A Large Central Bank Balance Sheet? The Role of Interbank Market Frictions

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Motivation

What should be the "new normal" in the conduct of monetary policy?

- Before the crisis ("old normal"):
  - Lean central bank balance sheet
  - Monetary policy conducted mainly through interest rates (corridor system)
- During the crisis:
  - Interest rates close to the effective lower bound (ELB)
  - Large expansions in central bank balance sheets → quantitative easing
  - Compression of spreads between interbank and central bank deposit rates (floor system)
- After the crisis: a "**new normal**"
  - Lean vs large balance sheets
  - Corridor vs floor systems

What we do

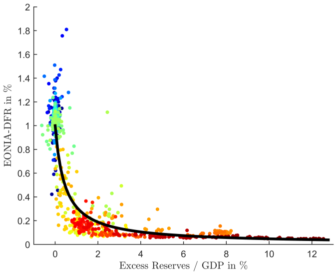
- Questions:
  - What is better: A lean or a large balance sheet?
  - How are they different: How do balance sheet policies affect the economy?

What we do

- Questions:
  - What is better: A lean or a large balance sheet?
  - How are they different: How do balance sheet policies affect the economy?
- Propose a DSGE model:
  - Standard New Keynesian model with price stickiness
  - Banks:
    - intermediate savings from households to firms
    - have heterogenous investment opportunities
    - trade amongst each other on a decentralized over-the-counter (OTC) interbank market

Main findings

- Balance sheet policies affect the economy through the interbank market by affecting the interbank-DFR spread, which triggers intertemporal substitution



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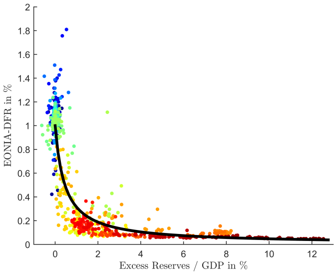

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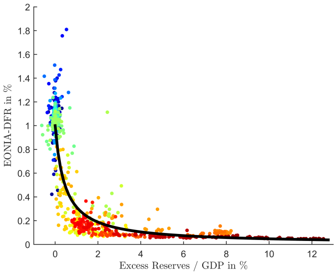

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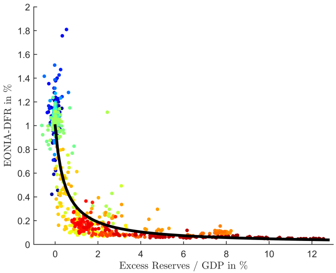

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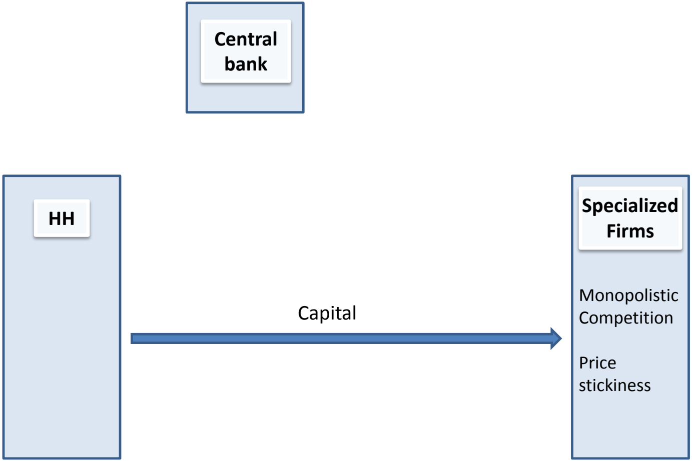
- LTROs and Asset purchases are close substitutes
- A large BS (floor system) buys additional policy space wrt. the ELB
- Temporary QE, if appropriately implemented, can buy the same policy space

