Unit 5 - Point 3

Output, the interest rate and the exchange rate: the basic IS-LM in an open economy

- Goods markets equilibrium and financial markets equilibrium.
- The IS curve in an open economy
- IS-LM in an open economy (under floating exchange rates and perfect capital mobility)
- Monetary policy in an open economy: the transmission mechanisms
- Fiscal policy in an open economy
- Effects of international real and financial shocks.
- Exchange rate regimes (definitions and comments on data)
- Fixed Exchange rates under perfect capital mobility
- Monetary policy under fixed exchange rates and perfect capital mobility.
- Fiscal policy under fixed exchange rates.
- International financial shocks under fixed exchange rates.

Goods markets equilibrium

$$Z = C(Y - T^N) + I(Y, i) + G + NX(Y^*, Y, \varepsilon)$$
$$Y = Z$$
$$\varepsilon = E\frac{P}{P^*}$$

Simplifying hipothesis: $\frac{P}{P^*} = 1 \Rightarrow \varepsilon = E$

$$Z = C(Y - T^N) + I(Y, i) + G + NX(Y^*, Y, E)$$
$$Y = Z$$

$$Y = C(Y - T^N) + I(Y, i) + G + NX(Y^*, Y, E)$$

Financial markets equilibrium:

i) Money market equilibrium

$$i = \bar{i}$$

$$[M^S = PYL(\bar{i})]$$

ii) Bonds markets equilibrium

$$(1+i) = (1+i^*)\frac{E_t}{E^e_{t+1}}$$

Which can be rewritten as:

$$E_t = \frac{(1+i)}{(1+i^*)} E^e_{t+1}$$

Simultaneous equilibrium in real and financial markets

1. $Y = C(Y - \overline{T^N}) + I(Y, \bar{i}) + \overline{G} + NX(Y^*, Y, E)$

   $(+)\quad (+)\ (-)\qquad (+)\ (-)\ (-)$

2. $i = \bar{i}$

   $[M = \bar{P}\, YL(\bar{i})]$

3. $E_t = \dfrac{(1+i)}{(1+\overline{i^*})}\, \overline{E^e_{t+1}}$

Simultaneus equilibrium in real and financial markets (system of equations 1,2,3) determines the equilibrium values of Y and E. Given Y and E one can get the values of all other endogenous variables (i.e. variables determined within the system).

Endogenous variables: Y, E, M, C, I, NX,

Exogenous variables : i, G, T^N, Y*, i*, E^e_{t+1}

Simultaneous equilibrium in real and financial markets

$$Y = C(Y - \overline{T}^{N}) + I(Y, \bar{i}) + \overline{G} + NX(Y^{*}, Y, E)$$

$$i = \bar{i} \quad [M = \overline{P}\, YL(\bar{i})]$$

$$E_t = \frac{1+i}{1+i^{*}} E^{e}_{t+1}$$

$$Y = C(Y - \overline{T}^{N}) + I(Y, \bar{i}) + \overline{G} + NX(Y^{*}, Y, \frac{1+i}{1+i^{*}} E^{e}_{t+1}) \quad > IS^{NX}$$

$$i = \bar{i} \quad > LM$$

$$[M = \overline{P}\, YL(\bar{i})]$$

The IS^{NX} curve

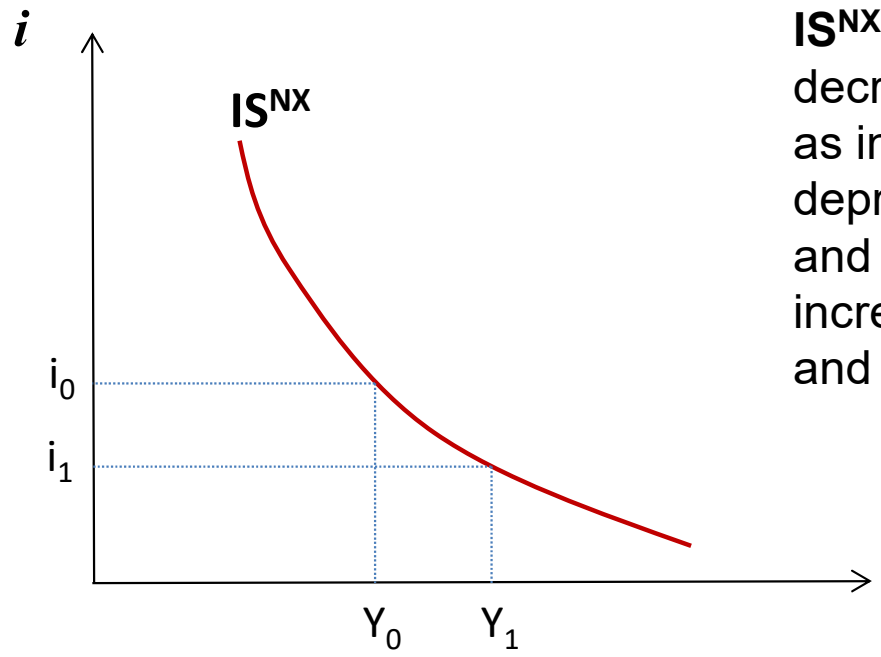
$$Y = C(Y - \overline{T}^{N}) + I(Y, \bar{i}) + \bar{G} + NX(Y^{*}, Y, E)$$

$$i = \bar{i}$$

$$E_t = \frac{1+i}{1+i^{*}} E^{e}_{t+1}$$

IS^{NX}> $$Y = C(Y - \overline{T}^{N}) + I(Y, \bar{i}) + \bar{G} + NX(Y^{*}, Y, \frac{1+i}{1+i^{*}} E^{e}_{t+1})$$

Can be represented on the (Y,i) plane for given values of T^N, G, Y*, i* and E^e_{t+1}



