

# IS-LM Equilibrium

Prof. Lutz Hendricks

Econ520

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# Objectives

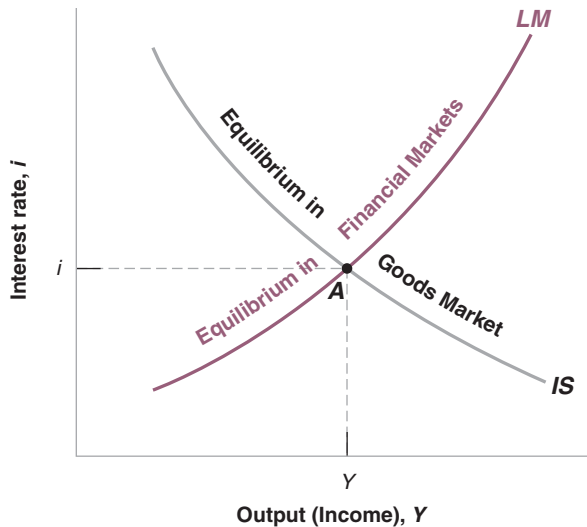
In this section you will learn how to

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:  $M/P = YL(i)$

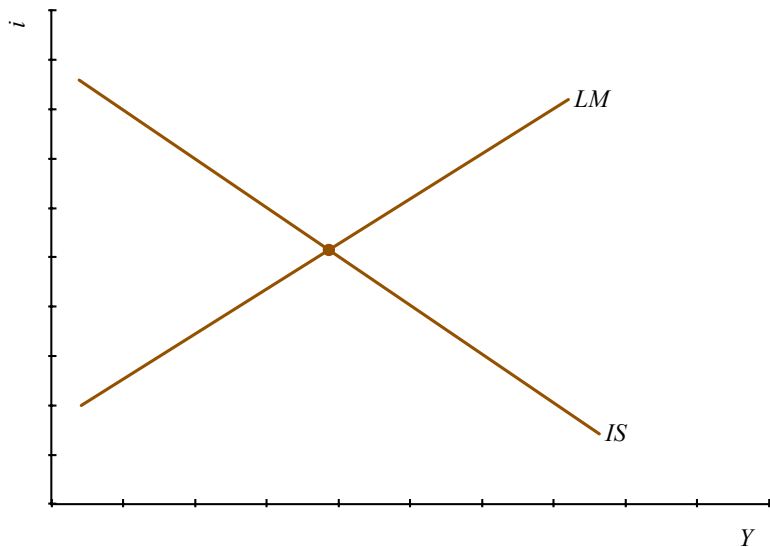
# IS-LM Graph



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:  $T \uparrow$

# Increasing Taxes: The Process

Key point:

- ▶  $Y \downarrow \implies$  agents hold too much money.
- ▶ Selling money means buying bonds.
- ▶ This drives up bond prices.
- ▶ This drives down interest rates.
- ▶ This stimulates demand for goods.

# Taxes and Investment

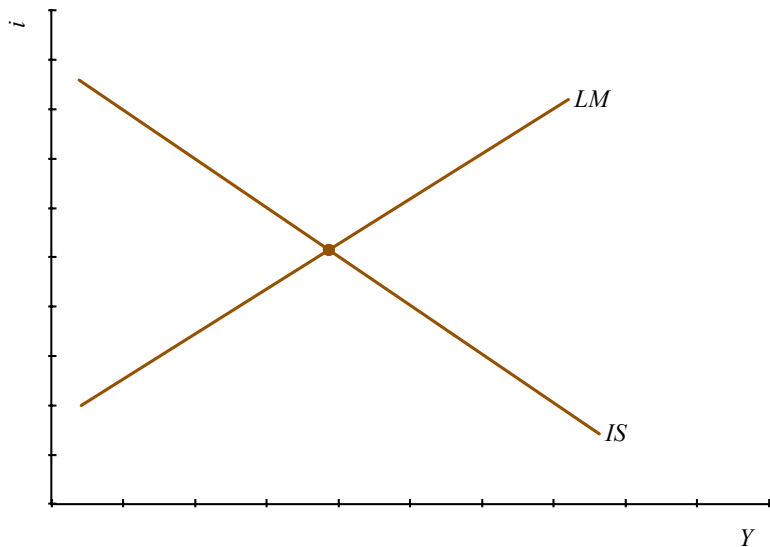
- ▶ A common argument:
  - ▶ higher taxes reduce disposable income and saving
  - ▶  $\text{saving} = \text{investment}$
  - ▶ investment must fall
- ▶ Another common argument:
  - ▶ higher taxes reduce the government deficit
  - ▶ more money available for investment
- ▶ Which argument is right?



