

# IS-LM Equilibrium

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Econ520

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# Objectives

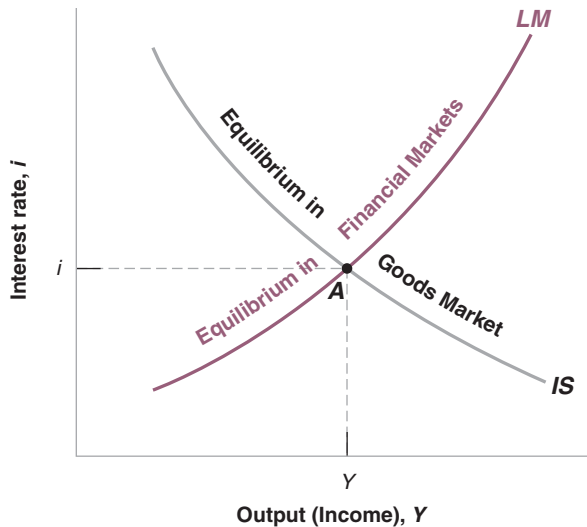
In this section you will learn how to

1. put IS and LM together and derive the equilibrium;
2. determine the effects of shocks and policies on equilibrium output and interest rate

# Model Summary

- ▶ Endogenous objects:  $Y, i$
- ▶ Exogenous objects:  $\bar{I}, c_0, G, T$ 
  - ▶ also  $M$ , which we take as controlled by CB for now
- ▶ Equations:
  - ▶ IS:  $Y = C(Y - T) + I(Y, i) + G$
  - ▶ LM:  $M/P = YL(i)$

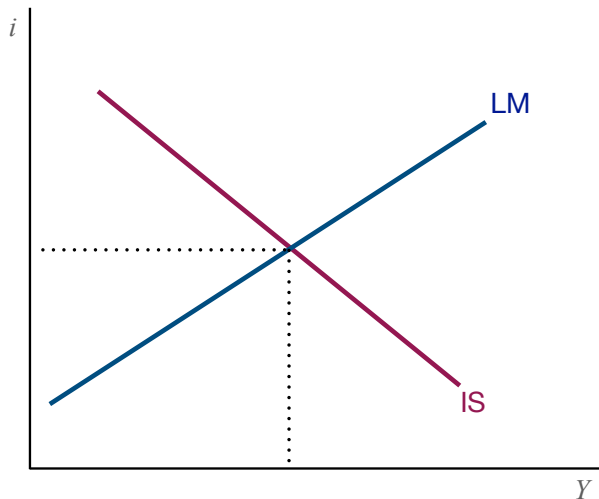
# IS-LM Graph



What happens in each market in each quadrant?

# Applications

## Increasing Taxes



IS:  $Y = C(Y - T) + I(Y, i) + G$ . LM:  $M/P = YL(i)$ . The shock:  $T \uparrow$

# Taxes and Investment

- ▶ A common argument:
  - ▶ higher taxes reduce disposable income and saving
  - ▶ saving = investment
  - ▶ **investment must fall**
- ▶ Another common argument:
  - ▶ higher taxes reduce the government deficit
  - ▶ more money available for investment
  - ▶ **investment rises**
- ▶ Which argument is right?

# What happens in the model?

Identity:  $I = S^P + S^G$

Public saving:  $S^G = T - G$

- ▶ rises by the change in  $T$
- ▶ assuming  $G$  is unchanged!

Private saving:  $S^P = Y - T - C(Y - T)$

- ▶  $(Y - T) \downarrow$
- ▶  $MPC < 1 \implies C \downarrow$  by less than  $Y - T$
- ▶  $S^P \downarrow$

Net change in  $S$  is ambiguous.



# Increasing Taxes

What is missing in our analysis?

- ▶ The **government budget constraint**.

