

The IS-LM Model - Part 1

EC 313, Macroeconomics

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Book Chapter 5

Overview

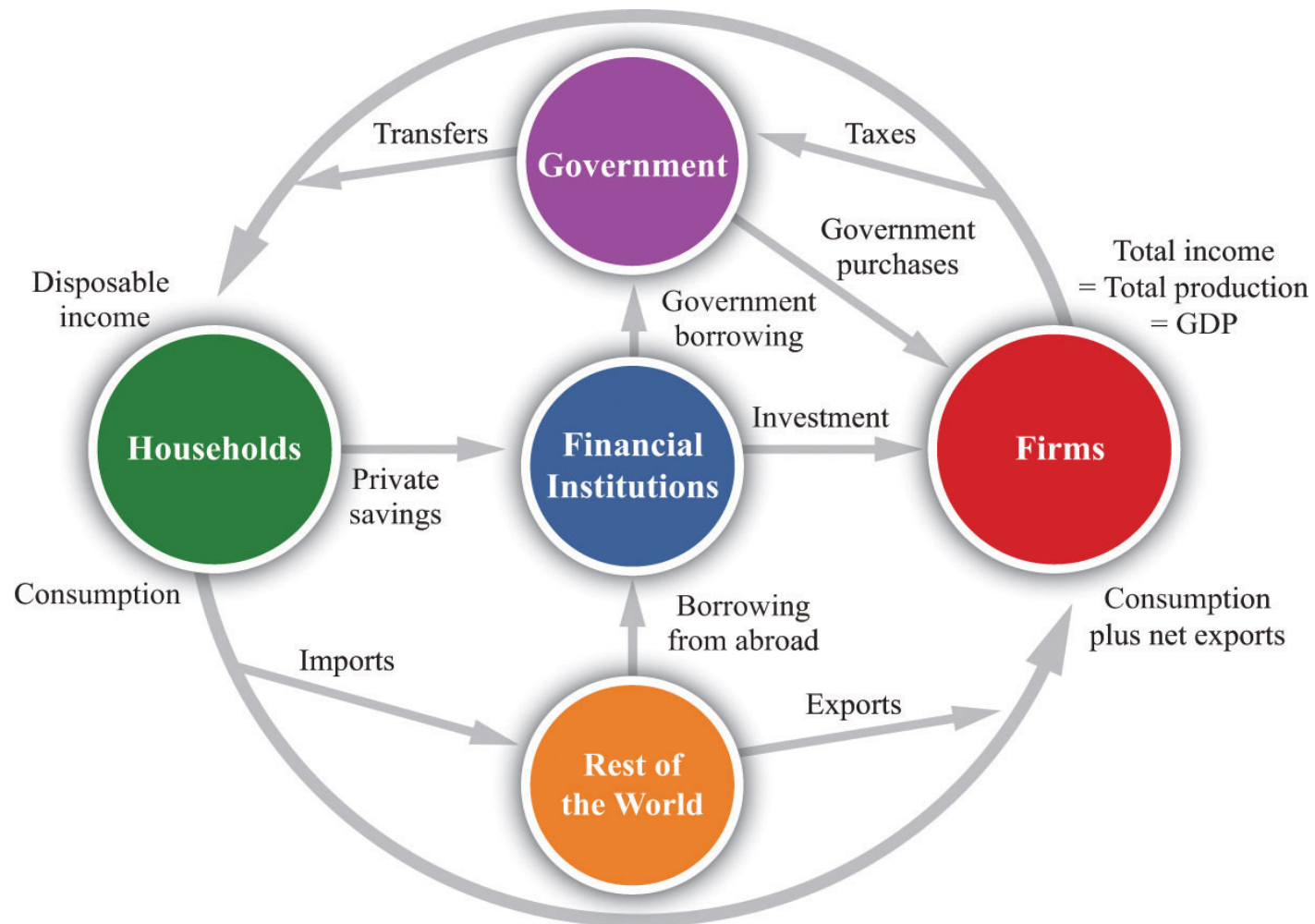
Overview

Overview

In the last four lectures, we studied the **goods market** and the **money market**:

- Goods Market Equilibrium:
 - Output (Y) is endogenous.
 - Interest Rate (i) is exogenous.
- Money Market:
 - Output (Y) is exogenous.
 - Interest Rate (i) is endogenous

Overview



Overview

Overview

In the last four lectures, we studied the **goods market** and the **money market**:

- Goods Market covers: Households, Firms, Government, RoW
- Money Market includes Financial Intermediaries.

Neither the model of Goods Market nor the model of Money Market gives us **the complete picture of the economy**.

This lecture: **IS-LM model** combining both Goods Market Model and Money Market Model.

Overview

IS-LM Meaning

- IS means **"Investment-Saving"**
- "Investment-Saving" is another way to solve for the **Goods Market Equilibrium** (Lecture 3)
- LM means **"Liquidity Preference–Money Supply"**
- "Liquidity Preference–Money Supply" solves the **Money Market Equilibrium** (Lecture 4-5)

Overview

Why IS-LM?

- Both Output (Y) and interest rate (i) are endogenous.
- The IS-LM model helps us study the **simultaneous determination** of output and the interest rate in the short-run equilibrium!
- A **General Equilibrium Model** that gives us a **relatively realistic description** of the **behavior of the economy**.

Overview

Overview

Question: What's the time scope IS-LM model falls into?

- Short Run?
- Medium Run?
- Long Run?

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Question: What's the time scope IS-LM model falls into?

- **Short Run!**
- ~~Medium Run?~~
- ~~Long Run?~~

Because IS-LM is based on Money Market and Goods Market, and **Goods Market is a short-run model.**

Overview

Overview

Question: What are the variables of interest in the IS-LM model

- Output (Y) and Interest Rate (i)

History

Keynes - **General Theory**, 1936;

Hicks - summarized Keynes' contributions, 1937;

- Joint description of Goods Market and Money Market

Hansen - extended Hicks Analysis, 1938.

