

CIGI Papers No. 250 – April 2021

# Central Bank Digital Currency and Governance Fit for Purpose?

Pierre L. Siklos





CIGI Papers No. 250 – April 2021

# Central Bank Digital Currency and Governance Fit for Purpose?

Pierre L. Siklos

---

## About CIGI

The Centre for International Governance Innovation (CIGI) is an independent, non-partisan think tank whose peer-reviewed research and trusted analysis influence policy makers to innovate. Our global network of multidisciplinary researchers and strategic partnerships provide policy solutions for the digital era with one goal: to improve people's lives everywhere. Headquartered in Waterloo, Canada, CIGI has received support from the Government of Canada, the Government of Ontario and founder Jim Balsillie.

---

## À propos du CIGI

Le Centre pour l'innovation dans la gouvernance internationale (CIGI) est un groupe de réflexion indépendant et non partisan dont les recherches évaluées par des pairs et les analyses fiables incitent les décideurs à innover. Grâce à son réseau mondial de chercheurs pluridisciplinaires et de partenariats stratégiques, le CIGI offre des solutions politiques adaptées à l'ère numérique dans le seul but d'améliorer la vie des gens du monde entier. Le CIGI, dont le siège se trouve à Waterloo, au Canada, bénéficie du soutien du gouvernement du Canada, du gouvernement de l'Ontario et de son fondateur, Jim Balsillie.

---

## Credits

Managing Director of Digital Economy **Robert Fay**

Publications Editor **Susan Bubak**

Publications Editor **Lynn Schellenberg**

Graphic Designer **Brooklynn Schwartz**

Copyright © 2021 by the Centre for International Governance Innovation

The opinions expressed in this publication are those of the author and do not necessarily reflect the views of the Centre for International Governance Innovation or its Board of Directors.

For publications enquiries, please contact [publications@cigionline.org](mailto:publications@cigionline.org).



This work is licensed under a Creative Commons Attribution — Non-commercial — No Derivatives License. To view this license, visit ([www.creativecommons.org/licenses/by-nc-nd/3.0/](http://www.creativecommons.org/licenses/by-nc-nd/3.0/)). For re-use or distribution, please include this copyright notice.

Printed in Canada on Forest Stewardship Council® certified paper containing 100% post-consumer fibre.

Centre for International Governance Innovation and CIGI are registered trademarks.

67 Erb Street West  
Waterloo, ON, Canada N2L 6C2  
[www.cigionline.org](http://www.cigionline.org)

---

# Table of Contents

vi	About the Author
vi	Acronyms and Abbreviations
1	Executive Summary
2	Introduction
4	CBDC: Tailwinds and Headwinds
11	CBDC: Governance Matters
19	Conclusion: Where Do We Go from Here?
21	Works Cited
24	Appendix

---

## About the Author

**Pierre L. Siklos** is a CIGI senior fellow. He has held seven visiting researcher positions at central banks in European and Asian countries, including Germany, Hong Kong, Hungary and Japan. Pierre has also held more than 20 visiting fellowships at leading academic institutions, such as the International School of Economic Research in Siena, Italy; Oxford University in the United Kingdom; and Princeton University and the Hoover Institution, Stanford University, in the United States.

He has a particular interest in central bank independence, the governance models of central banks and the challenges that arise in an interdependent world. To that end, he has compared and contrasted how European models of integration differ from those in Asia. His work in applied time series analysis and monetary policy focuses on inflation and financial markets.

Pierre teaches macroeconomics at Wilfrid Laurier University and is a visiting professor at the Westfälische Wilhelms-Universität Münster in Germany. He is a former chair of the Bundesbank Foundation of International Monetary Economics at Freie Universität in Berlin, Germany. He is also a research associate at Australian National University's Centre for Macroeconomic Analysis in Canberra, and a research fellow at the C. D. Howe Institute. Pierre is the former managing editor of the *North American Journal of Economics and Finance*.

Pierre earned his Ph.D. in economics from Carleton University and his M.A. in economics from the University of Western Ontario. He is fluent in English, French and Hungarian.

---

## Acronyms and Abbreviations

<b>AEs</b>	advanced economies
<b>ATMs</b>	automated teller machines
<b>BCRA</b>	Banco Central de la República Argentina
<b>BIS</b>	Bank for International Settlements
<b>BRICS</b>	Brazil, Russia, India, China and South Africa
<b>CBDCs</b>	central bank digital currencies
<b>COVID-19</b>	coronavirus disease 2019
<b>EMEs</b>	emerging market economies
<b>G20</b>	Group of Twenty
<b>GFC</b>	global financial crisis
<b>IMF</b>	International Monetary Fund
<b>ISO</b>	International Organization for Standardization

---

## Executive Summary

The ongoing coronavirus disease 2019 (COVID-19) pandemic has shone a light on digital forms of payment. At central banks, this has given rise to what has since been called central bank digital currency (or currencies; CBDCs). At a minimum, CBDC has the potential to replace the traditional role of notes and coins in circulation. However, CBDC also creates the possibility that additional services provided through digital technology can be added. At the global level, CBDC can ease the burden and costs of transacting in different currencies, thereby facilitating, if not encouraging, cross-border payments. The latter is deemed a priority issue of the Group of Twenty (G20).

This paper addresses three main issues: Should the data-gathering activities of central banks be separated from other central banking activities? Do current governance arrangements, limited to G20 economies, constrain the introduction of CBDC? And how is central bank autonomy impacted, or our understanding of the concept influenced, by the creation of CBDC?

There are many tailwinds and headwinds swirling around the deployment of a CBDC. These are listed and discussed below. They are used as the basis for constructing a heat map that shows how receptive G20 economies are to a CBDC. Next, a survey of central bank legislation, which represents just one piece of the governance puzzle that policy makers must confront, clearly suggests that, while some of the feared excesses from the uses that a CBDC can be put to are likely exaggerated, too few legal mechanisms are in place to argue that the world is ready for the widespread adoption and use of CBDC. Hence, existing central bank legislation is not entirely fit for purpose in response to the potential introduction of a CBDC.

As well, policy implications are drawn and suggestions for going forward are provided.

Clearing and settlement systems need to be flexible enough, not only to cover traditional financial institutions but also to deal with the emergence of financial technology (fintech) and other types of digital platforms that may offer digital financial services. Moreover, initially, a CBDC should serve primarily as a means of payment and reduce the existing frictions that limit the

ability of individuals and firms to transact locally and globally. Progress needs to be made to clarify, via effective regulation and supervision, the limitations of a CBDC's use across borders and ensure conflict resolution mechanisms are in place domestically to prevent governments from abusing the potential for CBDC as a form of fiscal policy.

Central banks should investigate the public's views about the value that households place on the means-of-payment and the store-of-value functions of money. There is too little clarity at present about the aims of CBDC in this connection. Next, it is difficult to argue that a central bank should be responsible for the data generated thanks to a CBDC; this may overburden central banks. Any privacy or related legislation should clearly outline the responsibilities of the central bank in this regard. In principle, a CBDC brings us close to the world of "helicopter money."<sup>1</sup> Therefore, the list of limitations on lending provided by a central bank needs to be revisited and the location of accountability for digital interventions by a central bank clearly spelled out.

Finally, cross-border and settlement systems may well prove to be one of the main battlegrounds for the make-up and deployment of CBDC. Concerns over cross-border payments — a G20 priority in 2020 — are simply another means of highlighting the role of sovereignty, together with the race to become the first to deploy a CBDC. At a time when the concept of fiduciary duty (i.e., acting in the best interests of another party, especially when it is a foreign country) is in retreat, it is conceivable that roadblocks to the spread of digital currencies will increasingly emerge. The fiduciary obligation is even more pressing for select advanced economies (AEs) since cross-border digital currency holdings will likely reside in a few internationally accepted currencies (for example, the US dollar, the euro).

---

<sup>1</sup> Milton Friedman (1969) used the example of a helicopter dropping money to illustrate the demand-inducing potential of a cash drop. Critically, however, the effectiveness of such a policy is entirely dependent on the assumption that the policy would never be repeated.



---

# Introduction

Monetary authorities around the world remained behind the scenes in discussions about payments technologies until the debate shifted to the possibility that “money,” principally in the form of cash, might eventually be issued digitally. This development has given rise to what has since been called CBDC. The ongoing COVID-19 pandemic has only served to raise the stakes even further as some businesses became reluctant, or refused outright, to accept notes and coins as a form of payment.<sup>2</sup>

At a minimum, CBDC has the potential to replace the traditional role of notes and coins in circulation. More broadly, CBDC creates the possibility that additional services can be provided through digital means.<sup>3</sup> The introduction of CBDC also has the potential to transform central banking. For example, CBDC may offer, depending on its form, the option for individuals to hold balances at the central bank, as well as the option to compensate the holders of CBDC.<sup>4</sup> At the global level, CBDC can ease the burden and costs of transacting in different currencies, thereby facilitating, if not encouraging, cross-border payments. The latter is deemed a priority issue of the G20.<sup>5</sup>

Beyond the surge in electronic forms of payment due to COVID-19, why is there so much interest in CBDC? First, central banks around the world, whether they are AEs or emerging market economies (EMEs), agree about many of the motivations for adopting a CBDC, with financial stability and monetary policy considerations

topping the list, at least they do according to a recent survey conducted by the Bank for International Settlements (BIS) (see, for example, Boar, Holden and Wadsworth 2020).<sup>6</sup>

Yet, governance- and data collection-related issues, for example, have not attracted the same attention, even if some observers to date have indicated discomfort with the current state of legislation and regulation in this connection (see, for example, International Monetary Fund [IMF] 2020).

Second, there has been considerable emphasis placed on how CBDC can improve the efficiency and safety of payments systems (see, for example, BIS 2020). Whether CBDC offers the chance to enhance oversight and provides a safety net of sorts for payments systems remains to be seen. However, there remain underappreciated factors, exacerbated by the pandemic, from the introduction of CBDC. Two are worth highlighting. One is cultural; the other more technical in nature. The cultural one comes from the well-known tendency in some countries to continue to rely on conventional notes and coins as the preferred means of payment (for example, as in Germany, Japan, Switzerland and the United States).<sup>7</sup> Even in countries most favourable to a CBDC (for example, Sweden), policy makers have been asked to slow the process in order to further consider the broader societal implications of the rise of the digital economy (see, for example, Alderman 2018).

It is worth noting that, globally, there already exist a large number of networks for real-time settlement, although not all are on an equal footing in terms of their readiness. Readiness and resilience are critical ingredients, given that, in legal terms, settlement in cash is considered final.<sup>8</sup> This is on top of retail payment systems,

---

2 For example, in May 2020, the Bank of Canada asked retailers to continue accepting cash even though the central bank “recognizes that these measures are being taken with the safety and well-being of both staff and consumers in mind.” See Bank of Canada 2020. Heng Chen et al. (2020) later confirmed that consumer demand for cash actually increased. The author returns to discussing this phenomenon below.

3 In what follows, the author will not discuss cryptocurrencies. Many authors have drawn attention to the confusion surrounding what is meant by a CBDC (for example, Meaning et al. 2018). Moreover, there is also a difference between CBDC and stablecoins. The latter are a private sector creation ordinarily backed by physical or financial assets (for example, gold, dollars).

4 The emerging CBDC literature does not make sufficiently clear that commercial banks offer an array of services well beyond merely providing interest income to their customers. Indeed, in several countries, bank income from non-interest sources, including service fees, has tended to rise over time. Proposals to create CBDC, published by central banks and some international agencies, clearly state that central banks are not expected to emulate the range of services offered by banks.

5 See, for example, [www.g20.org](http://www.g20.org).

6 Other motivating factors include facilitating financial inclusion, improving the efficiency of payments systems, and reducing the costs of and easing cross-border payments.

7 Surprisingly, perhaps (see also note 2), there has been a noticeable shift to holding more notes and coins in some AEs. In particular, the data reveals growth in the holding of large-denomination notes. Thus, for example, the European Central Bank is phasing out the €500 note in response to some of these concerns, although the decision predates the arrival of COVID-19. Jonathan Ashworth and Charles A. E. Goodhart (2020) also note changes in holdings of large- versus small-denomination notes in several countries. The ongoing pandemic is revealing that large-denomination notes may also be held for precautionary purposes (see Chen et al. 2020).

