Chapter 15: The Fed-Funds Market
(mostly Fed Funds – plus other policy tools)

- 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

- Regular components (Textbook treatment):
  - Supply through open market operations: $NBR = Non-borrowed.$
  - Supply through regular discount loans: $BR = borrowed at interest rate $i_d$, expire automatically, provided to banks on demand.
  - Write as supply function $BR = BR(i_{ff} - i_d)$.
  - Elastic supply function for $i_{ff} \geq i_d$. Zero for $i_{ff} < i_d$.

- Regular reserve supply as function of the Fed Funds rate:
  $$R^s(i_{ff}) = NBR + BR(i_{ff} - i_d)$$
  - Vertical for $i_{ff} < i_d$. Kink at $i_{ff} = i_d$. Flat for $i_{ff} \geq i_d$. 

[Notes on Mishkin Ch.15 - P.1]
Demand for Reserves

- Demand by banks to satisfy reserve requirements or to hold clearing balances.
  
  - Required reserves: \( RR = rr \cdot D \)
  
  - Excess reserves: \( ER = e \cdot D \)

\[ R^d = RR + ER = rr \cdot D + ER \]

1. Fed controls the required reserve ratio \( rr \); sets discount and reserve interest.

2. Banks make decisions about excess reserves.

3. Bank customers determine the deposit volume.

- How and why does reserve demand depend on the Fed Funds rate?
• Argument #1: The Fed funds rate determines banks’ incentives to attract deposits and make loans => required reserves.
  - 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 consumer rates. Shifting when spreads change. Combine: \(D(i_{ff},Y,P,...)\)
  - Required reserves are proportional to deposits:
    \[RR = rr \cdot D(i_{ff},Y,P,...)\]

• Argument #2: Excess reserves are costly whenever the Fed funds rate is greater than the interest rate on reserve balances. Opportunity cost: \(i_{ff} - i_{or}\).
  - For \(i_{ff} > i_{or}\): \(ER = 0\), so reserve demand is downward sloping.
  - For \(i_{ff} \leq i_{or}\): excess reserves are costless or even profitable
    \[R^d = rr \cdot D(...) + ER(i_{ff} - i_{or})\] is elastic (flat) at \(i_{ff} = i_{or}\).
• Caution: Deposit responses take time. Reserves not a daily requirement.
  => Need separate arguments for daily Fed funds demand.
• Argument #3: The Fed funds rate influences banks’ incentives when to hold reserves within a reserve maintenance period
  - Facts about reserve accounting: \( R \geq r \cdot D \) applies to reserves and deposits at different dates: applies with 30-day delay and over a two-week average
  - Reserve computation period: a Tuesday to second following Monday
  - Reserve maintenance period: starts 30 days later, a Thursday to second following Wednesday. Allows 16 days for calculations.
  - Reserves are costly if \( i_{ff} > i_{or} \) (otherwise RR not binding)
    \[ ER \approx 0 \text{ on average} \text{ over the reserve maintenance period} \]
  - Opportunity cost of reserves on a particular day = \( i_{ff} - i_{or} \)
    \[ \Rightarrow \text{Cost varies if } i_{ff} \text{ fluctuates within a reserve maintenance period} \]
  - Banks will hold \( R >> rr \cdot D \) if \( i_{ff} \) is below average \( \Rightarrow ER > 0 \)
  - Banks may hold \( R << rr \cdot D \) if \( i_{ff} \) is above average \( \Rightarrow ER < 0 \)

• Conclude: Even if deposits don’t respond to \( i_{ff} \) in the short run, short run reserve demand is elastic and downward sloping.
Overall Reserve Demand

• Two-part argument:
  - Short run (within a reserve maintenance period): Demand is downward sloping because ER is downward sloping.
  - Longer run (beyond a reserve maintenance period): Demand is downward sloping because D is downward sloping.
  - Overall reserve demand $R^d(i_{ff}, i_{or}, Y, P, rr, ...)$ depends on Fed-funds rate, interest on reserves, output and prices, the reserve ratio; and it may shift.

• For macro analysis: Skip functional details, but remember the determinants:
  - Reserve demand is a downward sloping function of the Fed funds rate.
  - Reserve demand shifts right if Y or P increase (about proportionally)
  - Reserve demand shifts in response to changes in the financial system (shifts in D or changes in retail rates relative to $i_{ff}$)
  - Reserve demand is very elastic for $i_{ff} \leq i_{or}$
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 \( i_{or} \)
  - 2003 – Oct. 2008: \( i_{ff} < i_d \) (≈1% penalty) and \( i_{ff} > i_{or} = 0 \).
  - Zero interest period starting Dec.2008: \( i_{ff} \leq i_{or} = 0.25\% \).
Mishkin’s Diagrams
1. Market Equilibrium

[Notes on Mishkin Ch.15 - P.7]
2. Impact of an Open Market Operations

[Notes on Mishkin Ch.15 - P.8]
3. Impact of a reduced discount rate

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

(Detail: $R^d = \text{rr} \cdot D \Rightarrow$ Reserve demand should “rotate” outwards—similar answers)

[Notes on Mishkin Ch.15 - P.10]
5. Impact of a higher interest rate on reserve balances
6. How the discount rate and interest on reserves limit fluctuations in the Fed-funds rate

**Step 1.** A rightward shift of the demand curve raises the federal funds rate to a maximum of the discount rate.

**Step 2.** A leftward shift of the demand curve lowers the Federal funds rate to a minimum of the interest rate on reserves.
What About Private Sector Changes?

- Deserves attention: Reserve demand is volatile, subject to shocks.
  - Examples: Output Y, prices P, competitive shifts between banks a/o intermediaries, seasonal shifts, holiday cash needs, etc
  => Fed faces a choice:
    (a) Do nothing \( \implies i_{ff} \) varies, NBR remain unchanged.
    (b) Do defensive open market operations to stabilize \( i_{ff} \implies R \) fluctuates

- Normal situation (current U.S. practice):
  - Stabilize \( i_{ff} \) between FOMC meetings.
  - Review \( i_{ff} \)-target as FOMC meets.

- Foreign central banks operate similarly: Target a money market rate, choice between stabilizing an interest rate or stabilizing bank reserves.
**Illustration in Mishkin ch.16**

**Step 1.** A rightward or leftward shift in the demand curve for reserves...

**Step 2.** Lead the central bank to shift the supply curve of reserves so that the federal rate does not change...

**Step 3.** With the result that non-borrowed reserves fluctuate between $NBR'_{fr}$ and $NBR''_{fr}$. 

[Notes on Mishkin Ch.15 - P.14]
Choice: Interest Rate versus Quantity Target

- If the Fed systematically stabilizes NBR, the supply curve for Fed Funds is effectively vertical in the range between \( i_{or} \) and \( i_d \).
- If the Fed systematically stabilizes the Fed funds rate, the supply curve for Fed Funds is effectively horizontal at the target rate.