The Macroeconomics of Central Bank Issued Digital Currencies

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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.

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.
- Households:
  - Deposits: Created by banks.
  - CBDC: Created by central bank.
  - 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.

4.2 Endogenous Deposits and Exogenous CBDC

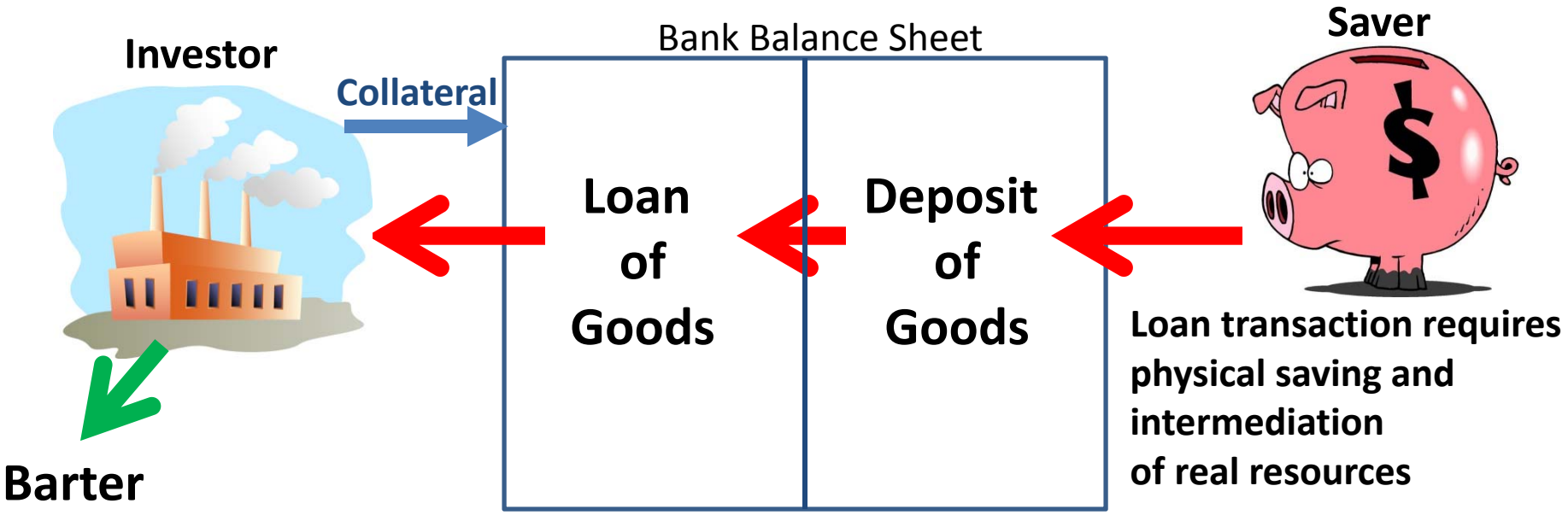
- Monetary models of the 1980s/1990s:
  1. Representative household with a demand for money.
  2. Government money (3% of all money) is the **only** money.

- The main problem is 2, not 1. Therefore, in our model:
  - We keep the representative household assumption.
  - Bank deposits (97% of all money) enter into TA cost technology.
  - Government money (3% of all money) is omitted entirely.