Notice:

IS^{NX} is still **negatively sloped on the (Y,i) plane**. If i decreases: 1) Aggregate Investment increases (same as in a closed economy) and 2) The exchange rate depreciates, and the depreciation decreases imports and increases exports, thereby increasing NX. The increase in NX determines an increase in production, and the increase in production and income, etc…

The **slopes depends on**:

1) the sensitivity of Investment to the interest rate,
2)the sensitivity of Investment and Consumption to the level of income Y:
3) the sensitivity of net exports to the level of income
4) The sensitivity of net exports to the exchange rate

The higher 1), 2) e 4) and the lower 3) the flatter will be IS^{NX} (Y increases more for a given reduction of i)

Changes of T^N, G, Y*, i* E^e_{t+1} shift the curve on the plane

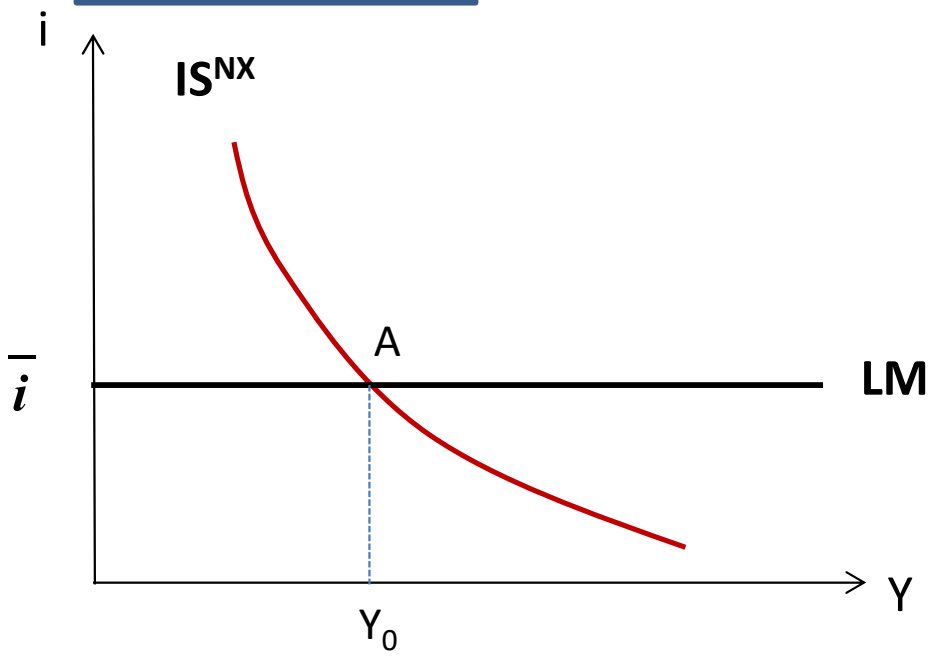
Expansionary fiscal policies shift the curve to the right (fiscal contractions shift it to the left)
Increases in Y* shift the curve to the right (decreases in Y* shift it to the left)
Increases in i* shift the curve to the right (decreases in i* shift it to the left)
Increases in E^e_{t+1} shift the curve to the left (decreases in E^e_{t+1} shift it to the right)

Simultaneous equilibrium in real and financial markets

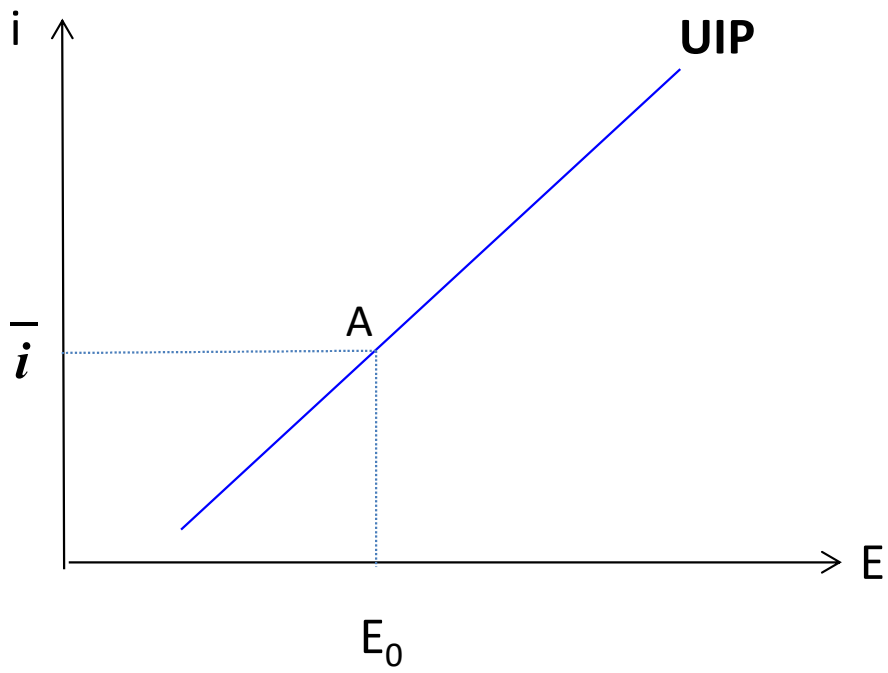
IS^{NX}> $Y = C(Y - \overline{T}^{N}) + I(Y, \bar{i}) + \overline{G} + NX(Y^{*}, Y, E)$

LM> $i = \bar{i} \quad [M = \bar{P} Y L(\bar{i})]$

UIP> $E_t = \frac{1+i}{1+i^{*}} E^{e}_{t+1}$



(behind the scenes)



Given Y_0, E_0 and we can determine all the other endogenous variables (M, C, I, NX)

