulated investments and firms involved in an ICO may be conducting regulated activities. In March 2018, Bank of England Governor Mark Carney said in a speech that the crypto-asset ecosystem should be held to the same standards as the rest of the financial system, signaling the direction of future regulatory moves.

<https://www.gov.uk/government/publications/revenue-and-customs-brief-9-2014-bitcoin-and-other-cryptocurrencies/revenue-and-customs-brief-9-2014-bitcoin-and-other-cryptocurrencies>

<https://bit.ly/30eqx0M>

<https://www.fca.org.uk/news/statements/initial-coin-offerings>

<https://bit.ly/2WDMRyC>

United States

The U.S. Commodity Futures Trading Commission (CFTC) classified Bitcoin and other cryptocurrencies as commodities under the Commodity Exchange Act. The CFTC maintains general anti-fraud and manipulation enforcement authority over virtual currency cash markets as a commodity in interstate commerce.

Reporting: In March 2013, the Financial Crimes Enforcement Network (FinCEN) of the Treasury stated that virtual currency exchangers and administrators must comply with the Bank Secrecy Act (BSA), which imposes record keeping and reporting obligations.

Tax: In March 2014, the U.S. Internal Revenue Service issued a guidance stating that it would treat virtual currencies such as Bitcoin as property for federal tax purposes. As a result, general tax principles that apply to property transactions also apply to transactions using virtual currency.

ICOs: In December 2017, the Securities and Exchange Commission (SEC) issued a statement saying that to date no initial coin offerings had been registered with the SEC. The SEC also had not until that date approved for listing and trading any exchange-traded products (such as exchange traded funds or ETFs) holding cryptocurrencies or other assets related to cryptocurrencies. The statement asserts that cryptocurrencies are not securities and that the offer and sale of cryptocurrencies are beyond the SEC's jurisdiction. However, it notes that the structures of initial coin offerings (ICOs) directly involve the securities registration requirements and other investor protection provisions of federal securities laws.

Derivatives: In December 2017, the CFTC allowed the Chicago Mercantile Exchange (CME) and the Chicago Board Options Exchange (CBOE) to commence trading of bitcoin futures products and Cantor Exchange to commence trading of bitcoin binary options.

<https://bit.ly/2le57iz>

<https://www.irs.gov/pub/irs-drop/n-14-21.pdf>

<https://bit.ly/2MEnFap>

<https://bit.ly/30a4dW5>

<https://www.sec.gov/news/public-statement/statement-clayton-2017-12-11>

<https://www.cftc.gov/PressRoom/PressReleases/pr7654-17>

Appendix C. The Federal Reserve's Faster Payments Task Force³⁰

The Faster Payments Task Force was convened in early 2015. At that time, the Federal Reserve (Fed) issued a report entitled *Strategies for Improving the U.S. Payment System*, which came after an extensive 18-month research program that identified key gaps and opportunities in the payments system. James Powell, then governor of the Fed, remarked that “a safer, more efficient and faster payments system contributes to public confidence and economic growth.” The faster payments task force was therefore set up to advise the Fed on this goal.

The task force was a collaboration between the Fed and the financial services industry, while also representing payments system stakeholders such as businesses and consumer groups. The main objectives of the task force were as follows: identifying goals and attributes of effective faster payments systems; proposing and evaluating tentative solutions to achieve such goals; and encouraging the payments industry to undertake implementation. The task force concluded in July 2017 with a comprehensive set of recommendations to achieve faster payments by 2020. The task force also evaluated 19 proposals from the financial services sector aimed at achieving faster payments, providing detailed feedback on each of them.

Landscape of Payments Systems in the U.S.

The task force identified a fragmented structure of payments systems in the U.S, with different entities conducting similar businesses, sometimes under the purview of multiple regulators, without a top-tier policy framework.

The wholesale payments system (interbank payments system, or Real Time Gross Settlements System, RTGS) is dominated by Fedwire and Clearing House Interbank Payments System (CHIPS). Fedwire, which is operated by the Fed, has more than 8000 participants, mostly commercial banks. Institutions without accounts at the Fed, including depository institutions and branches of foreign banks, can also be participants. As of 2018, Fedwire handled 631,000 payments per day, with a total value of transfers at \$716 trillion. Its operation time is from 21:00 ET previous day to 18:30 ET Monday through Friday, excluding holidays.

