The Macroeconomics of Central Bank-Issued Digital Currencies

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Disclaimer: The views presented are those of the authors and not necessarily those of the Bank of England or its Committees.

Outline

"Why might central banks issue digital currencies?"

- One Bank Research Agenda (Bank of England, 2015)
- Although there have been various 'e-money' systems in the past, the emergence of Bitcoin was a watershed moment
- It may, for the first time, be feasible for central banks to offer universal electronic access to their balance sheets
- Should they do it?

Outline

What is a digital currency?

An electronic form of money in which the ledger is *distributed*: shared across multiple transaction verifiers, arranged in a peer-to-peer network.

- Transaction verifiers do not hold deposits on behalf of end users.
- By comparison, traditional electronic payment systems are *tiered*, with payments *routed* through specific third parties who hold deposits on behalf of end users and are critical to the operation of the system.

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- By comparison, traditional electronic payment systems are *tiered*, with payments *routed* through specific third parties who hold deposits on behalf of end users and are critical to the operation of the system.
- Bitcoin combines a distributed ledger with an alternative monetary system.
- We reject the monetary system of Bitcoin, but take inspiration from its payment system.

Maintaining the ledger

- Arriving at consensus over the contents of the ledger is critical.
- In a permissionless system (where entry is open), suggested additions to the ledger are **cheap talk**: costless, non-binding and unverifiable.
- Cryptocurrencies make changes *costly* through a 'proof of work' system
- A permissioned system makes proposed changes *binding*

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  - Winner-takes-all + individual probability of winning increases in individual computing power and decreases in total computing power.
  - $\Rightarrow$ A negative externality: too much investment in computing power.
  - O'Dwyer and Malone (2014): In 2014, Bitcoin was consuming 5GW (cf. Ireland).
  - Deetman (2016): By 2020, it could be 15GW.
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- A permissioned system makes proposed changes *binding*
  - Transaction verifiers are regulated to ensure veracity.
  - No 'proof of work' system needed.

What is a *Central Bank* Digital Currency (CBDC)?

Universal, electronic, national-currency-denominated and interest-bearing access to the central bank's balance sheet, available 24/7 and co-existing with the present banking system.

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- A distributed ledger would (only) be needed to ensure resiliency.
- If implemented successfully, the vast majority of deposits would remain within commercial banks and subject to central bank arrangements to protect against large scale deposit flight.
- Credit provision would remain the purview of existing intermediaries.
- Commercial banks would continue to be the creators of the marginal unit of money in the economy.

Our main suppositions

- The central bank only holds government bonds against CBDC.
- The central bank issues CBDC worth 30% of NGDP and then indefinitely maintains it around that figure, on average.
- CBDC is adjusted countercyclically, either by a quantity rule (relative to NGDP) or by a price rule (relative to the main policy interest rate).

Outline

Structural effects

Four Main Factors

1. Lower real policy rates
2. Higher deposit rates relative to policy rates
3. Lower tax rates
4. Lower transaction costs

Steady State Effect

Structural effects

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   - Less *defaultable* government debt
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Steady State Effect

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Structural effects

Four Main Factors	Steady State Effect
1. Lower real policy rates	$+1.8\%$
• Less *defaultable* government debt	
2. Higher deposit rates relative to policy rates	-0.9%
• Banks face more competition	
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Total	**+2.9%**

Outline

Price and output stability

- An additional policy instrument
  - Assuming that there remain impediments to using non-money assets for transaction purposes
- A more direct implementation of 'quantitative easing'
  - Commercial banks' balance sheets no longer (directly) affected
  - e.g. Imagine if the CB charged a *negative* transaction fee
- Increased interdependence of monetary and fiscal policy
  - Risk of increased politicisation of stabilisation policies
- More, and more timely, data
  - Transaction-level data, in real time

$\Rightarrow$ Improved (or no worse) amelioration of the business cycle

Using a monetary aggregate as an instrument of policy

Didn't the 1980s teach us to not target monetary aggregates?

1. Problems in defining the relevant aggregate: Does not apply to CBDC.
2. Problems in controlling the aggregate: Does not apply to CBDC.
3. Lower benefits of controlling the aggregate: Poole (1970).
   - Volatility increases if money demand shocks are important.
   - This does apply to our model, but much more weakly than in Poole (1970).
   - The reason: banks remain the creators of the marginal unit of money.

Outline

Financial stability: benefits

- Increased payment system resiliency, both within and across systems:
  - Within: A distributed system has multiple internal redundancies, by definition
  - Across: A new payment system alongside existing frameworks
- Partial (*but not complete*) removal of Too Big To Fail concerns
  - Systemic importance from deposit or payment services removed
  - Systemic importance from credit or (vanilla) derivative provision remains
  - CBDC would supplement, not replace, existing measures to address TBTF
- Potentially (vastly) more data on interconnectedness
  - Especially if the system embraced 'smart contracts'

Financial stability: possible problems

- Design risks
  - Communication protocols, incentive structures, security features, etc
- Transition risks
  - Uncertainty around private sector response
- Funding risks for commercial banks
  - We do not model risky deposits, fire sales, panic buying or non-rationality.

