

**3543 Fiscal and Financial System in Japan A**  
**/ KC3002 International Finance**

Fall 2013

Lecture 10(Dec 13)

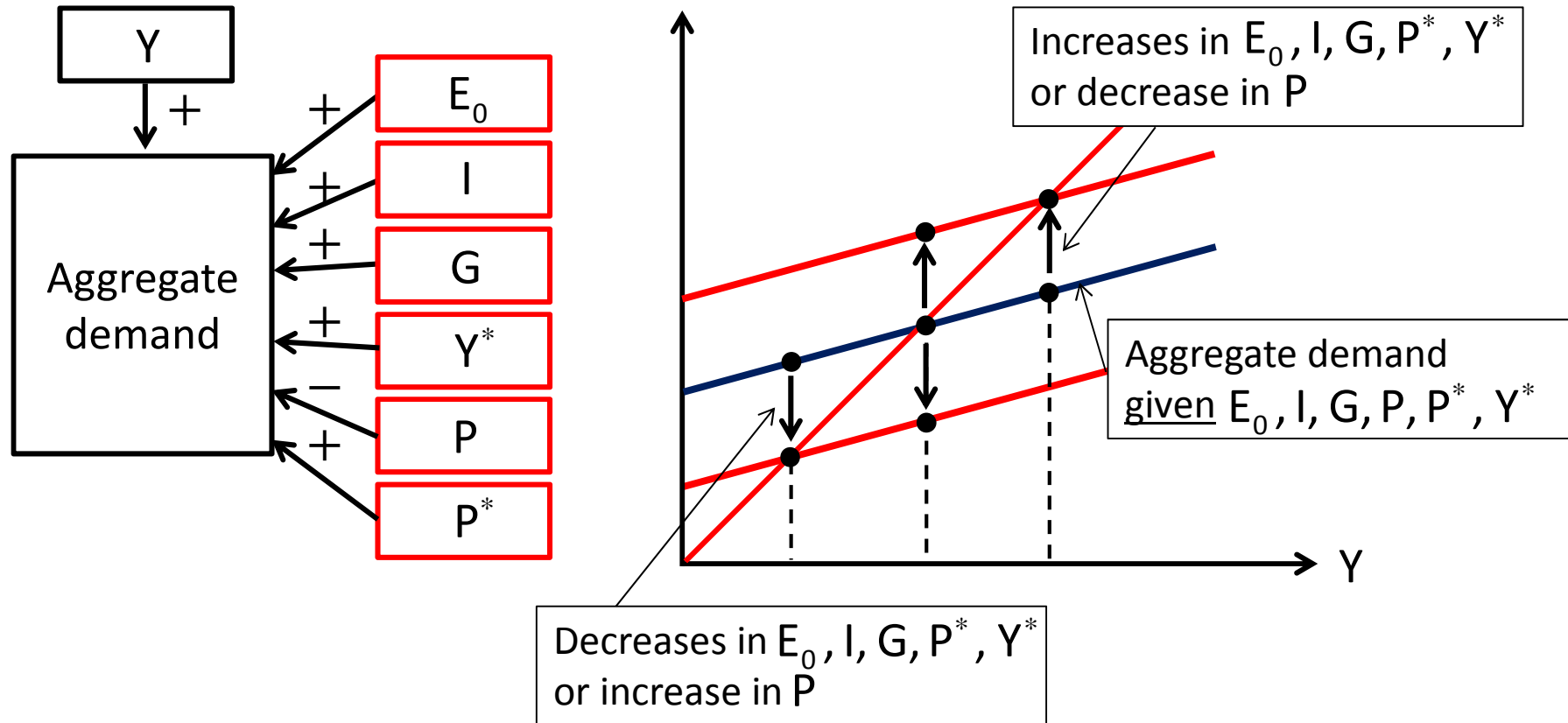
The DD-AA Model

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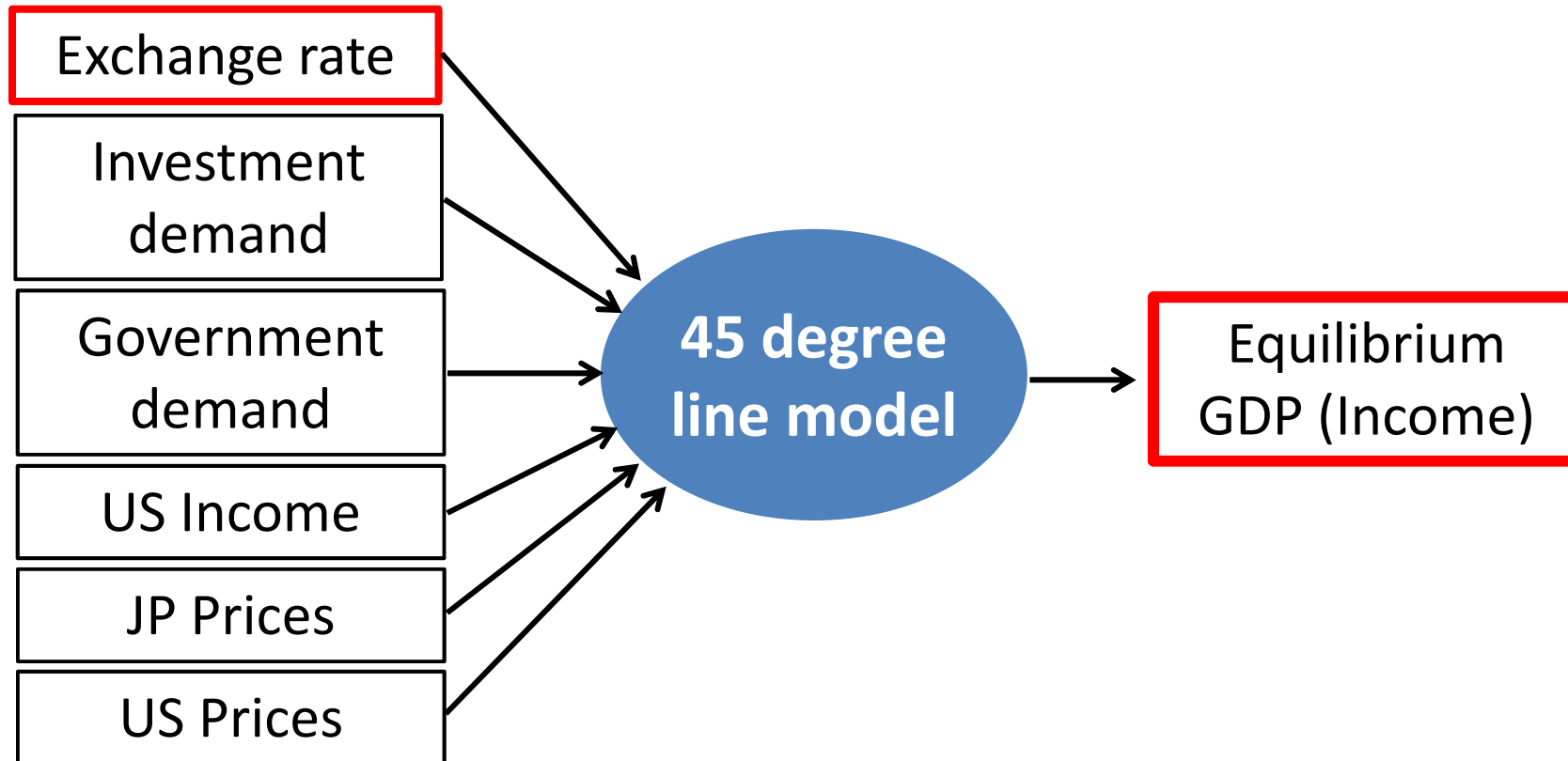
Rev 1

# Equilibrium in the Goods Market



Given  $E_0, I, G, P^*, Y^*$ , GDP is determined so that aggregate demand for output, which is affected by GDP itself, is equal to GDP.

