11. CENTRAL BANK DIGITAL CASH: PRINCIPLES & PRACTICAL STEPS[1]

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11.1. INTRODUCTION

A fundamental purpose of the monetary system is to provide a stable unit of account that facilitates the economic and financial decisions of households and businesses. Thus, as of a few decades ago, monetary economists were primarily concerned about how to prevent a recurrence of the "Great Inflation", i.e., the design of systematic and transparent monetary policy frameworks that would ensure low and stable rates of inflation.

More recently, however, a number of advanced economies have experienced protracted periods of relatively weak aggregate demand, with inflation falling persistently short of its stated objective and conventional monetary policy constrained by the effective lower bound (ELB) on nominal interest rates that arises from the zero interest rate on paper cash. Consequently, a number of major central banks – including the Bank of Japan, the European Central Bank, and the Federal Reserve – have deployed unconventional policies such as quantitative easing that have proven to be complex, opaque, discretionary, and ineffectual.

Thus, a crucial task in advanced economies is to strengthen the monetary system to ensure that the central bank can provide sufficient monetary stimulus to preserve price stability and foster economic recovery even in the face of severe adverse shocks. One potential option would be to raise the inflation target by several percentage points, essentially allowing inflation to return to the levels last experienced a half-century ago. By raising the normal level of nominal interest rates, the central bank would have more room to cut rates sharply without being constrained by the ELB.[2] However, such an approach would complicate the decisions and plans of ordinary families and businesses, and the inflation target would most likely become a political football rather than a credible anchor.

Therefore, our analysis indicates that the central bank should take active steps to establish digital cash as the fulcrum of the monetary system.[3] Digital cash – often

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[2] See Blanchard et al. (2010), Ball (2014), and Ball et al. (2016).

referred to as central bank digital currency – can serve as a practically costless medium of exchange and as a secure store of value that yields essentially the same rate of return as other risk-free assets. Individuals and businesses would remain free to use paper cash if desired, but its obsolescence would be accelerated by the convenience, security, and ubiquity of digital cash. Arbitrage between paper cash and digital would be mitigated by a graduated system of transfer fees, thereby eliminating the ELB. Thus, the central bank would be able to follow a systematic and transparent strategy in adjusting the interest rate on digital cash, without the need to rely on unconventional policy tools, and would be able to foster true price stability.

The remainder of this paper is organized as follows. Section 2 documents the muted effectiveness of unconventional monetary policy tools. Section 3 sets forth basic principles for the design of digital cash, and Section 4 discusses the characteristics of the monetary policy framework. Section 5 considers some near-term practical steps that central banks can take in the process of establishing digital cash. Section 6 reflects on financial stability issues. Section 7 concludes.

11.2. ASSESSING UNCONVENTIONAL MONETARY POLICIES

Paper cash pays zero interest and hence limits the extent to which a central bank can provide conventional monetary accommodation by reducing nominal interest rates in the face of weak aggregate demand and persistently low inflation. In the wake of the global financial crisis, a number of major central banks became constrained by this effective lower bound (ELB) and deployed two basic forms of unconventional monetary policy: quantitative easing (QE) in the form of large-scale asset purchases, and forward guidance about the likely trajectory of short-term nominal interest rates. Each of these policy tools is intended to provide monetary stimulus, thereby fostering the pace of economic recovery and bringing inflation back upwards to its stated objective; thus, these tools are intrinsically different from the emergency liquidity measures that a central bank may implement in serving as a lender of last resort during a financial crisis.

In deploying these unconventional policies, central bankers and other analysts were quite optimistic that implementing QE and forward guidance could substantially mitigate the severity of the ELB. However, those projections relied heavily on extrapolations from statistical patterns over preceding decades and on event studies of policy actions taken in the midst of the financial crisis. Consequently,

[3] A number of central banks are actively exploring the potential introduction of digital cash. Most notably, the Sveriges Riksbank has been engaged in public consultations about introducting digital cash ("e-krona") in Sweden; see https://www.riksbank.se/en-gb/payments--cash/e-krona/.

such assessments were necessarily subject to a high degree of uncertainty.[4] With the passing of time, however, it has become increasingly evident that QE and forward guidance are subject to intrinsic limitations and hence have relatively muted benefits in providing monetary stimulus.[5]

In the United States, for example, the Federal Open Market Committee (FOMC) began providing specific forward guidance in its August 2011 statement, which indicated that the target federal funds rate was likely to remain unchanged *"at least until mid-2013."* That announcement was associated with a decline of about 10 basis points in the 2-year U.S. Treasury yield – roughly similar to a small surprise in conventional monetary policy during the pre-crisis period.[6] By contrast, subsequent revisions in the FOMC's forward guidance in January 2012 *("at least through mid-2014")* and in September 2012 *("at least through mid-2015")* were associated with very small reductions in the 2-year Treasury yield of about 4 basis points and 1 basis point, respectively. Finally, in December 2012 the FOMC reframed its forward guidance in terms of specific quantitative thresholds for unemployment and inflation. According to the Federal Reserve Bank of New York's survey of primary dealers, that reframing came as a surprise to financial market participants but had negligible effects on their expectations regarding the likely timing of liftoff from the ELB.