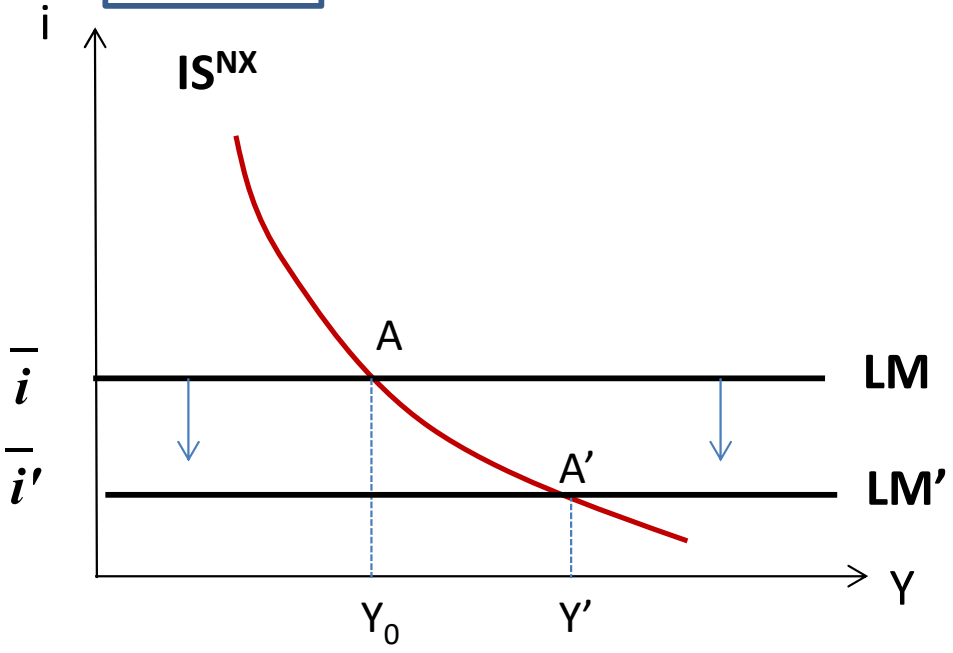
Monetary policy in an open economy

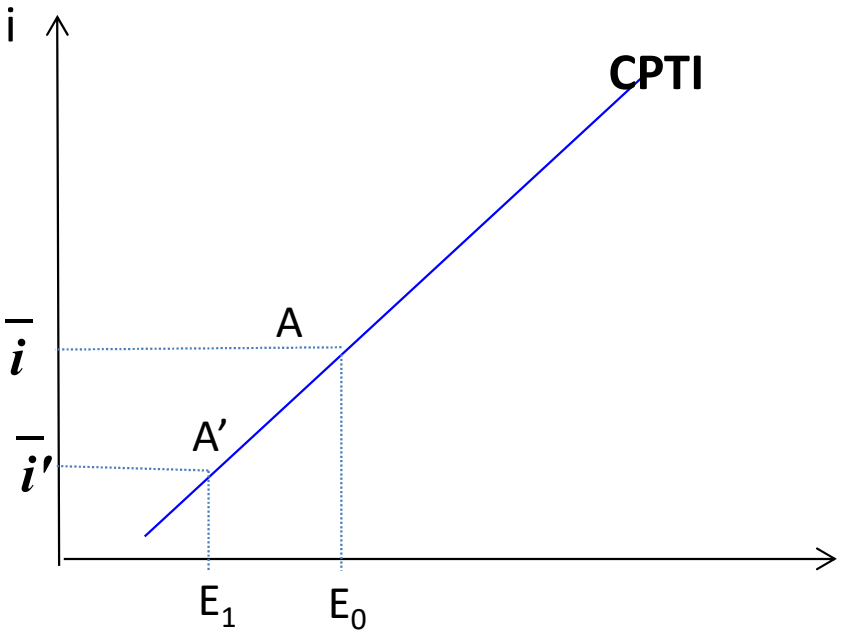
$$Y = C(Y - \overline{T}^{N}) + I(Y, \bar{i}) + \overline{G} + NX(Y^{*}, Y, E)$$
(+) (+, −) (+) (+) (−)

$$i = \bar{i} \qquad [M = \overline{P}YL(\bar{i})]$$

$$E_t = \frac{1+i}{1+i^{*}} E^{e}_{t+1}$$

Example: The central bank implements *an expansionary monetary policy,* and reduces the targeted interest rate





From A to A': The exchange rate depreciates and the level of production increases. C increases, I increases. Money supply increases.

Explanation: The **reduction of the interest rate now has 2 effects: 1) It determines an exchange rate depreciation, which increases net exports; 2) it increases aggregate investment (like in a closed economy). 1 and 2 determine an increase in expenditure and in production (direct effects)**. The increase in Y increases C e I and the increase in expenditure inn domestic goods determines further positive effects on production and income . (keynesian multiplier mechanism) …. As Y increases imports increase, so that in the new equiibrium the change in net exports is less pronounced that the one induced by the initial depreciation.

The transmission channels of monetary policy in an open economy are both the interest rate channel (which affects investment) and the exchange rate channel (which affects net exports)

