The Short-Run: IS/LM

Prof. Lutz Hendricks

Econ520

August 15, 2024

Objectives

In this section, we build the short-run IS-LM model

You will learn:

1. how to set up and interpret the IS-LM model
2. what its limitations are
3. how to solve for the equilibrium
4. how to analyze the effects of shocks and policies

All of this is review of material you previously learned in Intermediate Macro.

IS-LM Model

Key assumptions:

- Output is determined by aggregate demand
- There is no supply side
- Prices are fixed
- Closed economy

Think: economy in recession, with lots of unemployed resources.

We relax all of these assumptions later.

IS-LM Model

Two markets

- Goods (IS). Money (LM)
- In the background there is also a bond market

Two endogenous variables

- Output (Y). Interest rate (i)

Two policy variables

- Government spending (G). Money supply (M)

Modeling Choices

Why does the model have these ingredients?

We want to talk about monetary and fiscal policies

- main instruments for business cycle stabilization

Main outcome of interest: output Y

- so we need aggregate demand for goods

Monetary policy mainly works by changing interest rates i

- so we need the money / bond market

Fixed prices are for simplicity only.

Modeling Choices

The IS/LM model is the **simplest** model in which we can talk about

- monetary policy
- fiscal policy

A natural reaction is: "The model is too simple. It lacks feature X."

What makes a good model?

- What are models for?

Simple → understand mechanism

What do models do?

Models are stories told in math.

It's often a good idea to start really simple.
Tell the story as clearly as possible.
(You can always add bells and whistles later.)

The IS/LM story

The IS/LM is about **getting economies out of recessions**.

The government has three ways of affecting AD

1. Buy goods (G)
2. Cut taxes (T)
   because AD depends on after tax income.

} Fiscal

} mf

3. Change interest rates (i)
   because the interest rate affects saving (C) and borrowing for investment (I)

There are complicated interactions because

- i depends on AD (money market clearing)
- AD depends on income (a multiplier effect)

2. The Goods Market: IS Curve

Aggregate Demand

Start from an accounting identity

$$Z = C + I + G + \underbrace{X - IM}_{\text{Net exports}}$$

Z is aggregate demand / expenditure.

For now: closed economy with $X - IM = 0$.

Add behavioral assumptions to give it content.

Consumption function

$$C = C(Y_D) = c_0 + c_1 Y_D \tag{1}$$

$Y_D = Y - T$: disposable income (after taxes and transfers)

c_0: "autonomous consumption" (intercept)

c_1: marginal propensity to consume (slope)

$s = 1 - c_1$: marginal propensity to save

Consumption might also depend on wealth, expected incomes, etc.

- these are stuffed into c_0

Investment function

$$I = I(Y, i) = \bar{I} + b_1 Y - b_2 i \tag{2}$$

Investment depends on:

- interest rate i: cost of capital
- output Y: aggregate demand
- expectations etc (again stuffed into the intercept $\bar{I}$)

Government

- Exogenous G and T.
- G is government consumption
- T is tax revenue net of transfer payments

Aggregate Demand

$$Z = C + I + G \tag{3}$$

$$= \underbrace{[c_0 + c_1(Y - T)]}_{C} + \underbrace{[\bar{I} + b_1 Y - b_2 i]}_{I} + G \tag{4}$$

$$= \underbrace{[c_0 + \bar{I} + G - c_1 T]}_{\bar{Z}} + (c_1 + b_1)Y - b_2 i \tag{5}$$

$\bar{Z}$: autonomous spending / demand

- collects all the intercept terms

In words / intuition ...

Isn't this completely arbitrary?

Yes, it is arbitrary.

- We just made up a consumption function from introspection.
- When the model was developed, the choices were based on data.

Is this "bad"?

- It depends on the purpose of the model.

A model is a story told through math.

- This model tells the IS/LM story (see above).

Goods Market Clearing

Assumption: supply is perfectly elastic.

Output equals demand:

$$Y = Z = \bar{Z} + (c_1 + b_1) Y - b_2 i \tag{6}$$

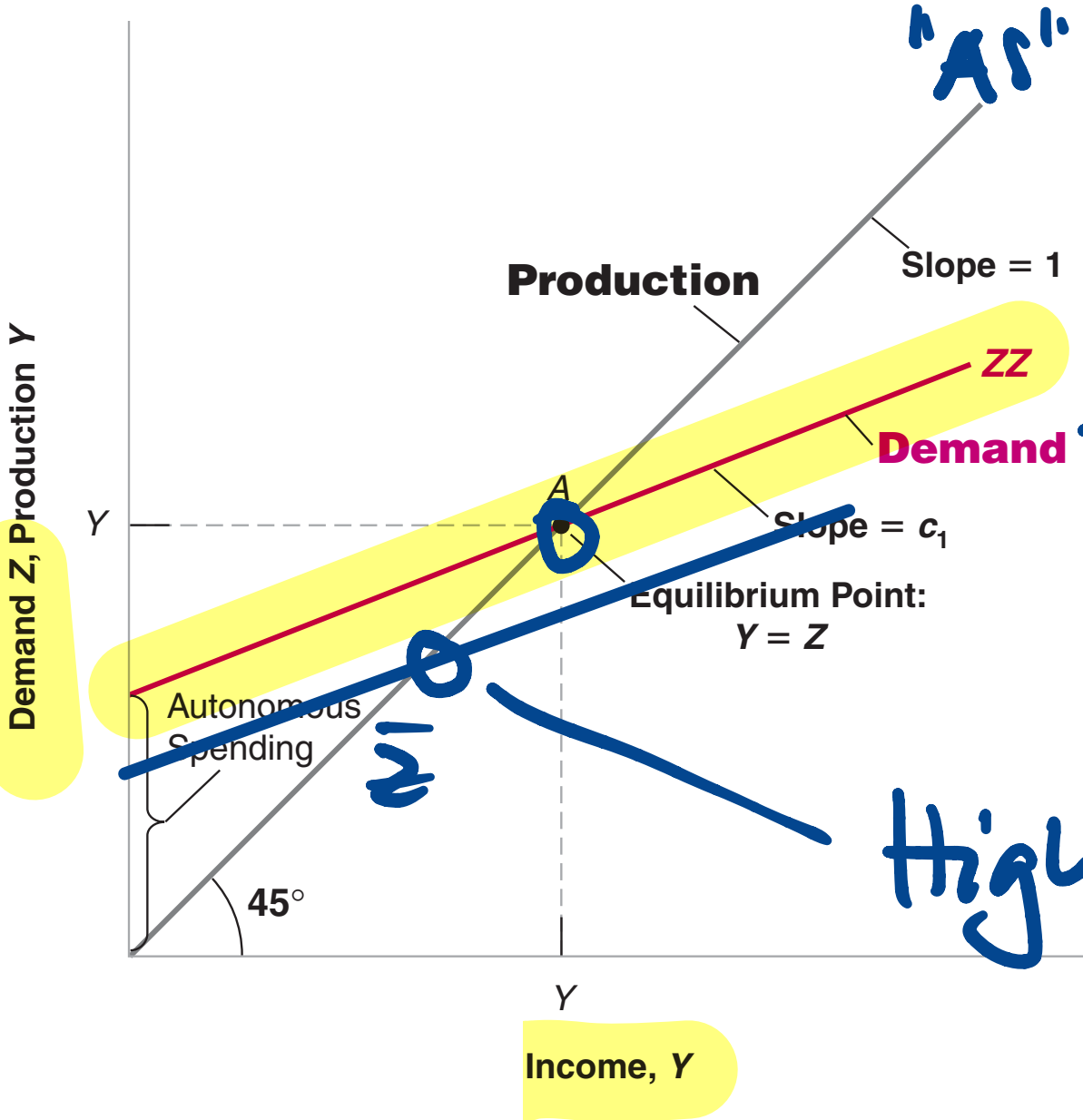
Solve for the level of output that clears the goods market:

