EC313: Intermediate Macroeconomics

Chapter 5

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Chapter 5

Goods and Financial Markets; IS-LM Model

1. The Goods Markets: IS Relation
2. The Financial Market: LM Relation
3. Putting the IS and the LM Relations Together
4. Policy Mix

Today we will outline the famous **IS-LM** Model of short-run economic behavior

- This model was developed by John Maynard Keynes in his seminal work, the *General Theory, 1936*
- In 1937, John Hicks and Alvin Hansen began to formalize (mathematically and graphically) the concepts outlined by Keynes
- Until the mid 1970's, this was the model of **Short-Run** economic behavior used to quantify the effects of Fiscal and Monetary Policy

Defining the Short Run:

- The **Short Run** is a period of time over which **the price level is fixed**
- This means, in the **short run**, prices do not change
- Our analysis of both the goods market and the financial market have been performed in the short run.

We will combine the Goods Market and the Money Market to develop the **IS-LM** relationship

- Money Market model(interest rate - Money demand/money supply system): output (or production) of goods is exogenous and interest rates are endogenously determined

- Goods Market model (goods supply Y/ goods demand Z - income Y system): interest rates are exogenous and output (or production) of goods is determined endogenously

- by combining goods and money markets, we can simultaneously determine output output and interest rate in short run equilibrium!

The Goods Markets: IS Relation

Determining Output

Recall Chapter 3:

- Goods Market Equilibrium is given by Production = Income = Demand, or $Y = Z$.
- Demand Z is a function of Consumption $C(Y_D)$, Government Spending G, and Investment I, where Consumption is a function of Disposable Income $Y - T$.
- $$Z \equiv C(Y - T) + \bar{I} + G$$

Determining Output

$$Z \equiv C(Y - T) + \bar{I} + G$$

- investment $\bar{I}$ was assumed to be constant (exogenous)
    - the **interest rate** did not affect the demand for goods
- Our first task in this chapter is to abandon this simplification and introduce the interest rate in our model of equilibrium in the goods market.

- now, investment is no longer exogenous!

Determining Output

If sales are very high, will firms invest more or less in capital?

- They will invest more!
- therefore, if ignoring inventory investment, the level of sales equal to the level of production
- Investment is an **increasing** function of production Y

Determining Output

If the interest rate (the price firms pay to borrow money) is low, will firms invest more or less in capital?

- Firms will invest more if the cost of borrowing (i) is low!
- Investment is a **decreasing** function of the interest rate i
- investment I depends on production Y and the interest rate i:

$$I = I(Y, i)$$

- here, interest rate i as determined as in Chapter 4 (bonds/money market equilibrium)

Determining Output

$$Z = C(Y - T) + I(Y, i) + G$$

- Equilibrium in the goods market is given by $Z = Y$

$$Y = C(Y - T) + I(Y, i) + G$$

- this is known as the **IS-Relation**

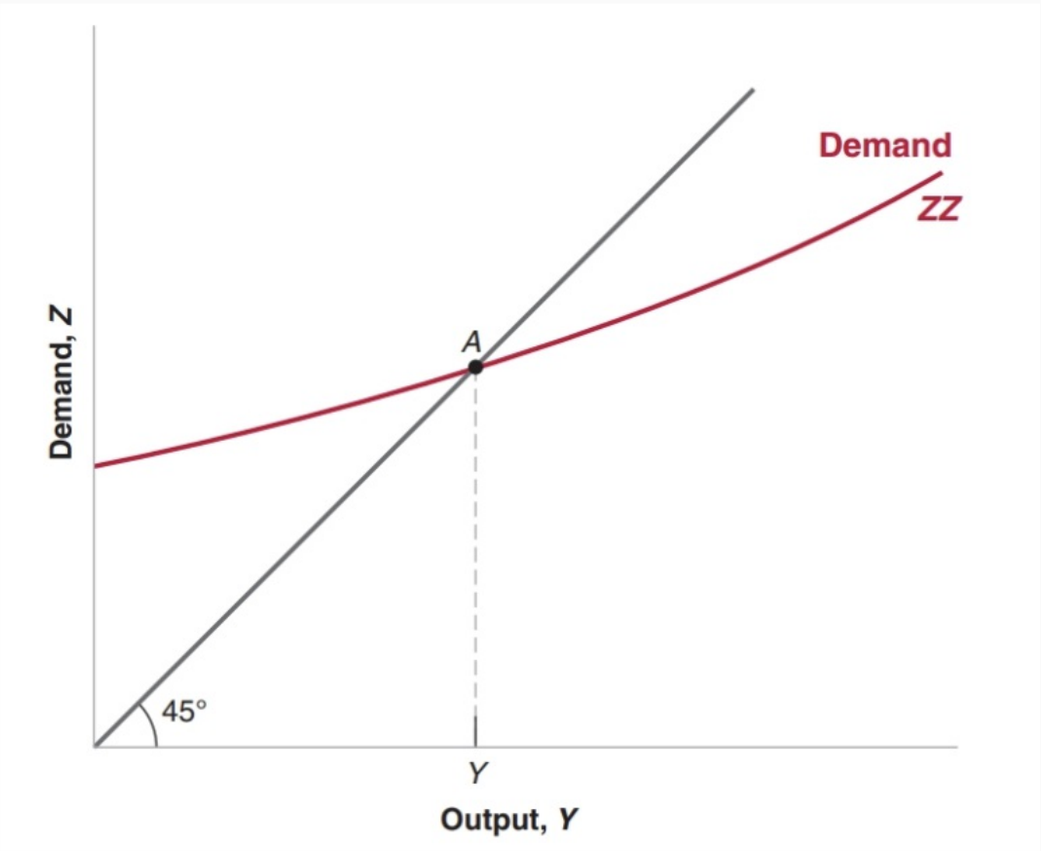
Determining Output

For a given level of i, demand $Z = C(Y - T) + I(Y, i) + G$ is an increasing function of output Y:

- output $Y \uparrow \implies$ income $Y \uparrow \implies$ disposable income $Y - T \uparrow \implies$ consumption $C(Y - T) \uparrow$ (recall chapter 3)
- output $Y \uparrow \implies$ Investment $I(Y, i) \uparrow$ (this is new in this chapter)
- in short, output $Y \uparrow \implies$ demand $Z \uparrow$

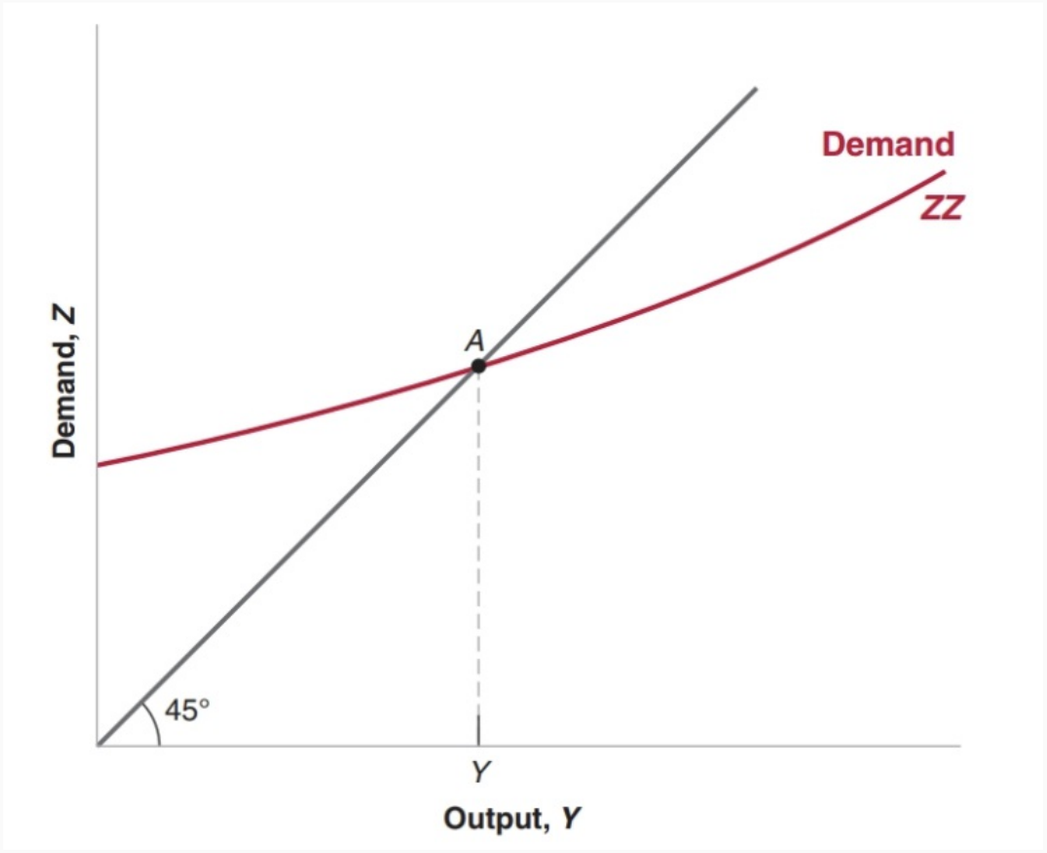
Determining Output

This relation between **demand** and **output**, **for a given interest rate**, is represented by the **upward-sloping** curve ZZ **flatter** than the 45-degree line