Outline of the talk

1. Introduction
2. Model
3. Mechanism
4. Lean or large balance sheet?

Model overview



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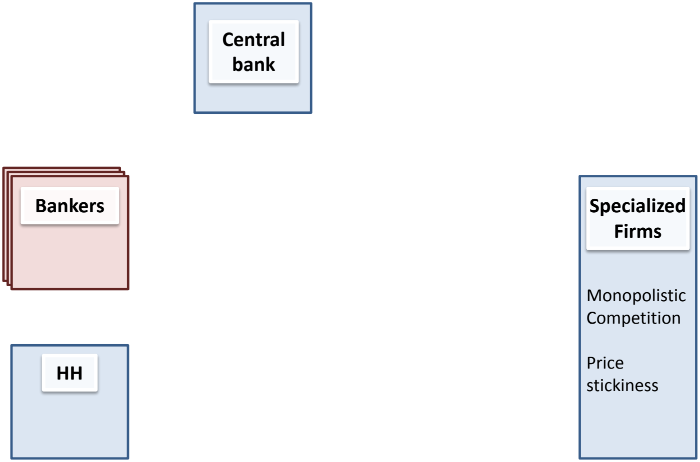

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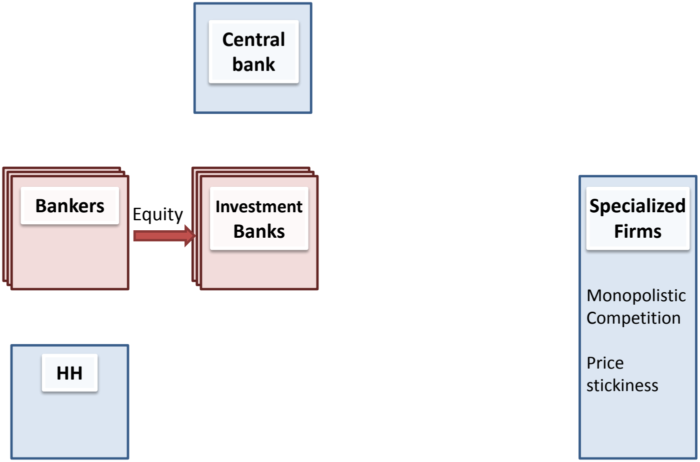

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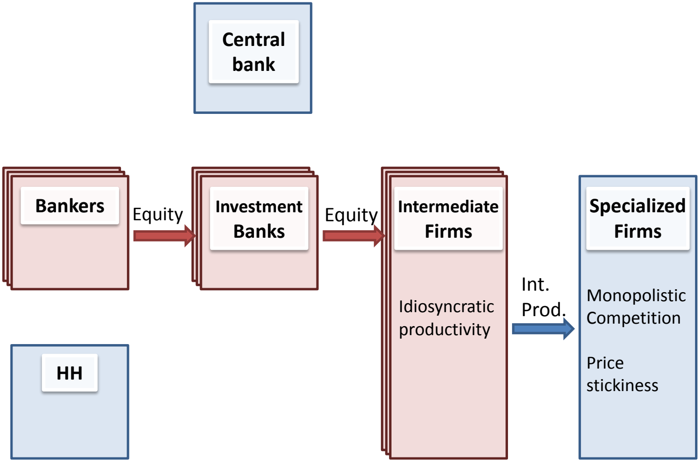

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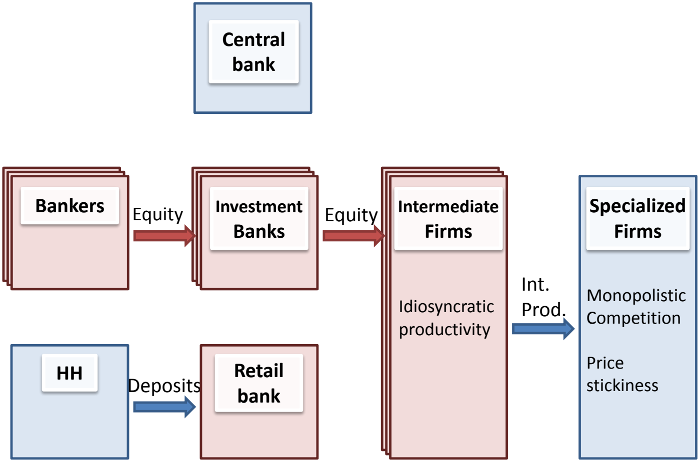

