Monetary Policy with Reserves and CBDC: Optimality, Equivalence, and Politics

Dirk Niepelt

Study Center Gerzensee; U of Bern; CEPR; CESifo

May 2021

What Monetary System?

Two-tiered system vs. “Reserves for All” (CBDC)

Macro economic implications

- Normative
- Equivalence
- Political economy

Questions, answers

- Optimal monetary system
- Optimal monetary policy
- Effect of introducing CBDC into two-tiered system
- Magnitude of implicit bank subsidies
- Sources of political support for CBDC

Framework

- Sidrauski (1967) plus banks, deposits, reserves, CBDC
- Banks issue deposits (mkt power), invest in capital, reserves

  Internal, external benefits of reserve holdings
- Central bank issues reserves, CBDC, subsidizes deposits
- Payment system requires resources

Related Literature Two-tiered monetary systems—Gurley and Shaw (1960), Tobin (1963; 1969; 1985), Benes and Kumhof (2012), Andolfatto (2018), Faure and Gersbach (2018), Taudien (2020), Farhi and Tirole (2020)

Reserves for interbank payments—Bolton et al. (2020), Kiyotaki and Moore (2019), Bianchi and Bigio (2020), Parlour et al. (2020)

Retail CBDC—Barrdear and Kumhof (2016), Niepelt (2018), Keister and Sanches (2020), Böser and Gersbach (2020), Piazzesi and Schneider (2021), Andolfatto (2019), Chiu et al. (2019), Keister and Monnet (2020), Williamson (2019), Niepelt (2020), Fernández-Villaverde et al. (2020), Kahn et al. (2018), Kumhof and Noone (2018), Bindseil (2020), Auer and Böhme (2020)

Equivalence—Brunnermeier and Niepelt (2019), Wallace (1981), Bryant (1983), Chamley and Polemarchakis (1984), Sargent (1987)

A Monetary Economy

Households

$$\max \sum_{t=0}^{\infty} \beta^t \mathbb{E}_0[u(c_t, z_{t+1}, x_t)]$$

$$\text{s.t.} \quad k_{t+1} + m_{t+1} + n_{t+1} = k_t R_t^k + m_t R_t^m + n_t R_t^n + w_t(1 - x_t) + \pi_t - c_t - \tau_t$$

Effective real balances, $z_{t+1} \equiv \lambda_t m_{t+1} + n_{t+1}$

Optimality conditions (asset demand)

Spreads χ_{t+1}^m, χ_{t+1}^n reflect liquidity benefits

Banks

$$
\begin{aligned}
\max \quad & \pi^b_{1,t} + \mathbb{E}_t[\mathrm{sdf}_{t+1}\, \pi^b_{2,t+1}] \\
\text{s.t.} \quad & \pi^b_{1,t} = -n_{t+1}(\nu_t(\zeta_{t+1}, \bar{\zeta}_{t+1}) - \theta_t) \\
& \pi^b_{2,t+1} = (n_{t+1} - r_{t+1})R^k_{t+1} + r_{t+1}R^r_{t+1} - n_{t+1}R^n_{t+1} \\
& R^n_{t+1} \text{ perceived endogenous}
\end{aligned}
$$

Optimality conditions (Klein, 1971; Monti, 1972)

$$
\begin{aligned}
\chi^n_{t+1} - (\nu_t(\ldots) - \theta_t - \nu_{1,t}(\ldots)\zeta_{t+1}) &= \frac{1}{\eta_{n,t+1}} \frac{R^n_{t+1}}{R^f_{t+1}} \\
-\nu_{1,t}(\zeta_{t+1}, \bar{\zeta}_{t+1}) &= \chi^r_{t+1}
\end{aligned}
$$

Competitive Firms

Combine capital, labor to produce output

Consolidated Government

$$k^g_{t+1} - m_{t+1} - r_{t+1} = k^g_t R^k_t - m_t R^m_t - r_t R^r_t + \tau_t - n_{t+1}\theta_t - m_{t+1}\mu_t - r_{t+1}\rho_t$$