Overview

Overview

The IS-LM model

- captures much of what happens in the economy in the **short run**
- helps us understand the **intuition**
- an **essential building block** for more advanced models

The Goods Market: IS Relation

The Goods Market: IS Relation

Goods Market Review

Recall, Goods Market Equilibrium is given by (consider a closed-economy)

- Demand[†]: $Z = f^C(Y - T) + \bar{I} + G$
- Supply: $Y = Z$

In the **model of Goods Market**, Investment (\bar{I}) is exogenous because we made **an simplifying assumption** that investment is **independent of the variable of interest, output (Y)**

Now in the model of IS-LM, we **relax** this simplifying assumption.

[†] The consumption function could be linear but doesn't have to be linear, so here $f^C(Y - T)$ instead of $c_0 + c_1(Y - T)$ is used.

The Goods Market: IS Relation

Investment and Output

Relax this simplifying assumption:

Question: Does Investment depend on output (Y)?

- If sales are very high, firms will invest more in the capital.
- In the short run, the level of sales is equal to output Y .

Conclusion: Investment is **an increasing function** of output Y !

The Goods Market: IS Relation

Investment and Interest Rate

In the IS-LM model, there are two variables of interest:

- both **output Y** and **interest rate i**

We have relaxed the assumption so that **Investment I depends on Y**

Does Investment depend on i ?

The Goods Market: IS Relation

Investment and Interest Rate

Does Investment depend on i ?

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

- Firms will invest more if the cost of borrowing (i) is low!

Conclusion: Investment is a **decreasing function of the interest rate**, i !

The Goods Market: IS Relation

Investment Function

In our IS-LM model,

Instead of assuming $I = \bar{I}$ as in the Goods Market Model,

We write $I = f^I(Y, i)$, which means investment I depends on both output Y and interest rate i .

Also $f^I(\underbrace{Y}_{+}, \underbrace{i}_{-})^{\dagger}$, which means f^I increases in Y and decreases in i .

\dagger Note $f^I(Y, i)$ could be but doesn't have to be a linear function.

The Goods Market: IS Relation

Consumption Function

From Goods Market Model, we already know consumption depends on Y :

$$C = f^C(Y - T)$$

Does consumption also depend on the interest rate, i ?

When **interest rate i is higher**, households **save more and consume less** to earn more interest in the future.

$C = f^C(\underbrace{Y - T}_{+}, \underbrace{i}_{-})$ which means consumption increases in disposable income $(Y - T)$ and decreases in interest rate i .

The Goods Market: IS Relation

Derive the IS Curve - Graphically

As mentioned at the beginning, the IS Curve is derived from **the Goods Market Equilibrium**.

Let's solve for the Goods Market Equilibrium again, but this time, with the modified consumption function and investment function.

Goods Demand: $Z = f^C(Y - T, i) + f^I(Y, i) + G$

Goods Supply: $Y = Z$

The Goods Market: IS Relation

Derive the IS Curve - Graphically

Two regularity assumptions:

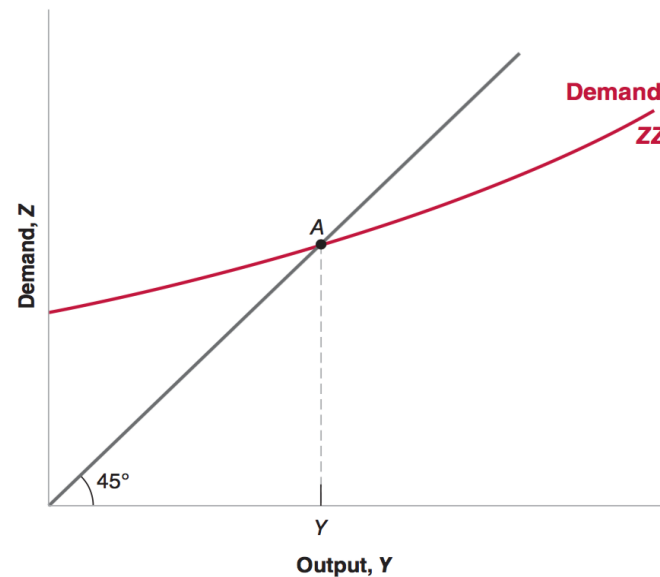
- In Goods Market Model, the intercept of Z , c_0 is larger than 0.
- In the IS-LM Model, Z is larger than 0 when Y is 0.
- In Goods Market Model, the slope of Z , c_1 , is between 0 and 1.
- In the IS-LM model, the slope of Z at a given point is less than 1.

The Goods Market: IS Relation

Derive the IS Curve - Graphically

Goods Demand: $Z = f^C(Y - T, i) + f^I(Y, i) + G$

Goods Supply: $Y = Z$



The Goods Market: IS Relation

Derive the IS Curve - Graphically

Recall: the demand curve (Z) is drawn for some fixed interest rate.