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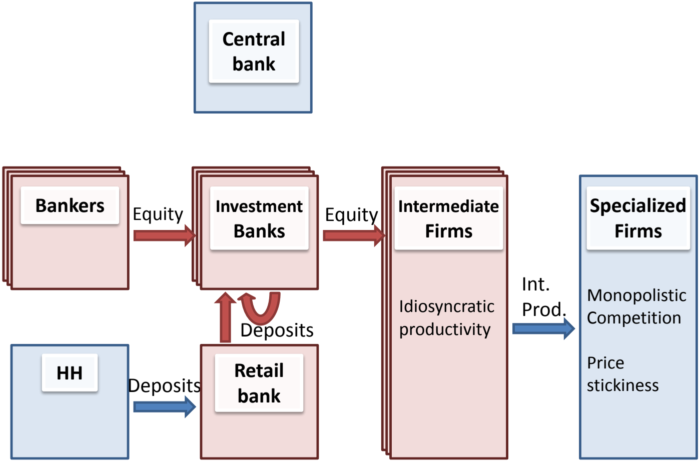

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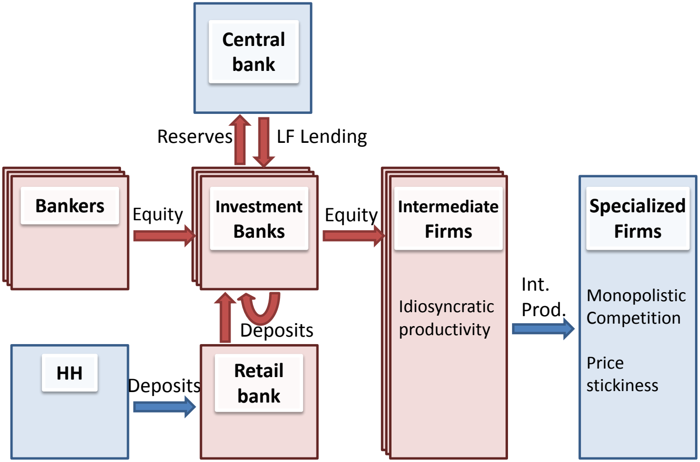

Structure of the economy

- Continuum of islands $j \in [0, 1]$
  - On each island there is 1 competitive intermediate firm with Cobb Douglas production function using capital and labor with island specific productivity $Y_t^j = \underbrace{\omega_{t-1}^j}_{\text{idios.}} K_t^\alpha L_t^{1-\alpha}$
  - Labor and capital are mobile
  - Capital is only provided by the local investment bank
  - Return on capital: $MPK_t^j = \underbrace{R_t^A}_{\text{aggr.}} \times \underbrace{\omega_{t-1}^j}_{\text{idios.}}$
- No aggregate uncertainty (for simplicity)

Investment Banks' problem

- Bankers maximize their log utility over consumption

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- LOM of equity (note: interbank borrowing and lending rates may differ $R_{t-1}^B \geq R_{t-1}^L$)

$$E_t^j = R_t^A \omega_{t-1}^j A_{t-1}^j + \frac{R_t^G}{1+\pi_t} b_{t-1}^{j,G} - \frac{B_{t-1}^j}{1+\pi_t}\left(1_{B_{t-1}^j>0} R_{t-1}^B + 1_{B_{t-1}^j<0} R_{t-1}^L\right)$$

Solution to the investment bank's problem

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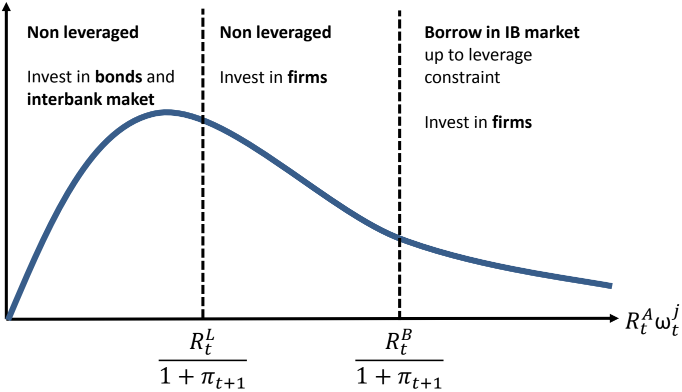
- Banks endogenously segmented in three groups depending on their idiosyncratic productivity ω_t^j



