

The Macroeconomics of Central Bank Issued Digital Currencies

John Barrdear, Bank of England

Michael Kumhof, Bank of England

CCBS Chief Economists' Workshop on CBDC
July 13, 2021

Disclaimer

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

1 Introduction: What is a CBDC?

- **Access to the central bank's balance sheet.**
- **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.**

2 The Model

2.1 Overview

- Based on Benes & Kumhof (2012, 2021) and Jakab & Kumhof (2015, 2021).
- The non-monetary model elements are standard.
- Households:
 - Deposits: Created by banks through loans.
 - CBDC: Created by central bank through asset purchases.
 - Deposits and CBDC jointly serve as medium of exchange.
- Banks: Create new deposits by making new loans.
- Government:
 - Fiscal policy.
 - Traditional monetary policy.
 - CBDC monetary policy.

2.2 Banks

- Loans: Bernanke, Gertler and Gilchrist (1999)
 - Costly state verification.
 - Difference: Pre-committed lending rates.
- Deposits: Schmitt-Grohé and Uribe (2004)
 - Transactions cost technology.
 - Difference:
 - * “Money” = bank deposits + CBDC.
 - * “Money” \neq cash + reserves.

2.3 The Liquidity-Generating Function (LGF)

- Transition to economy with CBDC:

$$f_t = (Deposits_t)^{\frac{\epsilon-1}{\epsilon}} + (CBDC_t)^{\frac{\epsilon-1}{\epsilon}}$$

CES + Decreasing Returns + Separability

- Shocks around CBDC steady state:

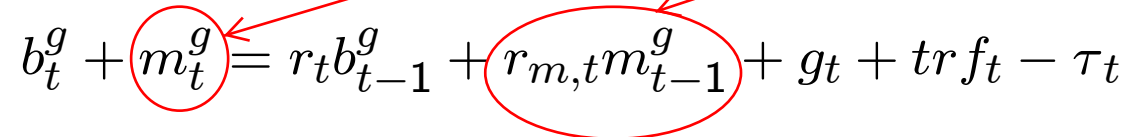
$$f_t = \left((1 - \gamma)^{\frac{1}{\epsilon}} (Deposits_t)^{\frac{\epsilon-1}{\epsilon}} + \gamma^{\frac{1}{\epsilon}} (CBDC_t)^{\frac{\epsilon-1}{\epsilon}} \right)^{\frac{\epsilon}{\epsilon-1}}$$

CES + Constant Returns + Non-Separability

2.4 Fiscal Policy

2.4.1 Government Budget Constraint

- CBDC enters like government debt.
- But it is much cheaper.

$$b_t^g + m_t^g = r_t b_{t-1}^g + r_{m,t} m_{t-1}^g + g_t + trf_t - \tau_t$$


2.4.2 Fiscal Policy Rule

- Overall Deficit Ratio:

$$gdx_t^{rat} = 100 \frac{g\check{d}x_t}{g\check{d}p_t} = 100 \frac{B_t^g + M_t^g - B_{t-1}^g - M_{t-1}^g}{GDP_t}$$

- **Relevant stock change: Government Debt + CBDC.**
- Insulates budget from potentially highly volatile CBDC seigniorage flows.

- Rule for Deficit Ratio:

$$gdx_t^{rat} = gdx_{ss}^{rat} - 100 d^{gdp} \ln \left(\frac{g\check{d}p_t}{gdp_{ss}} \right)$$

2.5 Monetary Policy - The Policy Rate

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

- This is a standard forward-looking Taylor rule with interest rate smoothing.

