

The IS-LM Model

GRADUATE MACRO – LAB SESSION 5

ETTORE GALLO

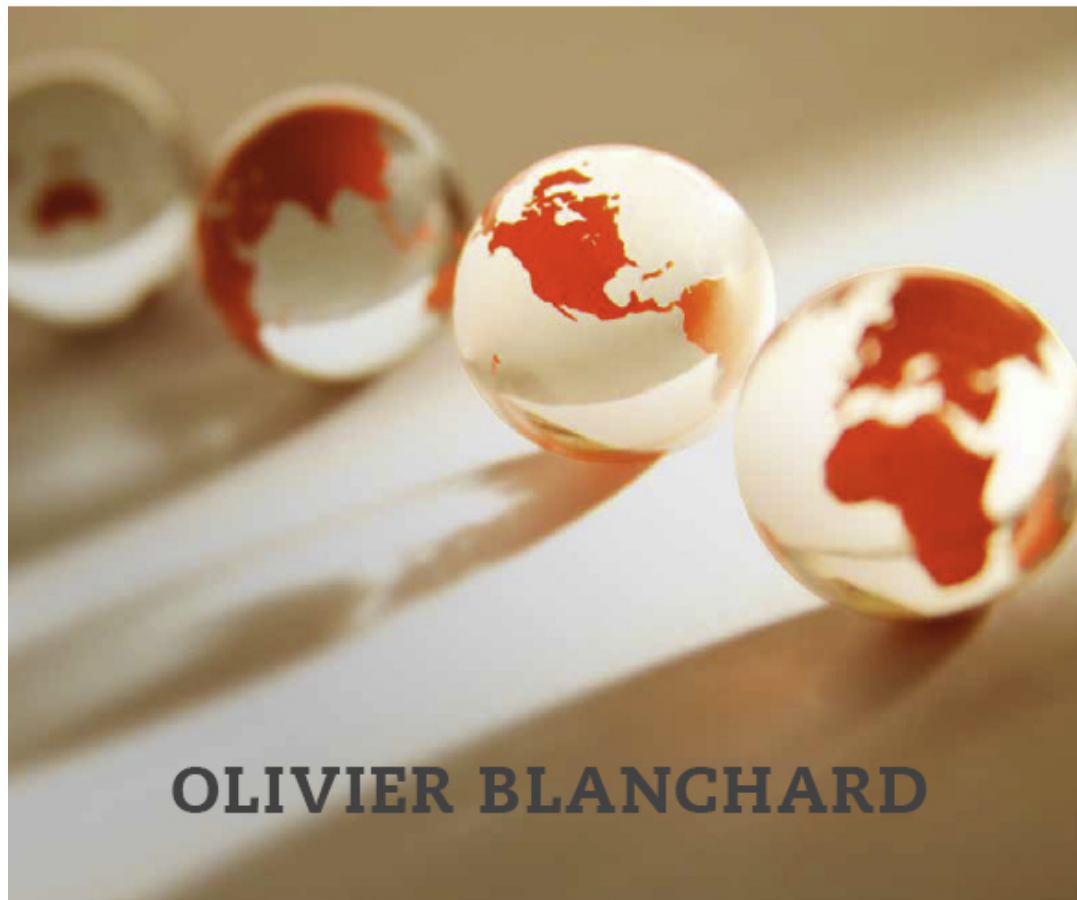


Class Outline

- 1 The Goods Market and the *IS* Relation
- 2 Financial Markets and the *LM* Relation
- 3 Putting the *IS* and the *LM* Relations Together
- 4 Using a Policy Mix
- 5 How Does the *IS-LM* Model Fit the Facts?

MACROECONOMICS

SEVENTH EDITION



OLIVIER BLANCHARD

Goods and Financial Markets; The *IS-LM* Model

Chapter 5

Goods and Financial Markets; The *IS-LM* Model

- We looked at the goods market in Chapter 3, and financial markets in Chapter 4.
- In this chapter, we look at goods and financial markets together, and understand how output and the interest rate are determined in the short run.
- John Hicks and Alvin Hansen called this framework the *IS-LM* model.

5-1 The Goods Market and the *IS* Relation

- In the model developed in Chapter 3, investment was assumed to be constant for simplicity.
- In fact, investment depends on production Y (or sales) and the interest rate i .

$$I = I(Y, i) \quad (5.1)$$

(+, -)

- So equilibrium in the goods market becomes:

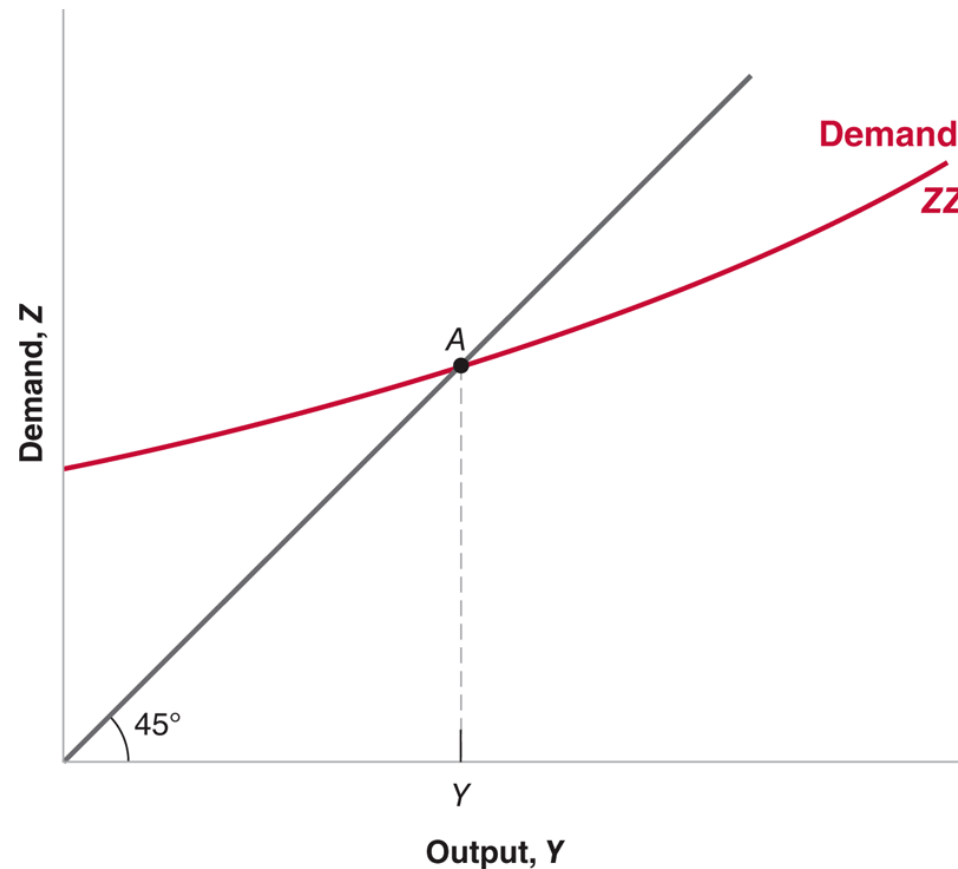
$$Y = C(Y - T) + I(Y, i) + G \quad (5.2)$$

which is the *IS* relation.

5-1 The Goods Market and the *IS* Relation

Figure 5-1 Equilibrium in the Goods Market

The demand for goods is an increasing function of output. Equilibrium requires that the demand for goods be equal to output.