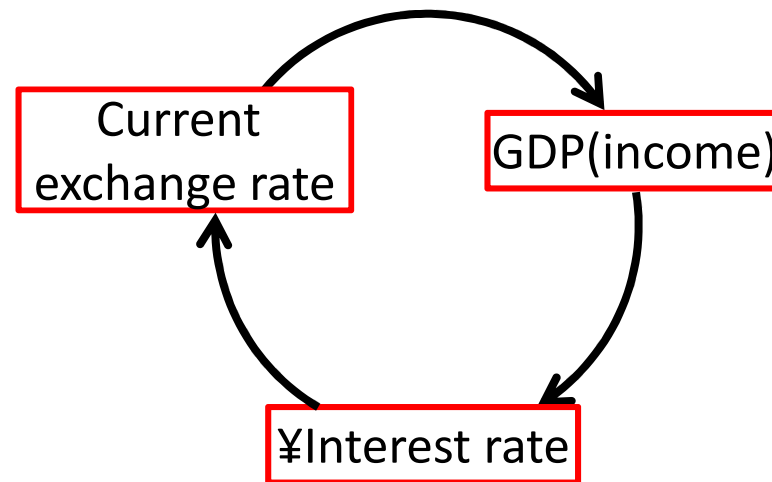
# Model of Goods Market



GDP determines the equilibrium exchange rate (the interest parity model + the liquidity preference model), while exchange rates determine the equilibrium GDP.

Rev 4

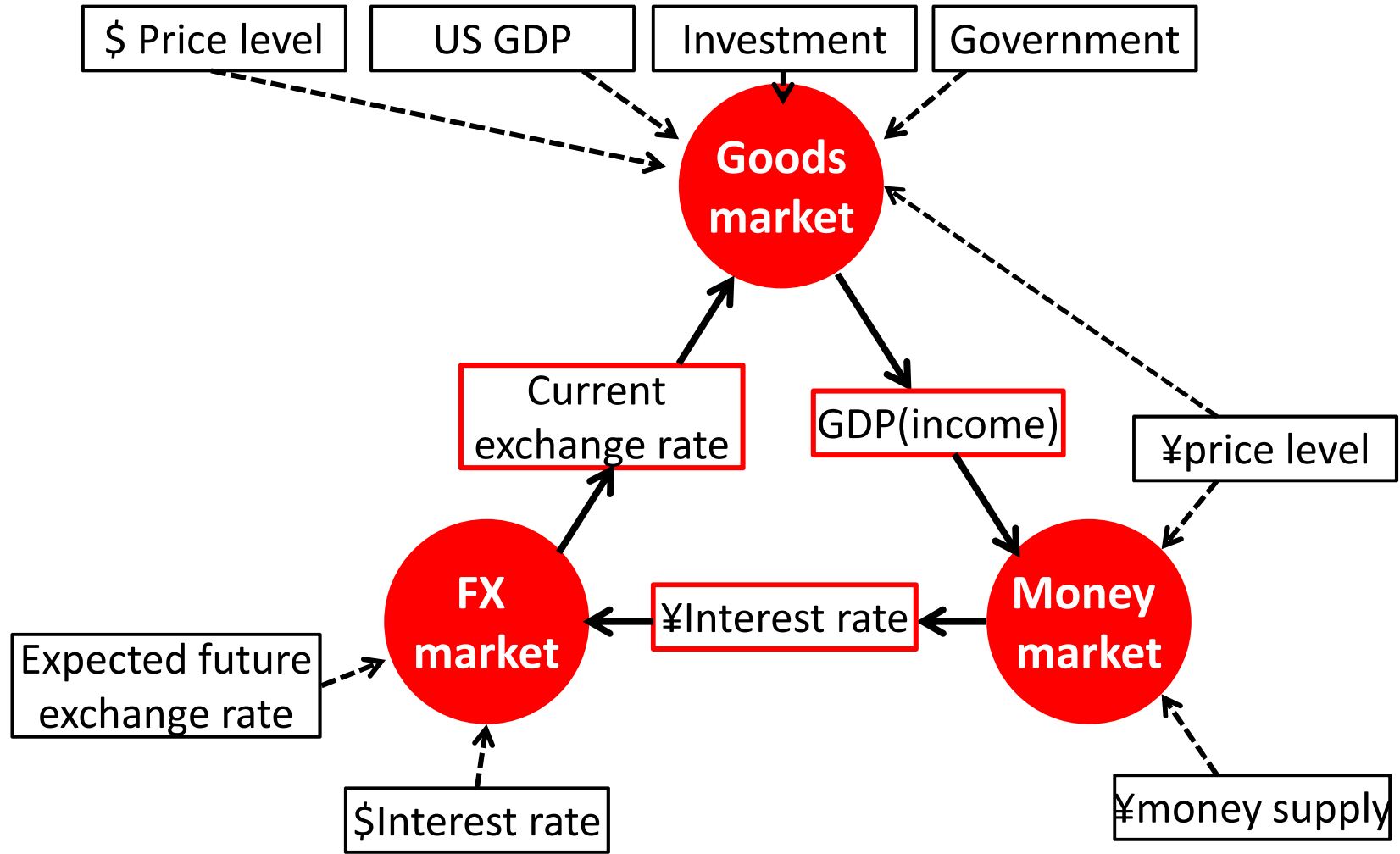
## Simultaneous Determination of Exchange Rate, Interest Rate, and GDP



Three variables affect one another, and are simultaneously determined.

“The DD-AA model” describes how the three variables are simultaneously determined in the medium term, that is, when the price levels are fixed and given from outside.

# How are the three models linked?



# Equilibrium of Economy as a Whole

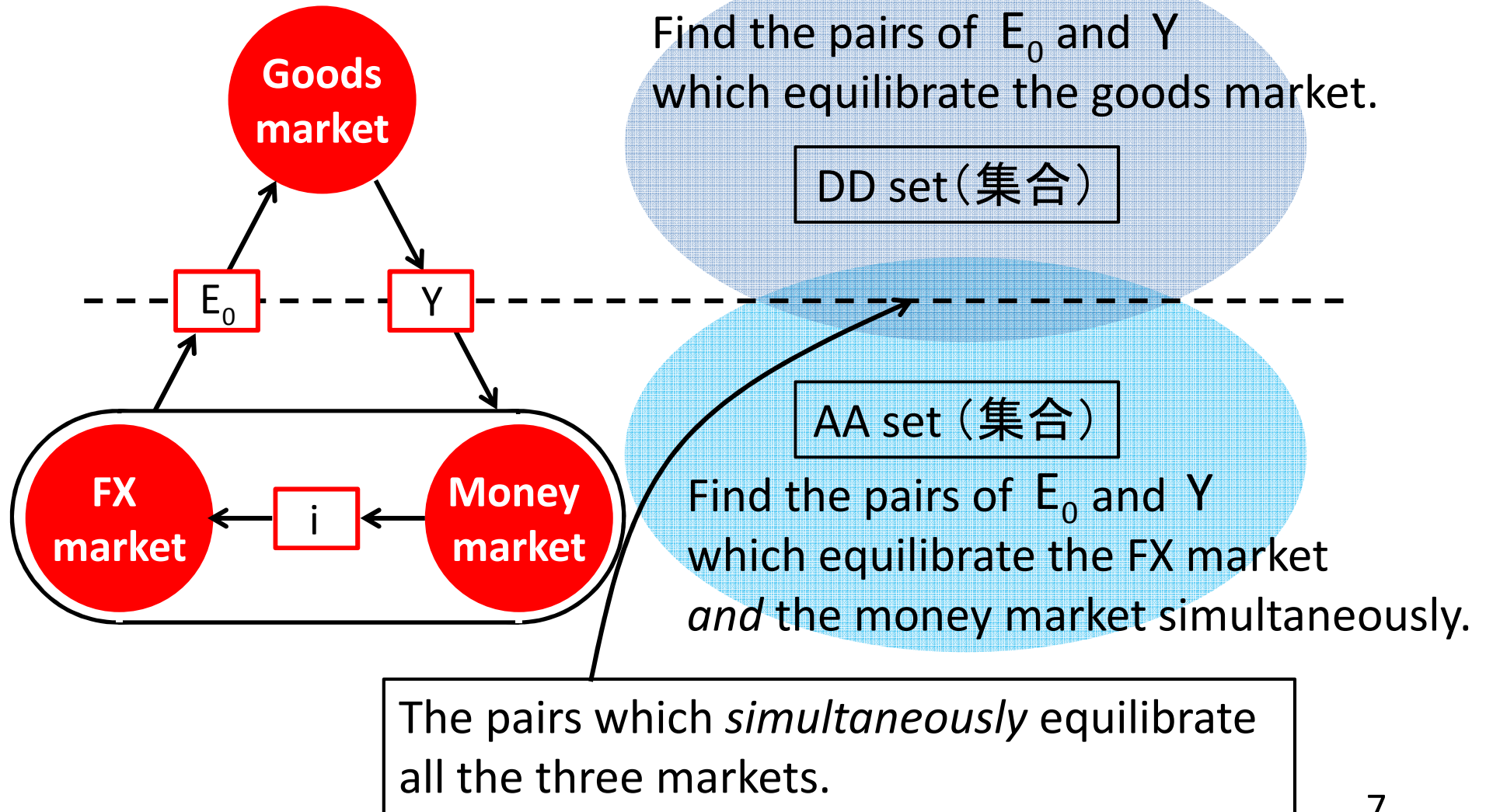
Output, exchange rates, and interest rates are determined so that demand matches supply in *all* the three markets *simultaneously*.