- Y on the horizontal axis and i on the vertical axis

Determining Output



- Equilibrium in the goods market: demand for goods equals output
- at point A: the intersection of ZZ and the 45-degree line
- Y: equilibrium level of output
- if we assume linearity for $C(Y - T)$ and $I(Y, i)$, ZZ will be a straight line

Determining Output

- **Chapter 3**: Demand Z was a linear function of output
- **Chapter 5**: Demand Z is not necessarily a linear function of output
- **Chapter 3**: The slope of ZZ is the marginal propensity to consume c_1, which is less than 1 by assumption
- **Chapter 5**: The slope of ZZ at a given point is assumed to be less than 1

Determining Output

- **Chapter 3**: Investment was exogenous and did not depend on Y
- **Chapter 5**: Investmentdepends on Y, so both consumption and investment increase with output
- **Chapter 3**: We could solve for equilibrium Y algebraically and graphically
- **Chapter 5**: We can only solve for equilibrium Y graphically! (unless we are given the form of $C(Y-T)$ and $I(Y,i)$)

Deriving the IS Curve

$$Z = C(Y - T) + I(Y, i) + G$$

Recall: The demand curve ZZ is drawn for **some fixed interest rate**

- There are infinitely many demand curves we could have drawn, each corresponding to a different interest rate
- We want to draw a relationship between the interest rate and output when the interest rate changes
- let's derive the IS curve with our peers

Group Work IV

Q1: deriving IS curve as instructed by the following steps

- step 1: in the top plot for Goods Market, label variables in x- and y- axis; draw demand curve ZZ and production curve; draw the Goods Market Equilibrium, and label as point A; label the equilibrium level of output as Y

- step 2: in the bottom plot, we will derive IS curve. First, label Y on the horizontal axis and i on the vertical axis

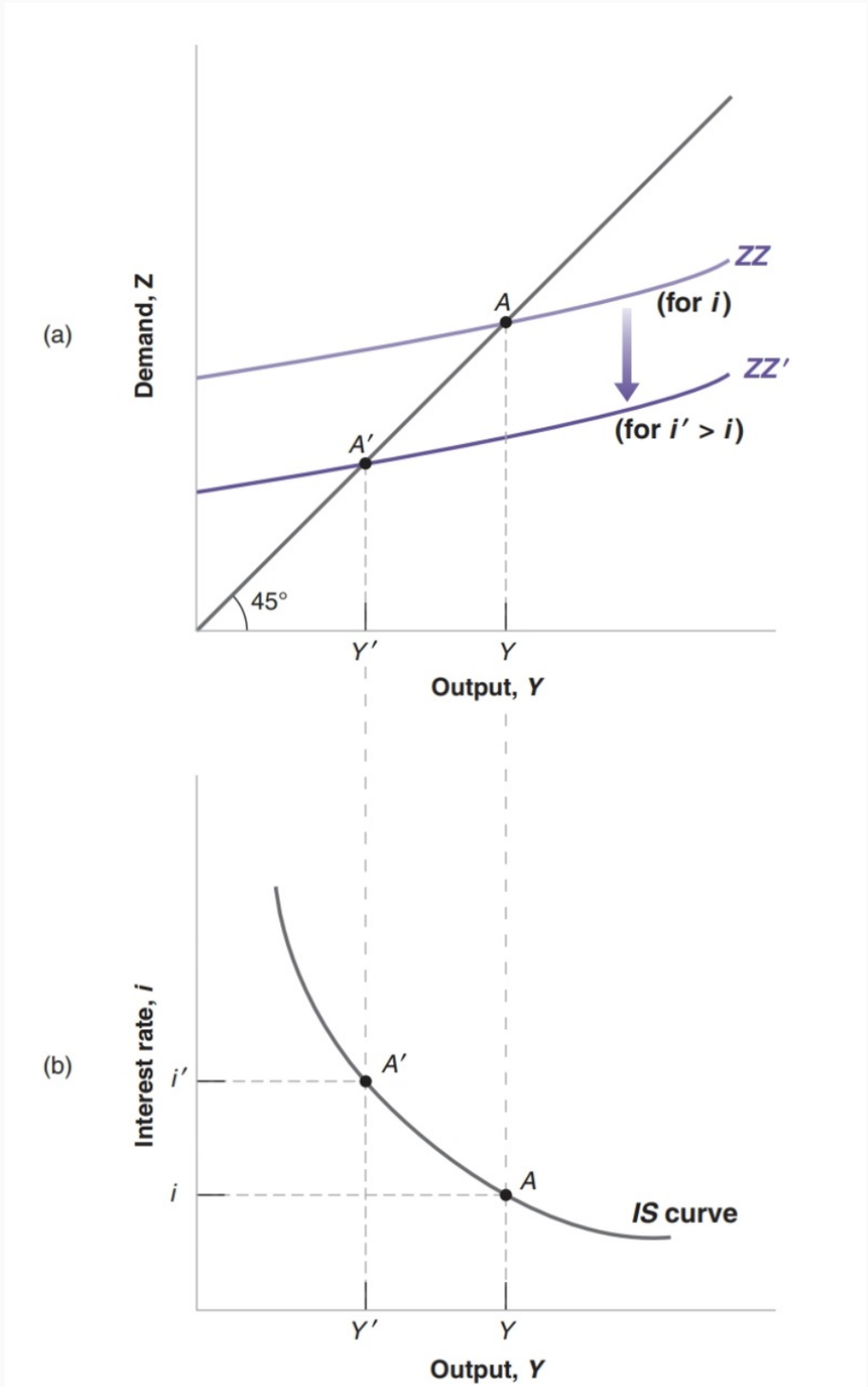
- step 3:Trace equilibrium Y down to the lower graph and choose some arbitrary interest rate i to correspond to this value of Y (recall: the demand curve is drawn for some *arbitrary interest rate*)

Group Work IV (cont'd)

Now, suppose the interest rate increases from i to i'

