New-Keynesian Macroeconomics

- Disagree with classical assumption that prices and wages are perfectly flexible.
  - Classical view: If the Fed increases M, price level P rises immediately and proportionally.
  - Implicit: immediate increase in nominal wages to keep real wage unchanged.

- Observation: most consumer prices and nominal wages change slowly.
  - Firms try to satisfy high demand without raising prices. Firms try to avoid price cuts when demand is low. Called: Sticky Prices; similarly, have sticky wages.
  - Key implication: P does not jump around in response to changes in M.
  - However: Prices and nominal wages adjust eventually – flexible in the long run; and they may respond quickly to changes in costs.

- Questions: How does an economy work when prices and wages are sticky? How does monetary policy work in such an economy?
Conceptual Overview of New-Keynesian Analysis

• Three new elements:
  1. **Short-run aggregate supply curve** (*AS-curve*): inflation increases when output is greater than potential output (Mishkin ch.22).
  2. **Liquidity Effect**: with sticky prices, higher money supply reduces nominal and real interest rates; lower money supply raises interest rates (Mishkin ch.5).
     => Central banks can control interest rates in the short run.
  3. **Taylor principle** (*MP-curve*): central banks should set interest rates so that the real interest rate increases with inflation (Mishkin ch.21).

• Three elements in common with classical analysis – remain unchanged:
  - Demand for goods = $Y^d(r)$, with new Keynesian label: called **IS-Curve**.
  - Supply of goods in the long run is determined by capital and labor; called Potential Output $Y = Y^P$ and graphed as vertical **LRAS**-curve
  - Demand for money relationship: $M^d = L(i,Y) \cdot P$.

• Overall: New assumptions about the **short-run**. Classical answers remain valid for the **long run**. In between: adjustment dynamics.
**Item #1: Short-run supply.**

**New-Keynesian Short-Run Aggregate Supply**

- Basic idea: each firm varies production to satisfy the demand for its goods.
  1. Recognize prevailing inflation: if demand is normal, each firm raises prices as much as it expects others to raise prices: set $\pi = \pi^e$ when $Y = Y^P$.
  2. Adjust prices up or down in response to excess demand: $\pi$ is an increasing function of the output gap $Y - Y^P$. Responses are small in the short run but more aggressive if excess demand persists.
  3. Respond quickly to disturbances in production – changes in cost

- Aggregate supply of goods – summing over all firms: $\pi = \gamma(Y - Y^P) + \pi^e + \rho$
  with slope $\gamma > 0$ to describe responses to aggregate demand ($Y$).
  - Graph as **AS-curve** in a ($Y$, $\pi$) diagram – upward sloping line.
  - Curve shifts up when $\pi^e$ rises and/or when $\rho > 0$ (e.g. oil shocks).

- Question: If supply depends on aggregate demand, what determines demand?
  - As before: $Y^d(r)$ depends on $r$. Next question: What determines $r$?
  - To show: with sticky prices, the central bank has the power to control $r$. 
Aggregate Supply Curves: Short-Run and Long-Run

(Figure from Mishkin ch.22)

Inflation Rate (percent)

LRAS

AS (π₀ = 2%)

Y₀ = 10

Aggregate Output, Y ($ trillions)

New-Keynesian Macro
Factors that shift the Short-Run Aggregate Supply Curve

(Table from Mishkin ch.22)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Change</th>
<th>Shift in Supply Curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected inflation, $\pi^e$</td>
<td>↑</td>
<td>AS$_2$ AS$_1$</td>
</tr>
<tr>
<td>Inflation shock, $\rho$</td>
<td>↑</td>
<td>AS$_2$ AS$_1$</td>
</tr>
<tr>
<td>Persistent output gap, $(Y - Y^p)$</td>
<td>↑</td>
<td>AS$_2$ AS$_1$</td>
</tr>
</tbody>
</table>

*Note: Only increases (↑) in the factors are shown. The effect of decreases in the factors would be the opposite of those indicated in the “Shift” column.*
Item #2: How can the central bank control interest rates?

The Liquidity Effect

- **Open Market Operations** = Purchases/sales of bonds for new money.
  - Recall market for money:
    \[ M = L(i, Y) \cdot P \]
  - Suppose M increases: How can the market remain in equilibrium?
  - Classical answer: Price level must jump up – cannot happen with sticky prices.
  - Keynesian answer: Interest rate \( i \) must decline, so \( L(i, Y) \) increases; \( V(i) \) declines
  - Real interest rate also declines because \( \pi^e \) is unchanged (or even rises).

\[ \Rightarrow \text{Higher money supply reduces interest rates} \] (while prices are sticky)

- **Bond market perspective:**
  - More demand for bonds => higher bond prices => lower bond yields.
  - Graphical analysis in Mishkin ch.5: **Liquidity preference framework**

- **Liquidity effect applies to asset allocation in the very short run:** At a moment in time, investors allocate wealth between money & bonds (and other assets)
The Liquidity Preference Diagram

Demand curve is downward sloping for given (P.Y). Supply is vertical.