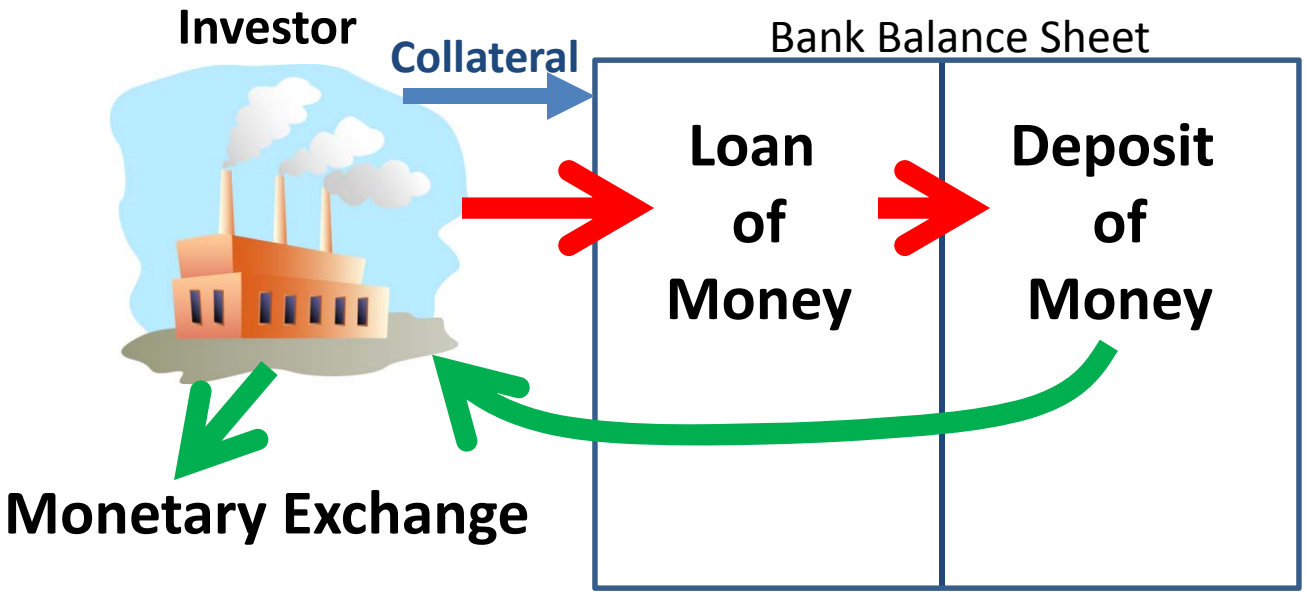
- CBDC puts exogenous government money back into the model. But:
  1. CBDC is universally accessible (unlike reserves).
  2. CBDC is interest-bearing (unlike cash).

Intermediation of Loanable Funds (ILF) versus Financing Through Money Creation (FMC)

Intermediation of Loanable Funds Model



Financing Through Money Creation Model



Loan transaction requires only digital ledger entries and no intermediation

We will insert CBDC into this model, not a loanable funds model. This matters a lot !

4.3 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.
  - Monetary Distortion = Liquidity Taxes:

$$\tau_t^{liq} = 1 + s_t + s_t' v_t$$

  - **Equivalent to consumption taxes and capital income taxes.**
  - **Banks' effect on the real economy:**
    - **Through these taxes.**
    - **Not through intermediation of "loanable funds".**

4.4 The Liquidity-Generating Function (LGF)

- Deposits: Schmitt-Grohé and Uribe (2004)
  - Transactions cost technology: Money reduces transactions costs.
  - Difference: "Money" = bank deposits + CBDC, not cash + reserves.

- Functional form:

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

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

4.5 Fiscal Policy

4.5.1 Government Budget Constraint

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

4.5.2 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:

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

4.6 Monetary Policy - The Policy Rate

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

- 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.