8 The authorities are aware of the need for “interoperability”; domestic interoperability between retail and wholesale systems is common in AEs while cross-border interoperability remains a work in progress.



where delays in settlement imply some residual risk, at least compared to cash transactions. Whether these risks may be ignored or hedged is a different issue. Nevertheless, cyberthreats, and the capacity of the authorities to contain them, both downplayed by central bankers at least until recently (see, for example, Carstens 2021), signal that the introduction of a CBDC raises risks of a different kind than with conventional notes and coins.<sup>9</sup>

It is worth repeating that the introduction of CBDC would take place in an environment where other forms of electronic and digital payments have become commonplace. Credit and debit cards, not to mention other forms of payment such as cash or gift cards, have become popular and are used widely.<sup>10</sup> Moreover, interbank networks have already emerged (for example, Interac in Canada, China UnionPay in China, STAR in the United States and LINK in the United Kingdom) to facilitate the transfer of funds at both the retail and the wholesale level. It is not inconceivable that these networks will adapt to new future needs, regardless of the form of CBDC that is introduced. Whether central banks join existing networks, or legislation is required to safeguard the security and other considerations required before CBDC can participate or lead to the creation of new networks, is a work in progress. Nevertheless, the adage that regulation lags innovation is as true today as in the past when policy makers were playing catch-up.<sup>11</sup>

Finally, the political economy implications from the introduction of CBDC raise a separate set of challenges. These include the loss of monetary sovereignty or in the status of global reserve currencies; a decline in the independence of central banks, not only from governments but also

from the commercial banking sector; the role of payments networks as a source of vast amounts of data that can be used for commercial and non-commercial purposes; and, lastly, but arguably most challenging of all, the loss of anonymity that cash transactions incur. While potential disruptions in the conduct of monetary policy and the end of monetary dominance are critical policy questions, the governance of central banks and their possible involvement as holders or dealers of massive amounts of private data have received less attention. Policy advice is urgently needed to offer guidance on these issues.

A recent report by a consortium of central banks (Bank of Canada et al. 2020) admits that complete anonymity in using a CBDC is implausible. It is worth adding that anonymity and privacy can, but need not, coexist. Whether the proliferation of online transactions and card use and, increasingly, smartphones means that some of these concerns are overblown remains in question (see, for example, Warzel and Thompson 2019). For example, cards and smartphones underscore the role that “loyalty” plays in transactions technology but at the loss of anonymity (see, for example, Amamiya 2019). Japan is one, but not the only example, where government intervention also skews the technology adopted for payment with implications for identifying individual transactions. An experiment was undertaken in Japan in 2019 in an effort to blunt the impact of the increase in the consumption tax from eight percent to 10 percent. The fiscal authorities decided to favour digital transactions through a discount program.<sup>12</sup> Central banks are keenly aware of the issues, but the bottom line is that no technology is able yet to provide foolproof anonymity with digital transactions (see also, for example, Bindseil 2020).

---

9 While the traditional threat of counterfeiting notes still exists thanks to technological developments in recent years, advances such as increasing reliance on polymer notes and enhanced security features on existing notes have contributed to reducing the threat. The creation of a Central Bank Counterfeit Deterrence Group ([www.rulesforuse.org/en/currencies-list](http://www.rulesforuse.org/en/currencies-list)) has also helped. See Richard Finlay and Amy Francis (2019) for an engaging recent history of counterfeiting.

10 Indeed, commercial banks, and many non-bank competitors, have also adopted technology alongside existing notes and coins in circulation, first through the spread of automated teller machines (ATMs), which have, over time, gone beyond simply dispensing cash to online banking, making cross-border payments easier, if costly.

11 There is a long list of such instances. Arguably, the best-known ones took place in the United States, where post-1930s Depression-era legislation failed to adapt to financial innovations created in the 1970s and 1980s, in part, as a means to circumvent existing financial restrictions. (See, for example, Siklos 2006).

---

12 See [www.nippon.com/en/japan-data/h00537/smart-shopping-reward-points-and-consumption-tax-hike-exemptions-a-bargain-for-consumers-i.html](http://www.nippon.com/en/japan-data/h00537/smart-shopping-reward-points-and-consumption-tax-hike-exemptions-a-bargain-for-consumers-i.html).

This paper addresses the following issues:

- Should the data-gathering activities of central banks be separated from other central banking activities? If not, how should central bank governance be adapted? What models are available? Is the fact that some CBDC may be held as reserve currency relevant? If so, what role should this play in international cooperation/coordination and in the reserves-holding activities and behaviour of central banks? In dealing with these questions, it is necessary to consider factors that favour or discourage the introduction of a CBDC.
- How do existing governance arrangements (for example, those limited to G20 economies) constrain the introduction of CBDC? How many central bank laws permit the central bank to offer commercial banking-type services, and what limitations are presently placed on these institutions and this kind of activity? No one, to the author's knowledge, has considered the current state of readiness of central bank legislation in dealing with the coming CBDC era.
- How can central bank autonomy survive, or our understanding of the concept change, as a result of the creation of CBDC? Should central banks simply piggyback on existing legislation (for example, as in legislation governing tax records), or will central bank legislation require changes by adding new directive-type clauses in case there is a conflict between the central bank, the government, or other governmental (or even international) institutions about transactions using CBDC? The introduction of a CBDC, on top of the economic fallout from the pandemic, suggests a return to a focus on the nature of the government-central bank relationship.

The remainder of this paper is organized as follows. The author begins with a discussion of the primary forces behind the introduction of CBDC. These are explained via the identification of tailwinds and headwinds that impact the prospects for CBDC. While the literature on the various facets of CBDC is growing, it is overwhelmingly generated by central banks and tends to emphasize the reasons why a digital currency in some form is desirable. Although there is acknowledgment of some of the challenges that central banks and governments, more generally, must confront prior to the introduction of CBDC, there is no scoresheet of

sorts to inform readers of the factors that favour or contradict the need to introduce a digital currency.<sup>13</sup>

Next, the author moves on to discuss the issues that lie at the core of the three issues listed above and to examine where G20 economies stand in terms of their predilection for adopting a CBDC, as well as their state of readiness as interpreted through the existing legislation that governs their central banks.

The paper concludes with a summary and an outline of some policy suggestions for a way forward in preparation for a CBDC.

---

## CBDC: Tailwinds and Headwinds

### Preliminaries

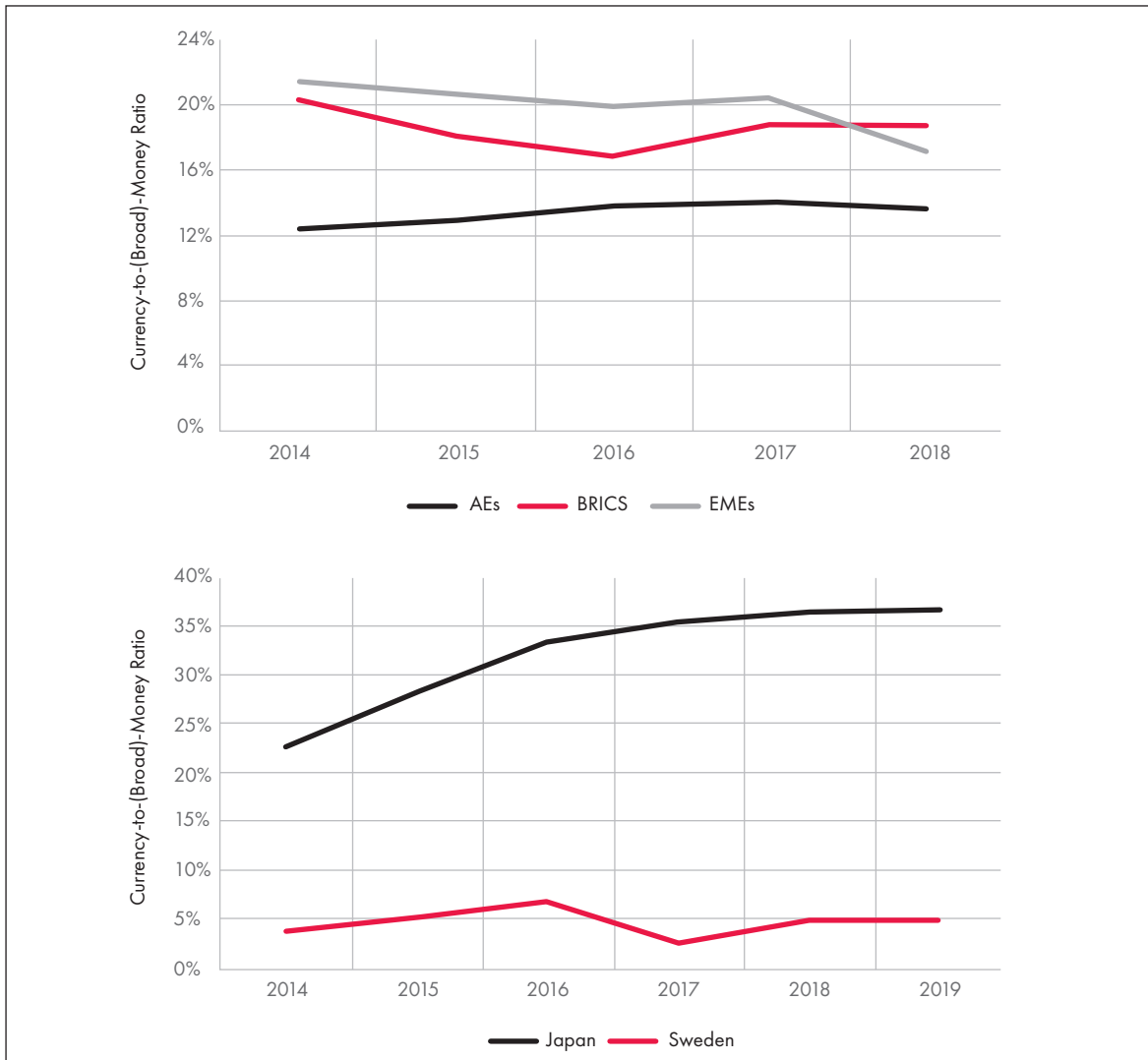
What is a CBDC? A unique definition does not exist for at least two reasons. First, because digitalization provides tremendous flexibility in the delivery of transactions services, CBDC potentially comes in many forms. Second, the legal environment also governs the ability of policy makers today to introduce a CBDC. Current discussions around CBDC focus on two forms: the first is as an alternative to the current use of notes and coins; the second is similar to the first form, but with the additional feature that individuals and firms may have an account at the central bank. Clearly, the second form suggests that a central bank can impinge on some of the functions of commercial banks.<sup>14</sup> The first form of a CBDC highlights the means-of-payment function of money. Other forms raise questions about the potential store-of-value role of CBDC.

---

13 Raphael Auer, Giulio Cornelli and Jon Frost's study (2020) is typical of this vintage of research. The focus is on the technological and other broader societal drivers that favour the introduction of CBDC but not on the countervailing challenges. In contrast, Sarah Allen et al. (2020) is an academic study that is more balanced in raising regulatory and technical challenges surrounding the creation of CBDC. Nevertheless, the latter do not provide a checklist of the kind discussed briefly in the next section, nor are the issues raised as comprehensive as in the present study.

14 Some of these issues are beyond the scope of this paper. See, however, *inter alia*, Bank of Canada et al. (2020); Bank of England (2020); and Auer, Cornelli and Frost (2020).

**Figure 1: Currency-to-Money Ratios across Selected Regions and Countries**



Data source: Annual data from the IMF, “International Financial Statistics”

(<https://data.imf.org/?sk=4c514d48-b6ba-49ed-8ab9-52b0c1a0179b>).

Notes: AEs, BRICS and EMEs refer to G20 economies only. AEs are Australia, Canada, the European Union, Japan, South Korea, the United Kingdom and the United States. BRICS are Brazil, Russia, India, China and South Africa. EMEs are Argentina, Indonesia, Mexico, Saudi Arabia and Turkey. See IMF (2016) for a precise definition of broad money.

The top portion of Figure 1 considers the G20 economies<sup>15</sup> and subdivides them into three groups. They are AEs; EMEs; and BRICS, an acronym for large EMEs that are also members of the G20 (i.e., Brazil, Russia, India, China and South Africa). CBDC, first and foremost, has the potential to displace existing notes and coins, that is, the currency portion of the total

money supply referred to as broad money (see also, for example, Chen and Siklos 2021). The digitalization of the economy, spurred on by the ongoing pandemic, also favours increased use of digital notes and coins.<sup>16</sup> Broad money generally

<sup>15</sup> A list of members is available from [www.g20.utoronto.ca/g20whatisit.html](http://www.g20.utoronto.ca/g20whatisit.html).

<sup>16</sup> The Digital Intelligence Index provides some data about digital progress for a large number of countries over time. See <https://digitalintelligence.fletcher.tufts.edu/trajectory>.

includes deposits at commercial banks and other interest-earning assets in the financial system.<sup>17</sup>

The gap between cash holdings in advanced versus other economies has shown some signs of narrowing over time. Hence, in spite of other large economic differences between members of the G20, currency holdings would not appear to be one factor that might explain earlier or later adoption of a CBDC. The bottom portion of Figure 1, however, does highlight an area where, even among AEs, prospects for an imminent introduction of a CBDC can differ, possibly for cultural reasons. The figure shows the same currency-to-money ratio as in the top portion of Figure 1 but now for two individual countries: Japan and Sweden.<sup>18</sup> Currency as a proportion of the total money supply is not only rising since 2014 in Japan but reaches more than a third of broad money. In contrast, levels have remained relatively stable in Sweden at around five percent. The gap is striking, and while central banks in both economies are moving ahead with plans for a CBDC, the motivations for doing so are not the same (see, for example, Bank of Canada et al. 2020). Whereas seeking to facilitate day-to-day transactions has pushed Sweden further ahead of most other countries in planning to introduce a CBDC, cross-border and efficient payments settlement are top of mind for Japanese authorities.