Resource Constraint

$$\kappa_{t+1} = f_t(\kappa_t, \ell_t) + \kappa_t(1-\delta) - c_t - m_{t+1}\mu_t - n_{t+1}\nu_t(\zeta_{t+1}, \zeta_{t+1}) - r_{t+1}\rho_t$$

General Equilibrium

Baseline RBC model plus wedges

- Monetary transmission through spreads
- Deposit rate reflects $\nu_t(\cdot), \chi^r_{t+1}, \theta_t$

Optimality

Social Planner

$$\max \sum_{t=0}^{\infty} \beta^t \mathbb{E}_0 \left[u(c_t, z_{t+1}, x_t) \right]$$

$$\text{s.t.} \quad \kappa_{t+1} = f_t(\kappa_t, 1 - x_t) + \kappa_t(1 - \delta) - c_t$$
$$- m_{t+1}\mu_t - n_{t+1}\nu_t(\zeta_{t+1}, \zeta_{t+1}) - r_{t+1}\rho_t$$

Friedman (1969) rules

$$u_z(c_t, z_{t+1}, x_t) \propto \min[\mu_t / \lambda_t,\ \nu_t(\zeta^\star_{t+1}, \zeta^\star_{t+1}) + \zeta^\star_{t+1}\rho_t]$$

$$-\nu_{1,t}(\zeta^\star_{t+1}, \zeta^\star_{t+1}) - \nu_{2,t}(\zeta^\star_{t+1}, \zeta^\star_{t+1}) = \rho_t \ \text{ if } \ n_{t+1} > 0$$

Ramsey (Optimal Government) Policy

Ramsey policy implements social planner allocation

- CBDC: $\chi^{m\star}_{t+1} = \mu_t$ (and price banks out of market)
- Deposits, reserves (two distortions, two instruments)

high $R^{r\star}$ induces $\zeta^\star$

$$\chi^{r\star}_{t+1} = -\nu_{1,t}(\zeta^\star_{t+1}, \zeta^\star_{t+1})$$

$$\theta^\star_t = \frac{1}{\eta_{n,t+1}} \frac{R^{n\star}_{t+1}}{R^{f\star}_{t+1}} + \zeta^\star_{t+1} \nu_{2,t}(\zeta^\star_{t+1}, \zeta^\star_{t+1})$$

pos/neg $\theta^\star$ corrects mkt power, $R^{r\star}$

Equivalence

CBDC, deposits are substitutes in general equilibrium as long as central bank intervenes appropriately

- **Condition**: $\mu_t / \lambda_t = \nu_t(\zeta_{t+1}, \zeta_{t+1}) + \zeta_{t+1}\rho_t$
- Argument $\perp$ model specific elements

Substitution of m_{t+1} for n_{t+1} affects balance sheets but not allocation, prices when central bank extends loan of size

$$(1 - \zeta_{t+1})\Delta m_{t+1}$$

to banks at interest rate

$$R^l_{t+1} = \frac{R^n_{t+1} + \text{unit res costs} - \zeta_{t+1} R^r_{t+1}}{1 - \zeta_{t+1}}$$

Banks (and macroeconomy) are insulated from m_{t+1}

- Unchanged bank capital holdings—no "socialism"
- Loan supply schedule replicates deposit supply schedule

Bank Profits and Lender-of-Last-Resort Support

Funding cost reduction for banks due to deposit issuance

- Status quo = CBDC & central bank loan at R^l_{t+1}
- Compare with loan at R^f_{t+1}
- Funding cost reduction as share of GDP

$$\text{fcr}_t \equiv \frac{R^f_{t+1} - R^l_{t+1}}{R^f_{t+1}} \frac{n_{t+1}(1-\zeta_{t+1})}{\text{GDP}_t}$$