4.7 Monetary Policy - CBDC

4.7.1 Quantity Rule for CBDC

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

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

4.7.2 Price Rule for CBDC

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

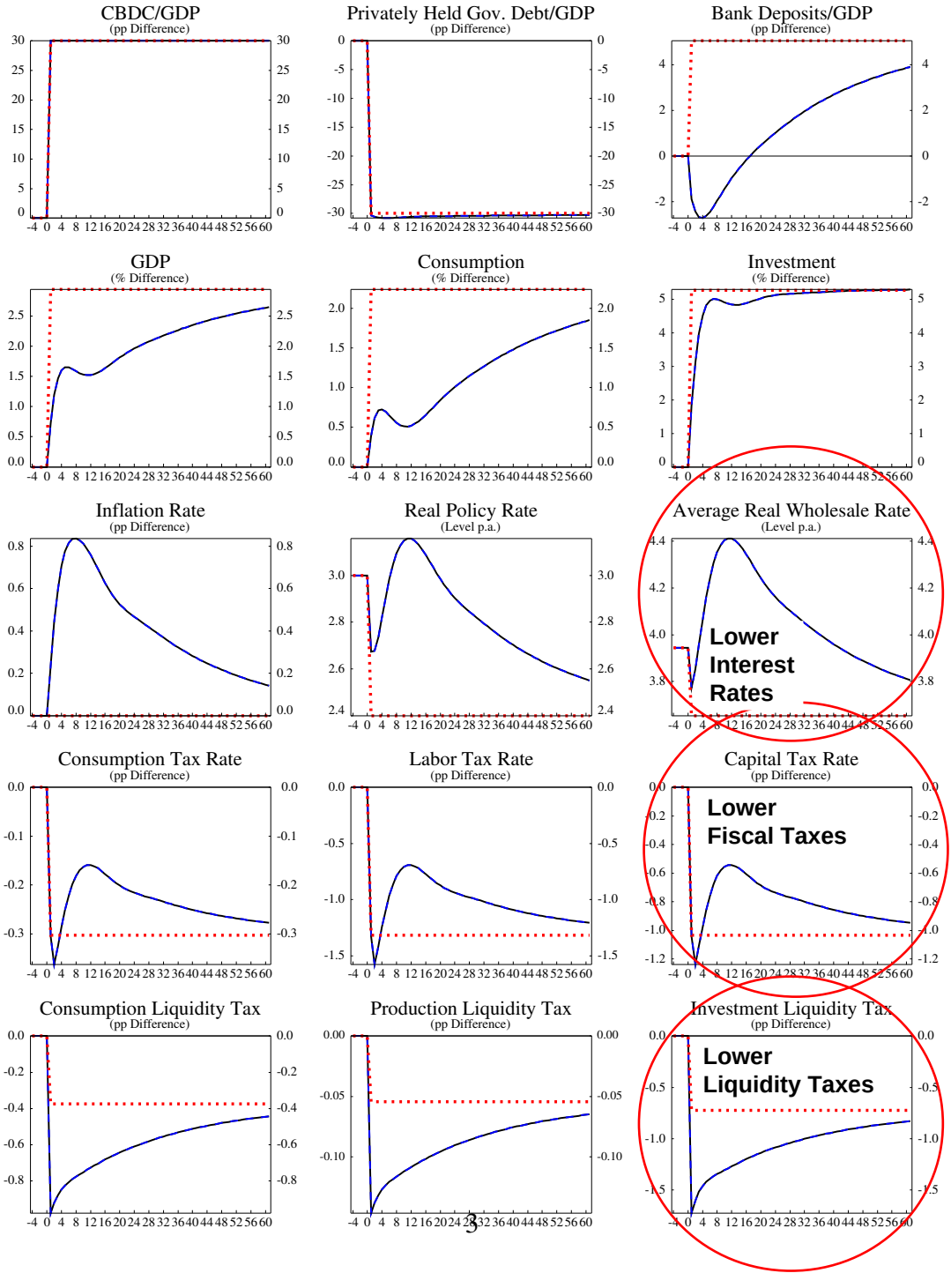
- Fix interest rate on CBDC, let the quantity of CBDC clear the market.
- $i^m_{\pi^p} > 0$: Makes CBDC less attractive in a boom.

5 Steady State Effects of the Transition to CBDC

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

- Results:

	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%

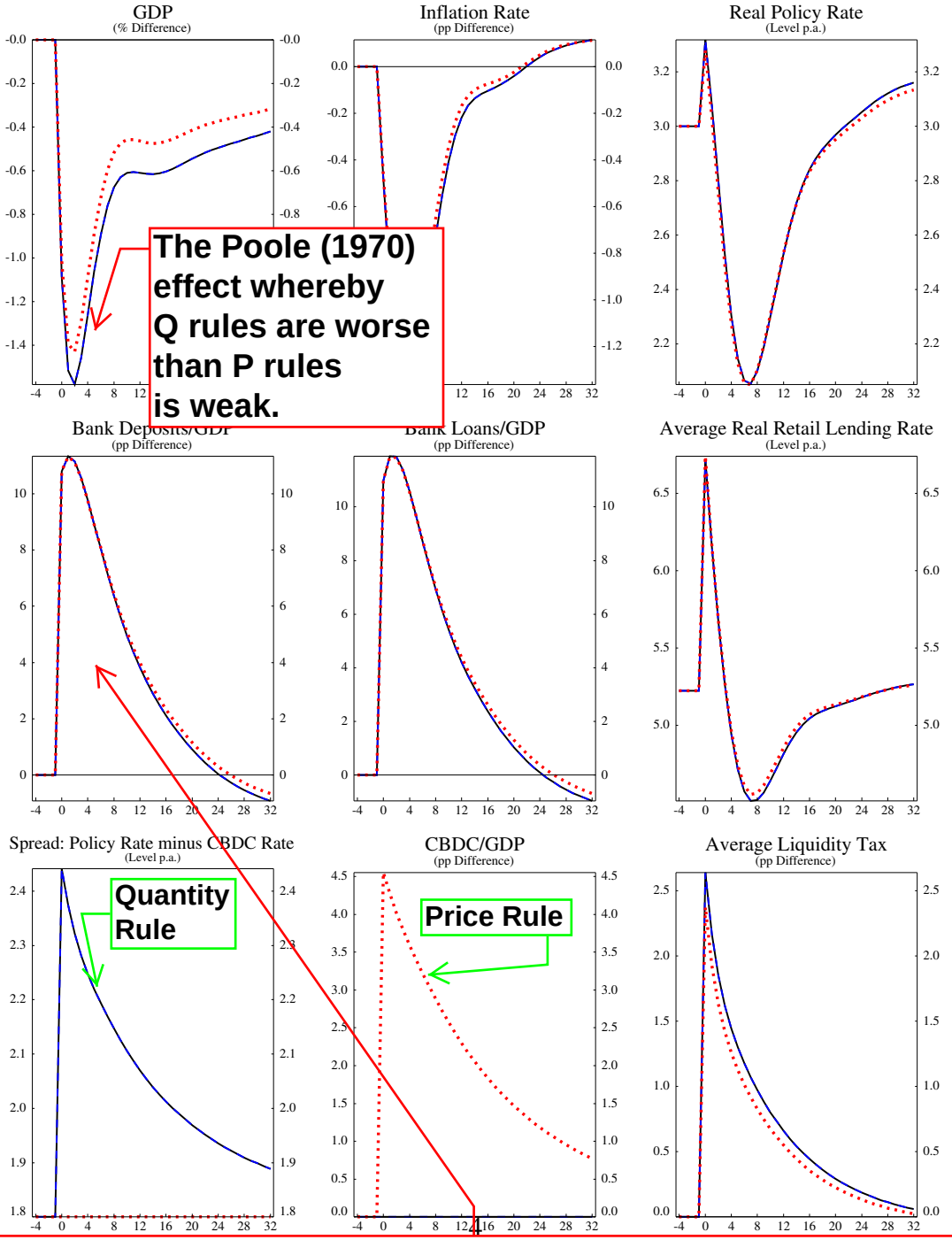


Transition to Steady State with CBDC

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

6 Quantity Rules or Price Rules for CBDC

A Poole (1970) contractionary money demand shock.



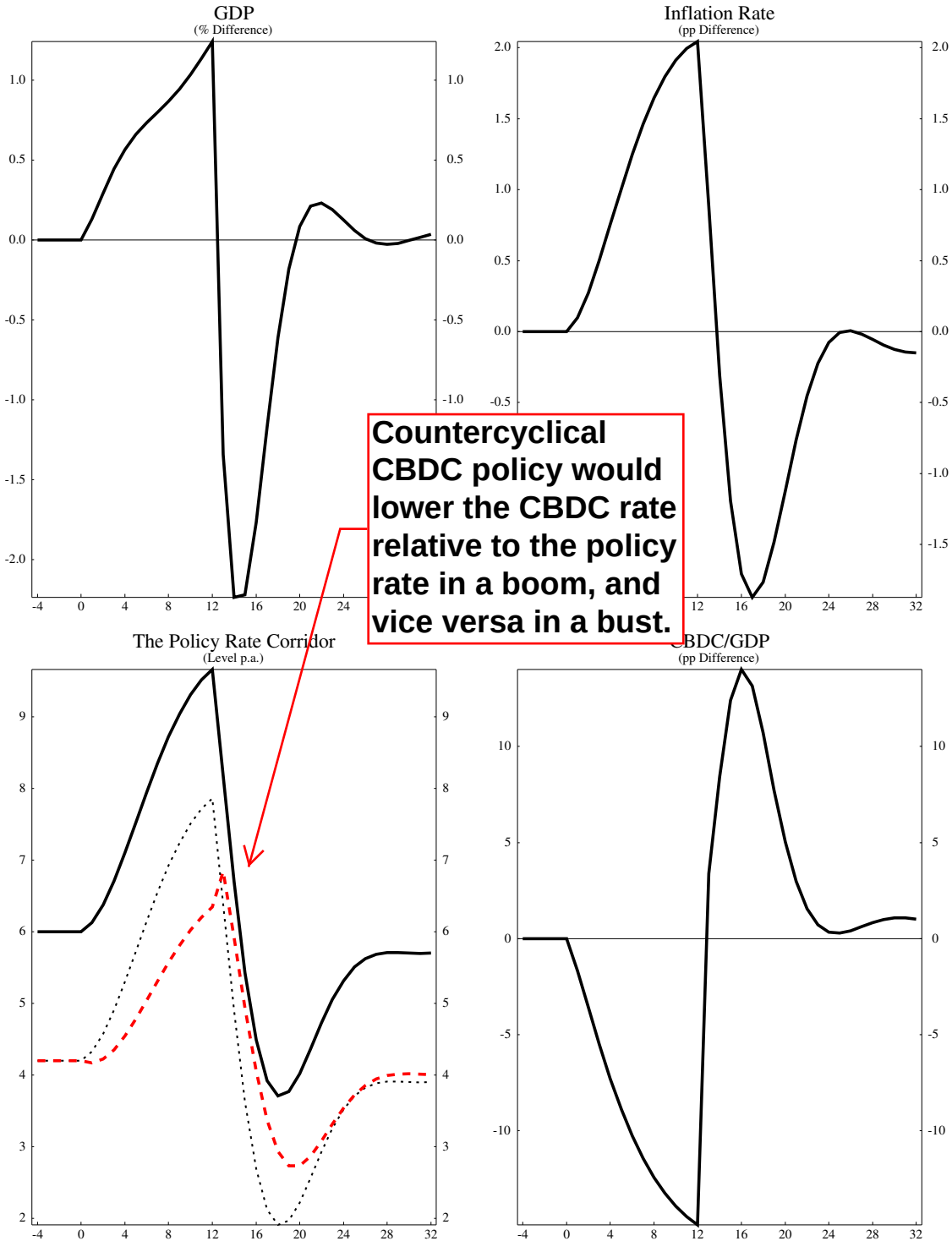
Liquidity demand is mostly satisfied by instantaneous creation of bank deposits through loans. But CBDC can help.

