# Federal Reserve Tools for Managing Rates and Reserves

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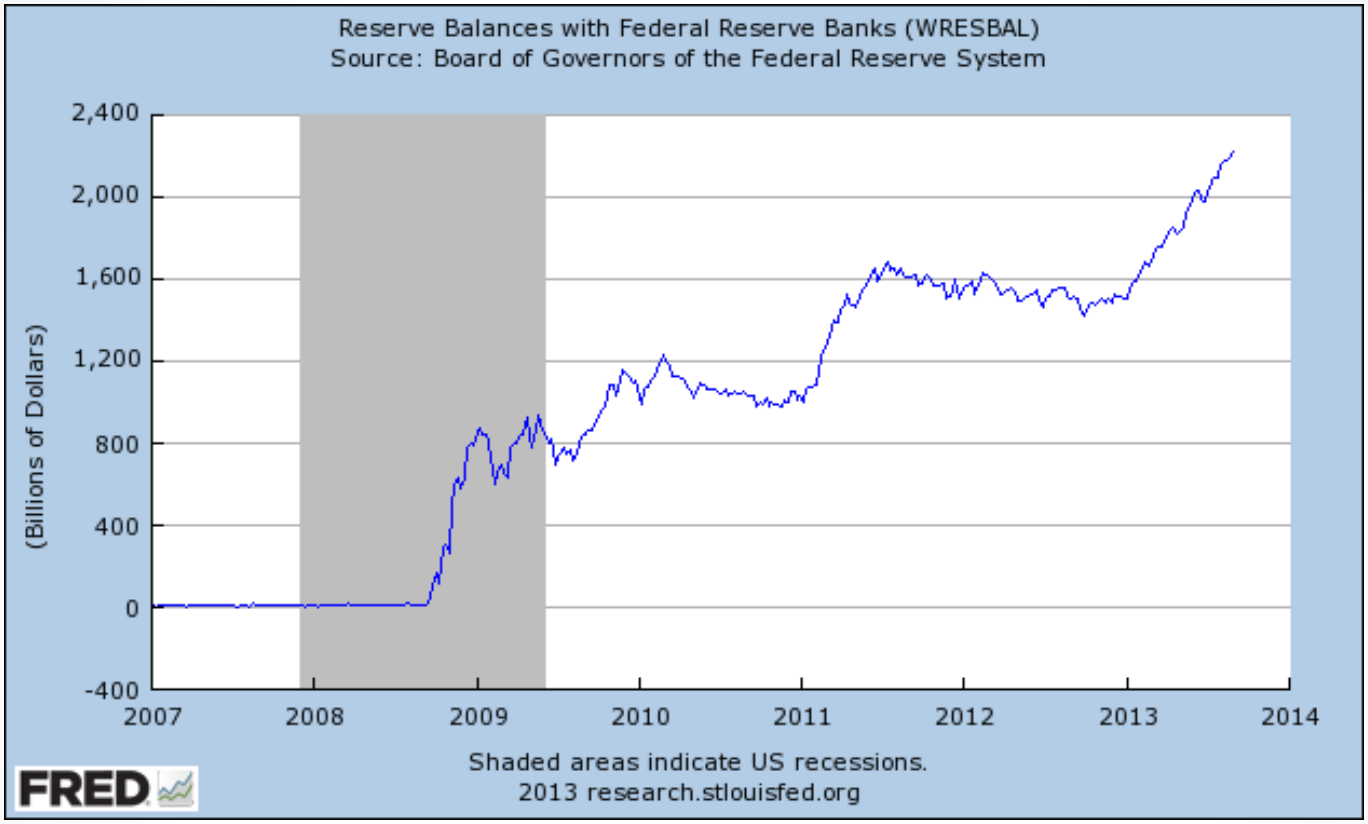
