

Open Economy II



EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání



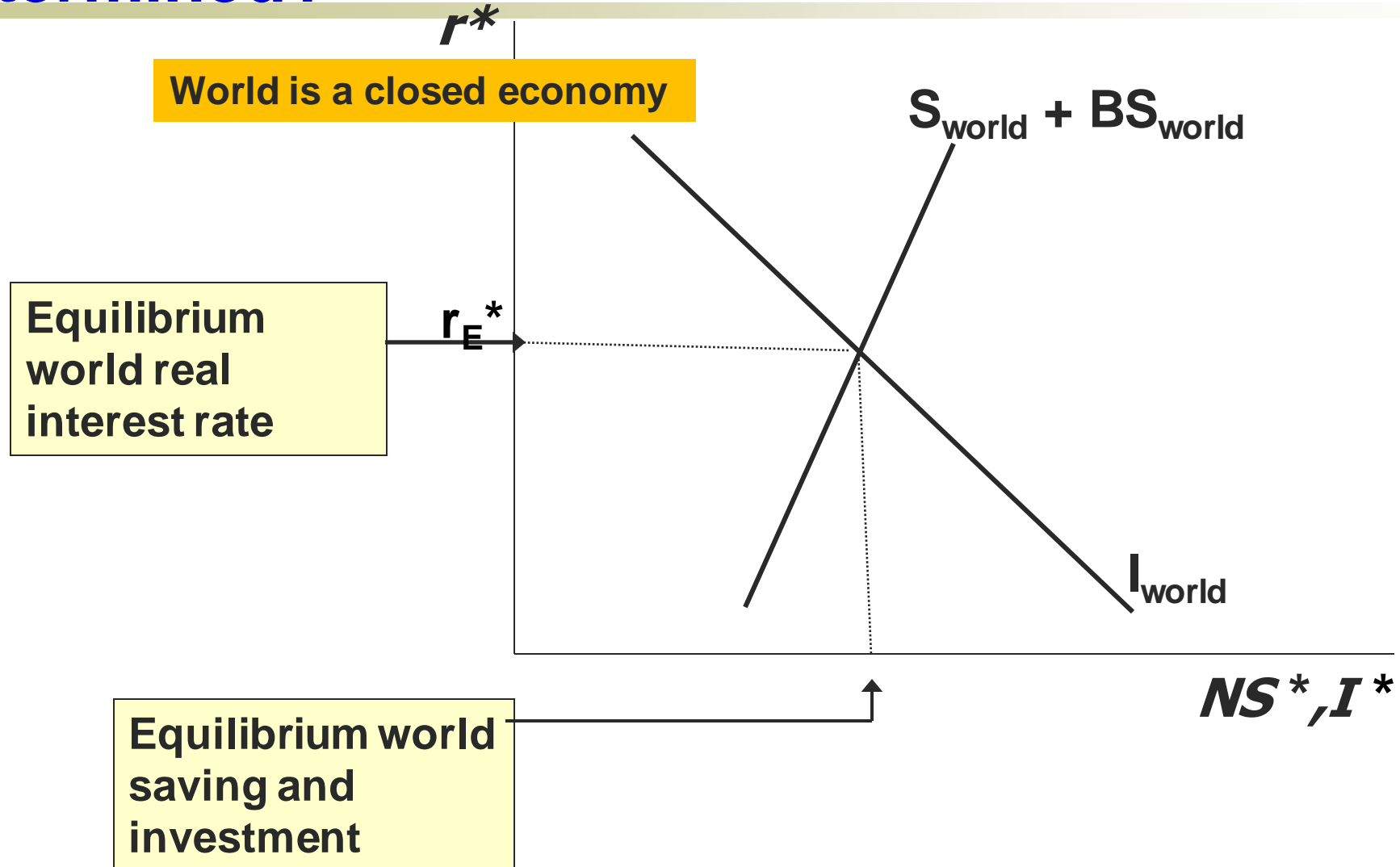
Saving and Investment in a Small Open Economy

- We rearranged accounting identities.
- Now we build a model that explains the behavior of these variables.
- Model:
 - Assumptions
 - Exogenous variables
 - Endogenous variables

$$r = r^*$$

- Borrowers of the small open economy need never borrow at any interest rate above r^* , because they can always get a loan at r^* from abroad.
- Lenders of the SOE need never lend at any interest rate below r^* because they can always earn r^* by lending abroad.
- If $r > r^*$, an infinite inflow of capital from abroad would reduce r to r^* .
- If $r < r^*$, an infinite outflow of capital to abroad would increase r to r^* .