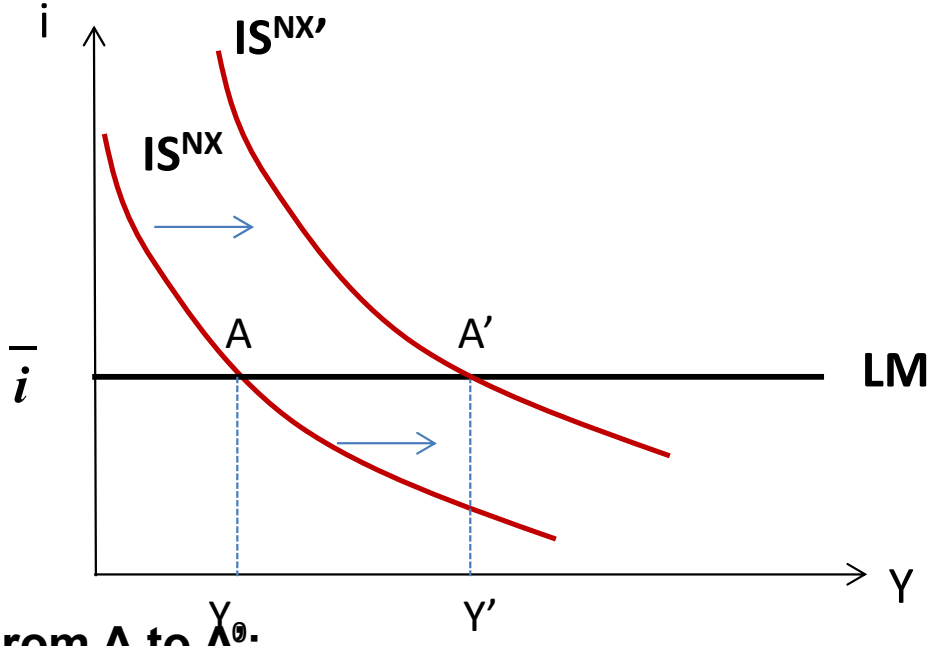
Fiscal policy in an open economy

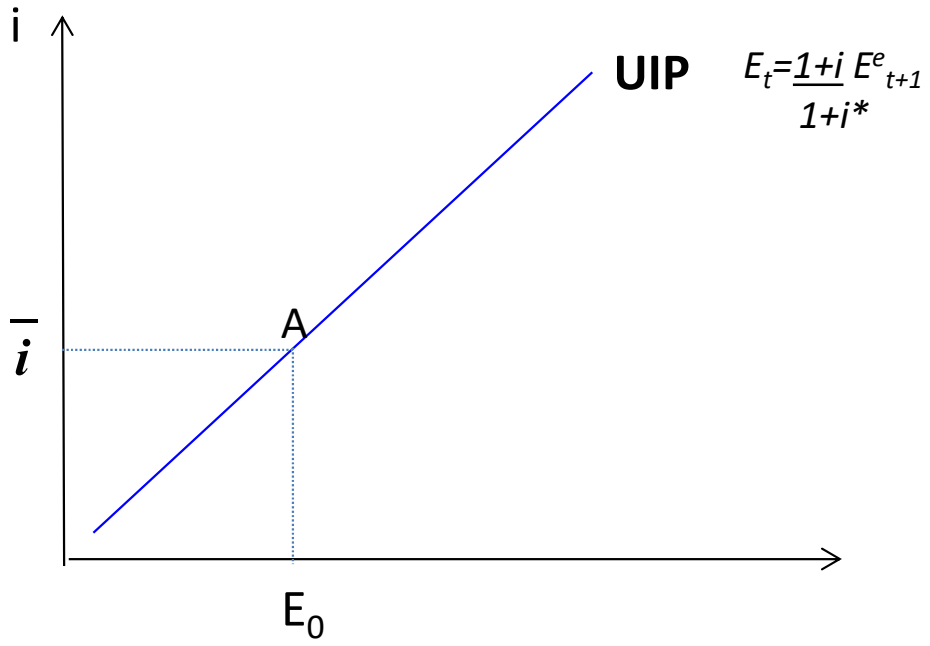
$$Y = C(Y - \overline{T}^{N}) + I(Y, \bar{i}) + \overline{G} + NX(Y^{*}, Y, E)$$

$$i = \bar{i} \qquad [M = \overline{P}YL(\bar{i})]$$

$$E_t = \frac{1+i}{1+i^{*}} E^{e}_{t+1}$$

Example. The goverment undertakes an expansionary fiscal policy (G increases, financed with deficit).





From A to A':

The level of production increases. E is unchanged, as the central bank has not changed i. C and I both increase, NX worsens (as the increase of Y increases imports M, with E unchanges). Money supply increases

Explanation: The increase in G increases expenditure and production. The increase in production and income determines positive induced effects on Consumption and Investment, which increase, thereby determining further increases in expenditure and production …(keynesian multiplier mechanism) …

•The increase in Y increases imports (part of the increases in C and I are satisfied with imported goods) and worsens net exports NX.

• In order to keep the interest rate unchanged, che central bank must increase the money supply (buy bonds on the open market). In fact the increase in Y infatti increases money demand: money supply must increase to re-establish equilibrium on the money market at the given interest rate.

