

# Central Bank Digital Currencies - Benefits versus Costs

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## Disclaimer

The views expressed herein are those of the authors, and should not be attributed to the Bank of England or the Reserve Bank of Australia.

# 1 Introduction

- The emergence of the distributed ledger technology (DLT) and of Bitcoin was a watershed moment in the history of 'e-monies'.
- It may, for the first time, be technically feasible for central banks to offer universal access to their balance sheet.
  - Existing centralized RTGS systems: Not robust for universal access.
  - New decentralized DLT systems: Can potentially solve this problem.
- Question: Is universal access economically desirable.

## 2 What is a Digital Currency?

- Traditional Electronic Payment Systems - **Tiered** Ledgers:
  - Payments routed through and must be verified by specific third parties.
  - Third parties arranged in a hierarchical network.
- Digital Currencies - **Distributed** Ledgers:
  - Payments are peer-to-peer and can be verified by multiple verifiers.
  - Verifiers arranged in a peer-to-peer network.
- Bitcoin - Distributed Ledger + Alternative Monetary System.
  - BoE research rejects the monetary system of Bitcoin.
  - BoE research takes inspiration from its payment system.

# Maintaining the Ledger

- Suggested additions to the Bitcoin ledger are **cheap talk**:  
Costless, non-binding and unverifiable.
- Bitcoin (cryptocurrencies) make proposed changes costly:
  - Through a proof-of-work system.
  - Result: Over-investment in computing power.
    - \* Bitcoin, by end-2018, will consume as much electricity as Netherlands!
    - \* And cryptocurrency electricity consumption is growing fast.
- A permissioned system (e.g. CBDC) makes proposed changes binding:
  - Transaction verifiers are regulated to ensure veracity.
  - Trust in central party replaces proof-of-work system.

### 3 What is a Central-Bank Digital Currency (CBDC)?

- **Access to the central bank's balance sheet.**
- **Availability:** 24/7.
- **Universal:** Banks, firms and households.
- **Electronic:** For resiliency reasons, probably using DLT.
- **National-currency denominated:** 1:1 exchange rate.
- **Issued only through spending or against eligible assets:** Government bonds.
- **Interest-bearing:**
  - To equate demand and supply at 1:1 exchange rate.
  - Second tool of countercyclical monetary policy.
- **Coexisting with the present banking system.**

# 4 The Model

## 4.1 Overview

- Based on Benes and Kumhof (2012) and Jakab and Kumhof (2015, 2018).
- The non-monetary model elements are standard New Keynesian fare.
- Households:
  - Deposits: Created by banks through loans (see keynote this morning).
  - CBDC: Created by central bank, issued via OMO or spending/lending.
  - Deposits and CBDC jointly serve as medium of exchange.
- Banks: Create new deposits by making new loans.
  - Loans are risky → banks can make losses.
  - Deposits reduce costs of transactions → can pay a lower interest rate.
- Government:
  - Fiscal policy.
  - Traditional monetary policy.
  - CBDC monetary policy.

## 4.2 Monetary Policy - The Policy Rate

$$i_t = (i_{t-1})^{i_i} (i_{steady\ state})^{(1-i_i)} \left( \frac{\pi_{4,t+3}^p}{(\pi_{tgt}^p)^4} \right)^{\frac{(1-i_i)i_{\pi^p}}{4}}$$

- This is a standard forward-looking Taylor rule with interest rate smoothing.
- I show this to make sure that central bankers do not get nervous:

This is not a completely new world.



## 4.3 Monetary Policy - CBDC

### 4.3.1 Quantity Rule for CBDC

$$m_t^{rat} = m_{tgt}^{rat} S_t^{ms} - 100 m_{\pi p} E_t \ln \left( \frac{\pi_{4,t+3}^p}{(\pi_{tgt}^p)^4} \right)$$

- Fix the quantity of CBDC, let CBDC interest rate clear the market.
- $m_{\pi p} > 0$ : Removes CBDC from circulation in a boom.

### 4.3.2 Price Rule for CBDC

$$i_{m,t} = \frac{i_t}{sp} \left( \frac{\pi_{4,t+3}^p}{(\pi_{tgt}^p)^4} \right)^{-i_{\pi p}^m}$$

- Fix interest rate on CBDC, let the quantity of CBDC clear the market.
- $i_{\pi p}^m > 0$ : Makes CBDC less attractive in a boom.

## 5 Steady State Effects of the Transition to CBDC

- Assumptions:
  - Issue CBDC against government debt.
  - Magnitude: 30% of GDP.