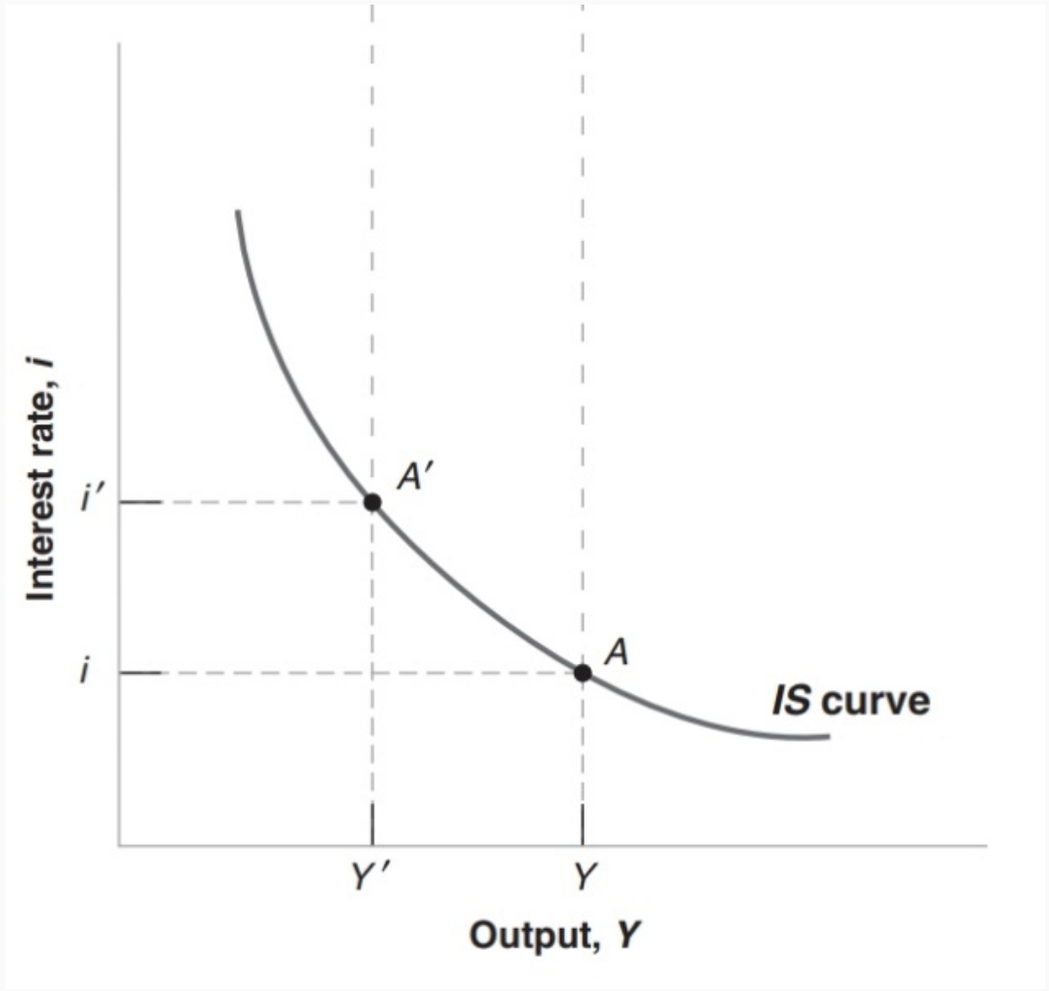
- step 4: investment will fall, therefore ZZ will shift down to ZZ'. At ZZ', label a new equilibrium point in the goods market A' and a new equilibrium output Y'
- step 5: Trace Y' down to the lower graph and find the point matching the higher interest rate i' to Y'.
- step 6: Do this for several different interest rates and you can fill in the entire IS curve

Group Work IV (cont'd)



Driving the IS Curve

IS curve: the downward–sloping curve in plot (b), representing the relationship between interest rate and output



Shifting the IS Curve

We have just seen that the IS curve can be derived by varying i and graphing the corresponding change in equilibrium Y. This was all done for some fixed values of T and G.

- What if T or G change?
- The IS curve SHIFTS

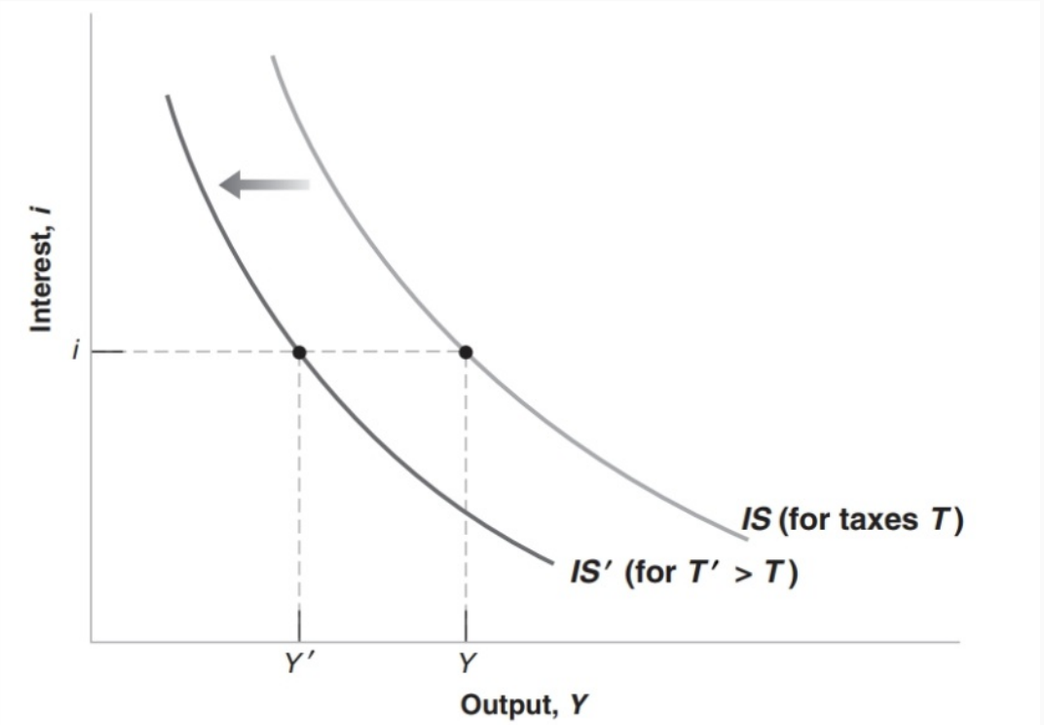
Shifting the IS Curve

$T \uparrow \implies Y_D(=Y-T) \downarrow \implies C \downarrow \implies$ demand $Z \downarrow \implies$ equilibirum ooutput $Y \downarrow$

- for a **fixed** level of i, we now have lower Y
- Thus, the IS curve **shifts LEFT/DOWN**
- Any factor that, for a given interest rate, decreases equilibrium output Y in the goods market will shift the IS curve left/down
- Any factor that, for a given interest rate, increases equilibrium Y in the goods market will shift the IS curve right/up

Shifting the IS Curve

If $T \uparrow$:



IS Curve Recap

- The **IS curve** is the relation between **interest rates** and **output** in the goods market
- The IS curve shows the value of equilibrium output associated with **ANY** possible interest rate
- **Any** point on the IS curve represents an **equilibrium in the Goods Market**.
- The IS curve is affected by $Y, G, i,$ and T
  - Changes in i and Y represent movements **along** the IS curve.
  - Changes in G and T represent **shifts** of the IS curve.

The Financial Market: LM Relation

Recall chapter 4

- money demand is given by

$$M^d = \$Y \times L(i)$$

`

- Money Supply is exogenously determined by the Central Bank: $M^s = M$
- Thus, the Money Market equilibrium is given by:

$$M = \$Y \times L(i)$$

`

- this is a relation between money, nominal income, and the interest rate

- Recall chapter 2: The GDP deflator is given by

$$Y = \frac{\$Y}{P}$$

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- we have seen the Money Market equilibrium:

$$M = \$Y \times L(i)$$

`

- divide both sides by the price level P, and then rewrite RHS using definition of GDP deflator

$$\frac{M}{P} = YL(i)$$

- Y: real income
- $\frac{M}{P}$: **real money supply**
  - the money stock in terms of quantity of goods, not dollars
- $YL(i)$: **real money demand**
  - depends on real income Y and the interest rate i
- money market equilibirum condition in real terms: real money supply = real money demand
- This equation is known as the **LM Relation**

Recall chapter 4: how does monetary policy function?

