IN THIS CHAPTER, YOU WILL LEARN:

- the IS curve and its relation to:
  - the Keynesian cross
  - the loanable funds model
- the LM curve and its relation to:
  - the theory of liquidity preference
- how the IS-LM model determines income and the interest rate in the short run when $P$ is fixed
Context

- Chapter 10 introduced the model of aggregate demand and aggregate supply.

**Long run:**
- prices flexible
- output determined by factors of production & technology
- unemployment equals its natural rate

**Short run:**
- prices fixed
- output determined by aggregate demand
- unemployment negatively related to output
Context

- This chapter develops the *IS-LM* model, the basis of the aggregate demand curve.
- We focus on the short run and assume the price level is fixed (so the *SRAS* curve is horizontal).
- Chapters 11 and 12 focus on the closed-economy case. Chapter 13 presents the open-economy case.
The Keynesian cross

- A simple closed-economy model in which income is determined by expenditure. *(due to J. M. Keynes)*

- Notation:
  - \( I \) = planned investment
  - \( PE = C + I + G \) = planned expenditure
  - \( Y \) = real GDP = actual expenditure

- Difference between actual & planned expenditure = unplanned inventory investment
Elements of the Keynesian cross

consumption function: $C = C(Y - T)$

govt policy variables: $G = \bar{G}, \quad T = \bar{T}$

for now, planned investment is exogenous: $I = \bar{I}$

planned expenditure: $PE = C(Y - T) + \bar{I} + \bar{G}$

equilibrium condition:

actual expenditure = planned expenditure

$Y = PE$
Graphing planned expenditure

\[ PE = C + I + G \]
Graphing the equilibrium condition

$PE = Y$

planned expenditure

income, output, $Y$

$45^\circ$
The equilibrium value of income

\[ PE = C + I + G \]

Equilibrium income

\[ PE = Y \]
An increase in government purchases

At $Y_1$, there is now an unplanned drop in inventory…

…so firms increase output, and income rises toward a new equilibrium.

$\Delta G$

$PE_1 = Y_1$

$\Delta Y$

$PE_2 = Y_2$

$PE = C + I + G_1$

$PE = C + I + G_2$
Solving for $\Delta Y$

\[ Y = C + I + G \]

\[ \Delta Y = \Delta C + \Delta I + \Delta G \]

\[ = \Delta C + \Delta G \]

\[ = \text{MPC} \times \Delta Y + \Delta G \]

Collect terms with $\Delta Y$ on the left side of the equals sign:

\[ (1 - \text{MPC}) \times \Delta Y = \Delta G \]

Solve for $\Delta Y$:

\[ \Delta Y = \left( \frac{1}{1 - \text{MPC}} \right) \times \Delta G \]
The government purchases multiplier

Definition: the increase in income resulting from a $1 increase in $G$. 

In this model, the govt purchases multiplier equals $\frac{\Delta Y}{\Delta G} = \frac{1}{1 - \text{MPC}}$.

Example: If $\text{MPC} = 0.8$, then 

$\frac{\Delta Y}{\Delta G} = \frac{1}{1 - 0.8} = 5$

An increase in $G$ causes income to increase 5 times as much!
Why the multiplier is greater than 1

- Initially, the increase in $G$ causes an equal increase in $Y$: $\Delta Y = \Delta G$.

- But $\uparrow Y \rightarrow \uparrow C$

  $\rightarrow$ further $\uparrow Y$

  $\rightarrow$ further $\uparrow C$

  $\rightarrow$ further $\uparrow Y$

- So the final impact on income is much bigger than the initial $\Delta G$. 
An increase in taxes

Initially, the tax increase reduces consumption and therefore $PE$:

\[ \Delta C = -MPC \times \Delta T \]

...so firms reduce output, and income falls toward a new equilibrium

At $Y_1$, there is now an unplanned inventory buildup...

\[ PE_1 = Y_1 \]

\[ PE_2 = Y_2 \]
Solving for $\Delta Y$

$$\Delta Y = \Delta C + \Delta I + \Delta G$$

eq’m condition in changes

$$= \Delta C$$

$I$ and $G$ exogenous

$$= \text{MPC} \times (\Delta Y - \Delta T)$$

Solving for $\Delta Y$:

$$(1 - \text{MPC}) \times \Delta Y = -\text{MPC} \times \Delta T$$

Final result:

$$\Delta Y = \left( \frac{-\text{MPC}}{1 - \text{MPC}} \right) \times \Delta T$$
The tax multiplier

def: the change in income resulting from a $1 increase in $T$:

$$\frac{\Delta Y}{\Delta T} = \frac{-MPC}{1 - MPC}$$

If $MPC = 0.8$, then the tax multiplier equals

$$\frac{\Delta Y}{\Delta T} = \frac{-0.8}{1 - 0.8} = \frac{-0.8}{0.2} = -4$$
The tax multiplier

...is negative:
A tax increase reduces $C$, which reduces income.