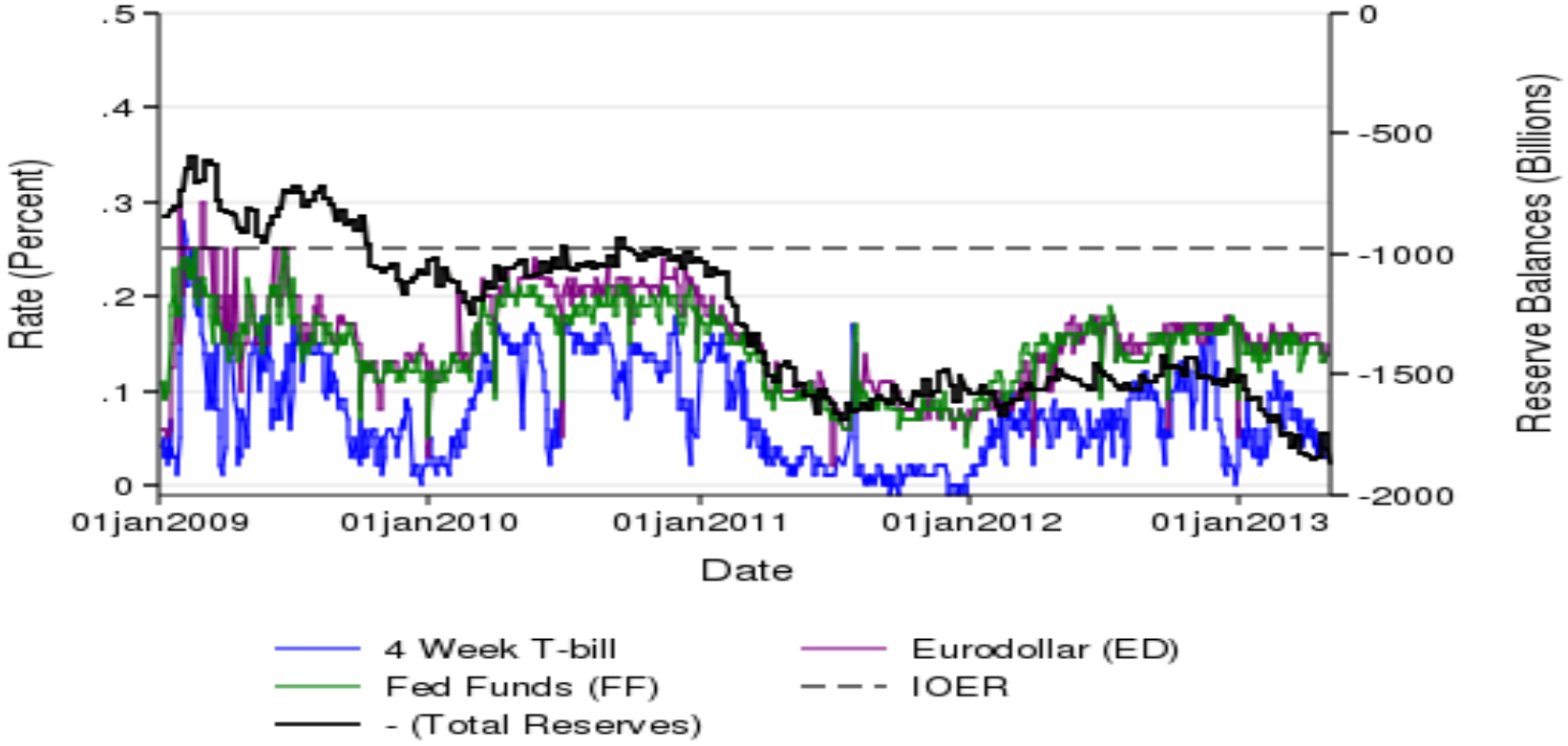
* The views expressed are those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of New York or the Federal Reserve System.

