

THE CASE FOR DIGITAL LEGAL TENDER

The Macroeconomic Policy Implications
of Digital Fiat Currency

Rohan Grey and Jonathan Dharmapalan
with foreword by Professor Njuguna Ndung'u

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FOREWORD

Historically, currency in an economy has acted like grease in a wheel of a car. Indeed, we often refer to “greasing the wheels of the economy.” Once grease serves its purpose for a given time, it is removed and thrown away – and so too, in the case of old currency notes, they are pasted and burnt, destroyed in time. Accounting methods differ among central banks as to how these currency costs are booked in their respective balance sheets, in some, the cost of currency is spread across its life span. This entails imprecise estimates, as some denominations have a shorter expected life spans than others.

Combatting these kinds of technical inefficiencies are the benefits which most observers consider when they contemplate the effects of introducing a digital fiat currency (DFC) into a modern, digitally driven economy. After all, physical currency is costly to design, print, ship, collect, destroy, and replace, and is of limited use apart from in-person transactions. A digital currency, by contrast, is created using durable hardware and software, can circulate without physical degradation, and can be used to instantaneously settle transactions over very large distances. In this way, DFC offers a chance for re-using our economic grease: offering major savings on the cost of reproducing and re-issuing currency.

But beyond these cost savings on central bank balance sheets, a DFC will move

payments platforms and payments infrastructures to the next level. We expect added advantages of real time transactions to solve for the liquidity distribution constraints currently imposed by physical cash movements. Recent studies show, that as these payments systems infrastructures improve, the fiscal side of tax payments and revenue administration will improve in turn.

While cost-efficiencies and technological improvements are valuable, also significant are the ways that DFC can change the very nature of macroeconomic policymaking, by changing how the monetary and financial systems work. Even without displacing notes and coins, but sitting alongside them, we expect improvements in the environment for monetary policy. So far, in several developing economies that have adopted digital financial systems, we have seen monetary policy frameworks change and even signaling in the market become more efficient. Just as the internet began as a simple protocol, and eventually altered the structures of human society, DFC has the potential to transform the transactional dynamics at the core of the financial system, and with them, the fiscal, monetary, and regulatory tools available to policymakers.

Such a transformation is welcome and timely, given global and political economic developments over the last decade.

Currently many aspects and even frameworks of fiscal, monetary, and financial development policy are being rethought. Our expectations for the implications of DFC are being expanded, and are the subject of increasingly complex analysis. The investigation which follows dives more deeply into how the monetary system and even the payments system may look different with the introduction of DFC, so that we can properly anticipate the secondary and tertiary effects of this innovation in stabilizing our macroeconomies. For example, in developing and emerging economies that use the Dollar, the Euro or the Pound Sterling as their reserve currency, it need not be shipped physically into the economy to support trade and the foreign exchange market, it could be available in DFC form. This would be a game changer. Moreover, although the long-term impacts of introducing DFC remain uncertain, as with all technology-induced change, the

ideas and insights expressed in this paper provide a valuable roadmap for the immediate future.

Of critical importance to our contextual understanding are the effects of DFC not only on monetary and fiscal policy and how economies will function efficiently, but also on the possibility of changing and transforming economic actors' lives and lives of the citizens in general. For where private e-mones before, and digital fiat currency today come in to solve the payments constraints, so too do they become agents in solving financial inclusion constraints. We have seen that financial inclusion opens the floodgates to other possibilities and the frontier is constantly changing, so we will embrace more of such efforts as time goes by.

With this pressing context in mind, I encourage your attention to the following analysis, which sheds light on digital fiat currency's role at the cutting edge of macroeconomic policymaking innovation.

Njuguna Ndung'u, Professor & Former Governor, Central Bank of Kenya

PREFACE

In early 2011, we set out to answer a set of then barely-looming questions. How might Central Banks, Ministries of Finance, national regulatory agencies effectively regulate the flows and functions of this new era of electronic payments and newly emerging private electronic monies?

Observing the time-tested simplicity of currency regulatory functions, we surmised that the answer should obviate the complexities of layered, patchwork regulatory fixes, and instead transform the properties of the electronic unit itself. How, we asked, could we make privately issued electronic monies more like paper currency? The answer, we decided, was to imbue a digital form with the same authority of issue and legal characteristics of fiat notes and coins.

Digital fiat currency would replace privately issued e-monies with a standard, secure digital unit. Its supply would be controlled by the central bank and distributed using the sophisticated payments infrastructures already laid.

Though it fills a governance gap, our solution is a technical one. Our team has pioneered a security technology which enables Central Banks to create, issue, distribute, and destroy digital fiat currency units. One can think of the eCurrency solution as a modernization of the currency mint. The eCurrency firm acts much as industrialists and technicians of years gone by, those who forged minting machines

and continue to innovate features of secure currency: serial numbers and watermarking technologies for national notes and coins.

We have spent the past five years rigorously testing our ideas and technologies. Policymakers from 36 institutions weighed in on early prototypes and helped us to refine our models. They hail from countries large and small, from economies just beginning to enjoy the fruits of economic growth and those stabilizing after the 2008 crisis.

Still, they shared fundamental goals: to ensure stability in their economies and transparency in their regulatory regimes. Their pain points and feedback pointed to not only the desire for, but to the inevitability of a Digital Fiat Currency solution. Our testing has gone far beyond boardrooms and ministry chambers. As we go to print this paper, eCurrency is being actively issued and transacted in multiple deployments.

As concerns over regulation of shadow banking and digital transactions become ever more pressing, eCurrency is just stepping into a widening spotlight of attention. Still, though our technology may just now be making casual acquaintance with a broader public, it is a trusted, in-market reality for countries who have been actively piloting and deploying real eCurrency units in distribution.

The first paper of this series investigated the financial inclusion implications implied by the adoption of digital fiat currency, most notably an expansion of the safety and scope of digital financial services. In this paper, we articulate a vision for how widespread adoption of digital fiat currency may affect the macroeconomic levers a nation has at its disposal to steady economic growth. We describe monetary (and certain fiscal) policy implications of a nation's choice to incorporate digital fiat currency into a country's currency mix.

As this paper summarizes:

Digital Fiat Currency presents a future for payments system innovation, post-crisis monetary policy implementation, and regulation of the shadow banking sector. It leverages the strengths of existing banking operations

and payments systems infrastructure, while addressing critical weaknesses in the structure of money markets, and the coordination process between fiscal and monetary policy. As contemporary understanding of central banking operations evolves, and new challenges emerge in monetary and fiscal policy, as well as macroprudential regulation, the basic innovation in payment instruments offered by a Digital Fiat Currency becomes increasingly relevant and necessary.

We conclude that although the eCurrency technology solution is novel and technologically sustaining, the governance solution enabled by eCurrency is a largely conservative one, enabling a re-wresting of economic controls by national regulators and central banks. As our early testing and enterprise launches demonstrate even today, the transition to an eCurrency era will be transparent, incremental, and secure.

Jonathan Dharmapalan, Founder & CEO, eCurrency

EXECUTIVE SUMMARY

Fiscal and monetary authorities around the world are presently struggling to respond to persistently anemic global growth, rolling regional crises, and increasing public outcry for regulatory reform and a realignment of budgetary priorities. At the same time, the rapid proliferation and evolution of digital financial technologies ushers in new opportunities and challenges for fiscal-monetary-macroprudential coordination, and for a fundamental reimagining of the technical infrastructure undergirding the global financial system. How to respond to these challenges in a way that takes advantage of new technological opportunities to promote financial services access, consumer protection, and inclusive growth, while bolstering macroeconomic stability and the resilience of financial systems, is the central challenge facing macroeconomic policymakers today.

One possible way forward is Digital Fiat Currency (DFC), a technically-innovative monetary instrument designed to serve as a universal means of settlement across digital payment networks. DFC units are issued by the central bank via a dedicated DFC payments platform, are legal tender, and can be readily converted into bank deposits and other forms of government-issued liabilities, including physical currency, central bank settlement balances (reserves), and interest-earning government securities. Transactions and cash storage are conducted via DFC wallets or

applications, which are hosted and managed by licensed financial intermediaries, but remain the property of the wallet- or application-owner.

In contrast to privately issued “e-money,” DFC is explicitly backed by the full faith and credit of the sovereign, and functions like a digital version of physical currency, rather than as a deposit of an intermediary financial institution. Furthermore, although the quantity of DFC units in circulation is ultimately controlled by the central bank, as with physical notes and coins, individual transaction and storage records remain decentralized, thereby preserving a greater degree of privacy and anonymity. At the same time, the technical design of the DFC system guarantees instantaneous settlement and prevents any transaction between DFC wallets from increasing or reducing the overall supply of DFC units in circulation, thereby reducing the credit and liquidity risks typically associated with private intermediary-based payment systems, such as traditional banking and mobile “e-money.”

The introduction of DFC would have a significant impact on a number of pressing macroeconomic problems.

First, depository institutions face significant competition from other non-bank financial institutions for basic checking and transactional services, including from above, by those seeking to service large institutional cash pool investors that require a level of principal safety that bank deposits cannot guarantee due to per-account caps on deposit insurance, and from below, by telecommunication and software-based firms and local communities seeking to overcome underdevelopment of the banking system, as well as deficiencies in the circulation of national currency.

Second, following almost a decade of policy innovation and experimentation, central bankers are becoming increasingly vocal about the limits of monetary policy, and need for complementary fiscal accommodation, in addressing the enduring deflationary bias and persistently high global unemployment that have characterized the post-2008 global economy.

Third, in response to the global financial crisis, central banks around the world have opened their balance sheets to non-bank financial institutions through

repurchase arrangements and other forms of collateral-based liquidity provision, thereby undermining the depository institutions' historical monopoly over central bank access. At the same time, there is increasing recognition that the persistent global undersupply of safe, liquid assets – namely, government securities – played a major role in the rise of 'shadow banking,' and the proliferation of risky 'near monies'¹ issued by private intermediaries, such as mobile money providers and money market mutual fund shares. Consequently, governments are reconsidering the appropriate division of labor between fiscal and monetary authorities with respect to macroprudential regulation and public debt management.

Against this tumultuous backdrop, DFC has the potential to be as revolutionary as paper currency in its time, by disrupting various markets and processes in which physical currency has long been inefficient or impracticable, while simultaneously preserving the core dynamics of public policymaking and the modern financial system.

Unlike traditional narrow banking proposals, the aim of a DFC system would not be to curb, restrict, or otherwise supplant the traditional banking system. To the contrary, the aim of a DFC approach would be to complement traditional banking activity, by facilitating the unbundling of its payments processing function from that of credit-creation and risk-analysis. In other words, a DFC system is an attempt to increase the range of market actors responsible for managing and distributing government-backed financial instruments, not restrict it.

Moreover, a DFC system has the potential to rapidly promote innovation and growth in countries suffering from persistent financial exclusion, poor financial infrastructure, and limited participation in the formal economy. Indeed, many of the populations of these often-remote regions, while severely underbanked, nevertheless enjoy widespread access to developed telecommunications networks, which can serve as the core infrastructure for a DFC system, and thereby

¹ "Near monies" are privately issued financial instruments that are considered safe by a large number of market participants, have a high liquidity premium, and are held and traded primarily for their cash-like properties.

leapfrogging more developed countries by avoiding the need for inefficient legacy bank-based payments systems, while avoiding the risks and inefficiencies of mobile money and other forms of private, e-money systems.