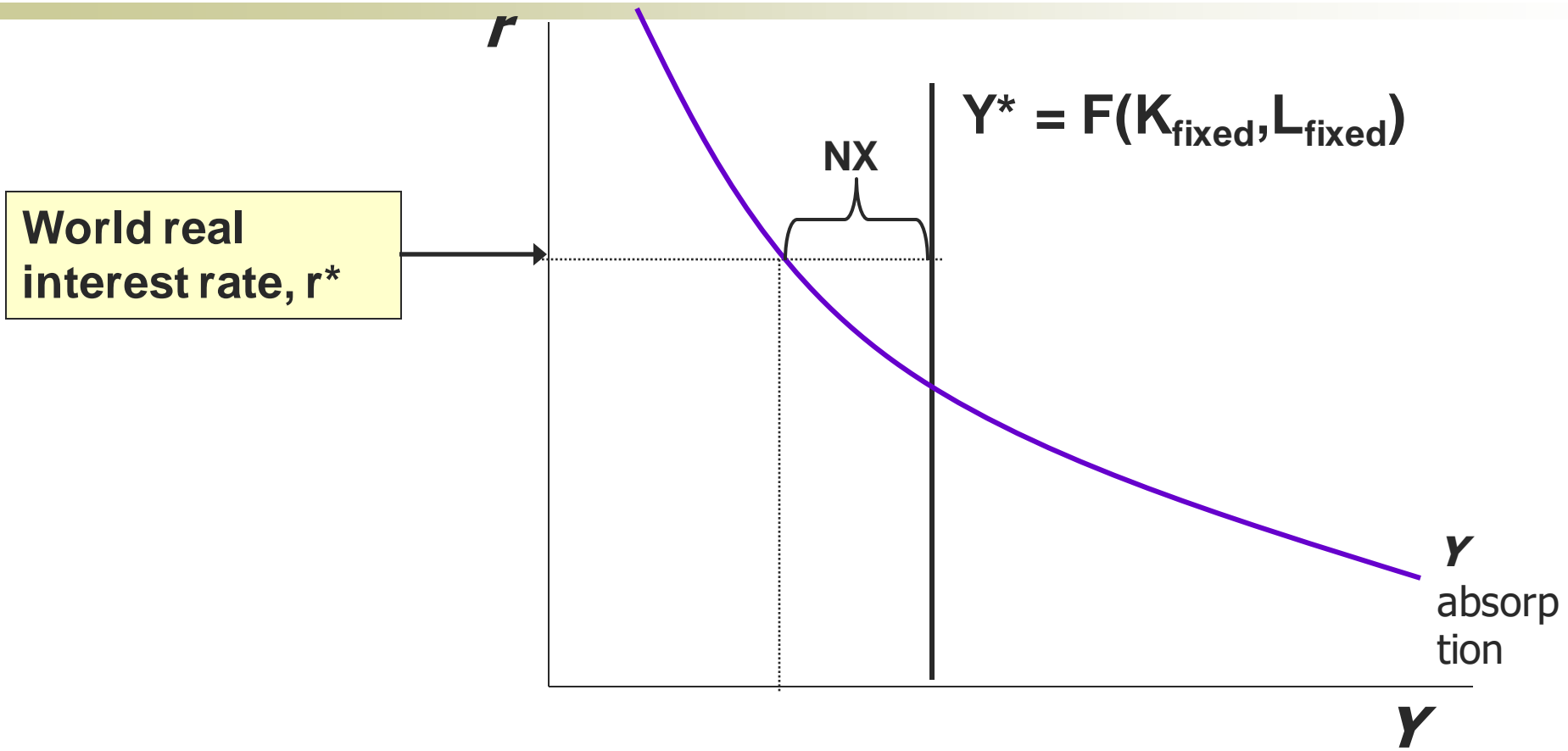
How is r^* (the world real interest rate) determined?



SOE classical model

- Aggregate supply: $Y^* = F(K_{\text{fixed}}, L_{\text{fixed}})$
- Aggregate demand: $Y = C + I + G + NX$
- Consumption function: $C = C(Y_d, r) \Rightarrow (\text{SOE}): C = C(Y_d, r^*)$
- Investment function: $I = I(r) \Rightarrow (\text{SOE}): I = I(r^*)$
- Net export function: $NX = NX(E_r, \dots)$
- $Y_d = Y - TA + TR$
- TA, TR, G, r^* are exogenous
- Aggregate demand: $Y = C(Y - TA + TR, r^*) + I(r^*) + G + NX(E_r)$
- Equilibrium: $Y^* = C(Y^* - TA + TR, r^*) + I(r^*) + G + NX(E_r)$
- Only E_r can bring the system into the equilibrium.

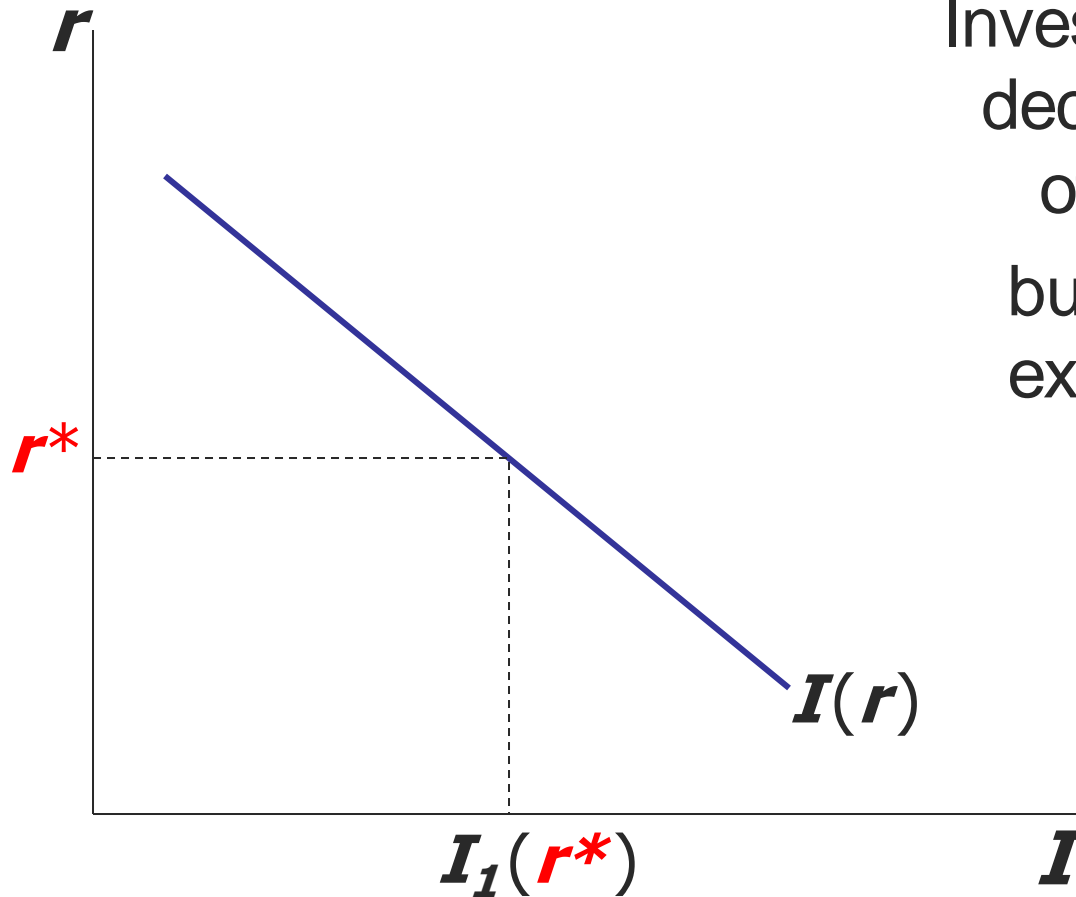
[The Classical Model]