Differing motivations for introducing CBDC tend to be ignored in many studies that prefer to focus on common drivers across countries. As we shall see in the next section, cross-border and settlement systems may well prove to be one of the main battlegrounds for the makeup and deployment of a CBDC. Another explanation resides with demographics and rapidly aging populations, such as in Japan, where there may be resistance to digital forms of payment. Even in Sweden, where progress toward completely digital forms of payment was thought to be imminent, policy

makers have slowed the process in order to more fully study the consequences of the digitalization process (see, for example, Alderman 2018). Once again, the role of demographics is largely unappreciated by central bank studies, although it is attracting increased attention among academics (see, for example, Goodhart and Pradhan 2020).

Technical preconditions, not to mention a certain comfort level with digital means of payment, will also contribute to the spread of CBDCs. Accordingly, Figure 2 shows bar charts for the available data giving the amount of cash, credit and debit cards per capita for 13 G20 countries since 2012. Two features from the data are worth highlighting. First, levels suggest a considerable divide in digital forms of payment; however, the division is not between AEs and EMEs. After all, in countries such as China, the number of cards of all kinds is not only rising but is reaching levels that, by 2018, were among the highest in the world. Second, levels are rising quickly in several EMEs, including India, Russia and Turkey, but numbers of cards per capita are far smaller than elsewhere in the G20.<sup>19</sup>

Next, a common feature across a majority of G20 economies is that per capita value holdings of large-denomination notes in circulation have risen over the 2012–2016 period.<sup>20</sup> The only exception is South Africa. Whether this is explained by illicit activities, which prompted Kenneth S. Rogoff (2017) and others to argue for replacing cash with a CBDC, or as a response to economic uncertainty, at least in some parts of the world (see, for example, Demir and Ersan 2017), is unclear. The pandemic has apparently only increased interest in the holding of larger-denomination notes (for example, Chen et al. 2020; Ashworth and Goodhart 2020).

## Tailwinds and Headwinds: A Checklist

Auer, Cornelli and Frost (2020) report that 16 central banks around the world have begun CBDC pilot projects, with several in EMEs involved in such an undertaking. Other than perhaps Uruguay (Licandro 2018) and Ecuador (Arauz 2019), the projects are very much in their infancy and not yet ready for

17 The IMF publishes base-to-(broad)-money ratios and base growth series in its “International Financial Statistics.” However, only the currency component is, strictly speaking, comparable across countries. Differences in definitions exist for the remaining portions of the monetary base. Nevertheless, the IMF strives to ensure international comparability. See IMF (2016, 197–200). The appendix (Table A2) provides some simple cross-country estimates of the main determinants of the currency-money ratio. The dependency ratio (i.e., an indicator of population aging) and the number of ATMs are significant determinants.

18 Sweden is not part of the G20. However, much the same interpretation would be obtained if Germany (a member) were used as an example instead of Sweden. Since Germans use the euro-zone common currency, the author opted to illustrate the point made here using data for a different country.

19 A simple regression (not shown in Figure 2; see the appendix) for a panel of 12 G20 countries with data available since 2004 suggests that demographics (i.e., dependency ratio) and the number of ATMs in a country both raise cash holdings while, on average, cash holdings in AEs are significantly and quantitatively lower than in EMEs.

20 The relevant evidence is relegated to the appendix.

**Figure 2: Per Capita Holdings of Digital Payments Instruments in 13 G20 Countries**



*Data source:* Data is from successive Red Book statistics from the Committee on Payments and Market Infrastructures ([www.bis.org/statistics/payment\\_stats.htm?m=6%7C36](http://www.bis.org/statistics/payment_stats.htm?m=6%7C36)).

*Notes:* Data is annual. The data plotted represents the sum of cash, debit and credit cards, where available, divided by population estimates also published in the same source.

widespread deployment. Moreover, relatively few central banks (six) have published reports on their progress. Indeed, for the most part, discussions around CBDC have, as this is written, tended to be in the form of speeches by central bankers. As far as the author is aware, there has been no attempt to list the tailwinds and headwinds in the drive to bring CBDC to the wider public.

Table 1 then provides a checklist. The list is not intended to be exhaustive. Moreover, Table 1 should not be interpreted as a rank ordering in terms of the importance of each item on the list. Indeed, as the remarks so far ought to make clear, the literature so far is nowhere near a consensus on which one of the issues considered will tip the balance in favour or delay the imminent introduction of a CBDC.

Starting with the tailwinds, the author has identified seven categories. Technological developments, combined with the desire to improve the efficiency of payments systems, arguably are the most obvious factors favouring the introduction of CBDC. Complications stemming from the demands of a CBDC to seamlessly ensure that huge numbers of transactions are settled are also being assisted, of course, by technological developments in machine-learning techniques and artificial intelligence. Technology is also increasing the demand, in evidence even before CBDC was seriously being discussed, to speed up the settlements of payments. Existing payments systems have the capacity, although it is not yet fully deployed, of ensuring that transactions are settled in real time.<sup>21</sup> Simultaneously, there are attempts to extend the immediacy of settled transactions to cross-border payments. The author will not devote too much space to the role of the ongoing pandemic as an event that promotes digital payments, or to the positive externalities associated with contactless payments. As noted previously, this need not translate into a permanent shift away from using cash. Moreover, this development

is offset by a critical headwind in the form of possible negative implications for privacy.

Both financial and trade globalization continue apace.<sup>22</sup> While the global financial crisis (GFC) of 2008–2009 appears to have bent the curve, the latest data does not yet reveal a reversal, although this may well begin to emerge once the full impact of COVID-19 is felt in the global economy (see, for example, Irwin 2020). The G20 is also contributing to blunting the impact of these kinds of shocks by placing priority on improving cross-border payments (see, for example, Financial Stability Board 2020).

Financial inclusion is often mentioned as another motivation for introducing CBDC since it offers the opportunity for neglected portions of the population to participate directly in the financial system. Concerns over financial inclusion are far from new (see, for example, Barajas et al. 2020 for a survey), and the role of CBDC in this context remains more in the theoretical sphere than a practical concern. After all, some of the technology required to participate in CBDC (for example, via a smartphone) is likely not used by the population that would benefit from greater financial inclusion. On the other hand, CBDC should ease the cost and enhance the appeal to the large community of individuals that deals with remittances.<sup>23</sup> Indeed, the form of CBDC may well dictate how financial inclusion is enhanced since, for example, a CBDC offers the potential for access to a wider array of financial products.

Just as financial inclusion is a long-standing motive of policy makers to expand access to the financial sector, so is the desire to stamp out corruption wherever possible. Corruption is aided and abetted by a lack of transparency. Transparency can be said to be the tailwind favouring the introduction of a CBDC, while corruption is the counterpart acting as a headwind. The presumption is that abuses for financial gain are mitigated if transactions are transparent, especially to supervisors and regulators (see, for example, Rogoff 2017).

---

21 At the risk of some simplification, there are three types of payments systems in place. Bilateral settlement, likely to involve a financial institution, is often used at the retail level. The modern-day clearing house (for example, the Clearing House Interbank Payments System) also operates alongside so-called real-time gross settlement systems. FedNow is the US Federal Reserve's attempt to defer the need for a CBDC, although it is not stated in these terms. (See, for example, Brainard 2020). Federal Reserve Chair Jerome Powell has expressed the Fed's considerable caution about introducing a CBDC. See <https://meetings.imf.org/en/2020/Annual/Schedule/2020/10/19/imf-cross-border-payments-a-vision-for-the-future>.

---

22 A useful indicator of trade and financial globalization is the KOF Globalisation Index published regularly by the KOF Swiss Economic Institute (<https://kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html>).

23 On a global scale, remittances are large and, according to the World Bank, reached a record in 2018. See, for example, World Bank Group (2019).



**Table 1: Tailwinds and Headwinds in CBDC Development**

Tailwinds	Headwinds
Technology and efficiency	Privacy
COVID-19	Blurring of commercial and central banking
Globalization	Cross-border payments
Financial inclusion	Deglobalization
Corruption	Exchange rate regime choice
Preserving financial stability	Preservation of sovereignty
Revising the monetary policy regime	Data management and storage
	Central bank legislation
	Cybersecurity
	Corruption
	Financial sophistication
	Public-private partnership
	Economic and economic policy uncertainty

Source: Author.

Note: Explanation of terms in the main body of the paper.

In central banking, the increase in transparency has been nothing short of dramatic over the past three decades (see, for example, Dincer, Eichengreen and Geraats 2019). Indeed, G20 EMEs (for example, India, Indonesia and South Africa) reached levels of transparency comparable to those in the AEs. The trouble, however, begins when central bank transparency is confronted by levels of corruption. Among the G20, only AEs (for example, Australia, Canada, the euro area, Japan, the United Kingdom and the United States ) are considered among the least corrupt.

We are fast approaching the fifteenth anniversary of the GFC. Yet economic growth worldwide has disappointed, leading to a revival of the decades-old hypothesis of “secular stagnation” (see, for example, Rachel and Summers 2019) in spite of greater digitalization.<sup>24</sup> The belief in a CBDC, combined with technological progress, is leading some to think that digital money may

spur economic growth.<sup>25</sup> The ongoing pandemic has reinforced pressure on central banks to maintain ultra-low interest rates for the foreseeable future, while responsibility for business cycle stabilization is being replaced by fiscal policy as debt levels rise. However, it is too early to tell whether debt levels are becoming unsustainable (see, for example, Eichengreen 2020).<sup>26</sup>

Since it is conceivable that certain forms of CBDC would allow central banks to inject liquidity into every part of the economy electronically and in real time, it is not surprising that a digital currency may conceivably play a role in preventing a future financial crisis. Note, however, that since most central bank reports tend to favour, at present, the narrowest form of CBDC, the role of a digital currency in mitigating financial instability provides, at best, a weak tailwind. As we shall see shortly, headwinds provide a less optimistic assessment of the financial stability motive for a CBDC.

24 Robert Solow’s (1987, 36) quip, namely, that “you can see the computer age everywhere but in the productivity statistics,” is apt here. Solow adds: “What everyone feels to have been a technological revolution...has been accompanied everywhere...by a slowing-down of productivity growth, not by a step up.”

25 Additionally, digitalization may also be accompanied by lower prices (see Anderton et al. 2020; European Central Bank 2020), potentially complicating the task of monetary policy, as discussed below.

26 History (see, for example, Reinhart and Rogoff 2009) does offer ample evidence that high levels of debt are equated with greater risks of financial instability.



Turning to the implications for monetary policy, if the arrival of a CBDC makes it easier to deliver “money” into individuals’ hands faster, this means that the digital equivalent of helicopter money is at hand and, at least in theory, provides a vehicle for the central bank to ensure that inflation remains close to the value it is expected to target. The theory assumes, of course, the possibility that slack in the economy would be reduced because the injection of liquidity would translate quickly in a rise in aggregate demand. Yet, despite ultra-low borrowing rates, and interruptions in global supply chains since the onset of the pandemic, inflation rates show few signs, if any, of rising excessively.

The connection between the introduction of a CBDC and inflation remains largely theoretical since there is no historical record to rely on. Hence, as is the case with the financial stability motive, the tailwinds driving the adoption of a CBDC to enhance the influence of monetary policy in the transmission mechanism are relatively weak. Instead, the headwinds due to the potential loss of central bank autonomy via the blurring of fiscal and monetary policies are potentially stronger, especially if a CBDC helps to create too much inflation that becomes difficult or costly to control.