At the same time, the introduction of a DFC system does not necessarily require disrupting existing consumer practices or preference, as the user experience transition to transacting in DFC would be mostly invisible to consumers. Users of transaction accounts of all types – whether intermediated by a financial or non-financial institution – would retain existing customer relationships and interfacing. Behind the scenes, a DFC system would resemble the existing bank depository system, with a separation between the consumer-facing ‘wallet,’ and the business-to-business (B2B) payments processing conducted by intermediaries. However, the DFC platform encourages interoperability by providing a common payments instrument standard for banks and non-bank payments service providers, including payments service providers and mobile finance operators.

Finally, the introduction of DFC allows for, but does not intrinsically require, modernization of monetary and fiscal policy operations. For example, central banks may use the DFC payments network as another channel for monetary policy implementation, by paying interest on DFC instruments, and/or offering lending and/or liquidity services, while fiscal authorities would be able to make public expenditures directly into DFC wallets, alongside direct payments into bank deposit accounts, and the issuance of paper checks.

Digital Fiat Currency presents a future for payments system innovation, post-crisis monetary policy implementation, and regulation of the shadow banking sector. It leverages the strengths of existing banking operations and payments systems infrastructure, while addressing critical weaknesses in the structure of money markets, and the coordination process between fiscal and monetary policy. As contemporary understanding of central banking operations evolves, and new challenges emerge in monetary and fiscal policy, as well as macroprudential regulation, the basic innovation in payment instruments offered by a Digital Fiat Currency becomes increasingly relevant and necessary.

INTRODUCTION

THE RISE OF DIGITAL FINANCE

The recent proliferation of mobile banking, high-frequency trading, and e-commerce is merely the latest chapter in the ongoing collision of financial and digital communications technologies. Earlier generations witnessed innovations like the telegraph, and, shortly after it, the wire transfer. Together, some of these developments have enhanced the speed and efficiency of existing markets, while others, such as e-commerce and the burgeoning mobile finance industry, have already altered the trajectory of global economic development.

Though these technologies are becoming more familiar, their implications for monetary system design, and for fiscal, monetary, and macro-prudential policy – macroeconomic policy, broadly speaking – remain poorly understood. The creditor-debtor relationship that lies at the heart of modern money remains largely invisible to many non-financial market actors. Consequently, public discourse around money tends to treat it as *physical commodity*, rather than as a *legal relationship*.²

² Most people are unaware, for example, that when they deposit money with a bank, their claim over the funds originally deposited is replaced with a generalized liability against the bank. Indeed, even the most ubiquitous form of money – physical currency, such as coins and notes – constitutes an obligation of the government to the bearer of the instrument to accept that instrument back as legal tender for settlement of public and private debts. Thus, whether the liability is created via a registered account, in the case of banks, or directly as a bearer instrument, as in the case of physical currency, it always constitutes a liability of the issuer. See C. Desan, (2015), *Money as a Legal Institution*, in D. Fox & W. Ernst (Eds), *Money in the Western Legal Tradition*, UK: Oxford University Press.

THE RAPID PROLIFERATION AND EVOLUTION OF DIGITAL FINANCIAL TECHNOLOGIES USHERS IN NEW POSSIBILITIES AND CHALLENGES FOR FISCAL-MONETARY-MACROPRUDENTIAL COORDINATION, AND FOR A FUNDAMENTAL REIMAGINING OF THE TECHNICAL INFRASTRUCTURE UNDERGIRDING THE GLOBAL FINANCIAL SYSTEM.

Complicating the story of rapid technological change, is the legacy of the 2007-2008 global financial crisis.

Presently, fiscal and monetary authorities around the world are struggling to respond to persistently anemic global growth, rolling regional crises, and increasing public outcry for regulatory reform and a realignment of budgetary priorities. At the same time, the rapid proliferation and evolution of digital financial technologies

ushers in new possibilities and challenges for fiscal-monetary-macroprudential coordination, and for a fundamental reimagining of the technical infrastructure undergirding the global financial system. Macroeconomic policymakers face a challenge: How to take advantage of new technological opportunities to promote access to financial services, consumer protection, and inclusive growth, while bolstering macroeconomic stability and the resilience of financial systems.

PART I:

Three Challenges of Post-Crisis Macroeconomic Policymaking

1. Vanilla Banking in Flux

Traditional ‘Vanilla’ style banks – that is, licensed depository institutions, such as commercial banks, credit unions, and thrifts (collectively referred herein as “banks”) – play three systemically important roles within the economy. First, they undergird the retail payments system by maintaining customer accounts, facilitating transfers, issuing checks, and converting their liabilities into physical currency (paper notes and coins) at par, on demand.³ Second, they conduct credit analysis and underwrite profitable loans by accepting borrowers’ liabilities and/or collateral in exchange for their own liabilities. Their own liabilities are highly liquid, as they are the dominant means of settlement in the retail payments system, and can be used

³ This promise of convertibility is typically backed by deposit insurance, which, in turn, is backed by the full faith and credit of the sovereign government. G. Gorton & A. Metrick, (2009), Haircuts, National Bureau of Economic Research Working Paper 15273, p. 1, (“The idea [of bank deposits] was to create a medium of exchange, that is, a security that would be easily accepted in transactions, without needing to do extensive and costly due diligence on the bank. If the design was successful, checks would be used with confidence in their value without extensive due diligence. The traditional problem ... was that sometimes this confidence disappeared. ... This is the problem that deposit insurance stopped”).

to pay taxes, fees, fines, and other public obligations.⁴ Third, they serve as an intermediary conduit for monetary policy, as banks' loan-making activities, which expand and contract borrower purchasing power, and thus, aggregate demand, are sensitive to the price of overnight settlement balances in the central bank reserve system.⁵

Each of these interrelated functions – payments system management, credit-analysis, and money-creation – serves a hybrid private-public purpose. To the private sector, banks offer network services, assume credit risk, and promote capital development. At the same time, banks undergird the public payments system, enjoy government-backed liability insurance, and are responsible for promoting the capital development of the economy by elastically expanding and contracting the supply of purchasing power.

Beginning in the years prior to the crisis, these traditional banking functions are increasingly carried out, not only by banks, but by a diverse and growing range of non-bank financial institutions (NBFIs).

At the retail level, telecommunications and software companies have developed various forms of mobile- and internet-based applications to provide checking account-like payments services. Services like 'mobile money' began as simple mechanisms to facilitate remittances, but have since blossomed into a high-volume industry that offers increasingly complex services, such as insurance policies and savings and credit features.

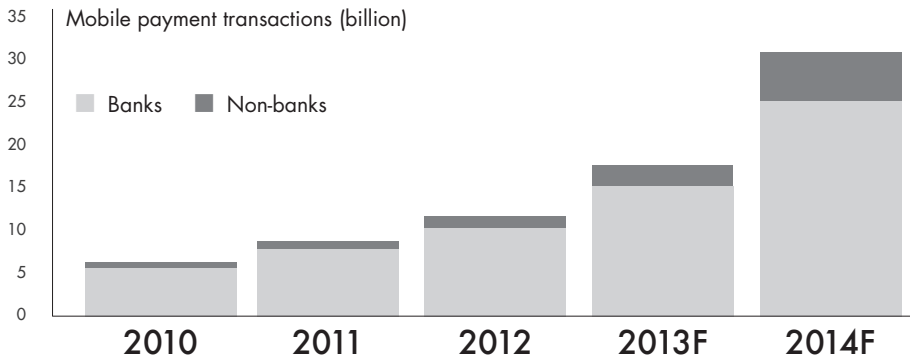
The emergence of mobile money operators and other NBFIs at the retail level is mirrored at the wholesale, institutional level by the rise of what is colloquially known

⁴ In 2014, the Bank of England observed that "some economists have referred to bank deposits as 'fountain pen money,' created at the stroke of bankers' pens when they approve loans ... Just as taking out a new loan creates money, the repayment of bank loans destroys money". M. McLeay, A. Radia, & R. Thomas, (2014), *Money Creation in the Modern Economy*, Bank of England Quarterly Bulletin (First Quarter), p. 4.

⁵ Central banks use this rate, known as the 'overnight rate', as the primary lever for influencing the broader market structure of interest rates. See Federal Reserve Bank of San Francisco, (2004), *What are the Tools of Monetary Policy?*

⁶ Cappgemini and The Royal Bank of Scotland (2013), *World Payments Report*, p. 15.

Figure 1: Annual Global m-Payment Transactions, 2010-14F⁶



as the “shadow banking” sector.⁷ This sector, comprised of various forms of NBFIs, including special purpose vehicles (SPVs) owned by licensed bank holding companies, conducts a range of bank-like functions, including cash and liquidity management, triparty market clearing, and credit intermediation via the securitization, collateralization, and rehypothecation of publicly- and privately-issued liabilities.

Although the rise of shadow banking cannot be traced to one single cause, a major precipitating factor was the persistent undersupply of liquid, safe money instruments, relative to global demand, over the past thirty-five years.⁸

For retail customers in developed economies, this demand has historically been satisfied by insured bank deposits.⁹ However, for low-income earners and for many emerging economies, access to even vanilla banking services remains out of reach, with brick and mortar branches failing to reach remote and rural areas and services often demanding minimum balances and fees which out-price poor clients. These unmet needs have driven demand for alternative services offered by NBFIs.

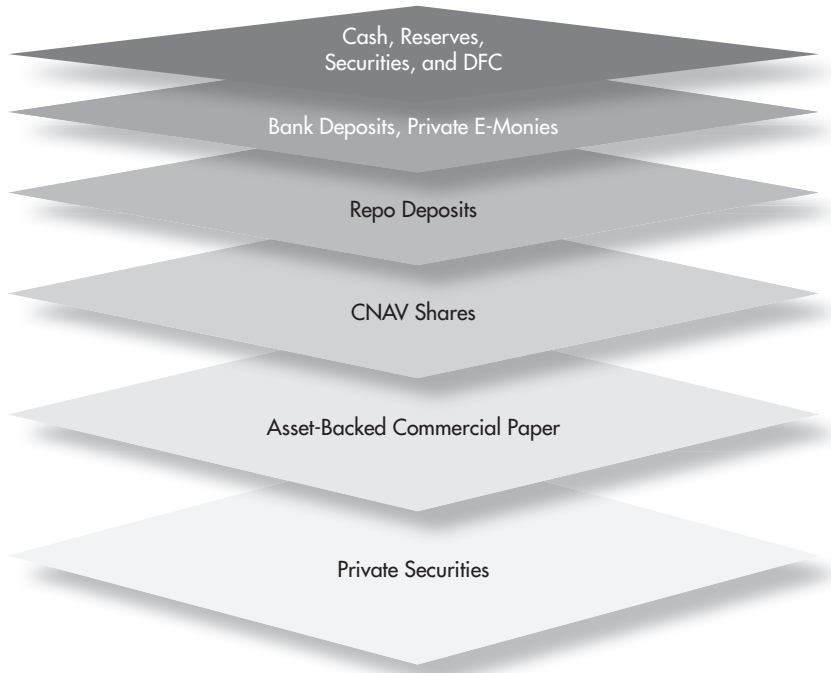
⁷ See, e.g., Z. Pozsar, (2014), Shadow Banking: The Money View, Office of Financial Research Working Paper 14-04; S. Claessens, Z. Pozsar, L. Ratnovski, & M. Singh, (2012), Shadow Banking: Economics and Policy, International Monetary Fund Staff Discussion Note 12/12; Z. Pozsar, T. Adrian, A. Ashcraft, & H. Boesky, (2010, revised 2012), Shadow Banking, Federal Reserve Bank of New York Staff Report No. 458.