SOE loanable funds market

- $Y = C + I + G + NX$
- $NX(E_r) = Y^* - C(Y^* - TA + TR, r^*) - G - I(r^*)$
- $NS(r^*) = Y^* - C(Y^* - TA + TR, r^*) - G$
- $NX(E_r) = NS(r^*) - I(r^*)$

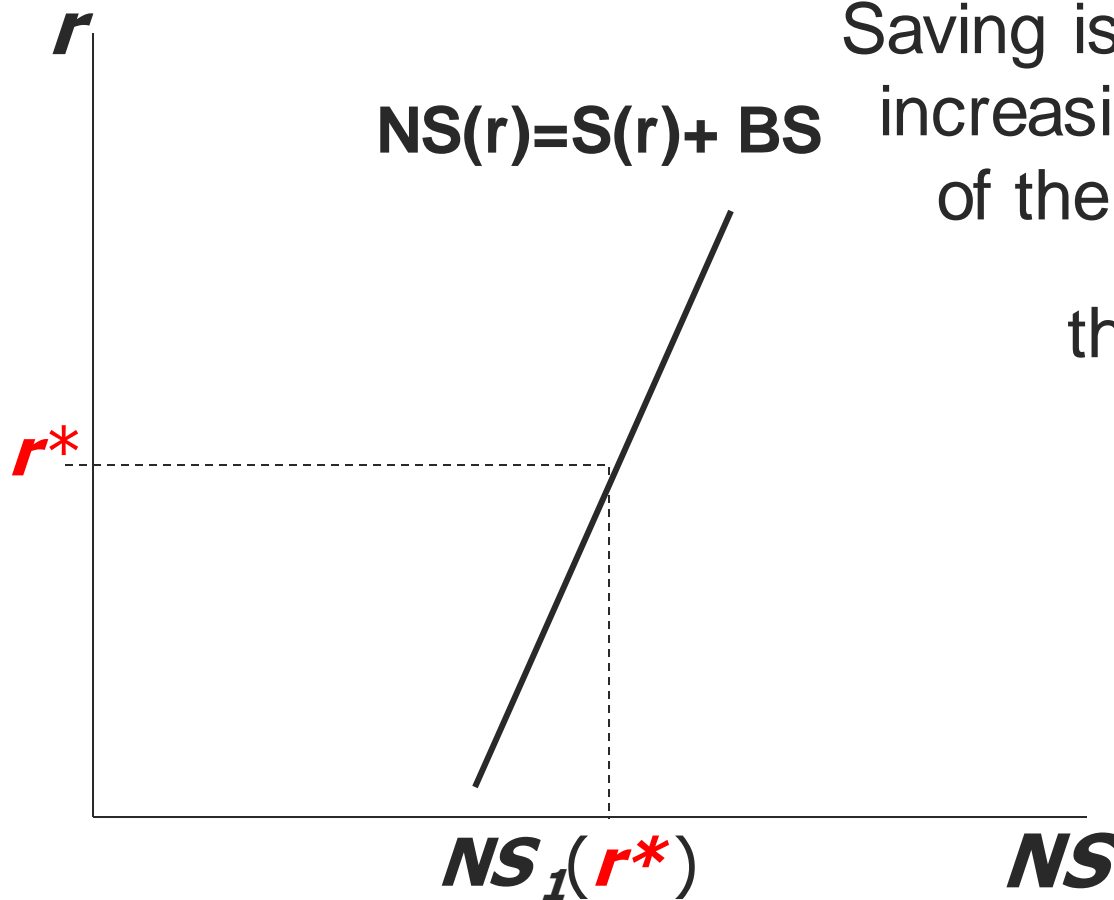
Investment: The demand for loanable funds



Investment is a decreasing function of the interest rate, but the interest rate is exogenous...

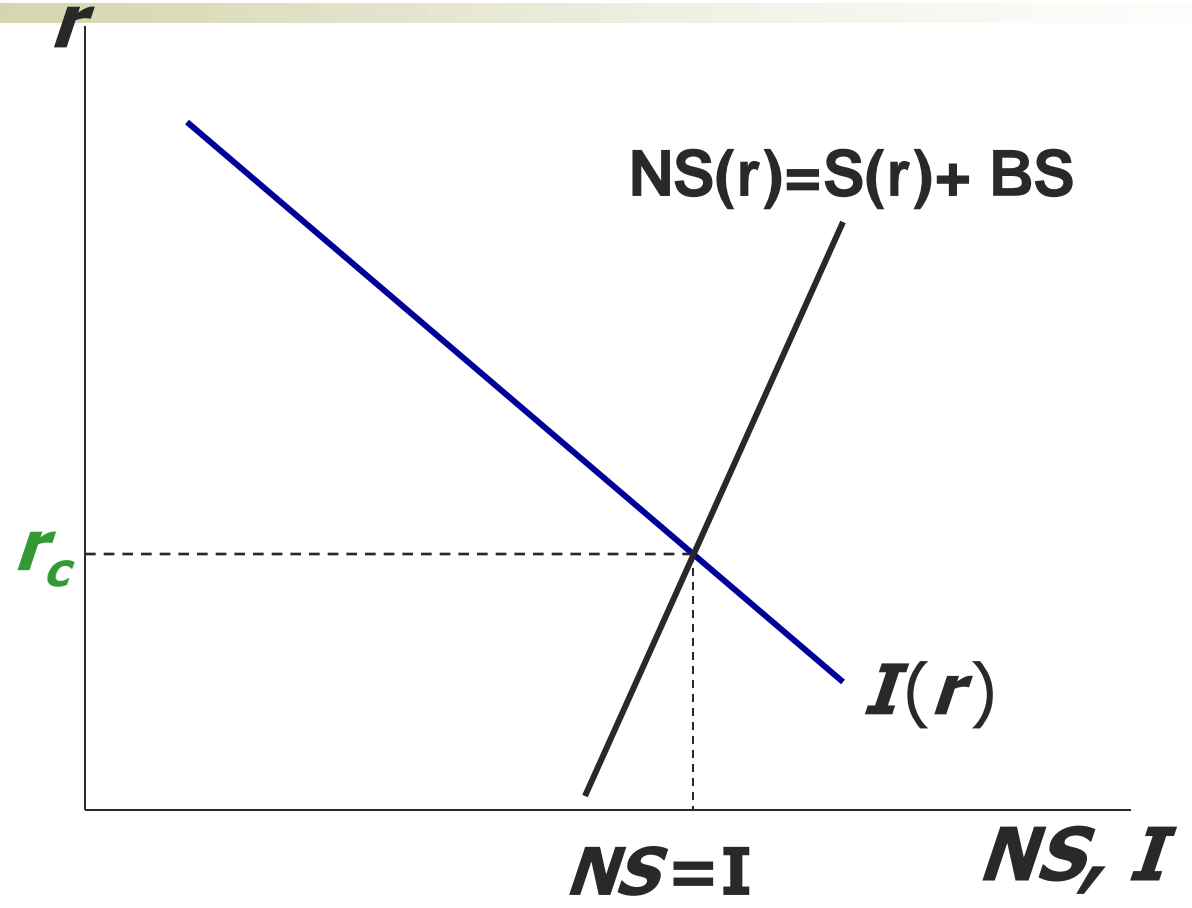
...it determines the level of investment.