- Results:

	<b>Steady State Output Effect</b>
1. Lower Real Policy Rates	+1.8%
2. Higher Deposit Rates Relative to Policy Rates	-0.9%
3. Reductions in Fiscal Tax Rates	+1.1%
4. Reductions in Liquidity Tax Rates	+0.9%
<b>Total</b>	<b>+2.9%</b>

# The Main Factors Explained

## 1. Lower real interest rates:

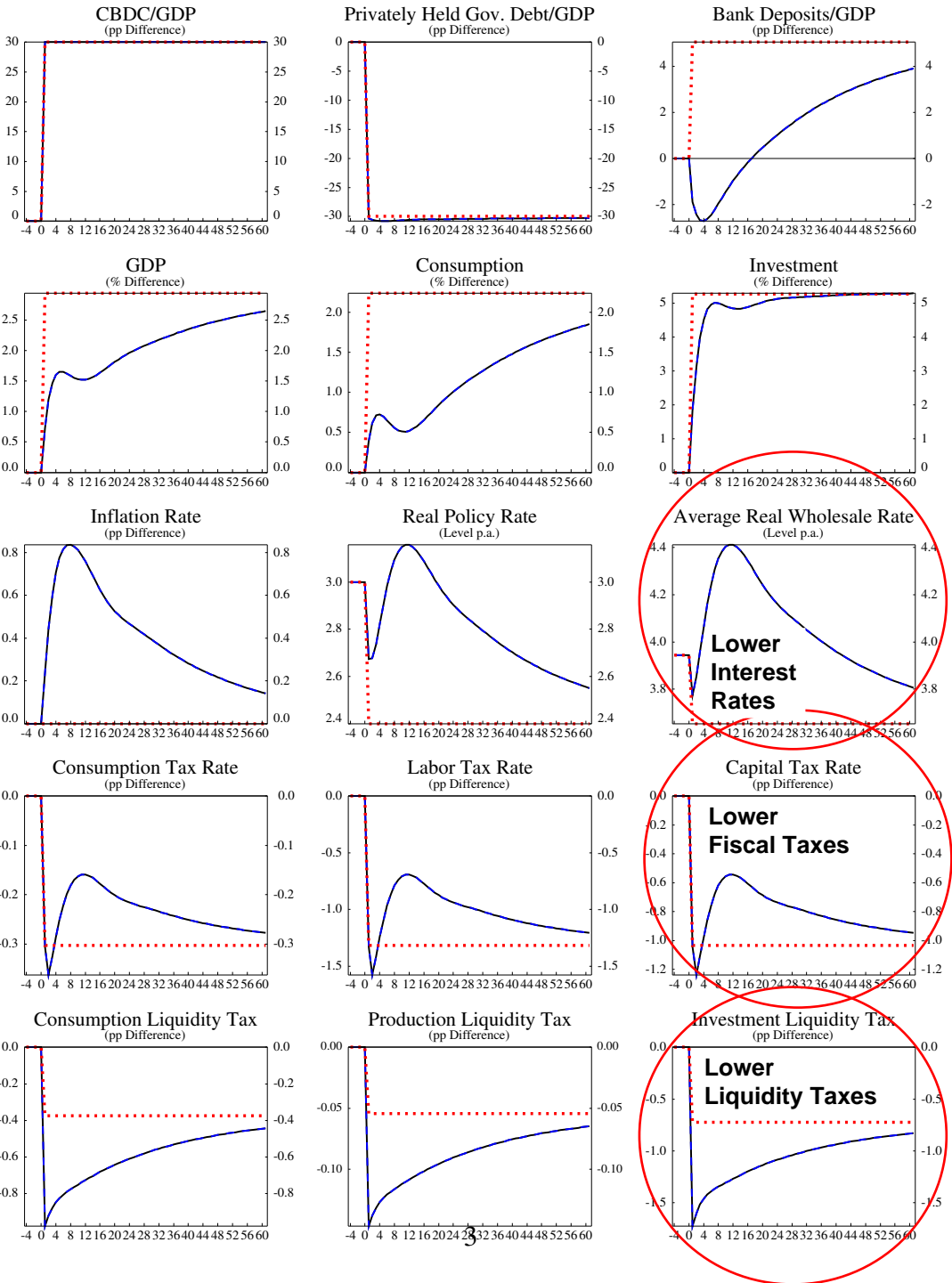
- Assumption: CBDC issued against government debt.
- CBDC is not defaultable, government debt is.
- CBDC carries a lower interest rate than government debt.

## 2. Lower distortionary taxes:

- Much larger central bank balance sheet.
- Therefore much larger seigniorage flows.
- Also: Lower interest costs (see above).
- Assumption: Seigniorage is used to reduce distortionary taxes.