Outline

Major elements

- Based on Benes and Kumhof (2012) and Jakab and Kumhof (2015).
- Households:
  - Consume goods and supply labour.
  - Produce physical capital.
  - Hold physical capital and land.
  - A transaction cost motive for holding money:
    - Borrow from banks to obtain deposits.
    - Hold CBDC.
- Financial investors: For bonds-deposits arbitrage condition.
- Banks: Create money through loans.
- Central bank: Monetary policy, including CBDC, targets inflation.
- Government: Fiscal policy is countercyclical, with a debt/GDP target.

Endogenous deposit creation

- Sidrauski-Brock monetary models of the 1980s/1990s:
  1. Representative household with cash-in-advance/money-in-utility/transactions-cost
  2. Government-supplied money.
- Jakab and Kumhof (2014) replace (2):
  - Cash and reserves (absent QE) are negligible shares of broad money and omitted.
  - Commercial bank-supplied money (loans creating deposits).
- CBDC puts government money back into the model. However:
  - CBDC is universally accessible (unlike reserves).
  - CBDC is interest-bearing (unlike cash).
  - CBDC competes with bank deposits.

A transaction cost motive for holding money

- Consumer pays: $P_t \ C_t \ \underbrace{(1+\tau_t)}_{\text{Tax}} \ \underbrace{(1+s_t)}_{\text{Transaction cost}}$
- Extend Schmitt-Grohé and Uribe (2004):

$$s_t = av_t + \frac{b}{v_t} - 2\sqrt{ab}$$

$$v_t = \frac{P_t C_t (1+\tau_t)}{f(D_t, M_t)} \text{ where } D_t = \text{deposits and } M_t = \text{CBDC}$$

- $f(D_t, M_t)$ is the liquidity generating function.
  - We use quasi-linear and CES

Four types of lending

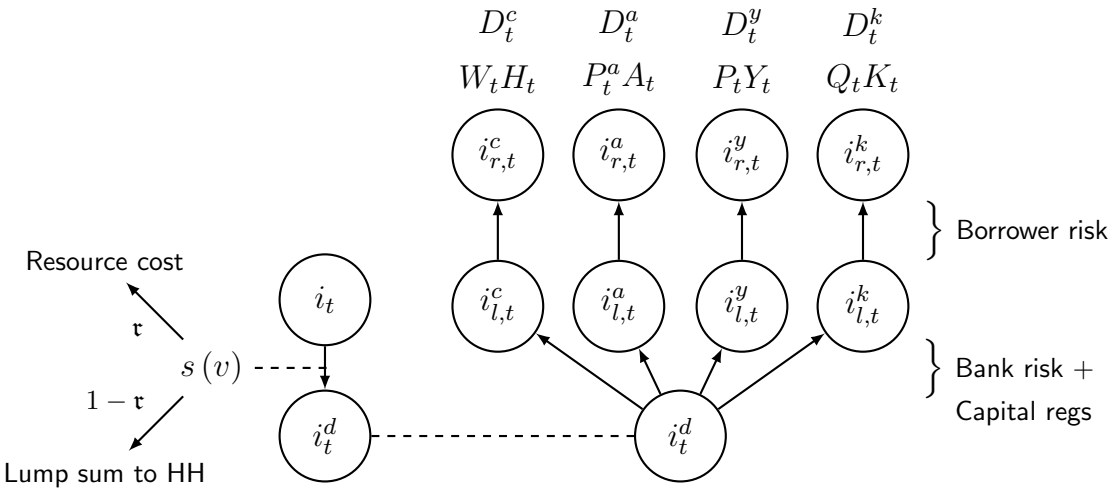
- Consumption, backed by wage income
- Housing, backed by the property purchased
- Working capital, backed by firm revenue
- Physical capital, backed by the capital purchased

There is idiosyncratic risk:

- By borrower, handled by BGG (1999) diversification
- By bank $\Rightarrow$ gives rise to capital requirements

Lending

- Banks are actuarially fair ⇒ Zero expected profit



Monetary Policy

The main policy rate is a basic Taylor rule, increasing when inflation is high:

$$i_t = \phi_\pi \left(\pi_t - \pi^*\right)$$

A *quantity rule* for CBDC removes liquidity when inflation is high:

$$m_t = m^* - \varphi_{\pi,m} \left(\pi_t - \pi^*\right)$$

A *price rule* for CBDC makes liquidity less attractive when inflation is high:

$$i_{m,t} = \left(i_t - \mathfrak{sp}\right) - \varphi_{\pi,i} \left(\pi_t - \pi^*\right)$$

- Adjusting CBDC acts directly on the 'liquidity tax'
- Equivalently, we could vary the transaction cost charged by the CB

Outline

Conclusions

- Overall, we like the idea of Central Bank-Issued Digital Currency.
- Increase in steady-state GDP of as much as 3%:
  1. Lower real interest rates.
  2. Lower distortionary fiscal tax rates.
  3. Lower distortionary liquidity tax rates.
- Improved CB ability to stabilise inflation and the business cycle:
  1. Especially under shocks to money demand or credit creation.
  2. Especially under low substitutability between CBDC and deposits.
- It should reduce some FS risks, but it would introduce others.
- Main necessary conditions:
  1. Issue CBDC only against government debt.
  2. Issue a sufficiently large stock of CBDC.