Digital Money and Central Bank Operations

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ABSTRACT: The rise of new and proposed monetary vehicles, including CBDC, stablecoins, payment service providers etc., are unprecedented. An important question for central banks is the extent to which these innovations upend the role of and implementation of monetary policy. The paper focuses on the interest rate channel and if digital money (especially CBDC) will change monetary policy and central bank operations. We argue that new policy instruments make sense only to the extent that there is limited substitutability between the various payment sectors. We analyze trends in currency-in-circulation, and how it may impact central bank's seigniorage, monetary base, and transactional velocity of digital money if money demand declines. Liquidity outside the monetary base will also be important to understand.

Digital Money and Central Bank Operations

Prepared by Charles Kahn, Manmohan Singh, and Jihad Alwazir[1]

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Introduction

The rise of new and proposed monetary vehicles, including central bank digital currency (CBDC), stablecoins, payment service providers (e.g., mobile network operators), etc., means an unprecedented change in the retail and wholesale payments system. At the same time, central banks and infrastructure providers are examining new ways to facilitate transfer of value across wholesale payments platforms. An important question for central banks is the extent to which these innovations upend the role of and implementation of monetary policy.

On the one hand, it can be argued that while the changes the monetary systems are undergoing are rapid, they are no more extensive than changes seen in the past: the rise of card-based payments at the retail level, netting systems and new cross-border systems at the wholesale level—all of which were taken in stride by the departments in the central banks responsible for monetary policy implementation. On the other hand, several observers and commentators have argued that the speed of the change, the ability of technology to effect rapid, possibly uncontrolled transmission from one payments arrangement to another, and the increased attractiveness of new non-bank, and non-regulated structures mean that central banks must take account the extra stress on their systems,[1] and indeed the threat of irrelevance. Coupled with this threat is a potential opportunity, noted by other commentators: the addition of new monetary instruments may enable the central bank to operate on additional dimensions, opening up new avenues for more targeted policy responses, through adjustment of multiple interest rates or monetary aggregates.

This paper attempts to start to untangle this puzzle, examining the effect on monetary policy implementation of the introduction of CBDCs and of bank and nonbank stablecoins into an economy (Quarles, 2021; Carney, 2021). The significance of the advent of alternative payment arrangements differs depending on whether the monetary authority is conducting a traditional policy intended to affect overall real interest rates, or a quantitative easing or tightening, focused on altering the differential between returns on two different categories of assets, for example maturity premia, risk premia, or liquidity premia. It also differs depending on whether the authority implements its policy by targeting nominal interest rates or by targeting monetary aggregates. We take the perspective in this paper that controlling relevant interest rates is the macroeconomic goal of the monetary authority, and that monetary aggregates are used as a target by an authority that finds interest rates are difficult to observe or directly control on a timely basis.

In addition, a central bank has other goals besides reaching a macroeconomic target. New payment systems can be sources of financial instability and so it may be appropriate to have policies which focus on these risks. Different forms of new money will yield different seigniorage revenues; if these revenues are an important part of the central bank's mandate, it may need to establish policies that tilt the mixture of payment arrangements chosen in the economy. There are many different implications for central bank operations from the introduction of digital money; the paper will focus on three questions: (i) Can digital money affect the interest rate channel?; (ii) Would it require a new instrument for the central bank?; and (iii) What are the implications for currency-in-circulation, monetary base and seigniorage?

The paper is outlined as follows: Section I describes key features of the existing and new types of payments arrangements we consider. Section II focuses on the interest rate channel and whether digital money will change monetary policy and central bank operations (with a focus on CBDC). It also suggests the need to

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[1] For example, Gorton and Zhang (2021) argue that, while there is nothing new about privately provided money, stablecoins create systemic risks that should be addressed by regulation and CBDC issuance.

redefine monetary aggregates to take into account new payment assets. Section III focuses on other central bank goals. It argues that new instruments make sense to the extent that there is limited substitutability between the various payment sectors, both on the demand side of customers for the instruments, and on the provision side. Section IV centers on currency-in-circulation (CiC) trends globally, and how it may impact central bank operations such as seigniorage, transactional velocity of digital money, and sterilization, including parallels between CiC and CBDC.

Many of the issues that arise from the introduction of non-bank providers of payments assets are already present in countries with large penetration of e-money. Section V focuses on a sub-set of digital money: e-money and payment service providers (PSP) such as mobile network operators (MNOs), and how liquidity outside the monetary base may be important to understand, including decline in money demand and other money metrics such as M2. Section VI concludes that we will need a better understanding how the elasticities of their demand of the new digital technology compare with the elasticities of the demand for the existing methods of payment.

I. Payments Assets, Old and New

Proposed and actual innovations in payments are arriving at a mind-boggling rate. To understand the different implications, we need to provide our own typology (for different typologies, see Adrian and Mancini-Griffoli, 2021; Carstens, 2021, McLaughlin, 2022, Bech and Garratt, 2017). For the most part, existing money comes in two varieties: debt of a central bank, used by individuals in the form of physical currency, and bank money—that is, debt of commercial banks in a form acceptable for payments. Central bank money is fiat currency, issued by the central bank essentially without cost. Commercial bank money promises redemption in central bank debt. Commercial bank money is backed by reserves of central bank debt, by regulatory structures assuring the safety and soundness of the issuing commercial bank, and by deposit insurance and central bank lender-of-last-resort facilities.

Since money is useful for payments it commands a liquidity premium. Thus, issuers of it can reap profits by providing it to agents in the economy who desire it for payments purposes. When provided by the central bank, the profits are "seigniorage": the central bank trades its monetary asset for non-monetary assets (for example Treasury bonds) and profits from the difference between the interest payable on the bonds and the interest cost it pays (typically zero) on the monetary asset. [2] Similarly, a commercial bank profits from the spread between the interest it receives on the loans it makes, and the lower interest it pays to individuals who hold transactions deposits for payments purposes, net of the costs of any reserves it is necessary carry as backing for the deposits. The mix of cash and demand deposits that the public prefers to hold depends on the convenience and relative cost of each.