National saving: The supply of loanable funds

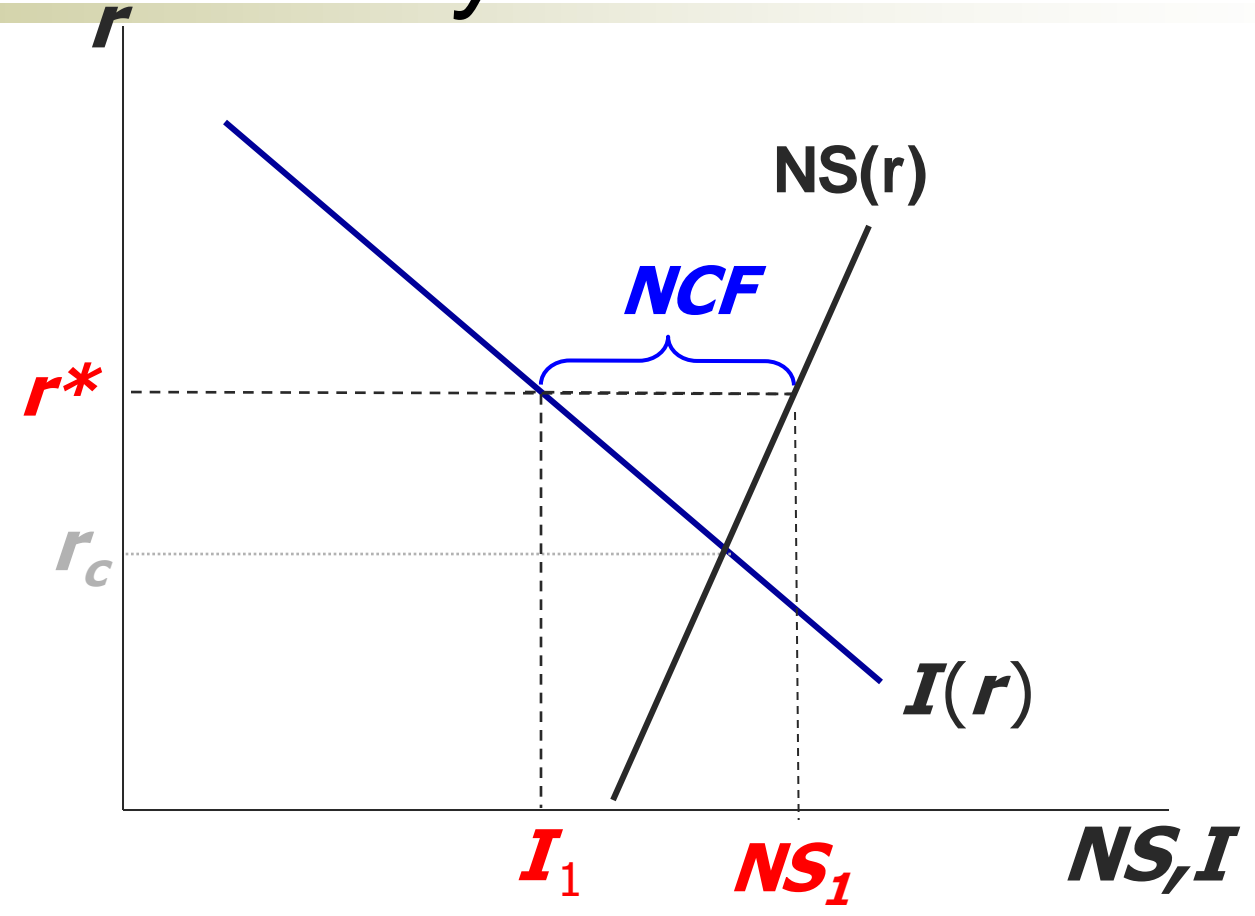


Saving is an increasing function of the interest rate, the interest rate is exo...
...it determines the level of saving.