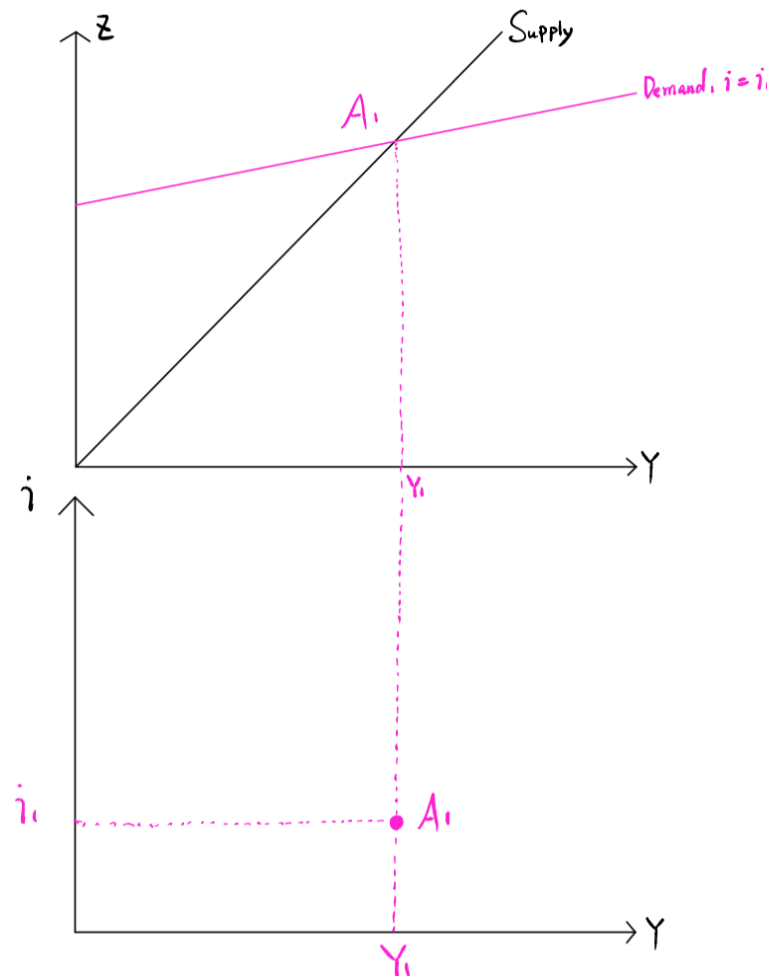
- There are infinitely many demand curves we could have drawn, **each corresponding to a different interest rate.**
- Our goal is to derive the IS curve, which is a relationship between the interest rate and output implied by the Goods Market Equilibrium.

What should we do?

- We can draw the effect of increasing or decreasing the interest rate on goods market equilibrium output, and then map these changes to their own curve!