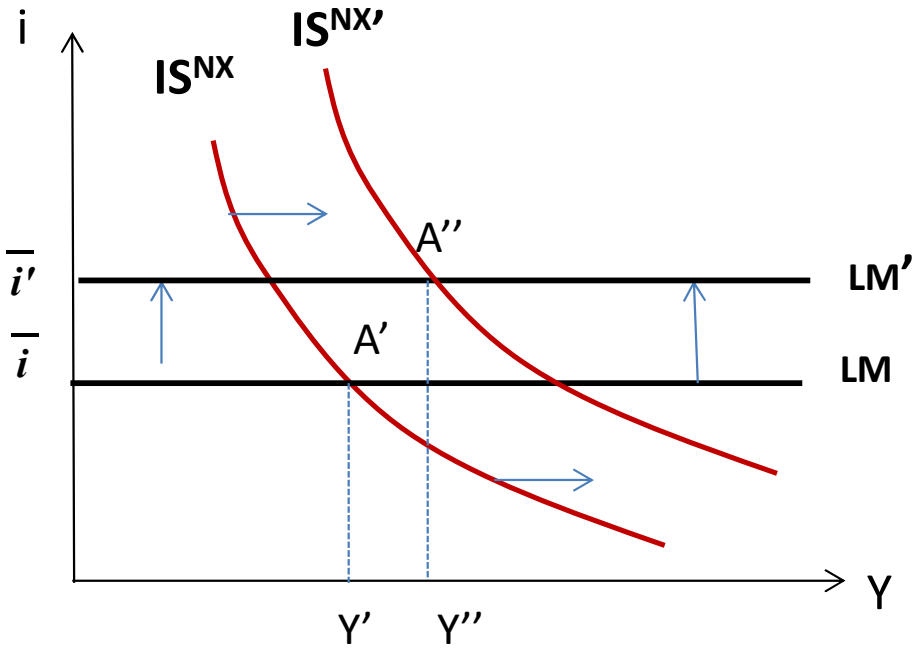
Fiscal and monetary policy mix

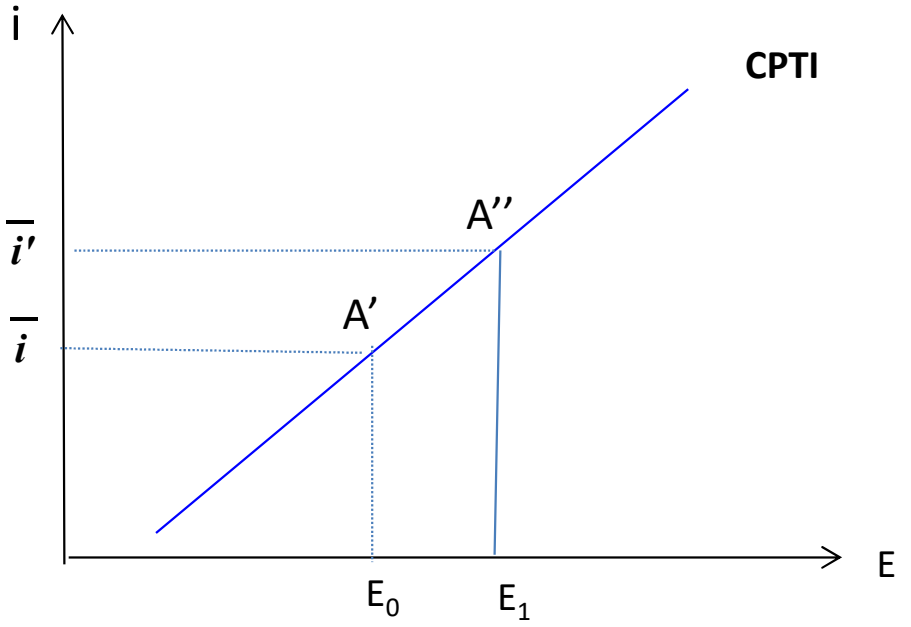
$$Y = C(Y - \overline{T}^{N}) + I(Y, \bar{i}) + \overline{G} + NX(Y^{*}, Y, E)$$
$$(+)\quad (+)\ (-)\quad (+)\ (-)\ (-)$$

$$i = \bar{i} \quad [M = \overline{P}YL(\bar{i})]$$

$$E_t = \frac{1+i}{1+i^{*}} E^{e}_{t+1}$$

Example: Output is at its potential level. The government implements a fiscal expansion (an increase in G). The central bank, fearing the inflationary effects of an excessive increase in spending, responds by raising the target interest rate.





From A' to A'': Y increases, E appreciates. C increases. NX worsens both because of the appreciation (which reduces exports and increases imports) and because of the increase in Y (which raises imports). The effect on I is ambiguous (the increase in i and the increase in Y have opposite effects on I).

Compared to the previous case (fiscal policy only), the expansionary effects on the level of economic activity will now be smaller, for two reasons:
1. The increase in the interest rate has a negative effect on aggregate investment, which at least partly offsets the positive effect of the increase in Y. 2. The increase in the interest rate leads to an appreciation of the exchange rate, and the appreciation has negative effects on the trade balance, which deteriorates more than in the previous case because now the effects of the appreciation (which reduces X and increases Q^M) are added to the effects of the increase in Y (which increases Q^M).
If the effects of the increase in i and of the appreciation are not sufficient to fully offset the increase in G, there will still be an expansionary effect (as in the figure), but it will be more limited than in the previous case (fiscal policy alone).

Exercise (homework)

Starting from an equilibrium like the one illustrated in the graph below, describe the macroeconomic effects of :

i) A reduction of foreign output/income Y*.

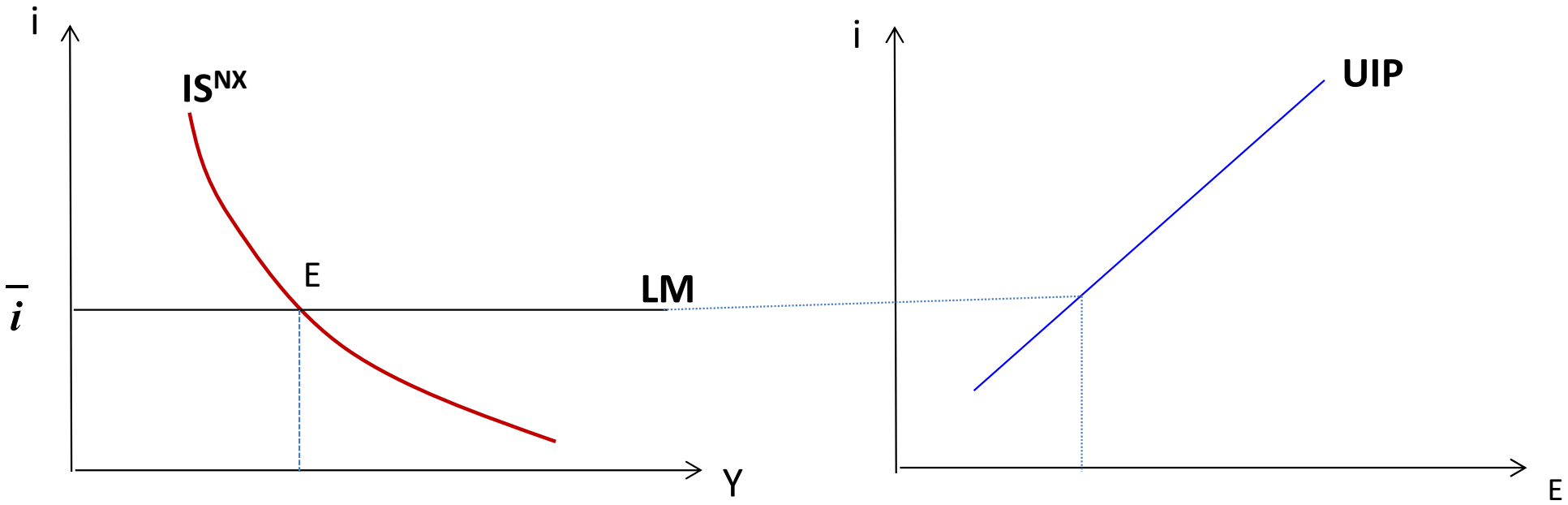
ii) An increase of the foreign interest rate i*.