# Large Quantity of Reserves




- How can the Fed manage interest rates in this environment of large reserves?

# How Can the Fed Manage Rates?




- Interest on excess reserves (IOER) rate has not created a floor for short term rates
  - What determines rates once IOER is raised to 100bps? 500bps?
  - Historically, scarcity of reserves creates demand, allowing for control of the fed funds rate

# New Federal Reserve Tools

- New Fed tools have been developed to manage:
  - Short term rates
  - Quantity of reserves
  - *Composition* of the Fed's liabilities away from reserves alone

- Fixed-rate or fixed-quantity auction facilities for a variety of maturities
  - TDF
    - Term Deposit Facility
    - Banks can deposit reserves with the Fed for a term maturity
  - RRP
    - Reverse Repurchase agreement
    - Banks and non-banks, such as money market mutual funds (MMFs), can do collateralized lending to the Fed
  - FRFA ON RRP
    - Fixed-rate, full-allocation overnight RRP

# Outline

1. Model
2. Benchmark market equilibrium without tools
3. Equilibrium using tools
4. Conclusion

# Model

- Dates $t = 0, 1, 2$
- Two sectors each with representative:
  - Bank (B), household (H) and firm
  - Banks issue:
    - Deposits ($D^0$ and $D^1$) and preferred equity ($E$) to households, loans ($L$) to firms, and interbank loans ($I$)
- Government issues bonds ($B$)
- Central bank (CB) issues reserves ($M$), TDF, term RRPs and overnight RRPs

# Model Assumptions

- Banks face frictions in supplying "money" in the form of:
  - Deposits to households
    - Bank has convex risk-shifting opportunities
  - Interbank loans to other banks
    - Convex interbank monitoring cost

# Benchmark Timeline
## Without Fed Tools

Date $t$=0: Bonds, deposits, preferred equity and loans

- Yield return at $t$=2
  - Deposits can be withdrawn early at $t$=1
- Banks can risk-shift on assets obtained in $t$=0

Date $t$=1: One sector has a liquidity shock

- Probability of shock is half for each sector
- Portfolio shock:
  - Depositors in shocked sector demand additional bonds equal to a fraction ($\lambda$) of their bank assets
- Depositors can make new (one-period) overnight deposits
- Banks can borrow and lend on the interbank market
- Banks can risk-shift on assets obtained in $t$=1 and issue new preferred equity

Date $t$=2: Assets mature and consumption occurs

# Real Economy

- Households
  - Sell endowment *W* at $P_0$ (normalized to 1) at *t*=0
  - Buy production goods for consumption at price $P_2$ at *t*=2
    - Goods prices (inflation) is determined according to fiscal theory of the price level as $\Pi = \frac{P_2}{P_0}$
  - Households obtain a liquidity benefit of θ on liquid assets

- Firms
  - Buy household endowment at *t*=0 and sell production goods at *t*=2

# Optimizations
## Firms and Households

Firms maximize profits:

$$\max \; U^F \equiv \left[\Pi \int_0^L r(\hat{L})d\hat{L} - R^L L\right]$$

- $r(L)$ is a firm's marginal real return on production

Households maximize expected utility:

$$\max \; U^H \equiv \frac{1}{2\Pi}\{(R^B+\theta)B^{H0} + R^{E0}E^0 + (R^{D0}+\theta)D^0 + (R^{D1}+\theta)(B^{H1}P^{B1} - E^1) + R^{E1}E^1 - (R^B+\theta)B^{H1} - \tau + U^B + U^F\}$$

Unshocked Sector

$$+\frac{1}{2\Pi}\{(R^B+\theta)B^{H0} + R^{E0}E^0 + (R^{D0}+\theta)[D^0 - \lambda(D^0+E^0)] + (R^B+\theta)\left(\frac{\lambda(D^0+E^0)R^W}{P^{B1}}\right) - \tau + U^B + U^F\}$$

Shocked Sector

$$\text{s.t.} \quad D^0 + E^0 + B^{H0} \leq W$$
$$B^{H1} \leq B^{H0}$$

# Optimizations
## Banks

Banks maximize expected profits:

$$\max\ U^B \equiv \frac{1}{2}[R^L L + R^{M^2} M - R^{E0}E^0 - R^{D0}D^0 + R^M A^1 - R^{D1}D^1 - R^{E1}E^1 + (R^I - R^M)I - \Pi \int_0^I f(\hat{I})d\hat{I}]$$

Unshocked Sector

$$+\frac{1}{2}[R^L L - R^{E0}E^0 + R^M \max\{R^M M - \lambda A^0 R^W,\ 0\} - R^I \max\{\lambda A^0 R^W - R^M M,\ 0\} - R^{D0}(1-\lambda)D^0]$$

