Unit 7
Building the IS-LM Model

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Learning Objectives

- the IS curve, and its relation to the Keynesian cross

- the LM curve, and its relation to the theory of liquidity preference

- how the IS-LM model determines income/output and the interest rate in the short run when P is fixed

Contents

1. The IS curve
2. The LM curve
3. The Equilibrium in goods and money markets
4. Impact of fiscal and monetary policy under IS-LM Model

The IS – LM Model

- IS–LM model, or Hicks–Hansen model, is a two-dimensional macroeconomic tool that shows the relationship between interest rates and real output in goods and services market.
  - The model was created, developed and taught by J. M. Keynes. However, it is often believed that John Hicks invented it in 1937, and was later extended by Alvin Hansen.
- IS: Investment – Saving
- LM: Liquidity preference – Money supply

Building the IS Curve

- IS curve Relationship between aggregate output and the interest rate in the goods market.

- The IS curve represents various combinations of interest and income/output along which the goods market is in equilibrium.
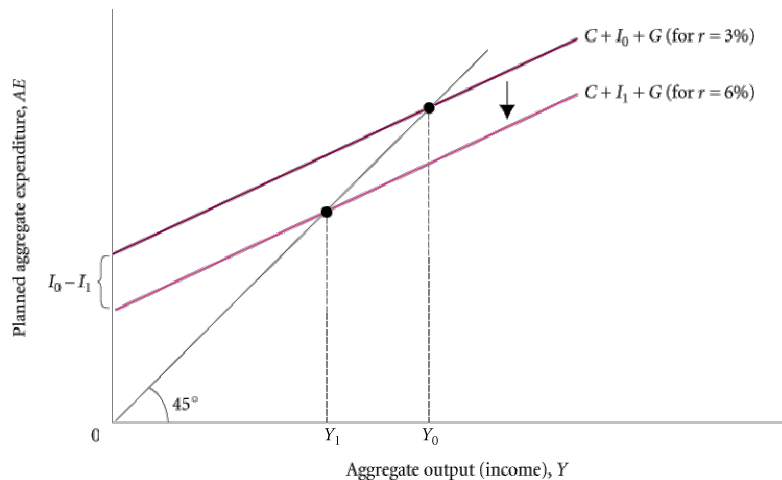
The Effect of an Interest Rate Change on Planned Aggregate Expenditure and Equilibrium Output

- A high interest rate (r) discourages planned investment (I).

- Planned investment is a part of planned aggregate expenditure (AE).

- Thus, when the interest rate rises, planned aggregate expenditure (AE) at every level of income falls.

- Finally, a decrease in planned aggregate expenditure lowers equilibrium output (income) (Y) by a multiple of the initial decrease in planned investment.

The Effect of an Interest Rate Increase on Planned Aggregate Expenditure and Equilibrium Output

An increase in the interest rate from 3 percent to 6 percent lowers planned aggregate expenditure and thus reduces equilibrium output from Y_0 to Y_1.

The Effect of an Interest Rate Change on Planned Aggregate Expenditure and Equilibrium Output
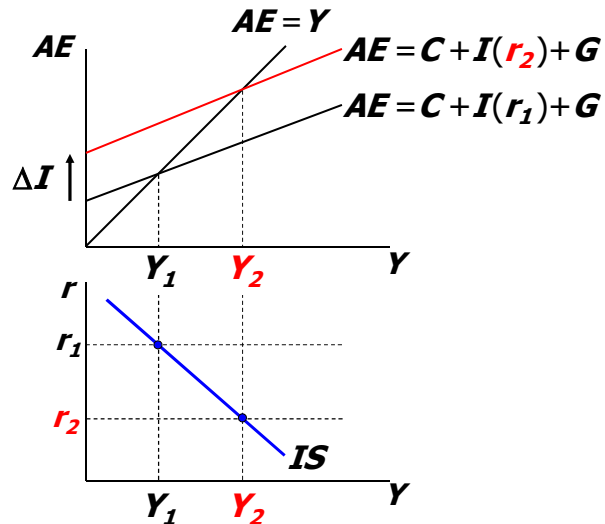
- Using a convenient shorthand:

$$r \uparrow \rightarrow I \downarrow \rightarrow AE \downarrow \rightarrow Y \downarrow$$

$$r \downarrow \rightarrow I \uparrow \rightarrow AE \uparrow \rightarrow Y \uparrow$$