5-1 The Goods Market and the *IS* Relation

- ZZ is upward-sloping because, **for a given value of the interest rate**, an increase in output leads to an increase in the demand for goods through its effects on consumption and investment.
- ZZ is a curve rather than a line because **we have not assumed** that the consumption and investment relations in equations (5.2) are linear.
- ZZ is flatter than the 45-degree line because **we have assumed** that an increase in output leads to a less than one-for-one increase in demand.
- **The intersection of ZZ and the 45-degree line (point A) is the equilibrium level of output.**

5-1 The Goods Market and the *IS* Relation

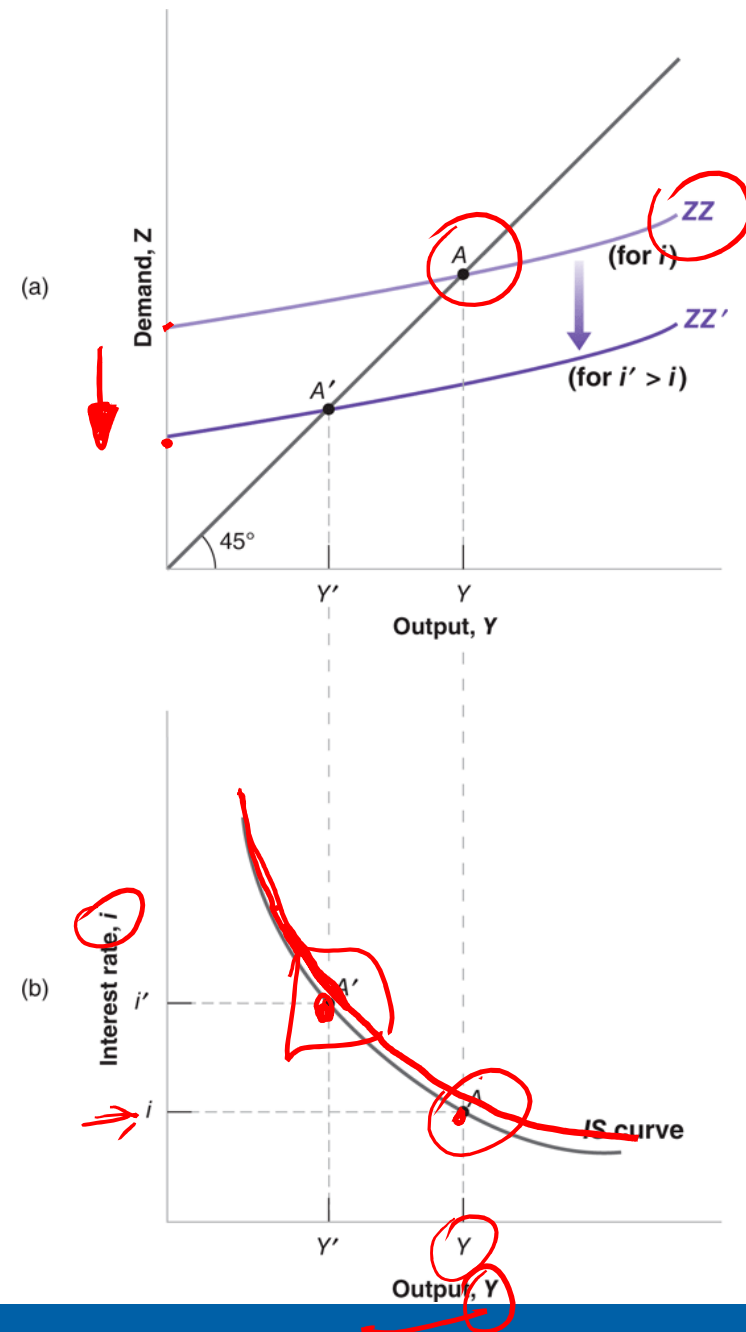
$$i \uparrow \Rightarrow I \downarrow \Rightarrow Z \downarrow \Rightarrow C + I + G \downarrow$$

Figure 5-2 The Derivation of the *IS* Curve

(a) An increase in the interest rate decreases the demand for goods at any level of output, leading to a decrease in the equilibrium level of output.

(b) Equilibrium in the goods market implies that an increase in the interest rate leads to a decrease in output.

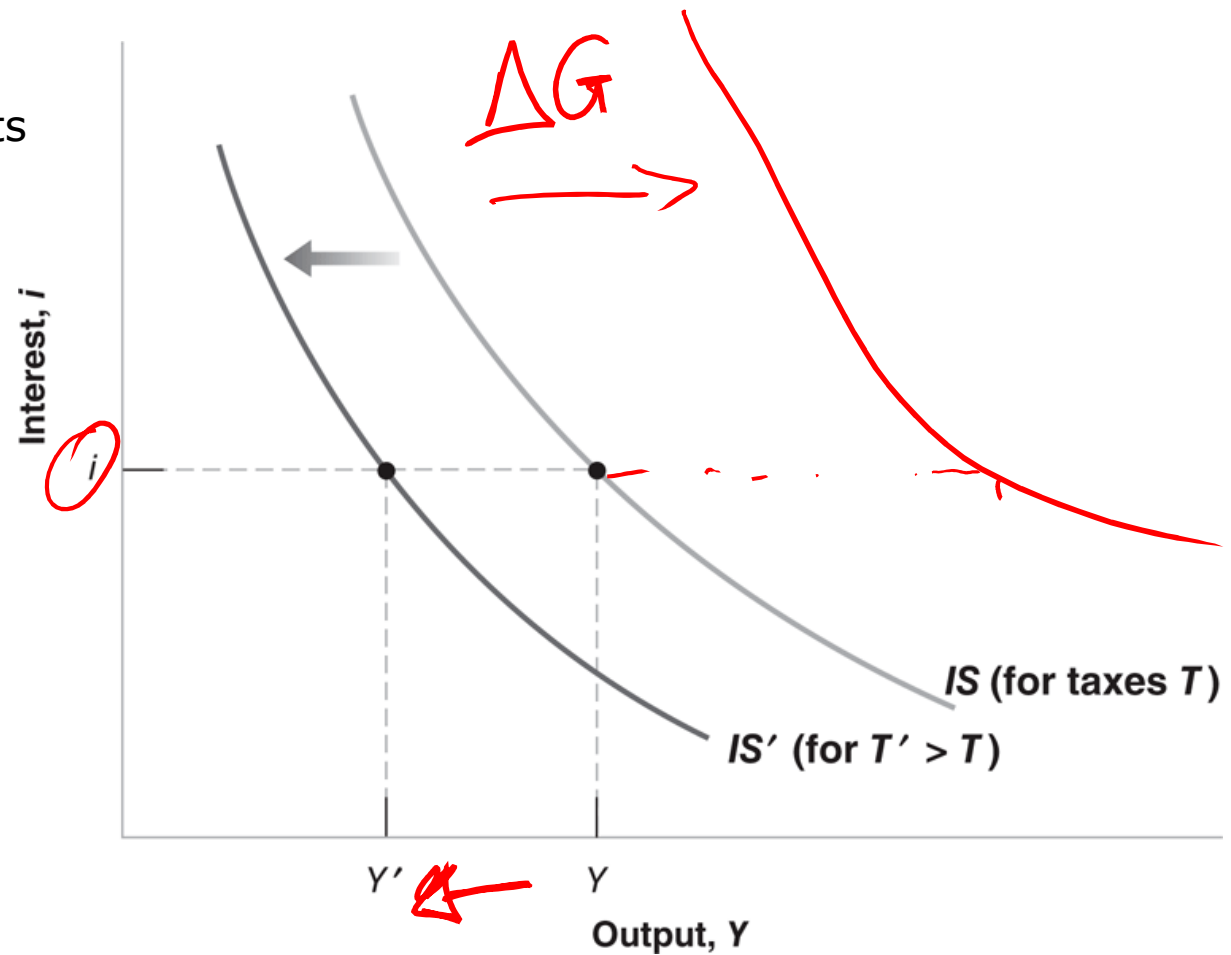
The ***IS* curve** is therefore downward sloping.



5-1 The Goods Market and the *IS* Relation

Figure 5-3 Shifts of the *IS* Curve

An increase in taxes shifts the *IS* curve to the left.



5-1 The Goods Market and the *IS* Relation

- **Downward-sloping *IS* curve:** Equilibrium in the goods market implies that an increase in the interest rate leads to a decrease in output.
- **Shifting the *IS* curve:** Changes in factors that decrease (increase) the demand for goods given the interest rate shift the *IS* curve to the left (right).