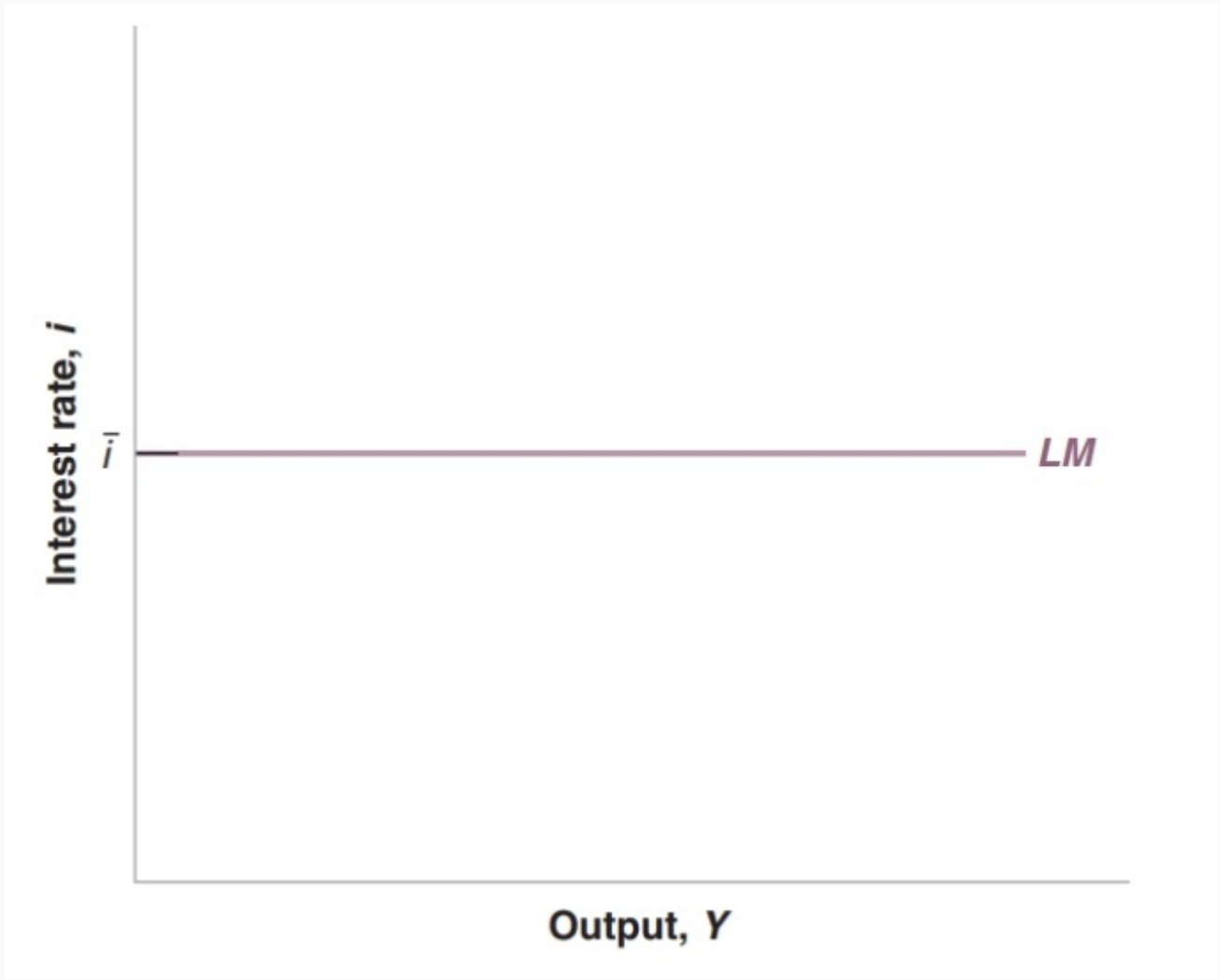
- if the central bank wanna achieve a lower interest rate, it will increase money supply by purchasing bonds from the public (expansionary monetary policy)
- if the central bank wanna achieve a higher interest rate, it will decrease money supply by selling bonds from the public (contractionary monetary policy)

Deriving the LM Curve

- The central bank picks a target interest rate, called $\bar{i}$;
- in order to achieve this target, the central bank adjusts the money supply (via monetary policy such as open market operation) such that $i = \bar{i}$, regardless of what Y is
- what does this look ike on a graph with axes Y and i

Deriving the LM Curve

LM curve: a horizontal line at the value of the interest rate $\bar{i}$ chosen by the central bank.



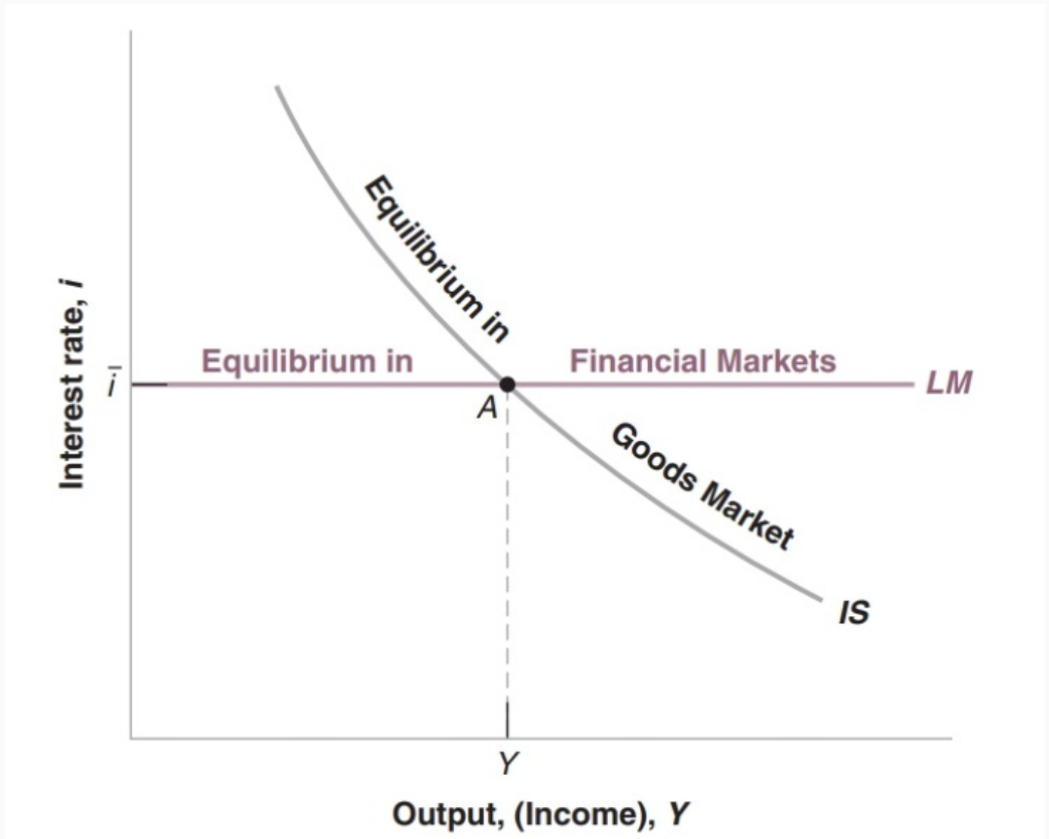
LM Curve Recap

- The LM curve is the relation between the interest rate and output in the Money Market.
- The LM curve shows the value of the equilibrium interest rate associated with ANY possible level of output.
- Any point on the LM curve represents an equilibrium in the Money Market.
- The LM curve is a flat line because we assume that the central bank adjusts the real money supply to achieve its target rate.
- The LM curve SHIFTS up (down) when the central bank increases (decreases) the target rate.