We consider two basic types of monetary innovations: (i) central bank digital currency (CBDC); and (ii) bank electronic money and fintech-issued electronic money. In each case we only consider moneys whose rate of exchange with existing money is intended to be "fixed."[3] The primary difference in types of innovations we consider is in the nature of the guarantee of fixed redemption. The guarantee for CBDC comes from the fact

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[2] Seigniorage is (and has been) an integral part of non-AE. Central banks send a check to their Ministry of Finance as part of the MoF budget. See Reserve Bank of India speech: https://www.rbi.org.in/Scripts/BS_SpeechesView.aspx?Id=1111.

[3] Realistically speaking only assets denominated in the prevailing unit of account are serious contenders for use as mainstream payments assets.

that the central bank can issue whatever currency it needs to redeem CBDC. The redemption guarantee for the other forms of money depends on the nature and extent of the backing the issuing entity holds: electronic money may be backed wholly or fractionally, and the backing asset may be central bank reserves or short-term government assets. The liabilities may be liabilities of the payment institution, backed by the assets of the institution as a whole, or the backing assets may be ring fenced; for example, held by the issuing authority in custody for the holders of the electronic money, protected from any bankruptcy risk of the institution (see Box 1 and Box 2).

Box 1. Types of Central Bank Digital Currency

A variety of arguments have been made as to why central banks might wish to issue CBDC, among them, financial inclusion, spurring retail payments innovation by slow moving financial institutions, simplifying wholesale and international payments, breaking the zero-nominal interest rate lower bound in monetary policy, and protecting central banks from irrelevancy. Corresponding to this variety of justifications, there has been a variety of design proposals, suggesting CBDCs at the retail level and at the wholesale level; CBDCs implemented through accounts at the central bank, or through wallets maintained by intermediate institutions, CBDCs which are non-interest bearing or interest bearing (or possibly negative interest bearing), and CBDCs with restrictions on the amounts a user can accumulate or with additional functionality for use in smart contracts.[1] Each variation would potentially put its own wrinkle on monetary policy (Sanches and Keister, 2021; Kahn et al., 2020; Adrain and Mancini-Grifolli, 2019).

In this paper we focus on a set of features we regard as the most relevant case, a non-interest bearing asset issued by the central bank, useful for payments purposes and acting as a substitute for CiC, and freely redeemable in CiC (although authorized firms will probably handle customer service for administering the electronic wallets in which CBDC is stored).[2] To the extent that the CBDC is an improved means of payment over CiC, interest would be unnecessary for its acceptance. At the retail level, an interest-bearing CBDC is most easily thought of as a savings vehicle substituting for time deposits and the like, and its economic effect would be comparable, for example, to an expansion of a program for issuing retail government savings bonds. At the wholesale level, an interest bearing CBDC would quickly replace other forms of central bank reserves. For central banks, moving from being a net recipient of interest from the rest of the economy to a net payer of interest to the rest of the economy would be a dramatic shift, one that no central bank would willingly contemplate.

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1/ See for example the recent speech by Brainard (2022) in which she highlights "*design features that could be introduced to limit such risks, such as offering a non-interest bearing CBDC and limiting the amount of CBDC an end user could hold or transfer.*" Brainard also notes that "*such that financial intermediaries rather than the Federal Reserve interface directly with consumer.*" (See also Box 2 on Stablecoins.)

2/ Some have considered the possibility of an interest bearing CBDC; for example, CBDC may remunerate retail in the same vein as deposits at a bank. Also, inter-bank market settle in central bank money or "reserves"; however, excess reserves and paying interest on excess reserves (IOER) is only a recent post-Lehman phenomenon. This paper is not about QE related excess reserves, which is a paper in itself (e.g., should wholesale CBDC be remunerated at policy rate, or at excess reserve rate, or at zero rate like CiC, etc.)

3/ If policy rate in a country is 12 percent, remunerating the *stock* of CBDC at 12 percent (and not just the *flow*), may likely result in negative seigniorage—unless required reserves from the banking system are relatively large. This will be a significant change from CiC that generates positive seigniorage.

Box 2. Stablecoins are Money if Backed by Central Bank Reserves

Stablecoins are sometimes dismissed as the poor relations of the cryptocurrency family. Think of them like government money market funds that are anchored at a par value of $1, versus stocks whose prices can swing around wildly. Stablecoins are designed to be a medium of exchange, rather than a speculative asset. And, despite their apparent stability, they may pose bigger challenge for policymakers than their freewheeling crypto-cousins. The market for stablecoins backed by high quality liquid assets is around $180 billion and sizable growth is expected for US dollar backed coins. To maintain a stable value, issuers need to back the coins with a riskless asset, such as short-term US Treasury obligations. This introduces into the economy a privately established dollar-denominated currency that is not backed by reserves at the US central bank. Their appearance on the scene requires a rethink of the basics of monetary policy—a rethink so fundamental that it is useful to go back to the foundations of monetary policy, and rework from there.

The traditional understanding of monetary policy was based on the idea that the money supply was influenced by the central bank's open market operations (OMOs). Most money was bank account money—deposits at banks—after all. Central banks require that deposits be partially backed by central bank reserves, they tended to be a multiple of those reserves; in this model, US Treasury bonds, while a safe and interest-bearing, cannot be used to back bank accounts. So, when the Fed carried out OMOs, trading its reserves for Treasuries, it changed the amount of reserves available to banks and thus altered the money supply. One consequence of stablecoins becoming available as money is that the money supply no longer needs to be backed by reserves only—Treasuries work just as well. Thus, the central bank's ability to influence the money supply through OMOs will be reduced as stablecoins grow.

Reserves will continue to be in demand in the banking system. The crucial difference between reserves and safe collateral is not their safety (both are safe) but their liquidity. For some purposes—specifically for instantaneous transmission over large value payments systems in order to meet obligations—reserves are useful, and Treasuries are not. However, this need for reserves does potentially have knock-on effects as the bank must be able to provide payment services to any customer with a demand deposit. To the extent that the rest of the economy depends on banks to make payments for them, the banking system will need reserve balances (Singh, Kahn, Long, 2021).

