4 Theory of Economic Fluctuations

4.1 Business Cycles
4.2 The IS-LM model
4.3 The AD-AS model
4.4 (Neo-) Classical Models of Fluctuations,
4.5 (New-) Keynesian Models of Fluctuations
PART 4.2 The IS-LM Model

- The **Keynesian Cross**
- The **IS Curve**: Equilibrium in the Goods Market
- The **LM Curve**: Asset Market Equilibrium
- Equilibrium in the Complete IS-LM Model

IS-LM is the basis of the aggregate demand curve.

We assume the **price level is fixed** (SRAS curve is horizontal).

We also assume a **closed economy**.
Short-Run vs. Long-Run Analysis

**Long run:**
- Prices $P$ flexible
- Output determined by factors of production & technology
- Unemployment equals its natural rate

**Short run:**
- Prices $P$ fixed
- Output determined by aggregate demand
- Unemployment negatively related to output

IS-LM model determines income $Y$ and the interest rate $r$ when $P$ is fixed

IS-LM therefore focuses on **short-run** analysis.
Keynesian Cross

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

- Notation:

  \[ I = \text{planned investment} \]

  \[ E = C + I + G = \text{planned expenditure} \]

  \[ Y = \text{real GDP} = \text{actual expenditure} \]

- Difference between actual and planned expenditure = unplanned inventory investment
Elements of The Keynesian Cross

- Consumption Function:
  \[ C = C^a + MPC \times (Y - T), 0 < MPC < 1 \]
- Investment: exogenous for now
  \[ I = \bar{I} \]
- Government: exogenous
  \[ G = \bar{G}, T = \bar{T} \]

So planned expenditure
\[ E = C^a + MPC \times (Y - \bar{T}) + \bar{I} + \bar{G} \]

Goods Market Equilibrium Condition:

actual expenditure = planned expenditure
\[ Y = E \]

Note: this is the same as saying that savings must equal planned investment:
\[ (Y - \bar{T} - C) + (\bar{T} - \bar{G}) = \bar{I} \]
Planned expenditure, $E = C(Y - T) + I + G$

**Diagram:**
- Planned expenditure, $E$
- Income, output, $Y$
- MPC
- $1$
Expenditure, $E$

Actual expenditure

Planned expenditure

Unplanned drop in inventory causes income to rise.

Unplanned inventory accumulation causes income to fall.

Equilibrium income

Income, output, $Y$

$Y_1$

$E_1$

$E_2$

$Y_2$

$45^\circ$
An Increase in Government Spending

1. An increase in government purchases shifts planned expenditure upward, ...

2. ...which increases equilibrium income.
Solving for $\Delta Y$

$Y = C + I + G$  \hspace{1cm} \text{(equilibrium condition)}

$\Delta Y = \Delta C + \Delta I + \Delta G$  \hspace{1cm} \text{(in changes)}

$= \Delta C + \Delta G$  \hspace{1cm} \text{(I is exogenous)}

$= MPC \times \Delta Y + \Delta G$  \hspace{1cm} \text{(using consumption function)}

After solving for $\Delta Y$:

$\Delta Y = \frac{\Delta G}{1 - MPC}$
Solving for $\Delta Y$

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

Suppose $MPC = 0.8$ then a 1$ increase in $G$ leads to a $\frac{1}{1-0.8} = 5$ increase in income!

$$\frac{\Delta Y}{\Delta G} = \frac{1}{1-MPC}$$ is the government spending multiplier.
An Decrease in Taxes

1. A tax cut shifts planned expenditure upward, ...

2. ...which increases equilibrium income.

Expenditure, $E$

$E_2 = Y_2$

$E_1 = Y_1$

$\Delta Y$

Income, output, $Y$

$\Delta Y$

$E_1 = Y_1$

$E_2 = Y_2$

Actual expenditure

Planned expenditure

MPC $\times$ $\Delta T$
Solving for $\Delta Y$

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

Suppose $MPC = 0.8$ then a 1$ decrease in $T$ leads to a
$$\frac{0.8}{1-0.8} = 4$$ increase in income!

$$\frac{\Delta Y}{\Delta T} = -\frac{MPC}{1-MPC}$$ is the **tax multiplier**.