5-2 Financial Markets and the *LM* Relation

- Recall Chapter 4: $M = \$Y L(i) \Rightarrow \frac{M}{P} = \frac{\$Y}{P} \cdot L(i)$
- Divide both sides of the equation by the price level P :

$$\frac{M}{P} = \overset{\text{Real income}}{Y} L(i) \quad (5.3)$$

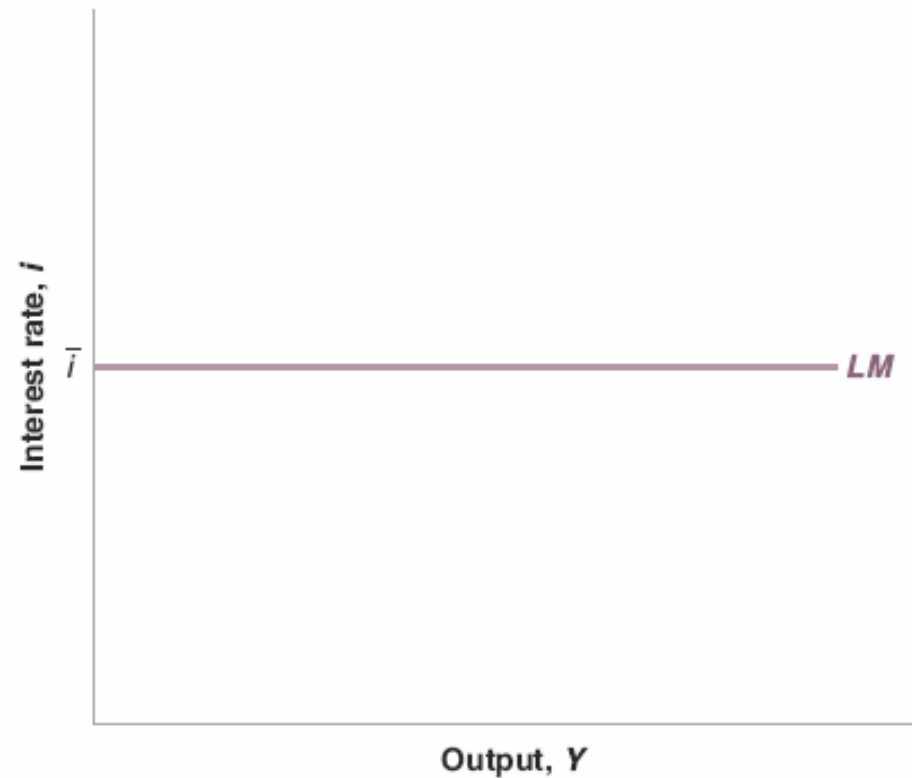
which is the *LM* relation.

- In equilibrium, real money supply equals the real money demand, which depends on real income Y , and the interest rate i .

5-2 Financial Markets and the *LM* Relation

Figure 5-4 The *LM* Curve

The central bank chooses the interest rate (and adjusts the money supply so as to achieve it).



5-2 Financial Markets and the *LM* Relation

- *IS* relation: $Y = C(Y-T) + \underline{I(Y,i)} + G$
- *LM* relation: $i = \bar{i}$
- The *IS* and *LM* relations together determine output.
- *Any point* on the downward sloping *IS* curve corresponds to equilibrium in the goods market.
- *Any point* on the horizontal *LM* curve corresponds to equilibrium in financial markets.
- *Only at* their intersection (*point A*) are both equilibrium relations satisfied.

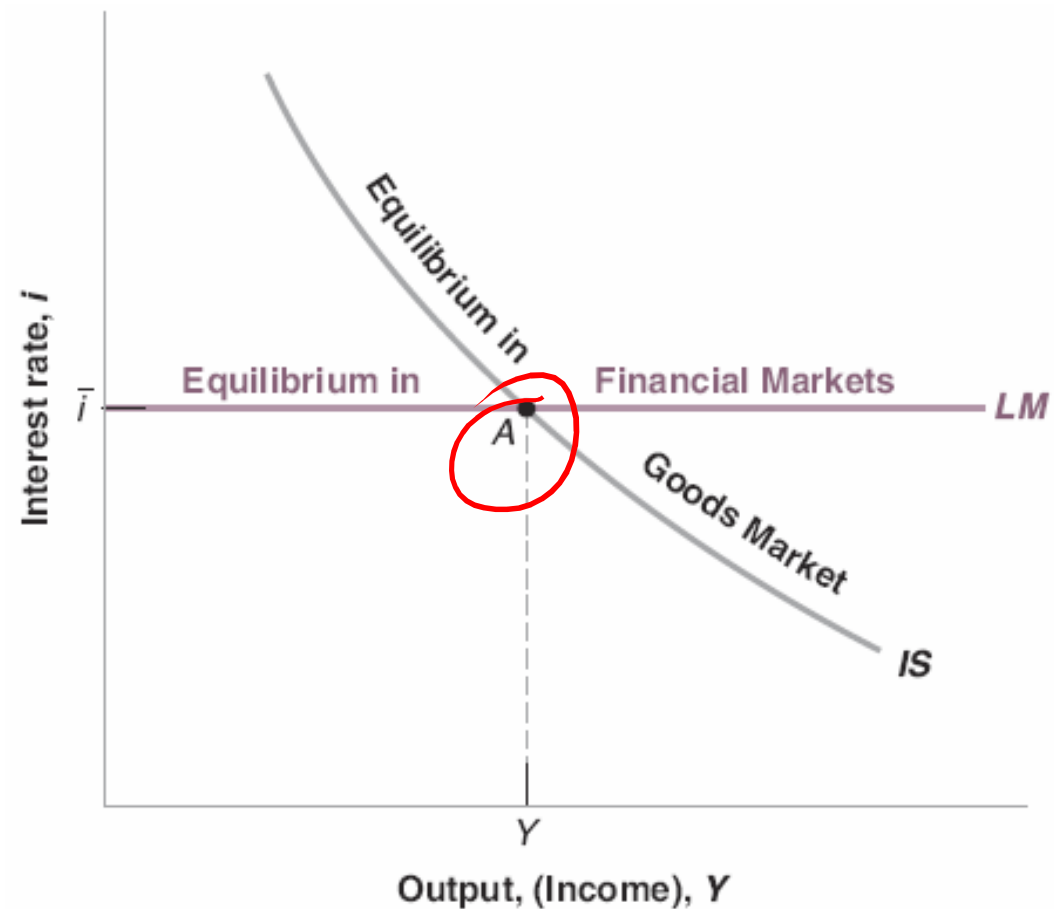
5-3 Putting the *IS* and the *LM* Relations Together

Figure 5-5 The *IS*–*LM* Model

Equilibrium in the goods market implies that an increase in the interest rate leads to a decrease in output.

This is represented by the *IS* curve.

Equilibrium in financial markets is represented by the horizontal *LM* curve. Only at point *A*, which is on both curves, are both goods and financial markets in equilibrium.



