Monetary Policy Implementation with an Ample Supply of Reserves

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with G Afonso, A Martin, E Nosal, S Potter and S Schulhofer-Wohl
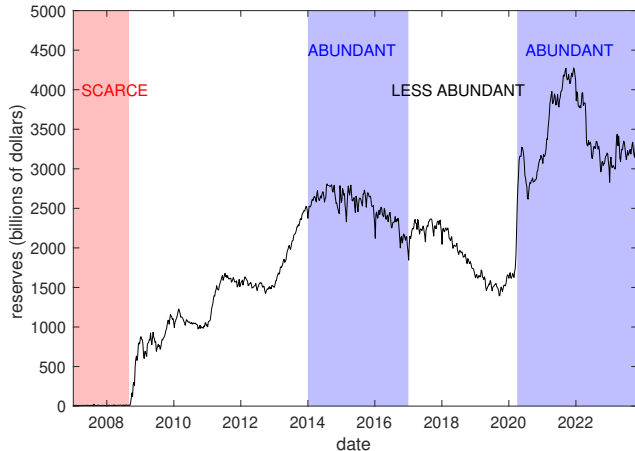
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Motivation

- Monetary policy implementation regime has been changing in the U.S. and elsewhere:
  - In 2019, the Federal Reserve announced that it would implement policy with an ample supply of reserves.
- Is this a good idea?
- What is the optimal level of reserve supply?
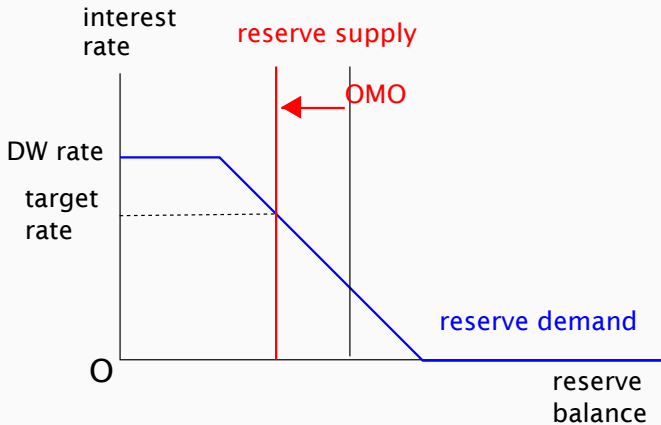 - QT is happening again.

- Level of reserve supply has been changing.

Pre-2008 Regime: Scarce Reserves

- Tightly managed reserve supply to control the fed funds rate.
  - (Excess) Reserve supply was very low, $\sim$ \$2B in 2007.
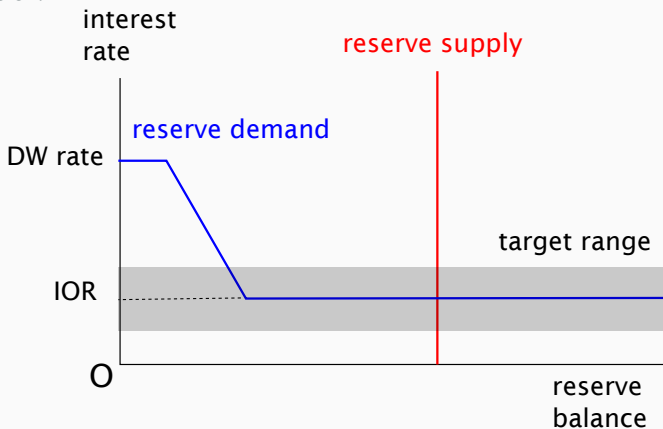 - Daily forecast of reserve demand and open market operations: $\sim$ a few \$B.