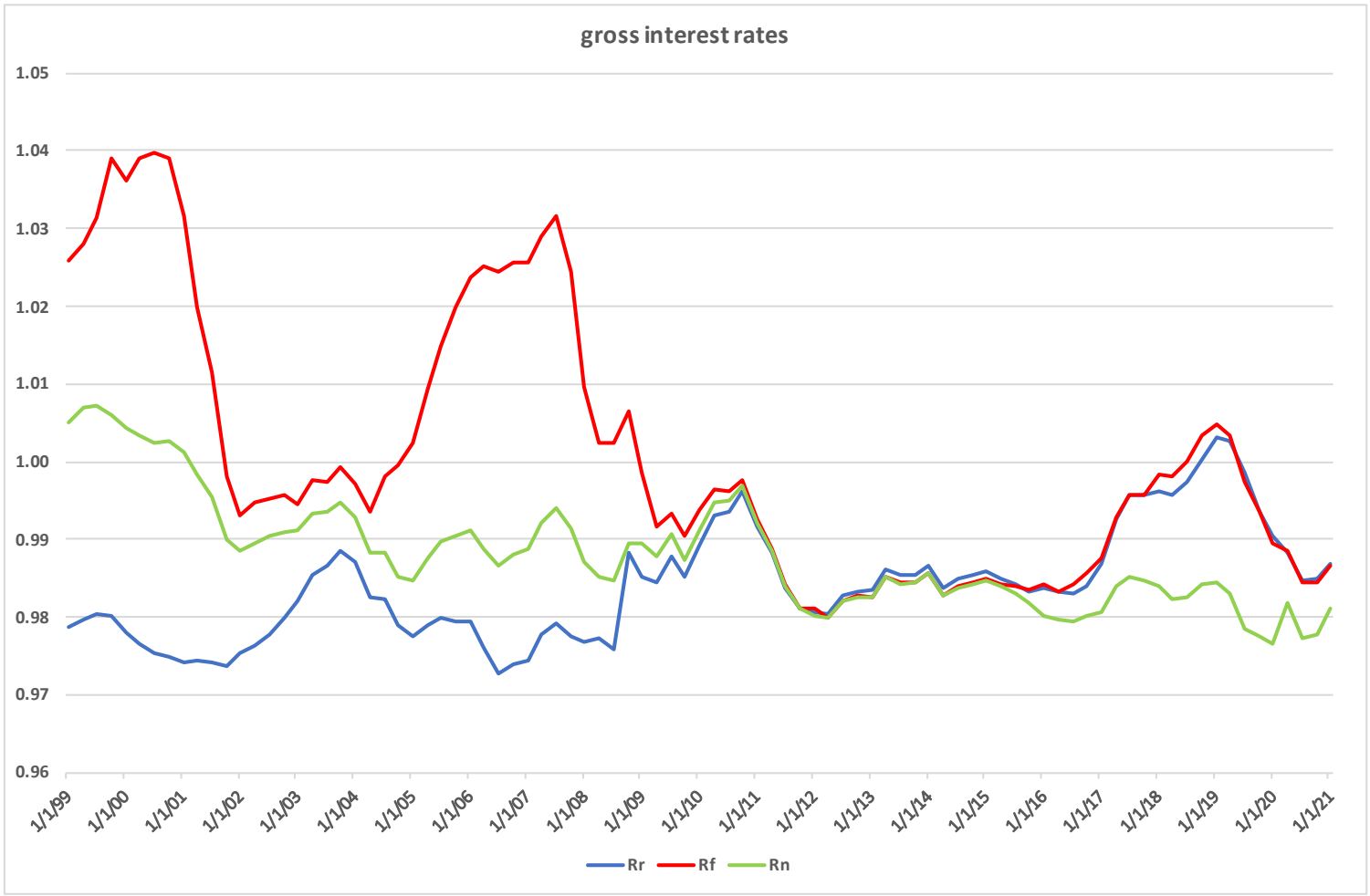

Figure 1: Gross interest rates [sources: FRED, Kurlat (2019)]