Next, the author turns to the headwinds that will delay, slow down or impact the form a CBDC takes when it is introduced. Suffice it to say that among the headwinds that will create challenges for a CBDC, the most notable are deglobalization, the fight against corruption, difficulties in finding a balance in private-public partnerships (envisaged for some forms of CBDC) and privacy concerns. Yet the implications for cross-border payments may well be the most problematic. For example, only recently, Tiff Macklem, governor of the Bank of Canada, which is at the forefront of plans to deploy a CBDC, explained that the prospect of a CBDC is shortly to move beyond the trial stage and will be “ready for launch,” prompted by the desire not “to be surprised by some other country” (Sinclair 2020). Nevertheless, his call to ensure that CBDC be managed in a globally coordinated fashion in an era where opposing forces appear to be in the ascendancy raises difficulties that central banks are only beginning to confront (Bank of Canada et al. 2020). Closely related is the constant threat to cybersecurity. Although central banks are keenly aware of the problem, it is unclear whether this will be addressed independently of commercial banks, the financial system or

another element in proposed public-private partnerships. Recent interruptions, for example, in the TARGET2 system in Europe also raise concerns over risks in electronic payments systems.<sup>27</sup>

Governor Macklem’s concerns over cross-border payments are simply a recognition that monetary sovereignty matters. A CBDC is a potential threat because it allows the public to hold financial assets in another currency in digital form that is deemed safer than domestic equivalents. At a time when the concept of fiduciary duty (i.e., acting in the best interests of another party, especially when it is a foreign country) is in retreat, it is conceivable that roadblocks to the spread of digital currencies will increasingly emerge. The fiduciary obligation is even more pressing for select AEs since cross-border digital currency holdings will likely reside in a few internationally accepted currencies (for example, the US dollar, the euro).<sup>28</sup>

Concerns about the potential loss of privacy are also exacerbated thanks to a decline in adherence to the rule of law and a reduction in the public’s trust in government.<sup>29</sup> Trust is critical for money in any form. After all, money is arguably one of the safest assets and, given the ongoing global shortage of safe assets (see, for example, Caballero, Farhi and Gourinchas 2017), a digital form may contribute to raising the demand for a CBDC. Add the desire for safe-haven currencies, especially in uncertain or crisis times, and the cross-border role of a CBDC may become even more salient.

A related concern is the role of exchange rates. A return to competitive depreciations or devaluations is a possibility, and a CBDC enhances considerably the speed with which exchange

27 In late October 2020, an “incident” led to delays in payments settlements. At the time of writing, the suspicion is that the root cause was software-related. See [www.ecb.europa.eu/paym/target/target2/shared/pdf/Communication\\_on\\_TARGET\\_incident\\_20201023\\_update.pdf](http://www.ecb.europa.eu/paym/target/target2/shared/pdf/Communication_on_TARGET_incident_20201023_update.pdf). Software, of course, will also be critical in any CBDC operation.

28 In this connection, it is worth reminding readers of a court case, largely settled in 2011, over whether lenders had recourse to the central bank of Argentina’s (Banco Central de la República Argentina’s [BCRA’s]) foreign exchange reserves held at the Federal Reserve Bank of New York. The argument by the plaintiffs is that since the BCRA was not independent of government, reserves could be used to settle outstanding debts. The US Court of Appeals for the Second Circuit decided that the BCRA was immune to the loss of reserves (Cohen 2011). One can only imagine the new court cases over ownership of financial assets in the digital space.

29 Changes in the World Bank Governance Indicators of the rule of law, as well as the Organisation for Economic Co-operation and Development’s indicator of trust in government, support this interpretation. See <https://info.worldbank.org/governance/wgi/> and [www.oecd.org/gov/trust-in-government.htm](http://www.oecd.org/gov/trust-in-government.htm).

rate changes can impact portfolios made up of many currencies.<sup>30</sup> Beyond the economies whose currencies are used globally, and the potential for a CBDC to displace currencies of smaller or more vulnerable economies, the latter are also at a disadvantage because their financial systems are not as sophisticated. How much of a threat this poses is unclear since the associated headwinds stemming from this factor operate alongside the other forces pushing societies quickly in the direction of a CBDC as well as more traditional or other forms of digital payments. Nevertheless, it is quite certain that countries will resist CBDC if this is seen as another mechanism for large economies to maintain or increase their dominance in the realm of global finance.

Perhaps the most belatedly discussed headwind, with obvious implications for the governance of CBDC, is the management and storage of digital information (Carstens 2021). Central banks underemphasize the challenges (see Group of Thirty 2020; Arner et al. 2020; Kiff et al. 2020; Allen et al. 2020; Bank of England 2020). Using digital forms of payment requires that CBDC-related information be stored. The idea of centralizing such storage raises all sorts of risks, namely, privacy and security. Yet even if data is stored in several locations,<sup>31</sup> the durability of collected information, not to mention ownership of data, may well present very daunting challenges.<sup>32</sup>

Finally, a related but separate issue that has received little attention is the extent to which existing central bank legislation is fit for purpose, that is, whether existing statutes are capable of coping with a CBDC. Accordingly, the author turns to governance matters in the next section.

---

## CBDC: Governance Matters

Central banks do not, of course, operate in a vacuum. In most countries, central bank legislation regulates an institution that must often cooperate or coordinate with other government-controlled institutions to ensure that payments systems operate efficiently; banks and other financial institutions are properly supervised; and deposit insurance schemes are functional, to give a few examples.<sup>33</sup> Other than for a few of the policy recommendations to be made in the next section, the focus in what follows is on central bank legislation. Nevertheless, when it comes to the governance of CBDC, other institutions are highly likely to be implicated once CBDCs are introduced.

To deal with the state of governance in relation to the impact on central bank governance, the author proceeds in two steps. Table 2, inspired by the discussion in the previous section, provides a heat map that considers the influence of 11 different variables on the need, readiness and likelihood of the successful deployment of a CBDC. The premise of the heat map is straightforward. As the previous section makes clear, there are several economic and financial characteristics that favour or prevent the introduction of a CBDC. Some are purely economic in nature, such as the extent to which a country is open financially and in trade terms to the rest of the world, while others are more technological in nature, such as the level of financial sophistication or development attained by an economy. Some of the characteristics discussed in the previous section can even be said to be political in nature, such as corruption and financial inclusion. Typically, these features go hand in hand, that is, several must reach a certain level or threshold before, on balance, conditions are favourable to introducing a CBDC. Therefore, the author has collected data that quantifies as many of the features discussed in Table 1 as practical and calculates, data permitting, the degree to which each of the G20 economies exhibits common features over time. Data was collected for the period 2002–2018. In almost all cases, 2018 was the last year for

---

30 A CBDC makes it easier to impose negative interest rates. While there is no conclusive evidence yet, Allaudeen Hameed and Andrew K. Rose (2017) find little impact of negative interest rates on exchange rate behaviour.

31 If this is done across borders, sovereignty-related questions may also emerge.

32 Storage and durability questions are inspired by similar challenges faced by others. For example, data generated by the European Organization for Nuclear Research is enormous and requires storage and management in a variety of countries. This aspect may well prove difficult in the case of a CBDC. It is also worth pointing out that the life expectancy of existing storage technology is much lower than conventional paper or polymer notes.

---

33 Domenico Lombardi and Pierre L. Siklos (2016), as well as Rochelle M. Edge and J. Nellie Liang (2019), consider the complex governance structures that stem from the growing emphasis on central banks to maintain not only price stability but also financial stability.

**Table 2: Heat Map of Factors Influencing the Introduction of CBDC**

	ARG	AUS	BRA	CAN	CHN	EUR	GBR	IDN	IND	JPN	KOR	MEX	RUS	SAU	TUR	USA	ZAF
Global	0.45	-0.18	0.12	0.32	-0.26	0.44	0.46	0.42	0.21	0.43	0.33	0.38	-0.20	-0.66	0.29	0.39	0.28
ERR									0.02		0.31				0.35	-0.41	0.37
CA	-0.20	0.41	-0.14		-0.30			0.49	-0.31		0.35	0.19	0.43		0.29		-0.18
Crises	0.53					0.22	-0.06	0.49					-0.16			-0.03	
GPR	0.53	0.33	0.21	0.24	0.30	-0.28	-0.11		-0.25	0.26	0.16	0.33	0.36	0.57	0.26	-0.20	-0.25
GOV	-0.33	-0.25	-0.34	-0.30	0.38	-0.43	-0.29	-0.52	0.04	0.40	0.31	-0.34	0.03	-0.28	-0.05	-0.34	-0.38
ND	0.29	-0.12	-0.22	0.42	0.06	-0.22	-0.19	0.26	-0.08	0.12	-0.10	-0.08	-0.21	0.40	-0.29	-0.05	-0.15
INT		0.43	0.43	0.42	0.39	0.44	0.47		0.45	0.42	0.37	0.39	0.43		0.38	0.41	0.38
BRB		0.36	0.43	0.42	0.39	0.44	0.46		0.44	0.41	0.38	0.38	0.42		0.37	0.47	0.37
ATM		0.33	0.05	0.40	0.42	0.25	0.23		0.42	0.18	0.35	0.38	0.43		0.38	0.37	0.38
ADR		0.44	0.46	0.42	0.40		0.41		0.47	0.44	0.37	0.39	0.14		0.36		0.32

Data sources: KOF Globalisation Index (<https://kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html>); for exchange rate regime classification, see Ilzetzki, Reinhart and Rogoff (2019); for capital account openness, see Chinn-Ito Index ([http://web.pdx.edu/~ito/Chinn-Ito\\_website.htm](http://web.pdx.edu/~ito/Chinn-Ito_website.htm)); for financial crises, see Reinhart and Rogoff (2009); Geopolitical Risk Index ([www.matteoiacoviello.com/gpr.htm](http://www.matteoiacoviello.com/gpr.htm)); Worldwide Governance Indicators (<https://info.worldbank.org/governance/wgi/>); and International Disaster Database ([www.emdat.be/](http://www.emdat.be/)).

Notes: The higher the value, the greater the capacity for CBDC; the lower the value, the smaller the capacity for CBDC. Positive values contribute to capacity; negative values detract from capacity. The dark cells with no numerical value mean no data, insufficient data or no variation in data. Shading from grey (negative) to white (positive) is across variables for each country separately. Countries are as follows: Argentina (ARG), Australia (AUS), Brazil (BRA), Canada (CAN), China (CHN), European Union (EUR), United Kingdom (GBR), Indonesia (IDN), India (IND), Japan (JPN), South Korea (KOR), Mexico (MEX), Russia (RUS), Saudi Arabia (SAU), Turkey (TUR), United States (USA) and South Africa (ZAF). Variables are as follows: Global (mean of KOF Trade and Financial Globalization Index, higher number means greater integration); ERR (exchange rate regime [1=peg, 2=managed float, 3=float]); CA (capital account openness, higher number means more open); Crises (frequency of banking and debt crises [domestic and external], higher number means more frequent crises); GPR (geopolitical risk, higher value means greater geopolitical risk); GOV (mean of four World Bank Governance Indicators [control of corruption, government effectiveness, rule of law and regulatory quality], percentile rank is averaged, higher value means better governance); ND (frequency of natural disasters, higher number means more disasters annually); INT (percentage of the population using the internet, higher number means greater usage); BRB (fixed broadband subscriptions per 100 people, higher number means more subscriptions); ATM (number of ATMs per 100,000 population, higher number means more ATMs); and ADR (age dependency ratio [number of people 65 and older as a percentage of working population], higher number means greater dependency). The appendix (Table A2) provides some simple cross-country estimates of the main determinants of the currency-money ratio. The dependency ratio (i.e., an indicator of population aging) and the number of ATMs are significant determinants.

which data was available when this paper was prepared (July 2020 through February 2021).

Stated differently, the aim is to quantify the relative strength of the tailwinds and headwinds on the road toward introducing a CBDC. Equally important, the data can only be suggestive since, in many cases, the relative importance of the effects listed in Table 1 can only be imprecisely quantified.

The characteristics listed in Table 2 are not in order of importance and are for the G20 only.<sup>34</sup> Other than the darkest cells highlighted, indicating that there is either no or insufficient data, the shading is based on mostly data for the 2002–2018 period. The numbers shown inside each cell of the heat map should be read vertically for each country as the author explores for each country the set of common features indicating readiness to introduce a CBDC. The data in each cell represents the relative importance or weight that each one of the characteristics listed in the first column has in evaluating the preconditions for a CBDC.<sup>35</sup> A positive sign improves prospects for a CBDC while a negative sign detracts from it. The colours, ranging from red (positive influence or tailwind) to grey (negative effect or headwind), provide an indication of these effective weights and permit a comparison across the economies considered. For example, in the case of the globalization (“Global”) factor, the European Union, the United Kingdom and Japan are the most open economies and could conceivably benefit, whether through trade, currency holdings or cross-border transactions, from a CBDC.

The role of each variable in Table 2 is as follows.<sup>36</sup> “Global” is an indicator of the average level of financial globalization. Greater financial globalization is likely to be correlated with international acceptance of a particular currency as well as a financial system’s exposure to the global economy. ERR is an indicator of the type of exchange rate regime in place. The more flexible an exchange rate regime, the greater the influence from external shocks. As explained earlier, this may influence the balance between holding domestically generated currency versus a CBDC in the form of an internationally accepted currency. Because there is too little variation in exchange regimes over the sample considered in several G20 economies, it is, for the most part, included for G20 members that are EMEs. For the remaining economies considered, ERR is seen as a factor that is not able to explain the prospect for introducing a CBDC. CA refers to capital account openness. The index used ranges from 0 to 1, with a 1 consistent with full openness and a 0 indicating a capital account entirely closed to external influences. As argued above, a major factor driving the introduction of a CBDC is to facilitate cross-border transactions. The greater the restrictions of cross-border financial flows, the smaller the impact from the introduction of a CBDC, especially from the impact of an internationally accepted currency. “Crises” is a variable that aggregates the incidence of three types of financial crises: banking, domestic debt and external sovereign debt crises. More frequent crises are likely to increase the preference for a CBDC, especially if the public is able to more easily and cheaply hold a stable currency in digital form.