Retail banks

- Collect deposits from the households and lend these funds out through the interbank market.
- Perfect competition

$$\underbrace{R_t^D}_{\text{HH deposit rate}} = \underbrace{R_t^L}_{\text{Effective lending rate}}$$

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Solution to the bargaining problem

- Given the structure of the bank's problem and some additional simplifying assumption, each negotiation is concluded with an agreement at the same interbank rate

$$R_t^{IB} = \varphi_t R_t^{DF} + (1 - \varphi_t) R_t^{LF}$$

where

$$\varphi_t = \frac{\xi \left(1 - \vartheta \Gamma_t^L\right)}{1 - \xi \vartheta \Gamma_t^L - (1 - \xi) \vartheta \Gamma_t^B}$$

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- The effective borrowing rate for a borrowing bank is

$$R_t^B = \underbrace{\Gamma_t^B}_{\text{match prob}} R_t^{IB} + \left(1 - \Gamma_t^B\right) R_t^{LF}$$

- The effective lending rate for a lending bank is

$$R_t^L = \Gamma_t^L R_t^{IB} + \left(1 - \Gamma_t^L\right) R_t^{DF}$$

Public sector

- The CB sets the stance of MP by controlling R_t^{DF} and R_t^{LF}, as well as the value of public debt it holds, $b_t^{G,CB}$.
- The CB sets the corridor rates such that the nominal IB rate (the operational target) follows a Taylor rule in equilibrium:

$$R_t^{IB} = \rho(R_{t-1}^{IB}) + (1-\rho)\left[\bar{R} + \upsilon\left(\pi_t - \bar{\pi}\right)\right]$$

and keeps the corridor constant

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- CB balance sheet

$$\underbrace{b_t^{G,CB}}_{\text{Public. debt}} + \underbrace{\Phi_t^B\left(1-\Gamma_t^B\right)}_{\text{Lending facility}} = \underbrace{\Phi_t^L\left(1-\Gamma_t^L\right)}_{\text{Deposit facility}}$$

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- Profits/Losses are paid to the HH lump sum
- The treasury is passive and keeps debt stock constant, using lump sum taxes

Rest of the model

- The rest of the model is a standard new Keynesian model with Calvo pricing and investment adjustment costs, in which household deposit their savings at retail banks at rate R_t^D.
- Both households and banks have access to a storage technology with gross return

$$1 - \kappa$$

which provides the effective lower bound (ELB): $R_t^D \geq R_t^{DF} \geq 1 - \kappa$

Mechanism: How does conventional and unconventional MP affect interest rates?

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$$R_t^{IB} = \varphi(\overset{-}{x_t})R_t^{DF} + \left(1 - \varphi(\overset{-}{x_t})\right)R_t^{LF}$$

- Effective lending rate:

$$R_t^L = \Gamma^L\left(x_t\right)R_t^{IB} + \left(1 - \Gamma^L\left(x_t\right)\right)R_t^{DF}$$

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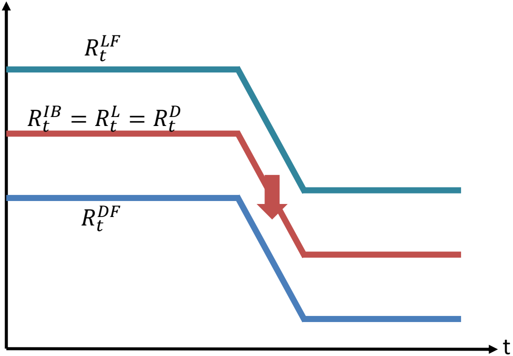
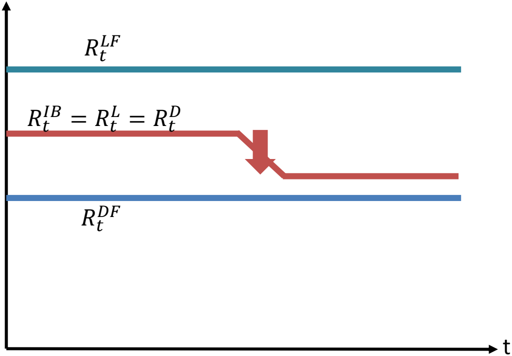
- Analogous for the expected borrowing rate: R_t^B
- **Conventional policy**: parallel movement of R_t^{LF} and R_t^{DF}, with x_t constant
- **QE**: withdrawal of bonds increases supply of liquidity by unproductive investment banks to the IB market, which reduces x_t. Since $\psi', \varphi' < 0$, this in turn moves R_t^L, R_t^B and R_t^{IB} towards the DFR R_t^{DF}.