$$Y = \frac{\bar{Z} - b_2 i}{1 - c_1 - b_1} \tag{7}$$

Key assumption: marginal propensity to spend $c_1 + b_1 < 1$.

- otherwise we have serious problems...

Goods Market Clearing

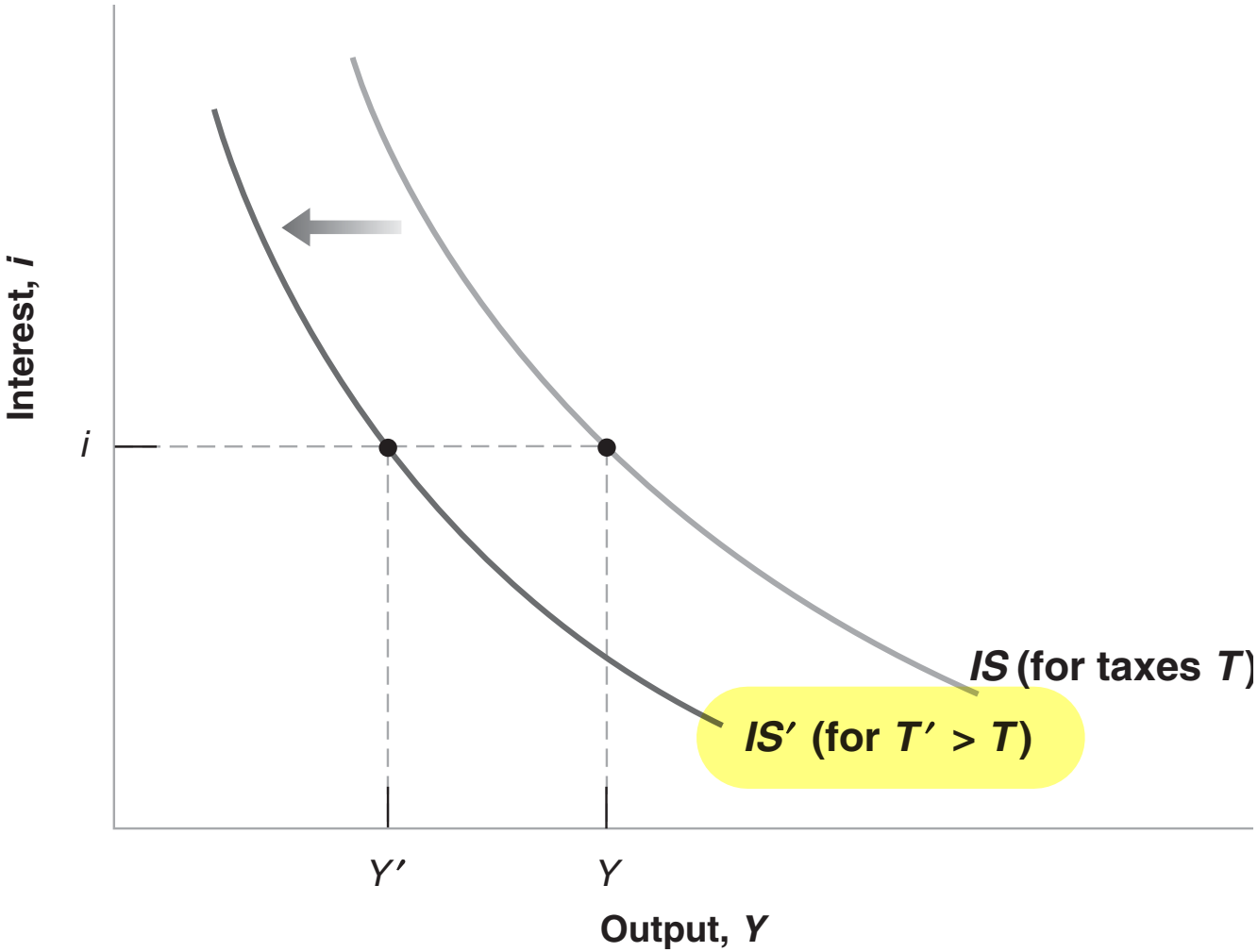


Demand:

$$Z = \bar{Z} + (c_1 + b_1)Y - b_2 i.$$

What happens when the interest rate i rises?