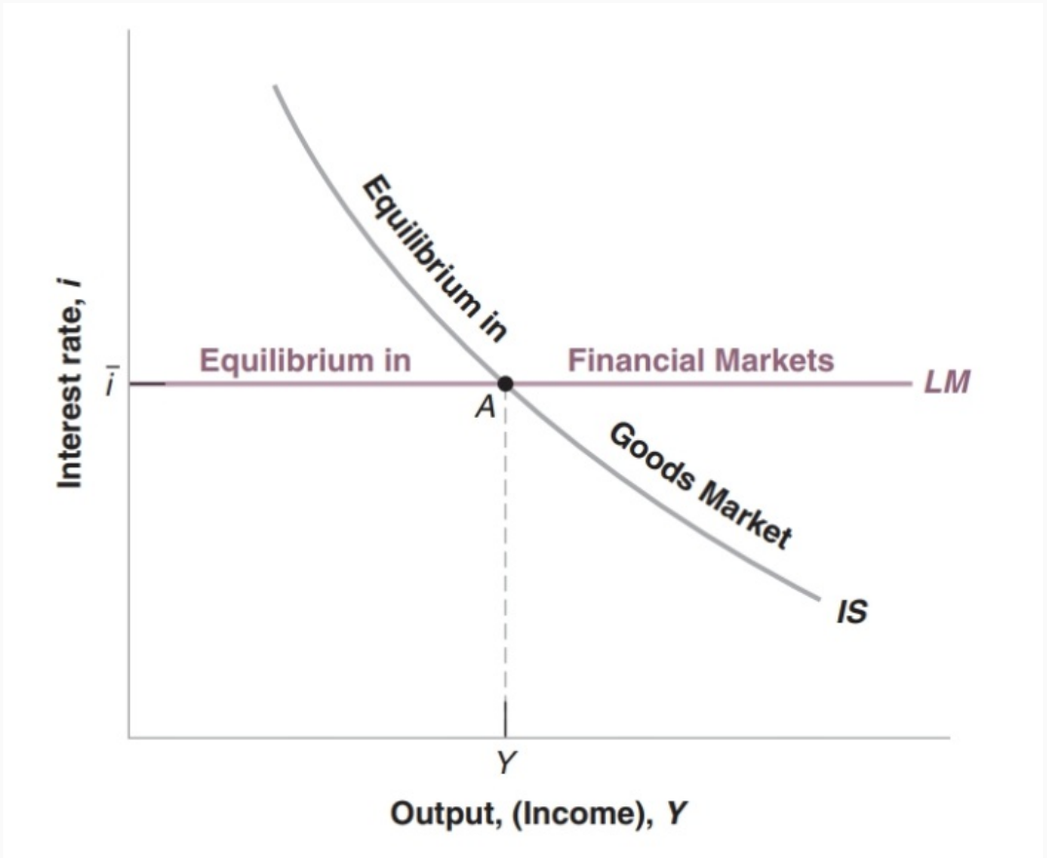
Putting the IS and the LM Relations Together

$$Y = C(Y - T) + I(Y, i) + G$$

$$i = \bar{i}$$



- Output (or production, income) is measured on the horizontal axis
- The interest rate is measured on the vertical axis



- Any point on the downward-sloping IS curve corresponds to equilibrium in the goods
- Any point on the horizontal LM curve corresponds to equilibrium in financial markets
- Only at point A are both equilibrium conditions satisfied

Fiscal Policy

Recall chapter 3: budget deficit = G-T

- **fiscal contraction/consolidation**: an decreases in the budget deficit
    - e.g. increasing taxes while keeping government spending unchanged
    - e.g. decreasing government spending while keeping taxes unchanged
    - e.g. increasing taxes and decreasing government spending
- **fiscal expansion**: an increase in the deficit
    - e.g. increasing government spending while keeping taxes unchanged
    - e.g. decreasing taxes while keeping government spending unchanged
    - e.g. decreasing taxes and increasing government spending
- What are the effects of a fiscal contraction on output and on the interest rate?

Group Work IV

Q2: What are the effects of an increased taxes on output and on the interest rate?

HINT:

Goods market and IS curve: $Y = C(Y - T) + I(Y, i) + G$

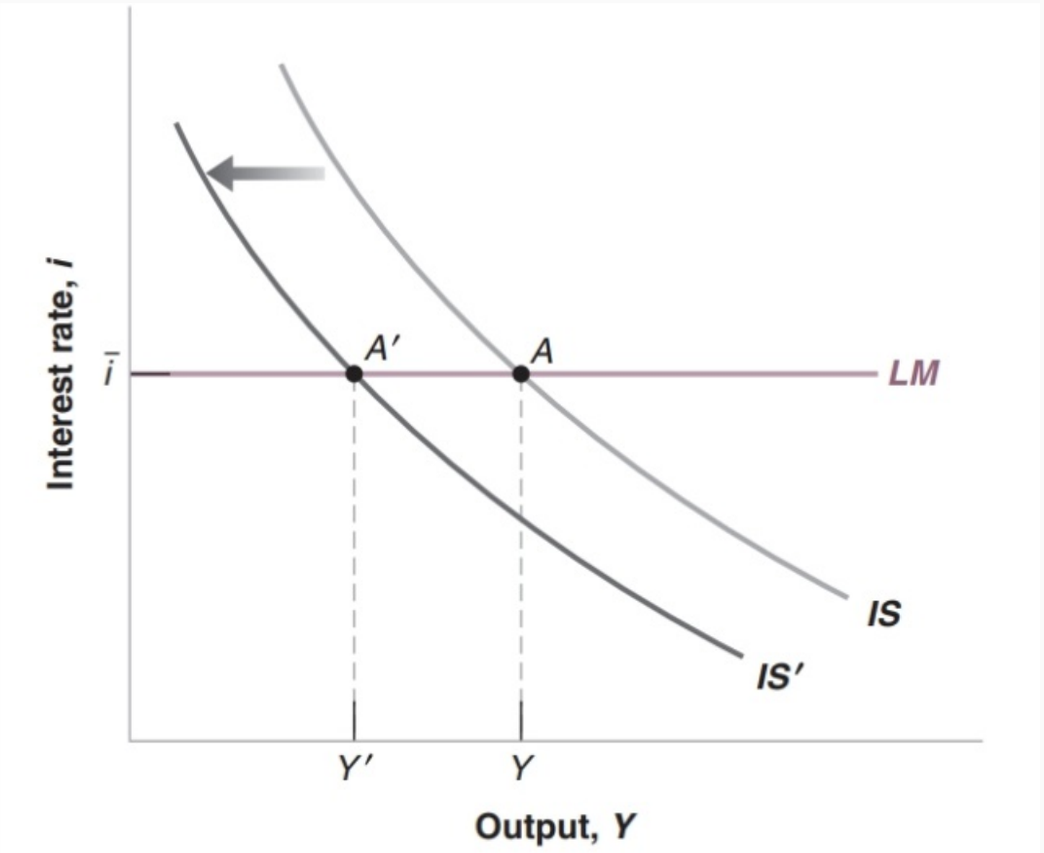
- Increased T leads to decreased demand $Z = C(Y - T) + I(Y, i) + G$
- For every value of i , equilibrium output Y is now lower
- How is IS curve affected?

Money market and LM curve: $i = \bar{i}$

- A change in taxes does not affect the target interest rate
- How is LM curve affected?

Group Work IV (cont'd)

IS curve Shifts Left, and LM curve is unaffected



- move along LM curve to the new equilibirum: lower Y, but same i

Group Work IV (cont'd)

(here, G assumde to be unchanged) $T \uparrow$:

- $Y_D \downarrow$
- $C \downarrow$
- output Y and income $Y \downarrow$ (through the multiplier)
- $I \downarrow$
- but i unchanged (here, by assumption, as we are looking at a change only in fiscal policy, the central bank does not change the interest rate)

Fiscal Policy Recap

- We start in equilibrium in the IS-LM model which implies equilibrium in the goods and money market.
- There is some shock to either T or G. This shock leads to a change in goods demand and thus a shift in the IS curve.
- In the money market, this shock has no impact at first, as G and T are not in the LM relation.
- The change in income from the fiscal shock changes money demand, but because the central bank is interest rate targeting, it adjusts the real money supply to keep interest rates constant.

Monetary Policy

- **monetary expansion**: the central bank decreases the target interest rate
  - to do so, it increases the money supply through open market purchase
- **monetary contraction/tightening**: an increase in the target interest rate
  - to do so, it decreases the money supply through open market sell

- What are the effects of a monetary expansion on output and on the interest rate?

Group Work IV

Q3: What are the effects of a monetary expansion on output and on the interest rate?