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Deriving the IS curve

$\downarrow r \implies \uparrow I$

$\implies \uparrow AE$

$\implies \uparrow Y$

AE

$AE = Y$

$AE = C + I(r_2) + G$

$AE = C + I(r_1) + G$

ΔI

Y_1 Y_2 Y

r

r_1

r_2

IS

Y_1 Y_2 Y

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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 (AE).

- To restore equilibrium in the goods market, output (a.k.a. actual expenditure, Y) must increase.

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Construct IS Function

Components of Keynesian Cross Model:

$$C = C_0 + mpcY_D$$
$$\color{red}{I = I_0 + I_r r}$$
$$G = G_0$$
$$T = T_0$$

$$AE = C_0 + mpc(Y - T_0) + I_0 + I_r r + G_0$$
$$AE = [C_0 + I_0 + G_0 - mpc\,T_0] + mpcY + I_r r$$

At equilbrium in good market: $Y = AE$

$$\rightarrow IS:\ Y = \frac{[C_0 + I_0 + G_0 - mpcT_0] + I_r r}{1 - mpc}$$

An economy:
Good Market
$C = 200 + 0.8\,(Y - T)$
$I = 100 - 500r$
$G = 80$
$T = 80$
Find the IS function?

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.

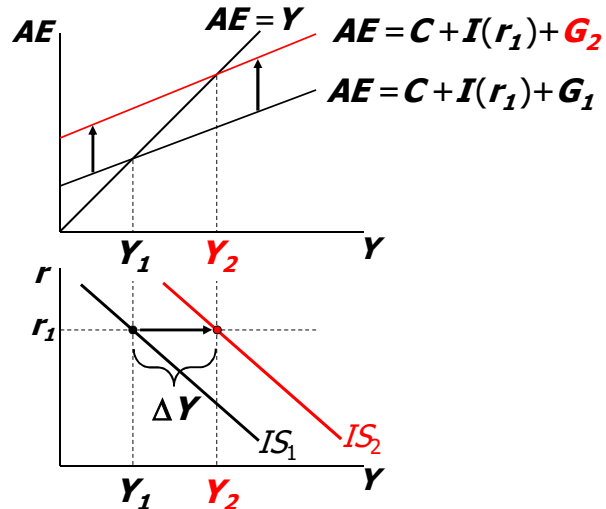- Let's start by using the Keynesian cross to see how fiscal policy shifts the IS curve…

Shifting the IS curve: ΔG

At any value of r,

$\uparrow G \Rightarrow \uparrow AE \Rightarrow \uparrow Y$

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

The horizontal distance of the *IS* shift equals

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

AE

$AE = Y$

$AE = C + I(r_1) + G_2$

$AE = C + I(r_1) + G_1$

$Y_1 \quad Y_2$

Y

r

r_1

ΔY

$IS_1 \quad IS_2$

$Y_1 \quad Y_2 \quad Y$

Exercise: Shifting the IS curve

- Use the diagram of the Keynesian cross to show how an increase in taxes shifts the IS curve.

Developing LM curve

- The LM curve shows the combinations of interest rates and levels of real income for which the money market is in equilibrium.

- At $Y_1 \rightarrow M_1^D = C_M - c_r r + c_Y Y_1 \rightarrow M^S = M_1^D \rightarrow equilbrium\ r_1$
- At $Y_2 \rightarrow M_2^D = C_M - c_r r + c_Y Y_2 \rightarrow M^S = M_2^D \rightarrow equilbrium\ r_2$
- $Y_2 > Y_1$ ....then .... $r_2 > r_1$