5-3 Putting the *IS* and the *LM* Relations Together

- Fiscal Policy:

Decrease in $G-T \Leftrightarrow$ **fiscal contraction** \Leftrightarrow
fiscal consolidation

Increase in $G-T \Leftrightarrow$ **fiscal expansion**

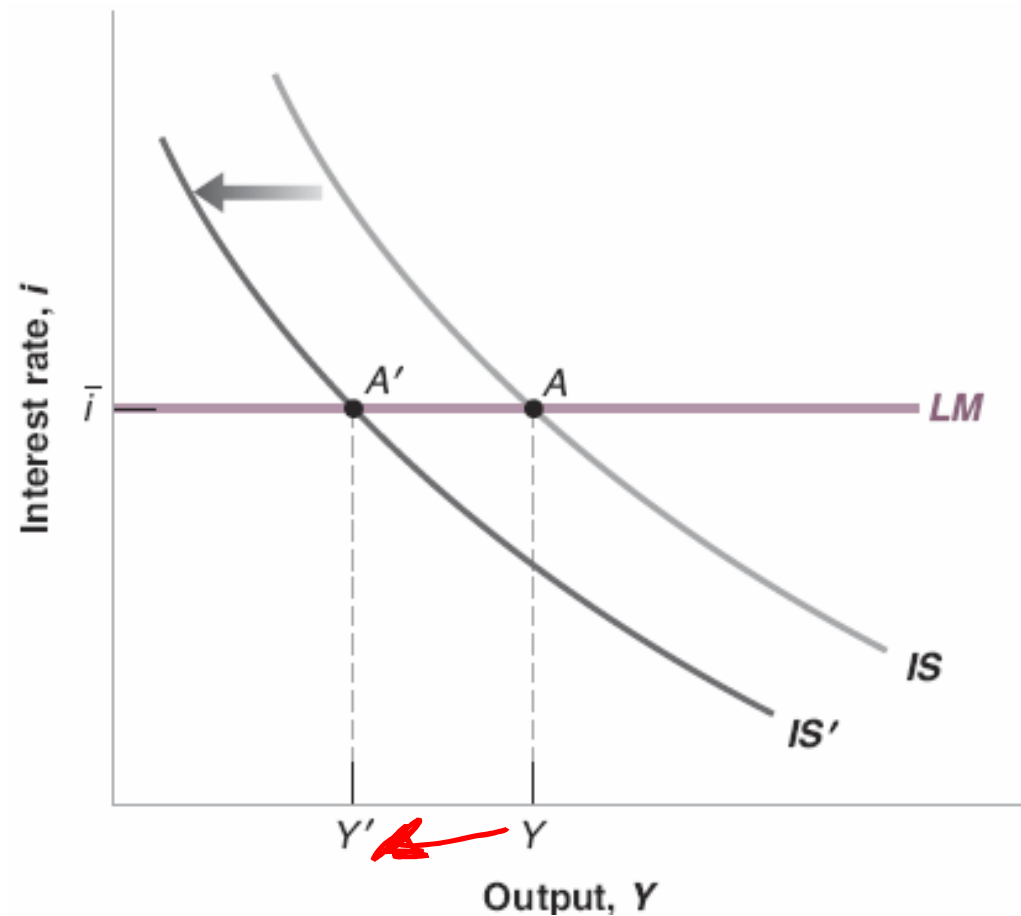
5-3 Putting the *IS* and the *LM* Relations Together

- Steps for analyzing the effects of changes in policy or exogenous variables:
 1. Does it shift the *IS* curve and/or the *LM* curve?
 2. What does this do to equilibrium output and the equilibrium interest rate?
 3. Describe the effects in words.

5-3 Putting the *IS* and the *LM* Relations Together

Figure 5-6 The Effects of an Increase in Taxes

An increase in taxes shifts the *IS* curve to the left. This leads to a decrease in the equilibrium level of output.



5-3 Putting the *IS* and the *LM* Relations Together

- Monetary Policy:

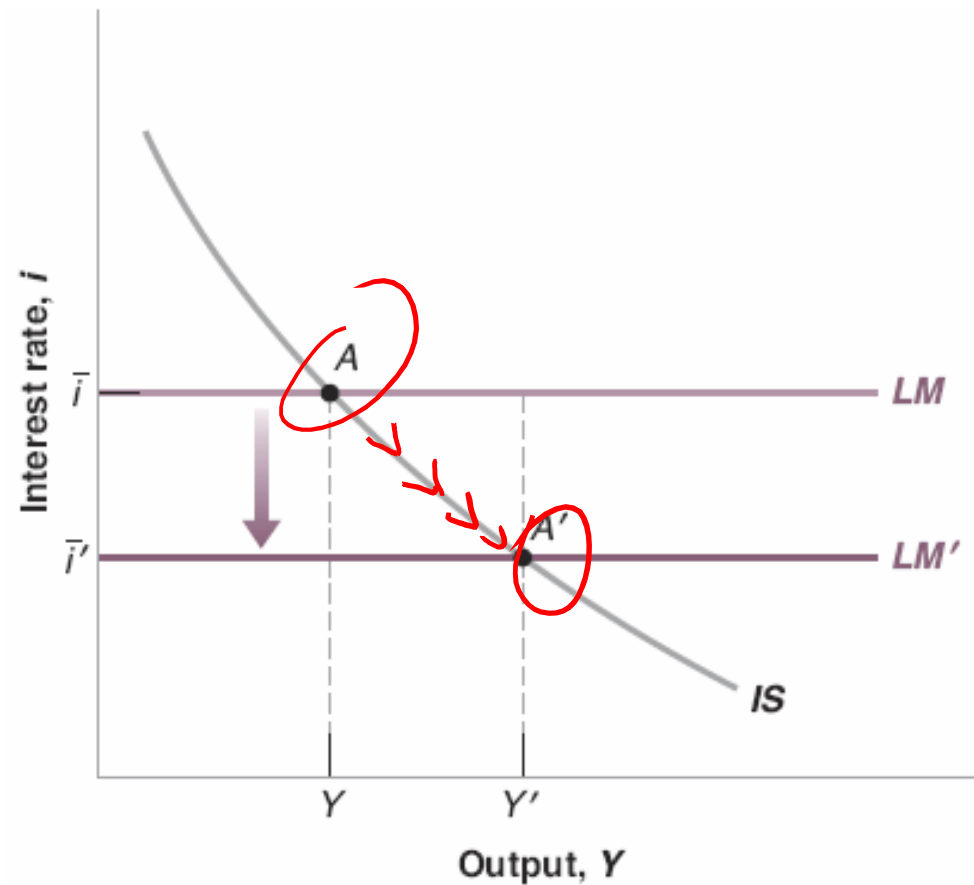
Decrease in $i \Leftrightarrow$ increase in $M \Leftrightarrow$ **monetary expansion**

Increase in $i \Leftrightarrow$ decrease in $M \Leftrightarrow$ **monetary contraction \Leftrightarrow monetary tightening**

5-3 Putting the *IS* and the *LM* Relations Together

Figure 5-7 The Effects of a Decrease in the Interest Rate

A monetary expansion shifts the *LM* curve down, and leads to higher output.