But, as the stablecoin business grows sizably, the demand for Treasuries, or Bunds or JGBs will grow as well. Central banks have no means of directly meeting this demand through standard monetary policy. An alternative would be to allow—or even encourage—stablecoin issuers to use reserves as backing rather than Treasuries (Singh et al, 2021). Nonbank stablecoin issuers would likely favor direct access to reserves through Fed master account and access to central bank payment rails, as this would be preferable to siloing caches of Treasuries or obtaining reserves through a correspondent bank (i.e., very unlike Tether). Should circumstances warrant, reserves are more plentiful in the post QE and post COVID era than good collateral (e.g., Eurozone).

At one extreme are stablecoins whose backing is central bank reserves or ring-fenced deposits of a banking system; at the other extreme are some "e-moneys" issued by companies and backed primarily by the reputation of the company itself (as is the case with PSP or MNOs in some jurisdictions—see Section V).

II. Interest Rate Channel

The most basic route for macroeconomic effects of monetary policy is the interest rate channel.[4] By altering, for example, the interest rate on government bonds, macroeconomic policy alters the level of investment in the economy, thereby adjusting the levels of economic activity and inflation. While the introduction of new means of payment can themselves have effects on economic activity, these are unlikely to be of first-order importance or sufficiently rapid to pose a significant effect on monetary policy in these circumstances. Thus target interest rates for real investment in the country are unlikely to change as a result of payments innovations.

Typically, the central bank targets the interest rates in the interbank market. Changing the cost of funding for banks, the monetary authority attempts to affect general economic activity, as banks expand or contract their lending activity in response. However new means of payment can also have direct effects on the financial institutions' behavior, either encouraging or discouraging its activity. Thus, one possible consequence of a payments innovation arises through the potential for new payments arrangements to change spreads between bank funding costs and lending rates, either by increasing the cost of funds through introduction of payments arrangements which compete with bank payment systems, or by enhancing the efficiency of those systems. Not only may changes in the payment system alter the average level of the differential between the rates set by the monetary authority and the rates at which banks lend to the public, they may also affect the variability of the differential.

The effects are even more significant if the monetary authority targets monetary aggregates. Money multipliers for various types of new payments media will be different from existing money multipliers and are likely to vary based on different external shocks. The question of which aggregates to target and how strongly to respond to changes in those aggregates will depend on the substitutability between the various payment mechanisms.

Consider for example, the effects of policy of quantitative easing whereby a central bank purchases relatively illiquid, non-payments assets in return for money. Changing the relative availability of the two types of assets changes their relative price. The effects on the interest rate premium will generally be more dramatic the less substitutable and more segmented the markets for two assets. If on the other hand, intermediate assets are readily available which serve as acceptable substitutes for each, the effect of the policy on the targeted asset's return is likely to be diluted.[5]

The introduction of a new payment asset increases the options available for making payments, and thereby in general increases economic efficiency. However, to the extent that the new payment asset substitutes for existing payments assets, it reduces the effectiveness of attempts to change the supplies of those existing assets. For example, it is more difficult for the central bank to attempt to reduce the liquidity of an economy if other agents can provide assets which are ready sources of liquidity.

Introducing a CBDC does not lead to this difficulty, since the CBDC is simply another asset issued by the central bank useable for payments. Since the CBDC is denominated one-for-one in units of existing currency

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[4] We focus on this channel as most relevant for the introduction of new moneys; but other channels are also important.

[5] The argument is really about the difference between the power of a monetary authority to engage in monetary policy by causing an economy wide change in interest rates, or by a quantitative easing or tightening, targeting one sector of interest rates relative to another. The question is really how tight the link remains between HQLA and reserves, once stablecoins become a major component of the demand for HQLA.

and acquired in exchange for other currency or assets it makes no fundamental change in the conduct of monetary policy; with a CBDC the outside money supply is simply the total of CBDC and cash in circulation. Indeed, to the extent that the CBDC increases the usefulness of central bank money, drawing demand away from the monetary assets of other agents, the CBDC has the potential to increase the central bank's control over monetary policy and the ability to reap seigniorage.

More subtly, however, the use of CBDCs might increases the velocity of money; some transactions are not only more convenient electronically, they are also quicker to achieve. The amount of time that money needs to stay in a person's possession between one transaction and the next falls. In other words, less money is needed in aggregate to achieve the same value of transactions.

When a nonbank private institution (e.g., fintech) issues electronic money, it acts as a substitute for the central bank's money, increasing the elasticity of demand for central bank money. However, to the extent that the issuing institution uses central bank reserves as backing for electronic money, it restores some of the power of the central bank to affect the liquidity premium—see Section V for liquidity outside the money base. An important factor that affects substitution between CBDC and privately issued electronic money is perceived safety. Increases in perceived risk of private money would be expected to cause significant swings in the mixture of payments assets held by the public.[6]

In the case of electronic (or digital) money issued by banks the considerations noted in the previous paragraph continue to apply; however, there are two additional distinctions. First the regulatory structure makes the money a closer substitute for central bank digital currency. Second, because these institutions are also lenders, changes in the costs they face can have a direct impact on their willingness to lend, and thus conceivably a stronger and more immediate effect than similar changes in costs of institutions which are solely in the business of providing payments.

Macroeconomic policy is intended to set an interest rate on investment that is consistent with the optimal level of aggregate economic activity in the economy. If a monetary aggregate is targeted, it should serve as a useful proxy of the size of the economy's liquidity premium or the tightness of the supply of payments assets. It therefore becomes important to understand how monetary aggregates should be adjusted to take into account the introduction of new payments assets. The ideal aggregate would measure the total of all forms of payments assets, public and private which act as close substitutes. However, it may not be possible to observe all of these magnitudes. A central bank will have readily available information on CiC, as well as information on the size of transactions accounts. To the extent that it cannot measure the magnitude of transactions assets in unregulated institutions, the measure is imperfect. A partial remedy would arise from measuring the assets used as reserves by these institutions and adjusting by a money multiplier to move from base to aggregate.