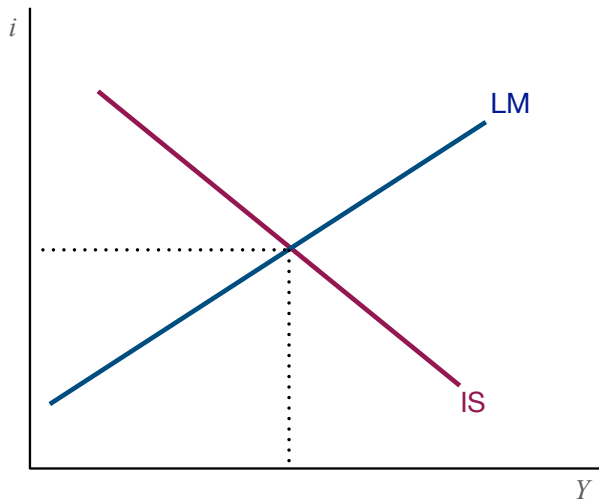
The government cannot raise taxes without changing another policy.

The revenue has to go somewhere.

- ▶ Either  $G \uparrow$  or public debt  $\downarrow$ .

A limitation of the IS/LM model.

## Monetary Expansion



IS:  $Y = C(Y - T) + I(Y, i) + G$ . LM:  $M/P = YL(i)$ . The shock:  $M \uparrow$

# Monetary Transmission

The link between monetary and real sector is the interest rate.

$$M \uparrow \implies i \downarrow \implies I \uparrow$$

What happens when investment is very interest inelastic?

- ▶  $I = \bar{I} + b_1 Y - b_2 i$

- ▶  $b_2$  is small

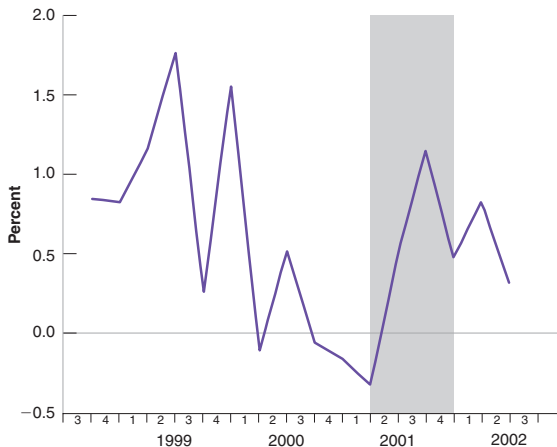
# Policy Mix

The government can, in principle, move  $Y$  and  $i$  independently.

- ▶ Monetary expansion:  $Y \uparrow, i \downarrow$
- ▶ Fiscal expansion:  $Y \uparrow, i \uparrow$
- ▶ Combination:  $Y \uparrow, i$  unchanged

In a typical recession, monetary and fiscal policies expand.

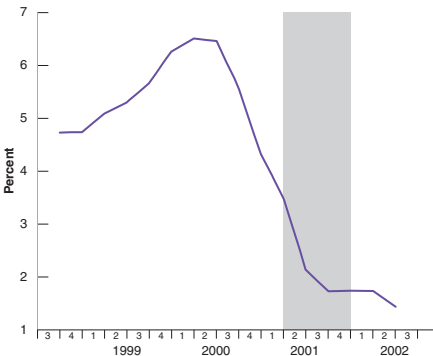
## Example: 2001 Recession



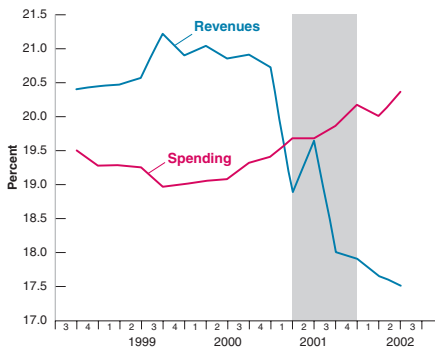
The shock: bursting of the tech bubble  $\Rightarrow I \downarrow$