The Federal Reserve initiated its first round of large-scale asset purchases (QE1) during the most intense phase of the financial crisis. In particular, at the tail end of 2008 and the first half of 2009, the Fed purchased $1.35 trillion of agency debt and mortgage-backed securities, predominantly issued by Fannie Mae and Freddie Mac, with the specific aim of *"providing support to the mortgage and housing markets"* by reducing risk spreads on those securities.[7] QE1 also included $300 billion in purchases of Treasury securities. In 2010-11, the FOMC initiated purchases of an additional $600 billion in Treasuries (QE2) and a program to expand the average maturity of its Treasury holdings (often referred to as "Operation Twist"). Nonetheless, the recovery remained sluggish and inflation remained well below target.

The FOMC's third major round of asset purchases, commonly known as QE3, was launched in autumn 2012 and concluded about two years later. The Federal Reserve concluded all of its emergency lending programs during 2009-10, and measures of U.S. financial stress remained at low levels thereafter. Thus, the QE3

4 For example, Hamilton and Wu (2012) noted: *"As should be clear from the description of the exercise, we are talking about a quite dramatically counterfactual event. If one considers the analogous forecasting equations,[this] would represent a 36? event, obviously something so far removed from anything that was observed during the historical sample as to raise doubts about interpreting the parameter estimates as telling policymakers what would happen if they literally implemented a change of this size."*

5 See Borio (2018), Greenlaw et al. (2018), and Hamilton (2018).

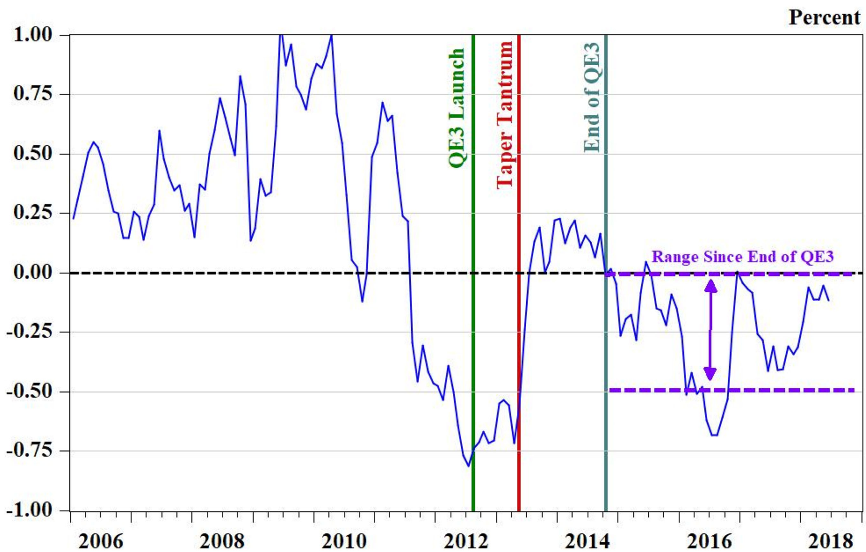
6 See Williams (2013).

7 https://www.federalreserve.gov/newsevents/pressreleases/monetary20081216b.htm.

program was clearly aimed at providing additional monetary stimulus. Indeed, the FOMC specifically stated that QE3 was intended to push down longer-term bond yields, thereby fostering a more rapid economic recovery and pushing inflation upwards to the FOMC's 2 percent goal.

In explaining the rationale for launching QE3, Federal Reserve officials extensively cited the analysis of Chung et al. (2012), who conducted simulations of the FRB/US model to assess the benefits of QE.[8] That study indicated that a $600 billion asset purchase program would reduce the term premium by 20 basis points, expand nonfarm payrolls by about 700,000 new jobs, raise real GDP by nearly 1 percent, and push up core inflation by about 0.3 percent. Given that the FRB/US model is essentially linear, the predicted macroeconomic effects of QE3 (which comprised $1.9 trillion in purchases) would be roughly three times larger, i.e., reducing the term premium by 60-70 basis points, expanding nonfarm payrolls by 2 million jobs, raising real GDP by about 3 percent, and raising core inflation by nearly a percentage point.[9] Indeed, internal staff memos that were sent to the FOMC in 2012 (and which have been subsequently released to the public after a five-year time lag) used this methodology to quantify the likely benefits of the QE3 program.[10]

Figure 1: The Term Premium on U.S. 10-Year Treasury Securities



Source: Federal Reserve Board, authors' calculations.