⁸ See Z. Pozsar, (2011), Institutional Cash Pools and the Triffin Dilemma of the U.S. Banking System, IMF Working Paper 11/190, p. 8.

⁹ And, to a lesser extent, physical currency and coins.

At the wholesale end of the financial spectrum, money managers and other large institutional investors face individual account limits on deposit insurance which render traditional deposits legally unsuitable vehicles for wholesale cash pool storage.¹⁰ Consequently, money managers turned to government securities – and in particular, those of the United States, the United Kingdom, and other large,

Figure 2: Hierarchy of Money¹¹



These layers depict a hierarchy of money, with safer or more ‘information insensitive’ assets positioned closer to the top layer. Thus, government-issued instruments, such as cash, reserves, securities, and DFC are at the top, followed by bank deposits and deposit-backed private e-monies, then repo deposits, money market fund shares, and, finally, asset-backed commercial paper and private securities.

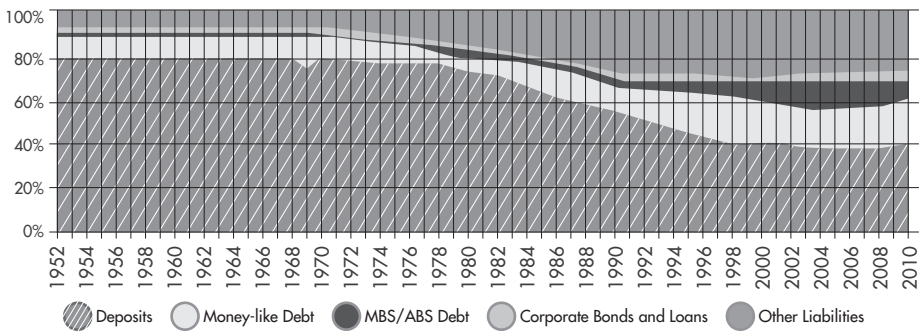
¹⁰ The United States, for example, approved a temporary increase in its individual depositor insurance limit from \$100,000 to \$250,000 in 2008, in response to public and market concerns about deposit safety stemming from the global financial crisis, and subsequently made this increase permanent in 2010.

¹¹ This graphic is inspired by a related pyramid depicting the hierarchy of shadow money by Daniela Gabor & Jakob Vestergaard. For more on the “hierarchy” of public and private money liabilities, see D. Gabor & J. Vestergaard, (2016), *Towards a Theory of Shadow Money*, Institute for New Economic Thinking, p. 14; R. Hockett & S. Omarova, (2017), *The Finance Franchise*, Cornell Law Review, Vol. 102 (forthcoming).

developed economies – as a safe, interest-earning alternative asset, which could be easily converted into settlement balances via the money markets.

When the global supply of insured deposits and treasury securities proved insufficient to meet market demand, however, money managers turned to the next-best alternative: the liabilities of NBFIs, such as repurchase agreements and the marketable shares of money market mutual funds (MMMMFs).¹²

Figure 3: Components of Safe Financial Debt¹³



NBFIs met this growing demand by issuing their own negotiable liabilities, which functioned as private ‘near-monies’ under regular business conditions, thereby cannibalizing wholesale cash and checking account services that had historically been performed by licensed banks.¹⁴ This blurred the distinction between commercial and investment banks – a distinction that had bifurcated the spectrum of financial institutions for much of the twentieth century. Importantly, this phenomenon was being mirrored at the retail level as the rise of mobile money giants m-pesa and G-Cash, Paypal, and other forms of private electronic money systems introduced ‘near monies’ to retail consumers.

¹² D. Gabor & J. Vestergaard, (2016), *Towards a Theory of Shadow Money*, Institute for New Economic Thinking, p. 14.

¹³ Source: G. Gorton, S. Lewellyn, & A. Metrick (2012), *The Safe-Asset Share*, National Bureau of Economic Research Working Paper No. 17777, ‘Figure 3: Components of Safe Financial Debt’, p. 10.

¹⁴ See Z. Poszar, (2011), *Institutional Cash Pools and the Triffin Dilemma of the U.S. Banking System*, IMF Working Paper 11/190, p. 8.

IT IS NOW GENERALLY ACCEPTED THAT THE PERSISTENT UNDERSUPPLY OF SAFE, LIQUID ASSETS INCREASES THE SYSTEMIC FRAGILITY OF THE FINANCIAL SECTOR.

Short-term liabilities issued by shadow bank institutions typically functioned like liquid money-instruments in good times. Critically, however, because they did not have the backing of the government, in periods of crisis – such as the global financial crisis of 2007-2008 – this money-resemblance faded, and they were treated as far more risky and unstable than insured bank deposits or government securities.

While these dynamics were not fully understood prior to the 2007-2008 crisis, it is now generally accepted that the persistent undersupply of safe, liquid assets increases the systemic fragility of the financial sector.¹⁵

Similarly, as mobile money and other retail-oriented e-money networks become more deeply embedded in developing and developed financial markets, the systemic risks posed by these private liabilities is magnified.

In sum, the traditional 'vanilla banking' sector faces competitive pressures from above and below. The unique institutional privileges that once ensured the dominance of licensed banks – i.e., responsibility for payments system management, direct access to central bank liquidity, and a guarantee of par convertibility between their deposit liabilities and government-issued currency – no longer afford them the same competitive edge.

At the same time, central banks and prudential regulators today are far more circumspect about the impact of private near-monies, at both the retail and institutional investor level, on systemic liquidity and global stability, and face considerable pressure to reform and adapt payments systems to meet the twenty-

¹⁵ A quote from the U.S. Office of Financial Research is particularly telling: “[F]or institutional cash pools, money begins where M2 ends, and as the crisis has shown, intra-system holdings of uninsured money market instruments can pose threats to financial stability.” Z. Pozsar, (2014), *Shadow Banking: The Money View*, p. 4. See also P. Gourinchas & O. Jeanne, (2012), *Global Safe Assets*, Presentation at the XI Bank of International Settlements Annual Conference, Lucerne, June 20-21, 2012.

first century needs of both retail and wholesale customers.

2. Improving Monetary Policy

In addition to the architectural issues described above, the global financial crisis and its aftermath undermined the consensus view of appropriate institutional division of labor between fiscal and monetary authorities. Despite responding swiftly and aggressively, central banks' traditional approach of monetary easing – lowering short-term interest rates – proved insufficient to revive global growth to pre-crisis levels. Moreover, the limited success central banks did achieve through easing was often undermined by the contractionary budget stance adopted by fiscal authorities, who were either unwilling or unable to engage in further stimulus due to concerns over public debt levels and the perceived inflationary impact of large deficits.¹⁶

These twin frustrations – the limited effectiveness of available monetary policy tools, and politically-induced fiscal inertia – have led central bankers to consider innovative ways to resurrect the effectiveness of traditional monetary policy. Such improvisations include introducing long-term as well as short-term interest rate targets, purchasing private sector financial assets, and enacting technological changes that would enable the central bank to lower short- and long-term interest rates further into negative territory. Still, such innovative efforts have, in turn, raised concerns about unintended long-term consequences: undermining the separation of fiscal and monetary authority, encouraging and/or backstopping unsound financial practices, and increasing the risk of future inflation and systemic instability.

While various counter-solutions have been proposed, including a full elimination of cash and abandonment of the par-convertibility guarantee between digital

¹⁶ Said Former US Federal Reserve Chairman Ben Bernanke, "Although long-term fiscal sustainability is a critical objective, excessively tight near-term fiscal policies have likely been counterproductive. Most importantly, with fiscal and monetary policy working in opposite directions, the recovery is weaker than it otherwise would be. But the current policy mix is particularly problematic when interest rates are very low, as is the case today. Monetary policy has less room to maneuver when interest rates are close to zero, while expansionary fiscal policy is likely both more effective and less costly in terms of increased debt burden when interest rates are pinned at low levels." B. Bernanke, (2014), 'The Federal Reserve: Looking Back, Looking Forward,' Speech at the Annual Meeting of the American Economic Association, January 3, 2014.

deposits and cash, there is limited consensus about the desirability and efficacy of these approaches among the global central banking class.¹⁷

3. Rethinking Fiscal Wisdom

In addition to revealing the limits of traditional monetary policy tools, the global financial crisis has challenged policymakers to fundamentally rethink the relationship between fiscal policy and monetary policy. On one hand, central bankers and treasury policymakers are increasingly vocal about the limits of monetary easing. They increasingly advocate for complementary fiscal stimulus, to address the deflationary bias and high global unemployment that have characterized the post-2008 global economy.¹⁸ Indeed, there is a growing appreciation among central bankers that the macroeconomic conditions in which monetary policy and macroprudential regulation are conducted are fundamentally dependent on the fiscal stance adopted by the government.

This recognition has resulted in some blurring of lines which formerly demarcated functions of monetary and fiscal policy levers. Three specific insights are of particular interest.

First, there is now a greater recognition of the need to create safe, government-backed assets to sufficiently accommodate the private sector's net savings desires, regardless of the fiscal stance and size of the budget deficit.¹⁹

Second, central banks are paying greater attention to the fact that the interest income earned on treasury securities by the private sector is a form of fiscal spending. In particular, by engaging in extensive purchases of longer-term treasury debt to further lower interest rates, and subsequently remitting all net profits earned

¹⁷ For an extended treatment on this issue, see K. Rogoff, (2016), *The Curse of Cash*, Princeton University Press.

¹⁸ See, e.g., J. Furman, (2016), *The New View of Fiscal Policy and Its Application*, Presentation by the Chairman of the White House Council of Economic Advisors at the Conference on 'Global Implications of Europe's Redesign,' New York, October 5, 2016; R. Greenwood, S. Hanson, J. Rudolph; L. Summers, (2014), *Government Debt Management at the Zero Lower Bound*, Hutchins Center Working Paper #5, p. 2.

¹⁹ This is partially in order to prevent the outsized growth of private 'near-monies,' which function like publicly-backed money in good times, but are subject to credit and liquidity risk in times of crisis. See P. Gourinchas & O. Jeanne, (2012), *Global Safe Assets*, Paper Presented at the Bank of International Settlements Annual Conference on June 20-21, 2012.

on these securities back to the Treasury, central banks are effectively engaged in contractionary fiscal policy, counteracting the intended stimulative effect of lower interest rates.²⁰

Third, as a result of quantitative easing (QE) and similar programs, many countries' banking systems are awash with central bank settlement balances (i.e., reserves). As a result, monetary policy in those countries is increasingly implemented not by the open market purchase and sale of treasury securities, but by the direct payment of interest on excess reserves, in combination with the issuance of central bank liabilities such as term deposits and/or marketable securities.

