Public Liquidity and Bank Lending: Treasuries, Quantitative Easing, and Central Bank Digital Currency

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Outline

Introduction

Facts

Theory

Conclusions

Motivation: Public Liquidity

- **What is the optimal supply of public liquidity?**
  - Treasury securities
  - (Traditional) central bank reserves: quantitative easing (QE)
  - Central bank digital currency

    (i.e., allowing firms and households to hold deposits at the central bank)
- Focus here: medium- and long-run average supply of public liquidity

Main results (1/2)

1. Empirical evidence: Structural VAR

   An increase in public liquidity (= debt/GDP) causes
   - Share of credit to firms that is intermediated by banks $\downarrow$
   - GDP $\downarrow$
   - No statistically significant effects on investments

2. Simple model to rationalize evidence

   Banks have better technology, but are subject to moral hazard

   Welfare analysis. Public liquidity $\uparrow$ [Treasuries/QE/Digital Currency]

   - Public liquidity is safer than bank debt $\Rightarrow$ welfare $\uparrow$
   - Households hold less deposits (consistent with evidence in literature) to economize on costs induced by moral hazard

     Banks' investments $\downarrow$ $\Rightarrow$ welfare $\downarrow$

   Optimal policy balances these two effects

Main results (2/2)

- Central bank can achieve the same outcomes using QE or digital currency
  - Formally, equivalence result
  - Key difference in implementation

$$\text{interest rate on reserves created by QE (held by banks)} > \text{interest rate on digital currency (held by households)}$$

- Treasury and central bank interaction
  - Size of optimal central bank balance sheet is non-monotonic in the stock of Treasury debt
  - Optimal joint policy
    - Assume central bank chooses size of balance sheet optimally
    - Multiple levels of Treasury debt supply (within a range) are optimal, as opposed to a single value

(Some) related literature

- Public liquidity injections reduce deposits at banks

  Greenwood, Hanson, and Stein (2015); Krishnamurthy and Vissing-Jorgensen (2015); Li (2019)

- Optimal supply of public liquidity

  Holmstrom and Tirole (1998); Lagos and Rocheteau (2008); Benigno and Robatto (2019); Angeletos et al. (2020)

- Quantitative easing with government bonds

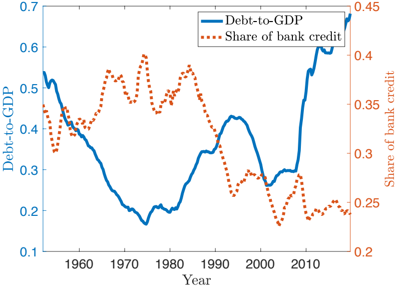
  Gertler Karadi (2013)

- Central bank digital currency

  Bordo and Levin (2017); Keister and Sanches (2020); Williamson (2020)

Outline

Overview



- U.S. Debt-to-GDP: Privately-held gross federal debt (excludes government accounts, Federal Reserve)
- Share of bank credit to firms (from Flow of Funds):

$$share = \frac{\text{bank loans}}{\text{bank loans + commercial paper + corporate bonds + other loans}}$$

bank = depository institutions

VAR

- What is the effect of higher debt/GDP on the share of bank lending?
- Reduced-form VAR

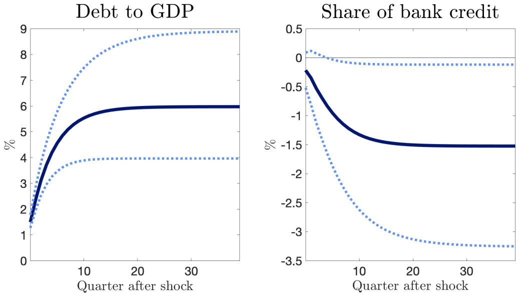
$$Y_t = \begin{bmatrix} \Delta \log (debt/GDP)_t \\ \Delta \log (share)_t \end{bmatrix}, \qquad Y_t = A_1 Y_{t-1} + ... + A_p Y_{t-p} + \begin{bmatrix} \varepsilon_t^1 \\ \varepsilon_t^2 \end{bmatrix}$$

  Baseline: $p = 2$ lags

- Long-run restriction (Blanchard Quah, 1989): Two orthogonal shocks
  1. One shock has transitory effects on $debt/GDP$
  2. **One shock has permanent effects on $debt/GDP$**

     Interpretation: variation in policymakers' attitude toward the long-run average level of debt to GDP

Results



- Long-term effect: 1% permanent increase in debt to GDP
  $\Rightarrow$ 0.25% reduction in the share of credit intermediated by banks

  90% confidence interval: $[-0.692\%, \ -0.046\%]$

- Results robust (almost unchanged) to using
  (i) Cholesky identification, any ordering, (ii) 4 lags, (iii) annual data

- Higher debt to GDP reduces GDP too
  but has no statistically significant effects on investments/GDP