In other words, output, exchange rates, and interest rates are determined so that all the markets are in equilibrium at once.

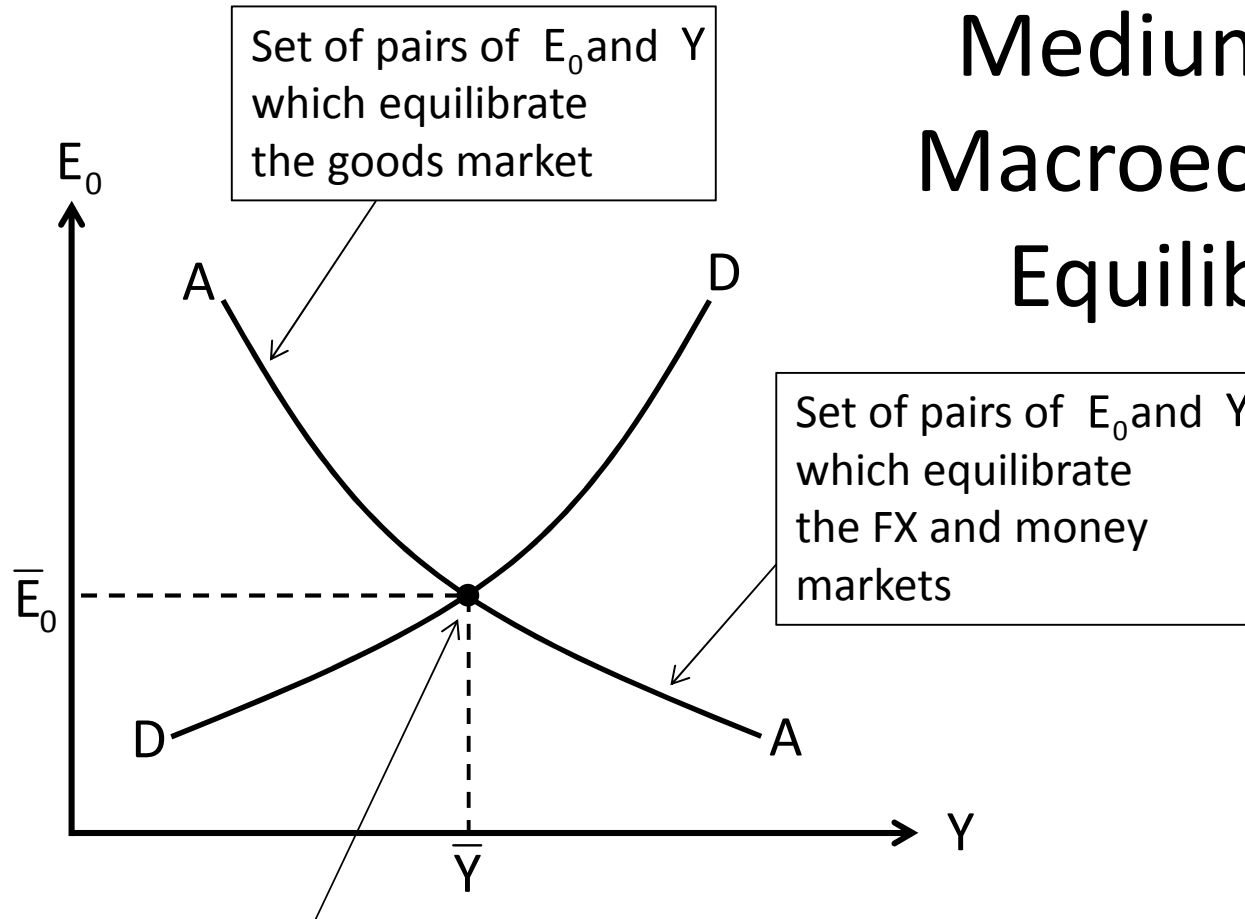
The set of  $E_0, i, Y$  which keeps all the markets in equilibrium simultaneously is the *macroeconomic equilibrium*.

How can we find it?

# How to find macroeconomic equilibrium



# Medium-term Macroeconomic Equilibrium



The medium-term macroeconomic equilibrium, where the goods, FX, and money markets are in equilibrium simultaneously.

Why does the DD schedule slope *upward*?

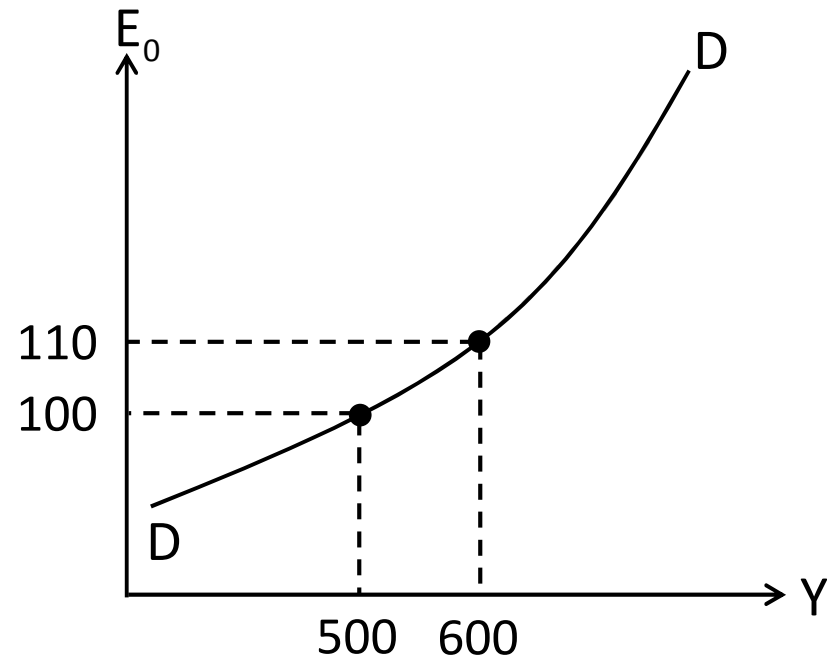
Why does the AA schedule slope *downward*?



# Deriving the DD schedule

Suppose  $E_0 = 100$  and  $Y = 500$  equilibrate the goods market.

Holding constant  $I, G, Y^*, P, P^*$ , a rise in exchange rate from 100 to 110 raises aggregate demand.



At  $E_0 = 110$ , aggregate demand exceeds 500.