8 See Bernanke (2012, 2014) and Yellen (2012, 2015).

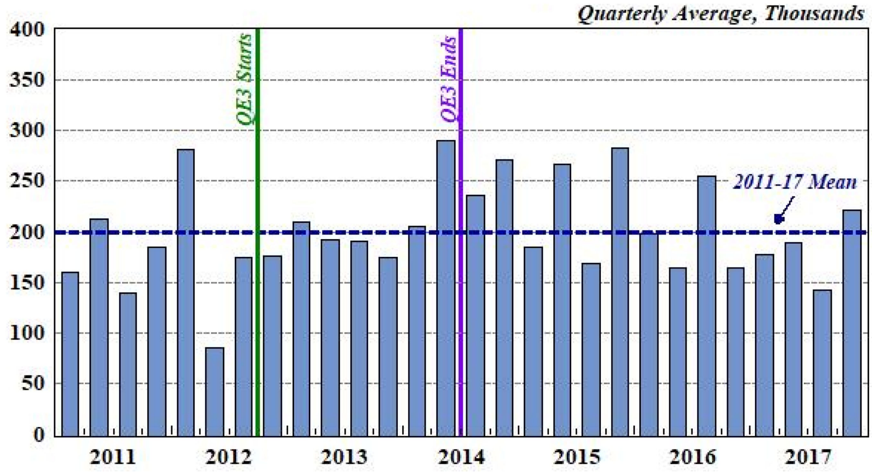
9 The FRBNY's parallel analysis by Chen et al. (2012) obtained much smaller effects of QE, roughly one-eighth those of Chung et al. (2012); however, those results were not cited by Bernanke (2012) or Yellen (2012).

10 See the staff memos by Laforte et al. (2012) and Cambron et al. (2012), which were sent to the FOMC on August 28, 2012 and November 30, 2012, respectively.

Nonetheless, as shown in Figure 1, the term premium on 10-year U.S. Treasury securities was broadly stable during the second half of 2012 and the first quarter of 2013, even as the FOMC initiated QE3.[11] The surveys of primary dealers conducted by the Federal Reserve Bank of New York indicate that the launch of QE3 was largely unanticipated prior to September 2012 and that over subsequent months financial market participants made large upward revisions to their assessments of its likely duration and cumulative size.

Any near-term effects from launching QE3 were subsequently swamped by the so-called "taper tantrum" in spring 2013. At that time, Fed officials suggested that the tantrum was a transitory phenomenon and that bond yields would quickly subside. However, the New York Fed's June 2013 survey indicated that most primary dealers attributed the tantrum to market confusion about the FOMC's policy strategy. And the term premium remained elevated over the subsequent year, even as investors made further upward revisions about the likely size of the Fed's balance sheet, and did not fall significantly until after the end of QE3 in late 2014.

Figure 2: Monthly Growth of U.S. Nonfarm Payrolls



Source: Bureau of Labor Statistics, authors' calculations.

As shown in Figure 2, the launching of QE3 and the initiation of explicit forward guidance appear to have had only muted effects on the U.S. labor market. Growth in nonfarm payrolls during 2013-14 was practically identical to its average pace from 2011 to 2016, with no evident acceleration due to QE3 nor any apparent

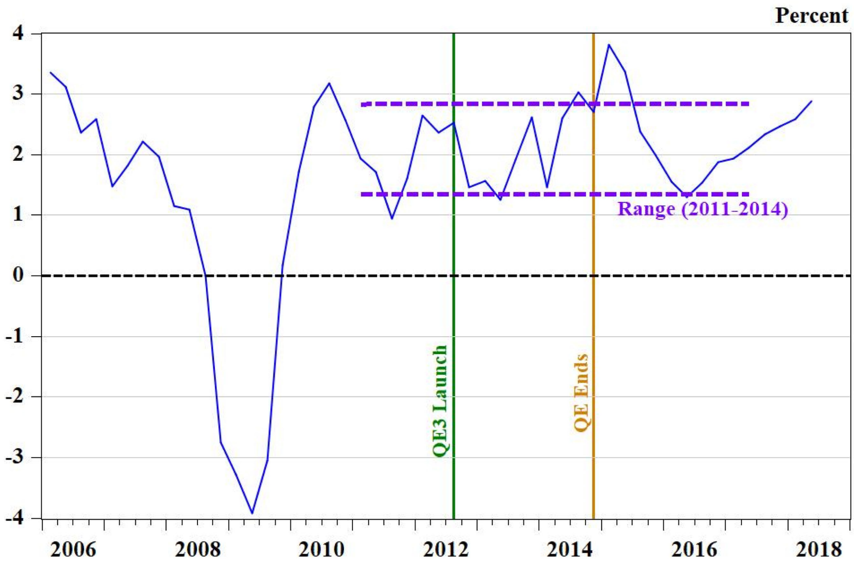
[11] Figures 1-6 are taken from a forthcoming study by Levin and Loungani (2019). Information on fnancial market perceptions of the likely size of the QE3 program.

deceleration following the conclusion of QE3. employment, output, and inflation.