iii) A reduction of E^e_{t+1} (future expected depreciation)

$$Y = C(Y - \overline{T^N}) + I(Y, \bar{i}) + \bar{G} + NX(Y^*, Y, E)$$

$$i = \bar{i}$$

$$E_t = \frac{1+i}{1+i^*} E^e_{t+1}$$



Suggestion for cases ii) and iii): changes of i and E^e_{t+1} shift both the IS^{NX} curve and the UIP.*

The model can be extended to account for the role of risk in portfolio choices ….

… or to account for the consequences of the *zero lower bound …*

Exchange rate regimes

So far, we have assumed that the exchange rate is free to adjust in response to demand and supply in the foreign exchange market. We have assumed that the central bank does not have a specific target for the exchange rate and instead sets the target interest rate (by appropriately adjusting the money supply), leaving the exchange rate free to adjust in order to ensure equilibrium in the foreign exchange market."

This assumption is not always realistic: in many cases, central banks use monetary policy to achieve specific exchange rate targets, which may be either explicit or implicit.

Exchange rate agreements, or exchange rate regimes, therefore, can be different.
Let us briefly define them

Floating exchange rates

In a floating exchange rate regime, the exchange rate is market determined: the central bank has no specific target on the exchange rate, which is free to float in response to supply and demand on the foreign exchange market market.
We can distinguish among:

Floating

The **E.R. is largely market determined**, but **the central bank can intervene** in the forex market in order **to prevent undue fluctuations**.
The cenral bank can of course also influence the ER indirectly through the interest rates.

Free floating

The **E.R. is purely market determined**: the **central bank does not intervene at all in the forex market**, except in exceptional circumstances to address disorderly market conditions.
In this case the c.b. can only influence the ER indirectly through the interest rates)

“Fixed exchange rates”: hard and soft pegs

In a fixed exchange rate regime, the central bank is committed to maintain a given parity in terms of a given foreign currency, and to intervene when the market exchange rate tends to deviate from the announced parity

In some cases the parity CANNOT be changed → Hard Pegs)

In other cases the parity can be changed (the exchange rate can be <u>devalued</u> or <u>revalued</u> → (Soft Pegs)

Hard Pegs

Exchange agreements with no separate legal tender (dollarization):
a country simply adopts the currency of another country
(e.g., Equador and El Salvador use the $, Montenegro uses the €)

Currency Boards
the central bank announces a fixed E.R. parity, which is supported by institutional arrangements that not only make it very difficult to change the E.R. parity, but binds monetary policy to the sole objective of defending the exchange rate.
(e.g. Bosnia and Herzegovina (€), Bulgaria (€))

Soft pegs

- **conventional peg arrangements**
  the central bank formally (de jure) pegs its currency at a fixed rate to another currency or a basket of currencies, and stands ready to defend the fixed parity both directly (by intervening in the foreigh exchange market) and indirectly (through interest rate policy). The country retains the discretion to change the parity in the future, to achieve its macroeconomic goals
  Stabilized arrangements are informal (de facto) conventional pegs