IS Curve



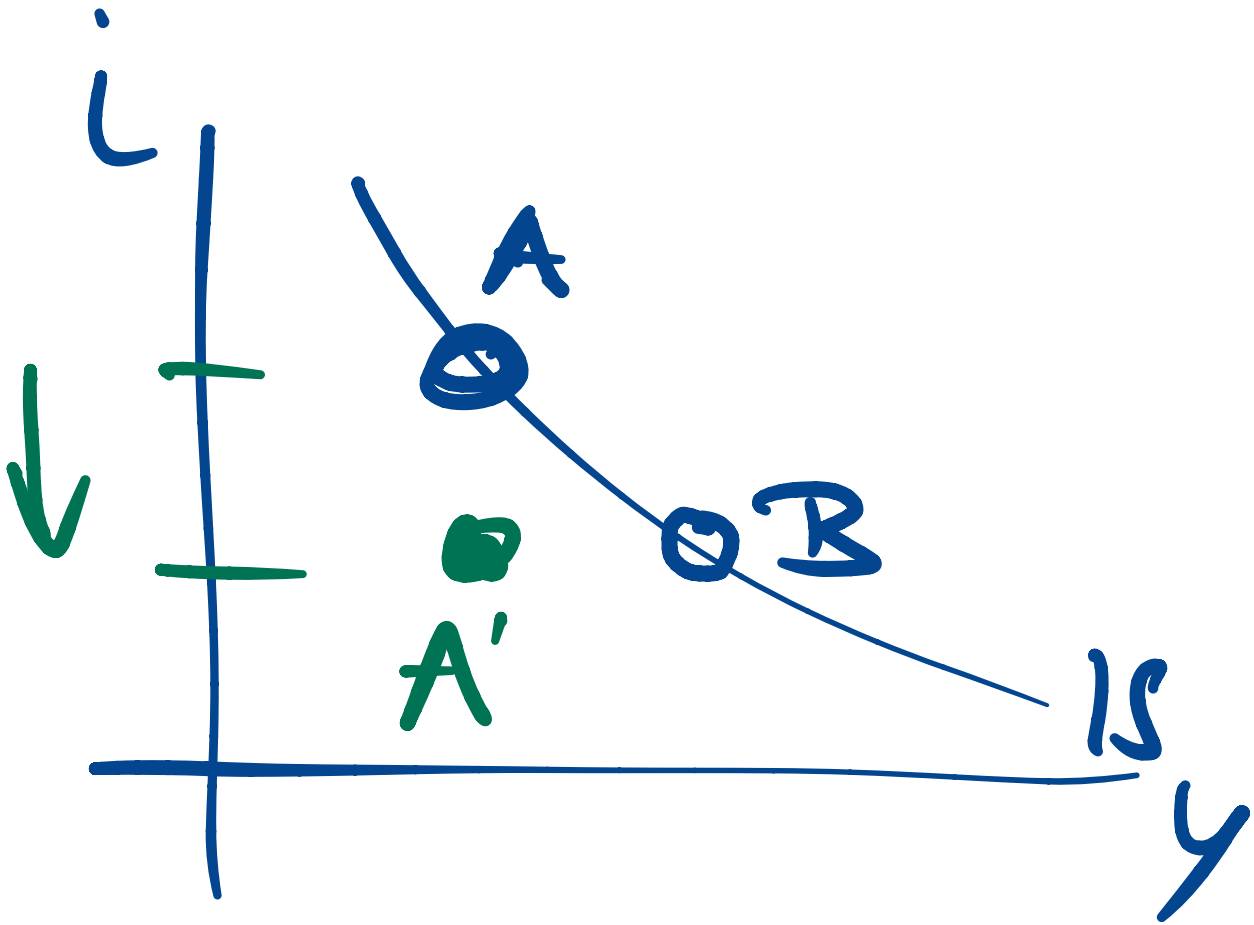
IS collects all (Y, i) for which the goods market clears.

Intuition: IS Curve

IS downward sloping:

$$i = \frac{\bar{Z} - (1 - b_1 - c_1)\, Y}{b_2} \tag{8}$$

Intuition ...



A': i↓, Y fixed → AD↑ > Y

RECAP: IS CURVE

$$Y = Z = C + I + G$$

Linear:

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

$\bar{Z}$: all shifters ($G, T, \ldots$)

Slope:

$$i = \frac{\bar{Z} - (1 - b_1 - c_1) Y}{b_2} \quad < 0$$

Shifting the IS Curve

Only autonomous demand $\bar{Z}$ shifts IS

Example: $G \uparrow$

- Excess demand $\rightarrow$ Need higher i to reduce I
- New IS curve shifted up

What else shifts IS?

$G, T, C_0, \bar{I}$

Clearly distinguish moving along the curve vs. shifting the curve!

The Fiscal Multiplier

$$Y = \frac{\bar{Z} - b_2 i}{1 - c_1 - b_1} \tag{9}$$

\$1 of government spending increases Y by $1/(1-c_1-b_1) > 1$.