- Daily open market operations to adjust reserve supply (vertical bar):
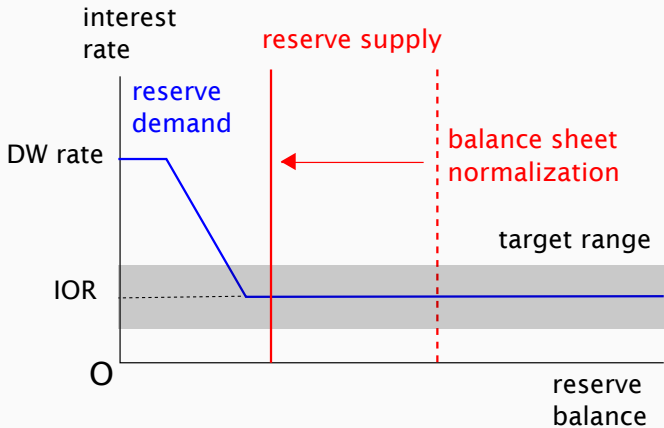
Post-2008 Regime: Abundant Reserves

- Large-scale reserve injections through quantitative easing post-2008: Fed funds rate was essentially at a floor.

Balance Sheet Normalization 2017-2019

- Only occasional and minimal movements in the fed funds rate emerged.

Determining a Policy Regime

- Federal Reserve stopped draining reserves in late 2019, at around $1.5T.
- Started draining reserves again in mid-2022.
- How do we choose the right regime or the optimal reserve supply?
  - A stylized model of MP implementation: CB chooses the level of reserve supply.
  - Depending on model parameters, either scarce or ample supply is optimal.
 - Recent changes favor ample reserves (relatively).

Model

- A six-period model describing events happening over a day.
  1. CB chooses the baseline supply of reserves R.
  2. Reserve supply shock s is revealed.
  3. CB adds x (drains $-x$) reserves.
  4. Demand shock d is revealed. $d = \sum d_i$, where d_i is bank i's demand shock.
  5. Fed funds market clears in a competitive market and the fed funds rate r is determined.
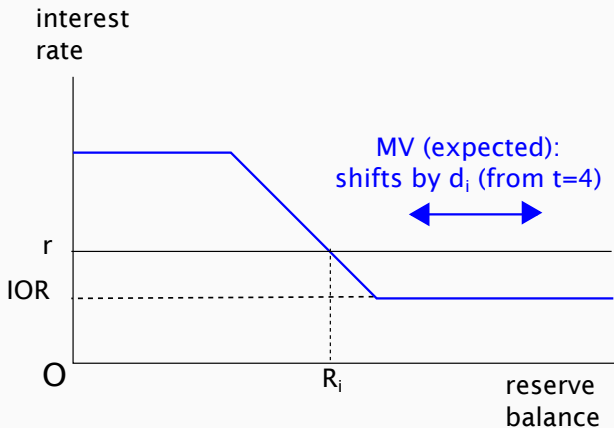 6. Each bank i receives a further shock to reserves, u_i (Poole 1968).

- Date 6: Bank i's MV for reserves is a step function.

marginal value

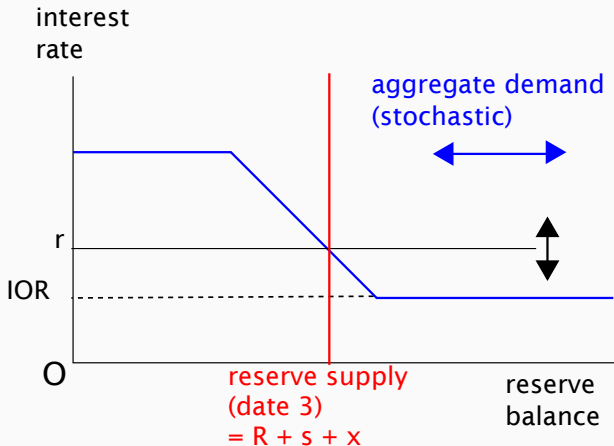desired level = constant + d_i (from t=4)