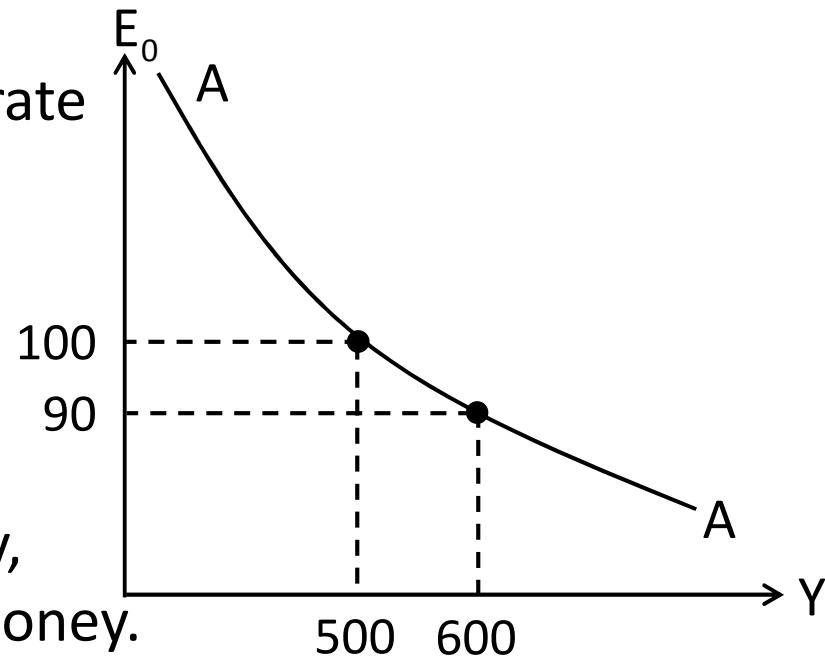
Larger output is required to meet aggregate demand at  $E_0 = 110$ .

Higher exchange rate needs larger output in order to keep the output market in equilibrium.  $\rightarrow$  DD schedule slopes upward.

# Deriving the AA schedule

Suppose  $E_0 = 100$  and  $Y = 500$  equilibrate the FX and the money markets.

Holding constant  $P, i^*, E_1^e, M$ , a rise in Japan's income from 500 to 600 raises the demand for money, resulting in an excess demand for money.



Higher interest rate is required to lower money demand and keep the money market in equilibrium at  $Y = 600$ .

\*Recall that a rise in income raises money demand by raising the volume of monetary transactions people must carry out. Recall also that a rise in interest rate lowers money demand by making bonds more attractive.

## Deriving the AA schedule(cont.)

At  $E_0 = 100$ , higher yen interest rate raises the expected return on yen assets and raises the demand for yen assets.

Lower exchange rate is required to equalize the expected returns on yen and dollar assets, and to keep the FX market in equilibrium.

Larger output needs higher interest rate in order to keep the money market in equilibrium, and higher interest rate needs lower exchange rate in order to keep the FX market in equilibrium.

→ The AA schedule slopes downward.

# Determinants of Equilibrium in DD-AA Framework

The DD schedule is derived holding constant  $I, G, Y^*, P, P^*$ .

→ The position of DD schedule is determined by  $I, G, Y^*, P, P^*$ .

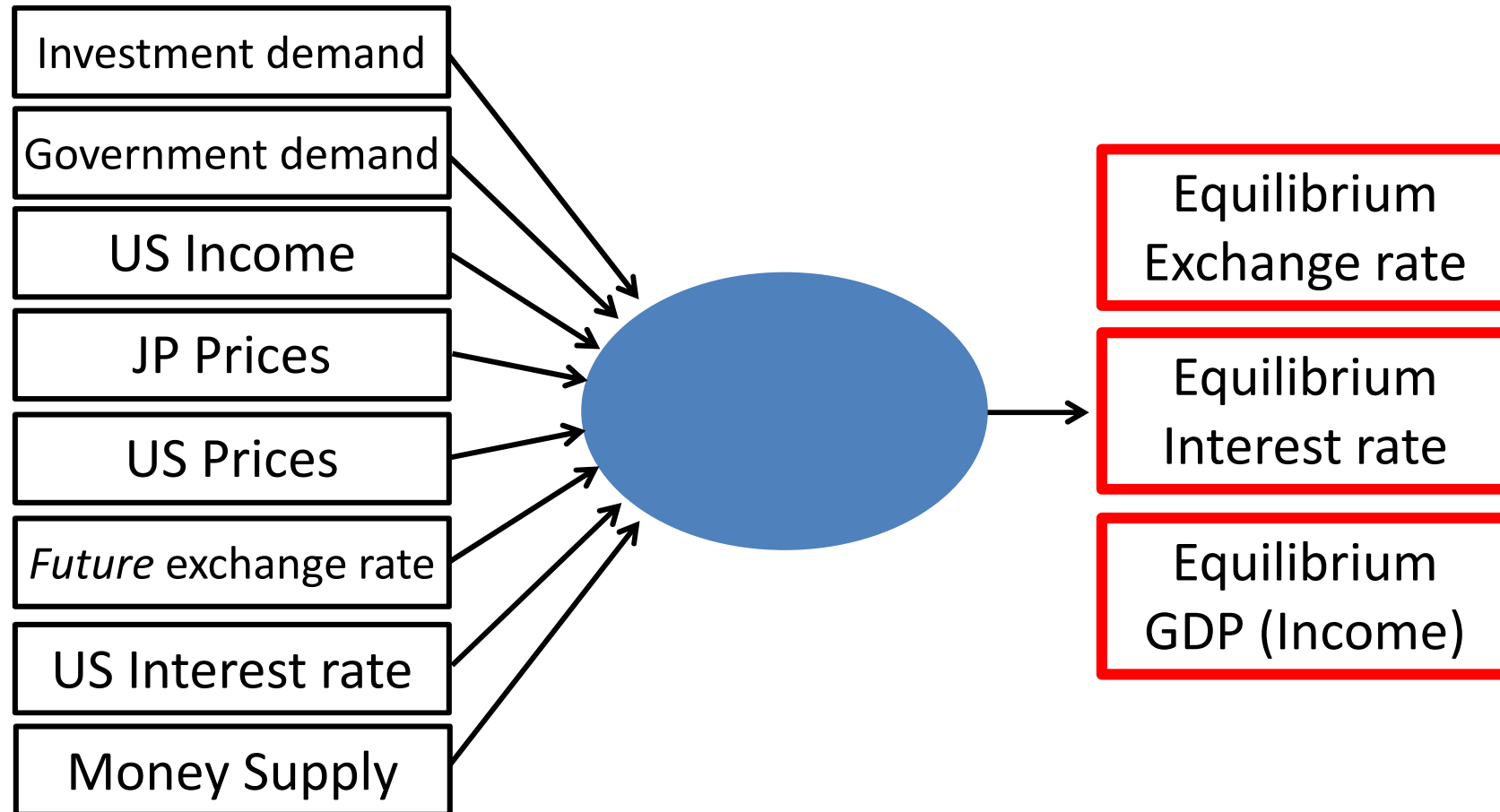
The AA schedule is derived holding constant  $P, i^*, E_1^e, M$ .

→ The position of AA schedule is determined by  $P, i^*, E_1^e, M$ .

The equilibrium is given by the intersection of DD and AA schedules.

The medium-term equilibrium exchange rate, interest rate, and GDP are determined by  $I, G, Y^*, P, P^*, i^*, E_1^e, M$ .