## 3. Lower transactions costs:

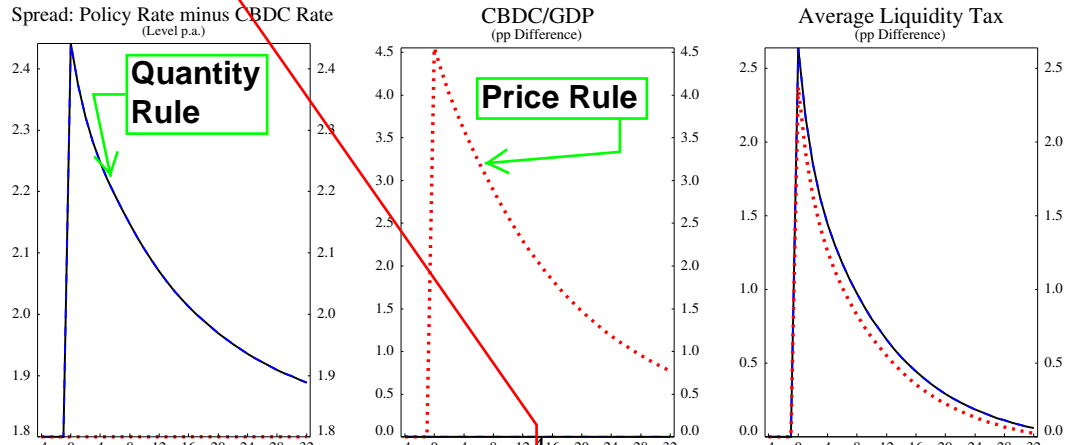
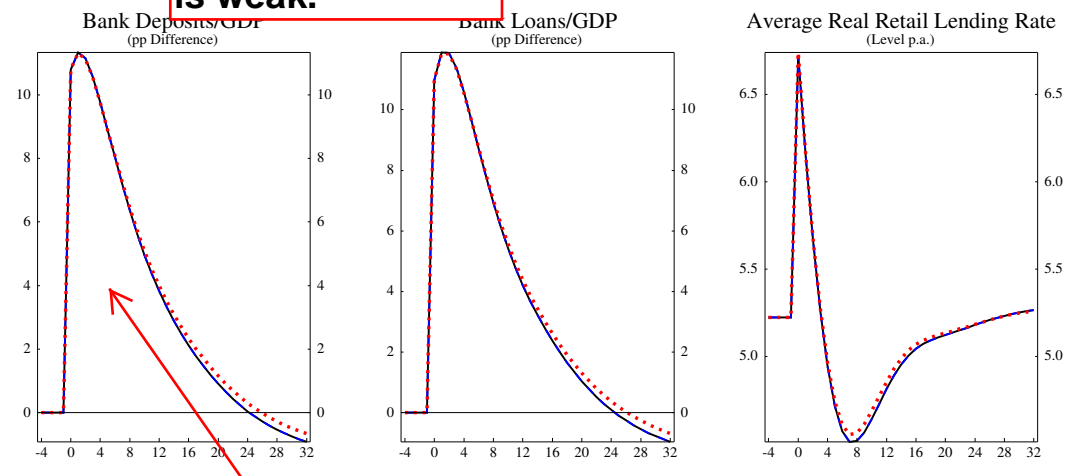
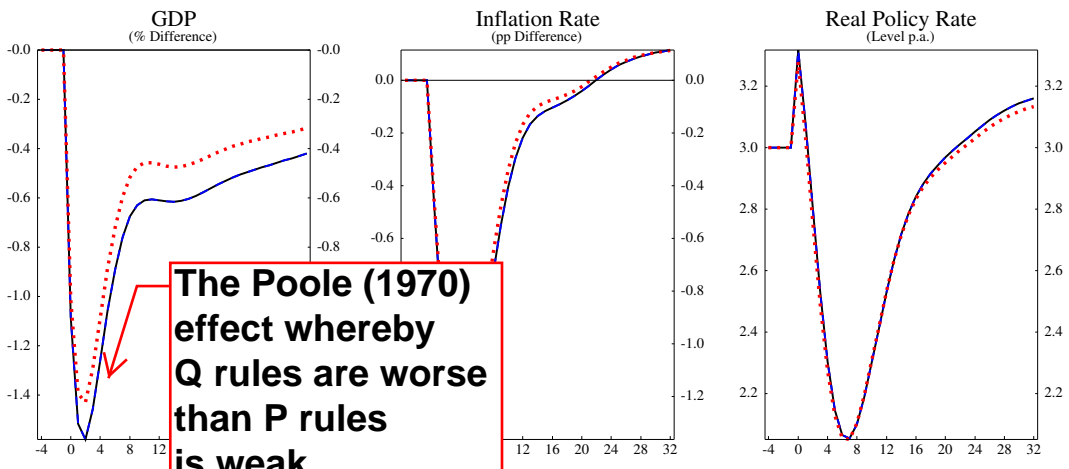
- Modern money is 95%+ created by private banks.
- This is costly: Spreads, regulation, bank market power, collateral.
- You can therefore never reach the Friedman rule.
- But with CBDC you can get much closer.