HINT:
Goods Market and IS: $Y = C(Y - T) + I(Y, i) + G$

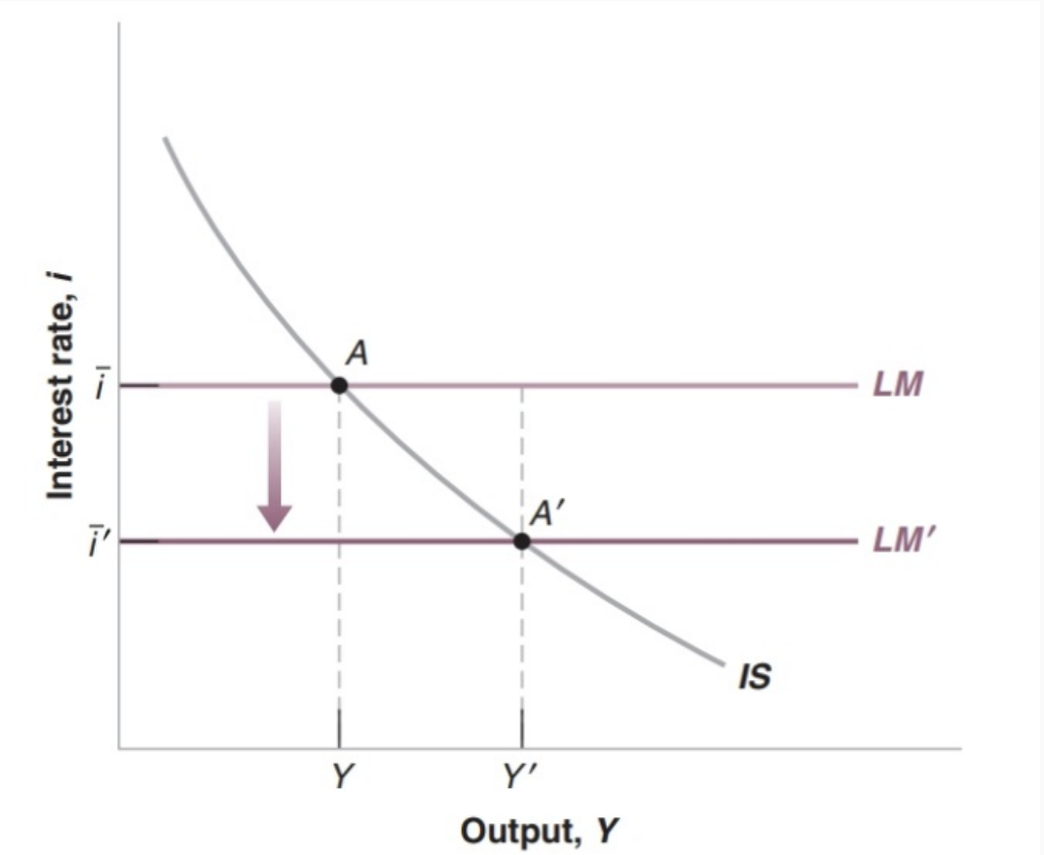
- A change in the level of i does not change the relationship between i and Y given by the IS curve.
- How is IS curve affected?

Money market and LM curve: $i = \bar{i}$

- The LM curve describes the relationship between the target interest rate and output
- How is LM curve affected?

Group Work IV (cont'd)

M curve Shifts down, and IS curve is unaffected



- move along IS curve to the new equilibirum: higher Y, and lower i

Group Work IV (cont'd)

(here, T and G are assumed to be unchanged) $\bar{i} \downarrow$:

- $I \uparrow$
- demand Z and output $Y \uparrow$
- $Y_D \uparrow$
- $C \uparrow$

Policy Mix

Policy Mix

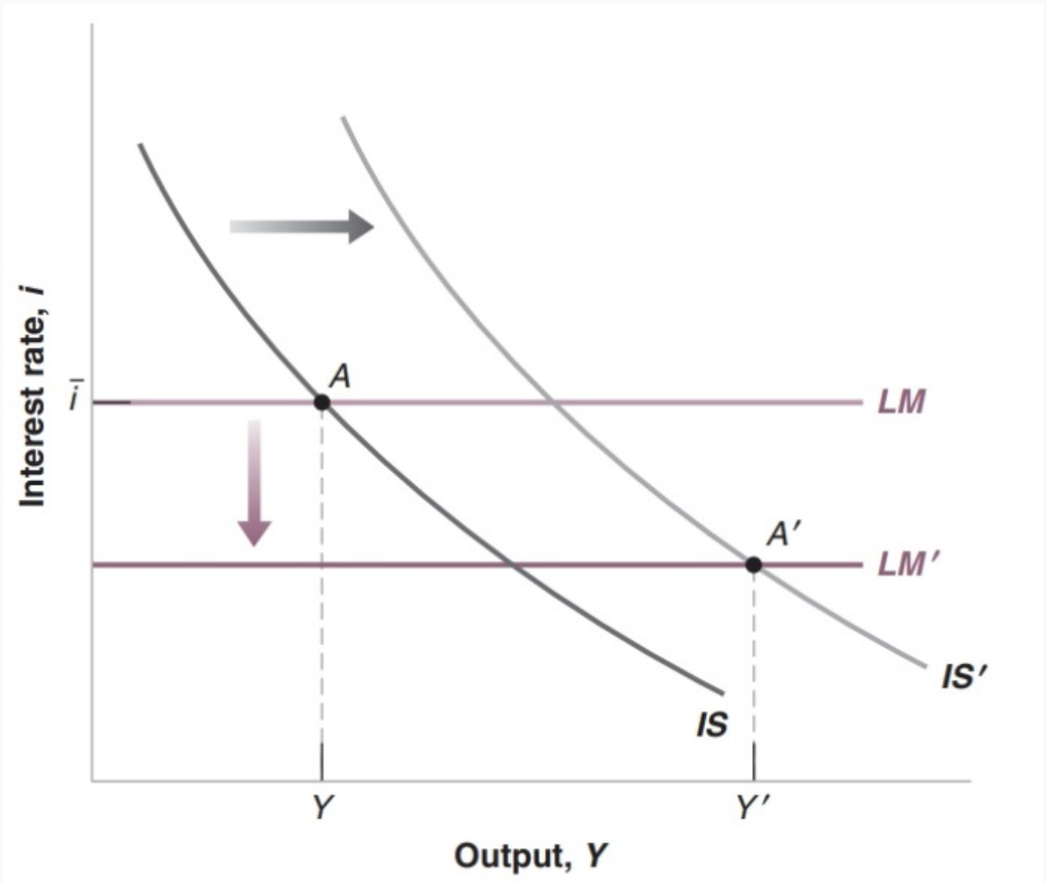
Policy Mix: the combination of monetary and fiscal policy

- In the real world, monetary and fiscal policy are often jointly employed to reach a specific policy target
- Recall: Monetary policy and Fiscal policy can either be expansionary or contractionary
  - **Expansionary** policies increase equilibrium output
  - **Contractionary** policies decrease equilibrium output

Policy Mix - Example I

Suppose the economy is in a recession and output is too low

- Then, both fiscal and monetary policies can be used to increase output



2001 U.S. Recession

a recession started in March 2001 and ended in December 2001

Figure 1 *The U.S. Growth Rate, 1999–1 to 2002–4*

2001 U.S. Recession: Cause

- rate of investment had been very high from 1995 to 2000
- In 2001, it became clear to firms that they had been overly optimistic and had invested too much
- This led them to cut back on investment, leading to a decrease in demand and, through the multiplier, a decrease in GDP

2001 U.S. Recession: Policies

feeling that the economy was slowing down, the Fed started decreasing the target interest rate (federal funds rate) aggressively

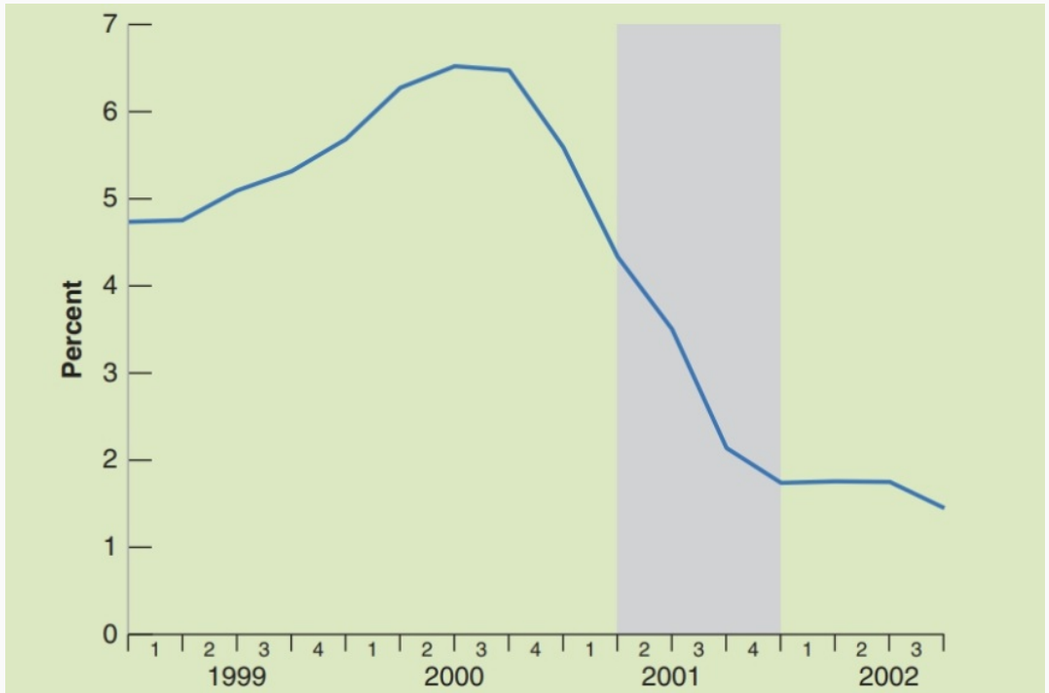


Figure 2 *The Federal Funds Rate, 1999–1 to 2002–4*

2001 U.S. Recession: Policies

- George Bush: cut tax rates
- the event of 9/11: increase in spending (defense and homeland security)