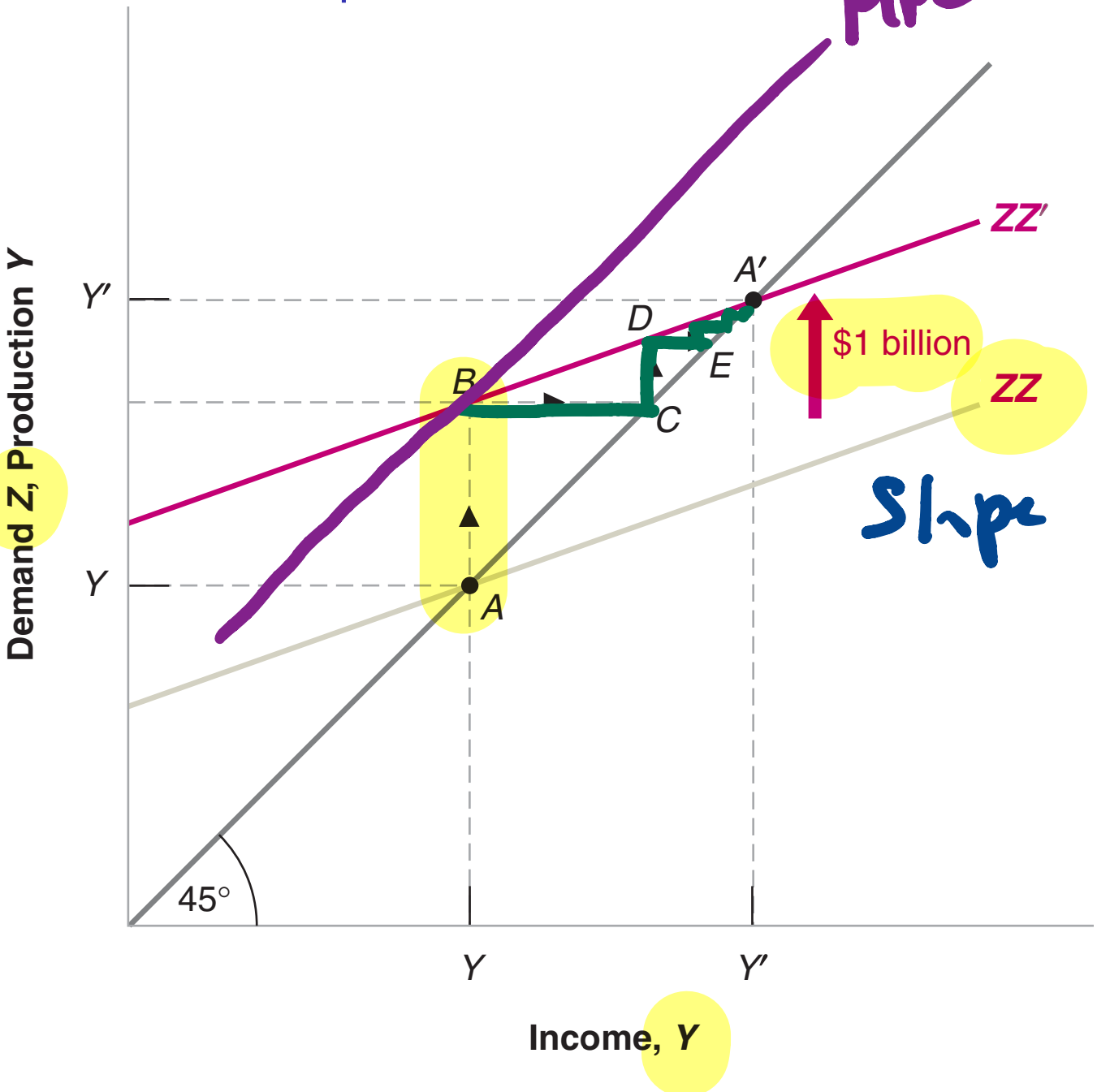
This holds the interest rate constant

- which will not be true in equilibrium

Intuition:

How does a higher MPC (c_1) affect the multiplier?

The Fiscal Multiplier



Saving Equals Investment

We can also think about goods market clearing as equating saving with investment.

Private saving:

$$S = Y_D - C = Y - T - C \tag{10}$$

Public saving:

$$S^P = T - G \tag{11}$$

Total saving equals investment:

$$I = \underbrace{Y - T - C}_{S} + \underbrace{T - G}_{S^P} \tag{12}$$

This yields goods market clearing

$$Y = C + I + G \tag{13}$$

Summary

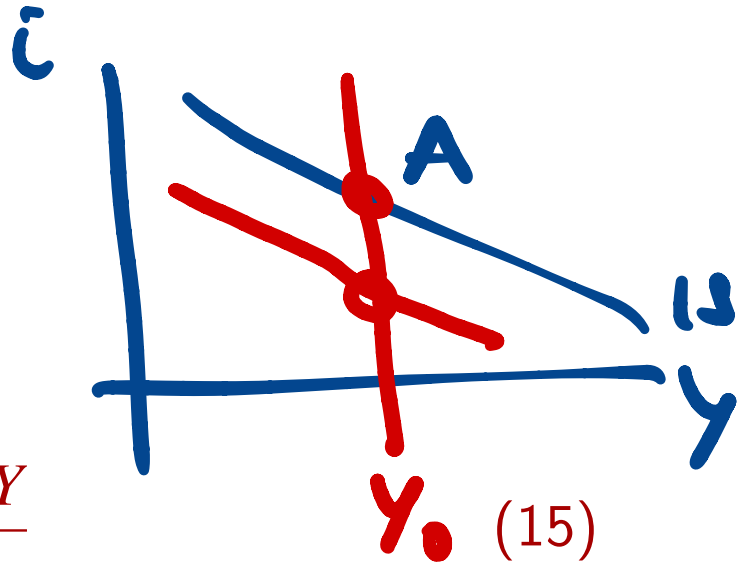
The IS Curve clears the goods market.

It is downward sloping:

$$i = \frac{\bar{Z} - (1 - b_1 - c_1) Y}{b_2} \tag{14}$$

Government spending $G \uparrow$ and other increases in autonomous demand shift IS right.

Questions



$$i = \frac{\bar{Z} - (1 - b_1 - c_1)\,Y}{b_2} \quad (15)$$

1. If taxes T rise, what happens to IS? Given Y, need i↓
2. If investment is highly interest sensitive (high b_2), what happens to IS? flatter
3. If the MPC (c_1) is high, what happens to IS?

$b_1 + c_1 = 0 \Rightarrow$ slope $-\frac{1}{b_2}$

$b_1 + c_1 = 1 \Rightarrow$ slope $= 0$

3. The Money / Bond Market: LM Curve

LM Curve

The LM curve equates supply and demand of "money."

What is "money"?

Key point

Any definition of money is arbitrary.

In reality, there are assets with higher or lower liquidity.

There is no sharp distinction between money (liquid) and "bonds" (illiquid) assets.

Money Demand

How to divide wealth between "money" and bonds?