Growth rate of output

# Policy Responses



Federal funds rate

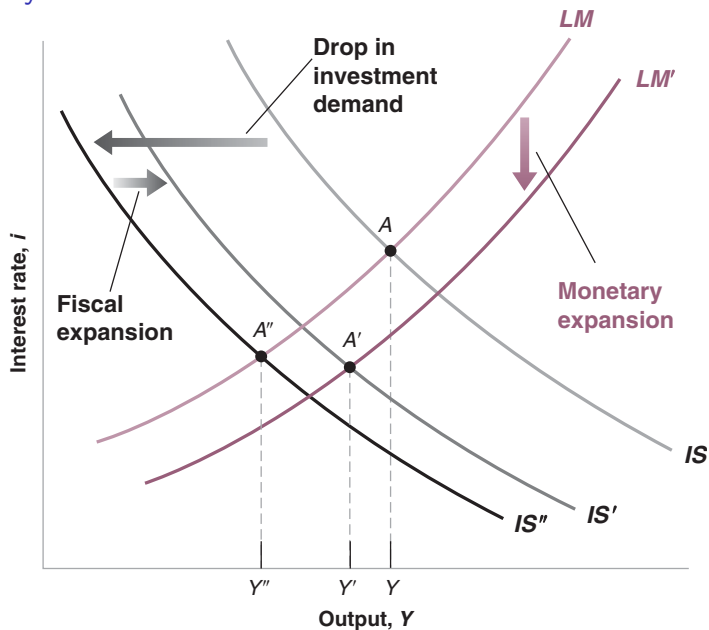


Government spending / revenue

Note that spending moves very slowly.

Revenues drop rapidly (automatic stabilizer).

# Analysis of the 2001 Recession



## How Effective are Tax Cuts?

$$\text{IS: } Y = \bar{Z} + \underbrace{c_1(Y - T)}_C + \underbrace{b_1Y - b_2i}_I$$

Solve for the interest rate:

$$i = \frac{\bar{Z} - c_1T - (1 - b_1 - c_1)Y}{b_2} \quad (1)$$

Slope of IS:  $(1 - b_1 - c_1)/b_2$

- ▶ high MPC  $c_1$  implies flat IS
- ▶ intuition?



# How Effective are Tax Cuts?

Key parameter:  $c_1$  – the marginal propensity to consume.

Shifter of IS (vertical):  $di/dT = -c_1/b_2$

- ▶ high MPC implies large vertical shift
- ▶ intuition?

Shifter of IS (horizontal):  $dY/dT = -\frac{c_1}{1-b_1-c_1}$

- ▶ high MPC implies large horizontal shift
- ▶ unsurprising

Graph: **tax cuts are less effective when MPC is low.**

- ▶ use vertical IS shift to show this
- ▶ intuition...

# How Large is the MPC?

*Empirical estimates of the aggregate marginal propensity to consume (MPC) in the U.S. range from 0.05 to 0.9 depending on the event and sample of the study.*

*– Background: Marginal Propensities to Consume in the 2021 Economy —{ } Penn Wharton Budget Model*

That's a pretty wide range!

Why so wide?

# How Large is the MPC?

## Key point

There is no one MPC.

Each person has their own MPC.

Each stimulus / shock has its own MPC.

A simple model of consumption / saving helps to understand this.

# A Simple Model

Assumptions:

- ▶ Households like smooth consumption
- ▶ They can borrow and lend freely

Budget constraint:

$$\text{present value of consumption} = \text{present value of income} \\ + \text{initial wealth}$$

Why?

- ▶ We derive this later for the government
- ▶ The same logic applies to any household who can borrow and save

If you want to see the details in a more general model, see the slides from previous years.

# A Simple Model

Simplifying assumption: households want **constant** consumption

- ▶ more general: smooth consumption, but the implications are the same

Simplifying assumption: the real interest rate is zero

- ▶ non-zero interest rates change the math, but not the message

Then the budget constraint is simply:

$$\underbrace{\sum_{t=1}^T c_t}_{\text{PV of cons.}} = T\bar{c} = \underbrace{\sum_{t=1}^T (y_t - Tax_t)}_{\text{PV of income}} + a_1 \quad (2)$$

## Marginal Propensity to Consume

$$\bar{c} = \frac{1}{T} \left[ \sum_{t=1}^T (y_t - Tax_t) + a_1 \right] \quad (3)$$

MPC out of one year's income:  $\partial \bar{c} / \partial y_t = 1/T$

- ▶ age 20; life-expectancy 85: MPC =  $1/65$
- ▶ age 50; life-expectancy 85: MPC =  $1/35$

# Implications

The MPC should be small for most people.