Consequently, just as coins and central bank notes function as largely interchangeable forms of physical currency, for many financial market actors, interest-earning treasury liabilities (notes, bills, bonds), and interest-earning central bank liabilities (reserves, term deposits, securities) have become functional substitutes for each other. Thus, the traditional distinction between government "currency" and government "debt" has become less definite, and traditional beliefs about the uniquely inflationary impact of "money-financed fiscal policy," in contrast to "debt-financed fiscal policy," are being reexamined.

As the U.S. Federal Reserve Bank of San Francisco articulated as early as 2011:

Until just a few years ago, bank reserves and cash were the same in many respects. Both were part of the monetary base. Both earned no interest. And both could be used to satisfy reserve requirements and settle payments between banks.

But now banks earn interest on their reserves at the Fed and the Fed can periodically change that interest rate. This fundamental change in the nature of reserves is not yet addressed in our textbook models of money supply and the money multiplier. ...[I]n a world where the Fed pays interest on bank reserves, traditional theories that tell of a mechanical link between reserves, money

²⁰ See S. Carpenter, J. Ihrig, E. Klee, D. Quinn, & A. Boote, (2015), The Federal Reserve's Balance Sheet and Earnings: A Primer and Projections, *International Journal of Central Banking*, Vol. 11:2, p. 253.

supply, and ultimately inflation no longer hold...if the Fed is willing to pay a high enough interest rate on reserves...the quantity of reserves held by U.S. banks could be extremely large and have only small effects on, say, M1, M2, or bank lending.²¹

At the same time, central banks are opening their balance sheets to a wider range of NBFIs via broad-based repurchase and reverse repurchase facilities. These facilities lend settlement balances overnight against adequate collateral, including privately issued securities. In contrast to traditional open market operations, which involve the exchange of government liabilities (i.e., treasury securities in exchange for central bank settlement balances), the accumulation and exchange of risky, private-sector liabilities by the central bank introduces a fiscal component.

Thus, while banks are coming to terms with the loss of their historic monopoly over access to central bank liquidity and the rise of market-driven pressure from retail and wholesale payments system competitors, fiscal and monetary authorities are beginning to consider new approaches to treasury-central bank coordination and macroeconomic stabilization.

²¹ J. Williams, (2011), Economics Instruction and the Brave New World of Monetary Policy, Federal Reserve Bank of San Francisco Economic Letter 2011-17.

PART II:

The Way Forward

ADDRESSING DEVELOPMENT AND TECHNICAL NEEDS

Part I outlined institutional challenges to the oversight of a healthy macroeconomy. But factors of policy and politics are not the only sources of macroeconomic uncertainty. Indeed, macroeconomic policymakers today face a range of challenges and opportunities stemming from global development imperatives and budding technological innovations. Pressing areas of discussion and priority include:

- > How to insulate consumers and businesses involved in retail and wholesale cash management activities from the systemic liquidity and solvency risks associated with relying on inferior near- and non-monies, including forms of privately issued e-money and money market mutual fund shares.
- > How to design a central bank-issued monetary instrument that can flow across different payments platforms, while preserving the independence and integrity of the reserve settlement system for those engaged in the subjective and risky process of bank lending.

- > How to encourage market-driven retail and wholesale payments platform innovation, including the creation of secure digital wallets and last-mile delivery channels, which faithfully meets the savings and transactional needs of all market actors, while preserving universal interoperability.
- > How to simplify the public budgetary process so as to reduce confusion regarding the distinction between ‘money-financed deficits’ and ‘debt-financed deficits,’ without simultaneously increasing self-reinforcing fears of inflation and/or macroeconomic instability.
- > How to provide the private sector with a sufficient supply of safe, government-backed financial assets, while simultaneously maintaining legislative discretion over fiscal policy, as well as reasonable rule-based limits on monetary policy.
- > How to preserve the operational independence of central banks in light of the evolving nature of fiscal-monetary coordination, and the functional similarity of treasury and central bank liabilities.
- > How to empower central banks to achieve and maintain stable, inclusive growth via simple, predictable monetary policy and macroprudential regulation, without assuming fiscal powers and/or undermining the existing market for physical currency.

DIGITAL FIAT CURRENCY: A TECHNICAL SOLUTION TO A TECHNICAL PROBLEM

We present here a partial solution to the challenges articulated heretofore, in the form of a new technical instrument: digital fiat currency. Gaining increased attention from central banks around the world, a central bank-issued digital fiat currency (“DFC”) instrument, is designed specifically to simplify the existing suite of government-issued monetary instruments, complement the current currency mix of notes and coins, and, in the long run, serve as a general digital media option for all forms of cash-like payments.²²

²² Digital Fiat Currency, like cash, promises significant privacy advantages over traditional account-based digital payments networks, while retaining design features that allow for some degree of legal regulation and oversight, similar to that provided by the inclusion of serial numbers or barcodes on banknotes. For more information on the relationship between banknote security design and regulatory oversight of cash transactions, see H. de Heij & A. van Gelder, (2006), Numbers on Banknotes: What is Their Use?, *Keesing Journal of Documents and Identity*.

Design Considerations and Constraints

A DFC instrument is explicitly designed to address both retail and wholesale money market needs by accommodating small-dollar and large-dollar transactions, and guaranteeing direct, at-par convertibility from other forms of government-backed liabilities. These include those liabilities not directly issued by the central bank, such as treasury securities and insured bank deposits.

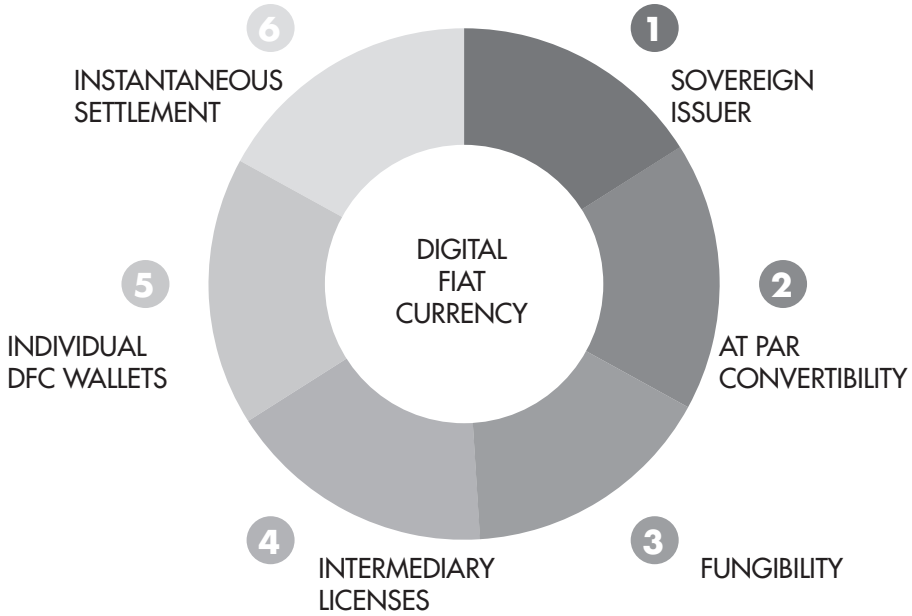
The value of government money is primarily determined by its unique legal and political characteristics – notably, its capacity to be submitted by any party as a means of final settlement of taxes, fees, fines, and privately-incurred liabilities. Thus, although DFC is a novel technological development, like coins, central bank notes, government-insured bank deposits, and government-issued securities, DFC units share the same underlying source of value as all other forms of government issued money: the full faith and credit of the issuing state.

The core features of DFC intermediary payments processing technology are: (1) all transactions are instantaneous and final, with no need for counterparty risk, or back end settlement;²³ and (2) any transaction between DFC wallets cannot increase or reduce the overall supply of DFC units in circulation. Together, these two constraints allow the central bank to serve as a central counterparty for all payments processing, without incurring additional credit or intermediary risk on behalf of intermediaries, or otherwise requiring information about DFC wallet balances or transactional history. Moreover, because the DFC network is

DFC IS DESIGNED SPECIFICALLY TO COMPLEMENT AND SIMPLIFY THE EXISTING SUITE OF GOVERNMENT-ISSUED MONETARY INSTRUMENTS, AND IN THE LONG RUN, TO SERVE AS A GENERAL MEDIA FOR ALL FORMS OF DIGITAL PAYMENTS.

²³ Instead, as in cash-based transactions, any post-transaction restitution can and would be accomplished via legal, rather than technical, means.

Figure 4: Characteristics of a Digital Fiat Currency System



completely liquid, it can be scaled up to manage wholesale transfers of extremely large quantities without incurring any additional processing risk as at the retail level.

A properly-designed DFC system has, at a minimum, the following characteristics:

1. The central bank is the sole authorized party to issue DFC liabilities, with similar ownership restrictions and legal tender protections as physical currency. Although the legal structure governing the DFC system will vary by national jurisdiction, it is generally expected that DFC units will be bearer-instruments, and will remain the property of the customer, in contrast to registered account deposits such as central bank reserves or bank deposits, which are a liability of the intermediary.²⁴

²⁴ We reserve a comprehensive treatment of the legal design and regulatory implications of the DFC model for a forthcoming examination. For a discussion of the legal dynamics of a registered account-based mobile finance system, see J. Greenacre & R. Buckley, (2014), Using Trusts to Protect Mobile Money Customers, Singapore Journal of Legal Studies, pp. 59-78.

2. The central bank directly guarantees the at-par convertibility of DFC liabilities into physical currency and/or settlement balance liabilities (reserves), and pays an interest rate on DFC liabilities consistent with the interest rate structure of other government liabilities, and the central bank's broader monetary policy and financial stability objectives.
3. The central bank pledges to buy, sell, loan or borrow any government-guaranteed interest-bearing assets in exchange for an equivalent amount of DFC liabilities, and to pay an equivalent interest rate on those DFC liabilities to that originally promised on the security, for a period of time consistent with the original duration of the security.
4. Private financial institutions that meet basic criteria are eligible to apply for a special DFC intermediary license, and, upon receipt of such a license, are eligible to establish and maintain DFC wallets on behalf of retail customers, and to convert, upon demand, currency and/or government-guaranteed obligations, at face value, into DFC units. Banks and other licensed depository institutions are automatically eligible for DFC intermediary licenses, and upon obtaining one, are eligible to receive, from the central bank, perpetual, rolling, zero-interest loans of DFC-units. This, upon pledging collateral underlying any loan consistent with that bank's capital adequacy requirements, up to an equivalent of the amount of demand deposits that would otherwise be covered by deposit insurance for that account.
5. Any individual or entity can obtain a DFC wallet, managed by a licensed DFC intermediary, and store funds in that wallet, without technical limit.²⁵
6. Licensed DFC intermediaries can make payments from customers' DFC wallets, on their behalf, through a trusted DFC intermediary network, mediated

²⁵ Although there are a range of conceivable uses of DFC wallets, most users are likely to fall into one of three categories: (1) retail consumers, who will use DFC for retail payments and basic checking account services; (2) commercial entities, who will use DFC for cash-flow and payments; and (3) financial investors, who will use DFC primarily for liquidity and storage purposes. Bardear and Kumhof at the Bank of England note that proposals based around capping digital currency accounts on a per-user basis would "naturally limit the set of transactions for which CBDC could be used, and so could potentially decrease its attractiveness to end users." J. Bardear & M. Kumhof, (2016), *The Macroeconomics of Central Bank Issued Digital Currencies*, Bank of England Staff Working Paper No. 605, p. 11. On the other hand, governments regularly impose restrictions on the holding and transportation of even physical currency.

and backed by the central bank. To minimize intermediary credit and/or liquidity risk, any such transactions occur instantaneously, and do not involve any expansion or contraction of the balance sheet of the facilitating intermediaries. Eventually, wallet-managing intermediary institutions could be replaced with individually managed wallets, stored on particular devices, with regulatory oversight conducted at the communications network level.