Shocked Sector

$$s.t.\ \ A^0 \equiv L^0 + M \le E^0 + D^0$$
$$A^1 \le E^1 + D^1$$
$$U^{B,RS} \le U^B \qquad \text{(No Risk Shifting Constraint)}$$

- $f(I)$ is bank's marginal interbank monitoring cost, with $f'(I) \ge 0$

# Risk-Shifting
## Banks

- Date *t*=0,1 risk shifting pays on new date *t* bank assets an additional return as a function of the balance sheet size at date *t*
  - With prob $\frac{1}{2}$, bank receives $\alpha(.) > 0$, where $\alpha'(.) \geq 0$
  - With prob $\frac{1}{2}$, bank loses $\beta(.) > 0$, where $\beta'(.) \geq 0$ and $\beta(.) > \alpha(.)$
    - $\beta(.) > U^B + E^0 R^{E0} + E^1 R^{E1}$

- $U^{B,RS} \equiv U^B + \frac{1}{2}[\,\alpha(A^0)A^0 + \frac{1}{2}\alpha(A^0 + A^1)A^1 - E^0 R^{E0} - \frac{1}{2}E^1 R^{E1}]$

- Constraint for no risk shifting at t=0,1:
  - $U^{B,RS} \leq U^B$

- Constraint satisfied by two conditions:

$$E^0 \geq \frac{\alpha(A^0)A^0}{R^{E0}}, \qquad E^1 \geq \frac{\alpha(A^0 + A^1)A^1}{R^{E1}}$$

# Equilibrium

- $C(.)$ is a bank's balance sheet cost

$$C(A^0) \equiv (R^L - R^{D0})$$

$$C(A^0 + A^1) \equiv (R^M - R^{D1})$$

- $C(.)$ increases (and deposit rates decrease) with $A^t$
  - Reflects costly bank equity

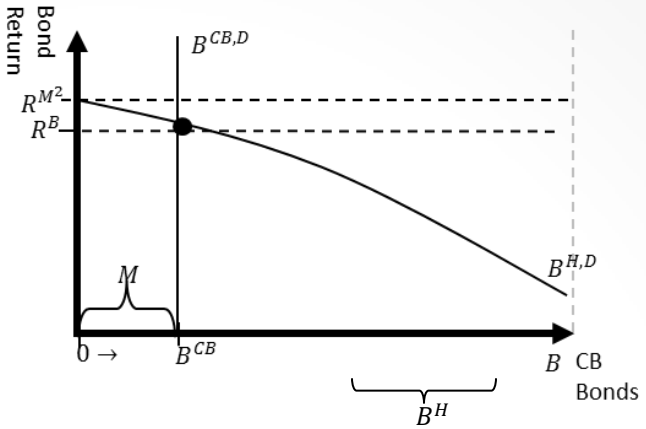
$$R^{E0} = R^{D0} + \theta$$

$$R^{E1} = R^{D1} + \theta$$

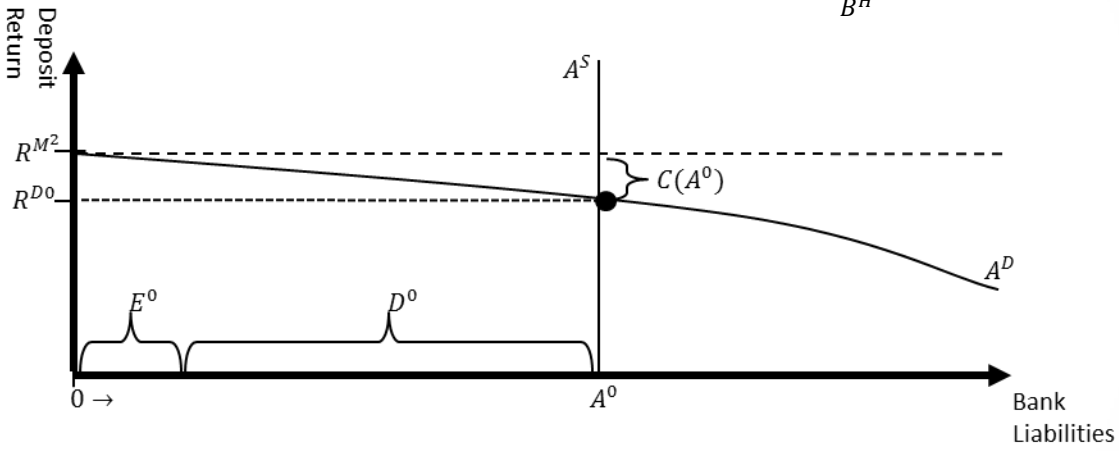
# Equilibrium (t=0)