- ▶ key, robust intuition ...

But **permanent** tax cuts are very different.

- ▶  $MPC = \dots$

Expectations of future income matter a lot.

- ▶ we come back to that point later.

So tax cuts are hopeless for stimulating the economy?

- ▶ who has a high MPC?

# Implications

Tax cuts can be effective, but they need to target the right populations.

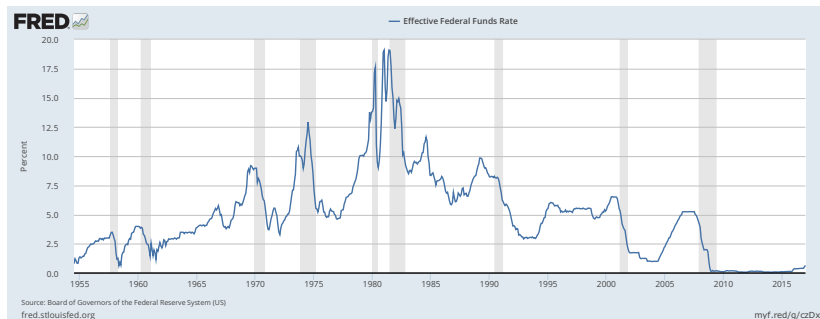
- ▶ tax cuts that benefit the rich are mostly saved
- ▶ tax cuts that benefit the poor are mostly consumed



# Liquidity Traps

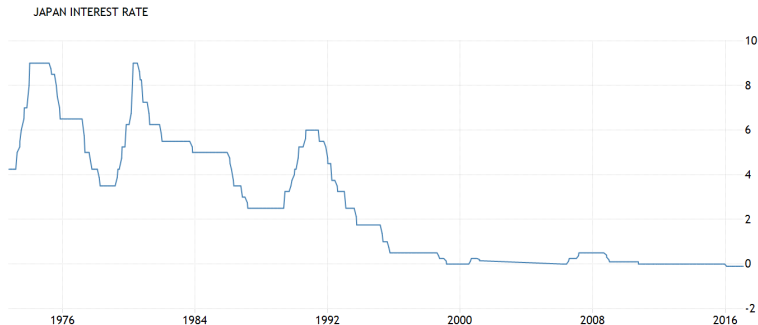
- ▶ How effective is monetary policy?
- ▶ Real interest rates have been near zero for some time.
- ▶ Suggests flat LM curve.
- ▶ “Liquidity trap”