2.6 Monetary Policy - CBDC

2.6.1 Quantity Rule for CBDC

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

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

2.6.2 Price Rule for CBDC

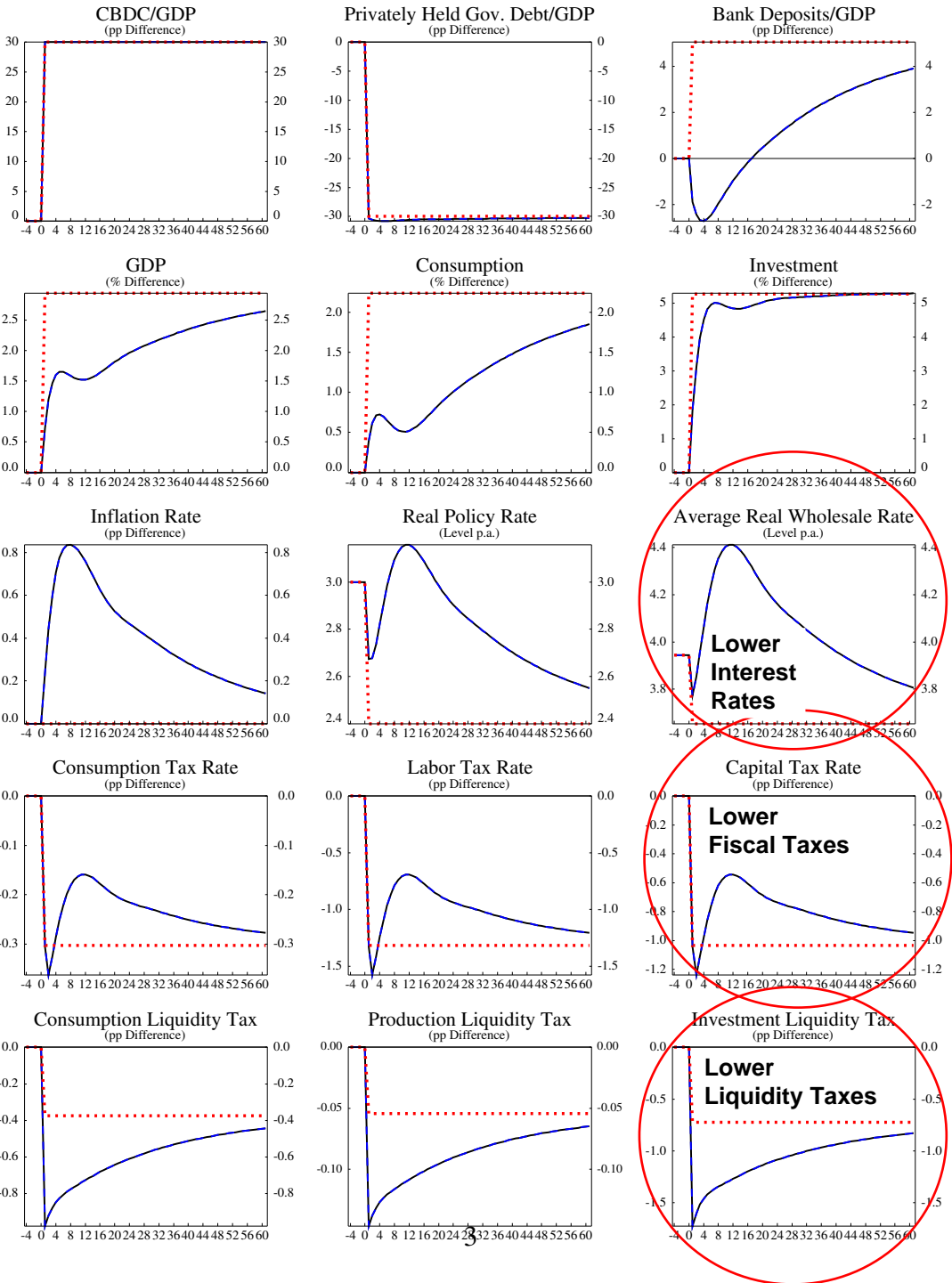
$$i_{m,t} = \frac{i_t}{sp} \left(\frac{\pi_{4,t+3}^p}{(\pi_{tgt}^p)^4} \right)^{-i_{\pi p}^m}$$

- 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.