Next, GPR is an indicator of the level of geopolitical risk faced by each economy in the sample. A higher level of exposure to geopolitical risk, that is, an increase in GPR, raises the prospect of a flight to safety. When combined with some of the other factors, such as CA, together with the ease and speed with which holdings of CBDC can change,

34 The European Union is represented by three euro-zone members (France, Germany and Italy). Hence, as far as Table 2 is concerned, the G20 consists of 17 economies but 20 countries.

35 The estimates are based on quantitative proxies used to measure each one of the factors or characteristics thought to impact the ability of each economy to introduce a CBDC. Once the data for each economy is collected, the first principal component is obtained. The first principal component is the linear combination of the characteristics listed in the first column of Table 2 that best fits the data and is a widely used method to summarize variables thought to be related to each other. More technical details are provided in the appendix.

36 At the outset, it is important to underscore the point that the variables described are not entirely independent from each other. For example, an economy that is open to the world may well be simultaneously technologically advanced and achieving high governance, thereby raising the prospect that a digital currency would be an attractive proposition. Similarly, as should be clear from the discussion around Table 1, most countries also experience a mix of economic and institutional conditions, some of which favour a CBDC while others simultaneously detract from the ability to introduce a digital currency; these factors are only imperfectly captured by the data collected. Most of the data sets used to construct Table 2 are annual but a few are available in raw form on a monthly or quarterly basis.

a lower GPR ought to increase the attractiveness of creating a CBDC. GOV averages four elements suggestive of the quality of governance in each country. There is, as far as the author is aware, no comparable indicator of governance quality for central banks alone. Nevertheless, along the following dimensions (namely, government effectiveness, regulatory quality, the rule of law and control of corruption), it is likely that a central bank will be relatively less effective and trustworthy the weaker its governmental institutions are more generally. The indicators range from -2.5 to +2.5, that is, from poorest to best governance. Clearly, the discussion in the previous section suggests that, as the overall quality of governance rises, so will acceptance and, therefore, the success and desirability of any digital currency.

The final set of factors seeks to capture broader societal forces that will impact the prospects for a CBDC. Hence, ND quantifies the incidence of natural disasters. Acceptance and success of a CBDC may well partly be influenced by policy makers' ability to ensure access to digital funds, which could be jeopardized in the event of a natural disaster. Being more prone to natural disasters (earthquakes, volcanic eruptions, hurricanes, floods, forest fires and so forth) will test the resilience and reliability of a digital infrastructure, which are necessary conditions to sustain a CBDC. Including this variable merely tries to capture operational risks to a digital infrastructure. The final four variables (INT, BRB, ATM and ADR) also represent an attempt to evaluate what might influence notional access to digital financial information. As a result, internet usage (INT), broadband subscriptions (BRB), the number of automated teller machines (ATMs) per 100,000 population and the age dependency ratio (ADR) are viewed as relevant proxies. In the case of ATMs, this could reflect resistance to a CBDC or, depending on how these are transformed in future, provide some services that complement a CBDC. In the case of ADR, as described in the previous section, an older population may be more resistant to a CBDC than a younger population.

The results shown in Table 2 suggest that societal forces potentially play an important role in all economies. Indeed, the values provided in each cell suggest that these factors are approximately equally important in each economy. Otherwise, the remaining variables have quite different effects across the G20. For example, it was already noted that financial globalization has its greatest

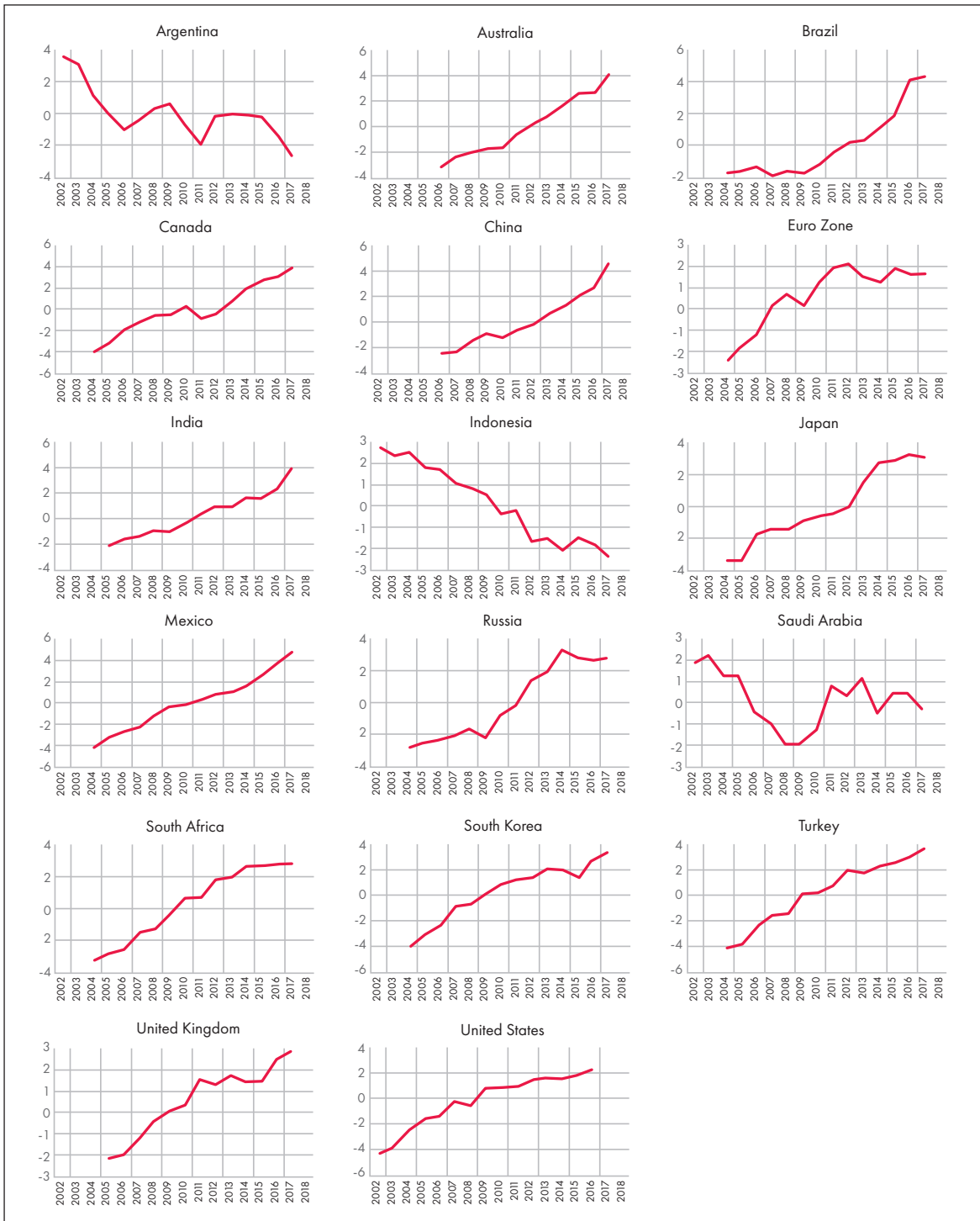
impact on countries whose currencies are held internationally (i.e., the European Union, Japan and the United States). Capital account openness has a negative influence, especially among the EMEs in the sample (i.e., Argentina, China and South Africa), as would be expected. Indeed, whereas China is close to launching a CBDC, its capital account remains relatively closed. Similar restrictions in Argentina and South Africa may also limit acceptance and widespread use of a CBDC in these countries. Where data is available, except for Indonesia, the incidence of financial crises has only a modest impact on the results. GPR generates a relatively large weight on indicators that favour or oppose a CBDC. In countries, at least over the sample considered, where there has been considerable instability (for example, Argentina, Russia and Saudi Arabia), this factor dims the prospect of a CBDC; this also seems to be the case in some AEs whose currencies are used internationally (for example, the European Union, the United Kingdom and the United States), a reflection of the turn of political events in recent years. Notice that these same forces impact China in the opposite direction. The results for GOV are interesting, for they capture the decline in overall governance quality in several AEs. Indeed, we observe improvements in governance in several of the EMEs that are members of the G20 and favour the introduction of a CBDC.

Overall, two of the 11 factors emerge as having a negative influence on the ability to deploy a CBDC across a large number of economies. The two factors are the quality of governance, which is negative in 12 of 17 economies, and the natural disasters variable, also negative in 12 of 17 economies. There is nothing a central bank can do to influence ND except to encourage building up the resilience of a digital currency system. In the case of governance, the focus is likely to be on the legislation governing central bank activities to which the author turns below.

While the results in Table 2 provide an indication of the readiness for a CBDC based on data covering a 15-year period, it is also worthwhile to briefly consider how readiness has changed over time. Accordingly, Figure 3 constructs an index of sorts, based on the combination of characteristics identified in Table 2, such that a rise is akin to greater readiness for adopting a CBDC while a fall suggests otherwise. Only two countries (Indonesia and Saudi Arabia) demonstrate



**Figure 3: Evaluating Preparedness for a CBDC among the G20**



Source: Author.

Notes: Based on the results shown in Table 2, the linear combination of characteristics for each country is converted into a score (normalized). Technical details are relegated to the appendix. Values shown are dependent on the available data. A rise signals better preparedness or improved preconditions; a fall signals the opposite.

reduced capacity over time to accommodate a CBDC. Otherwise, there is a broad upward trend in conditions favourable to a CBDC. Interestingly, China, India and South Korea are notable, since the speed with which CBDC readiness improves rises toward the end of the sample.<sup>37</sup>

Next, Table 3 examines central bank legislation and the extent to which it already facilitates the introduction of a CBDC.<sup>38</sup> If the existing legislation is incapable of handling the various issues raised previously that are impacted by the introduction of a CBDC, then policy makers will clearly have to enact revised legislation in anticipation of introducing a CBDC.

If a cell is filled in Table 3, this provides an indication that the existing legislation favours or permits sufficient flexibility in introducing a CBDC. The most recent version (as of 2018–2020) of central bank legislation was examined to determine whether terms such as *digital* or *digitalization* appear in clauses that explain the role and issuance of circulating notes and coins. As discussed previously, a successful CBDC requires for a central bank a balance of powers that enhances its flexibility to intervene in areas that, historically, it had not anticipated being involved in (for example, widening payments and settlements, deposits beyond ones from commercial banks and government, the issuance of directives) while retaining constraints on its capacity to lend to governments, the private sector and the Bagehot requirement of quality collateral for advances.<sup>39</sup>

The elements of existing legislation examined attempt to capture not only any potential spillovers from a central bank introducing a CBDC into commercial banking but also existing institutional flexibility in dealing with the risks discussed above that are impacted by the digitalization of money. Clearly, the tailwinds and headwinds favouring the creation of a CBDC motivate the focus on certain aspects of existing central bank legislation. Several

elements were considered with potential roles in the legal standing of a CBDC. The first three are, in the case of clearing and payments settlement, whether there is a separate piece of legislation governing them; whether participating in the existing system is flexible; and whether the central bank has the power, for example, via a directive to bring into the fold some institution in the existing system. Next, the author examines elements of central bank legislation for information about the extent to which the institution is permitted to exercise commercial banking powers. In particular, the author was interested in whether there is explicit prohibition on deposits at the central bank by individuals (for example, households or non-banking firms), as well as whether existing legislation is sufficiently flexible to permit the issue of notes in forms other than paper (or polymer).

As discussed previously, one of the potential sources of disruption stemming from a CBDC is the ease with which a central bank can potentially provide liquidity to a much broader segment of the economy. However, this must be balanced against lending too freely and potentially violating the requirement of delivering a stable monetary policy, usually interpreted as requiring a form of price stability. Therefore, the author also examines central bank legislation for language concerning existing limitations or prohibitions on lending. Several dimensions were considered: Are there quantitative limits on lending (for example, percent of GDP, government revenues or some other metric)? Does the legislation specify limitations on the kinds of securities a central bank can deal with? Is there an avenue that potentially permits persons or private institutions to access central bank credit? Next, legislation is examined to determine whether the central bank is able to impose restrictions on interest rates. Statutes that provide information on the kind of collateral a central bank is able to accept are also relevant since they indicate how wide the scope is for borrowing. Admittedly, this element can cut both ways. Nevertheless, even if a CBDC is able to provide a new avenue for the central bank to inject liquidity into an economy, this should not be at the expense of reducing the quality of the collateral against which loans are made as this will threaten trust in the central bank. Finally, central bank laws were examined to determine the scope for central bank action via directives (for example, a directive by the government to ask the central bank to perform a certain function or take a decision, rules for settling policy-related conflicts),

37 Speed is evaluated by the slope of the line plotted in Figure 3.

38 The most recent vintage of central bank legislation for the G20 economies is dated 2019 and text was obtained from the BIS ([www.ebis.org](http://www.ebis.org)). English-language versions of all legislation were consulted. Usual caveats apply, namely, that “official” legislation is not always in English.