Deriving the *LM* curve

(a) The money market   (b) The *LM* curve
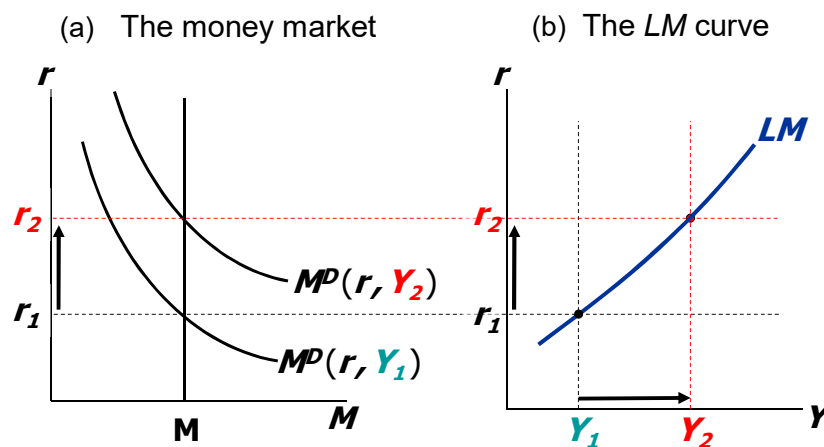
Why the *LM* curve is upward sloping?

- An increase in income raises money demand.

- Since the supply of money 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.

Contruct LM Function

- $M^D = C_M - c_r r + c_Y Y$

- $M^S = M1$

- $M^S = M^D \rightarrow M1 = C_M - c_r r + c_Y Y$
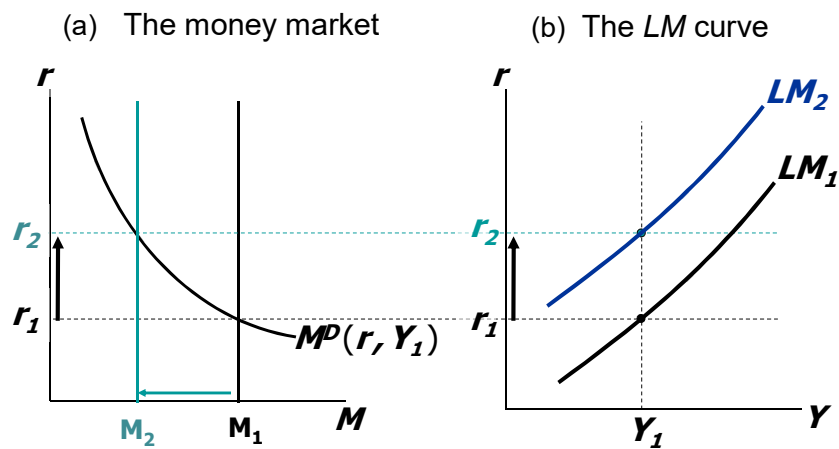
$\rightarrow$ LM: $r = \dfrac{(C_M - M1) + c_Y Y}{c_r}$

An economy:
Money market
MD = 200 − 300r + 0.3Y
MS = 650
Find the LM function?

How ΔM shifts the *LM* curve

(a) The money market

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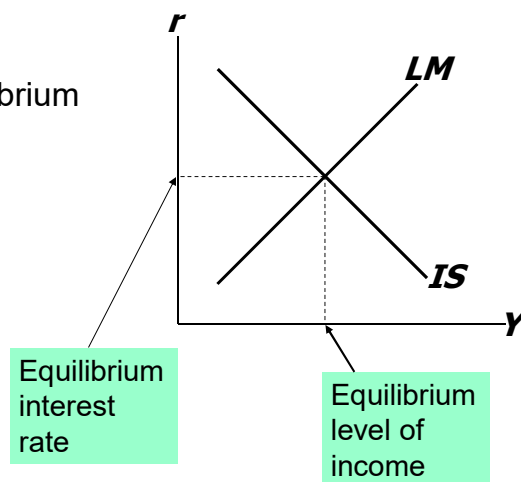
The short-run equilibrium

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

$Y = AE \rightarrow Y = C + I(r) + G$

$M^S = M^D \rightarrow M^S = C_M - c_r r + c_Y Y$

Equilibrium interest rate

Equilibrium level of income

Find Equilibrium Interest Rate and Income?