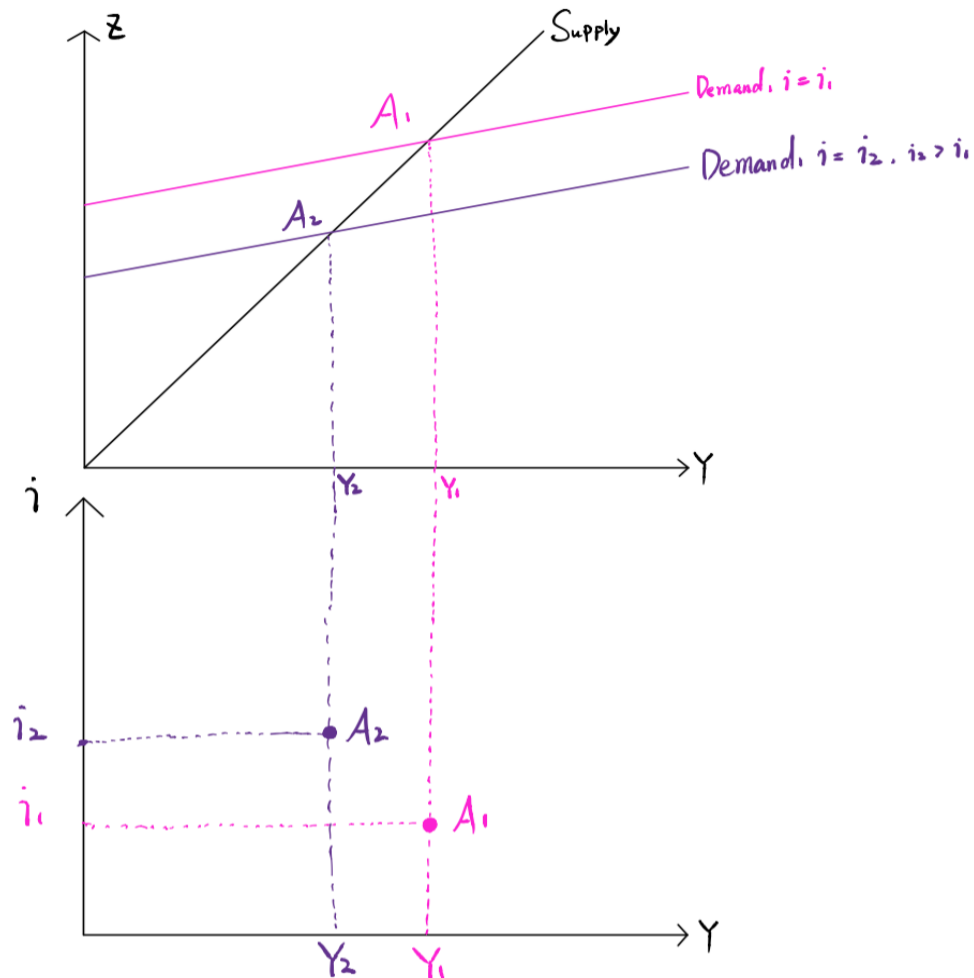
The Goods Market: IS Relation

Derive the IS Curve - Graphically



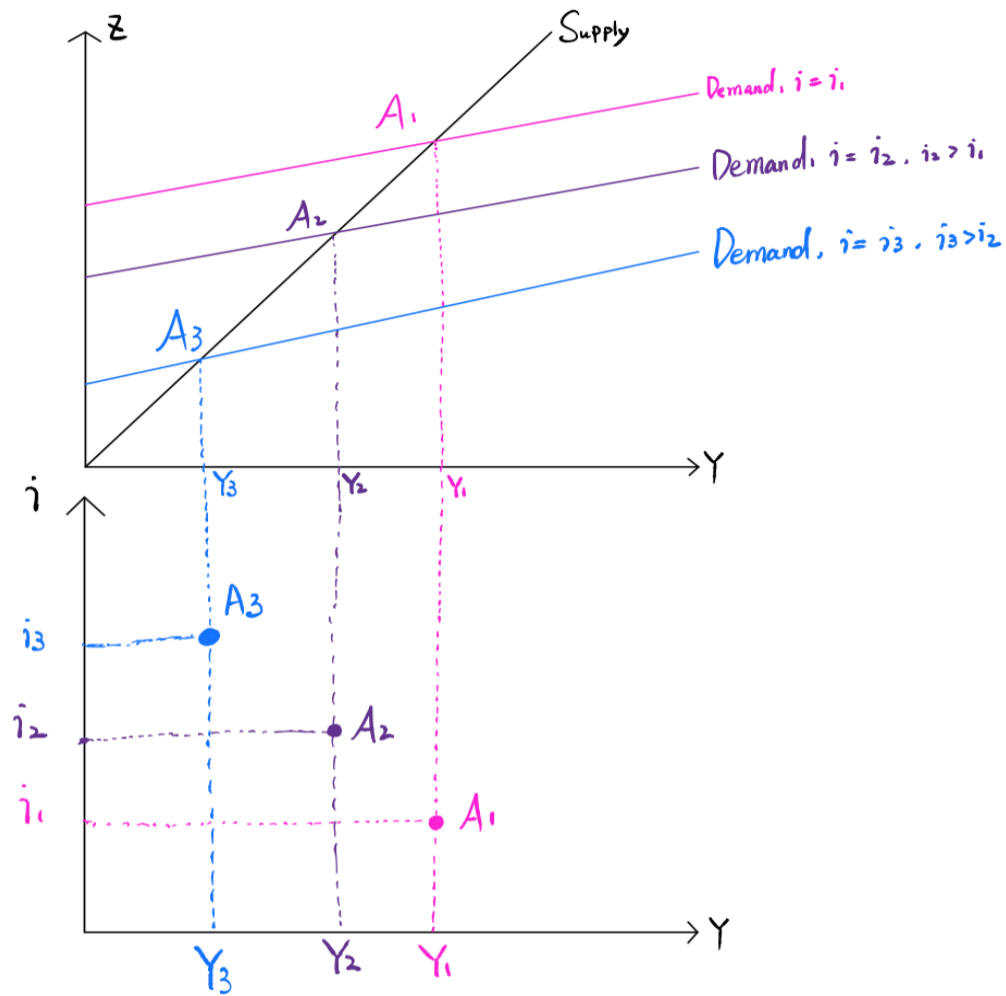
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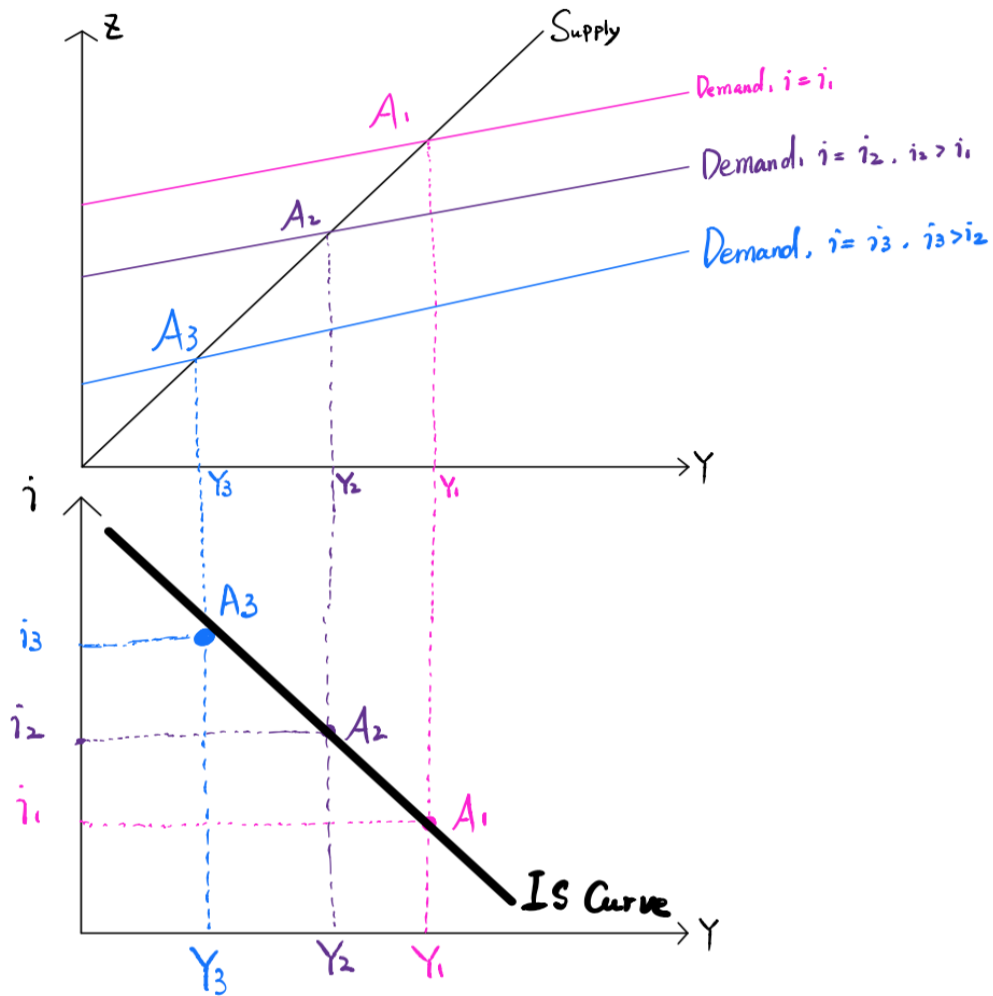
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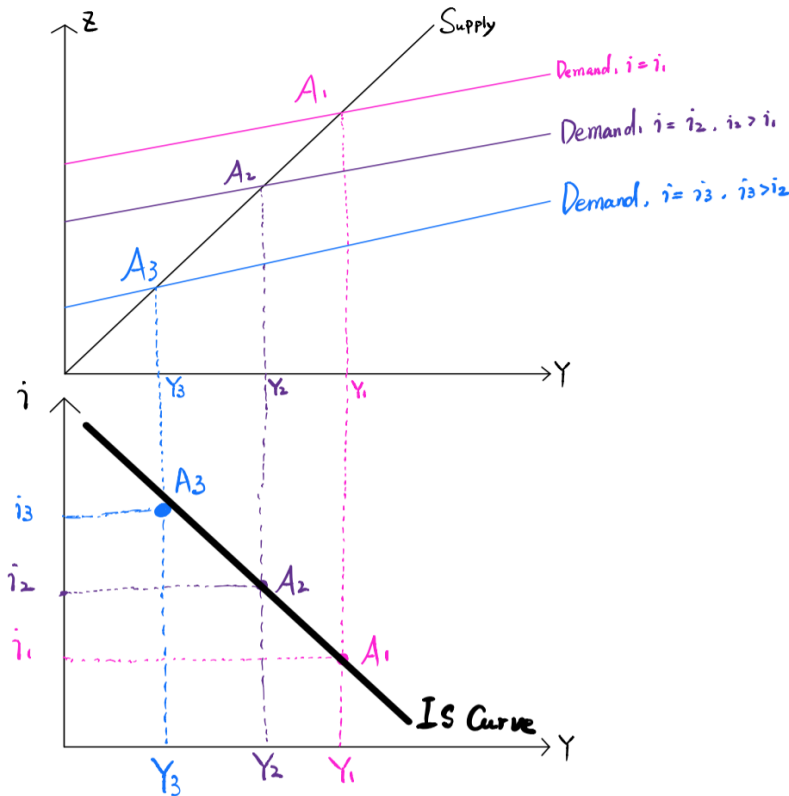
The Goods Market: IS Relation