## Small Reserves ($M<\overline{M}$)

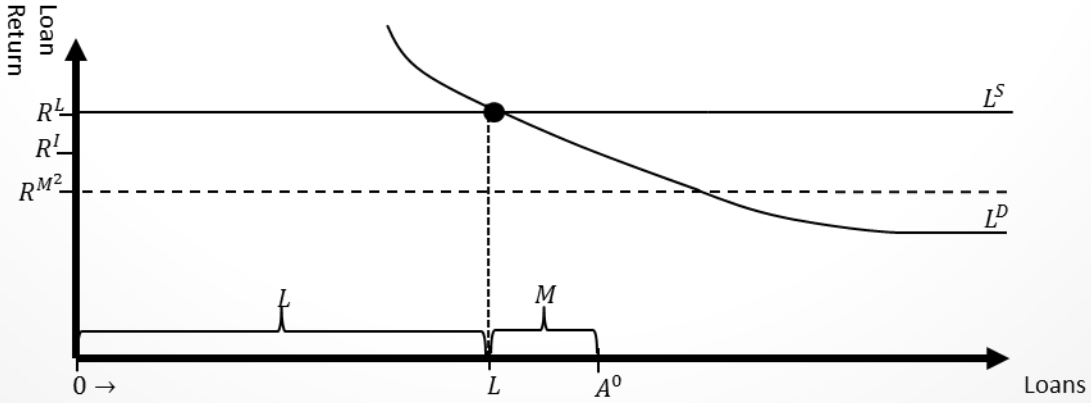
Bond Market




Deposit Market



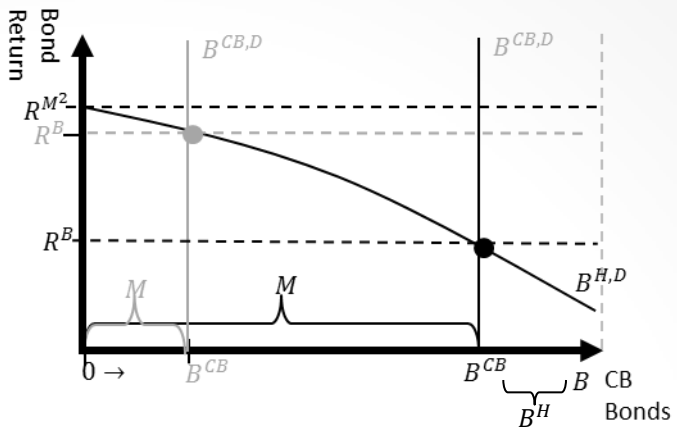

Loan Market



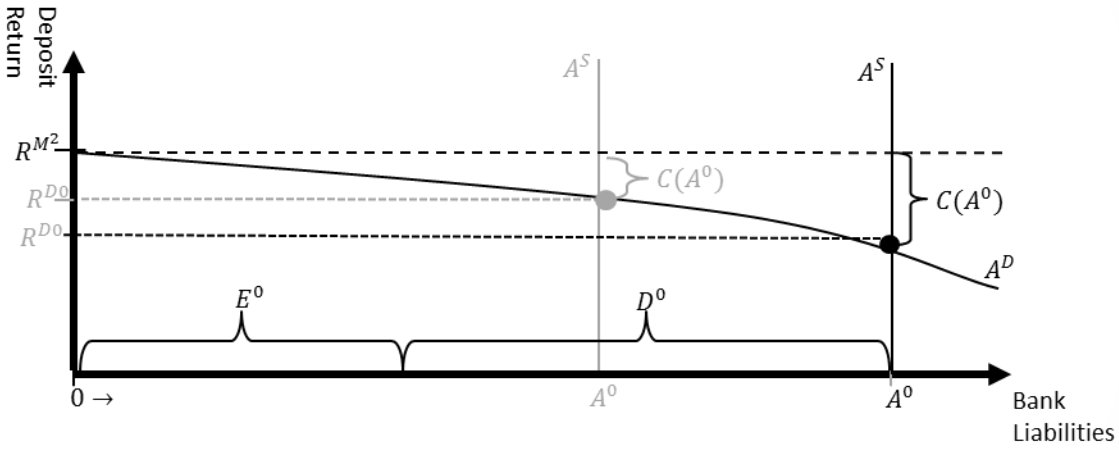
# Equilibrium (t=0)