39 The Bagehot rule recommends that, in a crisis, a central bank lend freely at good collateral. As James Grant (2019, 293) points out, this rule has more recently been distorted to mean “Lend freely at low rates of interest while materializing immense sums of fiat money with which to raise the prices of financial assets in order to stimulate spending by the people who own the assets.”



**Table 3: Elements of CBDC Governance**

Jurisdiction	Clearing and Settlement	Banking Powers	Limitations on Lending	Overrides and Directives	Explicit Prohibitions	Federations	Bank Assets to GDP (%) <sup>1</sup>	Capital Mobility <sup>2</sup>	Rule of Law <sup>3</sup>
Argentina			Q, B, A, R, C			Yes	21	0.82	-ve↑
Australia	S			O		Yes	140	1	+ve
Brazil	S, F					Yes	105	0.16	+ve↓
Canada	S, F, D		Q, B, A, C	O	I, E	Yes	246	1	+ve
China						No	175	0.16	-ve↑
European Union	F, S	N	C, Q, B		I, E	No	118 (ITA) 113 (FRA) 91 (DEU)	1	N/A
India	S, F	P, N	C, A, B	O	I	Yes	68	0.16	+ve↑
Indonesia		N	C, Q+		I, E	No	38	0.42	-ve↑
Japan		N			I	No	158	1	+ve
Mexico			C, R		I, E	Yes	41	0.70	-ve↓
Russia	F	N	Q, C			Yes	58	0.54	-ve
Saudi Arabia			Q+		E	No	65	0.70	+ve↓
South Africa	F	P	Q, A			No	78	0.16	-ve↓
South Korea		P, N	C, R, A	O	E	No	142	1	+ve↑
Turkey			Q+			No	73	0.16	-ve↓
United Kingdom	S, F				I	No	132	1	+ve↓
United States	S, D		C, R, A		I, E	Yes	62	1	+ve↓

Data sources: BIS, based on 2019 central bank legislation. <sup>1</sup>World Bank Development Indicators (data for 2017–2018).

<sup>2</sup>Chinn-Ito Index (data for 2018), ranging from 0 (no capital mobility) to 1 (perfect capital mobility); see

[http://web.pdx.edu/~ito/Chinn-Ito\\_website.htm](http://web.pdx.edu/~ito/Chinn-Ito_website.htm). <sup>3</sup>World Bank Governance Indicators, ranging from -2.5 to +2.5; “+ve” means the indicator was positive; “-ve” means the indicator was negative in 2018; arrows indicate whether, since 2014, there was a tendency for the indicator to rise (↑), fall (↓) or otherwise remain stable; see <https://info.worldbank.org/governance/wgi/>.

Notes: S (separate legislation); F (flexible participation); D (directive clause); P (accepts deposits from individuals/groups, not included in clearing and settlement); N (issue of notes in form other than paper); Q (quantitative, for example, % GDP, % government revenues); B (types of securities); A (access to central bank credit by persons/institutions); R (restrictions on interest rates); C (collateral limitations); I (ineligibility of persons with conflict of interest); O (override due to differences of opinion about monetary policy); E (specific prohibition, for example, interest on deposits). EU countries are ITA (Italy), FRA (France) and DEU (Germany).

and specific prohibitions not included elsewhere in the legislation (for example, interest setting on deposits at the central bank). Some of these characteristics may impact the form and ability of the central bank to introduce and manage a CBDC.

The author also adds several statutory matters that are relevant for the governance of a CBDC, whose importance was previously discussed, even though they are not explicitly part of any central bank legislation. Governance matters may come into play if the state is organized as a federation as opposed to a unitary state. The latter need not worry about regional differences, for example, in commercial banking or in the political economy consequences of monetary policy decisions with differing regional consequences. Even if a CBDC can, in principle, widen the scope of institutions that are able to offer commercial bank-like functions, the existing size of the banking system will continue to be relevant, since this is an obvious means through which the kind of public-private partnership thought to be necessary for a CBDC will play out. Countries with relatively small banking systems (for example, Argentina, Indonesia and Mexico) may face less pressure to introduce a CBDC, although the threat, both domestic and foreign, from fintech firms may well offset this.<sup>40</sup> In any case, this consideration enhances the need for central bank legislation, in particular, to anticipate the impact of a digital form of money. However, if capital mobility is high, then a CBDC introduced in an economy with an internationally accepted currency will have an impact on domestic portfolios in countries with a small banking system. This condition applies to Argentina and Mexico, and possibly Russia, but less so in a country such as Indonesia.

The capital mobility indicator can provide clues about potential constraints on cross-border transactions, at least according to the data for 2019. Recall that this is an area that has, arguably, attracted a great deal of attention among central banks that have already launched CBDC pilot projects. Notice that while capital mobility is very high in all of the Group of Seven economies and high in some EMEs (for example, Argentina, Mexico and Saudi Arabia), it is much lower among the remaining G20 members. Finally, given major concerns over privacy and data management, the

---

40 Fintech firms offer financial services, in some cases even deposits, relying on digital forms of service delivery. They may or may not be regulated as banks. A recent US example is discussed by Miles Kruppa and Robert Armstrong (2020).

rule of law will likely also play a role. Table 3's last column, therefore, indicates whether, over the period 2014–2018, the level and the trend in the rule of law are favourable (positive change) or not (negative change). While the governance indicators remain positive in the AEs, there are signs of a deterioration in the direction of change in the strength of the rule of law (in the United Kingdom and the United States). On balance, the rule of law is seen as improving in several EMEs (for example, Argentina, China, India and Indonesia); more often than not, levels of the indicator remain negative and distant from levels found in AEs.

Table 3 reveals that while the major industrialized economies have separate pieces of legislation that cover clearing and settlement systems, the vast majority of the remaining G20 members surveyed do not. A few more EMEs do, however, have the flexibility to include greater participation in such systems. Next, it comes as no surprise that few central banks operate under conditions that allow them, as it were, to provide services that might compete directly with ones provided by commercial banks. Moreover, only a handful of central banks appear to have the flexibility to issue notes other than in the traditional means of payment forms (i.e., paper and coins).<sup>41</sup> As the author shall argue in the concluding section, a good practice policy in deploying a CBDC favours maintenance of distance between the functions of central banks and ones provided by commercial banks.

It is not surprising that cells in Table 3 are most likely to be filled because of limitations on central bank lending. This reflects a trend that began in the 1980s and 1990s that culminated in the rise of the autonomous central bank from direct political influence. As part of the bargain, limitations on the ability of government, in particular, as well as of the private sector, to access central bank credit became the norm in central bank legislation around the world.<sup>42</sup> Only a handful of countries have explicit rules concerning overrides for policy differences, which could conceivably include the kind of CBDC deployed. Unless other portions of central bank legislation clarify the

---

41 There is wide variation in central bank statutes devoted to the subject of currency issue. Some (for example, India's) go into great detail about note and coin denominations, while others do not. In principle, once a digital currency is available, defining it in terms of the domestic currency unit (i.e., dollar, pound, euro and so forth) is sufficient, as denominations become less relevant.

42 This is a development first noted by Alex Cukierman (1992).

role and scope of a CBDC policy, differences may well emerge in the future as a source of conflict between the monetary and the fiscal authorities.<sup>43</sup>

There is one element missing from Table 3 because it is ubiquitous in all pieces of central bank legislation around the world, namely, the legal tender provision. This provision provides a quality to notes and coins that commercial forms of money (for example, cheques, deposits) cannot, namely, that it is a form of final payment that must be accepted by all who transact in a particular currency. Of all the reforms needed to bring central bank legislation up to speed in the CBDC era, this is the simplest one to enact. Yet it is also a legal provision that is generally underappreciated (Kyngé and Yu 2021 is an exception). As for the other legal ingredients that must be considered, the sheer variety of political systems in the G20 makes this difficult to judge. However, following a brief but global decline in geopolitical risks in the early 2000s (one of the ingredients in CBDC readiness), the spread of this form of risk has grown substantially in recent years.<sup>44</sup> Hence, even if the challenges in updating central bank legislation for the CBDC era at the individual country level can be overcome, the growing gaps in political risks among the G20 members render international cooperation in the management and operation of CBDC very difficult.

---

## Conclusion: Where Do We Go from Here?

Months and years of preparation, together with a flurry of reports suggesting how and in what forms, but not when, digital currencies will be introduced in several countries, still leave many unanswered questions. The ongoing pandemic is only accelerating forces that will deepen the role and influence of the digital world with as of yet unknown economic implications.

The many tailwinds and headwinds swirling around the deployment of a CBDC, however,

---

43 Siklos (2002), who reviews the international evidence on the role of a directive in central bank legislation and conflicts between the monetary authority and government, argues that such directives can, at times, play a crucial role in the behaviour of a central bank.

44 The appendix provides more details.

provide an opportunity for policy makers to get things right before unintended consequences from the introduction of digital forms of money impact monetary policy, specifically, and economic policy, more generally. A survey of central bank legislation, which represents just one piece of the governance puzzle that policy makers must confront, clearly suggests that, while some of the feared excesses from the uses that a CBDC can be put to are likely exaggerated, too few legal mechanisms are in place to argue that the world is ready for the widespread adoption and use of CBDC. Excesses may result due to worries that central bank autonomy is under threat. This state of affairs is exacerbated because of the blurring of fiscal and monetary policies (see, for example, Marsh 2021). Legal mechanisms are inadequate because the digitalization of money remains incompletely addressed in central bank legislation.

Since central banks will play a key role in managing CBDC, the legislation governing the actions and limitations of the monetary authorities needs to be revisited. Moreover, the international dimension will prove critical, since the desire to improve cross-border payments, a G20 priority, is taking place at a time when the primacy of the US dollar is being debated once again.

First, clearing and settlement systems need to have the flexibility not only to cover traditional financial institutions but also to deal with the emergence of fintech and other types of digital platforms that may offer digital financial services. This is also an imperative for the maintenance of financial stability. As discussed, some models exist among the G20, which can serve as starting points.

Central banks and other reports that discuss CBDC are fond of describing the various forms a CBDC can take, as well as competitive pressures from alternative digital payments mechanisms and technologies (i.e., stablecoins, cryptocurrencies). Central banks are also known to be cautious institutions. Therefore, a CBDC should, in the first instance, serve primarily as a means of payment and to reduce the existing frictions that limit the ability of individuals and firms to transact locally and globally. Legal tender provisions, extended to include CBDC, give central banks an edge over commercial banks in the digitalization of money. The store-of-value function of any digital money should come later, once progress is made to clarify, via proper regulation and supervision, the limitations of a CBDC's use across borders

and that conflict resolution mechanisms are in place domestically to prevent governments from abusing the potential for digital money as a form of fiscal policy. In addition, central banks should investigate the public's views about the value households place on the means-of-payment and store-of-value functions of money. There is little clarity about the aims of CBDC in this connection.

Central banks are not, however, the only ones impacted by the prospect of a CBDC. The storage of data, not to mention mechanisms to ensure the resilience of digital networks to risks of interruption or interference, also argue for a slow approach to exploiting all of the potential uses to which a CBDC can be put. This will require broadening the number of institutions and agencies involved in one way or another in the management of CBDC domestically and globally. Coordination and cooperation problems are bound to arise, and the current political environment around the globe is not conducive to reaching broad agreement on the issues. Perhaps more importantly, central banks must not become embroiled in attempts to collect and manage personal or institutional data that is generated once a CBDC is put in place. While any trade-offs between monetary policy and financial stability can be successfully handled by separate organizations that learn how to cooperate, if not coordinate, it is difficult to argue that a central bank should be responsible for the data generated thanks to a CBDC. This would clearly overburden an institution that is on the front lines in guaranteeing not only price stability but increasingly, and especially since the GFC, financial stability. Therefore, any privacy or related legislation should clearly outline the responsibilities of the central bank in this regard.

Related to data generation are data storage and security. This area is another beyond the remit of any central bank but should be one of concern. Adding to these concerns is the rising tension between the desire to improve digital cross-border payment systems and broaden the possibility that internationally accepted currencies can be held digitally, and the battle over trade in technology between the United States and China, two G20 member economies. This situation can only diminish the ability of these economies to cooperate over CBDC and reflects rising geopolitical tensions.

Needless to say, the foregoing points have implications for the role of the rule of law and other elements that contribute to ensure good

governance. Beyond these issues is the “elephant in the room” that plagues all financial transactions in the digital sphere, that is, how to protect privacy while limiting corrupt activities. *Privacy* and *anonymity* are not synonyms. The former is a desirable part of any open society, while the latter should be defended so long as it does not facilitate illicit activities.<sup>45</sup> Recent experience suggests we are far from developing a small set of worldwide standards. Perhaps different standards ought to be allowed to coexist until a preferred set of benchmarks can emerge.