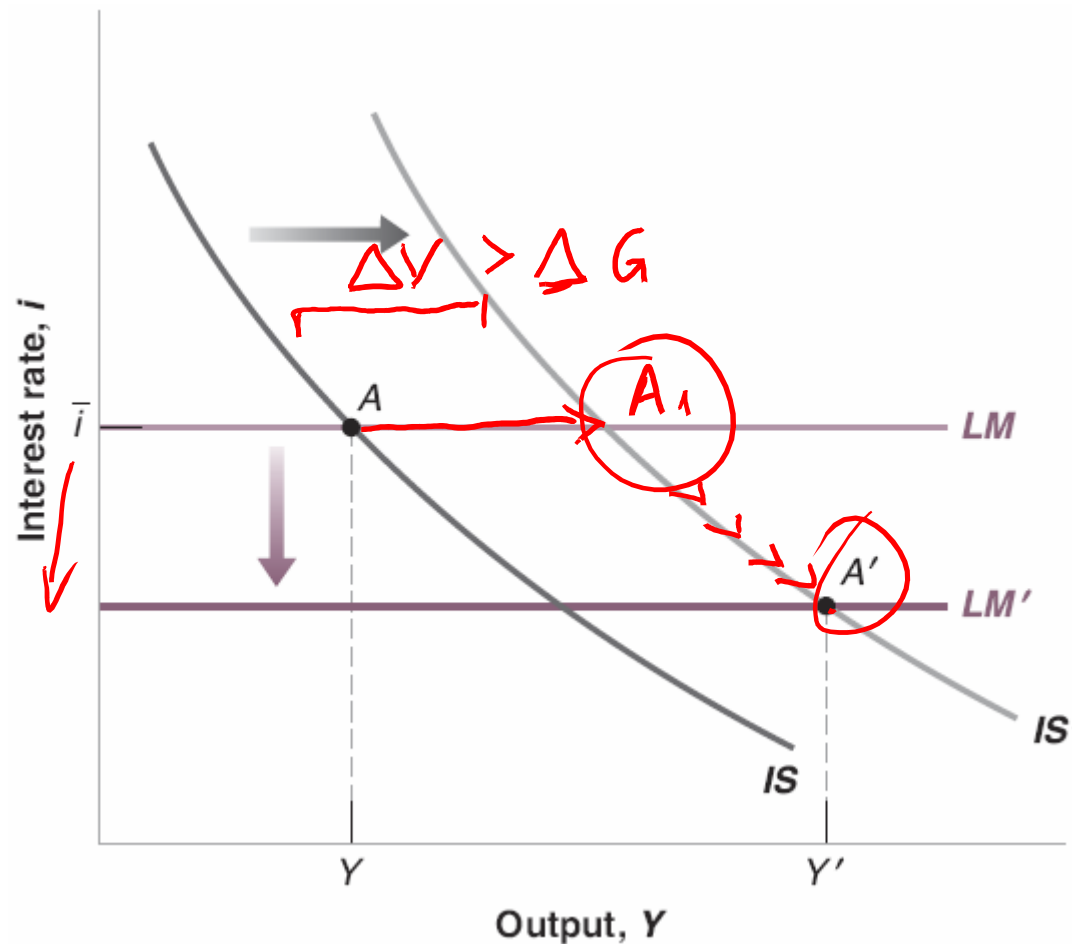
5-4 Using a Policy Mix

- Monetary-fiscal policy mix is the combination of monetary and fiscal policies.
- Suppose that the economy is in a recession and output is too low.
- Both fiscal and monetary policies can be used to increase output.

5-4 Using a Policy Mix

Figure 5-8 The Effects of a Combined Fiscal and Monetary Expansion

The fiscal expansion shifts the IS curve to the right.
A monetary expansion shifts the LM curve down.
Both lead to higher output.



2. Consider first the goods market model with constant investment that we saw in Chapter 3. Consumption is given by

$$C = c_0 + c_1(Y - T)$$

and I , G , and T are given.

- a. Solve for equilibrium output. What is the value of the multiplier for a change in autonomous spending?

Now let investment depend on both sales and the interest rate:

$$I = b_0 + b_1Y - b_2i$$

- b. Solve for equilibrium output using the methods learned in Chapter 3. At a given interest rate, why is the effect of a change in autonomous spending bigger than what it was in part (a)? Why? (Assume $c_1 + b_1 < 1$.)
- c. Suppose the central bank chooses an interest rate of \bar{i} . Solve for equilibrium output at that interest rate.
- d. Draw the equilibrium of this economy using an *IS-LM* diagram.

Solutions Ex. 2

2. a. $Y = [1/(1-c_1)][c_0 - c_1T + I + G]$
The multiplier is $1/(1-c_1)$.

b. $Y = [1/(1-c_1-b_1)][c_0 - c_1T + b_0 - b_2i + G]$

The multiplier is $1/(1-c_1-b_1)$. Since the multiplier is larger than the multiplier in part (a), the effect of a change in autonomous spending is bigger than in part (a). An increase in autonomous spending now leads to an increase in investment as well as consumption.

c. You simply replace the interest rate from the expression in (b) with its policy value \bar{i} , $Y = [1/(1-c_1-b_1)][c_0 - c_1T + b_0 - b_2\bar{i} + G]$.

3. *The response of the economy to fiscal policy*

- a. Use an IS-LM diagram, show the effects on output of a decrease in government spending. Can you tell what happens to investment? Why?

Now consider the following IS-LM model:

$$C = c_0 + c_1(Y - T)$$

$$I = b_0 + b_1Y - b_2i$$

$$Z = C + I + G$$

$$i = \bar{i}$$

- b. Solve for equilibrium output when the interest rate is \bar{i} . Assume $c_1 + b_1 < 1$. (*Hint: You may want to rework through Problem 2 if you are having trouble with this step.*)
- c. Solve for equilibrium level of investment.
- d. Let's go behind the scene in the money market. Use the equilibrium in the money market $M/P = d_1Y - d_2i$ to solve for the equilibrium level of the real money supply when $i = \bar{i}$. How does the real money supply vary with government spending?

Solutions Ex. 3

3.
 - a. The *IS* curve shifts left. Output falls at the same interest rate. Investment, which depends positively on the level of output and negatively on the interest rate, also falls. The interest rate remains the same. Output falls. So investment falls.
 - b. From the answer to 2(b), $Y = [1/(1-c_1-b_1)] [c_0 - c_1 T + b_0 - b_2 i \text{ bar} + G]$
 - c. $I = b_0 + b_1 Y - b_2 i = b_0 + b_1 [1/(1-c_1-b_1)] [c_0 - c_1 T + b_0 - b_2 i \text{ bar} + G] - b_2 i \text{ bar}$
This is obtained by substitution of the equilibrium level of income into the equation for investment.
 - d. From part (b), the equilibrium level of income is $Y = [1/(1-c_1-b_1)] [c_0 - c_1 T + b_0 - b_2 i \text{ bar} + G]$. This value is substituted into the LM relation so that

$$M/P = d_1 \{ [1/(1-c_1-b_1)] [c_0 - c_1 T + b_0 - b_2 i \text{ bar} + G] \} - d_2 i \text{ bar}$$

5. Consider the following numerical example of the IS-LM model:

$$C = 200 + 0.25Y_D$$

$$I = 150 + 0.25Y - 1000i$$

$$G = 250$$

$$T = 200$$

$$\bar{i} = .05$$

- a. Derive the IS relation. (*Hint: You want an equation with Y on the left side and everything else on the right.*)
- b. The central bank sets an interest rate of 5%. How is that decision represented in the equations?
- c. What is the level of real money supply when the interest rate is 5%? Use the expression:

$$(M/P) = 2Y - 8000i$$

- d. Solve for the equilibrium values of C and I , and verify the value you obtained for Y by adding C , I , and G .
- e. Now suppose that the central bank cuts the interest rate to 3%. How does this change the LM curve? Solve for Y , I , and C , and describe in words the effects of an expansionary monetary policy. What is the new equilibrium value of M/P supply?
- f. Return to the initial situation in which the interest rate set by the central bank is 5%. Now suppose that government spending increases to $G = 400$. Summarize the effects of an expansionary fiscal policy on Y , I , and C . What is the effect of the expansionary fiscal policy on the real money supply?