- $i^*$ is the equilibrium interest rate, where the demand for money ($M^d$) equals the supply of money ($M^s$).
- With excess supply, the interest rate falls to $i^*$.
- With excess demand, the interest rate rises to $i^*$.
Note on Mishkin ch.5: Liquidity Preference and the Bond Market

- Mishkin presents Liquidity Preference as perspective on the bond market (ch.5).
  - More general perspective: choice of money vs. all other assets – more than bonds.

\[
\text{Wealth} = \text{Money} + \text{Other Assets}.
\]

=> Decisions about money are about allocating wealth in the very short run.

- Perspective money demand & supply is insightful because money has special features:
  - Supply is controlled by the central bank – directly relevant for economic policy.
  - Demand is driven by transaction motives – positive \( M^d \) even at low expected returns.

- Recall from financial market analysis: Assets with relatively low return must have relatively high liquidity and relatively low risk.
  - Easiest comparison is between money (liquidity) vs. bonds (earn yield); both are safe.
  - Useful lessons from Mishkin’s analysis:
    1. Excess demand for money ⇔ Insufficient demand for other assets (incl. bonds)
    2. The interest rate that equilibrates the market for money is also the interest rate that ensures equilibrium the bond market, and vice versa.
Main application: Changes in Money Supply

Higher money supply reduces nominal interest rates

- Central bank can control interest rates by varying the money supply.
- Money demand curve remains unchanged because prices are sticky.
Main complication: Money demand may shift

- Source of shifts: changes in output; changes in the price level; disturbances.
- Central bank has a choice: Let interest rates drift or adjust the money supply
Note on Fed Policy since 2015: Interest on Reserves

- Keynesian policy perspective: *Central banks set interest rate targets.*

- Traditional “operating-level” approach: control the money supply via open market operations to control money market rates = Mishkin ch.5. Follow for now.

- Alternative approach (preview – more later in ch.15-16):
  - Central bank offers interest on bank reserves (IOR) – in U.S. since 2008.
  - IOR allows the Fed to set a lower bound on interest rates. At the lower bound, $M$ is determined by money demand, as if “supply” were perfectly horizontal

- By varying IOR, the Fed can control money market interest rates. Equilibrium $M$ is effectively determined by money demand.

New-Keynesian Macro
Item #3: How should central banks set interest rates?

**New-Keynesian Monetary Policy**

- Central banks have wide discretion to set interest rates, using open market operations and exploiting the liquidity effect.
  - Claim: inflation will be unstable in the long run, unless the central bank raises \( r \) in response to rising inflation. Motivates assumption:

- **Taylor Principle**: Central banks raise/reduce \( r \) when inflation is high/low.
  - Formalized in the MP-function: \( r = \bar{r} + \lambda \cdot \pi \) with positive slope \( \lambda > 0 \).
    - Move along the curve if \( r \) varies because of inflation.
    - Shift the curve if \( \bar{r} \) changes: interpreted as discretionary policy change.

- Interpret monetary policy as setting the intercept and slope of the MP function
  - Decision to cut rates at given \( \pi \) \( \Leftrightarrow \) shift MP down \( \Leftrightarrow \) increase money supply.
  - Decision to raise rates at given \( \pi \) \( \Leftrightarrow \) shift MP up \( \Leftrightarrow \) reduce money supply.
  - Policy on how aggressively to respond to inflation = choice of \( \lambda \).

- Key assumption in the Keynesian model: Central banks set interest rates in a way that satisfies the Taylor principle – they do what they should do.
The Monetary Policy Curve (MP)

(Figure from Mishkin ch.21)

Autonomous monetary policy tightening shifts the MP curve up.

Autonomous monetary policy easing shifts the MP curve down.
Keynesian Analysis: Solving the Model

• **Math**: three equations for output, inflation, and the real interest – all short run:

  1. **Short-run AS-curve**: \( \pi = \gamma (Y - Y^p) + \pi^e + \rho \)

     Inflation depends on the output gap \( Y - Y^p \) with slope \( \gamma > 0 \), on expected inflation \( \pi^e \), and on price shocks \( \rho \) (e.g. oil shocks).

  2. **IS-curve**: “real” demand \( Y = Y^d (r, ...) = \ddot{Y} - \ddot{d} \cdot r \), with negative slope.

     Draw as linear for simplicity. (Details in Mishkin ch.20 – optional reading.)

  3. **MP-curve** for interest rates: \( r = \overline{r} + \lambda \cdot \pi \) with slope \( \lambda > 0 \).

     Invokes liquidity effect: central bank controls \( r \). Assume target depends on inflation.