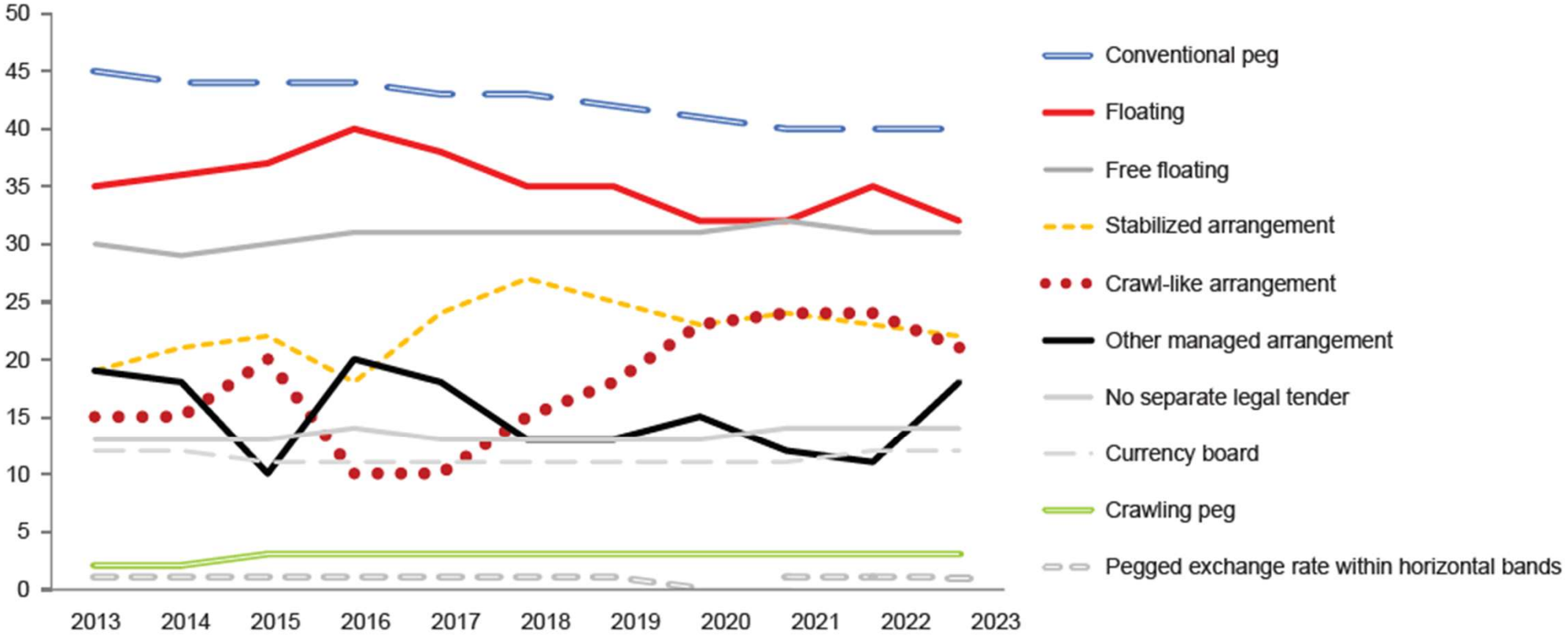
- **crawling pegs**
  the central bank formally (de jure) or informally (de facto)pegs its currency at a fixed rate to another currency or a basket of currencies, but the peg is adjusted in small amounts at a fixed rate or in response to changes in selected quantitative indicators.
  Crawl-like arrangements are are informal (de facto) crawling pegs

- **Horizontal bands**
  the value of the currency is maintained within certain official margins of fluctuations around an official fixed central parity.
  When the E.R. reaches the upper or lower bound the central bank is committed to intervene (directly of indirectly) to ensure that it does not go trough it.

Exchange rate regimes 2013-2023

2. Exchange Rate Arrangements, 2013–23

(Number of countries as of April 30)



Sources: IMF, AREAER database; and IMF staff calculations.

Source: IMF Annual Report on exchange rate arrangements and exchange rate restrictions, 2024
https://www.elibrary-areaer.imf.org/Pages/Home.aspx

“Fixed exchange rates”: implications for monetary policy

Both under floating and fixed exchange rates, if capital mobility is perfect, the domestic interest rate and the exchange rate must satisfy the uncovered interest parity condition (UIP) :

$$(1+i) = (1+i^*)\frac{E_t}{E^e_{t+1}}$$

Assume that a country pegs its exchange rate to a given value, $E_t = \bar{E}$

If the markets believe that the parity will be maintained, the future expected exchange rate will be equal to the fixed value for the exchange rate: $E^e_{t+1} = \bar{E}$

The UIP expression, then **simplifies to**:

$$(1+i) = (1+i^*) \quad \text{i.e.} \quad \Rightarrow \quad \boxed{i = i^*}$$

Under a fixed exchange rate regime and perfect capital mobility, the domestic interest rate must be equal to the foreign interest rate!

This implies that **the central bank CANNOT choose a target for the interest rate!** Terefore**:**

Under a fixed exchange rate regime and perfect capital mobility, the central bank gives up monetary policy as a policy instrument!

There is no discretion in conducting monetary policy. Monetary policy can only be used to guarantee that the target on the exchange rate is reached.

“Fixed exchange rates”: implications for monetary policy

UIP> $\boxed{i = i^*}$

What would happen if the central bank implemented an expansionary monetary policy?

For example: the central bank lowers the domestic interest rate, by buying bonds on the open market, which increases the monetary base.

The domestic interest rate is now lower than the international interest rate. With perfect capital mobility, this leads to an immediate outflow of capital abroad and puts pressure on the exchange rate, which tends to depreciate (fall below the fixed parity).

But the central bank cannot allow the depreciation and must intervene in the foreign exchange market to defend the peg, by purchasing domestic currency in exchange for foreign currency.

This reduces foreign exchange reserves, contracts the monetary base, and raises the interest rate.

The central bank must continue selling foreign currency in exchange for domestic currency until the monetary base returns to its pre–open market operation level and the interest rate returns to being equal to the foreign interest rate.

The final effect of the open market operation is to **change the composition of the central bank’s assets, while leaving the monetary base—and therefore the interest rate—unchanged**.

Central bank balance sheet

Assets	Liabilities
Bonds + ΔB	Monetary base + ΔB - ΔB = 0
Foreign exchange reserves - ΔB	

“Fixed exchange rates”: implications for monetary policy

In summary:

With fixed exchange rates and perfect capital mobilities a country foregoes monetary policy as a policy instrument.

With perfect capital mobility the domestic interest rate cannot deviate from the international interest rate.

Under fixed exchange rates, only with *imperfect capital mobility* (e.g. in presence of controls to capital movements) it would be possible to maintain some scope of action for monetary policy.

Under *Soft pegs*, however, exchange rate policy is a policy option: the exchange rate can be devalued, and an unexpected devaluation can have the same effects that we have studied for a real depreciation.
However, devaluation is not an option that countries can use regularly. This would impair the credibility of the fixed parity, and this would have destabilizing effects.