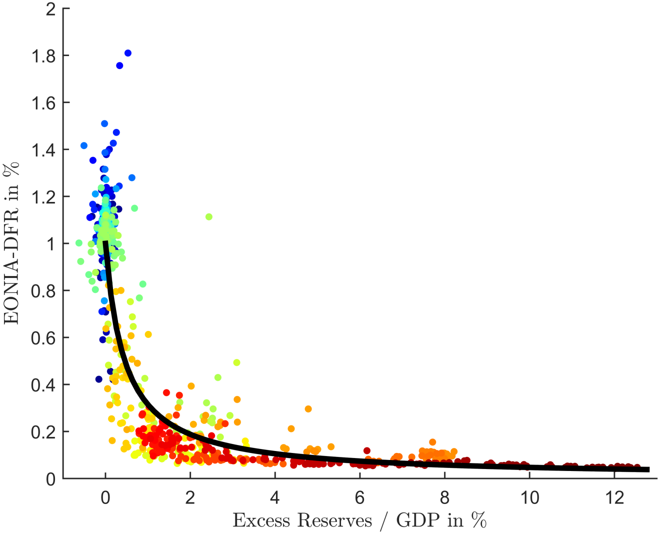
Conventional policy



Quantitative easing



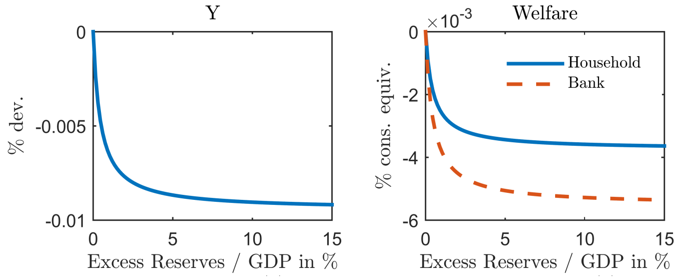
The EONIA - DFR spread and excess reserves



Additional insights on the effects of balance sheet policies

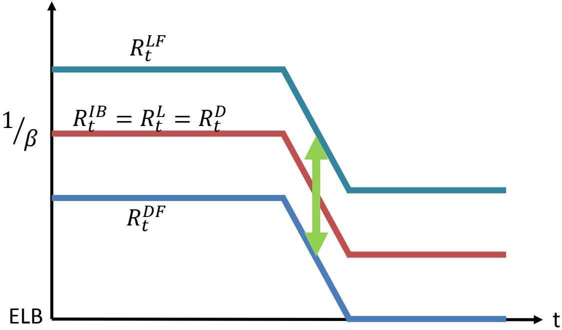
- QE is increasingly ineffective (Reis 2016)
  - We show that $\partial^2 R_t^{IB} / \partial \left(b_t^{G,CB} \right)^2 < 0 \implies \partial^2 Y_t / \partial \left(b_t^{G,CB} \right)^2 < 0$
- Interbank market breakdowns lead to CB balance sheet extensions
  - We show that a reduction in the efficiency of the matching technology, (i.e. $\Upsilon(\cdot) \downarrow$), leads to a bigger balance sheet even absent QE measures
- CB asset purchases and CB lending to banks at favorable rates (LTROs) are substitutes
  - We extend the model to allow for direct lending to borrowing banks (LTROs) as an additional QE measure.
  - We show analytically that for each path of bond purchases there is a path of LTRO, such that the real variables in the implied equilibria coincide.