- Money: liquidity benefit
- Bonds: interest benefit

Division depends on

- transactions volume (nominal income)
  - need for liquidity
- interest rate

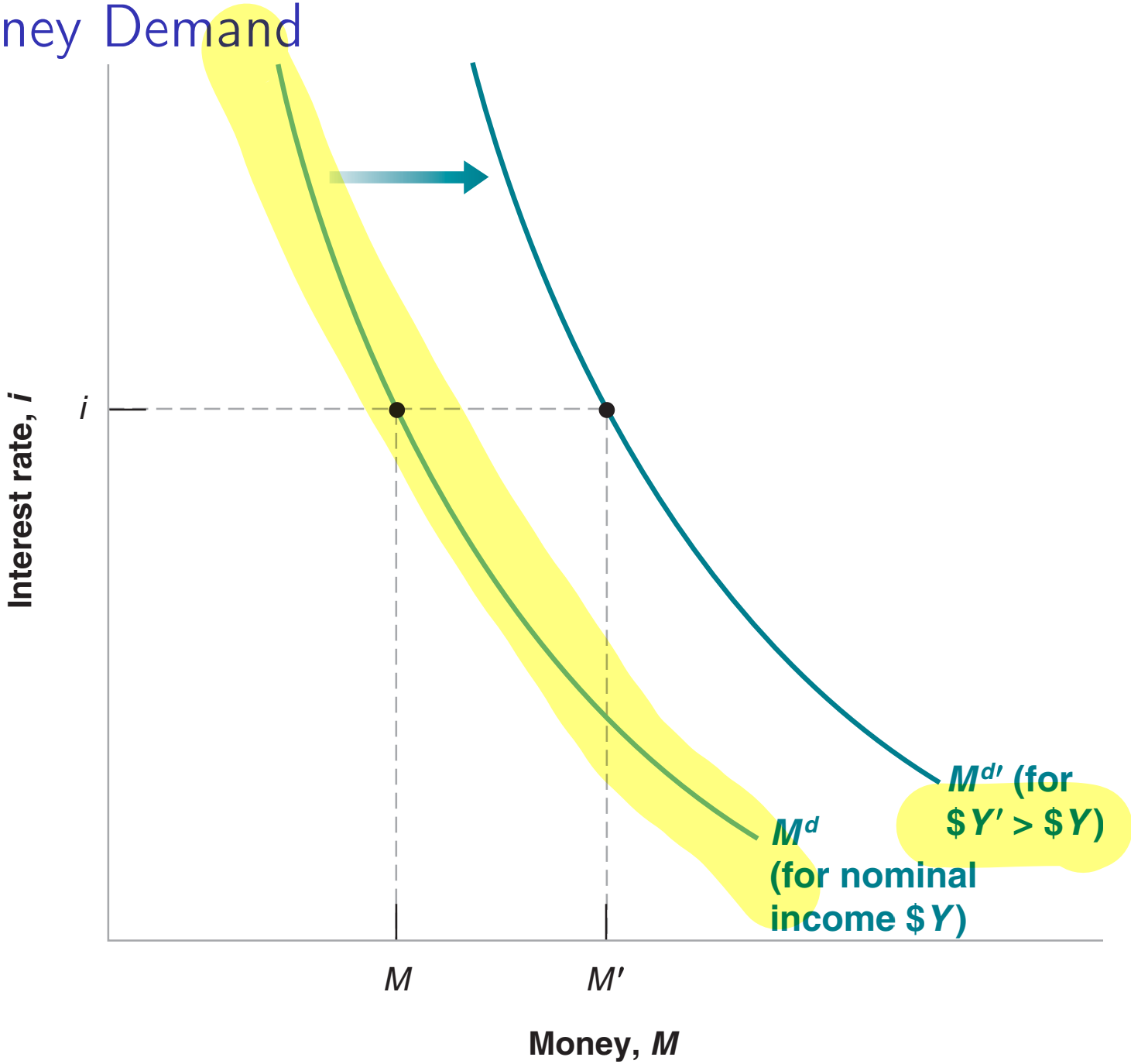
Money demand can then be written as

$$M^d = \$Y \times L(i) \tag{16}$$

$\$Y$ is nominal income (in dollars)

downward sloping

Money Demand



Money Supply

Real world: money = [currency] + [checkable deposits] + [more?]

Currency: controlled by CB

Checkable deposits: created by banks (**not** controlled by CB)