## Transition to Steady State with CBDC

solid line = actual transition ; dotted line = change in long-run steady state

## **6 Quantity Rules or Price Rules for CBDC?**

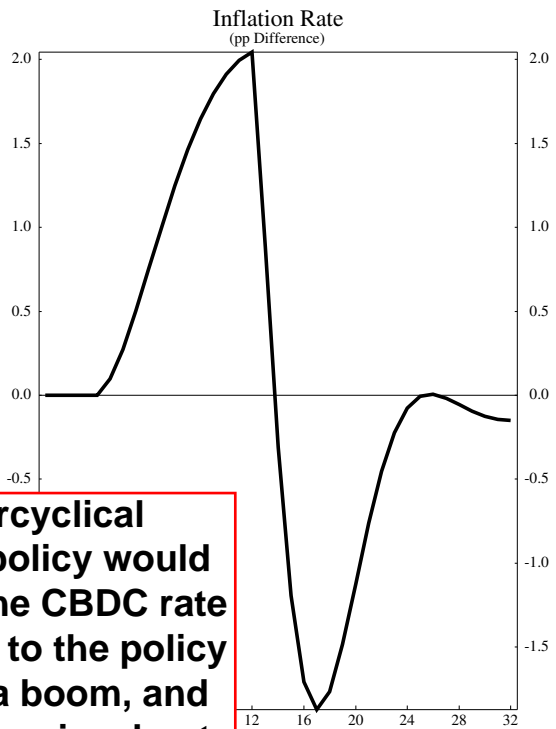
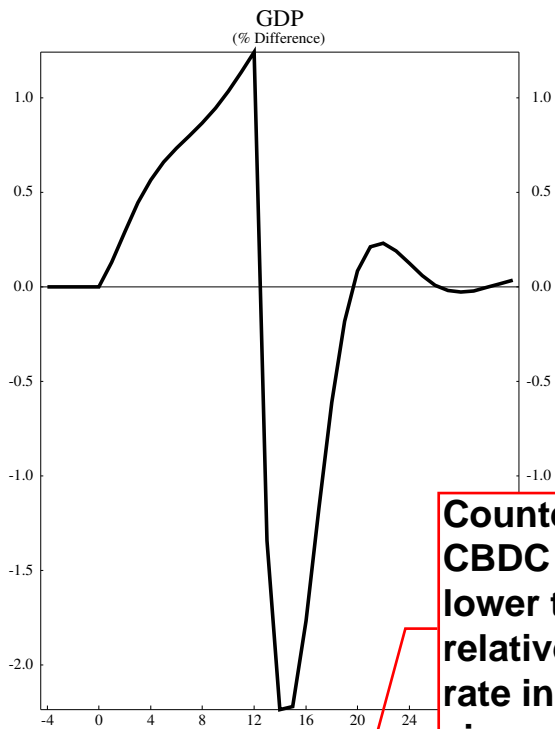