Lean or large balance sheet: Comparative statics

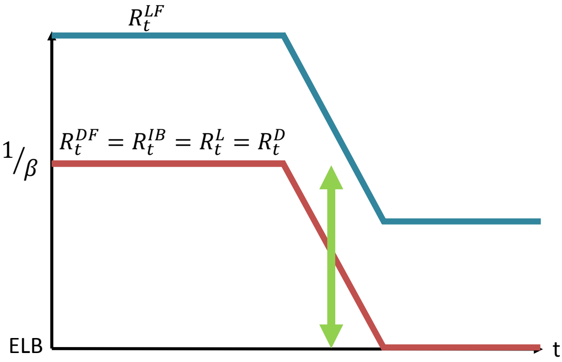


- Assuming that the IB market is *match efficient* (i.e. $\mathrm{Y}(x, x) = x$), excess reserves=bond holdings and there is no lending facility lending
- Higher CB bond holdings imply slightly higher seniorage, which is distortionary
- The magnitude of this effect is negligible for a reasonable calibration

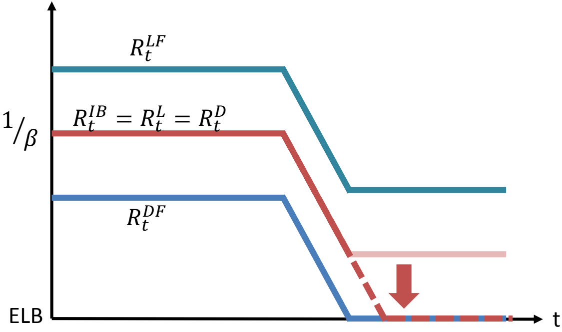
Policy space: Lean balance sheet



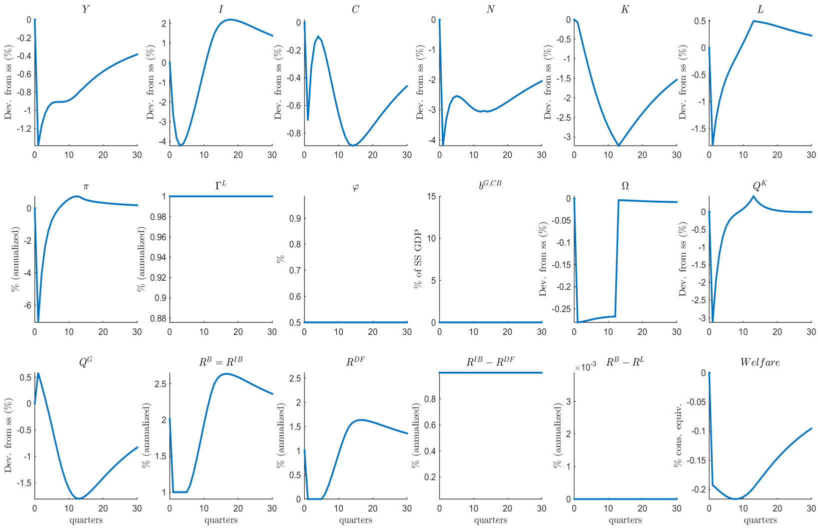
Policy space: Large balance sheet



Policy space: Lean balance sheet with temporary QE



Dynamic analysis



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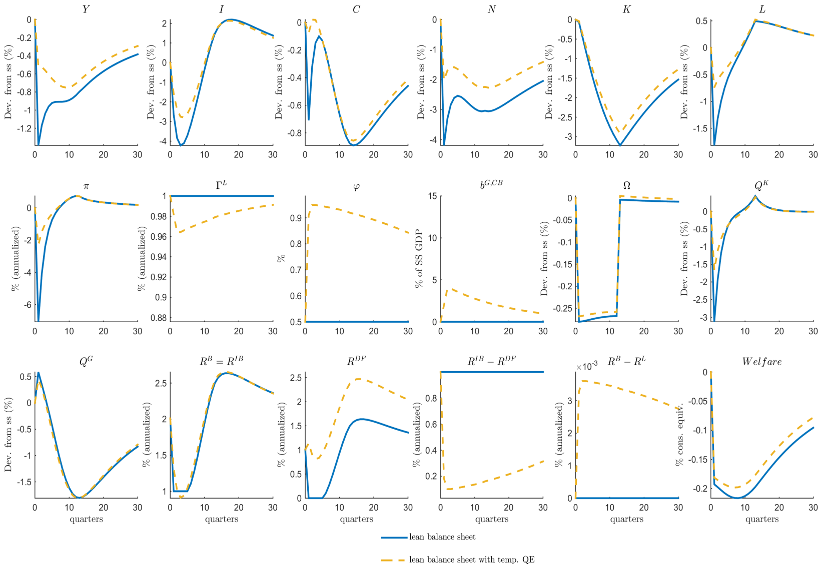

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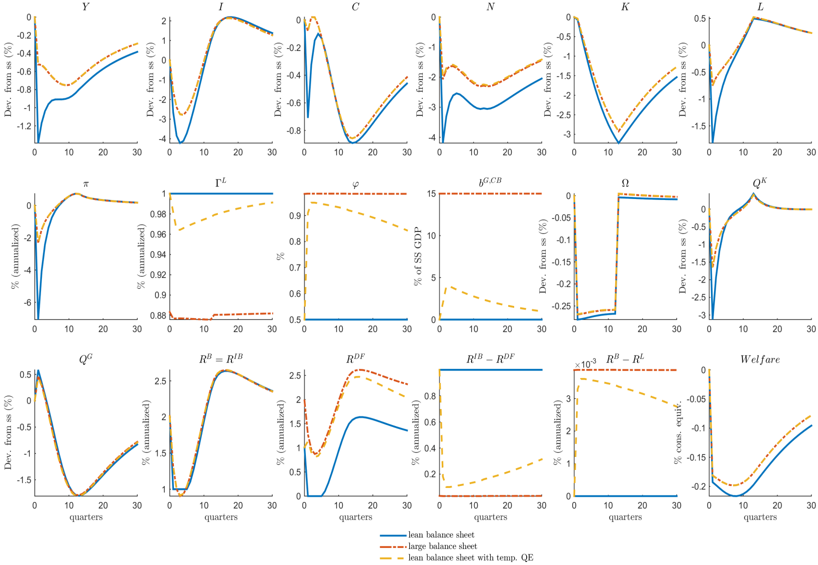

Conclusions

- Unconventional monetary policy has real effects due to frictions in the interbank market
- These effects decrease in the size of the balance sheet
- They are equal for APP and LTROs
- A lean balance sheet with a corridor system looks like a good alternative in normal times