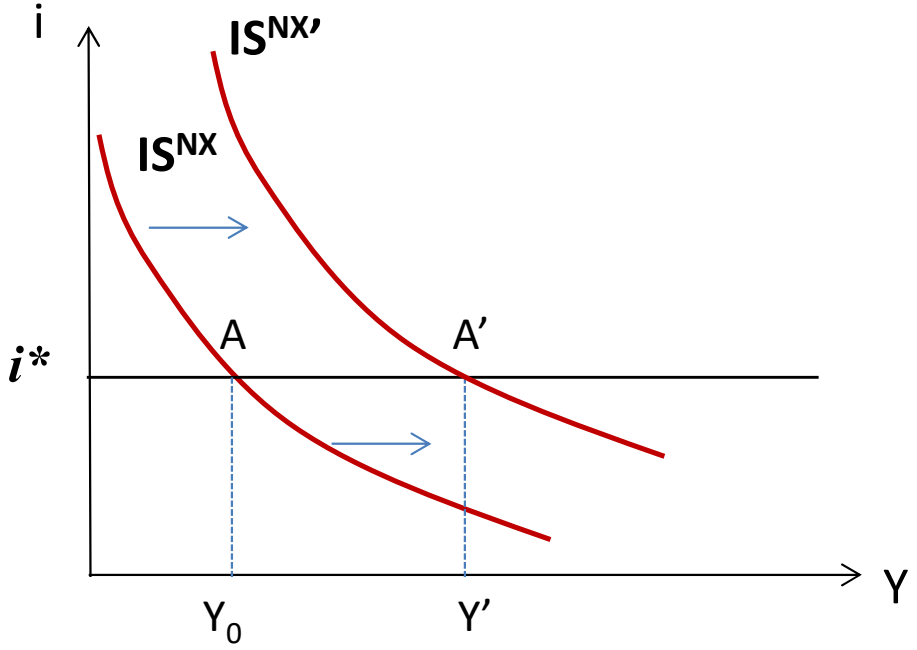
Devaluation is obviously not an option under *Hard Pegs*.

Fiscal policy with fixed exchange rates

IS> $Y = C(Y - \overline{T}^{N}) + I(Y, \bar{i}) + \overline{G} + NX(Y^{*}, Y, \overline{E})$

UIP> $i = i^{*}$

[LM> $M = \overline{P}\,YL(i^{*})$ **]**



What is the role of fiscal policy under fixed exchange rates?

The effects of a fiscal expansion (or contraction) are identical to those that we have studied for the case of floating exchange rates (slide 9)

This is because, under floating e.r., if the increase in spending is not accompanied by a change in the interest rate, the exchange rate does not change. Therefore, when government spending increases it makes no difference whether a country pegs its exchange rate or not.

The difference between fixed and floating e.r. **is in the ability of the central bank to respond: under fixed exchange rates the central bank cannot respond by changing the interest rate,** as the domestic interest rate must be always equal to the foreign interest rate.

Fixed e.r.: effects of an increase in the foreign interest rate, i*

Under fixed exchange rates, the reaction of the economy to international financial shocks is different with respect to the floating exchange rate case. For example consider an increase in the foreign interest rate:

IS> $Y = C(Y - \overline{T}^{N}) + I(Y, \bar{i}) + \overline{G} + NX(Y^*, Y, \overline{E})$

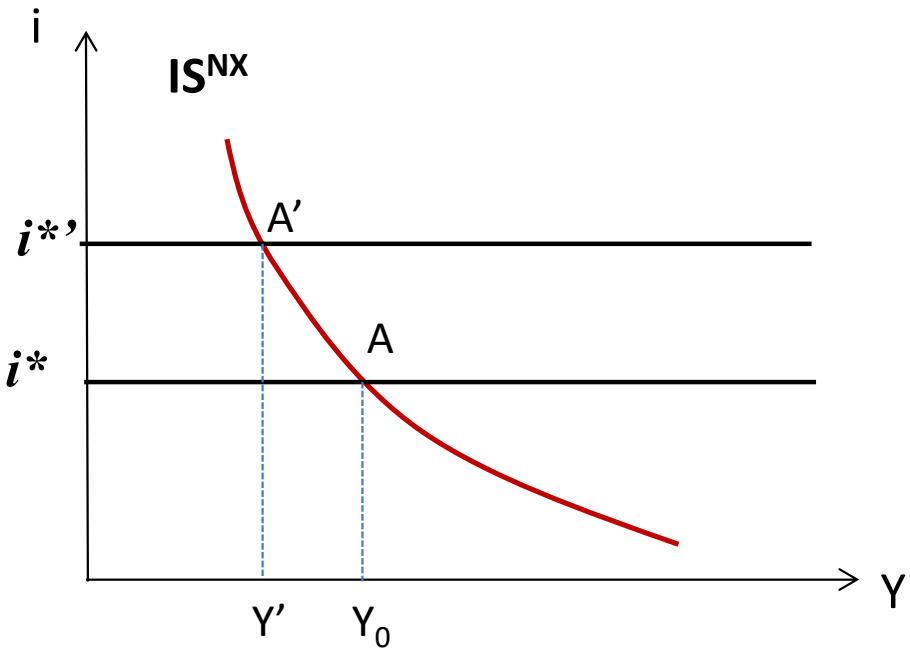
CPTI> $i = i^*$

$M = \overline{P}\, YL(i^*)$

[LM> **]**

i* ↑

The domestic interest rate must immediately adapt to the increase in the foreign rate: i must increase by as nuch as the increase in i*.



With recessionary effects on the domestic economy

From A to A':

- The supply of money decreases, and the domestic interest rate increases by as much as the increase in the foreign interest rate.
- There is a contraction of domestic production
- Consumption drops
- Investment drops (both due to the increase in i and to the decrease in Y)
- Net exports improve (as the reduction of Y reduces imports.

Question: **What would be the effects of an increase in i* under floating exchange rates?**