III. New Instruments for Other Goals

Central Banks have multiple objectives; it is important to consider whether the introduction of new forms of payment arrangement require new instruments to achieve these multiple goals. Consider some objectives generally attributed to central banks: price stability; financial stability, and generation of government revenue

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[6] In LICs or EMs, the issue of people wanting to transact outside the domestic banking system is more urgent and more legitimate and thus not restrict wallet holdings of CBDC; else, people will just hold other coins (not bank accounts). Thus, those licensed will issue CBDC freely/widely and collect seigniorage.

through seigniorage. Different forms of new money will yield different seigniorage revenues. Lender of last resort functions and associated interest rates and liquidity policies are instruments designed to improve financial sector stability. To the extent that the new payment facilities are separate sources of instability, it may be appropriate to have separate instruments targeted toward them. In either case, however, new instruments, only make sense to the extent that there is limited substitutability between the various payment sectors, both on the demand side of customers for the instruments, and on the provision side. If arguments for interest bearing (e.g., wholesale) CBDC are compelling, this new instrument will need to justify (and align with) the new objective.[7]

Highly liquid assets with associated risk are a source of financial instability. Historically, monetary policy handled the dual goals of financial stability and macroeconomic control by separate instruments: in the US for many years, macroeconomic stability was the province of open market operations, while financial stability was encouraged with discount window lending and deposit insurance, as well as safety and soundness regulation. As long as the institutions providing new forms of payment instruments are regulated and insured, this same division of work can continue without significant alteration. Different types of payments institutions might require different risk premia for deposit insurance, depending for example on the degree to which payments liabilities are backed by central bank reserves or liquid assets. The use of electronic payments might increase the speed of any bank run, necessitating more generous deposit insurance.

The main financial stability concern will arise from payments institutions which are unregulated or underregulated. As in the shadow banking crisis, the problem arises because the costs of regulation (whether small or large) lead institutions to engage in regulatory arbitrage, taking on systemic risks not fully borne by the institutions or the users of the institutions' services. Such problems could easily arise again if fintech payments institutions become widely popular. The most important protection against this, is to ensure that the benefits of joining the regulated sector are sufficiently great to offset the costs of the regulation. In the case of payments systems, for example, access to the payments backbone is an extremely large carrot, provided that the costs of regulations are reasonably adjusted to the risks imposed by the payments arrangement (for example, by allowing payments institutions which do not act as lenders to have regulation that is tailored to the payments function only).

When different payments arrangements arise, it becomes worthwhile to consider whether there is value in using central bank regulation to encourage a particular mix among the arrangements. For instance, seigniorage revenues will be greater from a CBDC than from the same amount of payment activity in a private payment institution, and the elasticity of demand for central bank reserves are likely to vary with the type of institution— see Box 2. However, the power of such fine-tuning will be limited both by the ease of substitution by customers between the different payment methods based on expense, by any swings in preferences among the monetary assets, based on perceived risk.

IV. Central Bank Operational Issues

The introduction of new payments platform by has great potential but may lead to new risks and in the long run, including possible changes in monetary policy transmission. The new services have the potential to change the

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[7] New objectives include liquidity management via CBDC, nonbank access to wholesale CBDC, etc.

relationship between base money in the economy and capacity to carry out transactions, with consequences for central bank seigniorage and monetary policy transmission.

The benefits include extending services to the large unbanked cash-based segment of the population and the potential for rapid growth of these services is dramatic**.** There is anecdotal evidence that in the short time the payment service providers (PSP) have been available, mobile phones provide the foundation technology to exchange mobile money. While the systems are of convenience to individuals who already are sophisticated in the use of electronic arrangements, the truly transformational effect on the economy could come from the spread of these services throughout the countryside and to the unbanked segments of the population. This is especially true where fraction of individuals with bank accounts is very small, and the economy is cash-based. An elaborate system of payments organizations has arisen as a way for individuals to make remote payments to, for example, utility companies. On the other hand, the vast majority of unbanked population has mobile phones and the mobile business is concentrated in large operators. Thus the phone-based system could rapidly expand beyond the initial use case for such phone-based systems as Kenya's M-pesa, which initially were used primarily for transmission of cash from workers in the cities to relatives in the countryside.[8]

A. Decline in Monetary Base and Seigniorage

A higher money base allows for higher income from seigniorage; cross-country data shows that in countries with low levels of bank penetration, the ratio of money base to GDP is higher. Countries with high money demand (i.e., money base to GDP is above average) can sterilize relatively more than average.

However, the monetary base could potentially be reduced by a more widespread use of mobile operator payments systems. Mobile payments accounts are beneficial as they extend services to the large unbanked segment of the population. The introduction of mobile operator payments system reduces the size of the monetary base; it swaps part of cash under circulation to demand deposits, through the payment to the mobile operator. This first effect reduces monetary base as only the fraction of reserve requirement on the demand deposit is now part of the monetary base. Second, as a larger number of customers use the mobile operator to make payments, there is less incentive for the mobile operator to keep the whole amount as demand deposits, so there is a further reduction in monetary base as demand deposits and consequently bank reserves also decrease. This translates into an increase in the velocity of money, where more transactions in the economy can be paid by using a smaller amount of base money. This will entail adjustment of operational calculations for those CBs using monetary aggregates for regulation.

We present a illustrative scenario to show the potential costs of a reduction in the monetary base ratio if mobile payment systems substitute the use of cash—Figure 1. We present three scenarios where base money shrinks from 16 to 10 percent of GDP: (i) a severe scenario, where the reduction takes place in the next six years where MB/GDP falls by 1 percent per year; (ii) a baseline scenario in the next 12 years, where MB/GDP falls by ½ percent per year; and (iii) a mild scenario in the next 24 years where MB/GDP falls by ¼ percent per year.