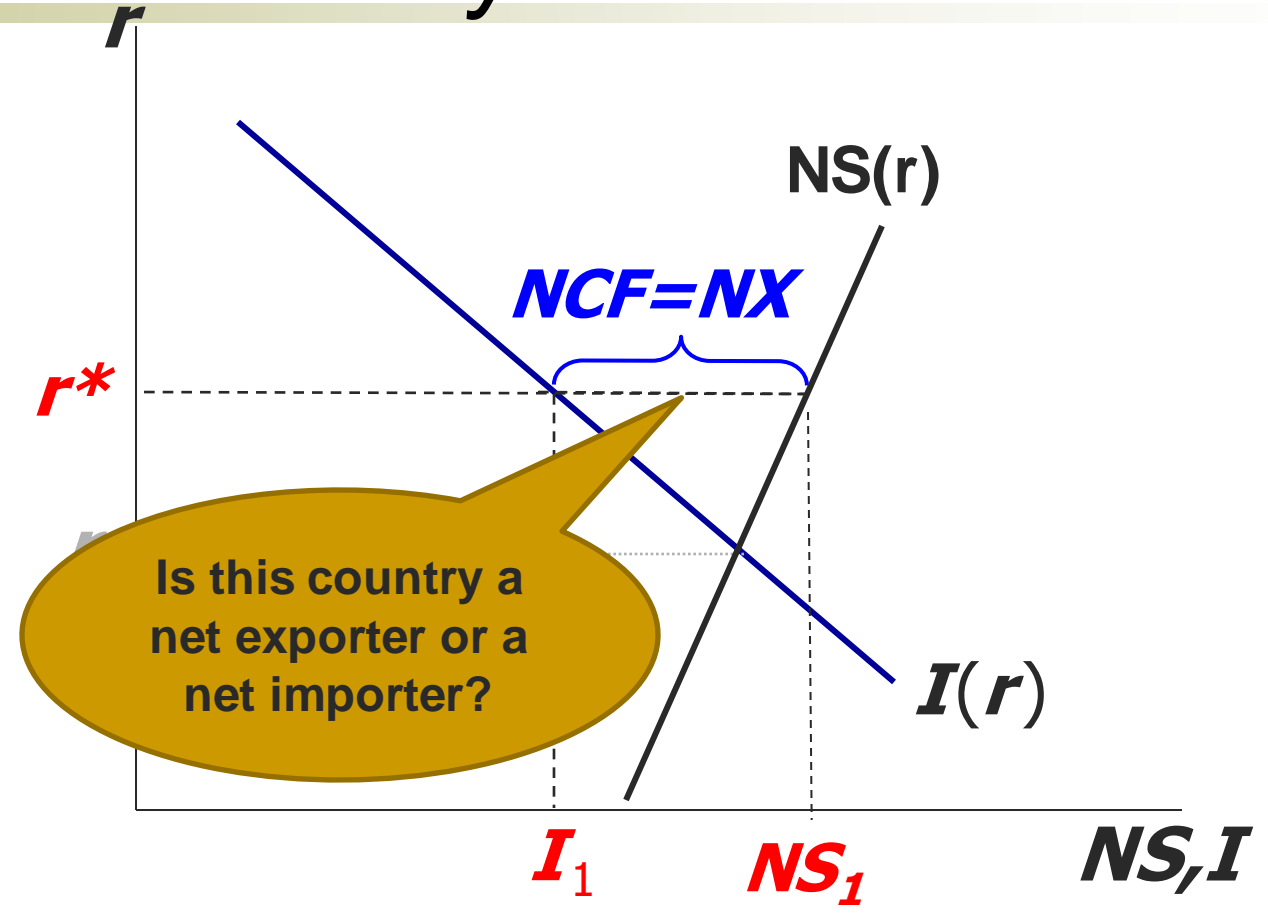
[*If the economy were closed...*]



[*In a small open economy...*]



[*In a small open economy...*]



Net export function

- What mechanism causes that net exports (NX) are equal to the net capital outflow (NCF=NS-I)?
- We will define a Net export function:
 - $NX = NX(E_r, \dots)$
- But what is the real exchange rate and how does it affect net exports?

The nominal and the real exchange rate

- Economists distinguish between two exchange rates: the nominal exchange rate and the real exchange rate.
- The **nominal exchange rate (E)** is the relative price of the currency of two countries.
 - E.g. $E = 25 \text{ CZK/EUR}$ or 0.04 EUR/CZK
 - Direct quotation (Depreciation $25 \rightarrow 30 \text{ CZK/EUR}$)
 - $e = 1/E = 0.04 \text{ EUR/1 CZK}$ or 0.05 USD/1 CZK
 - Indirect quotation (in the textbook; Depreciation $0.04 \rightarrow 0.033 \text{ EUR/CZK}$)

If $25 \rightarrow 20 \text{ CZK/EUR}$
(Nominal) Appreciation

The real exchange rate

- The **real exchange rate** (E_r) is the relative price of the goods of two countries.
- I.e. E_r is the rate at which we can trade the goods of one country for the goods of another country.
- Consider a single good produced in two countries: cars.
- E.g. Price of a car in the CR: $P = 200,000$ CZK
- Price of a similar car in Germany: $P^* = 10,000$ EUR
- If $E = 25$ CZK/EUR, then: $P^*_{\text{CZK}} = 250,000$ CZK
- Hence, German car costs $5/4$ of the Czech car.
- We can exchange 100 German cars for 125 Czech cars.

The real exchange rate

$$\text{Real exchange rate} = \frac{(25 \text{ CZK} / \text{EUR}) \times (10,000 \text{ EUR} / \text{German Car})}{200,000 \text{ CZK} / \text{Czech Car}}$$

$$\text{Real exchange rate} = \frac{250,000 \text{ CZK} / \text{German Car}}{200,000 \text{ CZK} / \text{Czech Car}}$$

Real exchange rate =

At these prices and this exchange rate, we obtain 1.25 of a Czech car per one German car.

$$\text{Real exchange rate} = 1.25 \frac{\text{Czech Car}}{\text{German Car}}$$

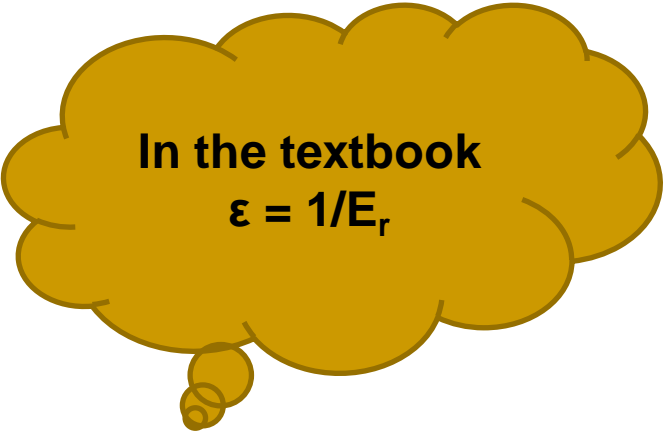
The real exchange rate

- For a broader basket of goods.

$$E_r = E \times (P^* / P)$$

$$E_r = \frac{E}{\frac{P}{P^*}}$$

$$E_r = \frac{25}{\frac{20}{1}} = 1.25; \quad 20 / 1 = 200,000 / 10,000$$



In the textbook
 $\varepsilon = 1/E_r$

The real exchange rate

- The real exchange rate between two countries is computed from the nominal exchange rate and the price levels in the two countries.
- *If the real exchange rate is high (e.g. $E_r=1.25$), foreign goods are relatively expensive, and domestic goods are relatively cheap.*
- *If the real exchange rate is low, foreign goods are relatively cheap, and domestic goods are relatively expensive.*
- => The higher the real exchange rate, the weaker the currency.