**Liquidity demand is mostly satisfied by instantaneous creation of bank deposits through loans. But CBDC can help.**

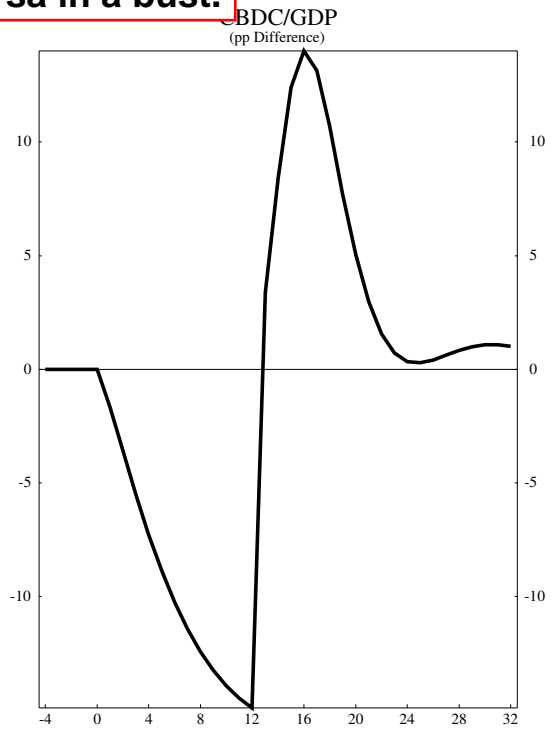
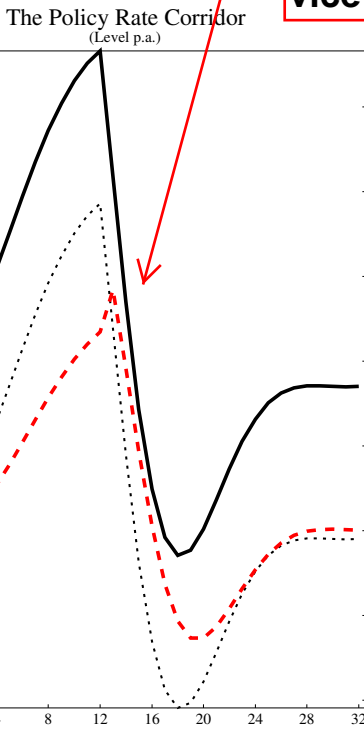
**Shock to Demand for Total Liquidity**

solid line = quantity rule ; dotted line = price rule

## **7 Countercyclical CBDC Rules**



**Countercyclical  
CBDC policy would  
lower the CBDC rate  
relative to the policy  
rate in a boom, and  
vice versa in a bust.**



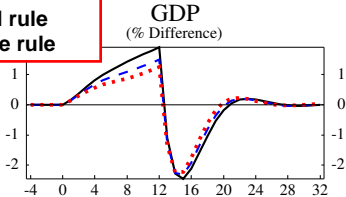
**Credit Cycle Shock - Price Rule - Policy Rate Corridor**

Bottom Left: Nominal Policy and CBDC Rates

Solid Line = Policy Rate, Dotted Line = Policy Rate minus Fixed Spread, Dashed Line = CBDC Rate



- Solid line = fixed rule
- Dashed line = cyclical rule
- Dotted line = aggressive rule



## 8 Financial Stability: CBDC Bank Runs?

- Bank-deposits-to-CBDC run difficult in aggregate. 2 reasons:
  1. Aggregate increases in CBDC demand do not affect bank deposits:
    - Central bank sells CBDC only against government debt.
    - **Not** against bank deposits: No unconditional LoLR guarantee.
    - CBDC purchases among non-banks are irrelevant for deposits.
  2. CBDC policy rules can further discourage volatile CBDC demand.
    - Quantity rule:
      - \* CBDC supply fixed, CBDC interest rate clears the market.
      - \* **Lower political bound on CBDC rate?** Switch to price rule.
    - Price rule:
      - \* CBDC supply endogenous, CBDC quantity clears the market.
      - \* **Running out of government bonds?** Switch to other securities.

- Kumhof and Noone (2018): Four Key Design Principles for CBDC
  1. **CBDC pays an adjustable interest rate:**
    - To clear the market under a quantity rule.  
Without large balance sheet or price level fluctuations.
    - As countercyclical tool under an interest rate rule.
  2. **CBDC and reserves are distinct, and not convertible into each other:**
    - To keep control of the quantity of reserves and the policy rate.
    - This also prevents deposits-to-CBDC runs through the back door.
  3. **No on-demand convertibility of bank deposits into CBDC:**
    - Convertibility at commercial banks requires CB support.
    - It thus requires convertibility at the CB.
    - This is a guarantee of unlimited and unsecured LoLR.
    - It opens the door wide to system-wide bank runs.
  4. **CB only issues CBDC against eligible securities:**
    - Principally government securities.
    - This is standard practice for issuance of government money today.

- The final two principles imply that:
  - Agents can freely trade deposits against CBDC in a private market.
  - Private market can freely obtain additional CBDC at the CB.
  - But only:
    - \* At the posted CBDC interest rate.
    - \* Against eligible securities.

## 9 Conclusions

- CBDC has significant benefits  $\implies$  further research is worthwhile.
1. Steady state efficiency:
    - Lower interest rates, higher seigniorage, more and cheaper liquidity.
    - Increase in steady-state GDP could be as much as 3%.
  2. Business cycle stability:
    - Second policy instrument.
    - Improved ability to stabilize inflation and the business cycle.
  3. Financial stability:
    - CBDC should reduce many financial stability risks.
    - But if it is not designed well it may introduce others.
    - The “run risk” can be mostly eliminated by sound system design.
- Critical issue: Design of a smooth transition.

Thank you!