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[8] MNOs are generally required to maintain liquid assets equal to the amount of money issued electronically. The funds are usually pooled and held by a bank in the name of the MNO. This arrangement ensures a customer's money will be available on demand. Often, the only regulation of the mobile phone operators is by the communications authorities; and they regulate for technical standards of the communications, not for any financial or liquidity standards.

Figure 1. Seigniorage and Base Money Changes
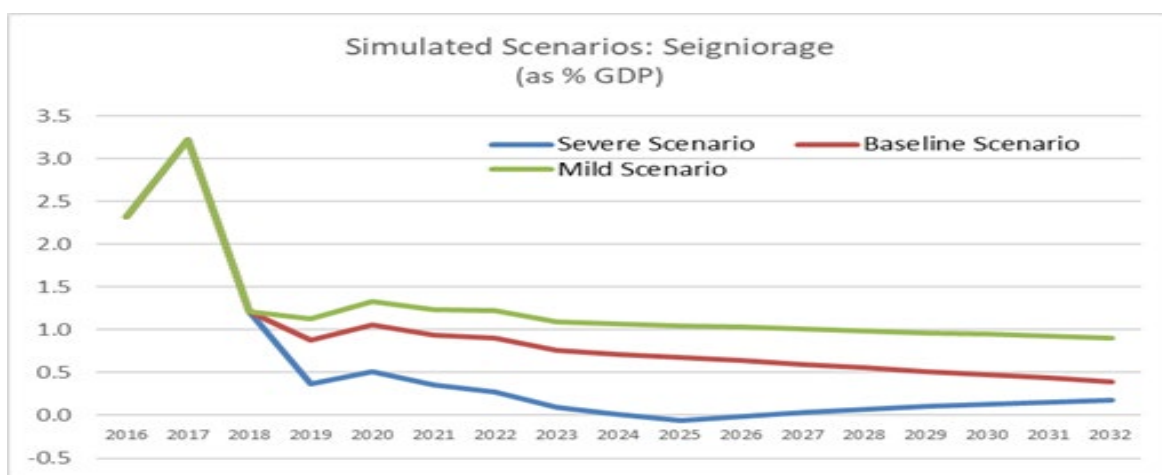
Source: IMF staff estimates; simulation.

Some central banks have adequate data to have a preliminary understanding of the use of e-wallets and associated velocity. They know the average holdings in e-wallets on particular dates (e.g., quarter-end or month-end). A recent study (technical assistance mission) finds volume using e-wallets for payment of goods and services (end-2018) have been 4.3 billion pesos; the average holdings or balance in e-wallets was about 265 million pesos (end-2018). This results in a "*transactions velocity*" of about 16. This provides a useful angle to understand how the interest rate sensitivity of these holdings compares with that for other money aggregates. The comparison, GDP/ M0, a standard metric and is roughly 3.0 as per monetary data files of this country.

A reduction of the monetary base in the future may somewhat constrain the ability of a CB to mop up excess liquidity and conduct monetary policy. A lower demand for cash reduces the rate of growth of the monetary base; this in turn reduces seigniorage revenues from money creation; reverse would be the case in a CBDC world (see Section II), if CiC increases base money (see Box 3).[9]

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[9] See Reserve Bank of India speech by deputy-governor Rabi Sankar, "*Central Bank Digital Currency – Is This the Future of Money*" (July 2021), paragraph 31 on CBDC and seigniorage. https://www.rbi.org.in/Scripts/BS_SpeechesView.aspx?Id=1111

Box 3. Demand for Money and Seigniorage

Developed economies have a currency demand between 2 and 4 percent of GDP, while for most other countries it ranges between 2 and 11 percent of GDP. Many central banks remunerate 70-80 percent of central bank profits must be transferred to the Treasury. If the digital/fintech growth is sizable, base money/GDP will decline; so will seigniorage. If a country adopts CBDC, and there is disintermediation of the banking system deposits, base money may go up; so will seigniorage.

The traditional definition of seigniorage depends on both inflation ("tax inflation") and the level of demand for reserve money. In the short run, seigniorage also depends on changes in reserve money. An illustrative example where inflation is 6 percent, and Reserve Money as percentage of GDP is 16 percent would result in seigniorage revenue of 0.9 percent of GDP. The illustration presented below does not include the short-term effect where base money/GDP is constant between the two periods (i.e., it is zero in the equation). If base money declines, zero in the equation will become negative and seigniorage will be lower. If base money increases, seigniorage will increase.

$$s_t \equiv \frac{(H_t - H_{t-1})}{P_t Y_t} = (h_t - h_{t-1}) + \left(\frac{\pi_t}{1 + \pi_t}\right) h_{t-1} = 0 + \left(\frac{6percent}{1+6percent}\right) * 16 \text{ percent} = 0.9 \text{ percent}$$

Where:

$H_t - H_{t-1}$: Flow of Reserve Money

$P_t Y_t$: Nominal GDP

$h_t = \frac{H_t}{Y_t P_t}$ Reserve Money as percentage of GDP
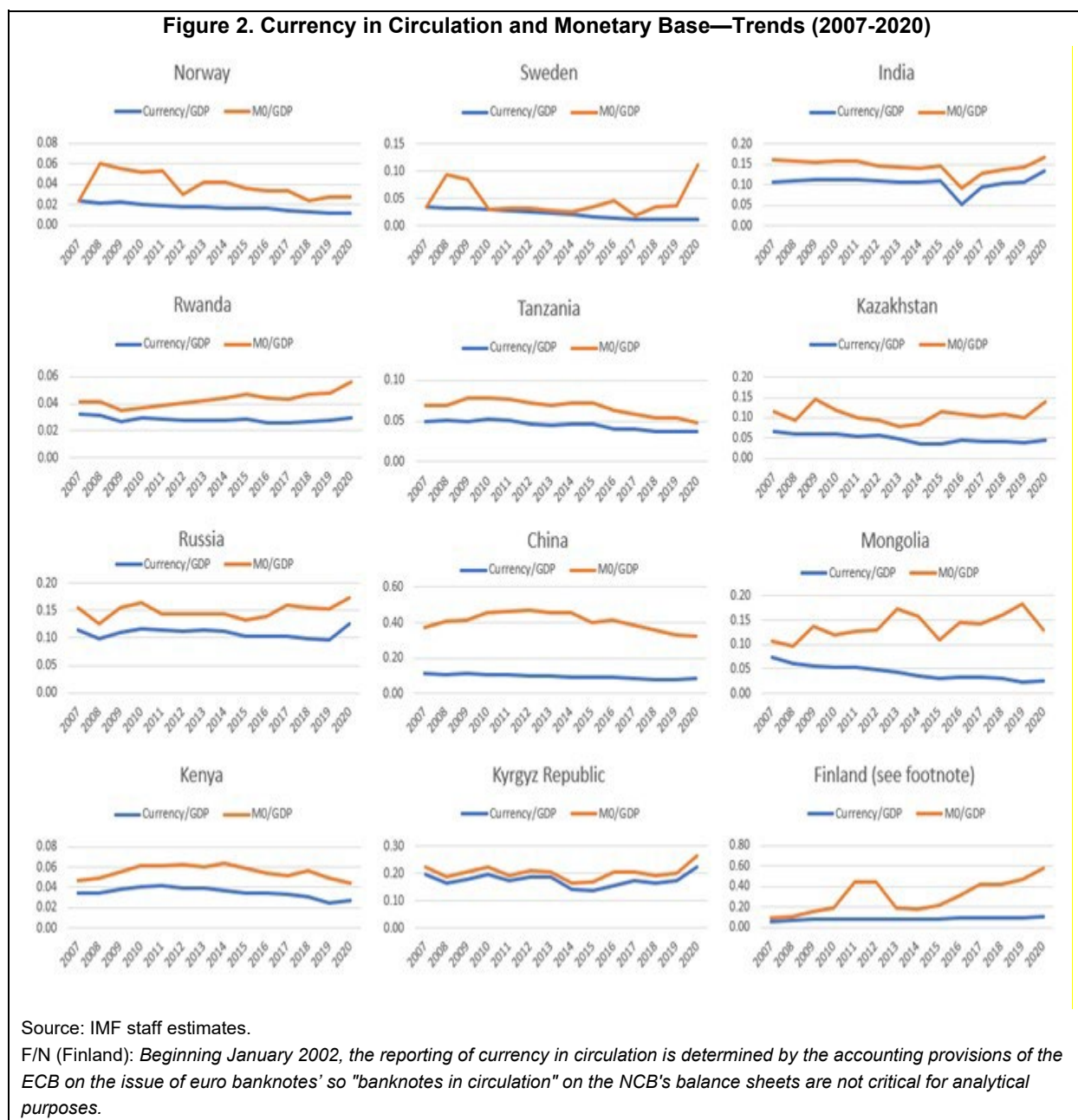
B. Currency in Circulation and Demand for Money

The new payments systems may represent a leakage in the transmission channels for monetary policy. Demand for cash depends on the alternatives available to cash. For instance, in economies where individuals are rapidly moving away from the cash economy into banking services, we expect to see the demand for cash falling relative to the demand for bank accounts. In economies where nonbank alternatives to cash are increasing, we expect a decrease in the ratio of cash outstanding to GDP, while the effect on broader monetary aggregates will depend on the degree to which reserves are held against the new money substitutes. For instance, in jurisdictions where regulations require holding reserves one for one against e-moneys, movement from cash to e-money will have no effect on broader aggregates (e.g., M2 in Kenya), while movement from bank deposits to e-money will reduce broader aggregates (e.g., Kyrgyz Republic) if there are no requirements to reserves against e-moneys.

The graphs in Figure 2 show the reduction trend in the ratio of CiC to GDP in a group of countries, where the fall in demand for cash is potentially related to moving away from the cash economy to nonbank alternatives to cash.[10] More importantly, the country teams acknowledge digital forays that may/maynot map fully into the trend lines (e.g., Finland). These countries are very heterogeneous, including developed economies such as

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[10] We removed all dollarization cases (Nigeria, Angola, Argentina, etc.) that would reduce CiC. Regressions were not a way out as dollarization, CiC, M0, etc. are not easy to control simultaneously. For example, "dummy" to "control for dollarization" is not a good route, as some cases dollarization doubles; or is flat, or increases marginally.

Sweden and Norway, major emerging economies such as China, India, and Russia, and developing economies as Mongolia, Kenya, Armenia, Kyrgyz Republic, Kazakhstan, Tanzania, and Rwanda.[11]

Generally, CiC decline usually pulls M0 with it; however the behavior of M0/GDP may not have declined due to financial deepening, e.g., Russia, Mongolia, Armenia, and Rawanda (i.e., larger banking sector, and thus more required reserves that contributes to M0 and thus higher seigniorage).

Figure 2. Currency in Circulation and Monetary Base—Trends (2007-2020)

Source: IMF staff estimates.

F/N (Finland): *Beginning January 2002, the reporting of currency in circulation is determined by the accounting provisions of the ECB on the issue of euro banknotes' so "banknotes in circulation" on the NCB's balance sheets are not critical for analytical purposes.*

[11] As per discussions with country teams at the IMF. There are more countries that exhibit digital money forays (e.g., Korea etc.); however related issues, example hoarding of "yellow notes" in Korea masks the fintech progress viewed from the lens of CiC and M0.

Recent research using "cash usage" metric also suggests declining demand for cash (see Khiaonarong and Humphrey, 2022). The metric is developed using BIS's granular data on 25 countries that includes cash, credit cards and e-money: the metric is (cash/cash+cards+e-money). Although the metric cannot be used for seigniorage calculation, it is a useful harbinger of where CiC may be trending. Although seemingly a detour, one of the preconditions for implementing a full-fledged inflation-targeting regime is the absence of fiscal dominance. This means that the government should take central bank's profit as an exogenous variable and let the central bank to run an independent monetary policy consistent with its legal mandate to preserve price stability and extent of sterilization (see Box 4). Under a fiscal dominance situation, the government could induce the central bank to increase its transfers to the Treasury beyond a level consistent with its macroeconomic goals in order to meet budgetary needs. Under such circumstances, the central bank may be unable to secure a stable and permanent low inflation. As a result, society does not trust the inter-temporal purchasing power of the domestic currency, and it is not possible to anchor inflation expectations.