Likewise, QE3 had no visible impact on the broader U.S. economy, as evident in Figures 3 and 4. Real GDP growth remained in a narrow range of about 1½ to 2¾ percent from 2011 thru 2016; the only exception was a temporary pickup in the first half of 2015, well after the conclusion of the QE3 program. Likewise, core PCE inflation – the Fed's preferred measure of underlying inflation-- averaged just over 1.5 percent during 2013-14, little different from its average pace over preceding and subsequent years.

Evidently, the transmission mechanism of QE is fundamentally different from that of conventional monetary policy. A long empirical literature has documented that an unanticipated shift in the target federal funds rate has a significant impact on output and employment within a few months and a peak effect within a few quarters.[12] By contrast, the launch of QE3 in autumn 2012 (which was almost entirely unanticipated prior to late August) had no visible impact on nonfarm payrolls or real GDP growth in 2013-2014.

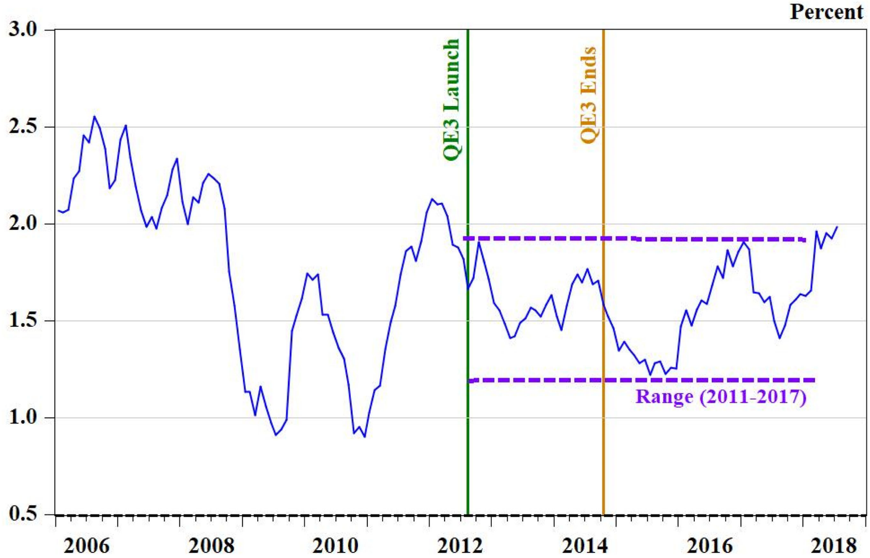
Figure 3: U.S. Real GDP Growth



Source: Bureau of Economic Analysis, authors' calculations.

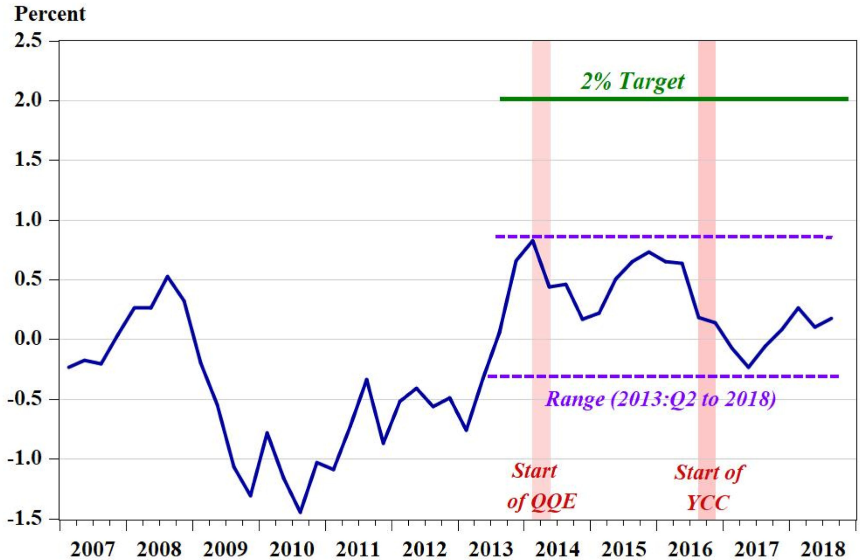
12 See the seminal contributions of Sims (1980), Christiano, Eichenbaum, and Evans (1999), and Romer and Romer (2000).

Figure 4: U.S. Core PCE Inflation



Source: Bureau of Economic Analysis, authors' calculations.