IMPACT AND BENEFITS

Benefits for Central Banks, Treasuries, and Users

DFC is, at its legal core, the digital equivalent of paper currency. As was paper currency in its time, DFC is both revolutionary, in that it promises to disrupt various markets and processes in which currency has long been inefficient or impracticable, and conservative, in that it seeks to preserve the core dynamics of the modern financial system and improve the efficiency of existing market actors, rather than replace them entirely.²⁶

Because DFC is conceived as a legal-tender liability of the central bank, seigniorage revenue from its creation is retained as earnings on the central bank's balance sheet, and can be periodically remitted to the Treasury as a form of government revenue, along with any other net-profits of the central bank. Thus, introduction of DFC will not negatively impact the budgetary position of the central bank, or its ability to finance its operations through issuance of its own liabilities.²⁷

From the perspective of the Treasury, DFC wallet holdings would be held as assets on its balance sheet, and would be included in measurements of the Treasury's net fiscal position. Like central bank settlement balances, the DFC system balance

²⁶ By contrast, other digital financial innovations, such as Bitcoin, are premised on a wholesale rejection of the validity of the state as the primary entity underlying the financial system, and the role of central banks in determining monetary policy, and managing the banking system. In that respect, Bitcoin and DFC are opposites, as DFC is premised on the recognition of the public nature of money, and the importance of public institutions in the maintenance and regulation of the financial system.

²⁷ Admittedly, DFC may affect the market for treasury securities in such a way as to affect the amount of interest earned on a central bank's stock of treasury securities, but such an impact is no different to the effect of other monetary policy tools, such as the payment of interest-on-reserves, and would ultimately only affect intragovernmental accounting flows between the treasury and central bank, rather than the net position of the consolidated government.

would be recorded as a dedicated account entry at the central bank. Fiscal outlays would therefore be managed through a combination of the settlement balance and the DFC system, with the choice of use of each platform depending on their relative suitability for the payee in question. This resembles the contemporary practice of many Treasury departments to manage a portion of daily tax payments through dedicated deposit accounts at licensed banks, in order to smooth inflows and outflows from the reserve settlement system.²⁸

LIKE PAPER CURRENCY WAS IN ITS TIME, DIGITAL FIAT CURRENCY IS BOTH REVOLUTIONARY AND CONSERVATIVE.

Similarly, DFC end users would hold DFC unit balances in their digital wallets as assets, and the central bank, via its licensed intermediaries, would guarantee convertibility of these units to either settlement balances, or physical cash, upon demand. Thus, the DFC settlement system would operate similarly to the reserve settlement system, while remaining quasi-independent of it. Indeed, if desired, net stock of outstanding DFC units in circulation within the DFC payments network could be represented via a single master account within the reserve system, similar to the way that the stock of outstanding physical currency notes are recorded as a line-item liability alongside the central bank's reserve liabilities. Such an approach would greatly improve the interoperability of the DFC network and the existing bank-based payments system.

At the same time, the introduction of a DFC system does not necessarily require disrupting existing consumer practices or preference, as the user experience transition to transacting in DFC would be mostly invisible to consumers. Users of transaction accounts of all types – whether intermediated by a financial or non-financial institution – would retain existing customer relationships and interfacing.

²⁸ See Federal Reserve of New York, (2016), Treasury Tax and Loan Program, ("Under the Treasury Tax and Loan (TT&L) program, tax payments by individuals and businesses go into accounts at depository institutions, rather than directly to the Treasury's accounts at the Federal Reserve...TT&L accounts help to stabilize the supply of reserves in the banking system, increasing the stability of financial markets and simplifying the implementation of monetary policy").

Behind the scenes, a DFC system would resemble the existing bank depository system, with a separation between the consumer-facing ‘wallet,’ and the B2B payments processing conducted by intermediaries.

On the other hand, the transactional dynamics of the DFC system are different to the reserve system; in a reserve system, depositors do not retain ownership over deposited funds, but instead retain a claim on the intermediary, whereas under a DFC system, the intermediary merely holds the depositor’s funds on behalf of their actual owner, the customer.²⁹

Although it would not be necessary for the central bank to provide consumers with the option of maintaining a retail DFC wallet at the central bank, a government could choose to do so. Alternatively, a government could provide such a wallet via the treasury or a sub-treasury agency, or through a network of public and/or postal or commercial banks. In most cases, however, it is expected that retail customers will interact with the DFC system through digital wallets that are managed by intermediaries, but whose funds remain the property of the customer. In addition, by structuring the payments infrastructure around bearer-instruments, as opposed to registered accounts, a DFC system offers greater freedom and flexibility for privacy-conscious consumers.

IMPACTS FOR EMERGING ECONOMIES

While a broad set of impacts and benefits is expected for all nations who adopt a DFC approach, emerging economies may benefit in even more profound ways. Of particular benefit to the emerging economy context are the following.

Data-Based Decision Making

As explained previously, a feature of the digital fiat currency system is the restoration of issuance functions of all electronic currency to the central bank. As intermediaries

²⁹ In contrast to a bank deposit, which is a chose in action entitling the depositor to sue the bank, rather than an actual claim on the underlying funds that were originally deposited, property held on one party’s behalf by another party is typically regulated under the legal principle of bailment. A full legal treatment of the role of bailment principles in the legal design of DFC will be addressed in a subsequent white paper in this series.

shift from offering customers private e-monies to acting as conduits to issue central bank-backed DFC to their clients, the central bank is able to more efficiently and effectively administer the issuance and distribution of safe money instruments, such as currency, coins, and book-entry reserves. The addition of a real-time aggregated dashboard to enable transparent monitoring of flows of DFC units allows central banks to make decisions about the tightening or loosening of monetary policy based not on conjecture, but on heretofore difficult to obtain data. Because cash-based economies suffer a paucity of real-time data about amount of currency in circulation, central banks have struggled to proactively use monetary policy levers to course correct for stability and growth. DFC fills this data gap, enabling sounder decision making, based in monitored supply of government-issued currency instruments.

A Powerful Policy Lever in Cash-Based Economies

Approximately 85% of all global consumer transactions are conducted in paper-based currency. In emerging economies, the ratio of cash to other forms of transactions skews higher still, until recently 98% for India and nearly 100% for Indonesia.³⁰ Most emerging economies are still heavily cash-based, with citizens and businesses conducting upwards of 80% of all transactions in physical cash currency. With lower participation in formal and wholesale borrowing and debt markets, a central bank's traditional policy lever of interest rate adjustment yields less power in the real economy. If adjustments to interest rates have a diminished effect on a nation's largely cash-based economy, a central bank must rely on a complementary policy lever, namely control over the issuance and destruction of the currency instruments. Surely control over the creation and destruction of legal tender remains a priority of all central banks. Still, the restoration of the currency issuing functions for cash-based economies will have a magnified effect, as it may be the most powerful policy lever that institution has at its disposal to support the health of its economy.

³⁰ H. Thomas (2013), *Measuring Progress Toward a Cashless Society*, MasterCard [comma] as cited in J. Dharmapalan & C. McMahon [comma] (2016 [bracket]), *The Case for Digital Legal Tender: Central Bank Issued Digital Currency and its Impact on Financial Inclusion*.

Leapfrogging Legacy Payment and Banking Systems

From a developmental perspective, a DFC system has the potential to rapidly promote innovation and growth in countries suffering from persistent financial exclusion, poor financial infrastructure, and limited participation in the formal economy. Indeed, many of the populations of these oft-remote regions, while severely underbanked, nevertheless enjoy widespread access to developed telecommunications networks, which can serve as the infrastructural basis for a DFC system. By leveraging as opposed to replacing existing payments infrastructures, the DFC approach offers the possibility of leapfrogging the legacy systems of developed markets, while avoiding the risks and inefficiencies of mobile money and other forms of private, e-money systems.

Simplifying Existing Systems

The distinction between non-interest bearing and interest-bearing liabilities is significant to the legal classification of DFC units, as historically, digital and mobile phone-based e-money instruments were distinguished from conventional bank deposits by the fact that the former did not pay interest.³¹

Although DFC could function as a non-interest bearing instrument, like a digital version of coins and central bank notes, central banks would also be technically capable of paying interest on DFC-units, like the contemporary practice of paying interest on excess reserves to depository institutions as part of the daily implementation of monetary policy. Indeed, payment of interest units would further increase the similarity of DFC units with retail demand deposits, and allow intermediaries that do not wish to undertake the full range of traditional banking activities to more effectively compete for deposits. It would also ensure that the introduction of DFC did not undermine or inhibit the effective conduct of unconventional monetary

³¹ Argent, J., Hanson, J., & Gomez, M. P., (2013), *The Regulation of Mobile Money in Rwanda*, International Growth Centre Working Paper, p. 7. Some mobile money theorists, on the other hand, argue that the collection of repayable funds from the public constitutes a "deposit" regardless of the collecting institution, particularly given the prevalence of saving-related activity undertaken through mobile money systems. Tarazi, M., (2009), *E-Money Accounts Should Pay Interest, So Why Don't They?*, March 17, 2009, Consultative Group to Assist the Poor. See also Weber, R., & Darbellay, A., (2010), *Legal Issues in Mobile Banking*, *Journal of Banking Regulation*, Vol. 11:2, 129-145, 132 (arguing that pre-paid phone accounts should be considered deposits due to their capacity to be used to make non-phone-related retail payments).

policy, such as negative nominal interest rates.

While there have been recent developments in this area – for example, Tanzania began permitting interest on mobile money deposits in 2014, and Ghana recently followed suit in 2016, there remains a noticeable lack of global consensus around the appropriate regulatory classification of mobile money funds.³² Moreover, such developments have typically involved the paying of interest by mobile money operators themselves, rather than merely acting as pass-through intermediaries of interest paid by the central bank (in the case of reserves) or Treasury (in the case of treasury securities). Such an approach increases the potential for systemic risk, as it conflates the fiduciary responsibilities of a common carrier-like network operator with those of a liquidity-generating financial intermediary.