The real exchange rate

- $E_r > 1$ implies a relatively undervalued currency.
- $E_r < 1$ implies a relatively overvalued currency.
- $E_r = 1$ implies that $E = P/P^*$
 - E.g.: $E = 20$ CZK/EUR; $P = 200,000$ CZK, $P^* = 10,000$ EUR
 - The price (in the same currency) of the same good (e.g. cars) is the same in both countries => one German car is exchanged for one Czech car.

Purchasing power parity

- **The law of one price** states that the same good cannot be sold for different prices in different locations at the same time.
 - *E.g.: $P=200,000$ CZK, $P^*=200,000$ CZK;*
 - If $P=200,000$ CZK < $P^*=250,000$ CZK, arbitrageurs would buy cars in the CR ($\uparrow D$) and sell them in GER ($\uparrow S$), which will increase the price in the CR and decrease the price in GER until the prices were equal in the two markets (e.g. 240,000 CZK).

Purchasing power parity

- The law of one price applied to international marketplace is called **purchasing power parity**.
- If international arbitrage is possible, then a CZK (or any other currency) must have the same purchasing power in every country.
- $P = 200,000$ CZK; $P^* = 10,000$ EUR; If $E = 25$ CZK/EUR, then: $P^*_{\text{CZK}} = 250,000$ CZK

Here, PPP does not hold!

Arbitrageurs should buy cars in the CR ($\uparrow D$ for CZK and Czech cars) and sell them in GER, until $E = 20$ CZK/EUR (or any combination of appreciation of E, increase in P and decrease in P*)

[Big Mac Index]

- <http://www.economist.com/content/big-mac-index>

Net export function

Notice that after real depreciation, one German car is exchanged for 1.5 of the Czech car.

- Consider a depreciation of the CZK from $E_1 = 25$ CZK per EUR to $E_2 = 30$ CZK per EUR $\Rightarrow E_r = 1.25$
- If CZK depreciates from $E_1 = 25$ CZK per EUR to $E_2 = 30$ CZK per EUR, then:
 - Real exchange rate rises to $E_r = E \times P_f = 1.5$
 - The price of German cars imported to the CR rises from 250,000 CZK ($25 \times 10,000$) to 300,000 CZK ($30 \times 10,000$).
 - The price of Czech cars exported to Germany falls from 8,000 EUR ($200,000:25$) to 6,667 EUR ($200,000:30$).
 - Hence, Czech cars exported to Germany are cheaper $\Rightarrow \uparrow X$
 - German cars imported to the CR are more expensive $\Rightarrow \downarrow M$
- Real depreciation (E_r from 1.25 to 1.5) improves X and decreases M , which leads to higher NX .

Net export function

Increase by 20 % $(30/25-1)$

- However, nominal depreciation accompanied by a rise in the price level (e.g. $E_2=30$ CZK/EUR and $P_2=240,000$ CZK $\Rightarrow P/P^*=24$):

- Leaves the real exchange rate unaltered $\Rightarrow F = E \times P^*/P = 30/24 = 1.25$