# Increasing Taxes

What is missing in our analysis?

## Monetary Expansion

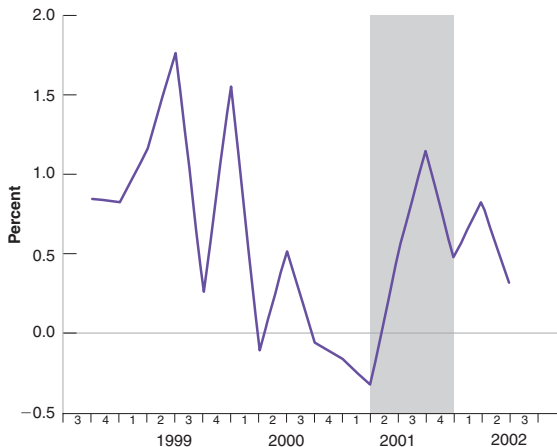


IS:  $Y = C(Y - T) + I(Y, i) + G$ . LM:  $M/P = YL(i)$ . The shock:  $M \uparrow$

# Policy Mix

- ▶ By combining monetary and fiscal policy, 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

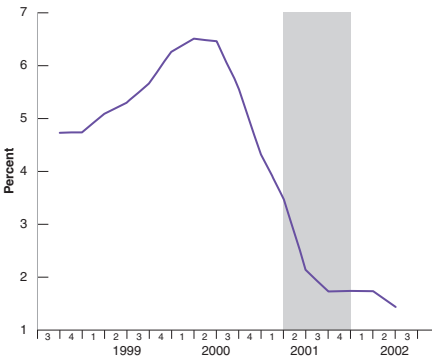
## Example: 2001 Recession



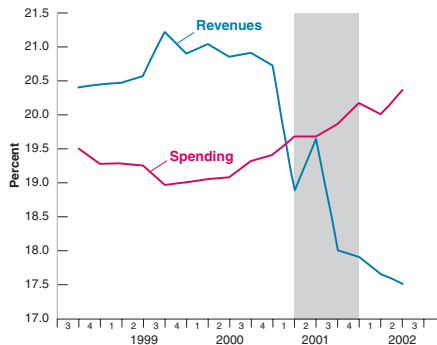
The shock: bursting of the tech bubble  $\Rightarrow I \downarrow$

Growth rate of output

# Policy Responses

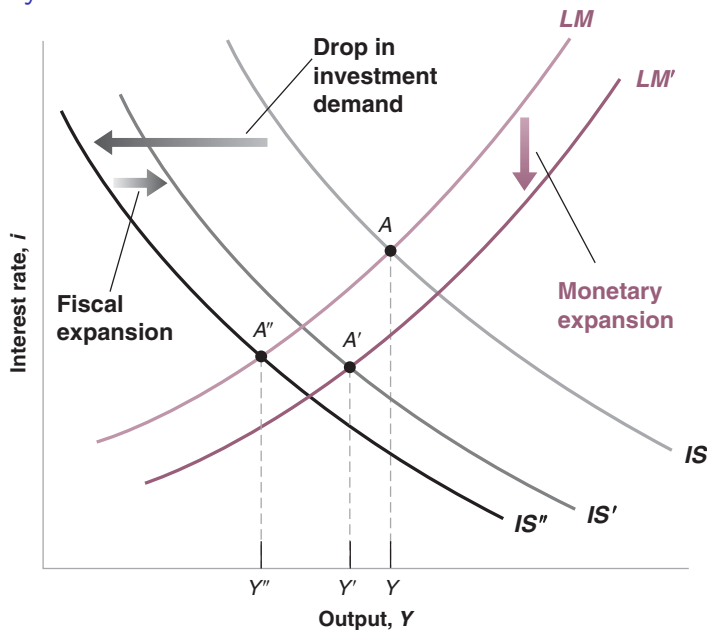


Federal funds rate



Government spending / revenue

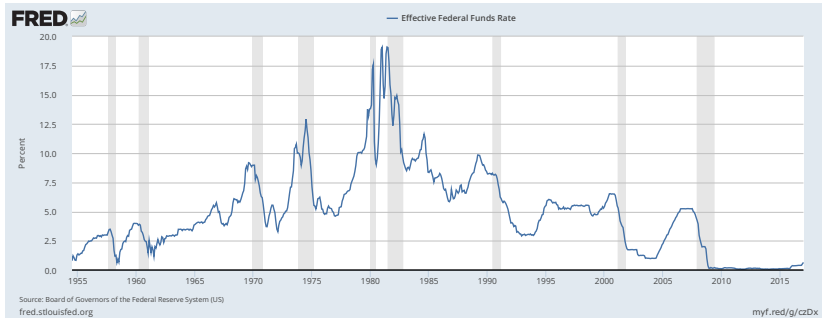
# Analysis of the 2001 Recession



# Liquidity Traps

- ▶ Why do monetary policies have such a hard time pulling Japan out of recession?
- ▶ Real interest rates near zero
- ▶ Suggests flat LM curve
- ▶ “Liquidity trap”

