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
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).
The Keynesian cross

- A simple closed-economy model in which income is determined by expenditure.
- 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: \[ G = \bar{G}, \quad T = \bar{T} \]
- Planned investment: \[ I = \bar{I} \]
- Planned expenditure: \[ PE = C(Y - \bar{T}) + \bar{I} + \bar{G} \]

Equilibrium condition:

Actual expenditure = Planned expenditure
\[ Y = PE \]
Graphing planned expenditure

\[ PE = C + I + G \]

Income, output, \( Y \)

Planned expenditure, \( PE \)
Graphing the equilibrium condition

\[ PE = Y \]

planned expenditure

income, output, \( Y \)

\( 45^\circ \)
The equilibrium value of income

Equilibrium income

Planned expenditure

\[ PE = Y \]

\[ PE = C + I + G \]
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.

$PE_1 = Y_1$

$PE_2 = Y_2$

$\Delta G$

$\Delta Y$
Solving for $\Delta Y$

\[ Y = C + I + G \]

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

$= \Delta C + \Delta G$

$= \text{MPC} \times \Delta Y + \Delta G$

because $\Delta C = \text{MPC} \Delta Y$


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

$\Delta Y = \left( \frac{1}{1 - \text{MPC}} \right) \times \Delta G$

Solve for $\Delta Y$:
The government spending multiplier

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

In this model, the government purchases multiplier equals

\[ \frac{\Delta Y}{\Delta G} = \frac{1}{1 - MPC} \]

Example: If $MPC = 0.8$, 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 one?

- 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 $PE$:

$\Delta C = -\text{MPC} \Delta T$

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

At $Y_1$, there is now an unplanned inventory buildup...
Solving for $\Delta Y$

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

= $\Delta C$

= MPC $\times (\Delta Y - \Delta T)$

Solving for $\Delta Y$:

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

Final result:

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

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

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

If $\text{MPC} = 0.8$, 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 government spending multiplier:
Consumers save the fraction $(1 - \text{MPC})$ 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

Definition: 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

\[ r \downarrow \Rightarrow I \uparrow \]
\[ \Rightarrow PE \uparrow \]
\[ \Rightarrow Y \uparrow \]
Why the IS curve is negatively sloped?

- A fall in the interest rate ($r$) motivates firms to increase investment spending, which drives up total planned spending ($PE$).

- To restore equilibrium in the goods market, output ($Y$) must increase.
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

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

\[ PE = C + I_1(r) + G_2 \]
\[ PE = C + I_1(r_1) + G_1 \]
The $LM$ curve

- **Definition:** Graph of all combinations of $r$ and $Y$ that equate the supply and demand for real money balances.
- **Theory of liquidity (L) preference.**
- **The equation for the $LM$ curve is:**

$$\frac{\bar{M}}{\bar{P}} = L(r, Y)$$
Money supply

The supply of real money balances is fixed:

\[
(M/P)^s = \bar{M}/\bar{P}
\]
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:

\[ \frac{M}{P} = L(r) \]
To increase $r$, Fed reduces $M$. 

**Diagram:**

- $r$: Interest rate
- $L(r)$: Demand for real balances function
- $M/P$: Real money balances
- $M_1/P$, $M_2/P$: Real money balances at interest rates $r_1$, $r_2$
The *LM* curve

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

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

and derive the *LM* curve.
Deriving the \( LM \) curve

(a) Market for real money balances

(b) The \( LM \) curve
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) 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:
The Big Picture

- Keynesian cross
- Theory of liquidity preference
- IS curve
- LM curve
- IS-LM model
- Agg. demand curve
- Agg. supply curve
- Explanation of short-run fluctuations

Model of Agg. Demand and Agg. Supply