...is greater than one (in absolute value):
A change in taxes has a multiplier effect on income.

...is smaller than the govt spending multiplier:
Consumers save the fraction $(1 - MPC)$ of a tax cut, so the initial boost in spending from a tax cut is smaller than from an equal increase in $G$. 
NOW YOU TRY
Practice with the Keynesian cross

- Use a graph of the Keynesian cross to show the effects of an increase in planned investment on the equilibrium level of income/output.
At $Y_1$, there is now an unplanned drop in inventory…

…so firms increase output, and income rises toward a new equilibrium.

$PE_1 = Y_1$

$PE_2 = Y_2$

$PE = C + I_1 + G$

$PE = C + I_2 + G$
The *IS* curve

def: a graph of all combinations of \( r \) and \( Y \) that result in goods market equilibrium

\( i.e. \) actual expenditure (output) = planned expenditure

The equation for the *IS* curve is:

\[
Y = C(Y - T) + I(r) + G
\]
Deriving the IS curve

\[ PE = Y \]

\[ PE = C + I(r_2) + G \]

\[ PE = C + I(r_1) + G \]

\[ r \rightarrow \Delta I \rightarrow PE \rightarrow Y \]

\[ Y_1 \rightarrow IS \rightarrow Y_2 \]

\[ Y_1 \rightarrow IS \rightarrow Y_2 \]
Why the *IS* curve is negatively sloped

- A fall in the interest rate motivates firms to increase investment spending, which drives up total planned spending \((PE)\).
- To restore equilibrium in the goods market, output (a.k.a. actual expenditure, \(Y\)) must increase.
The *IS* curve and the loanable funds model

(a) The L.F. model

(b) The *IS* curve
Fiscal Policy and the *IS* curve

- We can use the *IS-LM* model to see how fiscal policy (*G* and *T*) affects aggregate demand and output.

- Let’s start by using the Keynesian cross to see how fiscal policy shifts the *IS* curve…
Shifting the *IS* curve: $\Delta G$

At any value of $r$,
$\uparrow G \rightarrow \uparrow PE \rightarrow \uparrow Y$

...so the *IS* curve shifts to the right.

The horizontal distance of the *IS* shift equals

$\Delta Y = \frac{1}{1-\text{MPC}} \Delta G$
NOW YOU TRY

Shifting the IS curve: $\Delta T$

- Use the diagram of the Keynesian cross or loanable funds model to show how an increase in taxes shifts the IS curve.
- If you can, determine the size of the shift.
ANSWERS

Shifting the IS curve: $\Delta T$

At any value of $r$,
$\uparrow T \rightarrow \downarrow C \rightarrow \downarrow PE$

...so the IS curve shifts to the left.

The horizontal distance of the IS shift equals

$$\Delta Y = -\frac{MPC}{1-MPC} \Delta T$$
The theory of liquidity preference

- Due to John Maynard Keynes.
- A simple theory in which the interest rate is determined by money supply and money demand.
Money supply

The supply of real money balances is fixed:

\[
(M/P)^s = \frac{\bar{M}}{\bar{P}}
\]
Money demand

Demand for real money balances:

\[(M/P)^d = L(r)\]
Equilibrium

The interest rate adjusts to equate the supply and demand for money:

\[
\frac{\bar{M}}{\bar{P}} = L(r)
\]
How the Fed raises the interest rate

To increase $r$, Fed reduces $M$

$\frac{M}{P}$

$r$

interest rate

$L(r)$

real money balances

$\frac{M_2}{P}$

$\frac{M_1}{P}$
CASE STUDY: Monetary Tightening & Interest Rates

- Late 1970s: \( \pi > 10\% \)
- Oct 1979: Fed Chairman Paul Volcker announces that monetary policy would aim to reduce inflation
- Aug 1979–April 1980: Fed reduces \( M/P \) 8.0%
- Jan 1983: \( \pi = 3.7\% \)

How do you think this policy change would affect nominal interest rates?
Monetary Tightening & Interest Rates, cont.