Derive the IS Curve - Graphically



The Goods Market: IS Relation

Derive the IS Curve - Graphically



Every point on the IS curve represents an equilibrium in the Goods Market.

The Goods Market: IS Relation

Shift of 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 .

Q: What if T or G change?

A: The IS curve **Shifts**!

- For a fixed level of i , if T increases, from Goods Market Equilibrium, Y decreases. Thus, the IS curve **Shifts** Left!.
- For a fixed level of i , if G increases, from Goods Market Equilibrium, Y increases. Thus, the IS curve **Shifts** Right!.

The Goods Market: IS Relation

Shift of IS Curve

- Any factor change (except for i or Y) that decreases equilibrium Y in the goods market will **Shift** the IS curve left.
- Any factor change (except for i or Y) that increases equilibrium Y in the goods market will **Shift** the IS curve right.

Question: Suppose consumer confidence increases, and households would consume more even if they had no disposable income. Would the IS curve shift left or right?

The Goods Market: IS Relation

IS Curve Recap

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

The Money Market: LM Relation

The Money Market: LM Relation

Money Market Equilibrium

Recall, Money Market Equilibrium is given by †

- Demand:

$$M^D = YL(i)$$

- Supply:

$$M^S = M$$

The Money Market: LM Relation

Money Market Equilibrium

- Equilibrium:

$$M = \$YL(i)$$

- The IS curve relates the interest rate to **real income**, **Y**. **But** the money market relates the interest rate to **nomial income**, **\$Y**. What should we do?

† This Money Market Equilibrium comes from lecture 4 without financial intermediaries.

The Money Market: LM Relation

GDP Deflator

Definition: The GDP deflator is given by

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

or

$$\underbrace{\$Y}_{\text{Nominal GDP}} = \underbrace{Y}_{\text{Real GDP}} * \underbrace{P}_{\text{GDP Deflator}}$$

The Money Market: LM Relation

Derive LM Relation - Math

We can rewrite Money Market Equilibrium as:

$$M = \$YL(i)$$

$$M = Y * PL(i)$$

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

where $\frac{M}{P}$ is called the real money supply.

The Money Market: LM Relation

Derive LM Relation - Math

The following equation gives the LM relation:

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

Recall that $L(i)$ is a decreasing function in i . Suppose M and P are held fixed and increase Y

- The left-hand side is fixed
- The right-hand side: Y increases. To make the right-hand side fixed, $L(i)$ has to decrease, which means i has to increase.

Conclusion (LM Relation):

According to Money Market Equilibrium, i increases as Y increases.

The Money Market: LM Relation

Derive LM Relation - Graphically

Real Money Demand

$$M^D = YL(i)$$

Real Money Supply

$$M^S = \frac{M}{P}$$

The Money Market: LM Relation

Derive LM Relation - Graphically

Recall: the real demand curve M^D is drawn for some fixed output Y .