## Large Reserves ($M > \overline{M}$)

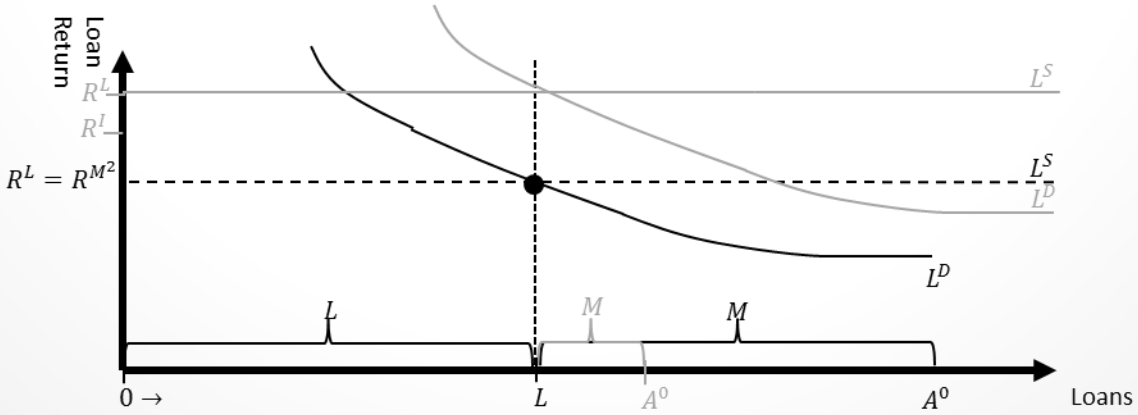
Bond Market




Deposit Market




Loan Market



# Federal Reserve Tools

- Term (two-period) RRP and/or TDF offered by the central bank at $t$=0
  - Either fixed-quantity or fixed-rate
  - The equilibrium quantity is $RRP^{TM}$ ($TDF$) and the rate is $R^{TM}$ ($R^{TDF}$)

- Overnight (one-period) RRP offered by the central bank at $t$=1
  - Fixed-quantity RRP
    - Auctions the quantity $RRP^{FQ}$ with equilibrium stop-out rate $R^{FQ}$
  - Fixed-rate, full-allotment RRP
    - Sets rate $R^{FR}$ with equilibrium quantity is $RRP^{FR}$

- Which tool is most effective for raising rates? For stabilizing rates?

# Balance Sheet Channel
## RRPs vs. TDF

RRPs (but not TDF) increase rates through the balance sheet channel by reducing balance sheet size

- RRPs are held by non-banks
  - Attract bank depositors, reducing banks' balance sheet size and equity cost
  - Raises overnight & term deposit rates
  - Provides a floor on the date-0 term deposit rate