# Determinants of Equilibrium in DD-AA Framework

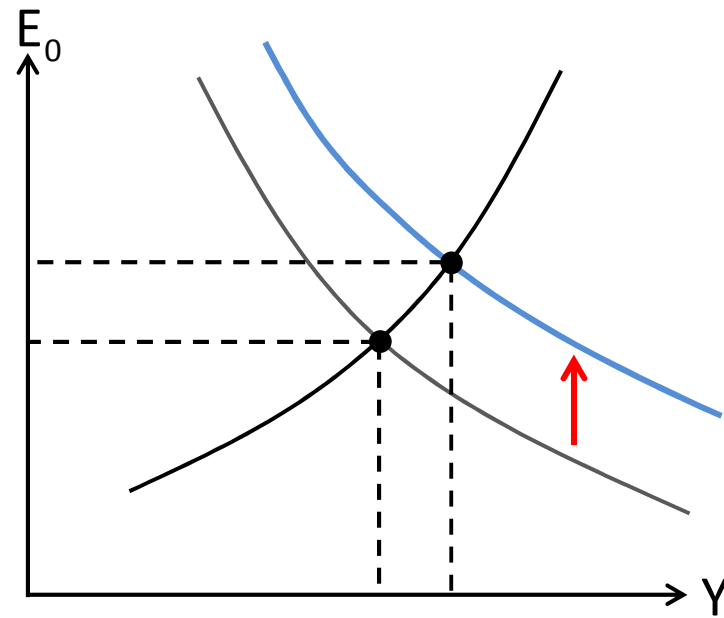
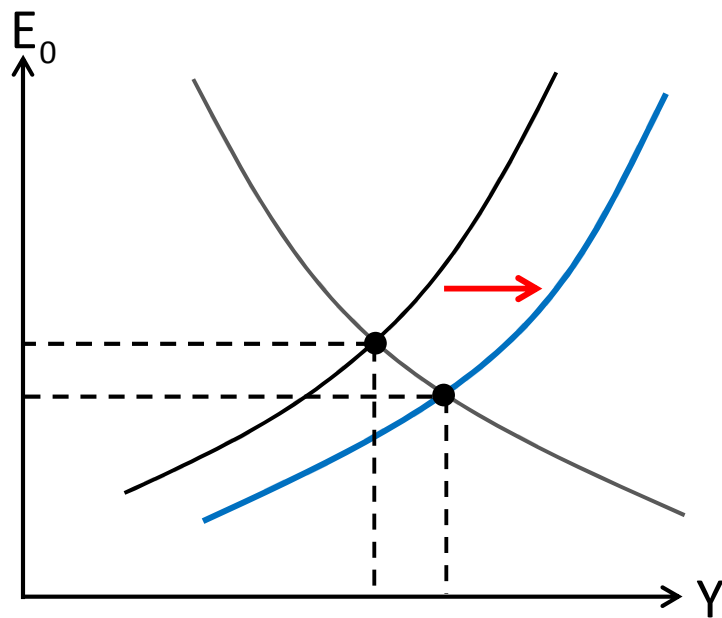


Changes in  $I, G, Y^*, P, P^*, i^*, E_1^e, M$  change the equilibrium exchange rate, interest rate, and GDP.

# Medium-term Fluctuations

How do changes in the determinants affect the equilibrium?

How can we find it?



We can find it by examining how changes in determinants shift the DD or AA schedule.

# Shifting the DD Schedule

The DD schedule is derived holding constant the variables that affect aggregate demand other than  $E_0$  and  $Y$ , that is,  $I, G, Y^*, P, P^*$ .

→ If some of  $I, G, Y^*, P, P^*$  change, we have to derive a new DD schedule.

→ Changes in  $I, G, Y^*, P, P^*$  shift the DD schedule and affect the equilibrium exchange rate and GDP.

# Increase in Investment Demand

Suppose that aggregate demand equals GDP

when  $E_0 = 100$ ,  $Y = 500$ ,  $I = 100$ ,  $G = 50$ ,  $Y^* = 1,000$ ,  $P = 200$ ,  $P^* = 20$ .

↔ The pair of  $E_0 = 100$  and  $Y = 500$  is on the DD curve.

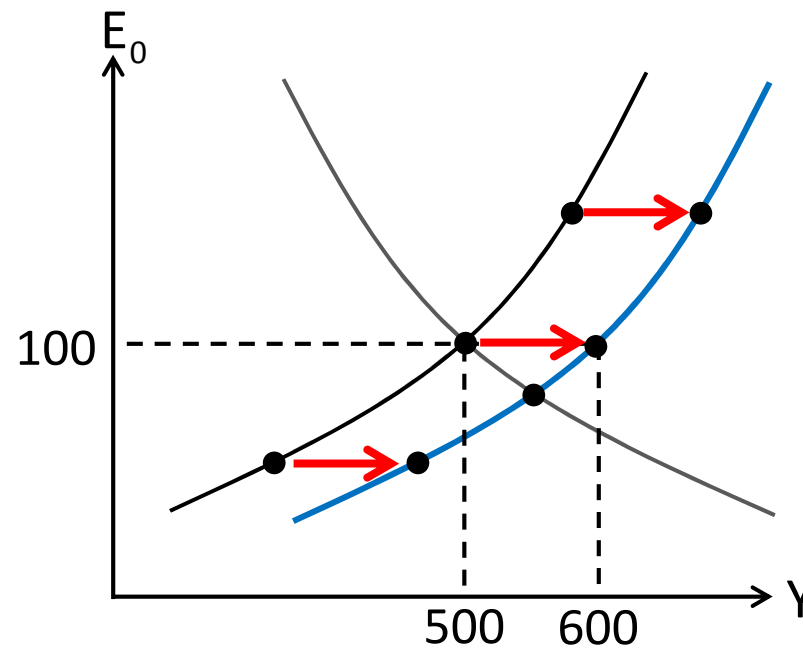
An increase in investment demand from 100 to 160 raises aggregate demand, causing an excess demand for output.

For the same exchange rate  $E_0 = 100$ , larger output, for example,  $Y = 600$  is required to equate supply with demand and keep output market in equilibrium.



# Increase in Investment Demand(cont.)

For any pair on the initial DD curve, after an increase in investment, larger output is required to keep the output market in equilibrium.



It implies that the DD schedule shifts rightward, raising equilibrium GDP (and increasing employment) and lowering the equilibrium exchange rate (yen's appreciation).

# Increase in US Income

Suppose that aggregate demand equals GDP

when  $E_0 = 100$ ,  $Y = 500$ ,  $I = 100$ ,  $G = 50$ ,  $Y^* = 1,000$ ,  $P = 200$ ,  $P^* = 20$ .

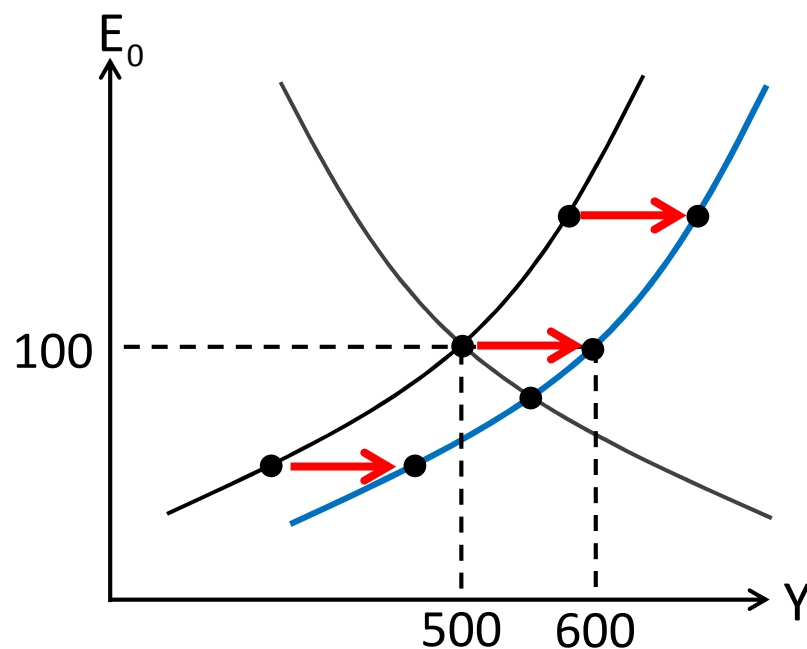
↔ The pair of  $E_0 = 100$  and  $Y = 500$  is on the DD curve.

An increase in US income from 1000 to 1200 raises net US demand for Japanese goods, and raises aggregate demand for Japanese goods, causing an excess demand.

For the same exchange rate  $E_0 = 100$ , larger output, for example,  $Y = 600$  is required to equate supply with demand and keep the output market in equilibrium.

## Increase in US Income(cont.)

For any pair on the initial DD curve, after an increase in investment, larger output is required to keep the output market in equilibrium.



It implies that the DD schedule shifts rightward, raising equilibrium GDP (and increasing employment) and lowering the equilibrium exchange rate (yen's appreciation).