The tax multiplier is

- **negative**: A tax increase reduces $C$, which reduces income.
- **greater than one** (in absolute value) if $MPC > 0.5$: A change in taxes has a multiplier effect on income
- **smaller than the government 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 $G$. 
The IS-Curve

Recall that consumption and investment also depended on the interest rate:

\[ Y = C^a(\bar{r}) + MPC \times (Y - \bar{T}) + I(\bar{r}) + \bar{G} \]

The IS-curve: a graph of all combinations of \( r \) and \( Y \) that result in goods market equilibrium, i.e. actual expenditure (output) equals planned expenditure or equivalently, savings equals planned investment

\[ Y = \frac{1}{1 - MPC} \left( C^a(\bar{r}) - MPC \times \bar{T} + I(\bar{r}) + \bar{G} \right) \]
The Slope of the IS-Curve

Why does the IS-curve have a negative slope?

Intuition from the Keynesian Cross:

- A fall in the interest rate motivates firms to increase investment spending, which drives up total planned spending \( E \).
- A fall in the interest rate motivates households to increase consumption spending because of the wealth effect, which drives up total planned spending \( E \).

To restore equilibrium in the goods market, output must increase.
3. ...which shifts planned expenditure downward...

4. ...and lowers income.

5. The IS curve summarizes these changes in the goods market equilibrium.
The Slope of the IS-Curve

Why does the IS-curve have a negative slope?

Intuition from Savings = Investment:

- An increase in income increases private saving by $1 - MPC > 0$. The saving curve shifts to the right.

To restore equilibrium in the goods market, the interest rate must decrease.

Either way of looking at it yields the same result: The IS curve is downward sloping.
The Slope of the IS-Curve

\[ Y = \frac{1}{1 - MPC} \left( C^a(\bar{r}) - MPC \times \bar{T} + I(\bar{r}) + \bar{G} \right) \]

Taking the total differential of this expression:

\[ dY = -\frac{C^a_r}{1 - MPC} dr - \frac{MPC}{1 - MPC} dT - \frac{l_r}{1 - MPC} dr + \frac{1}{1 - MPC} dG \]

Notation: \( C^a_r = -\frac{\partial C^a}{\partial r} > 0 \), \( l_r = -\frac{\partial l}{\partial r} > 0 \)

We can use this to obtain the slope of the IS-curve in \((Y,r)\)-space by setting all infinitesimals to zero except \(dr\) and \(dY\):

\[ \frac{\partial r}{\partial Y} \bigg|_{IS} = -\frac{1 - MPC}{l_r + C^a_r} < 0 \]
Shifting IS-Curve:

\[ dY = -\frac{C_a}{1 - MPC} dr - \frac{MPC}{1 - MPC} dT - \frac{I_r}{1 - MPC} dr + \frac{1}{1 - MPC} dG \]

**Government spending multiplier:**

\[ \frac{\partial Y}{\partial G} \big|_{IS} = \frac{1}{1 - MPC} > 0 \]

**Tax multiplier:**

\[ \frac{\partial Y}{\partial T} \big|_{IS} = -\frac{MPC}{1 - MPC} < 0 \]
(a) Desired national saving, $S^d$, and desired investment, $I^d$.

(b) Increase in $G$.
The LM-Curve

Recall **money demand** equation: \( M^d = PL(Y, i) \), where \( i \) is the nominal interest rate.

**Money supply** is \( M^s = M \), determined by the central bank.

The **LM-curve** is a graph of all combinations of \( r \) and \( Y \) that equate the supply and demand for real money balances, i.e.

\[
m \equiv \frac{M}{P} = L(Y, r + \pi^e)
\]

where we used the **Fisher equation** \( i = r + \pi^e \) and \( m \) to denote real money balances.
The Slope of the LM-Curve

Why does the LM curve have a positive slope?

- 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.
(a) Real money supply, $M_d/P$, and real money demand, $M_d/P$.