Box 4. Demand for Money and Sterilization

If the demand for money as percentage of GDP is high and the return of the net foreign assets (NFA) is high, sterilization can be absorbed within the central bank balance sheet more easily. In order to illustrate this simple arithmetic, let us assume a steady state situation where the balance sheet of the central bank does not growth as percentage of nominal GDP. We further assume that the return on net foreign assets is r_t^*. For simplicity we use the following notation for the analytical derivation: $\frac{NFA}{PY} = \gamma$, $\frac{NDA}{PY} = \chi$, $\frac{MB}{PY} = \lambda$ and $\frac{N}{PY} = \eta$; NFA: central bank net foreign assets, NDA: central bank net domestic assets, MB: monetary base, N: Central bank net worth, and PY: nominal GDP. In steady state, the return of central bank net worth has to be zero to ensure its balance sheet does not keep growing or shrinking. This implies that $(1 + r^*)\gamma - (1 + i)\chi - \lambda = \eta$ and using the identity, $\gamma - \chi - \lambda = \eta$, we can express the central bank sterilization cost in steady-state, $i\chi$, in the terms of the following simple equation:

$$i\chi = (\lambda + \eta)r^*$$

This simple equation shows that the sterilization costs that the central bank balance sheet can absorb in the long run. Using the average for emerging market economies, where λ or money base to nominal GDP = 10 percent, and further assuming a return on NFA of 3 percent in the long run, the steady-state, in this example sterilization cost is estimated in 0.30 percent of GDP. (Note η is zero in the equation, as we assume central bank's net worth does not change; level variable].[1] Restricting sterilization due to demands for budgetary needs to be below 0.30 (in this example) will adversely impact the conduct of monetary policy. Thus, the inroads of fintech/digital money and if demand for money (or λ) decreases, constraints to sterilization are possible.

[1] A constant monetary base in the long run converges to a value of λr^*.

V. Payment Service Providers and Demand for Money

Electronic money (or e-money) may be regulated as discussed in earlier sections (e.g., CBDC, stablecoins backed by reserves, quasi-CBDC issued by banks or nonbank within regulatory perimeter etc.) and will be part

of the central bank balance sheet.[12] However some e-money may be unregulated which is the focus of this section (IMF, 2021).[13]

The willingness of individuals and companies in the economy to absorb the monetary base issued by the central bank depends on the degree to which individuals wish to hold cash and the degree to which customers wish to hold demand deposits in banks (plus the rules by which banks hold monetary reserves against customers' bank deposits). Since banks hold reserves which are a fraction of demand deposits, while cash holdings are one-for-one central bank money, a change in consumer preferences for cash relative to bank accounts will change underlying demand for central bank reserves. If new payments systems are effectively subject to lower reserve requirements than traditional banks, then demand for central bank monetary base (especially CiC) further deteriorates.

In theory, availability of non-bank private PSPs like mobile network operators will both reduce the level of seigniorage and the effectiveness of transmission of monetary policy.[14] However, the empirical evidence on this issue is tentative. In part this follows because the most dramatic innovations are relatively recent, and it is difficult to interpret difference in money demand equations over long periods of time.

As customers make payments to other companies, the mobile operator will in effect use its bank accounts to make the payments, so balances in customer accounts and in the mobile operator's bank account will decrease one for one. But over time different individuals are topping off their accounts at the same time that others are utilizing theirs, so that these totals will remain fixed on average. For this reason, the mobile operator has no need to hold all its balances in a low interest demand deposit. It could, instead choose to invest in long term financial assets outside the banking system entirely. In this case, the central bank will be concerned, not only with the loss of seigniorage but also with the possibility of financial instability as in the classic Diamond Dybvig (1983) bank run model, since the mobile operator lacks the liquidity needed to honor the total demands of all customers should they decide simultaneously to use their funds for payments.

The key point is the asset side of non-bank private issuers of new money. If they keep 100 percent as banking deposits, no major change in the transmission mechanism and supply of banking loans should be expected. On the contrary, if they keep other assets such as treasury bonds or other financial assets, then it weakens the supply of credit from the banking system, assuming the banking current system follows a structure of both financial intermediation and maturities transformation. The impact on transmission will be more if non-bank payment institutions follow a more narrow-banking approach with assets different from the banking system.

Liquidity outside the monetary base is important to recognize.[15] The importance of these interactions will determine the extent to which the new arrangements reduce the effectiveness of monetary policy, as shown in sub-section A. Recent experience in some African countries requires phone companies to hold liquid reserves against the funds (though possibly not bank balances) that are in customers' accounts. In other countries, there is no such requirement.

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[12] As the title of the paper suggests, digital money is a broader concept, and we use e-money as a sub-set of digital money.

[13] Regulation does not necessarily imply regulation as banks, but some regulation to bring them within the regulatory perimeter

[14] In some countries, where PSPs are mandated to hold central bank reserves on their "float," liquidity outside monetary base will not change.

[15] CiC (currency in circulation) is generally close to M0 in EMs and LICs but where financial deepening has been fast and significant (but not quantitative easing), then M0 is a more complete metric for seigniorage calculation as contribution from required reserves may be sizable along with CiC.

A.   Liquidity Outside Monetary Base via Mobile Payments—An Illustrative Example

Assume a mobile operators' customer prepay for services. Assume the customers pay 200 to receive services. The mobile phone company uses 100 of this to invest in its infrastructure and puts the rest in bank deposits. Over time as customers receive services from the phone company, the balance in the customer accounts reduces and the net worth of the phone company increases correspondingly as its liabilities decrease, but assets are unaffected.