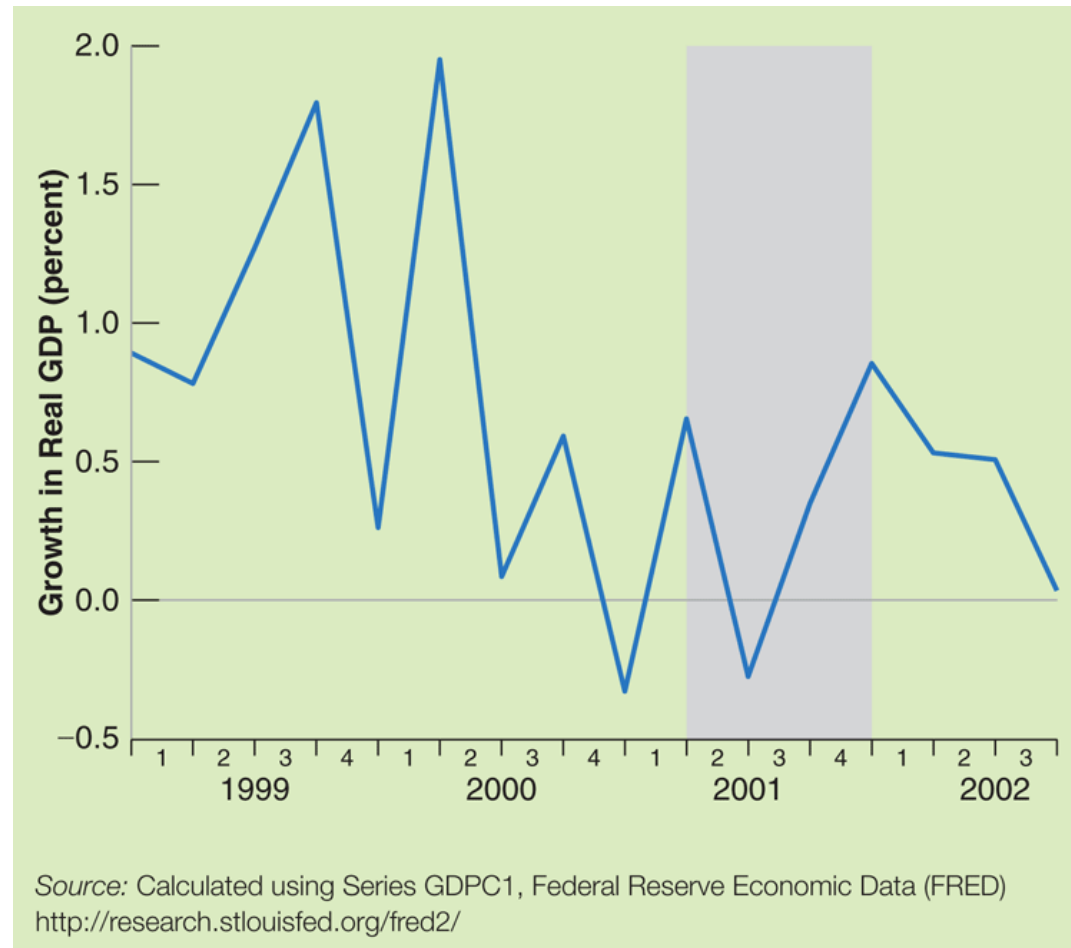
Solutions Ex. 5

5. a. $Y = C + I + G = 200 + .25(Y - 200) + 150 + .25Y - 1000i + 250$
 $Y = 1100 - 2000i$
- b. Substitute the interest rate of 5% (numerical value .05) into $Y = 1100 - 2000 \times (.05) = 1000$
- c. Now substitute both equilibrium income of 1000 and the interest rate of 5% into the right hand side of the real money demand expression
- $$M/P = 2000 - (.05 \times 8000) = 1600$$
- d. $C = 400$; $I = 350$; $G = 250$; $C + I + G = 1000$
- e. $Y = 1040$; $C = 410$; $I = 380$. The reduction in the interest rate increases output consumption increases because output increases. Investment increases because output increases and the interest rate decreases.
- f. At the initial interest rate of 5%, Y equals 1300 when G is increased to 400. A fiscal expansion increases output. Consumption increases because output increases. When the central bank keeps interest rates at 5% then investment increases as output increases, The new level of investment is 425. The new level of consumption is 475.

Focus: The U.S. Recession of 2001

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

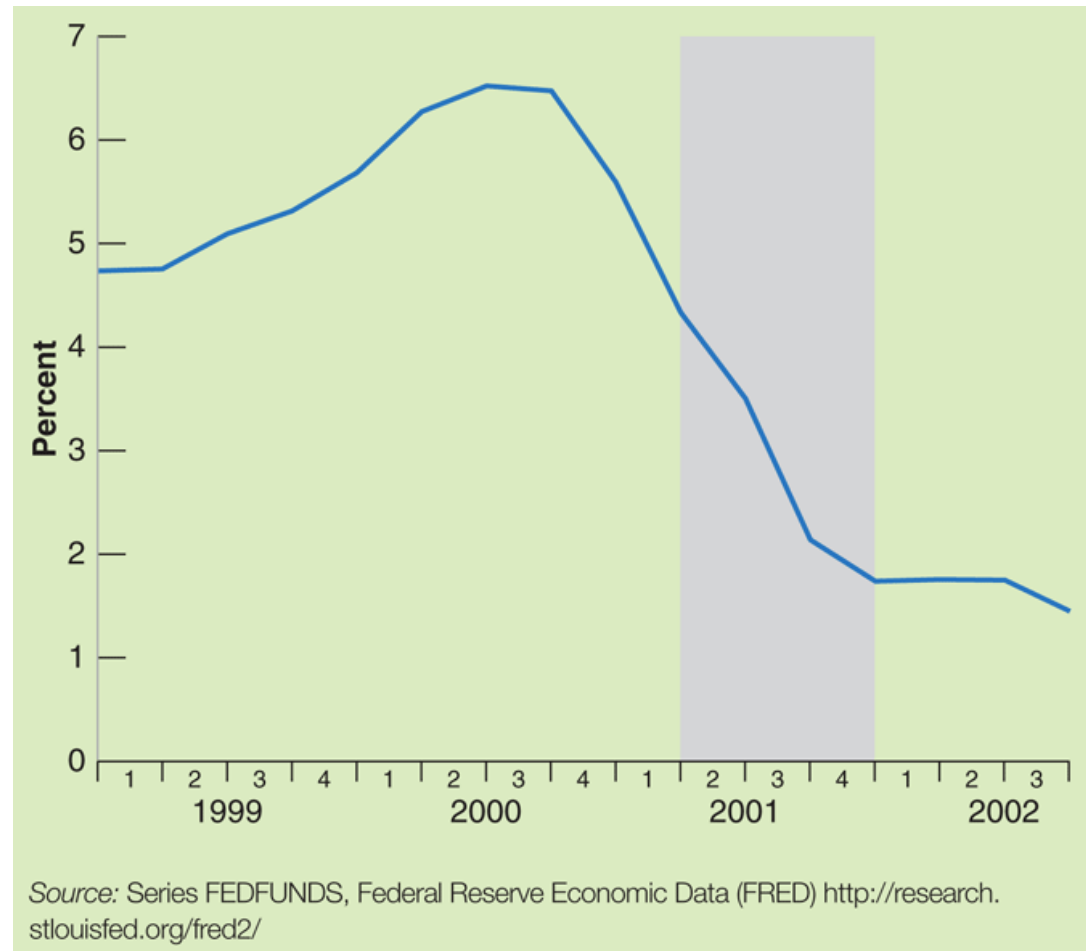
The National Bureau of Economic Research concluded that the U.S. economy was in a recession between March 2001 and December 2001, triggered by sharp declines in investment demand.