  - if the CB is willing to immediately engage in a QE program when the ELB is binding
  - and the IB market is working properly
- However, a large balance sheet is a better alternative
  - if the ELB is often binding and swift and flexible temporary QE programs are not implementable
  - or the IB market is not working properly

Interbank market

- OTC market similar to Bianchi and Bigio (2014) or Afonso and Lagos (2012).
  - Banks (both investment and retail) place lending orders
  - Orders are placed on a per-unit basis as in Atkenson et al. (2012).

- Masses of borrowing and lending orders

$$\Phi_t^B = (\phi - 1) N_t \left[1 - F\left(\omega_t^B\right)\right],$$
$$\Phi_t^L = F\left(\omega_t^L\right) N_t - b_t^G + B_t^L.$$

- Matching function,

$$\Upsilon\left(\Phi_t^L, \Phi_t^B\right).$$

- Probability that a borrowing order finds a lending order

$$\Gamma_t^B \equiv \frac{\Upsilon\left(\Phi_t^L, \Phi_t^B\right)}{\Phi_t^B} = \Upsilon\left(\frac{\Phi_t^L}{\Phi_t^B}, 1\right),$$

- Probability that a lending order finds a borrowing order

$$\Gamma_t^L \equiv \frac{\Upsilon\left(\Phi_t^L, \Phi_t^B\right)}{\Phi_t^L} = \Upsilon\left(1, \frac{\Phi_t^B}{\Phi_t^L}\right).$$