CHIPS is a private sector payments system subject to Fed regulations. Compared to Fedwire, CHIPS is exclusively for big players, with around only 45 participants, including foreign banks. As of 2018, it handled 461,000 payments per day, with total value of transfers at \$417 trillion. CHIPS also restricts its operations to business days.

Businesses and individuals in the U.S. conduct retail payments mainly through the “3 Cs”: (Debit/Credit) Card, Check and Cash. The task force notes that there are several areas in which improvements are needed:

³⁰ The Federal Reserve newsletter on strategies to improve the U.S. payments system is at: <https://www.federalreserve.gov/newsevents/pressreleases/other20150126a.htm>. The final report of the Federal Reserve Faster Payments Task Force is available in two parts: <https://fasterpaymentstaskforce.org/wp-content/uploads/faster-payments-final-report-part1.pdf> <https://fasterpaymentstaskforce.org/wp-content/uploads/faster-payments-task-force-final-report-part-two.pdf>

1. Speed and infrastructure: Consumers and businesses have unmet needs of payment speed. A Fed study in 2014 showed that at least 29 billion transactions (12 percent of the total) could benefit from faster settlement. Because the wholesale payments system does not operate around the clock, retail payments also suffer from delays. Moreover, the task force points out that many countries have managed to build payments systems that are ahead of the U.S. in many respects.

2. Fragmentation of payments and regulation: The task force assesses that faster payments solutions are being developed in a fragmented way without ubiquitous access for users. Moreover, the U.S. doesn't have a single central authority to mandate payment standards and improvements. Rather, Congress, state legislatures, and payments system providers all set specific rules. Consequently, "each payment method is governed by a different set of laws, rules, and regulations."

Recommendations of the Task Force

The task force views private sector initiatives, with the government providing a consistent and unified regulatory framework, as preferable to a government-operated payments system. The report notes that "some countries have addressed these challenges through a mandate and/or the development of a national faster payments system with a single operator...The task force believes competition among individual solution operators and service providers...should be the driving force."

The report contains ten specific recommendations that can be grouped into three categories:

A. Governance and Regulation

1. Establish a faster payments governance framework.
2. Recommend and establish faster payments rules, standards, and baseline requirements that support broad adoption; safety, integrity, and trust; and interoperability.
3. Assess the payments regulatory landscape and recommend changes to the regulatory framework.

B. Payments Infrastructure

4. Establish an inclusive directory work group to identify and recommend a directory design for solutions to interoperate in the faster payments system.
5. Enhance Federal Reserve settlement mechanisms to support the faster payments system. In particular, enhance payments infrastructure to enable 24x7x365 wholesale settlement service.
6. Explore and assess the need for Federal Reserve operational role(s) in faster payments. The Fed could expand its role from providing settlement capability to other functions such as directory services, transaction processing, network access, security, and/or cross-border payments.

C. Sustainability and Evolution

7. Recommend, develop, and implement methods for fraud detection, reporting, and information sharing in faster payments.
8. Develop cross-solution education and advocacy programs aimed at awareness and adoption.

9. Conduct research and analysis to address gaps in cross-border functionality and interoperability.
10. Continue research and analysis on emerging technologies.

Appendix D. Countries That Have Implemented Fintech Regulatory Sandboxes

Europe	United Kingdom, Lithuania, Denmark, Netherlands, Switzerland, Sweden, EU, Russia
Asia/Asia-Pacific	Singapore, Brunei, Australia, Hong Kong (China), Malaysia, Thailand, Indonesia, Korea, Japan, Kazakhstan, India (considering), ASEAN (regional)
Africa	Mauritius, Sierra Leone
North America	Arizona (USA), Canada
Middle East	Saudi Arabia, Abu Dhabi (UAE), Bahrain, Jordan, Kuwait
Caribbean	Eastern Caribbean

The country-by-country summary follows the same order as in the table above. Links to references and sources are provided at the end of the appendix in the same order as the countries below.

United Kingdom: The Financial Conduct Authority (FCA) launched a regulatory sandbox in June 2016. The sandbox is open to authorized firms, unauthorized firms that require authorization, and technology businesses. The sandbox also offers tools such as restricted authorization, individual guidance, informal steers, waivers and no enforcement action letters. As of February 2018, the sandbox has supported 60 firms to test potential innovations with real customers in the live market under controlled conditions.

In August 2018, FCA and 11 other financial regulators (including those of Australia, Singapore, Hong Kong) proposed the creation of a “Global Financial Innovation Network (GFIN)” (the so-called ‘global sandbox’), which was formally launched in Jan 2019.