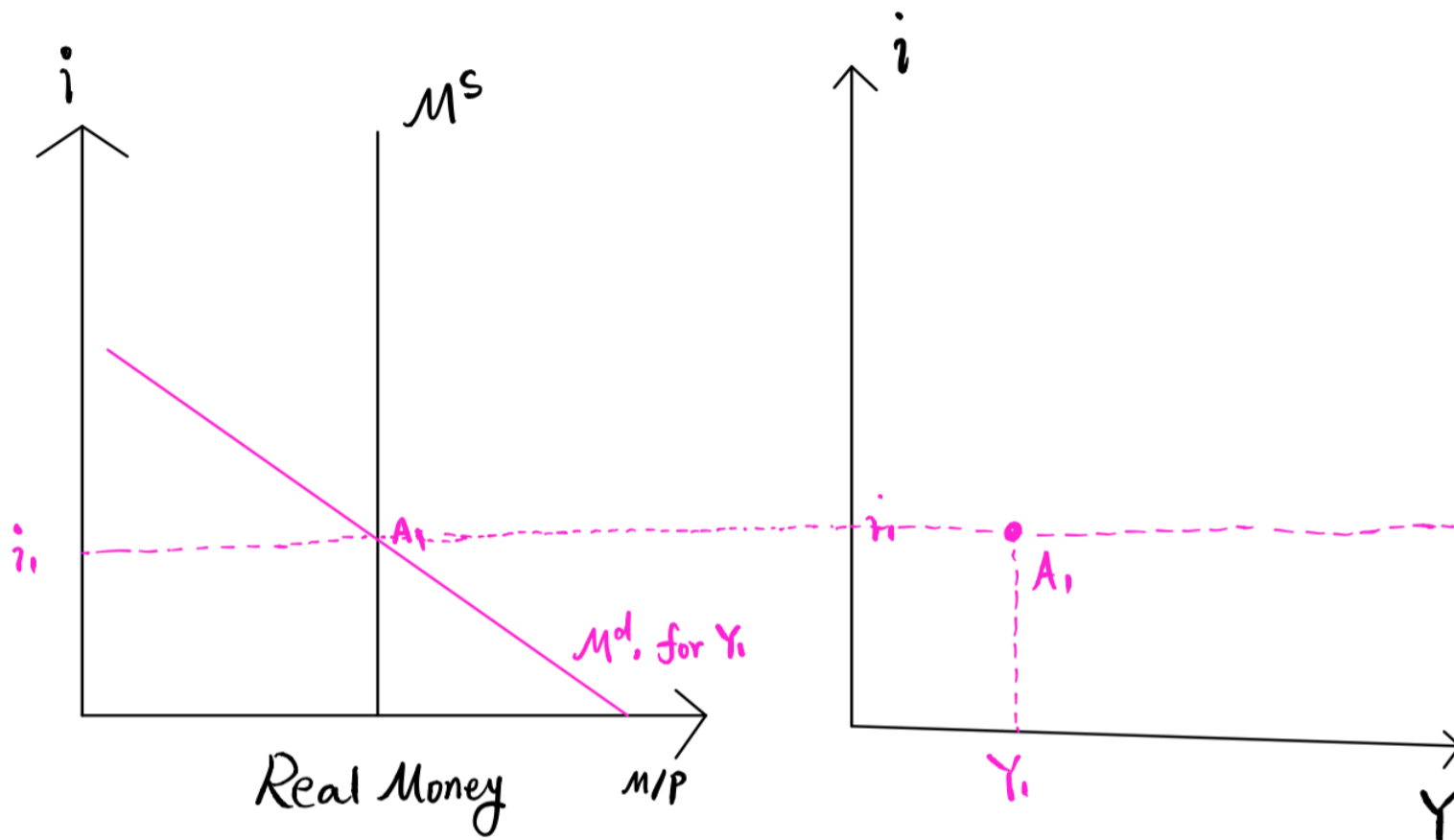
- There are infinitely many real demand curves we could have drawn, **each corresponding to a different output.**
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What should we do?

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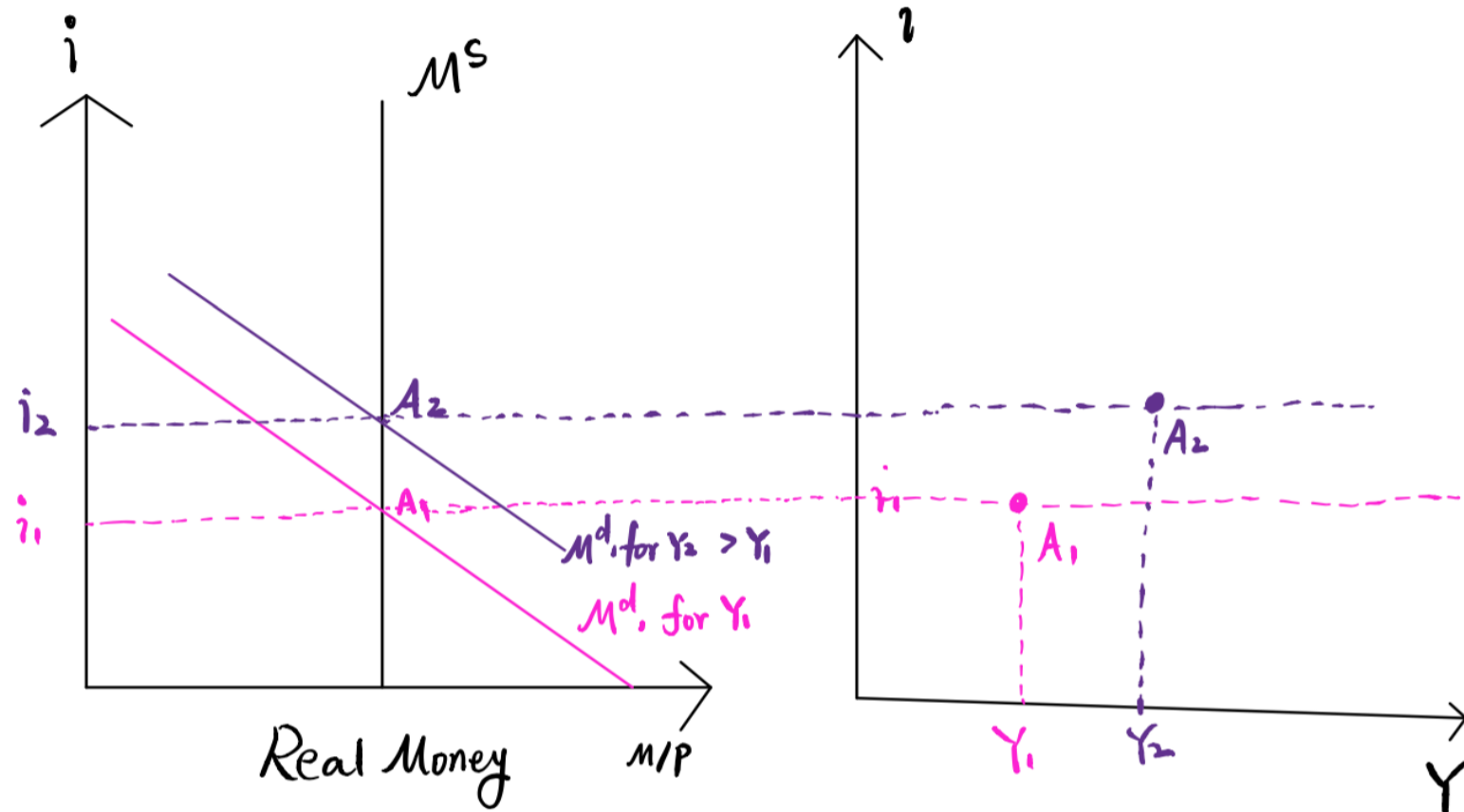
The Money Market: LM Relation