- The relative price of cars in the

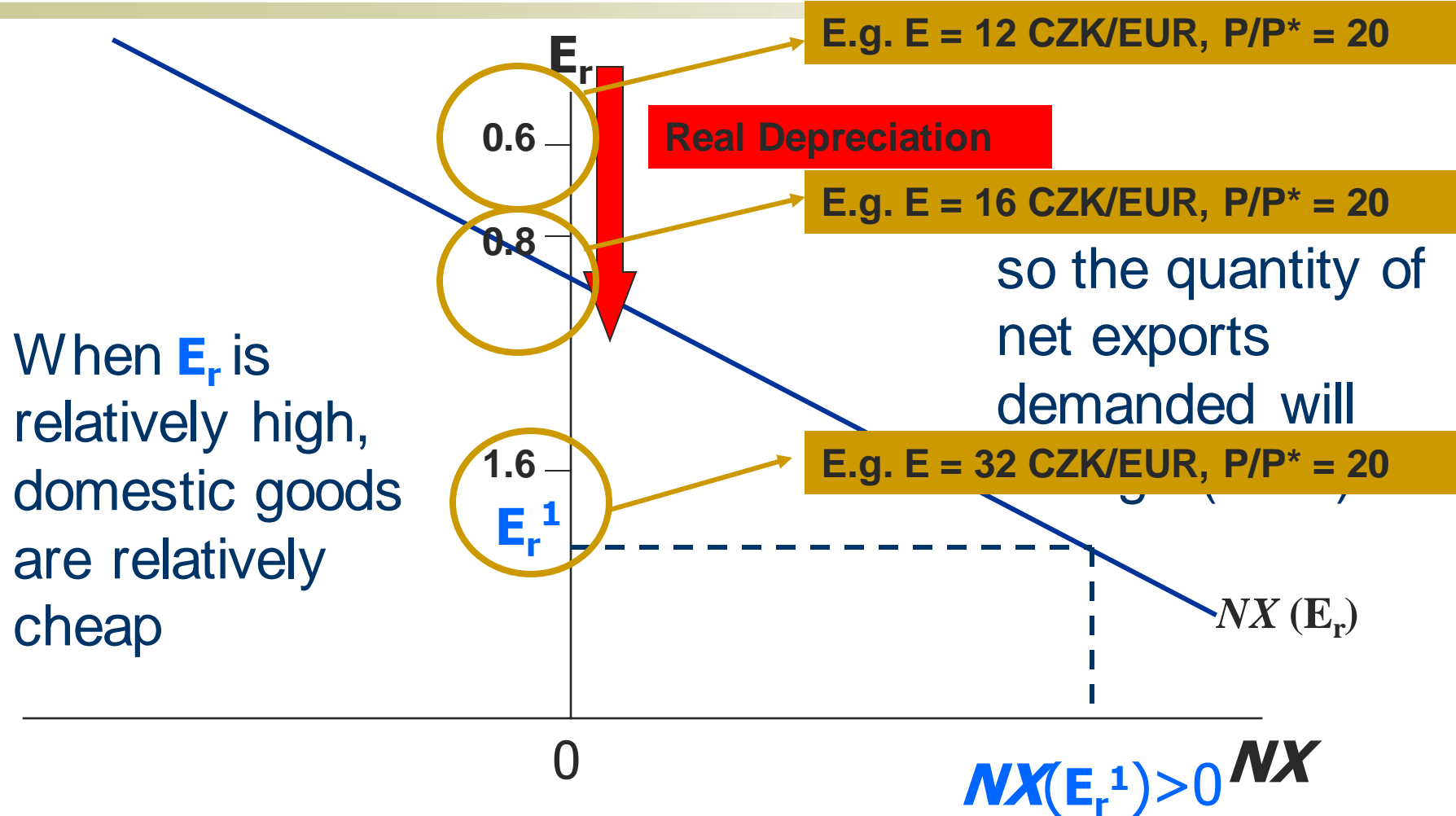
Increase by 20 % $(24/20-1)$

Increase by 20 % $(240,000/200,000-1)$

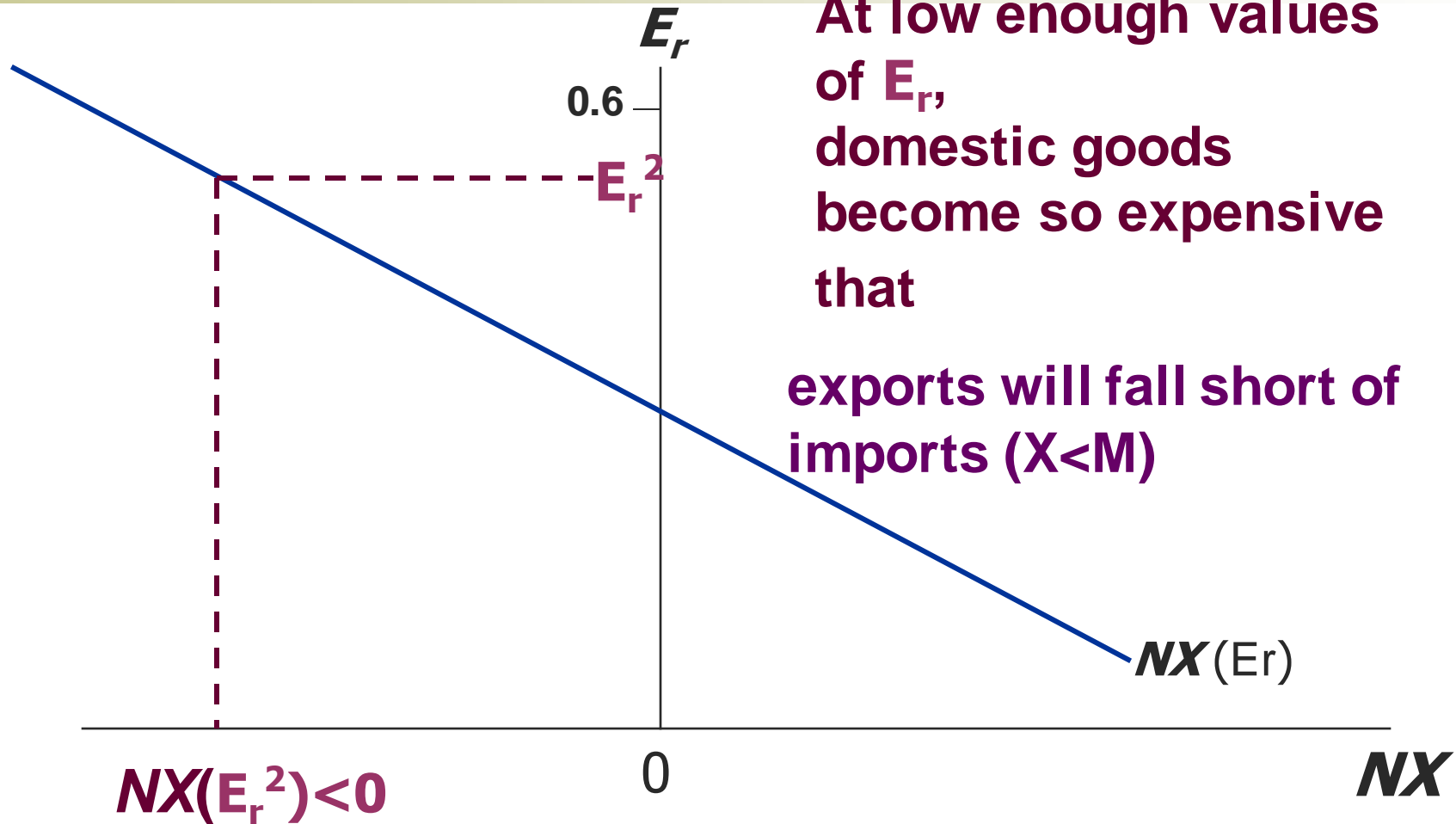
- The price of Czech cars in Germany will remain the same $240,000/30 = 8,000$ EUR \Rightarrow no change in X
- The price of German cars in the Czech. Rep. will rise at the same percentage as the price of Czech cars:
 - $10,000$ EUR $\times 30 = 300,000$ CZK \Rightarrow no change in M
- Hence, net export NX is a function of the **real exchange rate** $NX = NX(E_r)$

Increase by 20 % $(300,000/200,000-1)$

The NX curve



The NX curve



At low enough values of E_r , domestic goods become so expensive that

exports will fall short of imports ($X < M$)

And the quantity of net exports demanded will be low

How is real exchange rate determined?