Finally, even if a CBDC initially is only intended to replace notes and coins, the potential exists for this device to be used to further threaten central bank autonomy, especially if a central bank is directed to intervene by providing additional liquidity via injections of CBDC. In principle, a CBDC brings us close to the world of helicopter money originally envisaged by Friedman (1969).<sup>46</sup> Therefore, the list of limitations on lending by central banks needs to be revisited and the location of accountability for digital interventions by a central bank clearly spelled out.

The bottom line is that the imminent introduction of CBDC highlights, once again, the need for rules-based policies. The current international environment is not a propitious one in which to make such arguments. The digital economy ought to make it easier, at least in theory, to accommodate the reality of a multipolar world. Former Bank of England Governor Mark Carney's (2019) suggestion to create a “synthetic hegemonic currency” as a long-term solution to a transition away from US-dollar dominance may be a good one. However, in the short to medium term, the economic consequences of CBDC will first need to be better understood.

## Acknowledgments

Comments by two anonymous reviewers are gratefully acknowledged.

---

<sup>45</sup> The tension between the two is also reflected in another technical area involving CBDC, that is, the kind of technology used to verify transactions. For example, the distributed ledger approach used in cryptocurrencies such as bitcoin is intended to ensure that anonymity is maintained. Blockchain is a type of distributed ledger where transactions can be verified using encryption or digital wallets. The benefits of these systems, however, is that they are also a means to prevent falsifying transactions. Generally, central banks have spoken in favour of the blockchain approach.

<sup>46</sup> James Kynge and Sun Yu (2021) provide an indication that during the 2021 Chinese Lunar New Year, some government jurisdictions in China provided e-money in this form as a gift to many individuals.

---

## Works Cited

- Alderman, Liz. 2018. "Sweden's Push to Get Rid of Cash Has Some Saying, 'Not So Fast.'" *The New York Times*, November 21.
- Allen, Sarah, Srđjan Ćapkun, Ittay Eyal, Giulia Fanti, Bryan A. Ford, James Grimmelmann, Ari Juels, Kari Kostianen, Sarah Meiklejohn, Andrew Miller, Eswar Prasad, Karl Wüst and Fan Zhang. 2020. "Design Choices for Central Bank Digital Currency: Policy and Technical Considerations." National Bureau of Economic Research Working Paper 27634, August.
- Amamiya, Masayoshi. 2019. "Should the Bank of Japan Issue a Digital Currency?" Reuters Newsmaker Event speech, Bank of Japan, Tokyo, Japan, July 5.
- Anderton, Robert, Valerie Jarvis, Vincent Labhard, Julian Morgan, Filippos Petroulakis and Lara Vivian. 2020. "Virtually everywhere? Digitalisation and the euro area and EU economies." Occasional Paper No. 244. Frankfurt, Germany: European Central Bank.
- Arauz, Andrés. 2019. "The data of money." Amsterdam, the Netherlands: Transnational Institute. January 28. [www.tni.org/en/publication/the-data-of-money](http://www.tni.org/en/publication/the-data-of-money).
- Arner, Douglas W., Ross P. Buckley, Dirk A. Zetsche and Anton N. Didenko. 2020. "After Libra, Digital Yuan and COVID-19: Central Bank Digital Currencies and the New World of Money and Payment Systems." European Banking Institute Working Paper No. 65.
- Ashworth, Jonathan and Charles A. E. Goodhart. 2020. "The Surprising Recovery of Currency Usage." *International Journal of Central Banking* 16 (3): 239–77.
- Auer, Raphael, Giulio Cornelli and Jon Frost. 2020. "Rise of the central bank digital currencies: drivers, approaches and technologies." BIS Working Paper No. 880. Basel, Switzerland: BIS.
- Bank of Canada. 2020. "Update: Bank of Canada asks retailers to continue accepting cash." Press release, May 28.
- Bank of Canada, European Central Bank, Bank of Japan, Sveriges Riksbank, Swiss National Bank, Bank of England, Board of Governors of the Federal Reserve System and BIS. 2020. *Central bank digital currencies: foundational principles and core features*. Report No. 1. Basel, Switzerland: BIS.
- Bank of England. 2020. "Central Bank Digital Currency: opportunities, challenges and design." Discussion Paper, March. London, UK: Bank of England.
- Barajas, Adolfo, Thorsten Beck, Mohammed Belhaj and Sami Ben Naceur. 2020. "Financial Inclusion: What Have We Learned So Far? What Do We Have to Learn?" IMF Working Paper No. 20/157. Washington, DC: IMF.
- Bindseil, Ulrich. 2020. "Tiered CBDC and the financial system." Frankfurt, Germany: European Central Bank. Working Paper No. 2351.
- BIS. 2020. "III. Central banks and payments in the digital era." In *Annual Economic Report 2020*, 67–95. Basel, Switzerland: BIS.
- Boar, Codruta, Henry Holden and Amber Wadsworth. 2020. "Impending arrival — a sequel to the survey on central bank digital currency." BIS Paper No. 107. Basel, Switzerland: BIS.
- Brainard, Lael. 2020. "The future of retail payments in the United States." Remarks at the FedNow Service Webinar, Washington, DC, August 6.
- Caballero, Ricardo J., Emmanuel Farhi and Pierre-Olivier Gourinchas. 2017. "The Safe Assets Shortage Conundrum." *Journal of Economic Perspectives* 31 (3): 29–46.
- Carney, Mark. 2019. "The growing challenges for monetary policy in the current international monetary and financial system." Challenges for Monetary Policy speech, Symposium of the Federal Reserve Bank of Kansas City, Jackson Hole, WY, August 23.
- Carstens, Agustín. 2021. "Digital currencies and the future of the monetary system." Remarks at the Hoover Institution Policy Seminar, Basel, Switzerland, January 27. [www.bis.org/speeches/sp210127.pdf](http://www.bis.org/speeches/sp210127.pdf).
- Chen, Heng, Walter Engert, Kim P. Huynh, Gradon Nicholls, Mitchell Nicholson and Julia Zhu. 2020. "Cash and COVID-19: The impact of the pandemic on demand for and use of cash." Ottawa, ON: Bank of Canada. Staff Discussion Paper 2020-6.
- Chen, Hongyi and Pierre L. Siklos. 2021. "Central Bank Digital Currency: Some Macro-Financial Implications." Hong Kong Institute for Monetary and Financial Research Working Paper 05/2021, March.
- Cohen, H. Rodgin. 2011. "Court Rules Argentine Central Bank Reserves Immune." Harvard Law School Forum on Corporate Governance, August 3. <https://corpgov.law.harvard.edu/2011/08/03/court-rules-argentine-central-bank-reserves-immune/>.
- Cukierman, Alex. 1992. *Central Bank Strategy, Credibility, and Independence*. Cambridge, MA: The MIT Press.
- Demir, Ender and Oguz Ersan. 2017. "Economic policy uncertainty and cash holdings: evidence from BRIC countries." *Emerging Markets Review* 33: 189–200.



- Dincer, Nergiz, Barry Eichengreen and Petra Geraats. 2019. "Transparency of Monetary Policy in the Postcrisis World." In *The Oxford Handbook of the Economics of Central Banking*, edited by David G. Mayes, Pierre L. Siklos and Jan-Egbert Sturm, 287–333. Oxford, UK: Oxford University Press.
- Edge, Rochelle M. and J. Nellie Liang. 2019. "New Financial Stability Governance Structures and Central Banks." Hutchins Center Working Paper No. 50, February 21. Washington, DC: Brookings Institution.
- Eichengreen, Barry. 2020. "Managing the Coming Global Debt Crisis." Project Syndicate, May 13.
- European Central Bank. 2020. *Report on a digital euro*. Frankfurt, Germany: European Central Bank.
- Financial Stability Board. 2020. *Enhancing Cross-border Payments: Stage 3 roadmap*. Basel, Switzerland: Financial Stability Board.
- Finlay, Richard and Anny Francis. 2019. "A Brief History of Currency Counterfeiting." *Reserve Bank of Australia Bulletin* (September): 10–19.
- Friedman, Milton. 1969. *The Optimum Quantity of Money and Other Essays*. Chicago, IL: Aldine.
- Goodhart, Charles and Manoj Pradhan. 2020. *The Great Demographic Reversal: Ageing Societies, Waning Inequality, and an Inflation Revival*. London, UK: Palgrave Macmillan.
- Grant, James. 2019. *Bagehot: The Life and Times of the Greatest Victorian*. New York, NY: W. W. Norton.
- Group of Thirty. 2020. *Digital Currencies and Stablecoins: Risks, Opportunities, and Challenges Ahead*. Washington, DC: Group of Thirty.
- Hameed, Allaudeen and Andrew K. Rose. 2017. "Exchange Rate Behavior with Negative Interest Rates: Some Early Negative Observations." Tokyo, Japan: Asian Development Bank Institute. Working Paper No. 699.
- Izetzki, Ethan, Carmen M. Reinhart and Kenneth S. Rogoff. 2019. "Exchange Arrangements Entering the Twenty-First Century: Which Anchor will Hold?" *The Quarterly Journal of Economics* 134 (2): 599–646.
- IMF. 2016. *Monetary and Financial Statistics Manual and Compilation Guide*. Washington, DC: IMF.
- . 2020. *Digital Money Across Borders: Macro-Financial Implications*. Washington, DC: IMF. IMF Policy Paper No. 2020/050.
- Irwin, Douglas. 2020. "The pandemic adds momentum to the deglobalisation trend." VoxEU, May 5. <https://voxeu.org/article/pandemic-adds-momentum-deglobalisation-trend>.
- Kiff, John, Jihad Alwazir, Sonja Davidovic, Aquiles Farias, Ashraf Khan, Tanai Khiaonarong, Majid Malaika, Hunter K. Monroe, Nobu Sugimoto, Hervé Tourpe and Peter Zhou. 2020. "A Survey of Research on Retail Central Bank Digital Currency." Washington, DC: IMF. IMF Working Paper No. 20/104.
- Kruppa, Miles and Robert Armstrong. 2020. "Fintechs take on banks at their own game." *Financial Times*, November 2. [www.ft.com/content/0e8033e3-f633-4dc8-8a6a-f12f847eb399](http://www.ft.com/content/0e8033e3-f633-4dc8-8a6a-f12f847eb399).
- Kynge, James and Sun Yu. 2021. "Virtual control: the agenda behind China's new digital currency." *Financial Times*, February 17. [www.ft.com/content/7511809e-827e-4526-81ad-ae83f405f623](http://www.ft.com/content/7511809e-827e-4526-81ad-ae83f405f623).
- Licandro, Gerardo. 2018. "Uruguayan e-Peso on the context of financial inclusion." Presentation given at the BIS, Basel, Switzerland, November 16.
- Lombardi, Domenico and Pierre L. Siklos. 2016. "Benchmarking macroprudential policies: An initial assessment." *Journal of Financial Stability* 27: 35–49.
- Marsh, David. 2021. "Threats to central bank independence." Official Monetary and Financial Institutions Forum, February 1. [www.omfif.org/2021/02/in-the-line-of-fire/](http://www.omfif.org/2021/02/in-the-line-of-fire/).
- Meaning, Jack, Ben Dyson, James Barker and Emily Clayton. 2018. "Broadening narrow money: monetary policy with a central bank digital currency." London, UK: Bank of England. Staff Working Paper No. 724.
- Rachel, Lukasz and Lawrence H. Summers. 2019. "On Secular Stagnation in the Industrialized World." *Brookings Papers on Economic Activity* (Spring): 1–54.
- . 2011. *This Time Is Different: Eight Centuries of Financial Folly*. Princeton, NJ: Princeton University Press.
- Rogoff, Kenneth S. 2017. *The Curse of Cash: How Large-Denomination Bills Aid Crime and Tax Evasion and Constrain Monetary Policy*. Princeton, NJ: Princeton University Press.
- Siklos, Pierre L. 2002. *The Changing Face of Central Banking: Evolutionary Trends Since World War II*. Cambridge, UK: Cambridge University Press.
- . 2006. *Money, Banking, and Financial Institutions: Canada in the Global Environment*. Fifth edition. Toronto, ON: McGraw-Hill-Ryerson.

Sinclair, Sebastian. 2020. "Bank of Canada Governor Says Digital Dollar Project Moving Past Trial Stage." *Coindesk*, October 29. [www.coindesk.com/bank-of-canada-governor-says-digital-dollar-project-moving-past-trial-stage](http://www.coindesk.com/bank-of-canada-governor-says-digital-dollar-project-moving-past-trial-stage).

Solow, Robert M. 1987. "We'd Better Watch Out." *The New York Times Book Review*, July 12, 36.