Outline

Simple model (Treasury securities only)

(Builds on Benigno and Robatto, 2019)

- Timing
  - Two periods ($t = 0, 1$)
    Time $t = 1$ is divided into two subperiods
  - Two aggregate states at $t = 1$:
    - High state h, probability $1 - \pi$
    - Low state l, probability π
- Agents
  - Continuum of households
  - Continuum of intermediaries (i.e., banks)
  - Government
    [and central bank, in the full model]

Technology

- Households are less productive than banks

  One unit of investment at $t = 0$ produces, at $t = 1$:

  - $\begin{cases} A_h & h \text{ state} \\ A_l & l \text{ state} \end{cases}$ if the investment is made by banks
  - $\begin{cases} (1-\phi)\,A_h & h \text{ state} \\ (1-\phi)\,A_l & l \text{ state} \end{cases}$ if the investment made by households

- Normalizations:
  - Average output = $(1-\pi)\,A_h + \pi A_l = 1$
  - Output in low state: $A_l = 0$

Households

Notation:

Upper-case variables with no subscript: $t = 0$

Variables with subscript h and l: $t = 1$

- Utility

$$(1-\pi)\left[\log C_h + X_h\right] + \pi\left[\log C_l + X_l\right]$$

  - C_h, C_l: first subperiod of $t = 1$
    need to be financed with liquid assets (next slide)
  - X_h, X_l: second subperiod of $t = 1$

- Budget constraint at $t = 0$

$$\underbrace{K}_{\text{investments}} + Q^D \underbrace{D}_{\substack{\text{banks}\\\text{debt}}} + Q^B \underbrace{B}_{\substack{\text{gvt}\\\text{debt}}} \leq \underbrace{\overline{Y}}_{\substack{\text{endowment}\\\text{goods}}} + Q^B \underbrace{\overline{B}}_{\substack{\text{endowment}\\\text{gvt bonds}}}$$

  - D and B: zero-coupon debt securities, face value = 1
  - Q^D, Q^B: prices

Households: constraints at $t = 1$

- First subperiod: C_h, C_l financed with debt securities

$$C_h \leq \underbrace{B}_{\text{government debt}} + \underbrace{D}_{\text{bank debt}}$$

$$C_l \leq \overbrace{B}$$

  - Banks debt D: payoff $= 0$ in state l

- Second subperiod: budget constraint for X_h and X_l

$$X_h \leq \underbrace{\overline{Y}_h}_{\text{time-1 endowment}} + \underbrace{(B + D - C_h)}_{\text{liquid asset not used to finance } C_h} + \underbrace{A_h (1-\phi) K}_{\text{output of investments made at } t=0} + \underbrace{\Pi_h}_{\text{profits of banks}} - \underbrace{T_h}_{\text{lump-sum taxes}}$$

$$X_l \leq \overline{Y}_l + (B - C_l) + \underbrace{A_l}_{=0} (1-\phi) K + \Pi_l - T_l$$

Households: optimality conditions

- Consumption

$$\underbrace{\frac{1}{C_h}}_{\text{Marginal utility } C_h} = \underbrace{1}_{\substack{\text{Marginal utility}\\ X_h}} + \underbrace{\mu_h}_{\substack{\text{Lagrange multiplier}\\ \text{liquidity constraint}}} \quad , \quad \frac{1}{C_l} = 1+\mu_l$$

- Portfolio of debt securities

Choice of B :

$$\underbrace{1}_{\text{Payoff}} + \underbrace{[(1-\pi)\,\mu_h + \pi\mu_l]}_{\text{Liquidity value}} = \underbrace{\underbrace{(1-\phi)}_{\substack{\text{households'}\\ \text{productivity}}}\ \underbrace{Q^B}_{\text{price}}}_{\text{opportunity cost}}$$

Choice of D :

$$\underbrace{1 \times (1-\pi)}_{\substack{\text{Expected payoff}\\ \text{(payoff=1 only in } h)}} + \underbrace{(1-\pi)\,\mu_h}_{\text{Liquidity value}} = (1-\phi)\,Q^D$$

Intermediaries (banks)

- Budget constraint, $t = 0$

$$\underbrace{K^I}_{\text{investments}} \leq Q^D \underbrace{D}_{\text{debt}}$$

- Profits, $t = 1$: $\Pi_h = A_h K^I - D, \qquad \Pi_l = 0$

- Moral hazard friction (standard in macro-finance literature):
  - Intermediaries can extract private benefits $\theta A_h K^I$
  - To avoid misbehavior, intermediaries must earn rents

$$\Pi_h \geq \theta A_h K^I$$

- Parameter restriction: Moral hazard θ is sufficiently severe, in comparison to technological advantage ϕ of banks

$$\theta > \phi$$

$\Rightarrow$ Households prefer to manage some investments directly

(If $\theta < \phi \Rightarrow$ all investments are made by banks)