3 Steady State Effects of the Transition to CBDC

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

	Steady State Output Effect
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%
Total	+2.9%

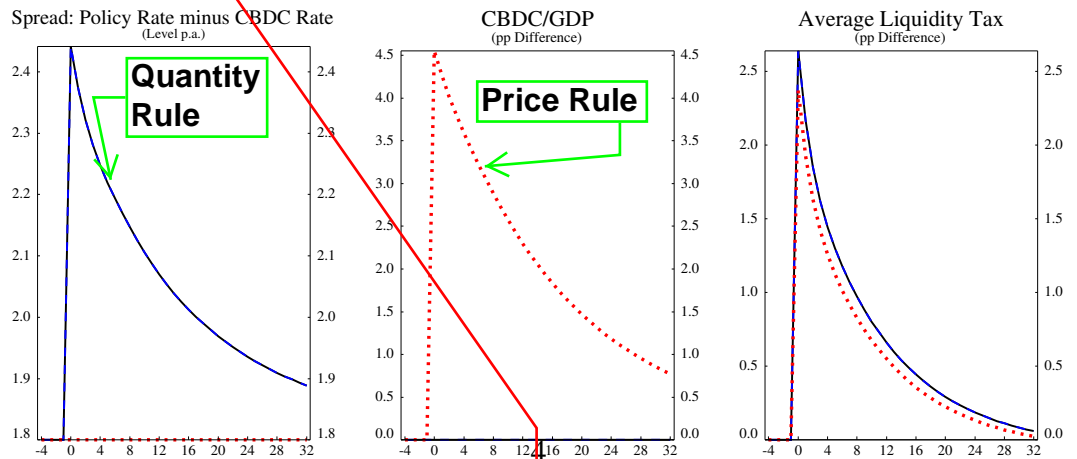
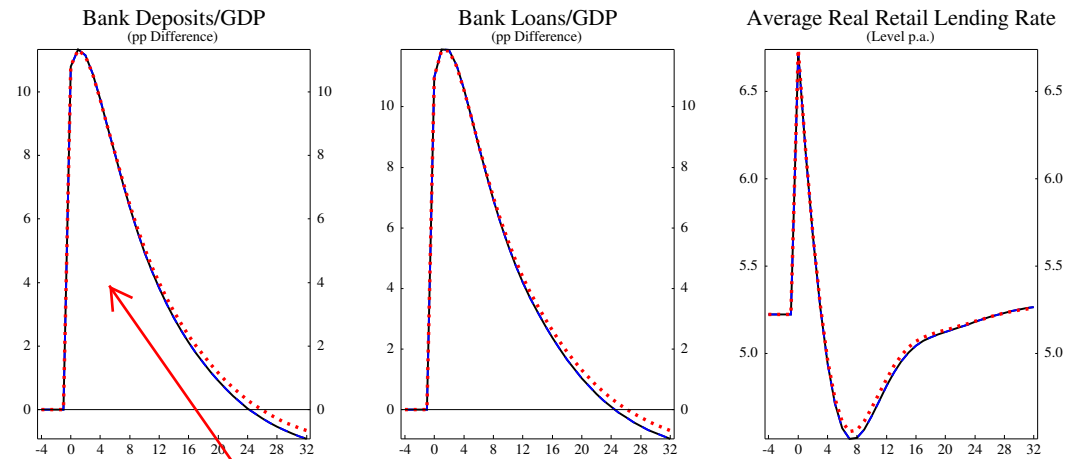
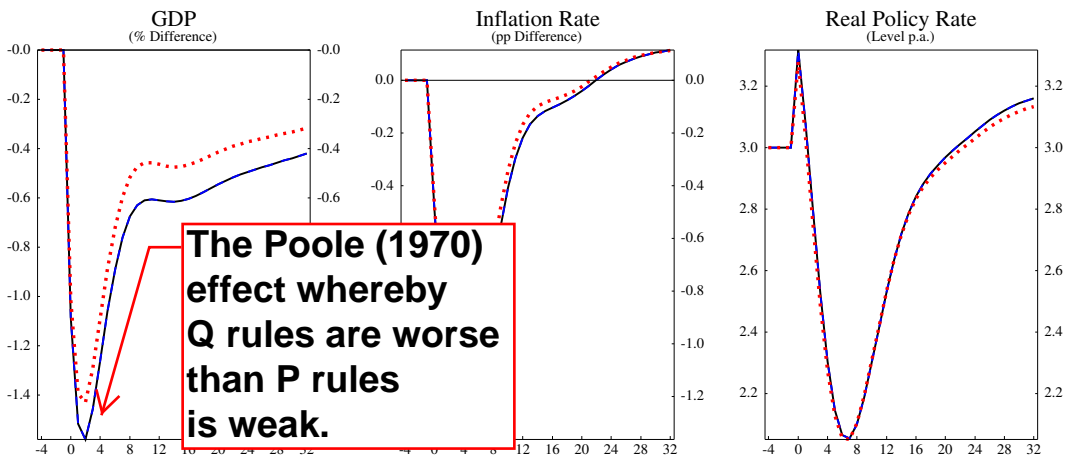