Bargaining

- Banks use a multi-round Nash bargaining to split the surplus of the dollar transfer
  - Outside options are the CB lending R_t^{LF} and deposit R_t^{DF} facility rates.
  - Banks bargain about the (gross) interbank rate, R_t^{IB}
  - $\xi \in (0, 1)$ is the bargaining power of the borrowers
  - If a matched pair of banks fail to agree at a given round, then with probability $\vartheta \in (0, 1)$ both banks search for a new trading partner

Match efficient IB market

Definition (match efficient IB market) The interbank market is match-efficient if $\Upsilon(1,1) = 1$. Otherwise $(\Upsilon(1,1) < 1)$ the interbank market is match-inefficient.

Definition (asymptotically match efficient IB market) A match-inefficient market is asymptotically match-efficient if $\lim_{x \to \infty} \Upsilon(x,1) = \lim_{x \to \infty} \Upsilon(1,x) = 1$.

Lean balance sheet

Proposition
If the interbank market is match-efficient and $b_t^{G,CB} = 0$ then

$$R_t^L = R_t^B = R_t^{IB} = \xi R_t^{DF} + (1 - \xi) R_t^{LF},$$

the amount of reserves at the central bank is zero

$$M_t / P_t = \Phi_t^L \left(1 - \Gamma_t^L\right) = 0.$$

Irrelevance of the corridor width in normal times

Lean balance sheet

Proposition

If the interbank market is match-efficient and $b_t^{G,CB} = 0$, given an arbitrary corridor width χ and an interbank rate R_t^{IB} such that the ELB is not binding the equilibrium allocation is independent of the corridor width. The policy rates in this case are

$$\begin{aligned} R_t^{DF} &= R_t^{IB} - (1 - \xi)\,\chi, \\ R_t^{LF} &= R_t^{IB} + \xi\chi. \end{aligned}$$

Policy space

Lean balance sheet

Proposition

If the interbank market is match-efficient and $b_t^{G,CB} = 0$, the distance from the deposit facility rate in steady state to the ELB is

$$R^{DF} - (1 - \kappa) = 1/\beta - (1 - \xi)\,\chi - (1 - \kappa)\,.$$

Large balance sheet

Proposition

If the interbank market is match-efficient and $b_t^{G,CB} \gg 0$ such that $\Gamma_t^L = 0$ then

$$\begin{aligned} R_t^L &= R_t^{DF}, \\ R_t^B &= R_t^{IB} = \varphi^\infty R_t^{DF} + (1-\varphi^\infty) R_t^{LF} > R_t^L, \end{aligned}$$

and the amount of reserves at the central bank is

$$M_t / P_t = \Phi_t^L \left(1 - \Gamma_t^L\right) = \Phi_t^L = b^{G,CB} + \Phi_t^B.$$

Floor system

Large balance sheet

Proposition

If the interbank market is match-efficient, $b^{G,CB} \gg 0$ (such that $\Gamma_t^L = 0$) and $\vartheta \to 1$ then the central bank operates a floor system with

$$R_t^B = R_t^{IB} \to R_t^L = R_t^{DF},$$

and the marginal lending facility R_t^{LF} rate does not affect the economy.

Policy space

Large balance sheet

Proposition

If the interbank market is match-efficient, $b^{G,VCB} \gg 0$ (such that $\Gamma_t^L = 0$) and $\vartheta \to 1$, then the distance from the deposit facility rate in steady state to the ELB is

$$R^{DF} - (1 - \kappa) = 1/\beta - (1 - \kappa) \,.$$

(Remember: with *lean* balance sheet, distance from the ELB is:

$$R^{DF} - (1 - \kappa) = 1/\beta - (1 - \xi)\, \chi - 1 < 1/\beta - (1 - \kappa)$$

)

The case of a match-inefficient interbank market

Lean balance sheet

Proposition

If the interbank market is inefficient and $b_t^{G,CB} = 0$ then

$$R_t^L < R_t^{IB} < R_t^B.$$