# Changes in Government Demand, JP Prices, and US Prices

An increase in government demand, a *fall* in Japan's prices, or a rise in US prices also raises aggregate demand at any pair of  $E_0$  and  $Y$  on the *initial* curve, causing an excess demand for output.

For any pair of  $E_0$  and  $Y$ , larger output is required to keep the output market in equilibrium.

The DD schedule shifts rightward, raising equilibrium GDP (and increasing employment) and lowering the equilibrium exchange rate.

# Shifting the AA Schedule

The AA schedule is derived holding constant the variables that affect demand and supply in the FX and money markets other than  $E_0$  and  $Y$ , that is,  $P, i^*, E_1^e, M$ .

→ If some of  $P, i^*, E_1^e, M$  change, we have to derive a new AA schedule.

→ Changes in  $P, i^*, E_1^e, M$  shift the AA schedule and affect the equilibrium exchange rate and GDP.

# Increase in Money Supply

Suppose that the FX and money markets are in equilibrium when  $E_0 = 100$ ,  $Y = 500$ ,  $P = 200$ ,  $i^* = 0.05$ ,  $E_1^e = 100$ ,  $M = 1000$ .

↔ The pair of  $E_0 = 100$  and  $Y = 500$  is on the AA curve.

In the money market, an increase in money supply from 1000 to 1200 causes an excess supply.

For the same level of output  $Y = 500$ , lower interest rate is required to raise money demand and keep the money market in equilibrium.

In the FX market, lower interest rate lowers the expected return on yen asset, causing an excess demand for dollar asset.

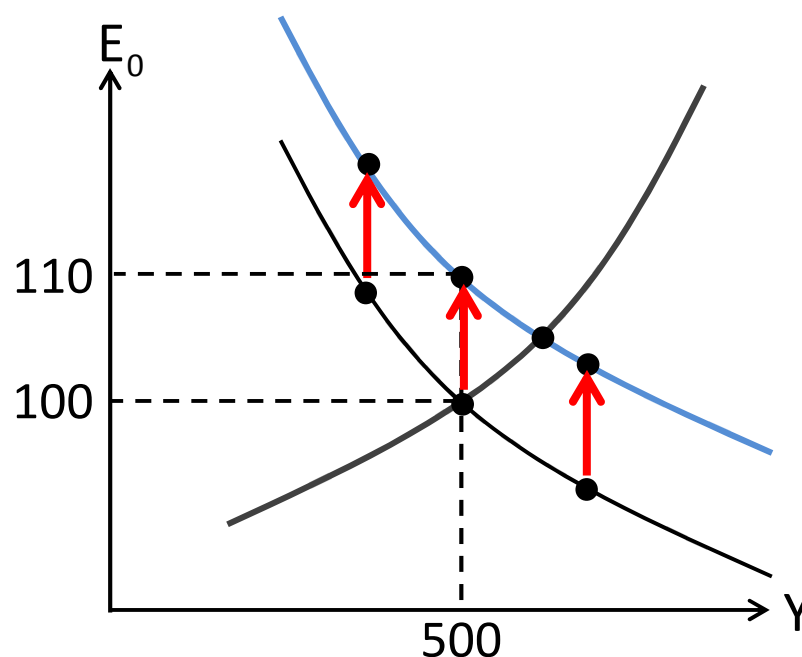
## Increase in Money Supply(cont.)

Higher exchange rate  $E_0 = 110$  is required to lower the expected return on dollar asset, equate returns on dollar and yen assets, and keep the FX market in equilibrium.

To keep the FX and money markets in equilibrium, higher exchange rate, for example,  $E_0 = 110$  is required for the same level of output  $Y = 500$ .

# Increase in Money Supply(cont.)

For any pair on the initial AA curve, after an increase in money supply, higher exchange rate is required to keep the FX and money markets in equilibrium.



It implies that the AA schedule shifts upward, raising equilibrium GDP (and increasing employment) and raising the equilibrium exchange rate (yen's depreciation).



# Rise in Japan's Price Level

Suppose that the FX and money markets are in equilibrium when  $E_0 = 100$ ,  $Y = 500$ ,  $P = 200$ ,  $i^* = 0.05$ ,  $E_1^e = 100$ ,  $M = 1000$ .

↔ The pair of  $E_0 = 100$  and  $Y = 500$  is on the AA curve.

In the money market, a rise in price level from 200 to 250 raises money demand, causing an excess demand.

For the same level of output  $Y = 500$ , higher interest rate is required to lower money demand and keep the money market in equilibrium.

In the FX market, higher interest rate raises the expected return on yen asset, causing an excess demand for yen asset.

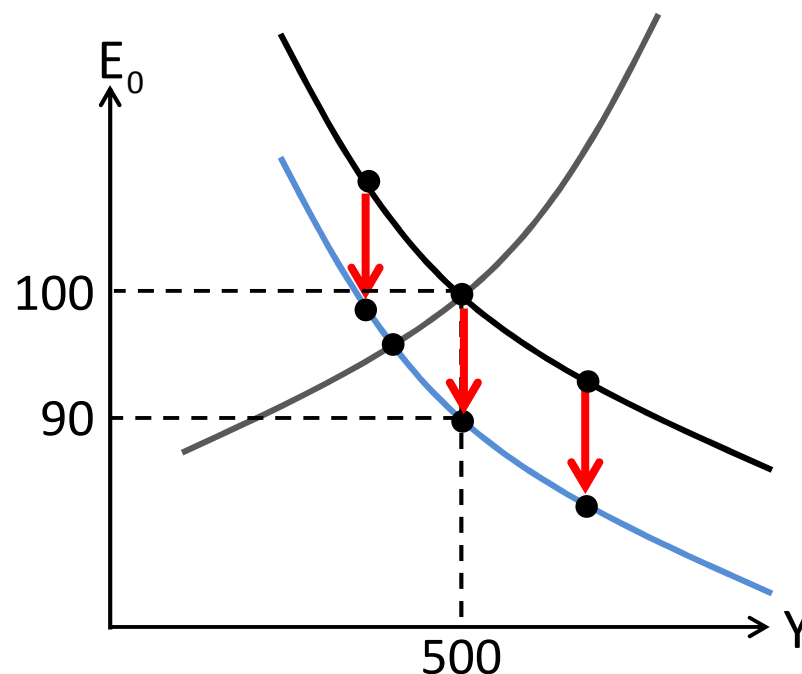
## Rise in Japan's Price Level(cont.)

Lower exchange rate  $E_0 = 90$  is required to raise the expected return on dollar asset, equate the expected returns on dollar and yen assets, and keep the FX market in equilibrium.

To keep the FX and money markets, lower exchange rate, for example,  $E_0 = 90$  is required for the same level of output  $Y = 500$ .

## Rise in Japan's Price Level(cont.)

For any pair on the initial AA curve, after a rise in Japan's price level, lower exchange rate is required to keep the FX and money markets in equilibrium.



It implies that the AA schedule shifts downward, lowering equilibrium GDP (decreasing employment) and lowering the equilibrium exchange rate (yen's appreciation).

# Rise in Dollar Interest Rate

Suppose that the FX and money markets are in equilibrium when  $E_0 = 100$ ,  $Y = 500$ ,  $P = 200$ ,  $i^* = 0.05$ ,  $E_1^e = 100$ ,  $M = 1000$ .