Good Market
$C = 200 + 0.8 (Y - T)$
$I = 100 - 500r$
$G = 80$
$T = 80$
IS: …………
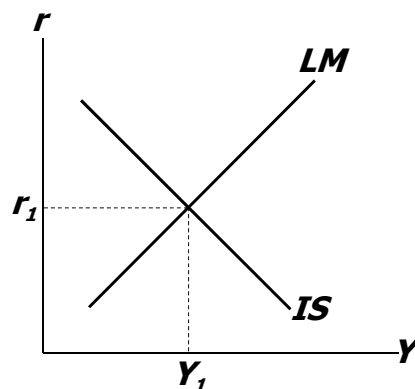
Money market
$MD = 200 - 300r + 0.3Y$
$MS = 650$
LM: ……………

Policy analysis with the *IS-LM* model

We can use the *IS-LM* model to analyze the effects of

- fiscal policy: **G** and/or **T**
- monetary policy: **M**

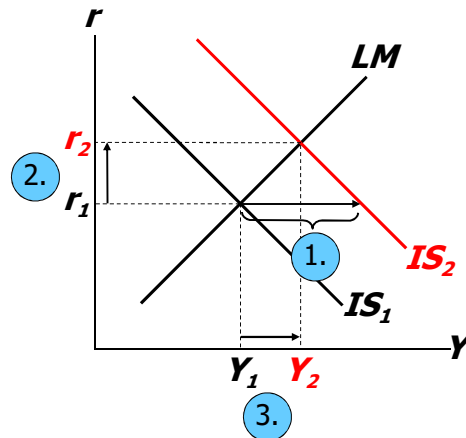# An increase in government purchases

1. *IS* curve shifts right
   by $\dfrac{1}{1-\text{MPC}}\,\Delta \boldsymbol{G}$
   causing output & income to rise.

2. This raises money demand, causing the interest rate to rise…

3. …which reduces investment, so the final increase in $\boldsymbol{Y}$
   is smaller than $\dfrac{1}{1-\text{MPC}}\,\Delta \boldsymbol{G}$

r

LM

r_2

r_1
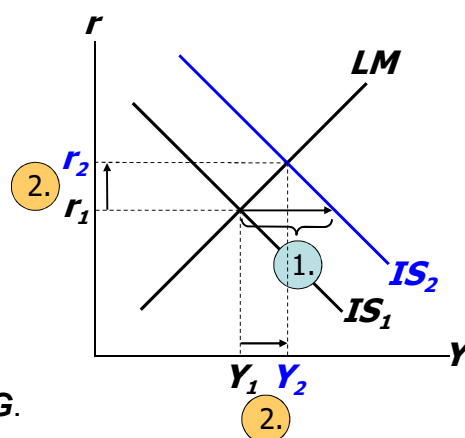
2.

1.

IS_2

IS_1

Y

Y_1 Y_2

3.

A tax cut

Consumers save $(1-MPC)$ of the tax cut, so the initial boost in spending is smaller for $\Delta \boldsymbol{T}$ than for an equal $\Delta \boldsymbol{G}$…

and the *IS* curve shifts by

1. $\dfrac{-\text{MPC}}{1-\text{MPC}}\,\Delta \boldsymbol{T}$

2. …so the effects on $\boldsymbol{r}$ and $\boldsymbol{Y}$ are smaller for $\Delta \boldsymbol{T}$ than for an equal $\Delta \boldsymbol{G}$.

r

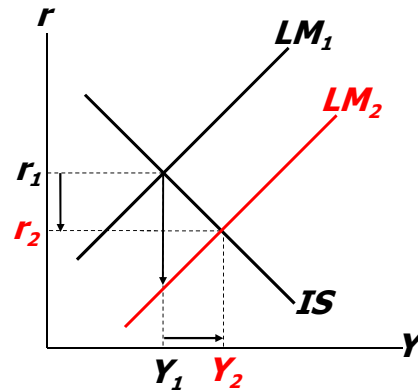LM

r_2

r_1

2.

1.

IS_2

IS_1

Y

Y_1 Y_2

2.