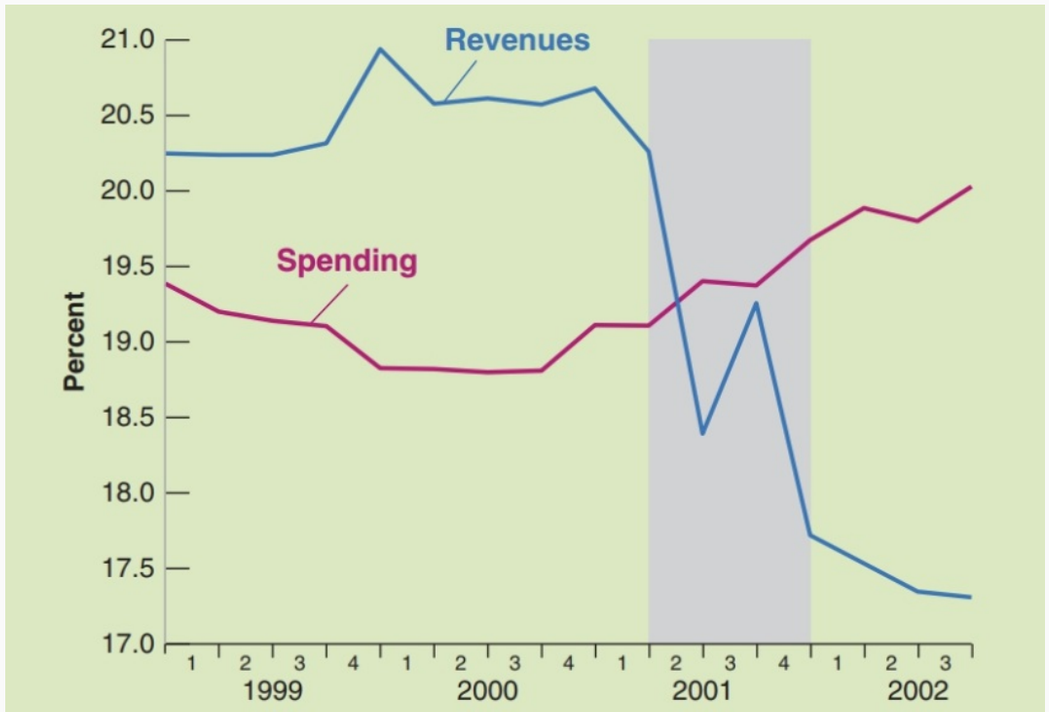


Figure 3 *U.S. Federal Government Revenues and Spending (as Ratios to GDP), 1999–1 to 2002–4*

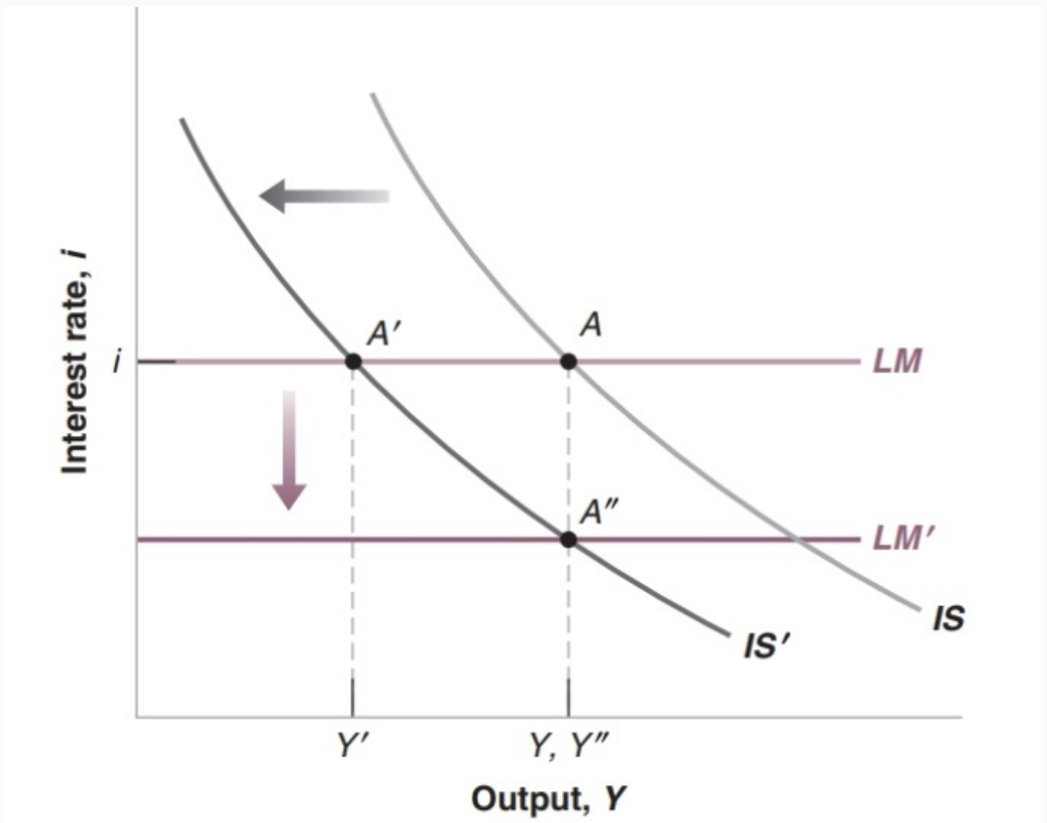
- large and persistent budget deficits

Policy Mix - Example II

- Sometimes, the right policy mix is to use the two policies in opposite directions
- Suppose the government is running a large budget deficit and would like to reduce it, but does not want to trigger a recession
- How would you mix the policies?
- to combine a fiscal consolidation with a monetary expansion