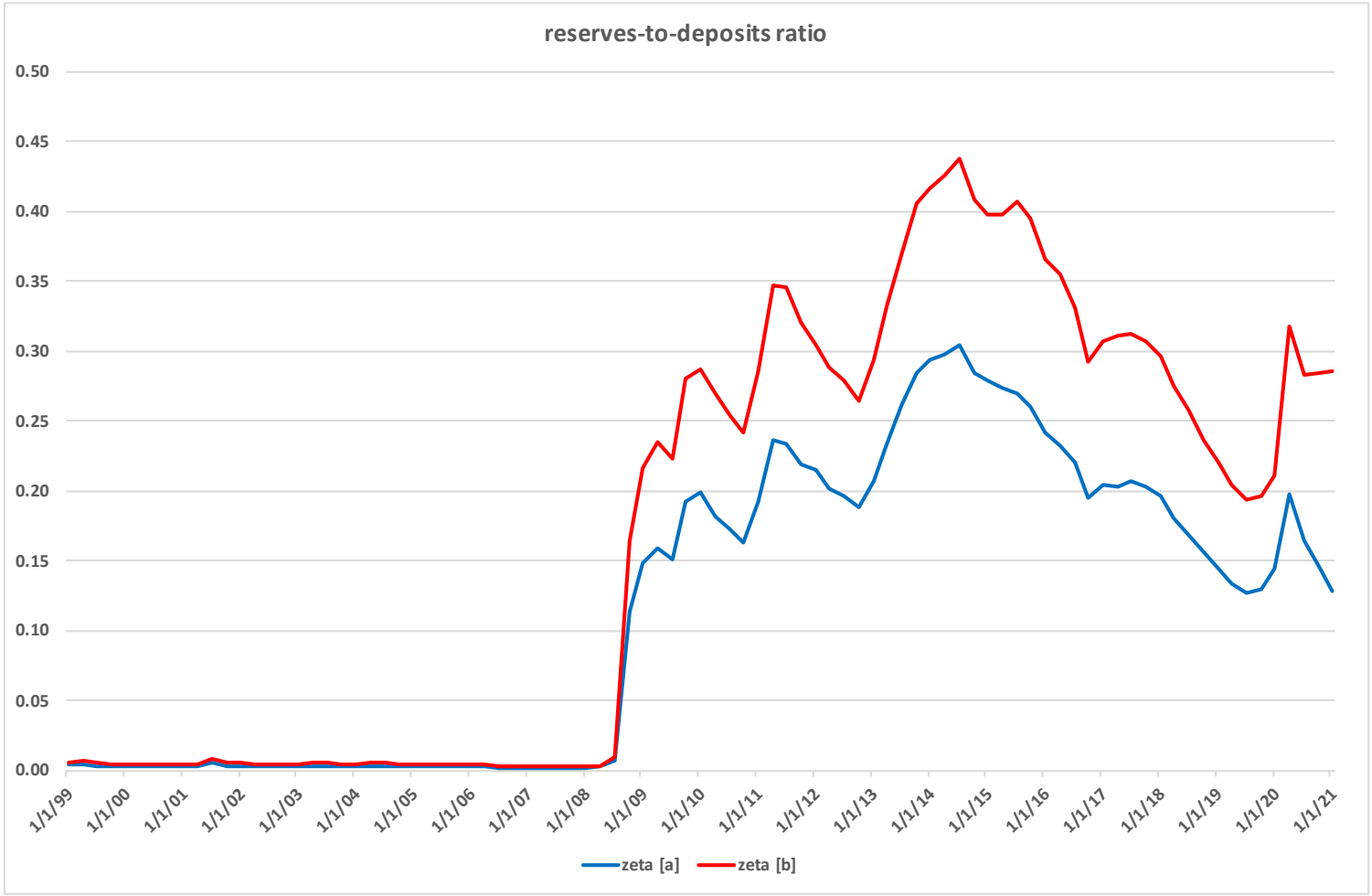

Figure 2: Two measures of the reserves-to-deposits ratio [sources: FRED, Lucas and Nicolini (2015)]