• Technical Note on the class page has math details. In class use mostly diagrams.

• **Graphical Analysis**:

  - Given: AS curve in \((Y, \pi)\) diagram, IS in \((Y, r)\) diagram; MP in \((r, \pi)\) diagram.

  - Solution: substitute MP into IS to obtain the **AD-curve**

    \[
    Y = \ddot{Y} - \ddot{d} \cdot (\overline{r} + \lambda \cdot \pi) = (\dddot{Y} - \ddot{d} \cdot \overline{r}) - \ddot{d} \cdot \lambda \cdot \pi
    \]

    - AD curve has negative slope because \( \pi \uparrow \Rightarrow r \uparrow \Rightarrow Y \downarrow \)

    - Combine AD and AS in \((Y, \pi)\) diagram: unique intersection \((Y^*, \pi^*)\)

    - Plug \( Y^* \) into IS or \( \pi^* \) into MP to obtain \( r^* \)
The Aggregate Demand Curve
(Figure from Mishkin ch.21)
**Keynesian Analysis: Applications**

- Common task: **Determine effects of policy shifts or disturbances** ("shocks").
  - Idea: Disturbances shift curves. Use economic interpretation & knowledge of the model to determine which curves shift in which directions.
  - AS shifts when firms change pricing; IS shifts when aggregate demand changes (C or I or G or NX); MP shifts when monetary policy changes
- Example: Increase in consumer confidence => IS and AD shift right: (Y, π, r) up.

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**AD-AS Diagram: Inflation & real output**
(Key diagram)

- **π**
- **AS**
- **AD**
- **Y**

**IS curve: Real interest rate & real output**

- **r**
- **IS**
- **Y**

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New-Keynesian Macro
Adjustments in the Longer Run

- Output vs. potential: if $Y \neq Y^P$ firms have idle capacity or struggle to meet demand => incentive to reduce or raise prices => shift AS down or up
- Actual vs. expected inflation: AS-curve $\pi = \gamma (Y - Y^P) + \pi^e + \rho$ implies that expectations are wrong whenever $Y \neq Y^P$ or $\rho \neq 0$ => expectations will adjust.
- Conclude: Keynesian model has intrinsic dynamics
  - AS curve shifts over time until $\pi = \pi^e$ and $Y = Y^P$. (Shocks are unexpected so $\rho = 0$ in expectation.). Line $Y = Y^P$ is vertical = LRAS curve
- Example with IS shift. After AS adjusts, return to $Y = Y^P$, higher ($\pi$, $r$).
**Key Policy Results**

- **Short-run effects of expansionary monetary policy:**
  - Monetary policy sets interest rates: Lower $\bar{r}$ => MP shifts down, AD shifts right => Higher output, higher inflation, reduced real interest rate.

- **Short-run effects of expansionary fiscal policy:**
  - Higher G increases aggregate demand => IS shifts right, AD shifts right. => Higher output, higher inflation, higher real interest rate.
  - Lower taxes may increase consumption. Then higher aggregate demand => IS shifts right, AD shifts right. => Output/inflation/real interest rate all higher.

- Note that higher output => higher employment => lower unemployment rate.

  => **New-Keynesian analysis implies that monetary & fiscal policy can influence real output and the unemployment rate.**

- Limitation: Sticky-price effects vanish in the long run: AS shifts up as $\pi^e \rightarrow \pi$.
  
  => **The effects of monetary & fiscal policy on real output and employment apply only for as long as prices are sticky – not in the long run.**

- Additional limitations: Effective interventions require good information and quick decision-making. Fiscal stimulus implies rising public debt.

New-Keynesian Macro
Note on Time Horizons

1. How long does it take for the AS curve to adjust? (A: Depends on scenario.)
   • Adaptive expectations: learning from experience, looking back (e.g., $\pi^e = \pi_{-1}$).
     Commonly assumed for AS-curve; implies slow adjustment.
   • Rational expectations: exploiting all available information, looking forward.
     Commonly assumed for financial markets (more in Mishkin ch.7)
   • Standard assumptions: On good and labor markets, expectations adjust gradually, so the full adjustment of prices and wages takes several years.
   • General principles: AS curve shifts up over time if $\pi > \pi^e$ (down if $\pi < \pi^e$).
     - Equilibrium $(Y, \pi)$ move along AD curve to intersection of AD and $Y^p$.
     - Equilibrium $(Y, r)$ move along IS curve to intersection of IS and $Y^p$.
   => Long run equilibrium is the same as the classical model

2. Think of SR and LR as key markers on a continuous adjustment process
   • Macro short run ~ 1-2 years. Macro long run ~ 5-10 years.
   • Financial markets respond much more quickly; e.g. Liquidity effect.
   • Stocks of government debt, external debt, physical capital accumulate more slowly—typically ignored in the Keynesian model, even in “LR”