Derive LM Relation - Graphically



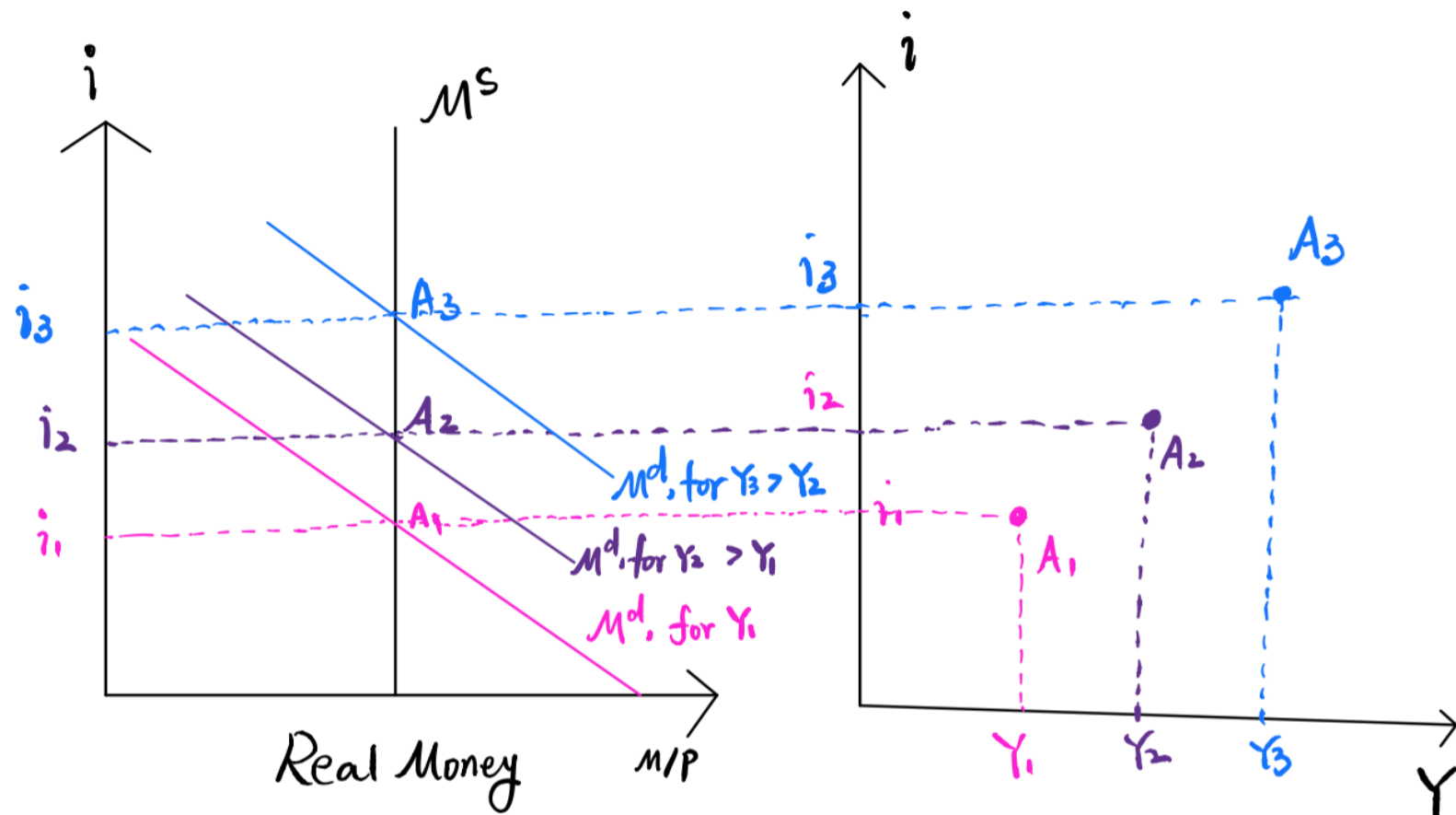
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Derive LM Relation - Graphically