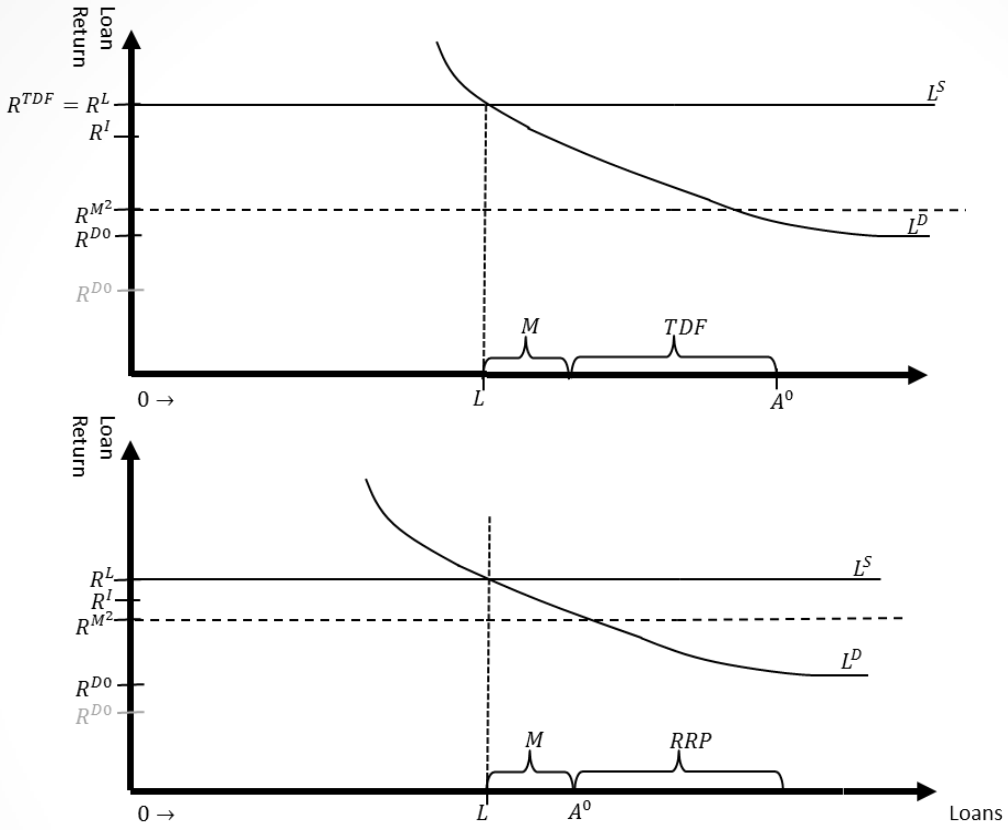
- TDF is held by banks and replaces reserves
  - Balance sheet size and deposit rates are unchanged
  - No reduction in equity

# Scarcity Channel

## RRPs vs. TDF (Loan Market, t=0)

TDF

RRP




- TDF raises bank asset rates and deposit rates by more than RRP through the scarcity channel
  - TDF reduces reserves and increases interbank lending
  - RRP additionally reduces bank size and liquidity needs, reducing interbank borrowing needs

# RRPs vs. TDF

To maximize the fed funds rate and deposit rate:

- When *M* is large, the balance sheet channel is stronger than the scarcity channel
  - Start by using the RRP
- When eventually M becomes small, the scarcity channel is stronger
  - Then use the TDF
- Result: both the TDF and RRP used together most increases rates

# Term vs. Overnight RRP

- Term RRPs are not available for date t=1 liquidity-shock needs
- Overnight RRP provides a stronger floor by absorbing short-term liquidity shocks
  - Directly increases date-1 overnight rates, the lowest of rates
- Overnight RRP reduces balance sheet size and cost at date t=1 through the balance sheet channel

# Fixed-Rate vs. Fixed-Quantity ON RRP

## Overnight Deposit Market (t=1)

Extension: information constraints

- $\lambda$ is random with a high or low realization at $t$=1

- The central bank chooses either a fixed-rate or fixed-quantity ON RRP to target the date-1 rate before observing the shock size ($\lambda$)

- Fixed-quantity RRP sets a rate floor with upward rate volatility
  - Cannot implement the same rate in all states

- Fixed-rate RRP implements the same rate floor rate in all states
  - Fully dampens volatility for overnight rates

# Conclusion

- Reserves alleviate interbank lending costs but increase balance sheet costs, which requires costly equity
- With RRPs, the Fed can provide public money to households without intermediation by banks
- RRPs and TDF together can increase rates the most through the balance sheet and scarcity channels, respectively
- Fixed-rate overnight RRPs provide a floor on the lowest (overnight) rates with the least rate volatility
- Normative: The optimal provision is ON RRPs to absorb shock and moderate reserves less than but close to $\overline{M}$