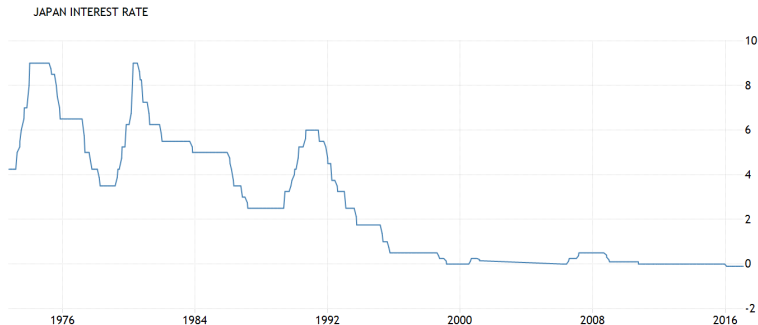
# US Federal Funds Rate



Soure: Fred



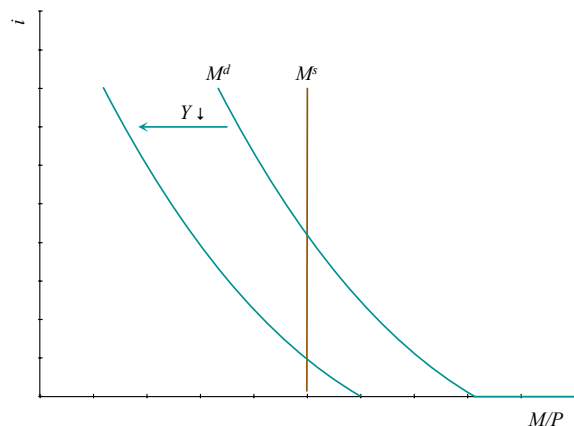
# Japan's Central Bank Rate



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

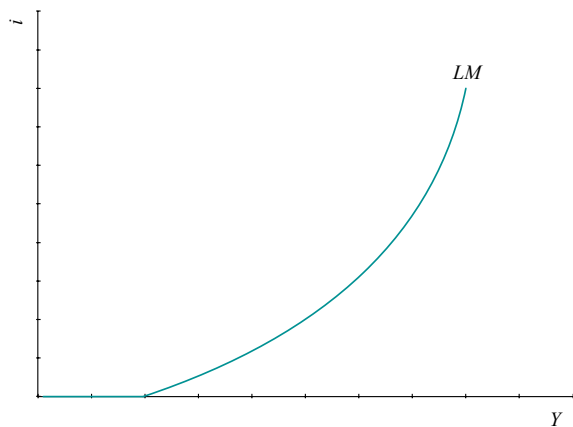
Source: Trading Economics

# Liquidity Trap



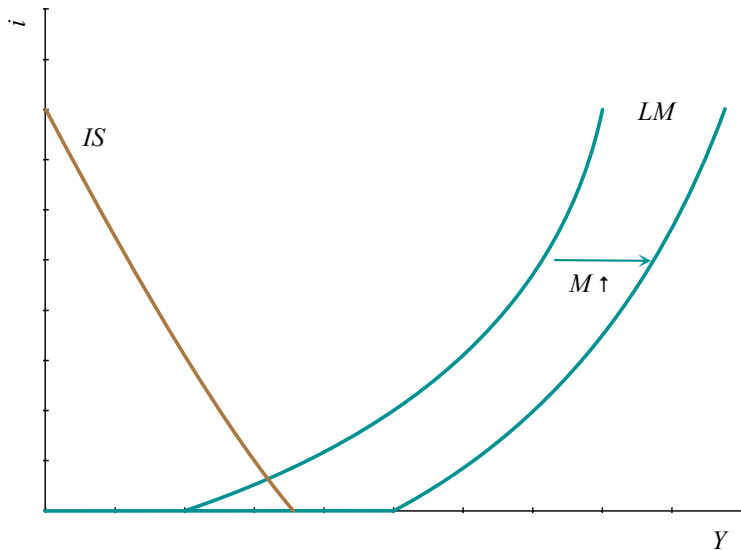
- ▶ The LM curve is derived by varying  $Y$  and tracing out  $i, M/P$  points that clear the money market.
- ▶ For low  $Y$  the interest rate hits 0 and the LM curve becomes flat.