Figure 5: Japanese Core-Core CPI Inflation ***(excluding food, energy, and VAT effects)***

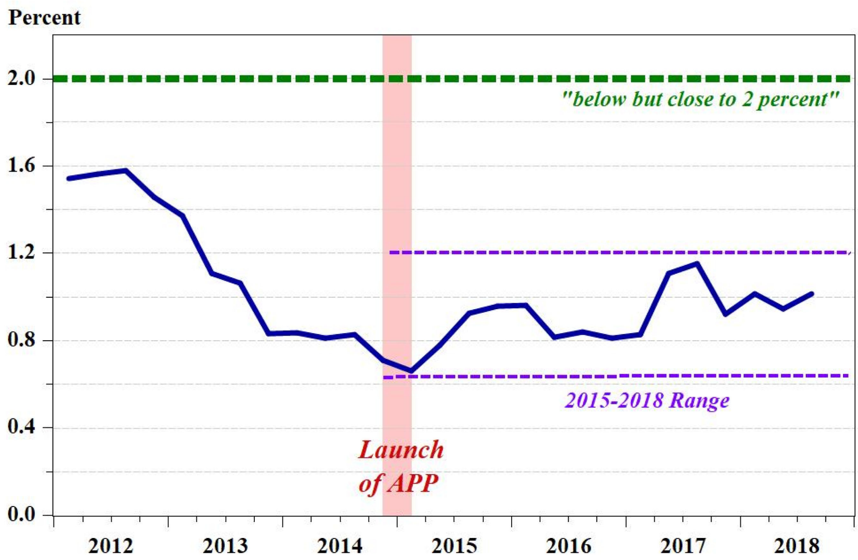


Source: Japan Statistics Bureau, authors' calculations.

Further evidence on the muted effectiveness of unconventional monetary stimulus can be obtained by considering the recent experiences of other major economies where conventional policy has been constrained by the ELB. For example, the Bank of Japan (BOJ) launched its quantitative and qualitative easing (QQE) program in April 2013 and augmented that program in September 2016 by initiating yield curve control (YCC).[13] Under QQE the BOJ's securities holdings have expanded by about ¥400 trillion, equivalent to roughly 80 percent of Japanese GDP. As shown in Figure 5, however, Japanese core-core inflation (excluding food and energy prices and the direct effects of the 2014 VAT hike) has remained far below the BOJ's 2 percent inflation target. Indeed, over the past year this indicator and other BOJ measures of underlying inflation in Japan have been mired close to zero.

The European Central Bank (ECB) announced its asset purchase program (APP) in late 2014 and initiated large-scale securities purchases – including government securities, corporate bonds, covered bonds, and asset-backed securities – in March 2015. Since that time, the ECB's asset purchases have totalled about 2.5 trillion euros, equivalent to about 15 percent of eurozone GDP. The ECB has specifically stated that this program was intended to *"address the risks of too prolonged a period of low inflation."* [14]

Figure 6: Eurozone Core Inflation ***(excluding food, energy, alcohol, and tobacco)***



Source: European Central Bank, authors' calculations.

13 https://www.boj.or.jp/en/mopo/outline/qqe.htm/
14 https://www.ecb.europa.eu/mopo/implement/omt/html/index.en.html.

As shown in Figure 6, eurozone core inflation (i.e., the 12-month change in the harmonized index of consumer prices excluding food, energy, alcohol, and tobacco) has crept upwards to around 1.1 percent in 2018 (an increment of 0.3 percent from its level about five years ago) but remains far below the ECB's objective of keeping inflation *"below but close to 2 percent over the medium run."*

11.3. FUNDAMENTAL DESIGN PRINCIPLES

With an appropriate design, digital cash can fulfill the three basic functions of money, serving as a practically costless medium of exchange, a secure store of value, and a stable unit of account.[15]

11.3.1. Medium of Exchange

Digital cash should serve as legal tender, usable for all public and private payment transactions. In the case of fiduciary currency, increasing returns and network externalities provide a strong rationale for currency to be issued by a public authority, as emphasized by classical economists. The same essential reasoning holds for digital cash.

One potential means of issuing digital cash would be in the form of electronic tokens, analogous to paper cash and stored-value debit cards. Under a token-based approach, however, verification might well be time-consuming and inefficient (as with other uses of distributed ledger technology). Moreover, there would be no intrinsic limit on the size and scope of fraud, and hence hackers could potentially undermine the entire payments system.

Another potential approach would be for individuals and firms to have digital cash accounts at the central bank itself. Such an approach is reminiscent of an earlier era when some private individuals held accounts at the Bank of England. Nonetheless, it seems undesirable for the central bank to start competing directly with commercial banks in attracting deposits, especially in cases where the central bank also regulates and supervises those banks. Such an approach would also raise a host of concerns about privacy and bureaucratic inefficiencies and could pose risks to financial stability, e.g., depositors shifting their funds from commercial banks to the central bank at the onset of a financial crisis.[16]

[15] See Bordo and Levin (2017) for a comprehensive discussion of design principles for digital cash.
[16] See Keister and Sanchez (2018).

Thus, our analysis indicates that digital cash should be provided through designated accounts held at supervised depository institutions, which would hold part or all of those funds in segregated reserve accounts at the central bank. This approach would foster competition among digital cash providers and protect the privacy of individual transactions while facilitating appropriate law enforcement. In effect, the provision of digital cash would be similar to that of many other public goods such as water, electricity, and transportation.

Under this approach, payment transaction can be transmitted instantaneously and securely at practically zero cost, simply debiting the payer's digital cash account and crediting the payee's digital cash account. The scope and scale of fraudulent transactions can be mitigated by straightforward and convenient methods such as two-step identity verification.

