Chapter 15: The Fed-Funds Market
(“Tools of Monetary Policy” working in the Fed Funds market)

- Market between banks = Buying and selling reserve balances held at the Fed.
  - Overnight loans, unsecured, OTC. Symbol: \( i_{ff} = \) Fed Funds rate.
  - Key point: Trading does not change total reserves.

Supply of Reserves

- Components:
  1. Supply through open market operations: \( NBR = \) Non-borrowed.
  2. Supply through discount loans: \( BR = \) borrowed at interest rate \( i_d \), provided to banks on demand, only for as long as discount loans are outstanding.
     - Write as function \( BR = BR(i_{ff} - i_d) \). Zero for \( i_{ff} < i_d \).
     - Interest-elastic for \( i_{ff} \geq i_d \). Extreme case in Mishkin: horizontal at \( i_{ff} = i_d \).

- Supply curve: Reserve supply as function of the Fed Funds rate

\[
R^s(i_{ff}) = NBR + BR(i_{ff} - i_d)
\]

Shape: Corner at \( i_{ff} = i_d \). Vertical for \( i_{ff} < i_d \). Elastic for \( i_{ff} \geq i_d \).
Demand for Reserves

• Two components, each with multiple determinants:
  - Required reserves: \( RR = rr \cdot D \)
  - Excess reserves: \( ER = ER_D + ER_I \)

=> Total reserve demand: \( R^d = RR + ER = rr \cdot D + ER \)

• Depends on the behavior of Fed, banks, and bank customers:
  1. Fed controls required reserve ratio (rr); may offer interest on reserves (i_{or}).

  2. Banks make decisions about excess reserves, multiple motives:
     - deposit taking – as discussed in the money multiplier model: \( ER_D = e_D \cdot D \).
     - interest on reserves – motivates banks to absorb excess: \( ER_I = ER_I(i_{or} - i_{fr}) \)
     - minimizing cost of reserves within a reserve maintenance period.

  3. Bank customers determine the deposit volume (D).

• Claim: Total reserve demand depends negatively on the Fed Funds rate
  - Several arguments …
• Argument #1: The Fed funds rate determines banks’ incentives to attract deposits and make loans => deposit volume D depends on \( i_{ff} \).
  - Deposits are part of money demand: Deposit volume depends on opportunity cost (consumer interest rates) and transaction needs. Needs: Real transactions (Y), their price (P); Shifting when payment habits changing.
  - Fed funds rate is the opportunity cost of funds for banks
    Changes in \( i_{ff} \) triggers changes in retail interest rates (loans, deposits)
    \[ D = D(i_{ff}, Y, P, \ldots) \] downward sloping function of \( i_{ff} \)
  - Desired deposits depends on real output and prices (like money demand)
  - Desired deposits also shift when C/D changes (at given money demand)

• Argument #2: Reserves are normally proportional to deposits
  - Required reserves are proportional to deposits (by definition)
    \[ RR = rr \cdot D(i_{ff}, Y, P, \ldots) \] downward sloping function of \( i_{ff} \)
  - Excess reserves are small and proportional to deposits, provided \( i_{ff} > i_{or} \):
    \[ R = (rr + e) \cdot D(i_{ff}, Y, P, \ldots) \] downward sloping function of \( i_{ff} \)

• Conclude: Reserve demand is normally a declining function of the Fed funds rate; the demand curve shifts whenever there is a shift in money demand.
• Special short-run argument:
  - Banks are obliged to hold sufficient reserves over a reserve maintenance period of 14 days => Incentives to hold more/less reserves on days when the Fed funds rate is unusually low/high => Reserve holdings are more interest-elastic than deposits within each reserve maintenance period.

• Special argument with interest on reserves (IOR; introduced Oct.2008):
  - If \( i_{ff} < i_{or} \), banks could earn arbitrage profits \( i_{or} - i_{ff} \) by borrowing Fed funds and holding them as excess reserves => Rules out \( i_{ff} < i_{or} \)
    => Reserve demand should be horizontal at \( i_{ff} = i_{or} \) (Textbook graph)
  - Technical Caveat: Some institutions not eligible to receive interest on reserves => Find that \( i_{ff} \geq i_{or} - \Delta \) with \( \Delta = \) small profit margin for intermediaries (Simplify theoretical exposition: assume \( \Delta \approx 0 \) so \( i_{ff} \geq i_{or} \).
  - Main result: IOR provides a lower bound for the Fed Funds rate.

• Conclude: Since 2008, U.S. reserve demand function has two parts:
  - Reserve demand is decreasing function of the Fed funds rate for \( i_{ff} > i_{or} \)
  - Reserve demand is horizontal at the lower bound \( i_{ff} = i_{or} \) (zero until 2008).
**Market Equilibrium**

- Equilibrium Fed Funds rate matches demand and supply:
  \[ R^s = NBR + BR(i_{ff} - i_d) = R^d(i_{ff}, i_{or}, Y, P, r, r, ...) \]

- Several cases for relationship between \( i_{ff}, i_d, \) and \( i_{or} \)
  - Before 2003: Discount rate below the Fed funds target; administrative restrictions on discount loans to discourage opportunistic borrowing by banks.
  - Since Dec.2008: Ample excess reserves and \( i_{ff} \approx i_{or} \).
Mishkin’s Diagrams

1. Market Equilibrium

With excess supply of reserves at \( i^s_f \), the federal funds rate falls to \( i^*_f \).