Lithuania: The central bank of Lithuania has launched a new regulatory sandbox for startups working with Blockchain. The “LBChain” initiative will see the Bank of Lithuania set up a dedicated platform around the technology, through which companies can develop services (though these services will be subject to some gatekeeping by central bank officials). It is a notable spin on the sandbox model, which sees institutions enabling firms to test financial products in a limited setting and under the auspices of regulators.

Denmark: In February 2018, the Finanstilsynet (Danish Financial Supervisory Authority) opened its first cohort applications for the FT Lab, a regulatory sandbox in which selected companies can test their innovative business models and fintech initiatives in a safe environment. Only a limited number of companies will take part in the first cohort of FT Lab. Based on the experience with the first cohort, the Financial Services Authority will again open up for applications from companies at a later date (e.g., when the companies from the first cohort are leaving the FT Lab).

Netherlands: The Authority for the Financial Market (AFM) and De Nederlandsche Bank (DNB) put a regulatory sandbox into practice in January 2017. The sandbox is available to all financial services companies looking to operate an innovative financial product, service or business model, whether they be supervised existing firms or newcomers. Such innovations may result from the application of technology (fintech), but this is not a prerequisite for qualifying for the sandbox, the scope of which is broader than just fintech.

Switzerland: In July 2017, the Swiss Federal Council amended the Swiss Federal Banking Ordinance to ease the Swiss regulatory framework for providers of innovative financial technologies. As a result, a regulatory sandbox entered into force in August 1 2017. It allows businesses in an early stage of development to experiment without being subject to prudential supervision. In December 2018, the Swiss parliament introduced FinTech license under the Banking Act with relaxed requirements.

Sweden: The Swedish Financial Supervisory Authority (FSA) established Fintech Regulatory Sandbox in Stockholm after receiving an assignment to facilitate fintech innovation from the Swedish National Innovation Council in May 2017.

European Union: In March 2018, the European Commission unveiled an Action Plan on how to harness the opportunities presented by fintech. The Fintech Action Plan set out that the Commission will present a “blueprint” with best practices on regulatory sandboxes, based on guidance from European supervisory authorities.

Russia: In April 2018, Bank of Russia announced a regulatory sandbox for any bank or organization to test innovative financial technologies. Bank of Russia would assess the impact of such technologies on financial markets and determine which ones could enter the market.

Singapore: In 2016, the Monetary Authority of Singapore (MAS) set up the Fintech Regulatory Sandbox to encourage more fintech experimentation. Financial institutions or any interested firm can apply to enter a regulatory sandbox to experiment with innovative financial services in the production environment, but within a well-defined space and duration. Depending on the financial service under experimentation (i.e., the applicant involved and the application made) MAS will determine the specific legal and regulatory requirements for each case. In July 2018, there were only 4 ongoing sandbox participants.

ASEAN (regional): In September 2018, ASEAN countries announced the creation of API Exchange (APIX), an online fintech marketplace and sandbox which aims to foster financial innovation and inclusion. It was officially launched in November 2018.

Brunei Darussalam: In February 2017, the Monetary Authority of Brunei Darussalam (AMBD) formally issued the Fintech Regulatory Sandbox Guidelines, which aim to aid in the development of fintech companies in Brunei Darussalam through the creation of regulatory sandboxes.

Australia: Australia’s regulatory sandbox framework is comprised of three broad options for testing a new product or service without a license: (i) relying on existing statutory exemptions or

flexibility in the law—such as by acting on behalf of an existing licensee; (ii) relying on Australian Securities & Investments Commission (ASIC) ‘fintech licensing exemption’ for the testing of certain specified products and services; and (iii) for other services, relying on individual relief from the ASIC. ASIC’s current fintech licensing exemption allows eligible businesses to test specified services for up to 12 months with up to 100 retail clients, provided they also meet certain consumer protection conditions and notify ASIC before they commence business operations.

Hong Kong: The Fintech Supervisory Sandbox (FSS), launched by the Hong Kong Monetary Authority (HKMA) in September 2016, allows banks and their partnering technology firms to conduct pilot trials of their fintech initiatives involving a limited number of participating customers without the need to achieve full compliance with the HKMA’s supervisory requirements. This arrangement enables banks and technology firms to gather data and user feedback so that they can make refinements to their new initiatives, thereby expediting the launch of new technology products and reducing development costs. In September 2017, HKMA announced Sandbox 2.0, which established a Fintech Supervisory Chatroom to facilitate regulatory feedback and linked sandboxes of HKMA, Futures Commission (SFC), and the Insurance Authority (IA) to create a single point of entry for pilot trials across sectors. By May 2018, 32 firms had participated in FSS.