Of course, individuals and firms should remain free to hold funds at private financial institutions and to make payment transactions using private forms of payment or paper cash. However, once digital cash becomes convenient and ubiquitous, the demand for paper currency will rapidly diminish, especially if deposits and withdrawals of paper cash are subject to a graduated fee system (as discussed further below).

11.3.2. Store of Value

Digital cash can enhance its role as a secure store of value. Following Friedman (1960) who argued that to have an efficient monetary system that government issued money should bear the same rate of return as other risk?free assets. Indeed currently central banks pay interest on the reserves of commercial banks and the Fed has begun paying interest to a much wider array of counterparties. In this framework the digital cash interest rate will be the central banks key monetary policy tool. With the obsolescence of cash, this rate can be cut below zero in response to a severe shock adverse shock (Goodfriend, 2016). The presence of paper money poses a constraint on the central bank's ability to cut its policy rate below zero. This constraint could be removed by establishing a graduated schedule of fees on transfers between cash and digital cash.

11.3.3. Unit of Account

Providing a stable unit of account facilitates the economic and financial decisions of individuals and firms. A digital cash system would do this by adjusting the digital cash interest rate. Indeed, because the digital cash interest rate can be adjusted downward as needed, there will no longer be a compelling rationale for the CB to target a positive average rate of inflation. Therefore, the monetary policy framework could ensure true price stability, i.e. the real value of digital cash would remain stable over time as measured in terms of a general index of consumer prices.

This design for digital cash embeds the most appealing features of the classical gold standard while avoiding its pitfalls. Indeed, the general price level was not stable during that era (Bordo 1984). It also resonates with Alfred Marshall's tabular standard, Irving Fisher's compensated dollar and Knut Wicksell's plan to use interest rate adjustments to foster price stability.

11.4. THE MONETARY POLICY FRAMEWORK

Digital cash can facilitate the systematic and transparent conduct of monetary policy, thereby facilitating the effectiveness of the monetary transmission mechanism and enhancing the central bank's accountability to elected officials and the public.

11.4.1. Transparency

To facilitate transparency and public accountability, the interest rate on digital cash would serve as the primary tool of monetary policy. In particular, policy-makers would be able to push market interest rates below zero in response to a severe adverse shock, and hence the central bank would be able to provide an appropriate degree of monetary accommodation without resorting to QE.

Thus, the central bank's balance sheet would become very transparent. In particular, the central bank could hold short-term government securities in the same quantity as its liabilities of digital cash. Since QE would no longer be necessary, the size of the central bank's balance sheet would simply reflect the demand for digital cash, and the maturity composition of government debt held by the public would be determined by the fiscal authorities and not the central bank.

The central bank's operating procedures would be correspondingly transparent: It would engage in purchases and sales of government securities to adjust the supply of digital cash in line with movements in demand for digital cash. The spread between the digital cash interest rate and interest rates on short-term government securities would be negligible due to practically costless arbitrage between these risk-free assets. With the obsolescence of paper currency, the central bank would no longer generate substantial seigniorage and would simply cover its expenses via miniscule fees on payment transactions.

11.4.2. Systematic Policy

The central bank's strategy for adjusting the digital cash interest rate can be expressed using a simple benchmark as follows:

$$i_t = \tilde{\pi}_t + r_t^* + \alpha(\tilde{p}_t - p^*) + \beta(p_t - p^*) + \delta(y_t - y_t^*)$$

This formulation is essentially a variant of the Taylor Rule that is oriented towards stabilizing the price level rather than the inflation rate. In particular, the central bank uses the digital cash interest rate (i_t) to keep the actual price level (p_t) stable at its target level (p^*). The digital cash interest rate also reacts to deviations in a core measure of the price level ($\tilde{p}_t$) and to deviations of real GDP from its potential $(y_t - y_t^*)$.

As in the Taylor rule, this specification can be viewed as a benchmark for adjusting the real interest rate in response to fluctuations in economic activity and prices. In particular, the *ex post* real interest rate is given by the nominal interest rate (i_t) adjusted for core inflation ($\tilde{\pi}_t$). When the price level is on target and output is at potential, then the real interest rate is set at its equilibrium value (r_t^*).

11.5. PRACTICAL STEPS

In light of these design principles, it's natural to ask whether digital cash is truly feasible, and if so, over what timeframe? Rather than decades or centuries, our analysis indicates that major central banks could take the essential steps within the next several years, although further refinements would surely take place in subsequent years. In particular, central banks should: (i) establish a real-time clearing and settlement system that facilitates efficient payments for consumers and businesses, and (ii) facilitate the establishment of safe and liquid bank accounts that accrue essentially the same rate of return as other risk-free assets.

11.5.1. Real-Time Clearing & Settlement

As noted above, a key feature of digital cash is to serve as an ***efficient medium of exchange***. Thus, a real-time clearing and settlement system is crucial for facilitating secure payments and eliminating counterparty risks by finalizing such transactions within minutes rather than hours or days.