Focus: The U.S. Recession of 2001

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

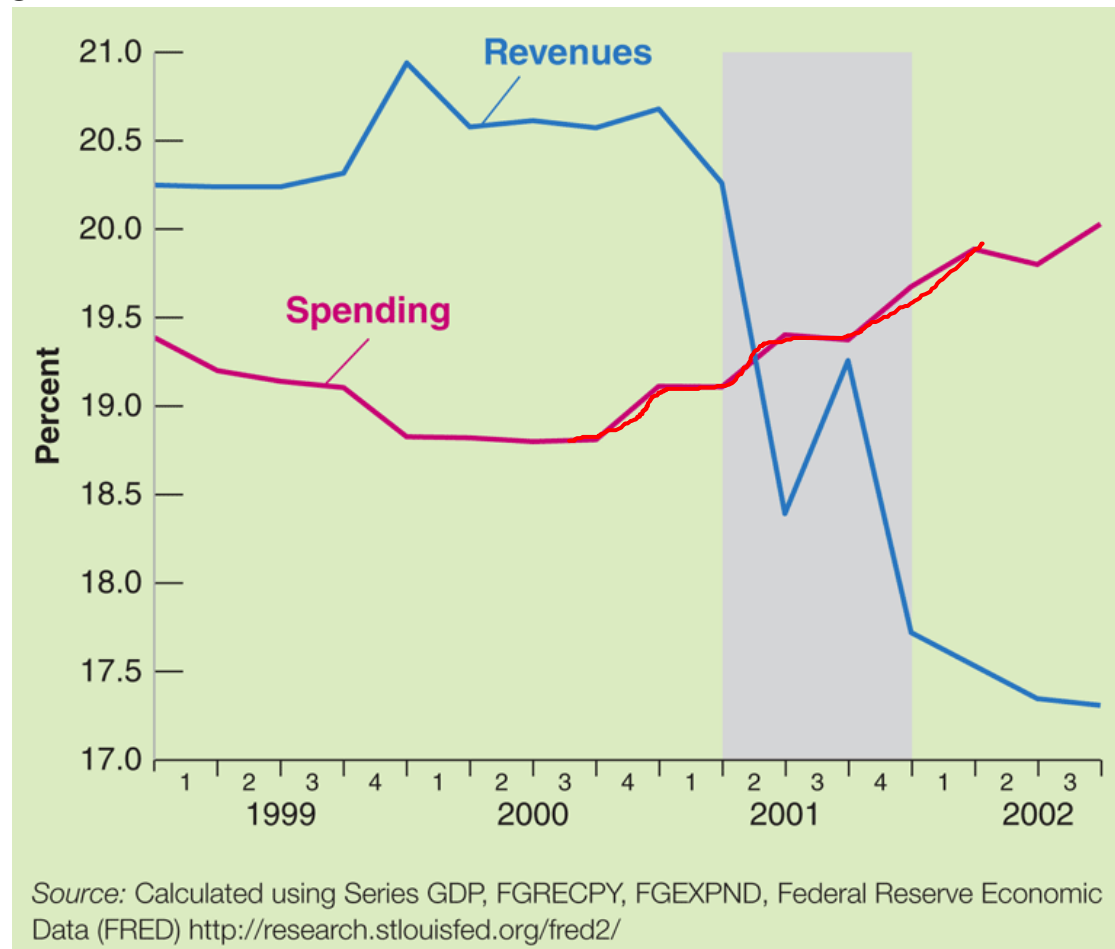
The recession was met by strong macroeconomic policy response. The Fed cut the federal funds rate from 6.5% in January to 2% at the end of 2001.



Focus: The U.S. Recession of 2001

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

President George Bush also cut taxes in 2001 and 2002 budgets. The events of September 11, 2001 also lead to an increase in spending on defense and homeland security.



Economic Growth and COVID-19

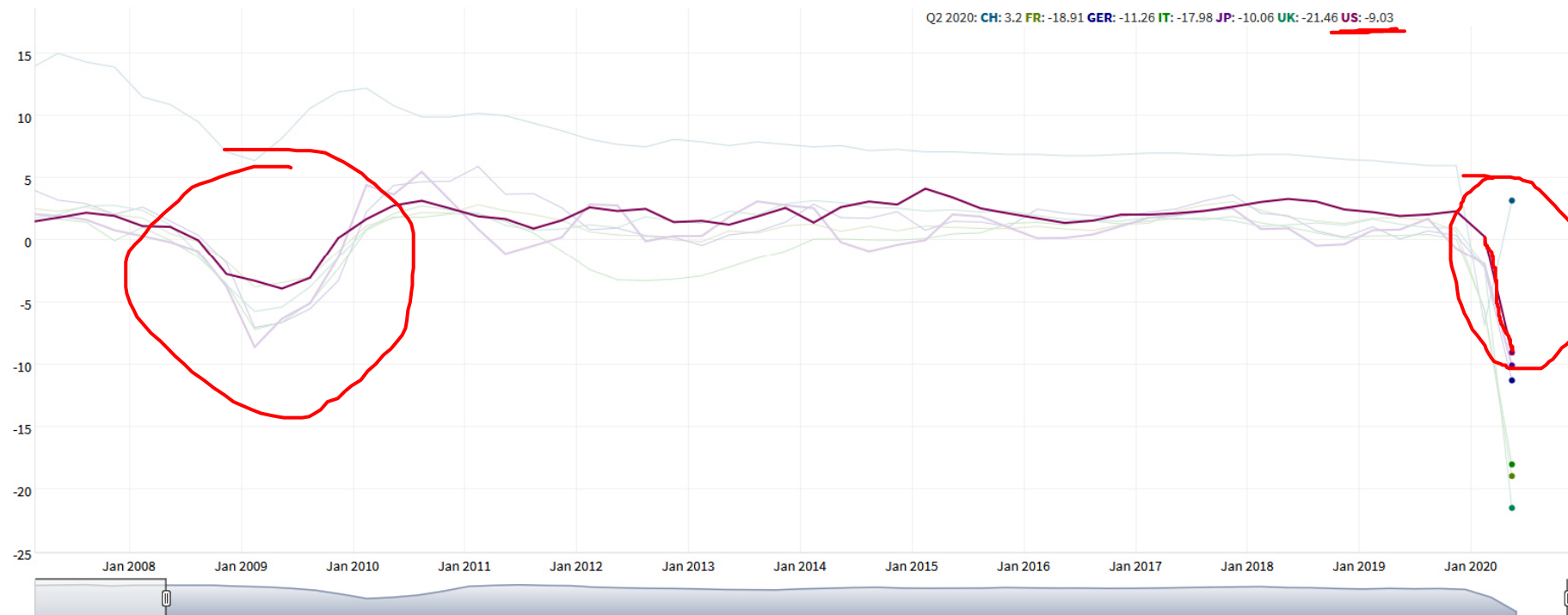
Indicator

Gross Domestic Product, Expenditure Approach, Gross Domestic Product, SA, Change Y/Y

Download

Choose countries

China France Germany Italy
Japan United Kingdom
United States



FOCUS: Deficit Reduction: Good or Bad for Investment?

- Equilibrium in the goods market implies (recall Chapter 3):

$$I = S + (T - G)$$

- Given private saving (S), a lower government deficit (higher $T - G$) means higher I .
- However, a fiscal contraction lowers output and so S goes down by more than $T - G$ increases, so I decreases.

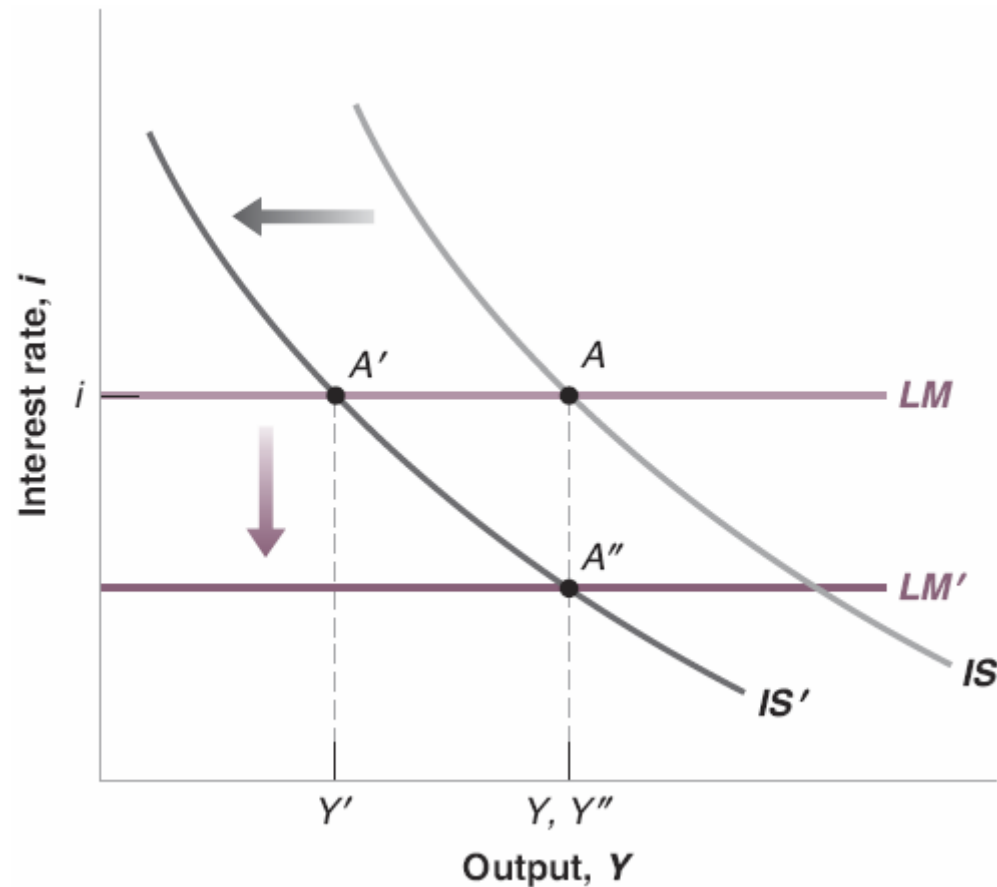
5-4 Using a Policy Mix

Figure 5-9 The Effects of a Combined Fiscal Consolidation and a Monetary Expansion

The fiscal consolidation shifts the IS curve to the left.