Malaysia: In October 2016, Bank Negara Malaysia, the country’s central bank, issued the Financial Technology Regulatory Sandbox Framework, which set out its key principles and approach in operationalizing the regulatory sandbox. As of 2017, Bank Negara had approved four firms to operate within its regulatory sandbox.

Thailand: The Bank of Thailand issued a consultation paper on Fintech Regulatory Sandbox Guidelines in October 2016. The purpose of the regulatory sandbox is to allow businesses to test their financial products or services in a live but limited environment, without being fully subject to all requirements that are normally applicable.

Indonesia: In September 2016, Bank Indonesia claimed to launch the Fintech Office and Regulatory Sandbox. Indonesia’s Financial Services Authority also has plans to launch regulatory sandbox.

South Korea: In Jan 2019, the Financial Services Commission (FSC) announced that a fintech sandbox would be launched in April 2019, along with other supportive measures. By early May 2019, it had already accepted 18 participants.

Japan: In Sep 2017, Financial Services Agency of Japan (FSA) launched “FinTech Proof-of-Concept Hub” to “eliminate the hesitation and concern that FinTech firms and financial institutions are inclined to have in conducting unprecedented tests.” By January 2019, the Hub had selected and tested four projects. This appears to be, in effect, a sandbox although it is not referred to as such.

India: In July 2016, Reserve Bank of India (RBI) set up an inter-regulatory working group to review the regulatory framework with respect to FinTech development. The report of the

working group was published in Feb 2018, and in April 2019 RBI released a framework for regulatory sandbox for public review.

Kazakhstan: Astana Financial Services Authority (AFSA) launched a fintech sandbox in July 2018 as part of an attempt to make Astana a global fintech hub.

Mauritius: The government of Mauritius announced the introduction of the Regulatory Sandbox License (RSL) in the 2016/2017 National Budget. The Board of Investment is responsible for managing the new scheme, and RSL will be delivered to eligible companies willing to invest in innovative projects within an agreed set of terms and conditions for a defined period.

Sierra Leone: The Bank of Sierra Leone will provide access to its newly launched regulatory sandbox to the finalists of the Sierra Leone Fintech Challenge 2017.

Arizona, U.S.A.: In March 2018, Arizona enacted a new law to establish a fintech sandbox, making it the first U.S. state to do so. The program, which is managed by the state attorney general's office, opened for applications in late 2018 and will run until July 2028. Applicants will be able to serve up to 10,000 Arizonian customers, and will have two years for testing.

Canada: In February 2017, the Canadian Securities Administrators (CSA) launched a regulatory sandbox, an initiative that supports businesses seeking to offer innovative products, services, and applications. The CSA regulatory sandbox is open to business models that are truly innovative from a Canadian market perspective. The CSA will assess the merits of each business model on a case-by-case basis and businesses that register or receive relief could be permitted to test their products and services throughout the Canadian market.

Saudi Arabia: In February 2019, the Saudi Arabian Monetary Authority launched a fintech sandbox which is open to local and international firms. It currently has 7 participating firms.

Abu Dhabi, UAE: Abu Dhabi Global Market (ADGM) unveiled its Innovation Centre at the Fintech Abu Dhabi Summit in October 2017. The Centre will also be home to participants of the Regulatory Laboratory (RegLab). ADGM's regulatory sandbox allows companies to live-test innovative fintech products in collaboration with the regulator. As of September 2018, the Centre had admitted a third batch of fintech startups to RegLab.

Bahrain: In June 2017, the Central Bank of Bahrain (CBB) announced new regulations to create a regulatory sandbox that will allow startups and fintech firms to test and conduct experiments of their banking ideas and solutions. The objective of the regulatory sandbox is to provide an opportunity for fintech businesses around the world to expand and thrive in the Gulf and strengthen Bahrain's position as a fintech and financial services hub in the Gulf Cooperation Council.

Jordan: In April 2018, Bank of Jordan launched a fintech sandbox, which is open to foreign firms as well.

Kuwait: In November 2018, the Central Bank of Kuwait launched a fintech sandbox offering a one year trial period.