Government

- Taxes finance repayment of government debt $\overline{B}$

$$T_h = \overline{B} \quad \text{(state } h\text{)}$$

$$T_l = \overline{B} \quad \text{(state } l\text{)}$$

Equilibrium (simplified)

Focus on case $\overline{B} < 1$ [i.e., public liquidity does not satiate liquidity demand] (but allow for any $\overline{B}$ in the policy analysis)

- Consumption at $t = 1$, first subperiod:

$$\underbrace{C_h = \overline{B} + D = 1}_{\text{first-best level}}, \qquad \underbrace{C_l = \overline{B} < 1}_{< \text{ first-best level}}$$

- Bank debt

$$D = 1 - \overline{B}$$

- Both households and banks invest:

$$\underbrace{K^I = \frac{\left(1 - \overline{B}\right)(1 - \pi)}{1 - \phi}}_{\text{investments by banks}} > 0, \qquad \underbrace{K = \overline{Y} - K}_{\text{investments by households}} > 0$$

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- Price of liquid securities

$$Q^B = \frac{1}{1-\phi}\left[(1-\pi) + \pi \frac{1}{\overline{B}}\right]$$

$$Q^D = \frac{1-\pi}{1-\phi}$$

- Intermediaries earn profits (to avoid moral hazard): $\Pi_h = \phi \frac{1-\overline{B}}{1-\phi} > 0.$

Policy: higher supply of government debt

- Government debt $\uparrow$

  Households' liquidity needs met using banks debt $\downarrow$

  (households economize on the cost of the moral hazard friction)

  1. Households hold less deposits, more public debt

     $\Rightarrow$ Welfare $\uparrow$ because public debt is safer

  2. Households invest more directly, hold fewer deposits

     Banks invest less (disintermediation)

     $\Rightarrow$ Welfare $\downarrow$ because households have worse technology

- Optimal supply of government debt trades off (1) and (2)
  - A too-large supply is not optimal
  - Under optimal policy: Liquidity premium on government debt > 0
    (i.e., Friedman-like rule is not optimal)

Central Bank Digital Currency (overview)

- Central bank purchases government debt B^{CB}, issues reserves R

  Reserves R [= digital currency] can be held by households

- Liquidity
  - Reserves R provides the same liquidity as deposits
  - Treasury debt is only partially liquid

- Results:
  - Central bank “transforms” partially-liquid B^{CB} into fully-liquid R

    Welfare $\uparrow$
  - Households’ deposits $\downarrow$, banks’ investments $\downarrow$

    Welfare $\downarrow$

Quantitative easing (overview)

- Central bank purchases government debt B^{CB}, issues reserves R

  Reserves are held by banks
  - Federal Reserve: 2010-2014, 2019, 2020
  - Euro Area: Public Sector Purchase Program

  (80% of ECB asset purchases)

- Liquidity: Treasury debt is only partially liquid

- Equivalence result: Every allocation that is achieved by QE

  can be achieved with central bank digital currency, and vice-versa

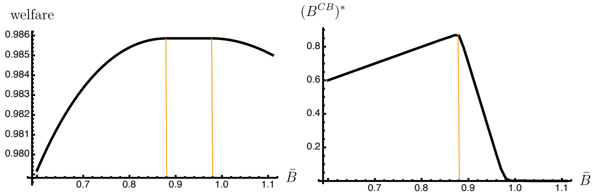
  Key differences:
  - Reserves are now intermediated by banks
  - Implementation (to deal with bank moral hazard)

    Interest rate on reserves created by QE (held by banks)

    $>$ Interest rate on digital currency (held by households)

Joint Treasury & central bank policies

Numerical example



- Supply of government debt $\overline{B}$ taken as exogenous
- Central bank chooses B^{CB} to maximize welfare
  - $\overline{B}$ is very low: QE is good (increases "effective" public liquidity)
  - $\overline{B}$ is very high: optimal QE=0
    Disintermediation is too large, QE would worsen it
  - Intermediate $\overline{B}$: welfare is maximized & flat in this region
    Optimal "effective" liquidity & share of bank credit

Outline

Conclusions

- Empirical evidence:
  - More public liquidity reduces GDP and the fraction of credit to firms that is intermediated by banks
  - No statistically significant effect on investments
- Theoretical analysis
  - Optimal policy balances positive, direct benefits of public liquidity against the reduction of credit supplied by banks
  - Results hold under various definition of "public liquidity": Treasury securities, traditional central bank reserves, central bank digital currency (i.e., reserves accessible to public)
  - Digital currency equivalent to quantitative easing, but difference implementation related to interest on reserves
  - Size of optimal QE policy is non-monotonic in the supply of Treasury debt

Outline

Appendix

Appendix

▸ Back