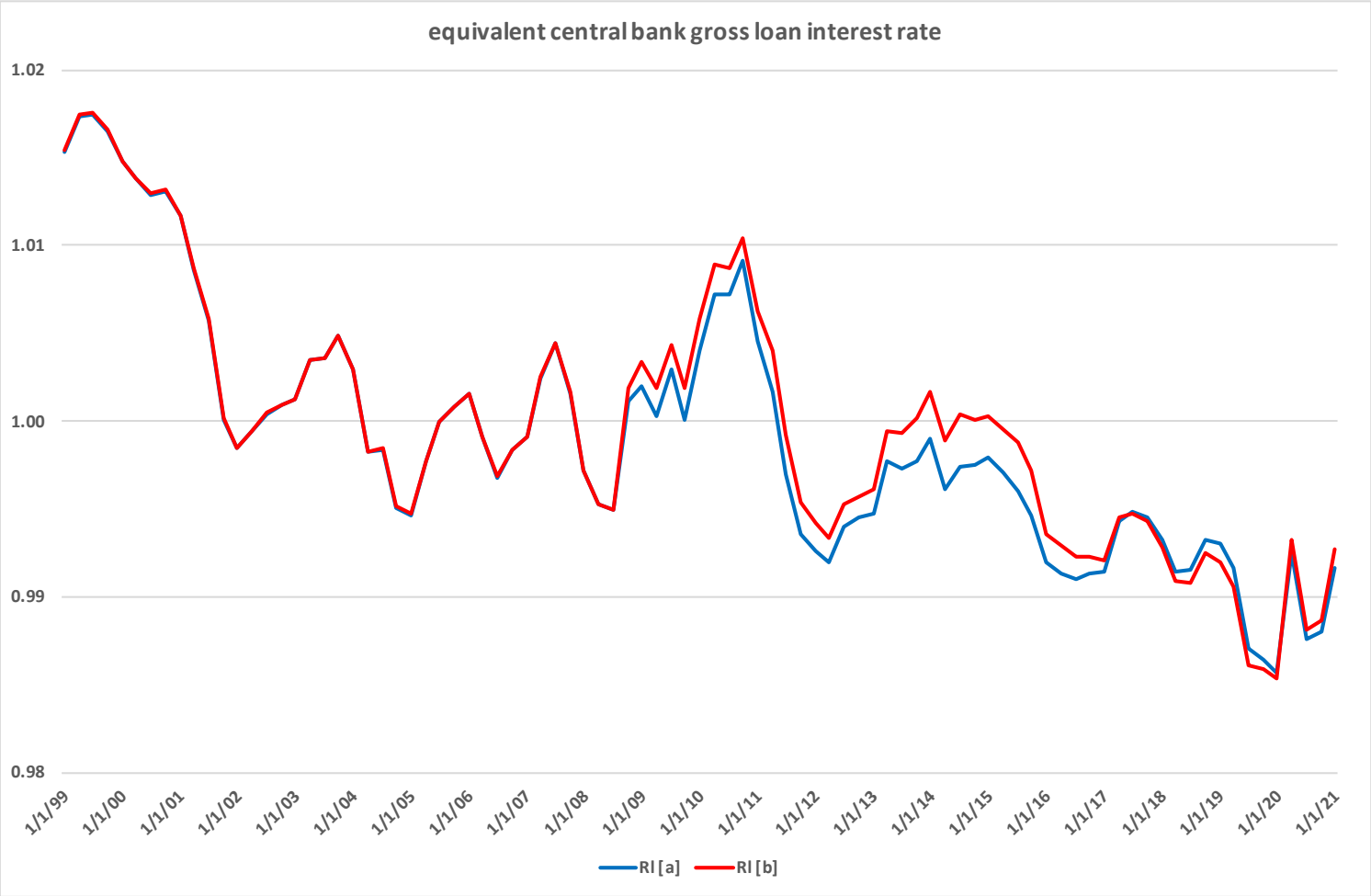

Figure 3: Two measures of the equivalent central bank gross loan interest rate

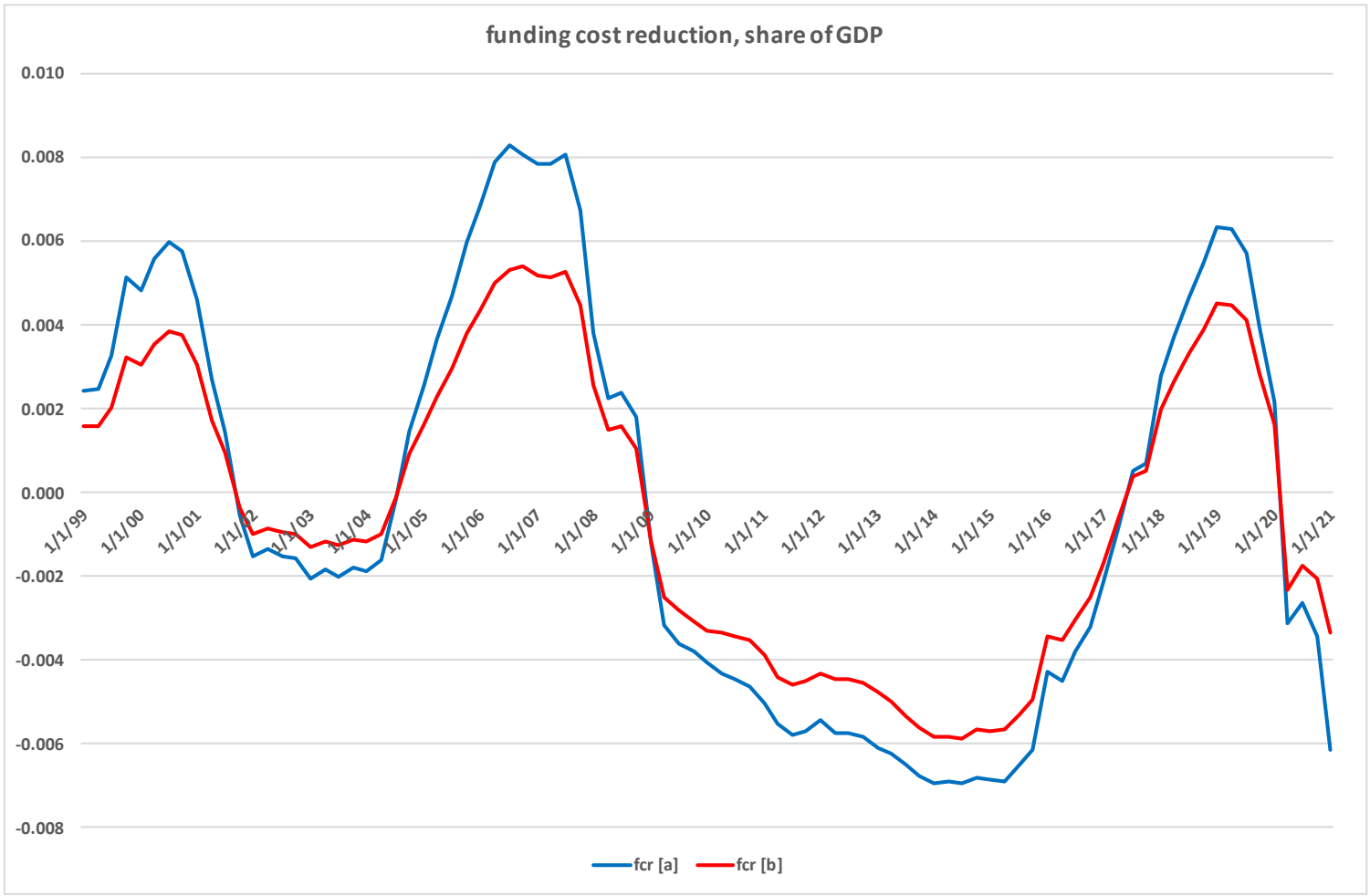

Figure 4: Two measures of banks' funding cost reduction

Results across specifications

- Funding cost reduction 0.5–1 percent of GDP prior to financial crisis
- Zero or negative after crisis
- Pattern currently repeats itself
- Compare with NIPA financial sector profits

  3 percent prior to, negative profits during, 2 to 3 percent after financial crisis

Politics

Monetary system shapes central bank profits (outside crises)

- CBDC & Friedman rule $\Rightarrow$ zero profits
- Deposits, reserves & Friedman rule $\Rightarrow$ negative profits

Implications

- Political support for introduction of CBDC, due to

  Tax distortions, redistribution to banks
- Central bank independence

Conclusion

Model of two-tiered monetary system & CBDC

- Optimal system determined by resource costs

  Modified Friedman rules

  Deposits taxed or subsidized
- Macro irrelevance of CBDC

  Implicit bank subsidies
- Two-tiered system requires higher taxes

  Political economy implications