Selective Assessment of Regulatory Sandbox Outcomes

The British sandbox has the most participants: 89 firms in four phases (18, 24, 18, 29 in each phase; among them 8, 9, 4, 12 claim to use blockchain or DLT). For the first two phases, FCA accepted 50 of 146 applications, and 41 are tested. 90 percent of phase 1 firms continued toward a wider market.

In the “lessons learned report,” the FCA notes that “Obtaining authorization helps firms access funding. For firms that are not yet authorized, the sandbox can offer a quicker route to authorization, enabling them to provide more certainty to prospective partners and investors.” The report cites the fact that “at least 40 percent of firms which completed testing in the first cohort received investment during or following their sandbox tests” as an indicator of success.

In contrast to this, a joint report led by the European Securities and Markets Authority (ESMA) raises two concerns about the sandbox approach: (i) the possibility that propositions tested in a regulatory sandbox may be perceived by consumers and/or the market as ‘endorsed’ by the competent authority, and (ii) the active guidance and close monitoring of the participants in the regulatory sandboxes could give rise to level playing field issues.

So far, Arizona’s sandbox has 3 participants.

Singapore’s sandbox currently has 2 active participants, and 2 firms have already completed testing. However, the number is an underestimate of Singapore’s support of fintech, because Singapore offers other programs such as Open Banking Platform and the Financial Sector Technology and Innovation (FSTI) scheme.

<http://www.mas.gov.sg/Singapore-Financial-Centre/Smart-Financial-Centre.aspx>
<http://www.mas.gov.sg/Singapore-Financial-Centre/Smart-Financial-Centre/FinTech-Regulatory-Sandbox/Experimenting-in-the-sandbox.aspx>

Malaysia’s sandbox has 6 participants.

Canada has authorized 8 firms as sandbox participants.

Australia has authorized 6 firms as sandbox participants.

South Korea’s sandbox, launched in April 2019, has already accepted 18 participants by early May.

In Hong Kong, 43 pilot trials have been conducted in the sandbox.

Regulatory lab of Abu Dhabi has admitted three batches of participants and a total of 26 firms from 20 countries. <https://www.adgm.com/mediacentre/press-releases/abu-dhabi-global-market-admits-3rd-reglab-cohort-with-more-uae-fintech-firms/>

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Regulatory Sandboxes and Financial Inclusion. Link: <http://www.cgap.org/sites/default/files/Working-Paper-Regulatory-Sandboxes-Oct-2017.pdf>

Five Bank Indonesia Initiatives for the Payment System. Link: https://www.bi.go.id/en/ruang-media/siaran-pers/Pages/sp_187316.aspx

Regulators to Play in ‘Sandbox’ with Infant Fintech Firms. Link: <http://www.thejakartapost.com/news/2016/09/06/regulators-to-play-in-sandbox-with-infant-Fintech-firms.html>

FinTech: Commission Takes Action for a More Competitive and Innovative Financial Market. Link: http://europa.eu/rapid/press-release_IP-18-1403_en.htm

Singapore: MAS FinTech Regulatory Sandbox Guidelines. Link:

<http://www.mas.gov.sg/~media/Smart%20Financial%20Centre/Sandbox/FinTech%20Regulatory%20Sandbox%20Guidelines%2019Feb2018.pdf>

ASEAN regional sandbox. Link: <https://bit.ly/2Vhc2G2>

Links for the subsection: Selective Assessment of Regulatory Sandbox Outcomes

Britain: FCA cohorts of sandbox participants: <https://www.fca.org.uk/firms/regulatory-sandbox/cohort-1>

FCA lessons learned report (may be helpful to skim over headers and graphs):

<https://www.fca.org.uk/publication/research-and-data/regulatory-sandbox-lessons-learned-report.pdf>

European Securities and Markets Authority (ESMA) report:

https://www.esma.europa.eu/sites/default/files/library/jc_2018_74_joint_report_on_regulatory_sandboxes_and_innovation_hubs.pdf

Arizona's FinTech Sandbox participants. Link: <https://www.azag.gov/fintech/participants>

Malaysia's FinTech Sandbox. Link: <https://www.myftcg.com/>

Canada's FinTech Sandbox participants. Link: <https://bit.ly/2LBUf8P>

Australia's FinTech Sandbox participants. Link: <https://bit.ly/2Q0TEQq>

Hong Kong's FinTech Sandbox participants. Link: <https://bit.ly/2QgVk7z>



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