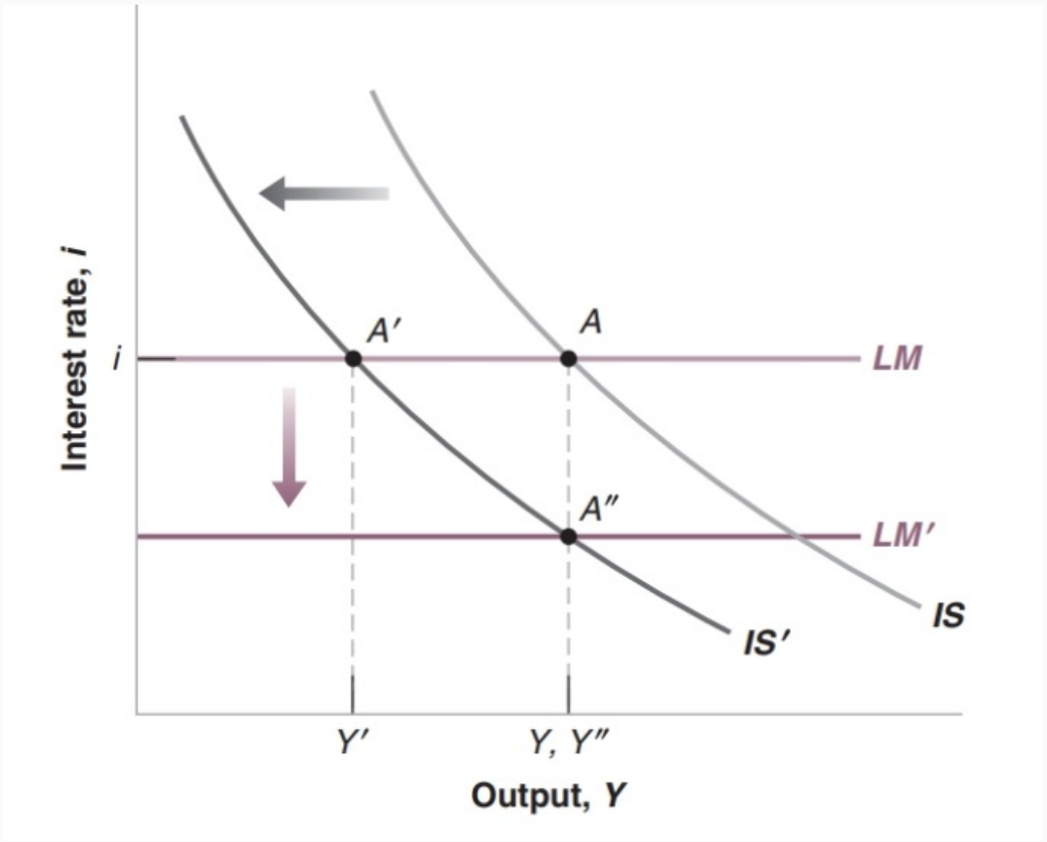
Policy Mix - Example II

- initial euiquilibrium: point A
- Output is thought to be at the right level, but the budget deficit, $T - G$, is too large.



Policy Mix - Example II

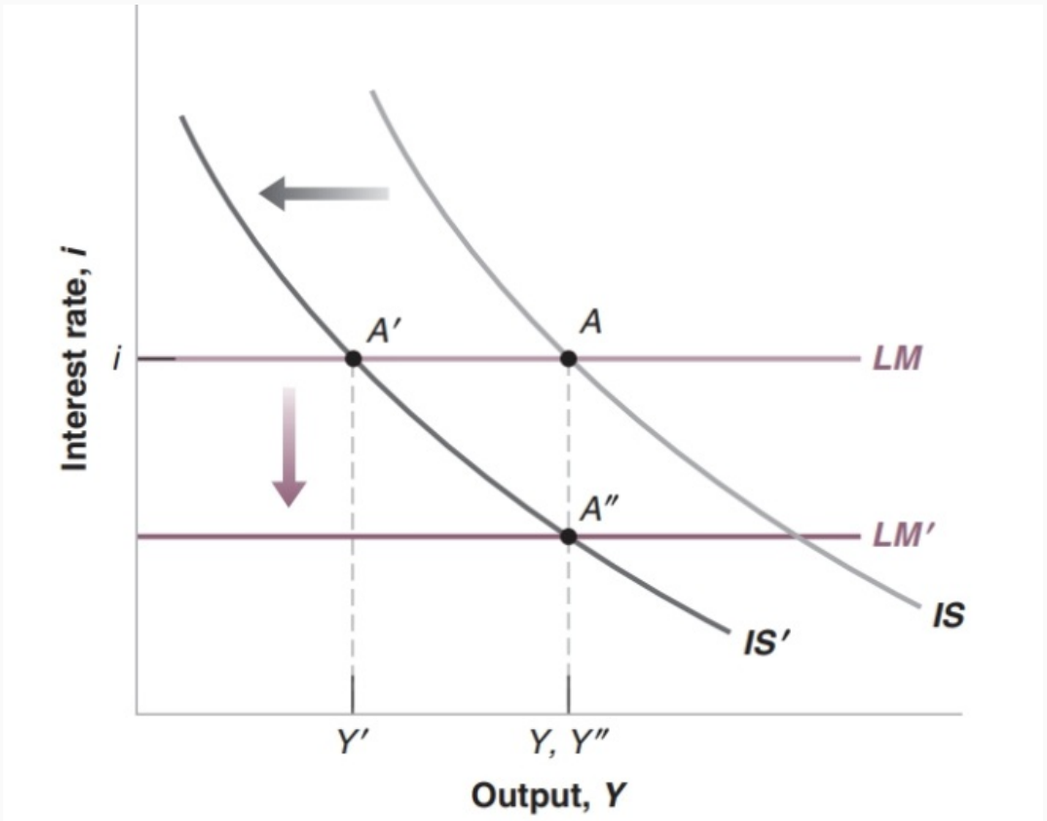
- If the government reduces the deficit, say by increasing T or by decreasing G (or both)



- equiibirum: A', $Y' < Y$
- the reduction in the deficit will lead to a recession

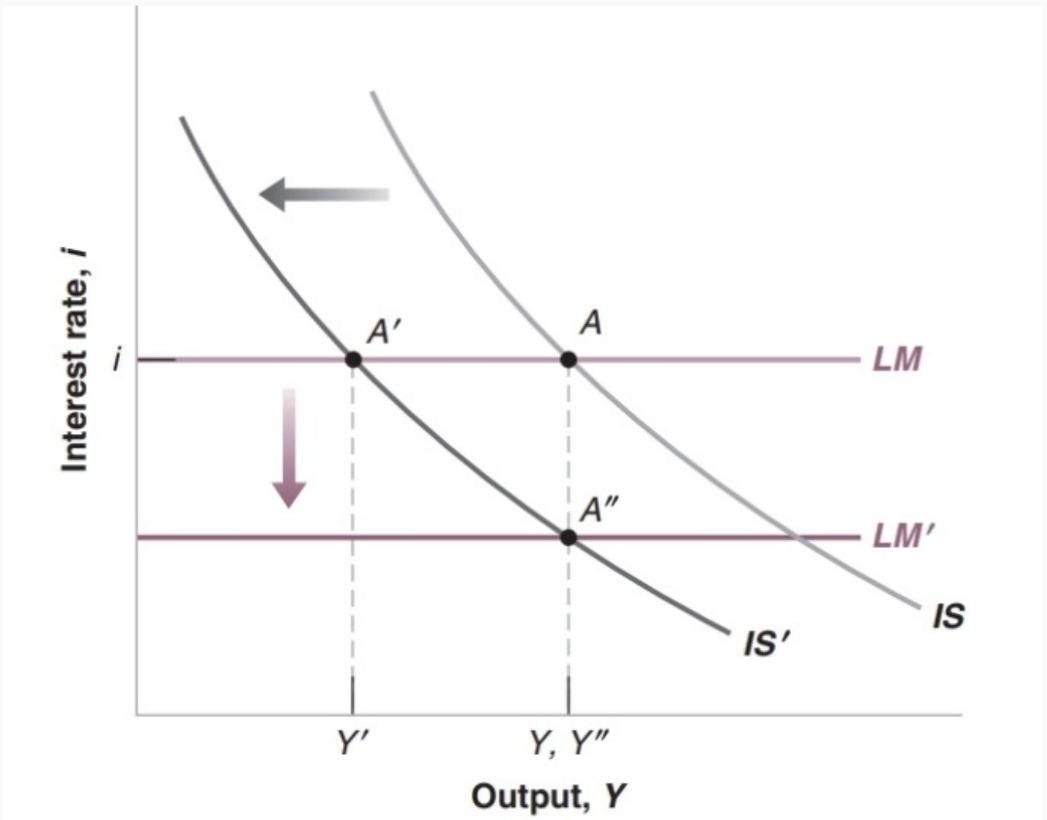
Policy Mix

- however, the recession can be avoided if monetary policy is also used
- If the central bank reduces the interest rate



- equilibrium: A'', $Y'' = Y$
- The combination of both policies thus allows for the reduction in the deficit, but without a recession

Policy Mix



- What happens to consumption and investment in this case?

Policy Mix

If the reduction takes the form of a decrease in government spending rather than an increase in taxes:

- income is unchanged, $Y'' = Y$
- disposable income is unchanged, $Y'' - T = Y - T$
- and so consumption is unchanged

If the reduction takes the form of an increase in income taxes:

- $Y'' = Y$, but T increases: disposable income is lower
- and so is consumption

What happens to investment is unambiguous: Unchanged output and a lower interest rate implies higher investment