(b) Real interest rate, $r$.
The Slope of the LM-Curve

\[ m = L(Y, r + \pi^e) \]

Taking the total differential of this expression:

\[ dm = L_y dY - L_r dr - L_r d\pi^e \]

Notation: \( L_y = \frac{\partial L}{\partial Y} > 0, \quad L_r = -\frac{\partial L}{\partial r} > 0 \)

We can use this to obtain the slope of the LM-curve in \((Y, r)\)-space by setting all infinitesimals to zero except \(dr\) and \(dY\):

\[ \left. \frac{\partial r}{\partial Y} \right|_{LM} = \frac{L_y}{L_r} > 0 \]
Shifts in the LM-Curve

As before
\[ dm = L_y dY - L_r dr - L_r d\pi^e \]

**Monetary Policy:** \[ dm = \frac{1}{P} dM + M dP, \text{ but keeping } P \text{ fixed, } dP = 0: \]
\[ \frac{\partial Y}{\partial M} \bigg|_{LM} = \frac{1}{PL_y} > 0 \]

**Expected Inflation:**
\[ \frac{\partial Y}{\partial \pi^e} \bigg|_{LM} = \frac{L_r}{L_y} > 0 \]
A monetary expansion that increases $m$
An increase in money demand (e.g. a decrease in $\pi^e$)
The IS-LM model

The short-run equilibrium (i.e. keeping P fixed) in the ISLM model is the combination of $r$ and $Y$ that simultaneously satisfies the equilibrium conditions in the goods and money markets.

Graphically, the short-run equilibrium occurs at the intersection of the IS and LM curve.

We can use the IS-LM model to analyze the effects of shocks, fiscal policy, and monetary policy.
An Increase in $\bar{G}$ Graphically

1. The IS curve shifts to the right by $\Delta G/(1 - MPC)$, ...

2. ... which raises income ...

3. ... and the interest rate.
An Increase in $\bar{G}$ Analytically

\[ dY = -\left[ \frac{C^a_t + I_r}{1 - MPC} \right] dr - \frac{MPC}{1 - MPC} dT + \frac{1}{1 - MPC} dG \]  \hspace{1cm} \text{(IS-curve)}

\[ dm = L_y dY - L_r dr - L_r d\pi^e \]  \hspace{1cm} \text{(LM-curve)}

Government spending increase $dG > 0$, all else equal means $dm = 0, dT = 0, d\pi^e = 0$:

\[ dY = -\left[ \frac{C^a_t + I_r}{1 - MPC} \right] dr + \frac{1}{1 - MPC} dG \]  \hspace{1cm} \text{(IS-curve)}

\[ 0 = L_y dY - L_r dr \]  \hspace{1cm} \text{(LM-curve)}

Solving for $dY/dG$:

\[ \frac{dY}{dG} = \frac{1}{(1 - MPC) + (C^a_t + I_r) \frac{L_y}{L_r}} > 0 \]
A Decrease in $\bar{T}$

1. The IS curve shifts to the right by $\Delta T \times \frac{MPC}{1 - MPC}$.

2. ... which raises income ...

3. ... and the interest rate.
A Decrease in $\bar{T}$ Analytically

$$dY = - \left[ \frac{C_r + I_r}{1 - MPC} \right] dr - \frac{MPC}{1 - MPC} dT + \frac{1}{1 - MPC} dG$$  \hspace{1cm} \text{(IS-curve)}

$$dm = L_y dY - L_r dr - L_r d\pi^e$$  \hspace{1cm} \text{(LM-curve)}

Tax cut means $dT < 0$, all else equal means $dm = 0, dG = 0, d\pi^e = 0$:

$$dY = - \left[ \frac{C_r + I_r}{1 - MPC} \right] dr - \frac{MPC}{1 - MPC} dT$$  \hspace{1cm} \text{(IS-curve)}

$$0 = L_y dY - L_r dr$$  \hspace{1cm} \text{(LM-curve)}

Solving for $dY/dT$:

$$\frac{dY}{dT} = - \frac{MPC}{(1 - MPC) + (C_r + I_r) \frac{L_y}{L_r}} < 0$$
A Monetary Expansion

1. An increase in the money supply shifts the LM curve downward, ...

2. ... which raises income ...