With excess demand for reserves at \( i^d_f \), the federal funds rate rises to \( i^*_f \).
2. Impact of an Open Market Operations

(a) Supply curve initially intersects demand curve in its downward-sloping section

(b) Supply curve initially intersects demand curve in its flat section
3. Impact of a reduced discount rate

- Discount rate usually changes with the Fed Funds target $\Rightarrow$ No separate role.
- Reserve requirements change $=$ Shift in reserve demand. Rarely used.
4. Impact of higher reserve requirements

(Detail: $R^d = rr \cdot D \Rightarrow$ Reserve demand should “rotate” outwards—similar answers)
5. Impact of a higher interest rate on reserve balances

- **Step 1.** A rise in the interest rate on reserves from \( i_{or}^1 \) to \( i_{or}^2 \)...
- **Step 2.** Leaves the federal funds rate unchanged.

(a) Initial \( i_{ff}^1 > i_{or}^1 \)

(b) Initial \( i_{ff}^1 = i_{or}^1 \)

[Notes on Mishkin Ch.15 - P.10]
Fluctuations in the Demand for Reserves

- Deserves attention: Reserve demand is volatile, subject to shocks.
  - Macro disturbances: changes in Y, P => shifts in $M^d$ => shifts in D and $R^d$
  - Financial disturbances: seasonal changes (holiday cash needs), banking competition causing shifts between D and other deposits (not subject to rr)

- Result: $i_{ff}$ varies with $R^d$. No Fed involvement => Loss of control over $i_{ff}$.
Coping with Fluctuating Reserve Demand

• Challenges for the Fed: Avoid interest rate volatility while maintaining control over the money supply. Monetary history = search for solutions.

1. Fed procedures before 2003: set the discount rate below the Fed funds rate target, use administrative controls to restrict discount loans:

- Reserve supply is elastic because banks can take out discount loans.
- Elastic supply reduces the interest rate effect of shifts in reserve demand.
- Restrictions on discount loans allow Fed to make \( R^s \) flat or more steep.
- Banks influence BR. Motivates writing \( M1 = m \times (MB_n + BR) \) in ch.14

- Problem: Administrative controls are opaque and create moral hazard: setup induces banks to claim emergencies to obtain “cheap” discount loans.
2. Fed procedures 2003-2008:
- Set the discount rate above the Fed funds rate target (penalty rate)
- Rely on open market operations to offset fluctuations in reserve demand.

- Banks use BR only in true emergencies.
- Normal procedure:
  - FOMC sets a Fed funds rate target
  - Open market desk is instructed to stabilize $i_{ff}$ between meetings.
  - FOMC reviews $i_{ff}$-the target as needed.

- Concern: Open market operations that stabilize $i_{ff}$ imply that money supply is perfectly elastic when demand shifts: Higher $M^d$ => higher $R^d$ => higher NBR to keep $i_{ff}$ constant => increase in $M1 = m \times MB_n$.
- Procedures rely on FOMC to adjust the target to avoid excessive $M1$ growth.
  Note: Shifts in $R^d$ are observed => gives FOMC information about $M^d$

- Set the IOR at or slightly above the Fed funds rate target. Supply sufficient reserves so that $i_f \approx i_o$. Set the discount rate at penalty level.

- No need for open market operations to stabilize $i_f$ between FOMC meetings
- Banks use BR only in true emergencies.
- FOMC reviews $i_f$-target as needed.

What could possibly go wrong?

- Concern:
  1. Shifts in $R^d$ are unobserved $\Rightarrow$ No information about banks’ desired reserves to support deposit taking vs. excess reserves held as investments
  2. Question about how/if the Fed can control money supply

- Analysis: Downward sloping segment of $R^d$ includes excess reserves for deposit taking. Flat segment captures reserves held as investment.
  - Define the corner point: $i_f = i_o$ and $R = \hat{R}^d = (rr + e_D) \cdot D(i_o)$
**Monetary Analysis with Ample Reserves**

- Ample reserves case applies when \( R^s > \hat{R}^d \). Traditional case when \( R^s \leq \hat{R}^d \).
- Whenever \( R^s > \hat{R}^d \):
  
  - \( ERI = R^s - \hat{R}^d > 0 \) and \( e = \frac{ER_D}{D} + \frac{ER_i}{D} > e_D \).
  
  - Open market purchases increase \( ERI \), increase \( e \), but have no impact on M1. Though MB increases, higher \( e \) reduces m enough to neutralize the effect.
  
  - Open market sales reduce \( ERI \), reduce \( e \), but have no impact on M1, unless they are large enough that reserve supply falls below \( \hat{R}^d \).

- Implications for M (M1 or M2): perfectly interest-elastic money supply

  - Liquidity preference diagram

  ![Diagram](insert diagram)

  - Term structure: money market rates (\( i \)) determined by current & expected \( i_{ff} \)
    
    \( \Rightarrow \) Fed can fix \( i = i^* \) by setting \( i_{or} \)
    
    \( \Rightarrow \) Then \( M = \) quantity demanded at \( i^* \)

  - If \( M^d \) curve shifts, M1 varies \( \Rightarrow \) Money supply curve is horizontal at \( i^* \)

  - To reduce or increase M by changing \( i_{or} \), the Fed must rely on term structure linkages and on the downward slope of \( M^d(i) \)

[Notes on Mishkin Ch.15 - P.15]
**Final Comment: What else could the Fed do?**

- Alternative suggested by ECB: traditionally (pre-crisis) used both lower and upper bounds to control money market interest rates
- For the US: IOR as lower bound. Discount rate as upper bound.

![Graph](image)

- When reserve demand varies, Fed funds rate would bounce within the interval
  - Provides information about reserve demand related to deposit taking
  - Setting tight bounds would allow the Fed to reduce security holdings without risk of triggering large interest rate changes.

=> Possible exit path from the Ample Reserves setting, return to pre-2008 operation of the Fed Funds market.