Transition to Steady State with CBDC

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

4 Quantity Rules or Price Rules for CBDC

A Poole (1970) contractionary money demand shock.



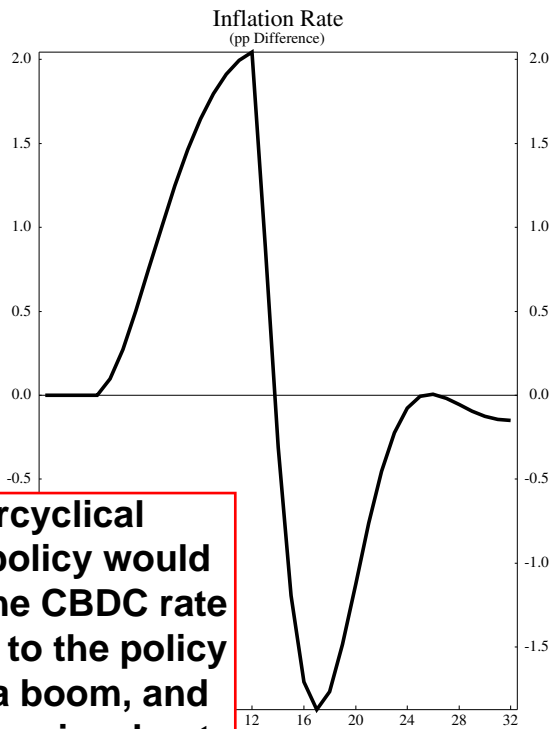
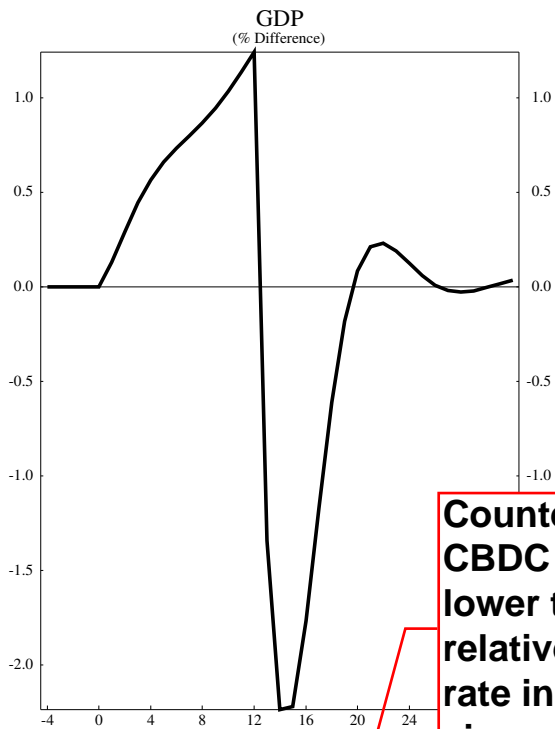
Liquidity demand is mostly satisfied by instantaneous creation of bank deposits through loans. But CBDC can help.