Monetary policy: An increase in *M*

1. $\Delta M > 0$ shifts the *LM* curve down (or to the right)

2. …causing the interest rate to fall

3. …which increases investment, causing output & income to rise.

Interaction between monetary & fiscal policy

- Model:
  Monetary & fiscal policy variables (*M*, *G,* and *T*) are exogenous.

- Real world:
  Monetary policymakers may adjust *M* in response to changes in fiscal policy, or vice versa.

- Such interaction may alter the impact of the original policy change.

The Central Bank's response to $\Delta G > 0$

- Suppose the government increases **G**.

- Possible central bank responses:
  1. hold **M** constant
  2. hold **r** constant
  3. hold **Y** constant

- In each case, the effects of the ΔG are different:
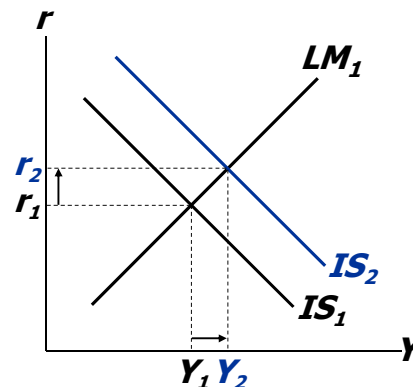
Response 1: Hold *M* constant

If the government raises **G**, the *IS* curve shifts right.

If central bank holds **M** constant, then *LM* curve doesn't shift.

Results:

$$\Delta Y = Y_2 - Y_1$$

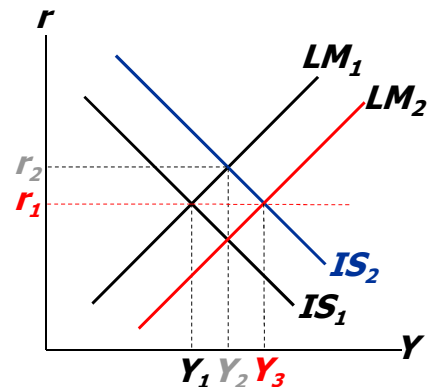$$\Delta r = r_2 - r_1$$

Response 2:   Hold r constant

If the government raises G,
the *IS* curve shifts right.

To keep r constant, central bank
increases M to shift *LM* curve right.

Results:

$$\Delta Y = Y_3 - Y_1$$
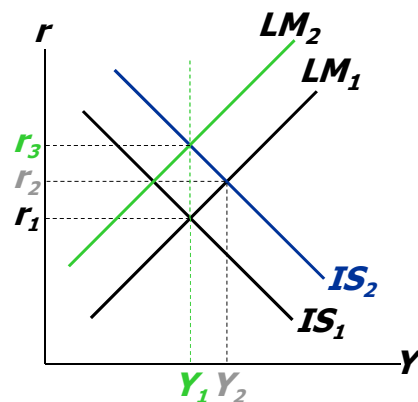
$$\Delta r = 0$$

Response 3:   Hold Y constant

If government raises G,
the *IS* curve shifts right.

To keep Y constant, central bank
reduces M to shift *LM* curve left.

Results:

$$\Delta Y = 0$$

$$\Delta r = r_3 - r_1$$

Estimates of fiscal policy multipliers
from the DRI macroeconometric model

Assumption about monetary policy	Estimated value of $\Delta Y/\Delta G$	Estimated value of $\Delta Y/\Delta T$
Fed holds money supply constant	0.60	−0.26
Fed holds nominal interest rate constant	1.93	−1.19

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Practice

Illustrate each of the following situations with a graph showing the IS – LM model, and explain what happens to the equilibrium values of the interest rate and output:

1. An increase in public spending by the government with the money supply held constant.

2. An increase in interest rates by the central bank to offset the effects of a reduction in taxation on prices.

3. An increase in the aggregate price level due to a rise in world energy prices. The central bank and the government do not react.

4. A decrease in the money supply due to inflationary pressures by the central bank in an attempt to keep the real money supply constant.

5. A decrease in public spending by the government with the interest rates held constant by the central bank.

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