# Liquidity Trap



The LM curve is flat at 0 interest rates.

## Liquidity Trap: Monetary Policy

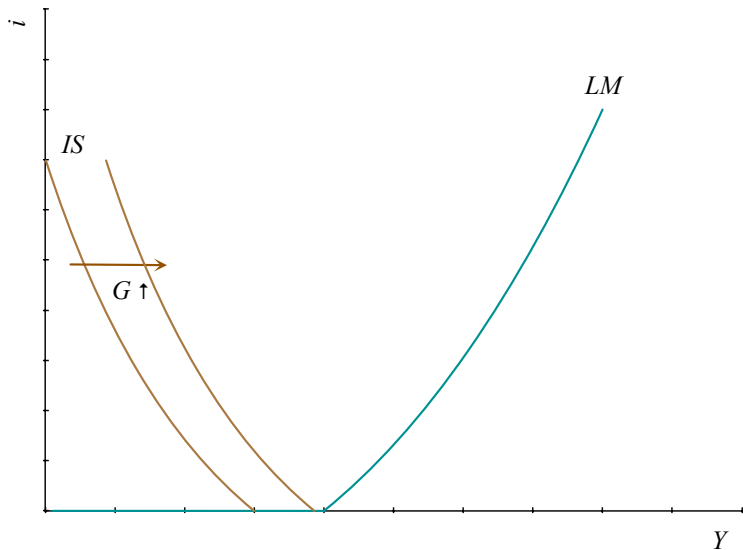


Monetary policy becomes ineffective

## 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

## 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)

Adding Banks

# Adding Banks

In the IS/LM model, the Fed looks very powerful.

- ▶ it controls  $i$  and thus investment.

In reality, the behavior of banks can undo monetary policy actions.

# The role of banks

Banks take in deposits and turn them into loans.

The Fed requires banks to hold about 10% of their deposits in **reserves**.

- ▶ “reserve requirement”
- ▶ reserves are held in special accounts with the Fed

The purpose: ensure that banks have enough **liquidity** in case deposits are withdrawn.

# Why do banks matter for monetary policy?

Suppose the Fed increases the supply of money.

- ▶ this is vague for now (how does the Fed actually do this?)

Typically, this increases the amount of loans banks make, which drives down  $i$ .

In some situations, banks absorb the additional money without creating additional loans.

- ▶ they increase their CB reserves
- ▶ then monetary policy has no power to lower interest rates
  - ▶ example: 2008 financial crisis

# The Money Multiplier

Money = currency + checkable deposits (+ perhaps other stuff)

▶  $M = CU + D$

The Fed does not directly control  $M$ .

It controls high powered money  $H$

▶ supplied as currency  $CU$  or reserves central bank  $R$ .

How do we get from  $H$  to  $M$ ?

▶ the answer is: via bank lending

## Bank lending

In principle, banks could make loans of unlimited size.

In practice, the **reserve requirement** limits bank lending

The Fed requires that banks hold fraction  $\bar{\theta}$  of their deposits in a Fed account.

Only the remainder can be lent out.

$$R \geq \bar{\theta}D \quad (1)$$

Typically,  $\bar{\theta} \approx 0.1$ .

Of course, banks may hold larger reserves:  $\theta \geq \bar{\theta}$

# Money Demand With Banks

Households:

$$M^d = \$Y \times L(i) \quad (2)$$

Split into deposits  $D$  and currency  $CU$ .

Assume: fraction  $c$  goes into currency

$$CU^d = cM^d \quad (3)$$

$$D^d = (1 - c)M^d \quad (4)$$

Banks: choose reserve ratio  $\theta \geq \bar{\theta}$ :

$$R^d = \theta D \quad (5)$$

$$= \theta(1 - c) \times \underbrace{\$Y \times L(i)}_{M^D} \quad (6)$$



# Money Market Clearing

$$H = CU^d + R^d \quad (7)$$

$$= [c + \theta(1 - c)]\$Y \times L(i) \quad (8)$$

With a fixed reserve ratio  $\theta$ :