3. ... and lowers the interest rate.
A Monetary Expansion Analytically

\[ dY = - \left[ \frac{C_r^a + I_r}{1 - MPC} \right] dr - \frac{MPC}{1 - MPC} dT + \frac{1}{1 - MPC} dG \]  
(IS-curve)

\[ dm = L_y dY - L_r dr - L_r d\pi^e \]  
(LM-curve)

Monetary expansion means \( dM > 0 \) and \( dm = \frac{1}{P} dM \) if prices are fixed \( (dP = 0) \), all else equal means \( dT = 0, dG = 0, d\pi^e = 0 \):

\[ dY = - \left[ \frac{C_r^a + I_r}{1 - MPC} \right] dr \]  
(IS-curve)

\[ \frac{1}{P} dM = L_y dY - L_r dr \]  
(LM-curve)

Solving for \( dY/dM \):

\[ \frac{dY}{dM} = \frac{\frac{1}{P} L_r (C_r^a + I_r)}{(1 - MPC) + (C_r^a + I_r) \frac{L_y}{L_r}} > 0 \]
<table>
<thead>
<tr>
<th>An increase in</th>
<th>Shifts the IS curve</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected future output</td>
<td>Up and to the right</td>
<td>Desired saving falls (desired consumption rises), raising the real interest rate that clears the goods market.</td>
</tr>
<tr>
<td>Wealth</td>
<td>Up and to the right</td>
<td>Desired saving falls (desired consumption rises), raising the real interest rate that clears the goods market.</td>
</tr>
<tr>
<td>Government purchases, $G$</td>
<td>Up and to the right</td>
<td>Desired saving falls (demand for goods rises), raising the real interest rate that clears the goods market.</td>
</tr>
<tr>
<td>Taxes, $T$</td>
<td>No change or down and to the left</td>
<td>No change, if consumers take into account an offsetting future tax cut and do not change consumption (Ricardian equivalence); down and to the left, if consumers don’t take into account a future tax cut and reduce desired consumption, increasing desired national saving and lowering the real interest rate that clears the goods market.</td>
</tr>
<tr>
<td>Expected future marginal product of capital, $MPK^f$</td>
<td>Up and to the right</td>
<td>Desired investment increases, raising the real interest rate that clears the goods market.</td>
</tr>
<tr>
<td>Effective tax rate on capital</td>
<td>Down and to the left</td>
<td>Desired investment falls, lowering the real interest rate that clears the goods market.</td>
</tr>
</tbody>
</table>
## Factors That Shift the $LM$ Curve

<table>
<thead>
<tr>
<th>An increase in</th>
<th>Shifts the $LM$ curve</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal money supply, $M$</td>
<td>Down and to the right</td>
<td>Real money supply increases, lowering the real interest rate that clears the asset market (equates money supplied and money demanded).</td>
</tr>
<tr>
<td>Price level, $P$</td>
<td>Up and to the left</td>
<td>Real money supply falls, raising the real interest rate that clears the asset market.</td>
</tr>
<tr>
<td>Expected inflation, $\pi^e$</td>
<td>Down and to the right</td>
<td>Demand for money falls, lowering the real interest rate that clears the asset market.</td>
</tr>
<tr>
<td>Nominal interest rate on money, $i^m$</td>
<td>Up and to the left</td>
<td>Demand for money increases, raising the real interest rate that clears the asset market.</td>
</tr>
</tbody>
</table>

In addition, for constant output, any factor that increases real money demand raises the real interest rate that clears the asset market and shifts the $LM$ curve up and to the left. Other factors that increase real money demand (see Summary table 9, p. 260) include:

- an increase in wealth;
- an increase in the risk of alternative assets relative to the risk of holding money;
- a decline in the liquidity of alternative assets; and
- a decline in the efficiency of payment technologies.
What happens to $Y$ and $r$ if

- There is an expected future technology improvement?
- People expect higher future inflation?
- There is a stock market boom that makes consumers wealthier?
- After a wave of credit card fraud, consumers use cash more frequently in transactions?