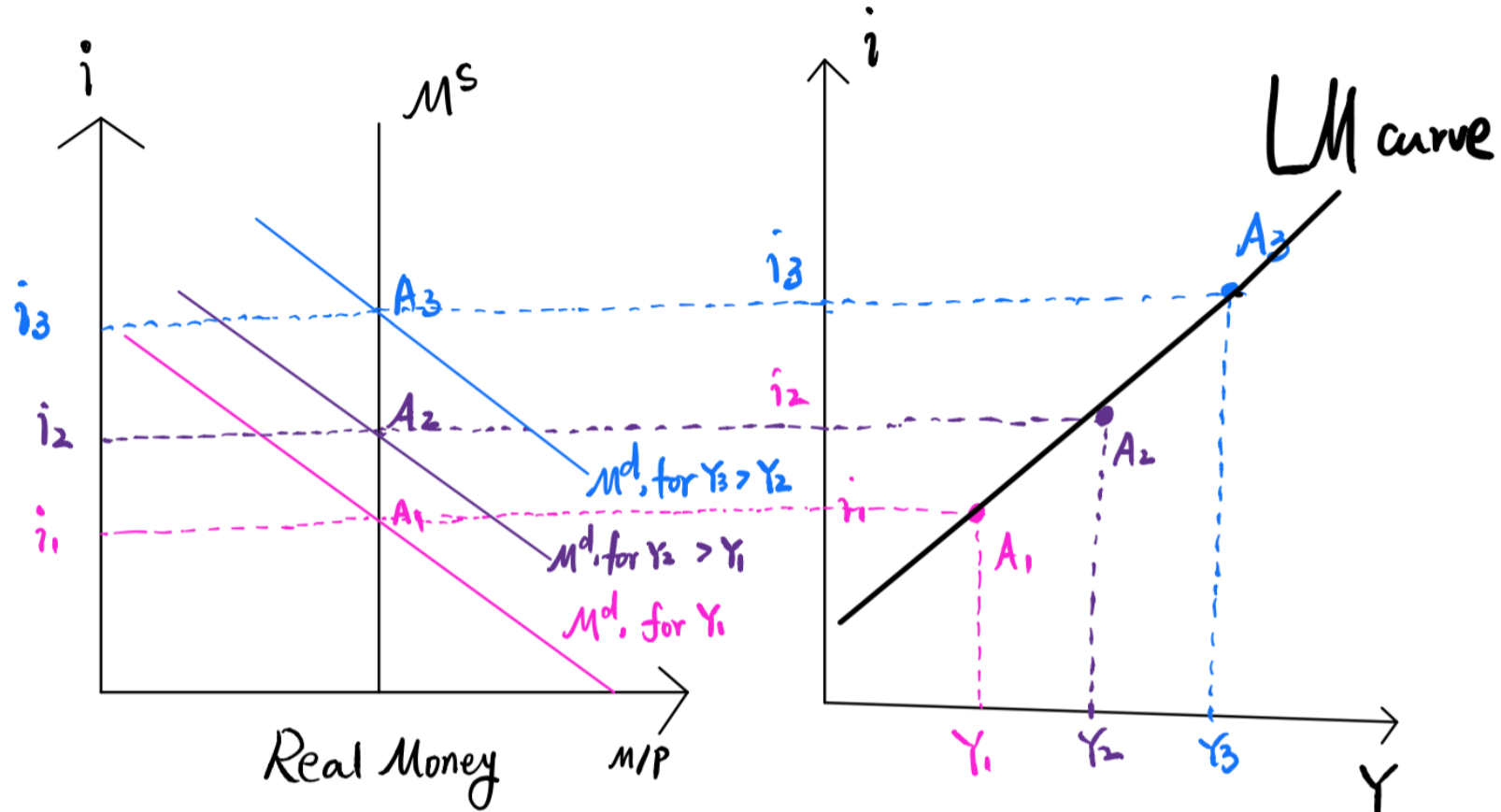
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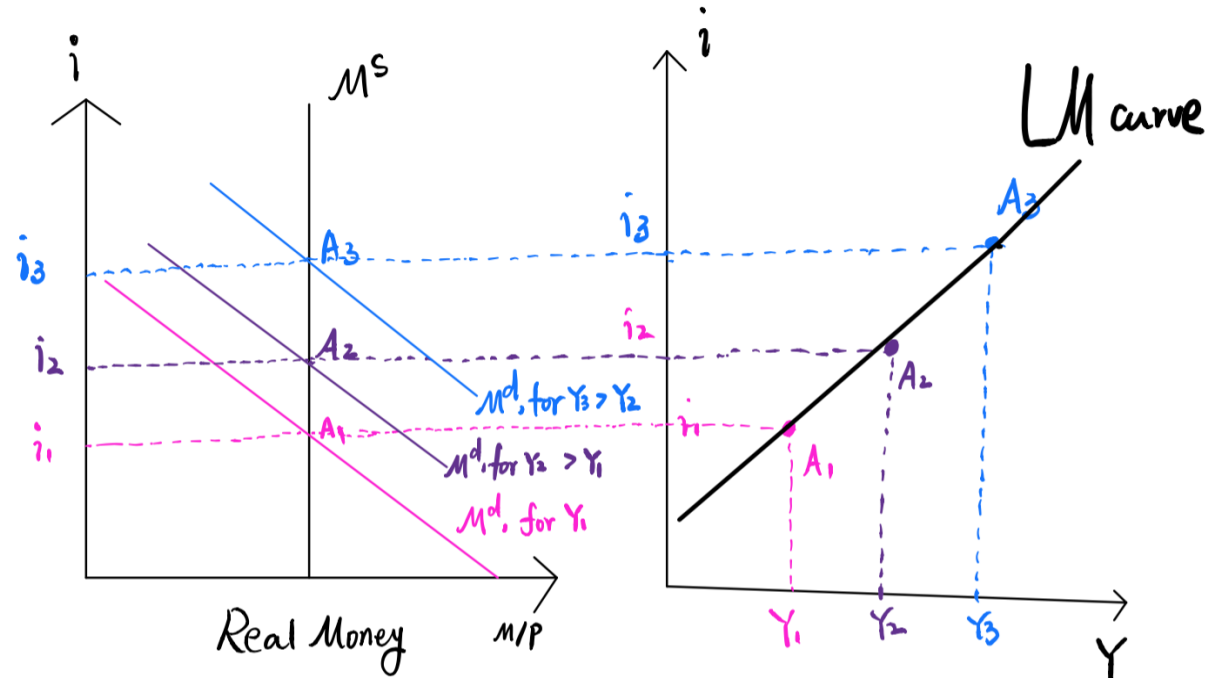
The Money Market: LM Relation

Derive LM Relation - Graphically



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Derive LM Relation - Graphically



Every point on the LM curve represents an equilibrium in the Money Market.

The Money Market: LM Relation

Shift of LM Curve

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

Q: What if M , or P change?

A: The LM curve **Shifts**!

- For a fixed level of Y , if M increases, from Money Market Equilibrium, i decreases. Thus, the IS curve **Shifts** Down!.
- For a fixed level of i , if P increases, from Goods Market Equilibrium, i increases. Thus, the IS curve **Shifts** Up!.

The Money Market: LM Relation

Shift of LM Curve