Mobile Operator Phone Company

Assets	Liabilities
100 Infrastructure	200 Customer Accounts
100 Demand Deposits at Commercial Bank	

In the country as a whole, there are a large number of unbanked individuals. They hold a total of 1,000 in currency in circulation, and 100 in the form of accounts with mobile phone operators for services. There are also a number of banked individuals; they hold 3,000 in bank deposits, 1,000 in currency in circulation, and 100 in mobile phone accounts. Thus, the commercial bank has deposits equal to 3,100. Assume the reserve requirement is 50 percent. The commercial bank's balance sheet is as follows:

Commercial Bank

Assets	Liabilities
1550 Commercial Loans	3000 Individuals' Demand Deposits
1550 Reserves at Central Bank	100 Phone Company Demand Deposits

Thus, the central bank has an outstanding monetary base of 1,550 reserves of commercial banks plus 2000 in currency in circulation. This 3,550 is the source of the central bank's seigniorage.

Central Bank

Assets	Liabilities
3550 Interest Bearing Financial Assets	2000 Currency in Circulation
	1550 reserves

Now suppose that the phone company introduces a facility which allows unbanked individuals to make payments through their accounts. Because of the convenience of this arrangement, individuals increase their holdings of balances with the phone company from 100 to 200. For the phone company, this increase does not represent an increase in demand for phone company services, so it makes no sense to make further investment in infrastructure. These balances could be held as additional balances in bank deposits

Mobile Operator Phone Company

Assets	Liabilities
100 Infrastructures	300 Customer Accounts
200 Deposits with Commercial Bank	

The commercial bank finds its deposits increasing—it gains 100 from the mobile phone company. On net the central bank, however, finds there is a lower demand for its monetary base, as, in aggregate, usage has switched from CiC to reserve backed transactions. Total demand for these assets is the same, but it is more

concentrated in the fractionally backed component. Outstanding monetary base reduces to 3,500 in total; 1,600 reserves in commercial banks, plus 1,900 of currency in circulation. As we have described it so far, the effect of introducing the phone company payments accounts is the same as the effect in developing countries of an increase in banking penetration. (Note: If the mobile phone company holds 100 percent of treasury bonds, then the amount of demand deposits is reduced; the demand for collateral and/or central bank reserves would go up.)[16]

B.   Payment Service Providers (and Mobile Payments) Interface with Banking

Careful examination is required of the potential use of the new services for bypassing existing channels for international remittances, and whether this is desirable. International remittances are 20-35 percent of GDP for many countries (El Salvador, Tajikistan, Serbia, Armenia, Philippines, etc.). Remittances are currently made through the banking system and the transmission process is apparently efficient. However, many remittances are via phone account payments systems and the cross-border flows are sizable and increasing.[17] It therefore becomes important to understand the extent to which these services can currently (or have the potential) to be used to make international remittances outside of the banking system; M2 metrics are incomplete if sizable payments are outside the banking system; base money decline is also being observed If LICs target money aggregates (and maybe on way to inflation-targeting), monetary aggregates continue remain important.

Payment services are a fundamental portion of the financial industry and are highly regulated because of their potential risks. Nonetheless, e-money and the mobile phone accounts in the new arrangement are effectively the equivalent of demand deposits, and as such subject to the same concerns. It is imperative that the central bank move quickly to bring a regulatory umbrella over these services. So far, phone company accounts have not grown to a level significant enough to have any economy-wide effect, but this could rapidly change especially in remittances receiving countries where payment activities maybe outside the banking system (and result in incomplete M2).

The new services put tremendous competitive pressure on the existing payment and banking systems; it will be necessary to reconsider where unnecessary regulatory burdens can be relaxed, while encouraging them to develop their own innovations. The mobile phone operators have enormous customer bases compared to the banks. They have expertise in customer service and platform design. They have low regulatory burdens. The banks will find it extremely difficult to induce unbanked customers away from a phone company account. On the other hand, for the time being the banks have natural advantages over the phone companies in offering banking services to customers who already have bank accounts with them: deposit insurance, links to existing savings accounts, and the inertia of moving to a different payments' platform. These natural advantages can reinforce their links with their existing customer base, provided they develop improved banking services.

VI. Conclusion

The rapid development of new methods of payments has made for enormous benefits throughout the world, and in particular has radically changed the situation for individuals who were previously disconnected from the

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[16] This would be the case if nonbank stablecoin issuers would be allowed to back their coins with central bank reserves; demand for central bank reserves would go up—see Box 2.

[17] For example, in Central Asia and Caucasus region. Russia in particular exercises stronger controls on access to SIM cards than countries that receive remittances (e.g., Armenia, Tajikistan and Kyrgyz Republic) from Russia.

modern financial system. Further encouragement of the development and expansion of the role of these new systems is an imperative for all central banks. But this development will pose new challenges for those in charge of implementing monetary policy.

The focus will be on the interest rate channel and if digital money (especially CBDC) will change monetary policy and central bank operations. New policy instruments make sense only to the extent that there is limited substitutability between the various payment sectors. Trends in currency-in-circulation, and their impact on central bank's seigniorage, monetary base, liquidity outside the monetary base, and transactional velocity will need to be understand better. As in the case of problems that have arisen from dollarization of deposits, or from new liquidity provision through shadow banking, effective regulation and policy making require understanding and readjustment. If anything, the new arrangements in payments are likely to be adopted even more rapidly than those earlier examples. Effective responses in the new environment will require careful monitoring of the demand for these new technologies and the factors that affect that demand.[18] Data gathering should begin now, before the changes in payments practices become overwhelming.

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[18] It will be interesting to see how retail CBDC will compete with digital money use at household level. The MNOs are ambitious, with goals of extending their reach much more broadly into payments services, into microlending, and most significantly into foreign remittances. Like unidentified e-wallets (issued by banks), mobile account payments are subject to a variety of restrictions primarily designed for AML protection, including limits on individual payments, use for foreign transactions, and cash withdrawal.

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