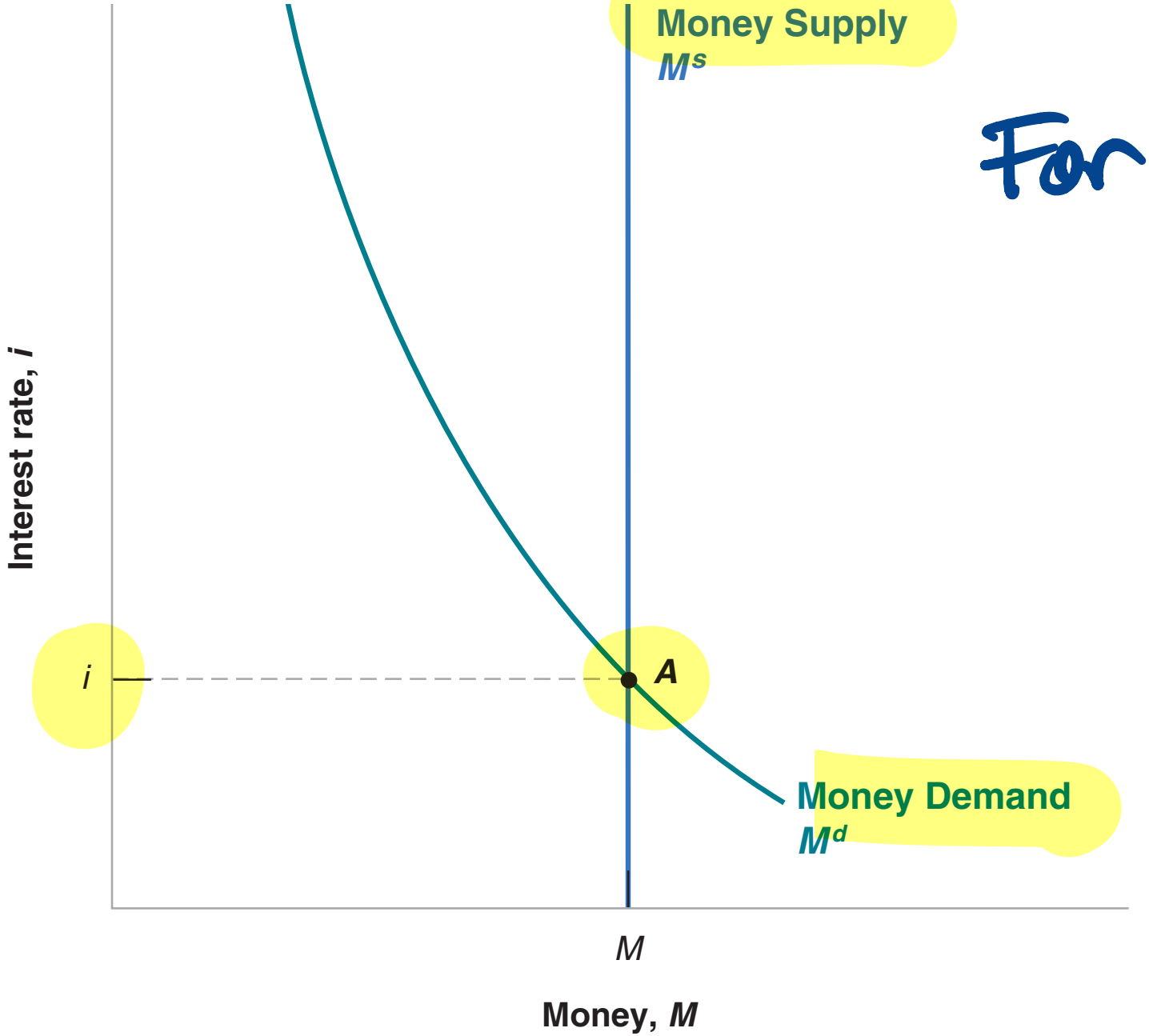
For now: assume that CB controls money supply

$$M = M^s \tag{17}$$

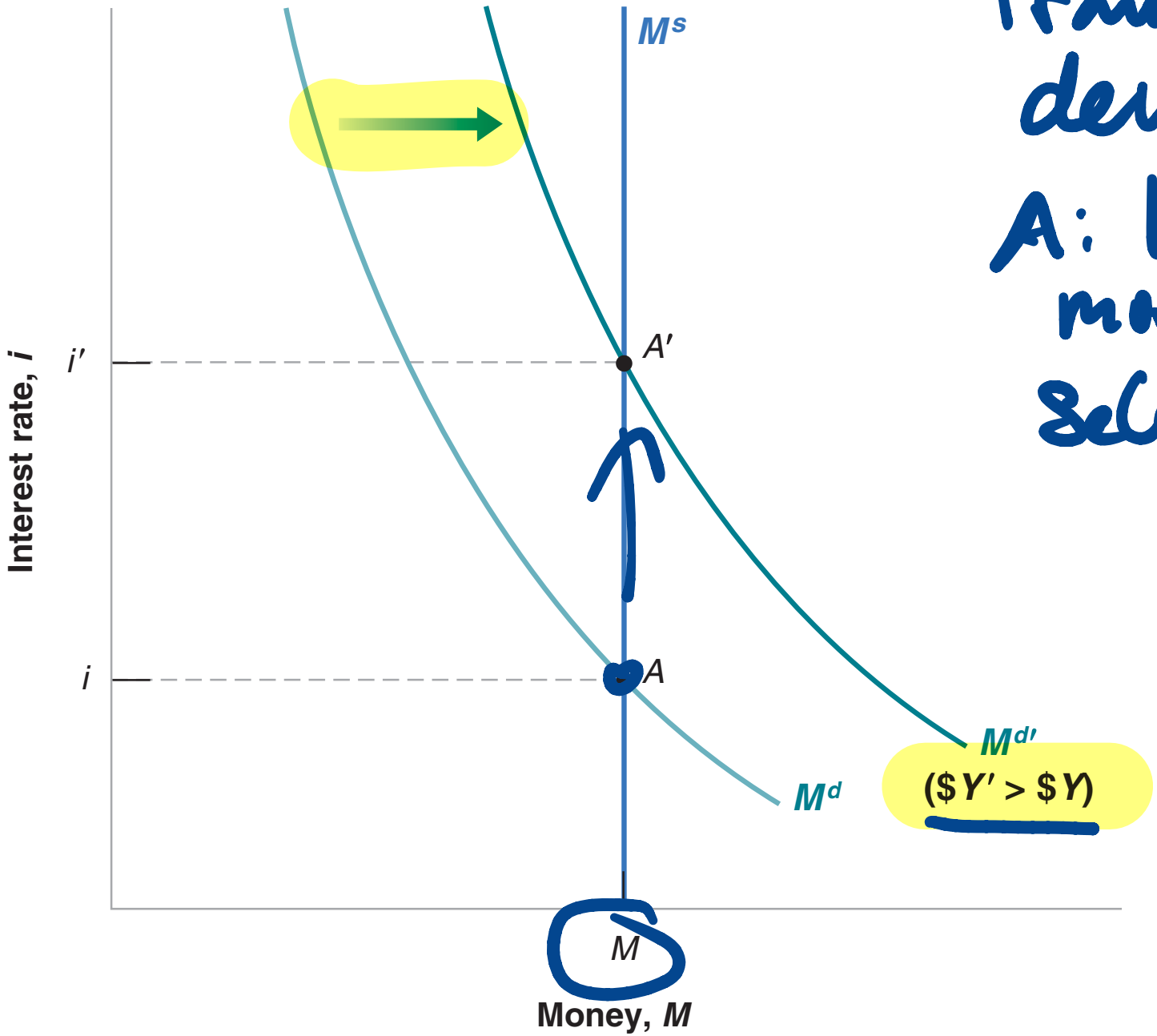
Money market clearing:

$$M^s = \$YL(i) \tag{18}$$

Money Market Clearing



Money Demand Increases



Transaction demand ↑

A: Want more $ Sell bonds

i ↑

The process

Bond price and yield

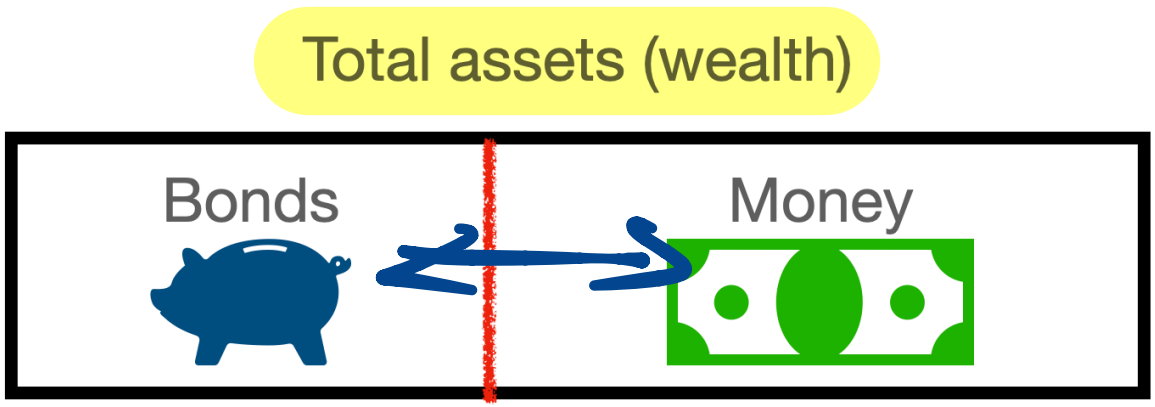
Bond p ↓ ⇒ yield ↑

Mechanical

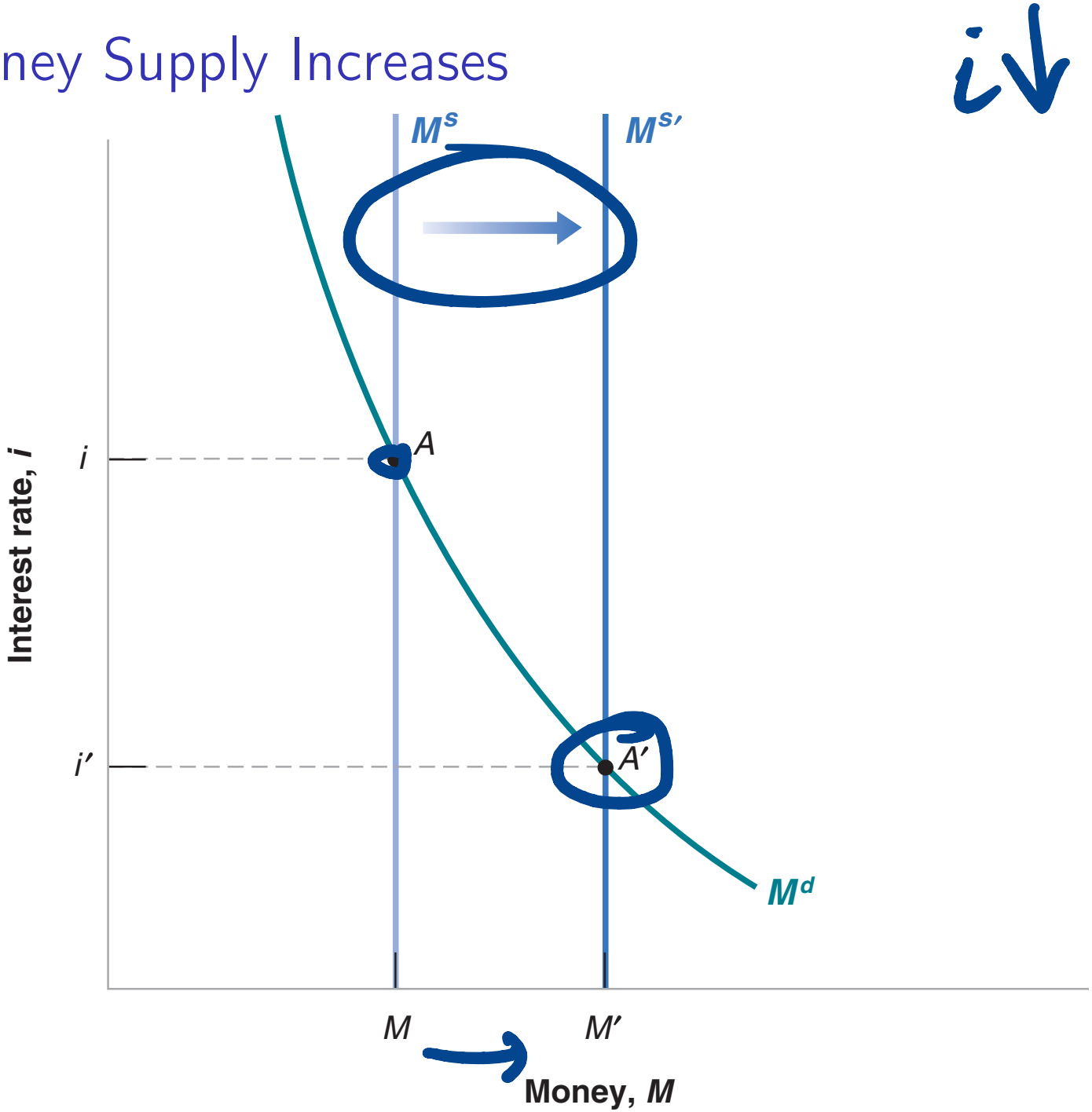
Money Demand Increases

Key assumption of the model:

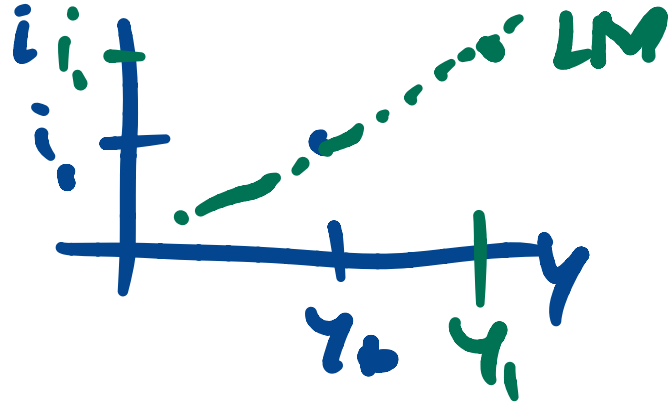
- When i changes, the household can only change the composition of wealth
- Money vs bonds
- Total wealth is fixed.