# US Federal Funds Rate



Source: Fred

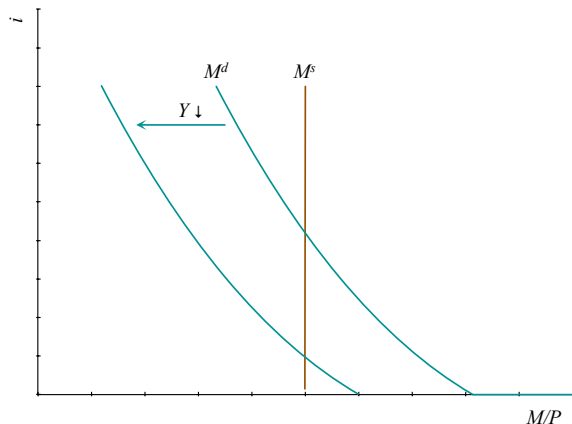
# Japan's Central Bank Rate



SOURCE: [WWW.TRADINGECONOMICS.COM](http://WWW.TRADINGECONOMICS.COM) | BANK OF JAPAN

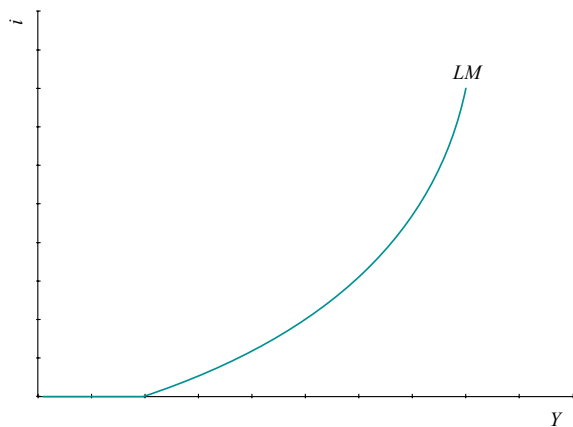
Source: Trading Economics

# Liquidity Trap



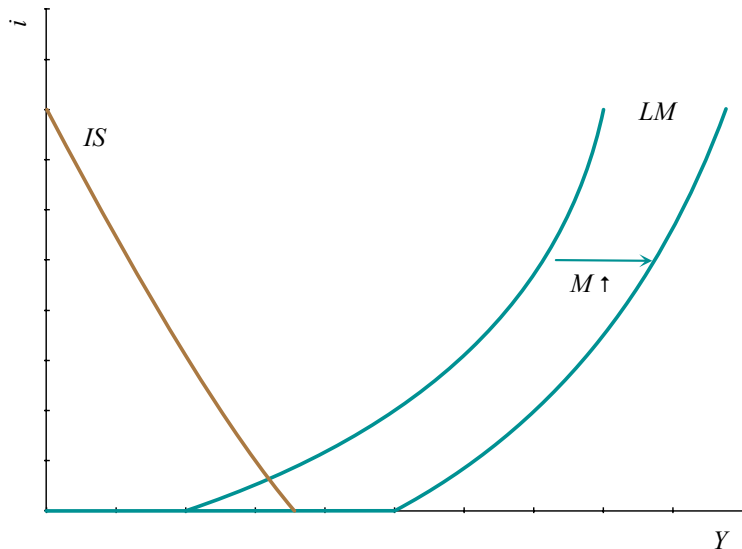
- ▶ The LM curve is derived by varying  $Y$  and tracing out  $i, M/P$  points that clear the money market.
- ▶ For low  $Y$  the interest rate hits 0 and the LM curve becomes flat.

# Liquidity Trap



The LM curve is flat at 0 interest rates.

## Liquidity Trap: Monetary Policy

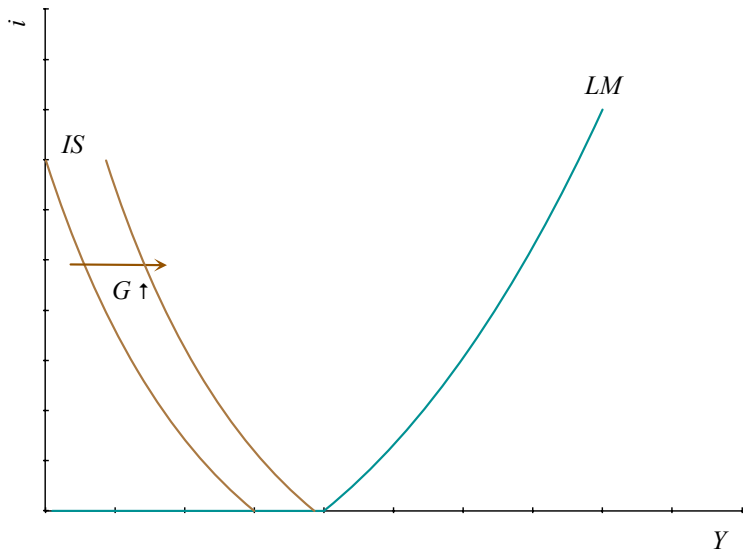


Monetary policy becomes ineffective

## Policy options in a liquidity trap

If the interest rate is zero, what can the Fed do?

## Liquidity Trap: Fiscal Policy



Fiscal policy becomes highly effective



# The Role of Expectations

# The Role of Expectations

Consumption and investment decisions are forward looking.  
Future output increases today's spending.