In an attempt to circumvent risks of destabilizing private e-mones, while still reaching historically excluded customers, some countries are beginning to experiment with ‘narrow bank’ licensing. The goal was to encourage intermediary financial institutions to provide low-income individuals with a safe way to store funds and conduct basic transactions without assuming the full costs associated with the business model or commercial risks of banking institutions. For example, India recently approved the issuance of eleven licenses for “payments banks,” which may issue interest-bearing deposits and make transactions, but are precluded from issuing loans or otherwise taking on the kind of credit risk associated with traditional banking.³³ Thus, there is a growing recognition of the need for innovative business models from both the payments processing and traditional banking sectors.

A NARROW PAYMENTS SYSTEM

In contrast to narrow banks, which remain firmly within the existing bank deposit-

³² See C. McKay, (2016), Interest Payments on Mobile Wallets: Bank of Tanzania’s Approach, Consultative Group to Assist the Poor; B. Buruku & S. Staschen, (2016), How Ghana Sets Its Rules on Interest Payment on e-Money Accounts, Consultative Group to Assist the Poor.

³³ Deloitte, (2014), RBI Guidelines for Licensing of Payments Bank: Opportunities and Challenges.

A DFC SYSTEM ALLOWS FOR FUNCTIONAL INTEROPERABILITY ACROSS THE ENTIRE PAYMENTS ECOSYSTEM, INCLUDING MOBILE FINANCIAL SERVICES, AND THE WHOLESALE MONEY MARKETS.

based payments infrastructure, a DFC system allows for functional interoperability across the entire payments ecosystem, including mobile financial services, and the wholesale money markets.

Thus, the DFC system serves as a parallel, 'narrow' payments system alongside the existing banking system.³⁴ DFC intermediaries

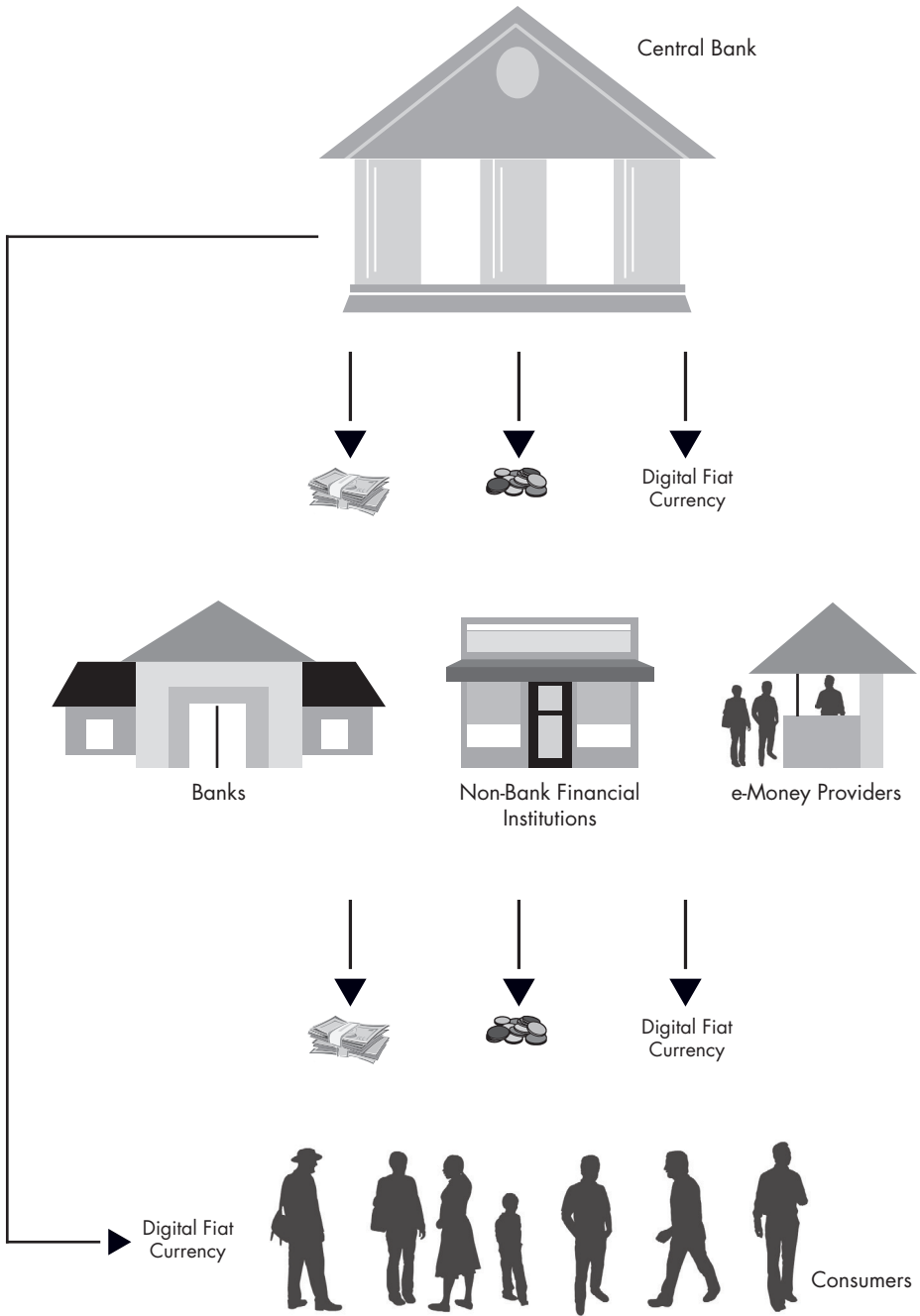
effectively function as a distribution network for, and passive conduit of the central bank's currency-creation power, as opposed to its credit-creation power. This allows for a conceptual and operational split between the entities responsible for payments processing and those responsible for loan-making. By eliminating the intermediary credit and liquidity risk associated with traditional payments, a DFC system can accommodate a far wider spectrum of financial institution intermediaries than can the depository banking system. Moreover, as DFC-units are directly guaranteed by the government, there is no need for deposit insurance, reserve requirements, and/or macroprudential regulatory restrictions on leverage, liquidity, and collateral quality.

Unlike traditional narrow banking proposals, such as the 'Chicago Plan' of the 1930s,³⁵ the aim of a DFC system would not be to curb, restrict, or otherwise supplant the traditional banking system. DFC makes no attempt to replace a banking system with a one in which the sole form of financial liquidity is issued directly by the state. As critics of that "full-reserve banking" approach have argued, such an attempt would likely impede the capital development of the economy by restricting

³⁴ See, e.g., D. Neipelt, (2015), Reserves for Everyone – Towards a New Monetary Regime?, VoxEU.

³⁵ The Chicago Plan was a proposal to eliminate fractional-reserve banking by splitting existing banks into narrow banks, who would be responsible for depository functions and required to back every deposit dollar-for-dollar with reserves, and investment banks, who would acquire funds solely through sale of their own securities, thereby limiting their lending capacity based on pre-acquired funds. For more, see R. Phillips & H. Minsky, (1995), The Chicago Plan and New Deal Banking Reform, Routledge.

Figure 5: Distribution of eCurrency – Fast, Secure, and Flexible



access to credit for productive, profitable enterprises. Moreover, in the absence of an extremely robust fiscal stance by the government, heavy-handed restrictions on private liquidity creation would likely lead to chronic demand shortages, or, at best, poorly-responsive and under-targeted forms of demand management.³⁶

To the contrary, the aim of a DFC approach would be to complement traditional banking activity, by facilitating the unbundling of its payments processing function from that of credit-creation and risk-analysis. In other words, a DFC system is an attempt to increase the range of market actors responsible for managing and distributing government-backed financial instruments, not restrict it. In so doing, it would provide consumers with a larger market of options for spending, storing, and sending value. Thus, rather than earn an interest-spread on loans, DFC intermediaries would presumably finance their operations through small transaction fees, and achieve efficiencies through cross-platform innovation, economies of scale, commercial partnerships, and cross-border remittances.

Complementary narrow banking systems have already been considered in the context of nations in which mobile money systems are the primary mechanism for payments processing,³⁷ as well as nations with more sophisticated banking systems.³⁸ However, these models typically involve the creation of a subclass of regular depository institutions, relying on the existing settlement system, or, alternatively, require narrow bank operators to maintain accounts at regular depository institutions, who are, in turn, responsible for final settlement. Both approaches are problematic, as the former does not allow for the structural separation of payments processing and credit-creation platforms (and with it, more directly focused innovation and regulatory responses), and the latter raises macroprudential concerns with respect to the safety of deposits, and the liquidity

³⁶ See, e.g., J. Kregel, (2012), *Minsky and the Narrow Banking Proposal: No Solution for Reform*, Levy Economics Institute Public Policy Brief No. 125.

³⁷ See, e.g., Greenacre & Buckley, (2014); GSMA, (2016), *Safeguarding Mobile Money*.

³⁸ For example, India's payments banks are prohibited from undertaking lending operations, and instead must invest all funds in excess of minimum reserve requirements directly in government securities. See, e.g., Deloitte (2014).

impacts of narrow bank payments flows.

By contrast, a DFC-centered narrow banking model establishes universal interoperability among various categories of DFC intermediaries, such as mobile money operators, banks, and large institutional investor funds, as well as a clear, system-level separation between payments processing and credit-creation systems. This interoperability also enables customers to seamlessly transact and move funds between various platforms, markets, and industries, thereby greatly reducing network frictions and inter-market transaction costs, and increasing the usefulness of digital financial services. Banks remain free to continue to engage in credit creation, and to attract deposits, but customer DFC balances are operationally and legally separated from depository balances. To the extent that regulators wished to allow banks to count DFC balances for settlement liquidity purposes, this could be achieved by pledging DFC balances as collateral to the central bank in exchange for reserves/settlement balances, in the same way as treasury securities are pledged today via reverse repurchase programs.

IMPACTS ON FISCAL POLICYMAKING

The introduction of DFC would allow for, but not intrinsically require, a major update to contemporary fiscal policy operations. It would, for example, be entirely possible to continue to manage fiscal policy as presently undertaken, without regard for the introduction of DFC, as it can be understood as simply a new channel through which to make public expenditures, alongside direct payments into bank deposit accounts, and the issuance of paper checks.

However, given the state of contemporary monetary-fiscal policy coordination, and recent central banking innovations in the conduct of monetary policy, it is equally possible for treasury departments to finance spending through the direct markup of central banking accounts as by the issuance and sale of treasury securities, commensurate with desired spending in excess of tax receipts (i.e., the fiscal deficit).

Such an approach would not necessarily be any more inflationary than traditional

deficit-financing via the issuance of treasury securities, provided that interest was paid on the newly-created settlement balances (or DFC balances) at a rate consistent with the IOR rate on excess reserves.³⁹

Moreover, with the adoption of central bank term deposits and/or central bank securities, such an approach would not inhibit a central bank's ability to set a long-term yield curve, or to facilitate a government securities market in which long-term interest rates were determined by the demand of private investors.

Thus, it is conceivable to imagine a point in the future in which all government deficits were financed directly by issuing new DFC balances, and taxes were 'received' via the extinguishing of DFC balances, with monetary policy determined by an independent central bank, via direct payment of interest on DFC balances.⁴⁰

IMPLEMENTATION CHALLENGES

Accounting System Interoperability

One foreseeable challenge with implementing a DFC system is ensuring smooth interoperability with the existing two-tier depository payments system, in which individuals hold depository accounts with licensed banking institutions, and banks hold depository accounts at the central bank.