A monetary expansion shifts the LM curve down.

This allows for the reduction in the deficit without a recession.



5-5 How Does the *IS-LM* Model Fit the Facts?

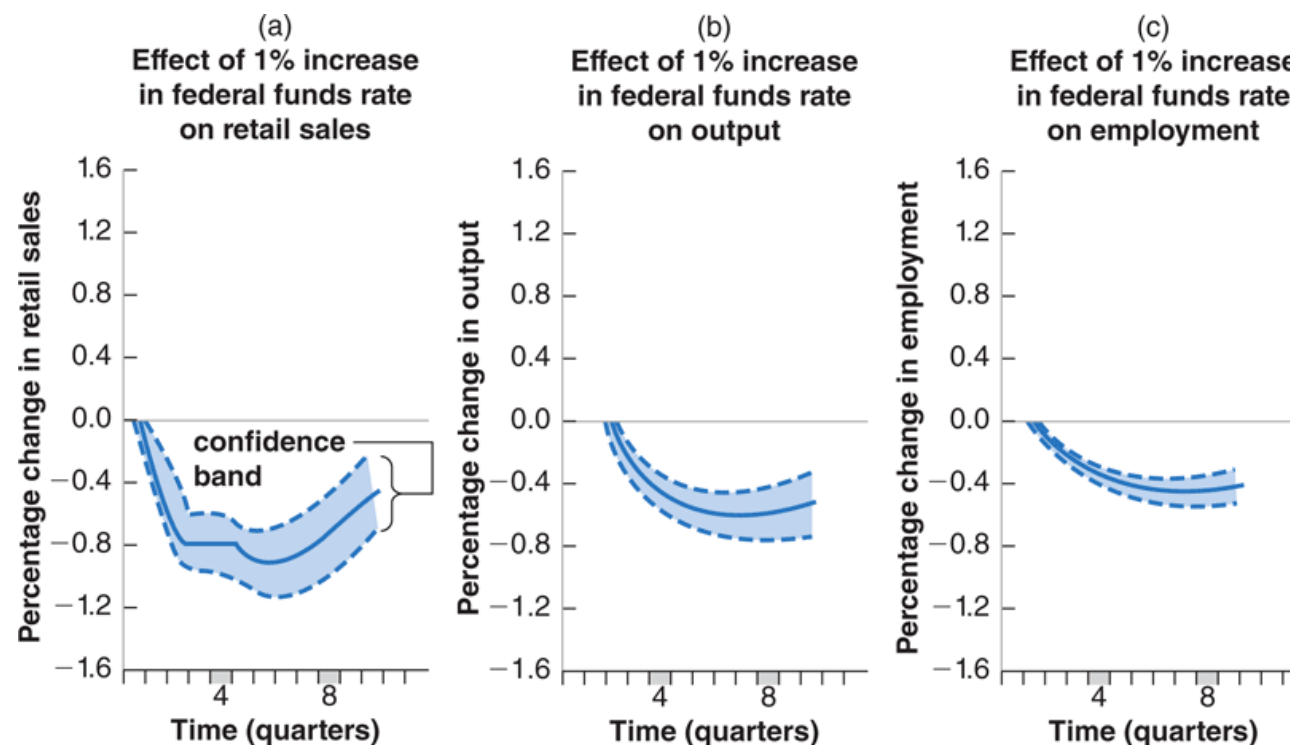
- Because the adjustment of output takes time, we need to reintroduce dynamics:
 - Consumers are likely to take time to adjust their consumption following a change in disposable income.
 - Firms are likely to take time to adjust investment spending following a change in their sales.
 - Firms are likely to take time to adjust investment spending following a change in the interest rate.
 - Firms are likely to take time to adjust production following a change in their sales.

5-5 How Does the *IS-LM* Model Fit the Facts?

Figure 5-10

The Empirical Effects of an Increase in the Federal Funds Rate

In the short run, an increase in the federal funds rate leads to a decrease in output and to an increase in unemployment, but it has little effect on the price level.

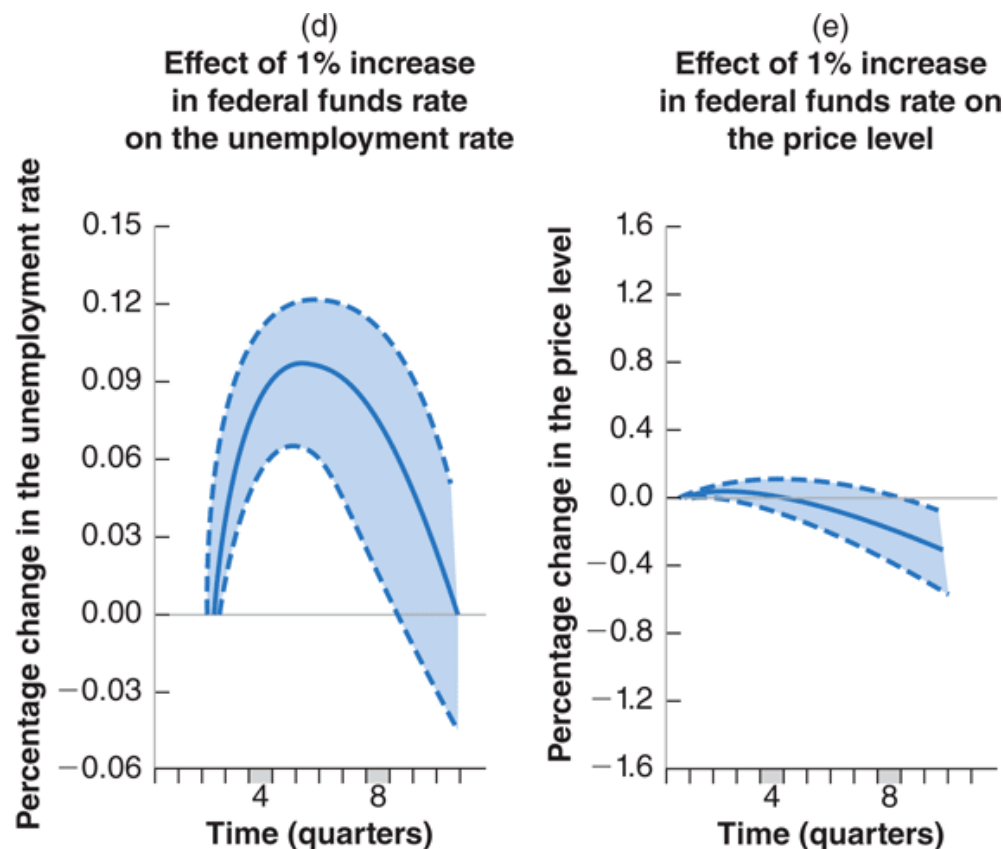


Source: Lawrence Christiano, Martin Eichenbaum, and Charles Evans, "The Effects of Monetary Policy Shocks: Evidence From the Flow of Funds," *Review of Economics and Statistics*. 1996, 78 (February): pp. 16–34.

5-5 How Does the *IS-LM* Model Fit the Facts?

Figure 5-10

The Empirical Effects of an Increase in the Federal Funds Rate



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