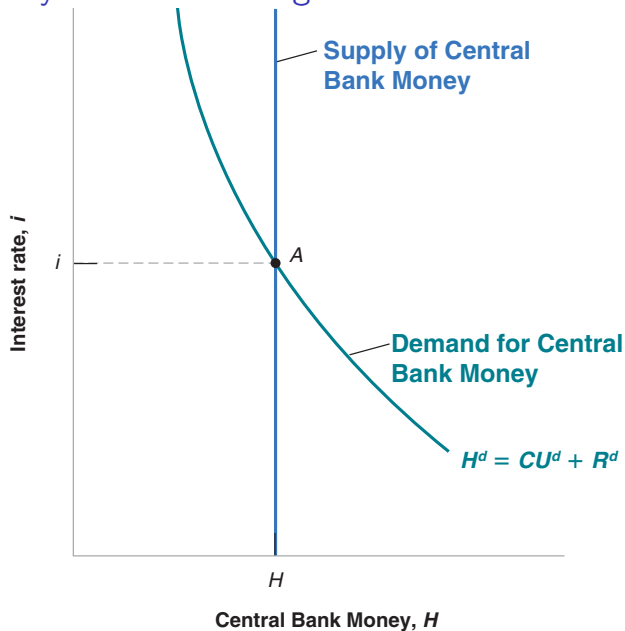
- ▶ higher  $H \implies$  lower  $i$

With variable  $\theta$ :

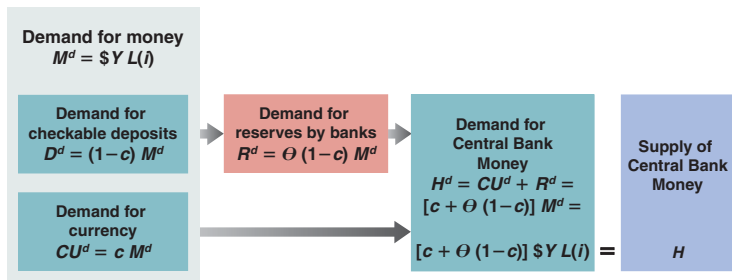
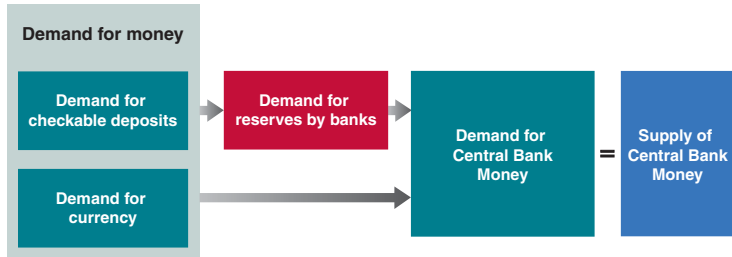
- ▶ bank actions can change the “effective” money supply and  $i$  even with constant  $H$
- ▶ example: 2008. Banks raise  $\theta$  to gain liquidity.

This is an important limitation of monetary policy.

# Money Market Clearing



# Money Market Clearing With Banks



# The Money Multiplier

$$\frac{1}{c + \theta(1 - c)} H = \$YL(i) \quad (9)$$

A \$1 increase in CB money supply increases money available to households by  $\frac{1}{c + \theta(1 - c)} > 1$

The lower the reserve ratio  $\theta$ , the larger the multiplier

Intuition: each dollar of  $H$  can be lent out many times

- ▶ round 1: lend  $(1 - \theta)$  and put  $\theta$  in reserves
- ▶ round 2:  $(1 - \theta)$  returns as new deposits and is lent out again
- ▶ round 3: ...

# The Fed Funds Rate

Long ago, changing the reserve requirement  $\bar{\theta}$  was an important tool of monetary policy

- ▶ this is no longer the case

Today, the main monetary policy tool is the **Federal Funds Rate**

- ▶ Banks lend reserves to each other over night at the Fed Funds Rate
- ▶ The Fed controls the FFR tightly by choosing available reserves

The mechanism:

- ▶  $H \downarrow \implies R \downarrow \implies i \uparrow$
- ▶ again, the complication is that banks may reduce  $\theta$  which dampens the effect on  $i$

# Reading

Blanchard and Johnson (2013), ch. 5 and 9.2

On how the Fed works:

- ▶ Johnson, Manuel (2002). “Federal Reserve System.” The Library of Economics and Liberty: a very brief overview of how the Fed operates.
- ▶ Monetary Policy Basics: a brief summary of fed operations.
- ▶ Labonte and Makinen (2017): A more detailed description (including unconventional monetary policy).

## References I

Blanchard, O. and D. Johnson (2013): *Macroeconomics*, Boston: Pearson, 6th ed.

Labonte, M. and G. E. Makinen (2017): “Monetary policy and the Federal Reserve: current policy and conditions,” Congressional Research Service, Library of Congress.