IOR

O

reserve balance
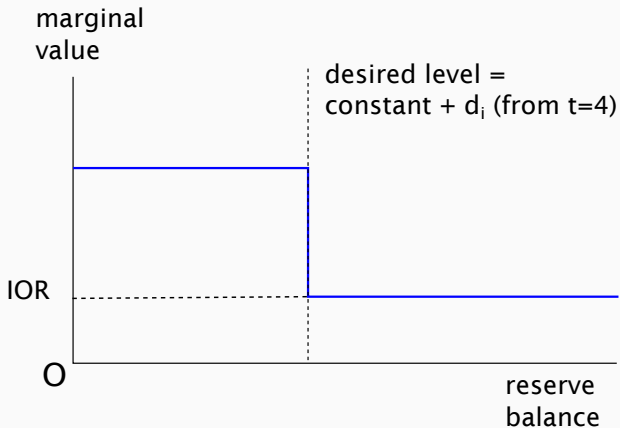
- Date 5: bank *i* trades using its expected MV.
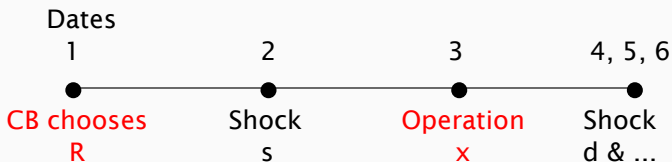
- From CB's perspective (date 3): Aggregate demand factor $d = \sum d_i$ is a random variable.

CB Actions

- CB chooses the initial reserve supply R and conducts operations $x(R, s)$ conditional on realized supply shocks:

Dates

1	2	3	4, 5, 6
CB chooses R	Shock s	Operation x	Shock d & ...

- Initial choice R determines the distributions of (conditionally optimal) x and r.

CB Objective

- CB wants to minimize:
    1. Interest rate uncertainty $\implies$ dist. of r.
    2. Size of operations $\implies$ dist. of x.
    3. Level of reserve supply (political cost) $\implies R$.
- The objective function is a weighted average of these:

$$\min_{R \geq R_{LC}, x(R,s)} E[\alpha |r(R+s-d+x(R,s)) - r(R)| + \beta |x(R,s)| + R]. \tag{1}$$

- $R \geq R_{LC}$: CB wants to supply at least some level of reserves for market functioning.
- α / β large enough to make operations worthwhile.

Local Optima

- Result 1: There are two local optima in choosing R: 'scarce' and 'ample'.
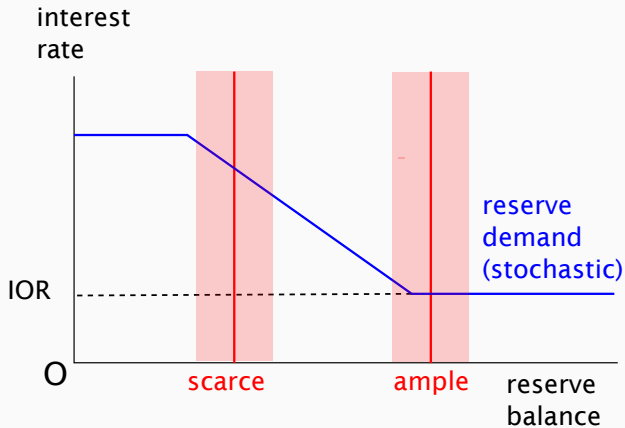
Characterization of Local Optima

- Scarce local optimum
  - Small R, large $E|x|$.
  - $R \uparrow$ does not $E|x| \downarrow$ enough.
- Ample local optimum
  - Large R, small $E|x|$.
  - $R \uparrow$ will eventually lead to $E|r - r(R)| \sim 0$ and $E|x| \sim 0$, thus suboptimal.

- Choice between scarce and ample depends on the distribution of s and d:

Dates
| 1 | 2 | 3 | 4, 5, 6 |

CB chooses R — Shock s — Operation x — Shock d & ...
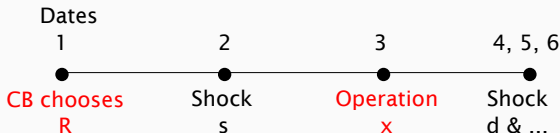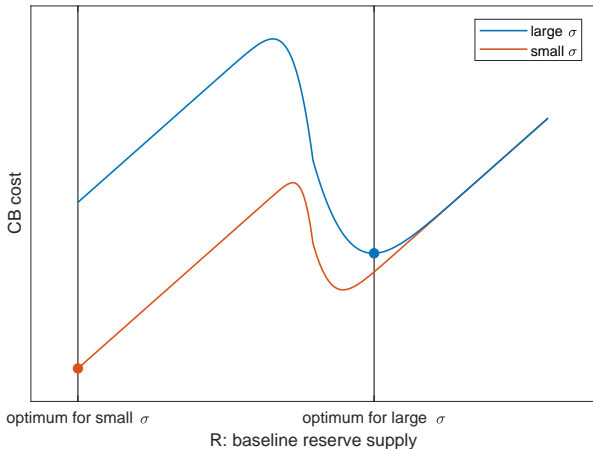
- Two shocks s (date 2) and d (date 4):

$$\begin{bmatrix} s \\ d \end{bmatrix} \sim \mathcal{N}(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \sigma^2 \begin{bmatrix} 1 - \rho^2 & 0 \\ 0 & \rho^2 \end{bmatrix}). \tag{2}$$

- σ: total magnitude of shocks.
- ρ: relative size of demand shocks.

- Result 2: Ample reserves are relatively preferred for larger shocks (larger σ).

Supply vs. Demand Shocks: an Example

Dates
| 1 | 2 | 3 | 4, 5, 6 |

CB chooses R — Shock s — Operation x — Shock d & ...

- Example: s and d can be $+1$ or -1 with equal prob. CB wants to offset $s + d$.
  - If $s = -1$, then $s + d$ can be either -2 or 0.
  - No operation.
  - Interest rate uncertainty.
- If instead s and d were both known, CB would totally offset interest rate movement.

- Recall
$$\begin{bmatrix} s \\ d \end{bmatrix} \sim \mathcal{N}(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \sigma^2 \begin{bmatrix} 1 - \rho^2 & 0 \\ 0 & \rho^2 \end{bmatrix}). \tag{3}$$
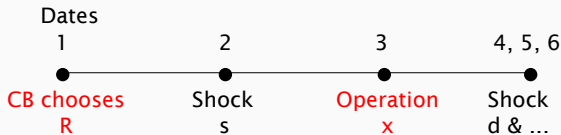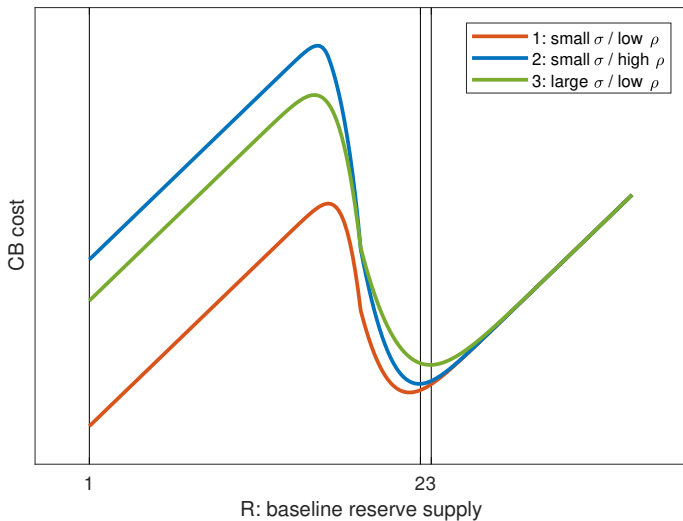
- Result 3: More uncertain (higher ρ) shocks increase the relative cost of the scarce-reserve regime.
    - Remaining uncertainty at the time of operations (d, variance $\rho^2\sigma^2$) makes open market operations less effective.

Cross-Model Comparison

Results Summary

- Recall: s on date 2 and d on date 4.

$$\begin{bmatrix} s \\ d \end{bmatrix} \sim \mathcal{N}(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \sigma^2 \begin{bmatrix} 1 - \rho^2 & 0 \\ 0 & \rho^2 \end{bmatrix}). \qquad (4)$$

- Larger σ: CB wants to avoid costs associated with reserve supply and demand shocks by supplying ample reserves.
  - Increases in the volatility of reserve supply and the complexity in regulations.
- Larger ρ: open market operations are less effective and thus ample reserves are preferred.
  - Emphasize the role of regulatory complexity.