Warzel, Charlie and Stuart Andrew Thompson. 2019. "How Your Phone Betrays Democracy." *The New York Times*, December 21. [www.nytimes.com/interactive/2019/12/21/opinion/location-data-democracy-protests.html?action=click&module=Opinion&pgtype=Homepage](http://www.nytimes.com/interactive/2019/12/21/opinion/location-data-democracy-protests.html?action=click&module=Opinion&pgtype=Homepage).

World Bank Group. 2019. *Migration and Remittances: Recent Developments and Outlook*. Migration and Development Brief 31, April. Washington, DC: World Bank.



# Appendix

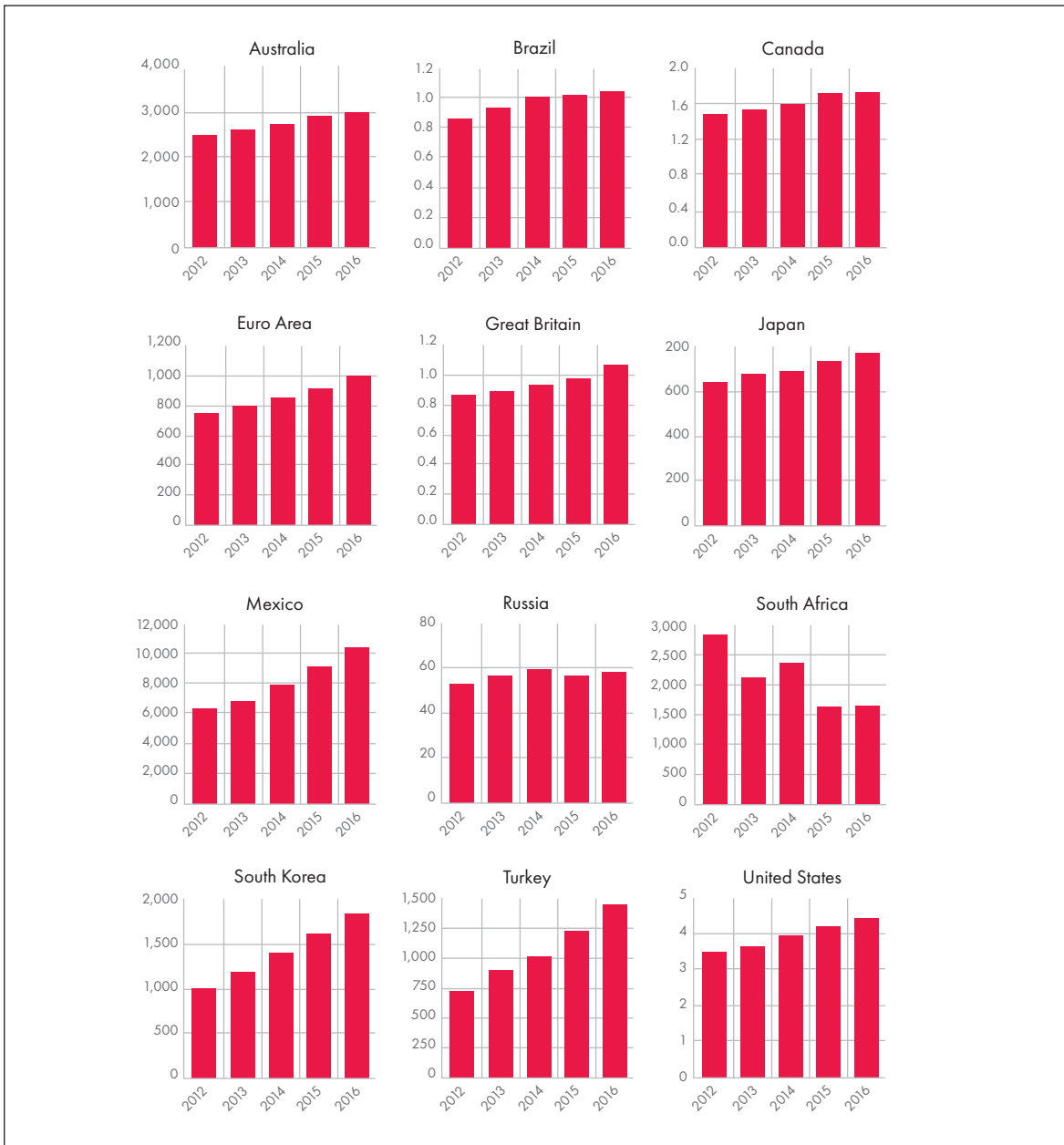
**Table A1: Definitions of Large and Small Denominations in Select G20 Economies**

Country/ Currency Code	Large Denominations	Small Denominations
AUD	10*, 20*, 100	5
BRL	20, 50, 100	2, 5, 10
CAD	50, 100, 1000	5, 10, 20
EUR	100, 200, 500	5, 10, 20
GBP	10*, 20*, 50	5
INR	500, 1000, 2000	1, 2, 10
JPY	2000*, 5000*, 10000	1000
KRW	5000*, 10000*, 50000	1000
MXN	200, 500, 1000	10, 20, 50
RUR	500, 1000, 5000	5, 10, 50
TRY	50, 100, 200	5, 10, 20
USD	20, 50, 100	1, 5, 10
ZAR	50*, 100, 200	10, 20

Source: Author.

Notes: \*Indicates overlap between the definitions of large and small denominations. The first two letters indicate the country name (for example, MX is Mexico) using the International Organization for Standardization (ISO) convention. The last letter represents the name of the currency (for example, “R” represents Indian rupee and Russian ruble). Country/currency codes are as follows: AUD (Australia/Australian dollar); BRL (Brazil/real); CAD (Canada/Canadian dollar); EUR (European Union/euro); GBP (United Kingdom/British pound); INR (India/rupee); JPY (Japan/yen); KRW (South Korea/won); MXN (Mexico/peso); RUR (Russia/ruble); TRY (Turkey/lira); USD (United States/US dollar); and ZAR (South Africa/rand).

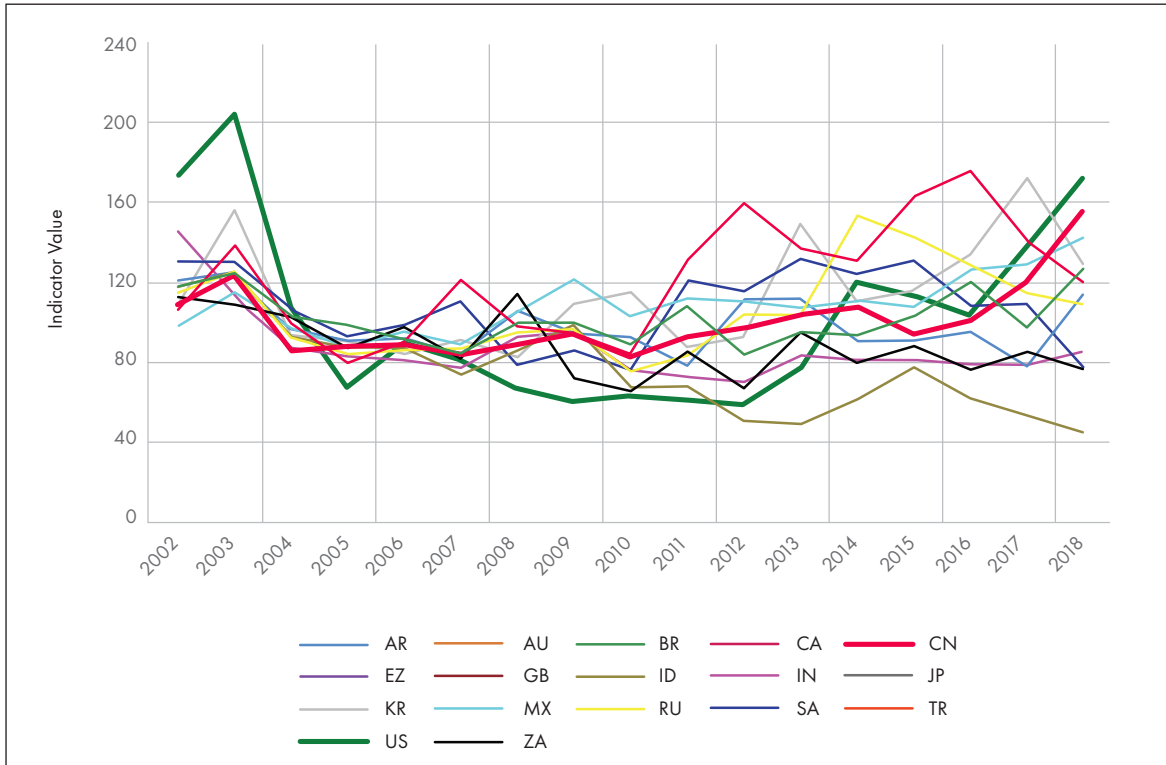
**Figure A1: Value of Large-Denomination Notes Held in 12 G20 Economies**



*Data source:* Data is from successive Red Book statistics from the Committee on Payments and Market Infrastructures ([www.bis.org/statistics/payment\\_stats.htm?m=6%7C36](http://www.bis.org/statistics/payment_stats.htm?m=6%7C36)).

*Notes:* Graphs represent value in domestic currency unit divided by population. Precise definition of what constitutes large denominations is relegated to the appendix.

**Figure A2: The Evolution of Geopolitical Risks across the G20 (2002–2018)**



Data source: Geopolitical Risk Index ([www.matteoiacoviello.com/gpr.htm](http://www.matteoiacoviello.com/gpr.htm)).

Notes: The higher the value, the greater the geopolitical risks. Countries are identified by their two-letter ISO codes as follows: AR (Argentina); AU (Australia); BR (Brazil); CA (Canada); CN (China); EZ (Czech Republic); GB (United Kingdom); ID (Indonesia); IN (India); JP (Japan); KR (South Korea); MX (Mexico); RU (Russia); SA (Saudi Arabia); TR (Turkey); US (United States); and ZA (South Africa).

**Table A2: Select Determinants of the Currency-to-Money Ratio in the G20**

Dependent variable: currency-to-money ratio

Sample (adjusted): 2004–2018

Included observations: 15 after adjustments

Cross-sections included: 12

Total pool (unbalanced) observations: 157

Variable	Coefficient	Standard Error	t-Statistic	Probability Value
Internet	0.03	0.06	0.50	0.62
Broadband	-0.10	0.14	-0.70	0.49
Dependency Ratio	1.35	0.09	14.31	<b>0.00</b>
ATMs	0.04	0.01	2.87	<b>0.00</b>
AEs	-31.21	2.07	-15.06	<b>0.00</b>
<i>Adj. R</i> <sup>2</sup> 0.55				

Data source: Author.

Note: Estimated via panel least squares.

## Factor Models and Principal Components: An Explanation

An empirical challenge is that there are several variables containing relevant information of interest, but there is no single index or variable that captures their common features. The premise of factor models and principal components analysis is that the common dynamics of a large number of time series variables stem from a relatively small number of unobserved (or latent) factors, which in turn evolve over time (for more details about the model, see Stock and Watson 2011; 2016). The dynamic factor model can be specified as follows:

$$X_t = \delta_t(L)f_t + \varepsilon_t \dots (1)$$

where  $X_t$  is a vector of observable time series variables that are explained by a vector of latent dynamic factors  $f_t$  with  $\delta_t(L)$  representing the dynamic factor loadings. Although there are potentially several linear combinations that can explain the variability of  $X$  over time, the first principal component explains more than 50 percent of the variation. Hence, a single common factor can be estimated non-parametrically using the principal components analysis and is the one reported in Table 2 of the paper. The factor loadings (i.e., the  $\delta_t(L)$  in equation (1)) can be interpreted as providing an indication of the relative importance of each one of the variables contained in the vector  $X$ .

The variables listed in the first column of Table 2 (i.e., Global, ERR and so on) represent the vector  $X$ . The numerical values in the individual cells represent the factor loadings with the sign dictating the colours in the heat map. Because the underlying series in the vector used to estimate the factor loadings have different variances, the estimates given in Table 2 are normalized.

Finally, the linear combination of the factors is used to generate scores, that is, a version of the original data (i.e.,  $X_t$ ), which represents the (normalized) linear combination with the weights given by the estimated factor loadings. As a result, an estimate over time of these linear combinations (i.e., scores) provides a proxy indicator in the present context of the progress in preconditions required for the adoption of a CBDC.

## Works Cited

- Stock, James H. and Mark W. Watson. 2011. "Dynamic Factor Models." In *The Oxford Handbook of Economic Forecasting*, edited by Michael P. Clements and David F. Hendry. Oxford, UK: Oxford University Press.
- . 2016. "Factor Models and Structural Vector Autoregressions in Macroeconomics." In *Handbook of Macroeconomics*, edited by John B. Taylor and Harald Uhlig. Amsterdam, the Netherlands: Elsevier.



---

**Centre for International  
Governance Innovation**

67 Erb Street West  
Waterloo, ON, Canada N2L 6C2  
[www.cigionline.org](http://www.cigionline.org)

 @cigionline