Shock to Demand for Total Liquidity

solid line = quantity rule ; dotted line = price rule

7 Countercyclical CBDC Rules

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

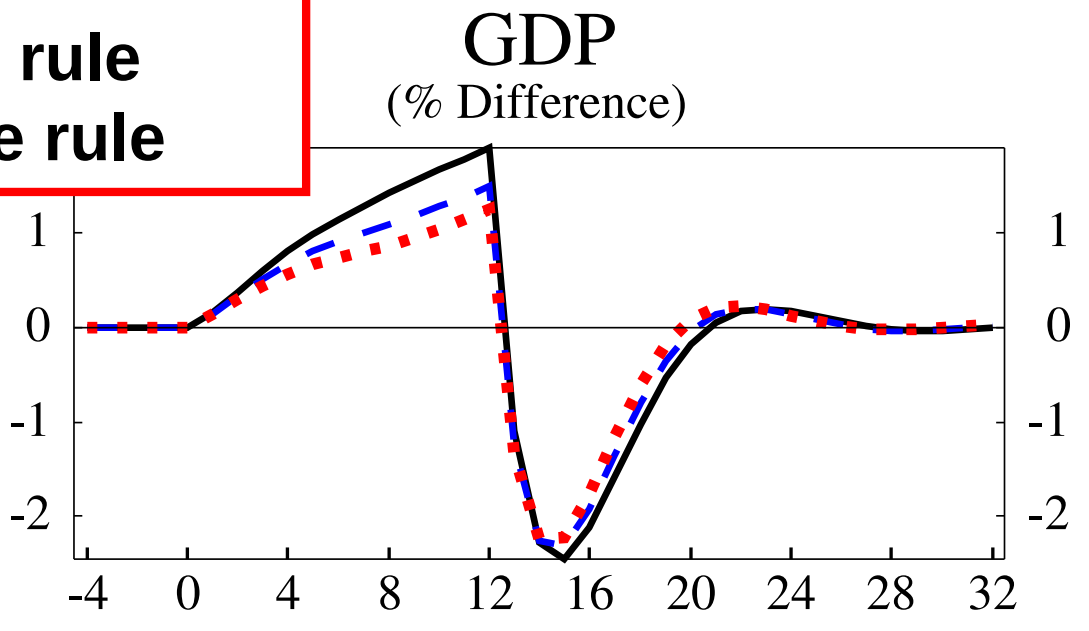


Credit Cycle Shock - Price Rule - Policy Rate Corridor

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 = c'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.

9 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.

10 Bank of England CBDC Agenda

- Main points:
  1. **Decision on CBDC:** Not yet, we are in exploratory mode.
  2. **Use case:** Focused on retail rather than wholesale use case.
  3. **Platform model:** Authorized private technological intermediaries.
  4. **Cash:** CBDC would co-exist with cash rather than replacing it.
  5. **Valuation:** CBDC would be in $\pounds$ rather than volatile "crypto".
  6. **Verification:** CBDC would replace "crypto" mining by authorization.
  7. **Technology:** No DLT presumption - centralised technology could work.
  8. **Stakeholder engagement:** BoE-HMT Taskforce, stakeholder forums.

- Open questions (other than the ones already mentioned):
  - Should there be limits on CBDC holdings or transactions?
  - How best to manage offline payments / financial inclusion / privacy?
  - Should CBDC be account-based or token-based?

THANK YOU