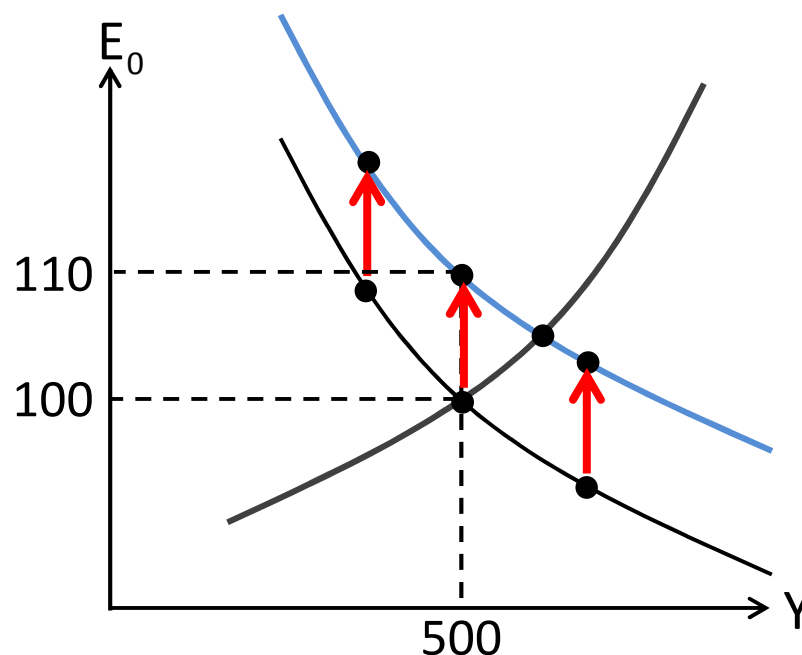
An increase in dollar interest rate raises the expected return on dollar asset and causes an excess demand for dollar asset.

For the same level of output, higher exchange rate  $E_0 = 110$  is required to lower the expected return on dollar and keep the FX market in equilibrium.

\*Note that because changes in dollar interest rate do not affect money demand or supply, yen interest rate do not have to change.

# Increase in Dollar Interest Rate(cont.)

For any pair on the initial AA curve, after a rise in dollar interest rate, higher exchange rate is required to keep the FX and money markets in equilibrium.



It implies that the AA schedule shifts upward, raising equilibrium GDP (and increasing employment) and raising the equilibrium exchange rate (yen's depreciation).

# Rise in Expected Future Exchange Rate

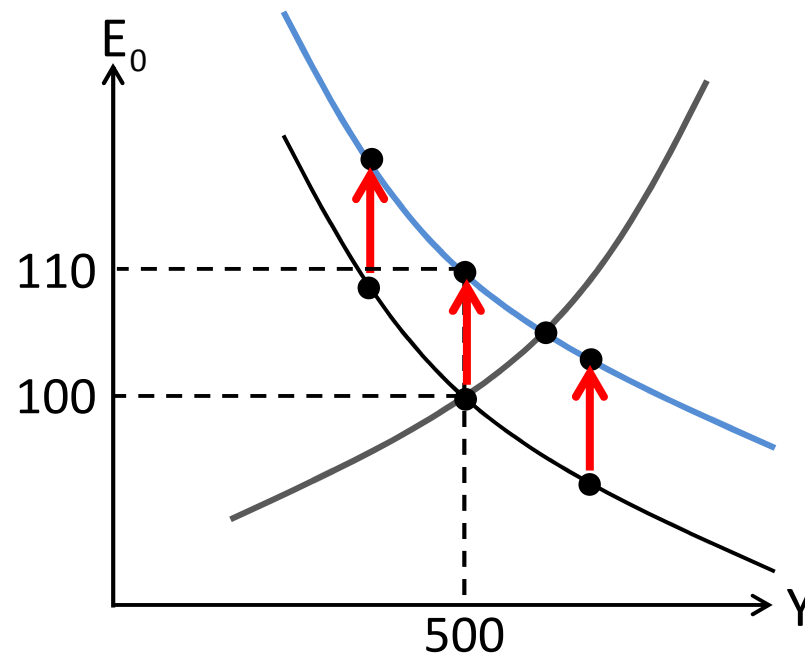
Suppose that the FX and money markets are in equilibrium when  $E_0 = 100$ ,  $Y = 500$ ,  $P = 200$ ,  $i^* = 0.05$ ,  $E_1^e = 100$ ,  $M = 1000$ .

A rise in the expected future yen/dollar rate from 100 to 102 raises the expected return on dollar asset and causes an excess demand for dollar asset.

For the same level of output, higher exchange rate  $E_0 = 110$  is required to lower the expected return on dollar and keep the FX market in equilibrium.

# Rise in Expected Future Exchange Rate(cont.)

For any pair on the initial AA curve, after a rise in the future yen/dollar rate, higher exchange rate is required to keep the FX and money markets in equilibrium.



It implies that the AA schedule shifts upward, raising equilibrium GDP (and increasing employment) and raising the equilibrium exchange rate (yen's depreciation).

## Medium-term Fluctuations of Exchange Rates and GDP :Summary (1)

An increase in		GDP	Exchange Rate
Investment demand	DD rightward	Rise	Fall (yen's appreciation)
Government demand	DD rightward	Rise	Fall (yen's appreciation)
US Income	DD rightward	Rise	Fall (yen's appreciation)
JP Price Level	DD leftward AA downward	Fall	Ambiguous
US Price Level	DD rightward	Rise	Fall (yen's appreciation)



## Medium-term Fluctuations of Exchange Rates and GDP :Summary (2)

An increase in		GDP	Exchange Rate
Money supply	AA upward	Rise	Rise (yen's depreciation)
US Interest rate	AA upward	Rise	Rise (yen's depreciation)
Expected future exchange rate	AA upward	Rise	Rise (yen's depreciation)

# Full-employment Level of Output

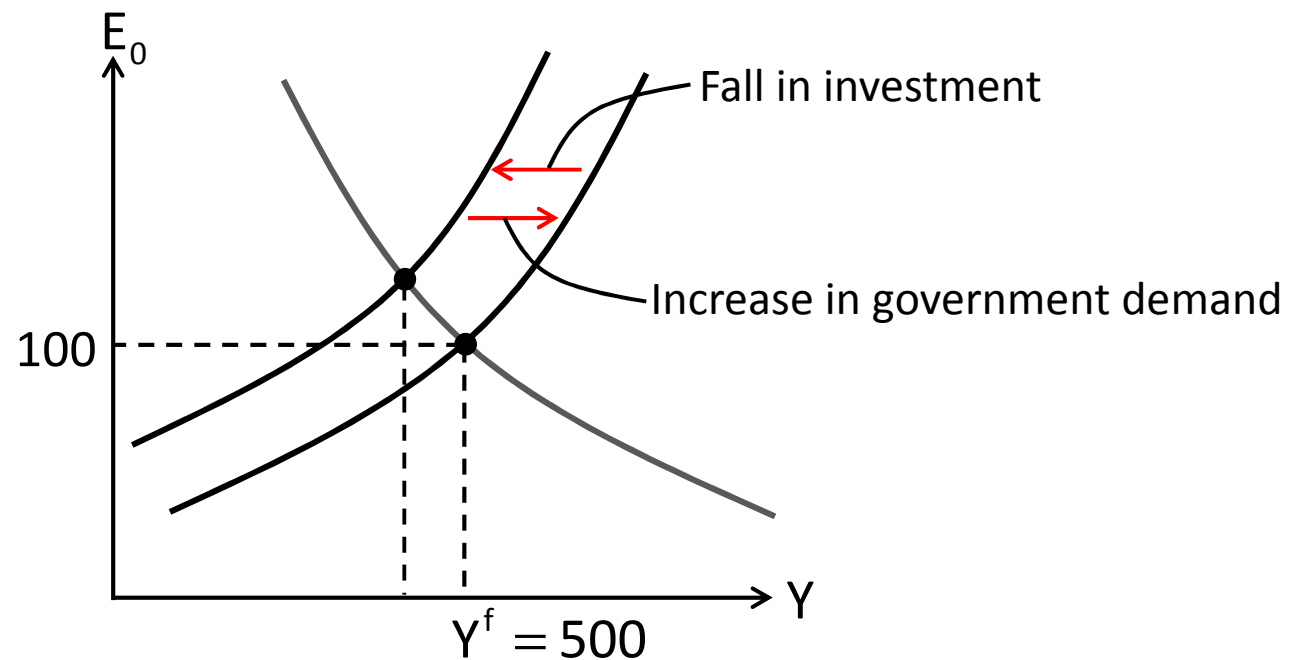
Larger output requires more factors of production, resulting in more employment.

*Full-employment level of output,  $Y^f$ , ensures employment of all the factors of production within the economy.*

*Full-employment level of output is determined by an economy's endowment of productive factors and technology.*

# Government Policy and Employment(1)

Suppose that a decrease in investment demand lowers equilibrium GDP below full-employment output.