One possible way to achieve this would be to create a dedicated reserve account, managed by the central bank, which matches every DFC-unit in existence within the DFC system with reserves, dollar for dollar, and then to embed

³⁹ See, e.g., N. Kocherlakota, (2016), Helicopter Money Won't Provide Much Extra Lift, Bloomberg News; S. Kelton & S. Fullwiler, (2013), The Helicopter Can Drop Money, Gather Bonds, or Just Fly Away, Financial Times Alphaville, December 12, 2013; G. Thomas Woodward, (1996), "Money and the Federal Reserve System: Myth and Reality," Congressional Research Service Report for Congress, No. 96-672 E.

⁴⁰ This is not too dissimilar to the current arrangement, in which central banks purchase significant amounts of treasury securities of varying durations from the secondary market, on a rolling basis, while the treasury simultaneously injects new securities into that same market. For example, since 2013, the Bank of Japan has purchased government bonds on the secondary market at a monthly rate equivalent to seventy percent of all new government issuance. Similarly, the Bank of Canada has had a longstanding policy of directly purchasing twenty percent of all newly issued Canadian government debt, on a non-competitive basis, in addition to other market operations. See Bank of Canada, (2015), Statement of Policy Governing the Acquisition and Management of Financial Assets for the Bank of Canada's Balance Sheet, p. 5, ("Typically, a fixed percentage of Government of Canada bonds is acquired on a non-competitive basis at each bond auction to achieve the target structure for asset allocations").

the new payments platform within the existing reserve system. In effect, this would create a sub-class of “100%-reserve” accounts within the reserve system, without affecting how existing banking institutions otherwise accumulate and transact in reserves for liquidity, settlement, and other purposes.

Under such an approach, all intra-DFC transactions would be recorded only by the DFC intermediaries in that particular transaction,⁴¹ while any transactions that resulted in net outflows from the DFC system would be recorded via a reduction in the overall balance of the DFC-system reserve account.

For example, a request to convert one’s digital fiat currency balance into physical currency (i.e., notes or coins) would be achieved by the intermediary marking down the individual’s DFC balance, and the central bank marking down the aggregate DFC-system account by an equivalent amount. Alternatively, a request to transfer funds from an individual’s DFC wallet, maintained by a bank, to his or her regular banking deposit account at the same bank, would be recorded by marking down the individual’s DFC wallet balance and the aggregate DFC-system account by the same amount, and marking up the individual’s deposit account and the bank’s reserve account by an equivalent amount. Both pairs of complementary transactions at the consumer and intermediary level – the markdown of one account, and simultaneous markup of an equivalent amount in another – happen simultaneously. Alternatively, if the bank chooses to retain its own DFC unit holdings, such a transfer would simply result in the bank increasing its DFC-denominated assets, and its deposit liabilities by an equivalent amount.

Another challenge is to avoid any negative impact on bank lending and credit creation activities resulting from the introduction of a DFC accounting network. Three types of risks must be addressed: a) depositor flight due to loss of

⁴¹ For example, if one individual with \$100 in a DFC wallet managed by intermediary A wishes to send \$40 to an individual’s DFC wallet, which currently has \$10 in funds, and is managed by intermediary B, the two intermediaries would simultaneously replace the two DFC wallet balances (\$100 and \$40) with two new balances (\$60 and \$50), and would notify the central bank that the old balances had been extinguished. Thus, the central bank could remain agnostic about the individual accounts involved in the transaction, while simultaneously ensuring that the processing of the transaction did not increase systemic liquidity/purchasing power, or alternatively, incur any intermediary liquidity or payments risk. Such a transaction would be equally possible with very large transactions, provided that DFC technology is technically agnostic as to size of the funds involved in a particular transaction.

competitiveness of demand deposits vis-à-vis DFC accounts; b) increased cost of reserves due to 100% backing of consumer DFC-accounts vis-à-vis depositor accounts; and c) negative impact on banks' capital, liquidity, and leverage positions.⁴²

The appropriate macroprudential regulatory response will depend on the particular conditions of the country and banking system in consideration. Broadly speaking, one option would be to maintain an equivalency between safety and returns on bank deposits and DFC balances by paying a rate of interest to DFC consumers that is equal to or lower than the rate paid by banks to depositors. Although purely theoretical at this stage, such an outcome could be achieved by, for example, maintaining a lower rate of interest on DFC balances than on excess reserves held by banks.

On the other hand, the introduction of DFC will likely result in some migration away from bank deposits towards the DFC system. Some theorists have suggested that this shift could facilitate the end of banks' role as creators of government-backed money liabilities.⁴³

An alternative strategy which would not destabilize existing banking operations would be to allow licensed banks to run unlimited overnight overdrafts against collateralized DFC balances at the target overnight rate, provided that the banks otherwise remain compliant with macroprudential regulatory requirements. If this dynamic impacted the central bank's ability to implement monetary policy (by creating arbitrage opportunities between reserve and DFC-account rates), another option would be to set the interest rate on DFC-account-backing overdrafts at far lower rates than the target interest rate on reserves used to settle demand deposit transactions.

A third challenge is to maintain a positive long-term yield curve if DFC reduces

⁴² See, e.g., M. Tolle, (2016), Central Bank Currency: The End of Monetary Policy As We Know It?, Bank Underground Blog.

⁴³ See, e.g., Tolle (2016), ("The conversion of bank deposits into CBcoin deposits at the CB would amount to 100% reserve backing for deposits. This could usher in a system like the Chicago Plan, a set of monetary reforms proposed by Irving Fisher during the Great Depression...The Plan's call for the separation of the credit and money-creating functions of private banks would be addressed – with 100% reserve backing, banks could no longer create their own funding – deposits – by lending").

demand for treasury securities by providing a simple, efficient alternative payments and accounting platform for institutional cash investors.⁴⁴ One option would be to create term-locked DFC balances, and offer positive savings rates on those balances, consistent with the central bank's target long-term interest rate band. However, typically term deposits are not marketable, and cannot be rehypothecated or serve as collateral in private money market borrowing. Thus, another alternative is to issue marketable central bank securities and to record them in book-entry form, much as treasury securities are today, then guarantee convertibility, at par, between those securities and DFC balances.⁴⁵

Such securities would effectively function like marketable term deposit balances, as any entity with access to the DFC-system would be eligible to hold and trade such securities, and could pledge them at the central bank in exchange for DFC-liquidity at any time. This would resemble the manner in which non-bank financial institutions use the reverse repurchase program and similar facilities today. Indeed, a central bank could easily establish a broker/dealer facility that accepts additional forms of collateral beyond government-backed securities in exchange for DFC liquidity thereby providing central banks with a new, flexible tool through which to conduct monetary policy through qualitative credit support and targeted liquidity provision.⁴⁶

⁴⁴ The payment of interest on reserves, while effective in maintaining a positive overnight interest rate, does not directly allow for long-term interest rate management.

⁴⁵ S. Gray & R. Pongsaparn, (2015), Issuance of Central Bank Securities: International Experiences and Guidelines, International Monetary Fund Working Paper 15/106, p. 15.

⁴⁶ "As a matter of practical implementation of [central bank digital currency "CBDC"] issuance, the central bank could set the interest rate paid on CBDC and allow the private sector to determine its quantity by offering to buy and sell CBDC in exchange for well-defined asset classes, or it could set the quantity of CBDC and allow the private sector to bid the CBDC interest rate up or down until the market clears." J. Barrdear & M. Kumhof, (2016), The Macroeconomics of Central Bank Issued Digital Currencies, Bank of England Staff Working Paper No. 605, p. 10.

PART III:

Conclusion

Digital Fiat Currency presents a future for payments system innovation, post-crisis monetary policy implementation, and regulation of the shadow banking sector. It leverages the strengths of existing banking operations and payments systems infrastructure, while addressing critical weaknesses in the structure of money markets, and the coordination process between fiscal and monetary policy.

The DFC model sketched above represents a clean, elegant, and efficient means of achieving these goals. It can simplify the patchwork of piecemeal policy and oversight solutions which central banks are currently debating and implementing in an attempt to improve stability and capture the benefits of swiftly developing technologies and consumer needs. It also enables developing countries to leapfrog the inefficient and expensive process of building a 20th century financial system, by providing their citizens with a safe, secure, and simple payments platform from which to conduct both retail and wholesale commercial transactions.

A Digital Fiat Currency system articulates a clear, simple architecture; a technical innovation of form. DFC is a new interoperable payment instrument which streamlines payments system functions. As contemporary understanding

of central banking operations evolves, and new challenges emerge in monetary policy and regulation of 'near monies' and the 'shadow banking' sector, the basic innovation in payment instruments offered by a Digital Fiat Currency becomes increasingly relevant and necessary.

REFERENCES

D. Andolfatto & L. Li, (2013), Is the Fed Monetizing Government Debt?, Federal Reserve Bank of St. Louis, www.stlouisfed.org/publications/central-banker/spring-2013/is-the-fed-monetizing-government-debt.

J. Argent, J. Hanson, & M.P. Gomez, (2013), The Regulation of Mobile Money in Rwanda, International Growth Centre Working Paper, www.theigc.org/publications/working-paper/regulation-mobile-money-rwanda.

Bank of Canada, (2015), Statement of Policy Governing the Acquisition and Management of Financial Assets for the Bank of Canada's Balance Sheet, www.bankofcanada.ca/wp-content/uploads/2010/07/statement_policy.pdf.

J. Barrdear & M. Kumhof, (2016), The Macroeconomics of Central Bank Issued Digital Currencies, Bank of England Staff Working Paper No. 605, www.bankofengland.co.uk/research/Documents/workingpapers/2016/swp605.pdf.

B. Bernanke, (2014), 'The Federal Reserve: Looking Back, Looking Forward,' Speech at the Annual Meeting of the American Economic Association, January 3, 2014, www.federalreserve.gov/newsevents/speech/bernanke20140103a.htm.

B. Buruku & S. Staschen, (2016), How Ghana Sets Its Rules on Interest Payment on e-Money Accounts, Consultative Group to Assist the Poor, www.cgap.org/blog/how-ghana-set-its-rules-interest-payment-e-money-accounts.

Capgemini Analysis and The Royal Bank of Scotland (2013), p15. World Payments Report, www.capgemini.com/resource-file-access/resource/pdf/wpr_2013.pdf

S. Carpenter, J. Ihrig, E. Klee, D. Quinn, & A. Boote, (2015), The Federal Reserve's Balance Sheet and Earnings: A Primer and Projections, International Journal of Central Banking, Vol. 11:2, www.ijcb.org/journal/ijcb15q2a7.pdf.

S. Claessens, Z. Pozsar, L. Ratnovski, & M. Singh, (2012), Shadow Banking: Economics and Policy, International Monetary Fund Staff Discussion Note 12/12, www.imf.org/external/pubs/ft/sdn/2012/sdn1212.pdf.