- Since the 2007-2009 financial crisis, reserve supply and demand have become more volatile and harder for CB to forecast in the U.S.

- Model illustrates why such changes make ample regime relatively more preferable.

- With no CB action, Δ(reserve supply to banks) = -Δ(reserves held by non-bank entities).
- The right-hand side has become more volatile:
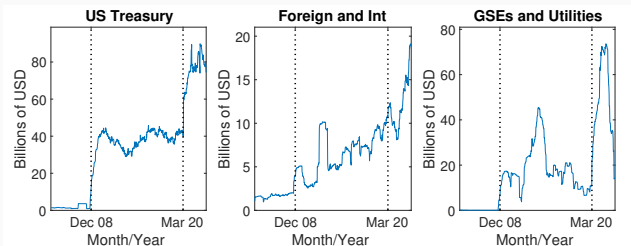
- Banks are willing to hold a large amount of excess reserves to meet regulatory requirements.
  - And willing to pay substantially more than IOR.
- More complex regulations: CB might find it difficult to forecast reserve demand precisely.
  - Liquidity Coverage Ratio (LCR): Banks needs to hold high-quality liquid assets (HQLA).
  - Can choose between reserves, government securities, and other lower-quality assets.
  - Resolution planning, etc.

Other Practical Concerns

- The stylized model emphasizes efficiency of implementation and operational cost.
- There are other potential considerations:
    - Robustness of transmission to money market rates.
   - CB liquidity interventions.

Transmission to Money Market Rates

- Near one-to-one transmission from IOR to money market rates with ample or abundant reserves.
- Predicted by theory and confirmed by market responses to technical adjustments.
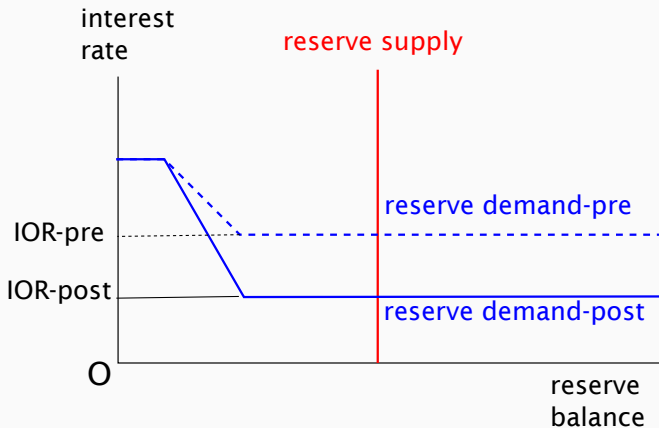
Liquidity Injections

- With ample reserves, large-scale liquidity injections has little impact on money market rates.
  - With scarce reserves, need to switch interest rate control regime or 'sterilize' reserve injections.
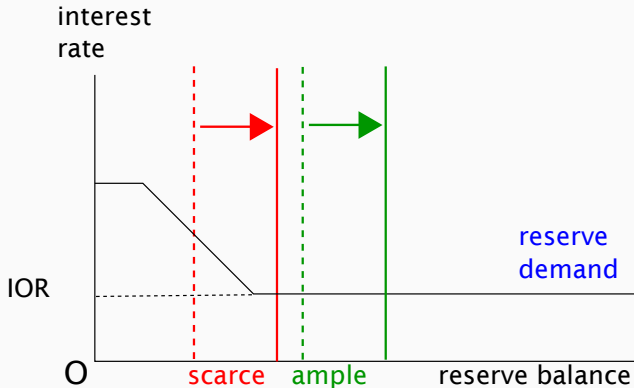
Conclusion

- Conceptual framework to understand the change in monetary policy implementation regime.
  - Stylized model captures changes in the banking environment post-2008.
  - Concept of ample reserves naturally emerges.
- Discussion of ample reserves has become relevant again.