For example, a task force commissioned by the Federal Reserve concluded last year that "*broad access to settlement services will help level the playing field and enhance competition among providers of faster payments services.*" That task force called on the Fed to *“begin efforts immediately”* on a real-time payment system that could be implemented *“by 2020.”*[17]

While a two-year timeframe might seem overly ambitious, recent experience in the Eurozone demonstrates that such a timeframe is indeed practical. Following about nine months of consultations with financial institutions and other stakeholders, the European Central Bank (ECB) reached a decision in June 2017 to establish a new system called Target Instant Payments Settlement (TIPS). The logistical details were worked out within about 15 months, and the new system became active in November 2018.[18]

Moreover, the ECB’s new system embodies the principle that digital cash payments can be secure, rapid, and practically costless. TIPS offers final and irrevocable settlements of instant payments in euros and operates on a cost-recovery and not-for-profit basis. In particular, entry and account maintenance are free of charges, and each payment transaction is subject to a miniscule fee of 0.2 eurocents (?0.002) or less.

Following a roughly similar approach, the Federal Reserve Board can move forward expeditously in carrying out the recommendations of its task force and expediting the establishment of a secure and efficient real-time payment system. Indeed, the Federal Reserve has recently issued a public notice calling for input and comments on the possibility of developing a real-time interbank settlement service along with tools for performing real-time transfers.[19]

11.5.2. Interest-Bearing Digital Cash

Another key design principle is that digital cash should serve as a ***secure store of value*** that bears the same rate of return as other risk-free assets, thereby eliminating the opportunity cost of holding money. In effect, consumers and businesses should be able to receive essentially the same interest on checkable deposits and other current accounts that commercial banks receive on reserves held at the central bank, that is, the interest rate on reserves (IOR) less a very small margin to cover operating costs.

While interest-bearing digital cash might seem like a dramatic new development, in fact the Federal Reserve has already implemented measures that are essentially similar. A wide range of financial institutions (e.g., money market funds) can earn

[17] The Faster Payments Task Force was created in 2015 as a broad and inclusive group of stakeholders with representatives from financial institutions, payment providers, businesses, consumer groups, public agencies, and other experts. Its conclusions are posted at: https://fedpaymentsimprovement.org/wp-content/uploads/faster-payments-task-force-final-report-part-two.pdf.

[18] https://www.ecb.europa.eu/paym/target/tips/html/index.en.html.

[19] https://www.federalreserve.gov/newsevents/pressreleases/other20181003a.htm.

interest on overnight reverse repurchase transactions with the Federal Reserve Bank of New York.[20] Moreover, the twelve Federal Reserve Banks have authority to maintain segregated deposit accounts for systemically important financial market utilities (FMUs) so that the customers of those FMUs may rest assured that their funds are secure, liquid, and interest-bearing.[21]

In a competitive banking system, it would be reasonable to expect that the interest rate on liquid deposits would roughly match or exceed the IOR. After all, commercial banks are only required to hold a small fraction of their liquid deposits as reserves at the central bank (which accrue the IOR), and they can earn a higher return by lending out the rest of those funds or through prudent investments in marketable securities. In fact, however, most liquid deposits earn little or no interest, and even short-term savings accounts accrue interest at a rate far below that of IOR.

Thus, one simple way to foster a more competitive banking system would be to encourage the establishment of narrow banks. The business model of a narrow bank is remarkably simple and transparent, because such a bank holds 100% of its deposits as reserves at the central bank. Thus, such deposits can accrue interest at essentially the same rate as IOR (less a small margin to cover the bank's operating costs).

Narrow banks could significantly enhance the competitiveness of the banking system without displacing most conventional banks. After all, huge banks obtain the bulk of their funding from wholesale markets and earn profits from managing complex portfolios, while community banks specialize in "relationship banking" with small businesses and local residents.

It should be feasible for a narrow bank to operate under the same legal arrangements as any other commercial bank. Moreover, it seems reasonable that a narrow bank would have no need for deposit insurance or access to the central bank's lending facility, since its deposits would be inherently safe and liquid.

In light of these considerations, the Federal Reserve and other major central banks should welcome the establishment of narrow banks. To the extent that some public officials have substantive concerns about such an approach, the central bank should initiate a transparent and inclusive process similar to the approach for establishing a real-time payments system, engaging in consultations with financial institutions, community groups, and other stakeholders. If such

20 Information about the design of the Federal Reserve's reverse repo facility and the expanded range of counterparties is available at https://www.newyorkfed.org/markets/rrp_faq.html.

21 For example, segregated reserve accounts at the Federal Reserve Bank of Chicago have been created to hold the funds of customers of the Chicago Mercantile Exchange *(*http://www.cmegroup.com/notices?/clearing?/2017/03/Chadv17-107.html) and the initial margin accounts of customers of ICE Clear Credit *(*https://www.theice.com?/publicdocs?/clear_credit/circulars/Circular_2017_015_FINAL.pdf*)*.

consultations conclude that narrow banks would indeed be beneficial to the general public, then the central bank should move expeditiously to facilitate their creation and thereby facilitate the goal of ensuring that the medium of exchange also serves as a secure store of value.