Deloitte, (2014), RBI Guidelines for Licensing of Payments Bank: Opportunities and Challenges, www2.deloitte.com/content/dam/Deloitte/in/Documents/financial-services/in-fs-deloitte-pov-on-payments-banking-license-guidelines-noexp.pdf.

Y. Demyanyk & D. Kolliner, (2014), Peer-to-Peer Lending is Poised to Grow, Federal Reserve Bank of Cleveland, www.clevelandfed.org/newsroom-and-events/publications/economic-trends/2014-economic-trends/et-20140814-peer-to-peer-lending-is-poised-to-grow.aspx.

C. Desan, (2015), Money as a Legal Institution, in D. Fox & W. Ernst (Eds), *Money in the Western Legal Tradition*, UK: Oxford University Press.

R. DeYoung & T. Rice, (2004), How do Banks Make Money? The Fallacies of Fee Income, Federal Reserve Bank of Chicago Economic Perspectives, Vol. 28:4, www.chicagofed.org/publications/economic-perspectives/2004/4qtr2004-part3-deyoung-rice.

J. Dharmapalan, (2015), Central Bank Issued Digital Currency and its Impact on Financial Inclusion, Speech to the Alliance for Financial Inclusion 2015 Global Policy Forum.

J. Dharmapalan, (2015), Central Bank Issued Digital Currency to Accelerate Financial Inclusion, eCurrency.

J. Dharmapalan, (2016), Digital Fiat Currency Issuance Model, Speech to Digital Financial Services Working Group at the Alliance for Financial Inclusion 2016 Global Policy Forum.

J. Dharmapalan & C. McMahon (2016), The Case for Digital Legal Tender: Central Bank Issued Digital Currency and its Impact on Financial Inclusion, eCurrency, ecurrency.epaperflip.com/v/May-2016/.

Ernst & Young, (2015), Money Money – The Next Wave of Growth, [www.ey.com/Publication/vwlUAssets/EY_-_Mobile_money_-_the_next_wave_of_growth_in_telecoms/\\$FILE/EY-mobile-money-the-next-wave.pdf](http://www.ey.com/Publication/vwlUAssets/EY_-_Mobile_money_-_the_next_wave_of_growth_in_telecoms/$FILE/EY-mobile-money-the-next-wave.pdf).

eCurrency, (2012), Electronic Currency: eCurrency in the Context of Thailand, White Paper.

eCurrency, (2013), Electronic Currency: eCurrency in the Context of Brazil (English & Portuguese), White Paper.

eCurrency, (2013), Electronic Currency: eCurrency in the Context of Kenya, White Paper.

eCurrency, (2013), Electronic Currency: eCurrency in the Context of the Philippines, White Paper.

eCurrency, (2013), Electronic Currency: eCurrency in the Context of Tanzania, White Paper.

eCurrency, (2014), Electronic Currency: eCurrency in the Context of Bangladesh, White Paper.

eCurrency, (2014), Electronic Currency: eCurrency in the Context of Uganda, White Paper.

eCurrency, (2015), Electronic Currency: eCurrency in the Context of India, White Paper.

eCurrency, (2016), Electronic Currency: eCurrency in the Context of Indonesia, White Paper.

Federal Reserve of New York, (2016), Treasury Tax and Loan Program, www.newyorkfed.org/aboutthefed/fedpoint/fed21.html

J. Furman, (2016), The New View of Fiscal Policy and Its Application, Presentation by the

Chairman of the White House Council of Economic Advisors at the Conference on 'Global Implications of Europe's Redesign,' New York, October 5, 2016, www.whitehouse.gov/sites/default/files/page/files/20161005_furman_suerf_fiscal_policy_cea.pdf.

D. Gabor & J. Vestergaard, (2016), Towards a Theory of Shadow Money, Institute for New Economic Thinking, www.ineteconomics.org/uploads/papers/Towards_Theory_Shadow_Money_GV_INET.pdf.

G. Gorton, S. Lewellyn, & A. Metrick (2012), The Safe-Asset Share, National Bureau of Economic Research Working Paper No. 17777, www.nber.org/papers/w17777.pdf].

G. Gorton & A. Metrick, (2009), Haircuts, National Bureau of Economic Research Working Paper 15273, faculty.chicagobooth.edu/john.cochrane/teaching/empirical_asset_pricing/Gorton_Metrick_Haircutsw15273.pdf.

P. Gourinchas & O. Jeanne, (2012), Global Safe Assets, Presentation at the XI Bank of International Settlements Annual Conference, Lucerne, June 20-21, 2012, www.bis.org/publ/work399.pdf.

R. Greenwood, S. Hanson, J. Rudolph, & L. Summers, (2014), Government Debt Management at the Zero Lower Bound, Hutchins Center Working Paper #5, www.brookings.edu/wp-content/uploads/2016/06/30_government_debt_management_zlb.pdf.

GSMA, (2016), Safeguarding Mobile Money, www.gsma.com/mobilefordevelopment/wp-content/uploads/2016/01/2016_GSMA_Safeguarding-Mobile-Money-How-providers-and-regulators-can-ensure-that-customer-funds-are-protected.pdf.

R. Grey, (2017), Mobile Money in Developing Countries: Policy Implications and Potential, Binzagr Institute Working Paper No. 115. www.binzagr-institute.org/working-paper-no-115/.

S. Gray & R. Pongsaparn, (2015), Issuance of Central Bank Securities: International Experiences and Guidelines, International Monetary Fund Working Paper 15/106, www.imf.org/external/pubs/ft/wp/2015/wp15106.pdf.

J. Greenacre & R. Buckley, (2014), Using Trusts to Protect Mobile Money Customers, Singapore Journal of Legal Studies, pp. 59-78, papers.ssrn.com/sol3/papers.cfm?abstract_id=2612454.

H. de Heij & A. van Gelder, (2006), Numbers on Banknotes: What is Their Use?, *Keesing Journal of Documents and Identity*, www.dnb.nl/binaries/Numbers%20of%20Banknotes_tcm46-146929.pdf.

R. Hockett & S. Omarova, (2017), The Finance Franchise, *Cornell Law Review*, Vol. 102 (forthcoming), papers.ssrn.com/sol3/papers.cfm?abstract_id=2820176##.

Bristol Pound, (2016), What is the Bristol Pound?, bristolpound.org/what.

S. Kelton & S. Fullwiler, (2013), The Helicopter Can Drop Money, Gather Bonds, or Just Fly Away, *Financial Times Alphaville*, December 12, 2013, ft.com/2013/12/12/1721592/guest-post-the-helicopter-can-drop-money-gather-bonds-or-just-fly-away-3/.

N. Kocherlakota, (2016), Helicopter Money Won't Provide Much Extra Lift, *Bloomberg News*, available at <https://www.bloomberg.com/view/articles/2016-03-24/-helicopter-money-won-t-provide-much-extra-lift>.

J. Kregel, (2012), Minsky and the Narrow Banking Proposal: No Solution for Reform, Levy Economics Institute Public Policy Brief No. 125, www.levyinstitute.org/pubs/ppb_125.pdf.

B. Leubsdorf, (2015), Fed Sent Nearly \$97 Billion to the U.S. Treasury in 2014, Wall Street Journal, blogs.wsj.com/economics/2015/03/20/fed-sent-nearly-97-billion-to-the-u-s-treasury-in-2014/.

C. McKay, (2016), Interest Payments on Mobile Wallets: Bank of Tanzania's Approach, Consultative Group to Assist the Poor, www.cgap.org/blog/interest-payments-mobile-wallets-bank-tanzania%E2%80%99s-approach.

M. McLeay, A. Radia, & R. Thomas, (2014), Money Creation in the Modern Economy, Bank of England Quarterly Bulletin (First Quarter), www.bankofengland.co.uk/publications/Documents/quarterlybulletin/2014/qb14q1prereleasemoneycreation.pdf.

Y. Mersch, (2017), Digital Base Money: An Assessment from the ECB's Perspective, Speech at the Farewell Ceremony for Pentti Hakkarainen, Deputy Governor of Suomen Pankki - Finland's Bank, January 16, 2017, www.ecb.europa.eu/press/key/date/2017/html/sp170116.en.html.

C. Mills, (2013), Digital Cash Replacement from Royal Canadian Mint in the Works, The Star, April 30 2013, www.thestar.com/business/personal_finance/spending_saving/2013/04/30/digital_cash_replacement_from_royal_canadian_mint_in_the_works.html.

J. Moncayo & M. Reis, (2015), An Early Analysis of the Government's Mobile Phone-Based Money in Ecuador and its Impacts in Financial Inclusion, Presentation at the 18th Microcredit Summit: Frontier Innovations in Financial Inclusion, Abu Dhabi, March 14-17, 2016, www.microcreditsummit.org/uploads/resource/document/an-early-analysis-of-the_59163.pdf.

D. Neipelt, (2015), Reserves for Everyone – Towards a New Monetary Regime?, VoxEU, voxeu.org/article/keep-cash-let-public-hold-central-bank-reserves.

R. Phillips & H. Minsky, (1995), The Chicago Plan and New Deal Banking Reform, Routledge.

Z. Pozsar, T. Adrian, A. Ashcraft, & H. Boesky, (2010, revised 2012), Shadow Banking, Federal Reserve Bank of New York Staff Report No. 458, www.newyorkfed.org/medialibrary/media/research/staff_reports/sr458.pdf.

Z. Pozsar, (2011), Institutional Cash Pools and the Triffin Dilemma of the U.S. Banking System, IMF Working Paper 11/190, www.imf.org/external/pubs/ft/wp/2011/wp11190.pdf.

Z. Pozsar, (2014), Shadow Banking: The Money View, financialresearch.gov/working-papers/files/OFRwp2014-04_Pozsar_ShadowBankingTheMoneyView.pdf.

K. Rogoff, (2016), The Curse of Cash, Princeton University Press.

M. Tarazi, (2009), E-Money Accounts Should Pay Interest, So Why Don't They?, March 17, 2009, Consultative Group to Assist the Poor, technology.cgap.org/2009/03/17/e-money-accounts-should-pay-interest-so-why-dont-they.

H. Thomas (2013), Measuring Progress Toward a Cashless Society, MasterCard, www.mastercardadvisors.com/_assets/pdf/MasterCardAdvisors-CashlessSociety.pdf.

G. Thomas Woodward, (1996), "Money and the Federal Reserve System: Myth and

Reality", Congressional Research Service Report for Congress, No. 96-672 E, <http://www.congress.gov/~/media/CRS-Reports/96-672E.pdf>.

M. Tolle, (2016), Central Bank Currency: The End of Monetary Policy As We Know It?, Bank Underground Blog, bankunderground.co.uk/2016/07/25/central-bank-digital-currency-the-end-of-monetary-policy-as-we-know-it/.

R. Weber, & A. Darbellay, (2010), Legal Issues in Mobile Banking, *Journal of Banking Regulation*, Vol. 11:2, 129-145.

J. Williams, (2011), Economics Instruction and the Brave New World of Monetary Policy, Federal Reserve Bank of San Francisco Economic Letter 2011-17, www.frbsf.org/economic-research/publications/economic-letter/2011/june/economics-instruction-monetary-policy/.

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