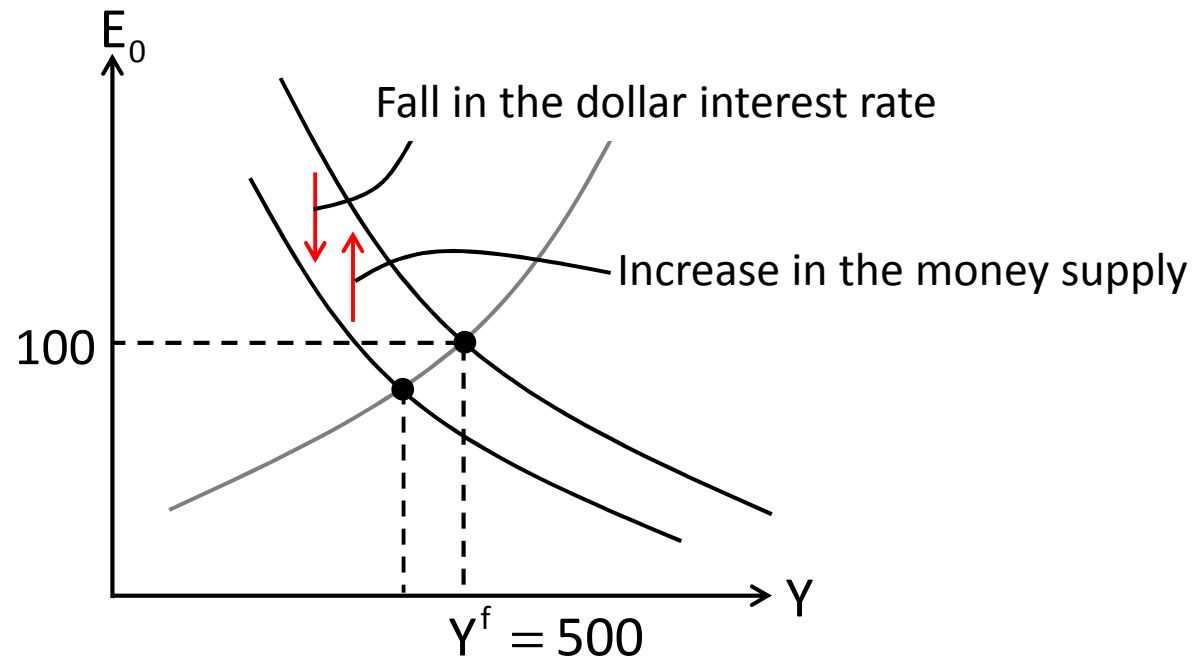


The government can increase its demand and put the economy back to full-employment output.

→ **Fiscal Policy** 財政政策

# Government Policy and Employment(2)

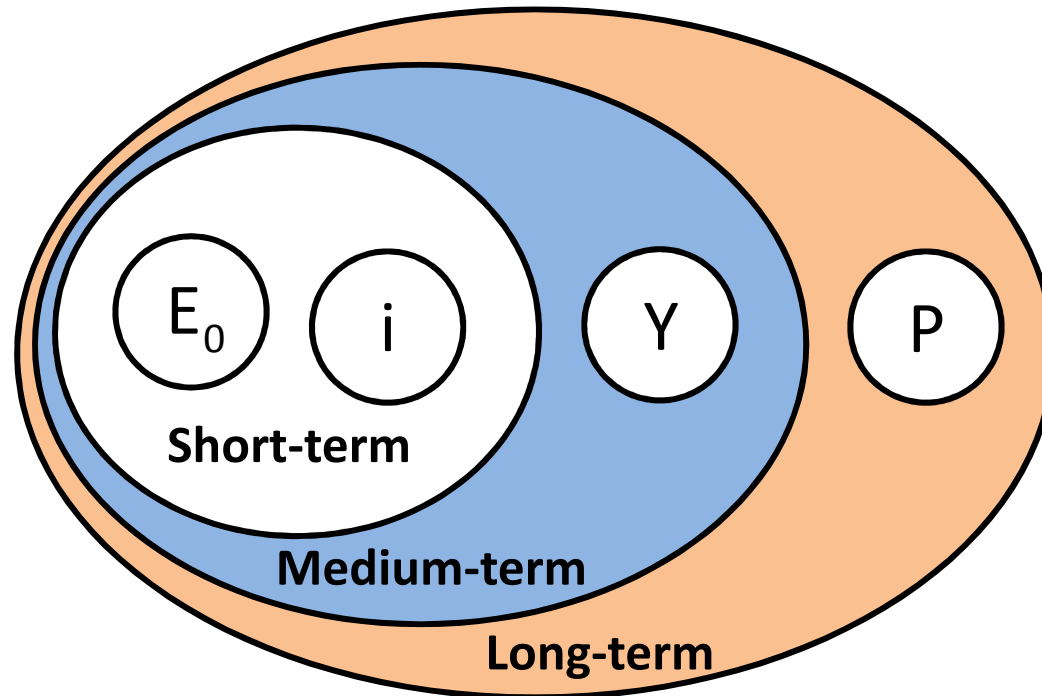
Suppose that a fall in US interest rate lowers equilibrium GDP below full-employment output.



The central bank can increase the money supply and put the economy back to full-employment output.

→ **(Expansionary) Monetary Policy** 金融政策

# Overview of the Models



**Short-term:**  $E_0$  and  $i$  are determined, while  $Y$  and  $P$  are unaffected.

→ **Interest Parity Model + Liquidity Preference Model**

**Medium-term:**  $E_0$ ,  $i$ , and  $Y$  are determined, while  $P$  is still unaffected.

→ **DD-AA Model**

**Long-term:**  $E_0$ ,  $i$ ,  $Y$ , and  $P$  are determined.

(\* )The long-term model has not covered and will not covered in Final.

# To be prepared for Final

For the short-term and medium-term models, what are the variables determined inside (*endogenous variables*) and what are the variables unaffected and given from outside (*exogenous variables*)?

	Endogenous Variables	Exogenous Variables
Short-term	$E_0$ $i$	<div style="display: flex; align-items: center;"> <div style="border: 2px solid red; padding: 2px; margin-right: 5px;"><math>Y</math></div> <div style="display: flex; flex-direction: column; align-items: center;"> <math>I</math> <math>G</math> <math>P</math> <math>P^*</math> <math>E_1^e</math> <math>i^*</math> <math>M</math> </div> </div>
Medium-term	$E_0$ $i$ $Y$	<div style="display: flex; flex-direction: column; align-items: center;"> <math>I</math> <math>G</math> <math>P</math> <math>P^*</math> <math>E_1^e</math> <math>i^*</math> <math>M</math> </div>

# To be prepared for Final (cont.)

For the short-term and medium-term models, how is the equilibrium affected by changes in exogenous variables?

## Short-term Model

Changes in Exogenous Variables	Changes in Equilibrium
$i^* \uparrow$	$E_0 \uparrow$
$E_1^e \uparrow$	$E_0 \uparrow$
$M \uparrow$	$E_0 \uparrow$ $i \downarrow$
$P \uparrow$	$E_0 \downarrow$ $i \uparrow$
$Y \uparrow$	$E_0 \downarrow$ $i \uparrow$

For the medium-term model, see 33-34.

# To be prepared for Final (cont.)

Be careful whether you are required to explain the *short-term* or *medium-term* outcome of changes in exogenous variables.

“Assume that income(output) and prices are given ...”

“Assume that income and prices are unaffected ...”

→ Apply the *short-term* model.

“Assume that prices are given ...”

“How is output affected?”

→ Apply the *medium-term* model.

For essay questions, take time and try to be more detailed (than in Midterm).



# Final

1. Final is held on December 20, 13:35 – 14:45, at the same room as the lecture.
2. You can withdraw any time if you're sure you've finished exam.
3. This is a closed book exam.
4. You are allowed to use a simple calculator. You can not use your cell phone, smart phone or notebook computer for calculation.
5. The exam includes 8 multiple-choice questions, 3-4 essay questions, one of which requires some calculation.