Shock to Demand for Total Liquidity

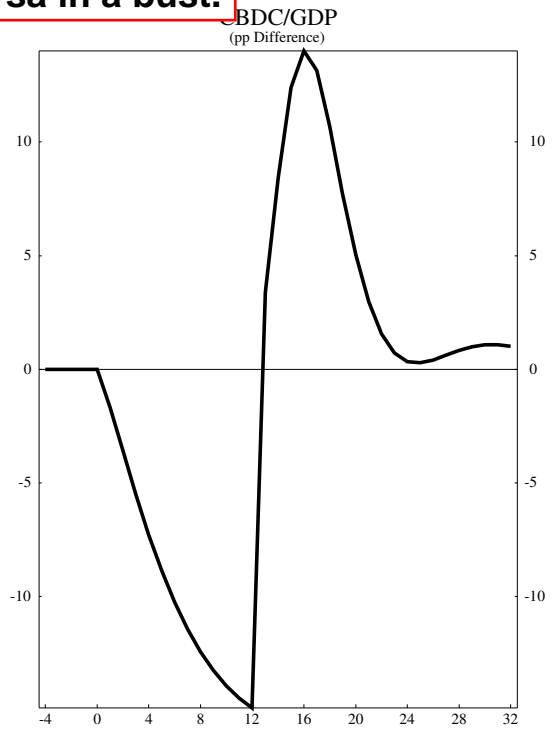
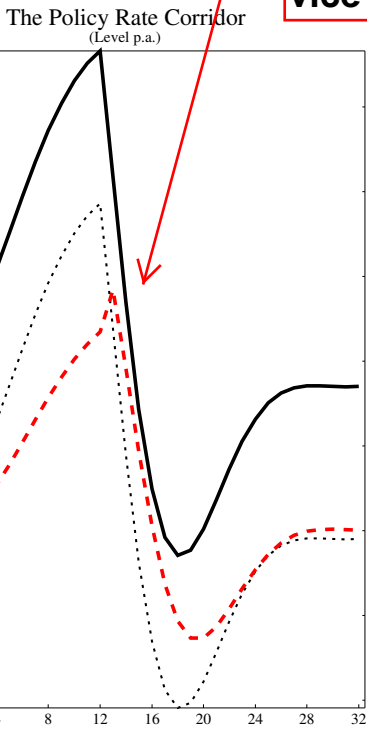
solid line = quantity rule ; dotted line = price rule

5 Countercyclical CBDC Rules

A Christiano-Motto-Rostagno (2014) boom-bust credit cycle.



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

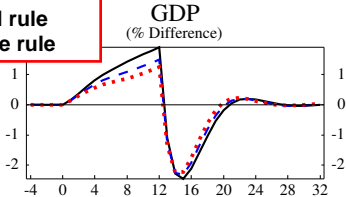


Credit Cycle Shock - Price Rule - Policy Rate Corridor

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



6 Financial Stability: CBDC Bank Runs?

- Proposal:
 1. CB to only guarantee issue of CBDC against eligible securities.
 - Same as with cash and reserves today.
 2. CB to never guarantee issue of CBDC against bank deposits.
 - Because this would open the door to an aggregate bank run.
 - With CB as potentially unsecured unlimited lender to banks.
 - This would not be harmless, it would be a catastrophe.

- Bank-deposits-to-CBDC run becomes very hard in aggregate. Why?
 1. Aggregate run to CBDC is not a run from deposits:
 - Non-banks can only buy CBDC against deposits from other non-banks.
 - CBDC purchases among non-banks irrelevant for aggregate deposits.
 2. CBDC policy rules can further discourage volatile CBDC demand.
 - Quantity rule:
 - * CBDC supply fixed, CBDC interest rate clears the market.
 - * Lower bound on CBDC rate? Switch to interest rate rule.
 - Interest rate rule:
 - * CBDC supply endogenous, CBDC quantity clears the market.
 - * Running out of government bonds? Switch to other securities.

7 Summary

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