Implications for policy:

1. Expectations become a policy tool.
2. Persistent policies are stronger than temporary ones.

## Expectations: Monetary Policy

A monetary expansion now has 2 effects:

1. direct:  $i \downarrow \implies LM$  shifts right
2. indirect: expectations change

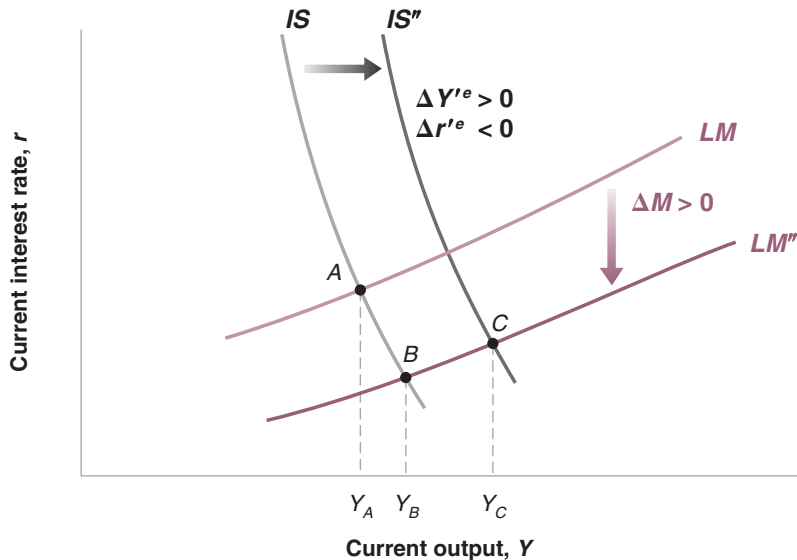
Transitory monetary expansion:

- ▶ no change in future  $Y', i'$  (primes denote future)
- ▶ small policy effect

Persistent monetary expansion:

- ▶ expect LM to stay shifted
- ▶  $Y' \uparrow$  and  $i' \downarrow$
- ▶ IS shifts right as well

## Expectations: Monetary Policy



Transitory  $M \uparrow$ :  $A \rightarrow B$ . Persistent  $M \uparrow$ :  $A \rightarrow C$

# Expectations: Monetary Policy

## Key point

Monetary policy is more powerful, if it can change expectations.

## Example

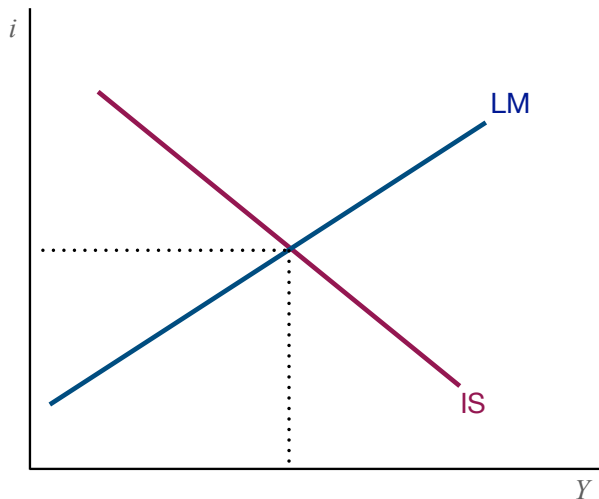
Quantitative Easing

The Fed buys large amounts of long-term bonds.

Signals that interest rates will remain low for a long time.

## Expectations: Fiscal Policy

Can a cut in government spending stimulate aggregate demand?



## A Few Major Caveats

The IS-LM model makes the government look too powerful.

- ▶ By raising  $G$  it can achieve any level of  $Y$ .
- ▶ When is this a reasonable shortcut?

It looks like saving lowers output.

- ▶ What is missing?

# Why Do We Still Have Recessions?

In the model, the government can stabilize output too easily.

Real world complications:

1. Big and variable lags until policies become effective
2. Lags in diagnosis and implementation of policies
3. Expansionary fiscal policies create debt
4. Expansionary monetary policies create inflation



## An important point to remember

The IS-LM model makes strong assumptions: fixed prices, elastic supply, government can borrow without cost.

When applying the model, you need to consider how these assumptions modify the results.

(Or build a more comprehensive model)

## Reading

Blanchard (2018), ch. 5 and 9.2; ch. 17 on expectations.

## References I

Blanchard, O. (2018): *Macroeconomics*, Boston: Pearson, 8th ed.