Money Supply Increases

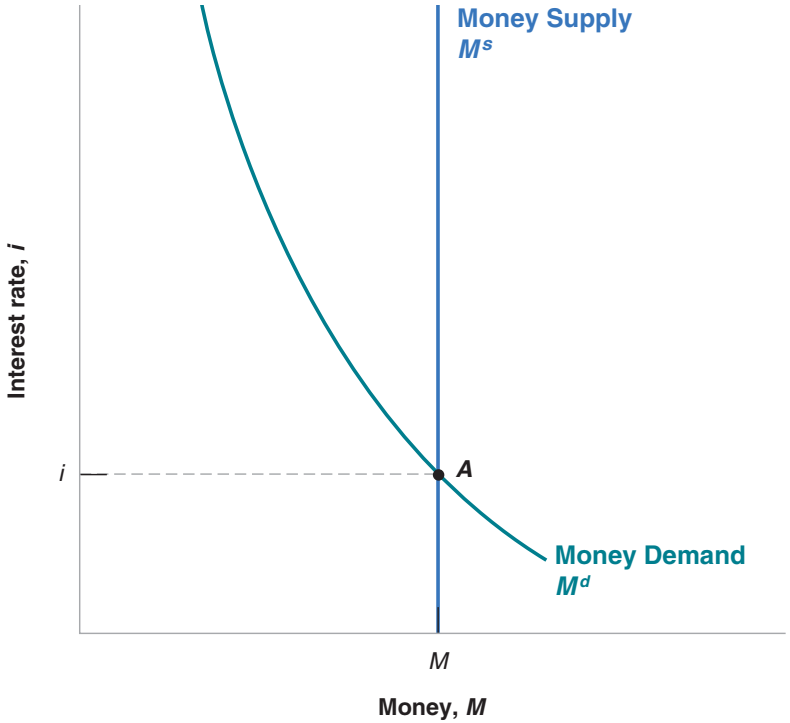


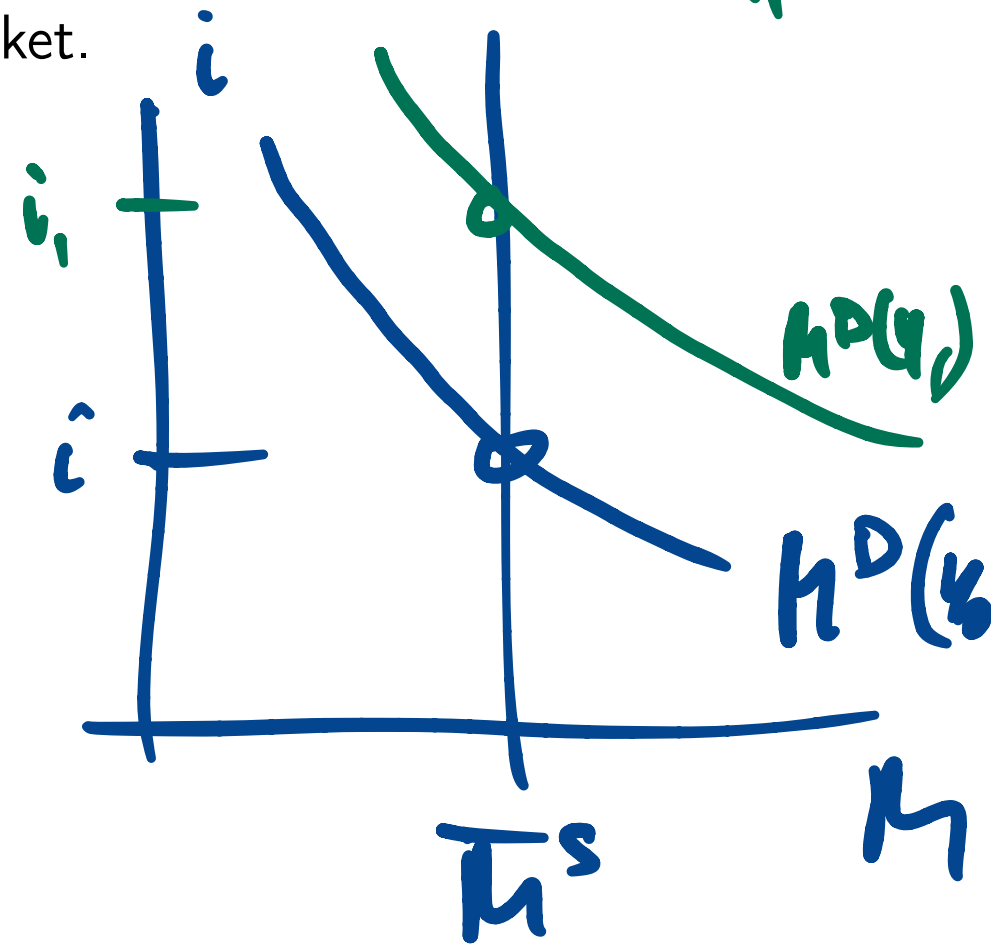
Deriving the LM Curve



Vary Y (on the x axis in the IS/LM graph).

Trace out i that clears money market.





Open Market Operations

The markets for money and bonds are linked.

To increase the money supply, the CB buy bonds and pays with currency.

- "open market operation"

The price of bonds rises $\Longrightarrow$ the bond yield i falls.

- the lower i is what the Fed aims for
- lower i stimulates aggregate demand

A complication:

- the Fed has no direct control over the supply of bonds / the bond interest rate.
- open market operations do not always work

Reading

- Blanchard / Johnson, Macroeconomics, ch. 3-4