11.5.3. Mitigating the ELB

Given the evident shortcomings of unconventional monetary policies, it is crucial to ensure that the central bank has the ability to foster economic recovery and preserve price stability, even in the face of severe adverse shocks. Indeed, while a decade has passed since the onset of the financial crisis, there is no room for complacency; the global economy remains turbulent, and no one can accurately predict how many more years will pass before the next major downturn. Thus, a key priority is to take steps to mitigate or eliminate the effective lower bound (ELB) on nominal interest rates.

As noted above, one potential option for mitigating the ELB would be to raise the inflation target to around 4 or 5 percent or perhaps even higher.[22] However, raising the inflation target to mitigate the ELB seems to illustrate the adage of "throwing out the baby with the bath water." After all, central banks have a legal mandate of fostering stable prices, and such a mandate seems inconsistent with persistently higher levels of inflation. Such a marked departure from price stability would complicate the decisions and plans of ordinary families and businesses, perhaps leading to widespread adoption of inflation indexation clauses that would in turn undermine the central bank's ability to keep inflation stable. Moreover, concerns about excessive and volatile inflation would become the subject of election debates, and the inflation target would become a political football rather than a credible anchor.

A far superior plan is to promote the use of digital cash and accelerate the obsolescence of paper cash. It would be completely inappropriate to abolish paper currency; individuals and businesses should remain free to use it for legitimate purposes (though not for criminal activity or money laundering).[23] But paper cash is inefficient and costly at every stage of retail use: supplying automated teller machines, maintaining cash registers at retail stores, using armored cars for transport, and ensuring that no cash is lost or stolen at any point in this process. By comparison, digital cash can be used instantly at practically no cost at all. Thus, as digital cash comes into widespread use, it seems reasonable to expect that paper cash will become practically extinct, just like typewriters and audio cassette tapes.

22 See Blanchard et al. (2010), Ball (2014), and Ball et al. (2016).
23 See Rogoff (2016).

In addition, central banks should establish a graduated system of fees for transfers between paper cash and digital cash. Small transfers – say, up to $100 per week for an individual or $10,000 for a small business – would be completely exempt from such fees. Moderately larger transfers would be subject to a nominal fee (e.g., 2-3%), roughly similar to the size of withdrawal fees at many ATMs and cash service fees incurred by many small businesses. And the largest transfers (say, over $5,000) would be subject to an even larger fee (e.g., 5-10%). These arrangements would effectively curtail incentives for arbitrage between paper cash and digital cash, thereby eliminating the ELB, while ordinary consumers and small businesses would remain free to use paper cash if so desired.

11.6. FINANCIAL STABILITY

During a financial crisis, the central bank can expand the stock of digital cash as needed to provide emergency liquidity to supervised financial institutions. Alternatively, the central bank could extend such emergency safeguards to another public agency such as a bank regulator or the deposit insurance fund. Appropriate legal safeguards will be necessary to ensure that the lender of last resort actions do not undermine the central bank's ability to carry out its commitment to price stability.

In the event of a financial crisis, the central bank would be able to reduce the digital cash interest rate below zero, thereby preventing runs from other financial assets into digital cash. In effect, a widening of risk spreads would be reflected by a corresponding drop in the risk-free interest rate, rather than a surge in private lending rates (which would remain close to normal levels). Moreover, this policy strategy generates a steep yield curve that facilitates the expansion of bank credit and fosters prudent risk-taking – precisely the opposite of QE and "lower for longer" forward guidance that encourage search-for-yield behavior. Thus, digital cash would foster a more rapid V-shaped recovery instead of the sluggish U-shaped recoveries that many advanced economies have experienced in recent years.

11.7. CONCLUSIONS

Although memories of the financial crisis are gradually receding, the global economy remains turbulent and unpredictable. The "new normal" level of nominal interest rates is likely to be markedly lower than in prior decades, and hence the ELB will almost surely be a perennial constraint on conventional monetary policy in coming years. And a clear lesson from recent experience is that unconventional monetary policy tools are complex, opaque and ineffectual.

Therefore, central banks should move forward expeditiously with the provision of digital cash as a means of mitigating the ELB. This approach will ensure that monetary policy will be systematic, transparent and effective during normal times and in responding to severe adverse shocks. Digital cash should be provided to the public through accounts at supervised financial institutions, which hold part or all of those funds in segregated reserve accounts at the central bank. In the near term, central banks can take practical steps in this direction by implementing a real-time payment system and by encouraging the establishment of narrow banks. Over time, as digital cash becomes ubiquitous, the central bank should foster the obsolescence of paper cash and establish a graduated system of fees that would limit arbitrage between digital cash and paper cash. These steps will strengthen the monetary system by providing a form of money that serves as a practically costless medium of exchange, a secure store of value, and a stable unit of account.

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