The effects of a monetary tightening on nominal interest rates

<table>
<thead>
<tr>
<th></th>
<th>short run</th>
<th>long run</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>model</strong></td>
<td>liquidity preference (Keynesian)</td>
<td>Quantity theory, Fisher effect (Classical)</td>
</tr>
<tr>
<td><strong>prices</strong></td>
<td>sticky</td>
<td>flexible</td>
</tr>
<tr>
<td><strong>prediction</strong></td>
<td>$\Delta i &gt; 0$</td>
<td>$\Delta i &lt; 0$</td>
</tr>
<tr>
<td><strong>actual outcome</strong></td>
<td>8/1979: $i = 10.4%$</td>
<td>8/1979: $i = 10.4%$</td>
</tr>
<tr>
<td></td>
<td>4/1980: $i = 15.8%$</td>
<td>1/1983: $i = 8.2%$</td>
</tr>
</tbody>
</table>
The *LM* curve

Now let’s put $Y$ back into the money demand function:

$$\left(\frac{M}{P}\right)^d = L(r,Y)$$

The *LM* curve is a graph of all combinations of $r$ and $Y$ that equate the supply and demand for real money balances.

The equation for the *LM* curve is:

$$\frac{\bar{M}}{\bar{P}} = L(r,Y)$$
Deriving the $LM$ curve

(a) The market for real money balances

(b) The $LM$ curve

The market for real money balances

$L(r, Y_2)$

$L(r, Y_1)$

$r_1$ to $r_2$

$M/P$

$M_1/P$

$r$

$Y_1$ to $Y_2$

$r$

$r_1$ to $r_2$
Why the $LM$ curve is upward sloping

- An increase in income raises money demand.
- Since the supply of real balances is fixed, there is now excess demand in the money market at the initial interest rate.
- The interest rate must rise to restore equilibrium in the money market.
How $\Delta M$ shifts the $LM$ curve

(a) The market for real money balances

(b) The $LM$ curve
Suppose a wave of credit card fraud causes consumers to use cash more frequently in transactions.

Use the liquidity preference model to show how these events shift the $LM$ curve.
ANSWERS
Shifting the $LM$ curve

(a) The market for real money balances

(b) The $LM$ curve
The short-run equilibrium

The short-run equilibrium is the combination of $r$ and $Y$ that simultaneously satisfies the equilibrium conditions in the goods & money markets:

$$Y = C(Y - \bar{T}) + I(r) + \bar{G}$$

$$\frac{\bar{M}}{\bar{P}} = L(r, Y)$$
The Big Picture

Keynesian cross

Theory of liquidity preference

IS curve

LM curve

IS-LM model

Agg. demand curve

Agg. supply curve

Model of Agg. Demand and Agg. Supply

Explanation of short-run fluctuations
Preview of Chapter 12

In Chapter 12, we will

- use the *IS-LM* model to analyze the impact of policies and shocks.
- learn how the aggregate demand curve comes from *IS-LM*.
- use the *IS-LM* and *AD-AS* models together to analyze the short-run and long-run effects of shocks.
- use our models to learn about the Great Depression.
CHAPTER SUMMARY

1. Keynesian cross
   - basic model of income determination
   - takes fiscal policy & investment as exogenous
   - fiscal policy has a multiplier effect on income

2. IS curve
   - comes from Keynesian cross when planned investment depends negatively on interest rate
   - shows all combinations of \( r \) and \( Y \) that equate planned expenditure with actual expenditure on goods & services
CHAPTER SUMMARY

3. Theory of liquidity preference
   - basic model of interest rate determination
   - takes money supply & price level as exogenous
   - an increase in the money supply lowers the interest rate

4. $LM$ curve
   - comes from liquidity preference theory when money demand depends positively on income
   - shows all combinations of $r$ and $Y$ that equate demand for real money balances with supply
5. IS-LM model

- Intersection of IS and LM curves shows the unique point \((Y, r)\) that satisfies equilibrium in both the goods and money markets.