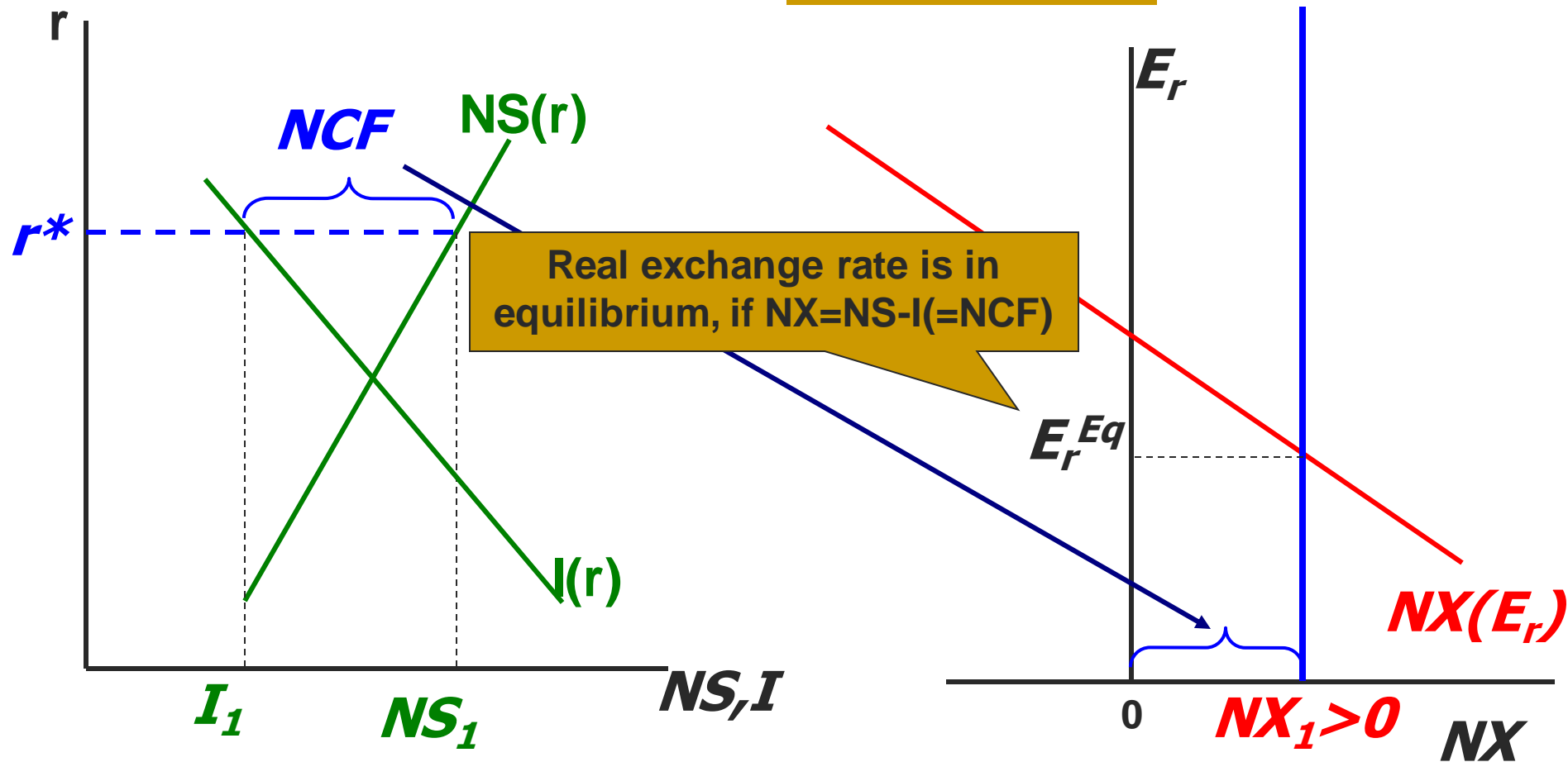
- The accounting identity says $NX = NS - I$
- We saw earlier how $NS - I$ is determined:
 - NS depends on output, consumption function, fiscal policy variables, and world interest rate r^*
 - I is determined by MPK and r^*
- Recall that Net capital flow (NCF) = $NS(r^*) - I(r^*)$
- So, E_r must adjust to ensure:
 - $NX(E_r) = NCF(r^*)$
 - $NX(E_r) = NS(r^*) - I(r^*)$

Small open economy

Neither saving nor investment depends on the real exchange rate

$NS > I \Rightarrow NCF > 0$

$$NCF = NS(r^*) - I(r^*)$$



Real exchange rate is in equilibrium, if $NX = NS - I (= NCF)$

E_r^{Eq}

$NX(E_r)$

$NX_1 > 0$

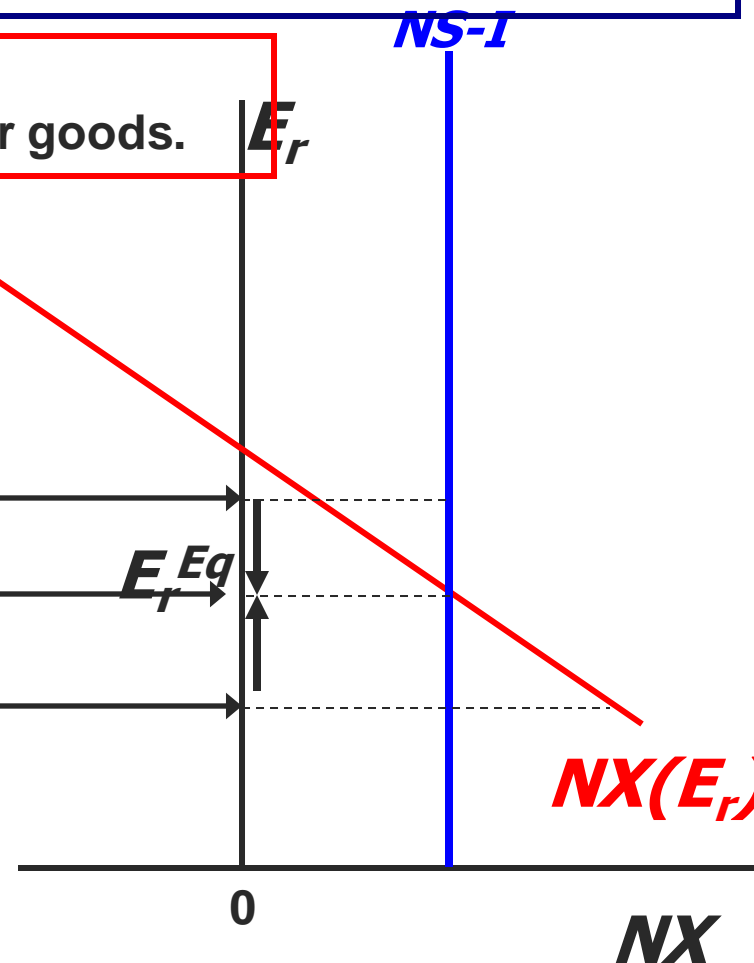
NX

Small open economy

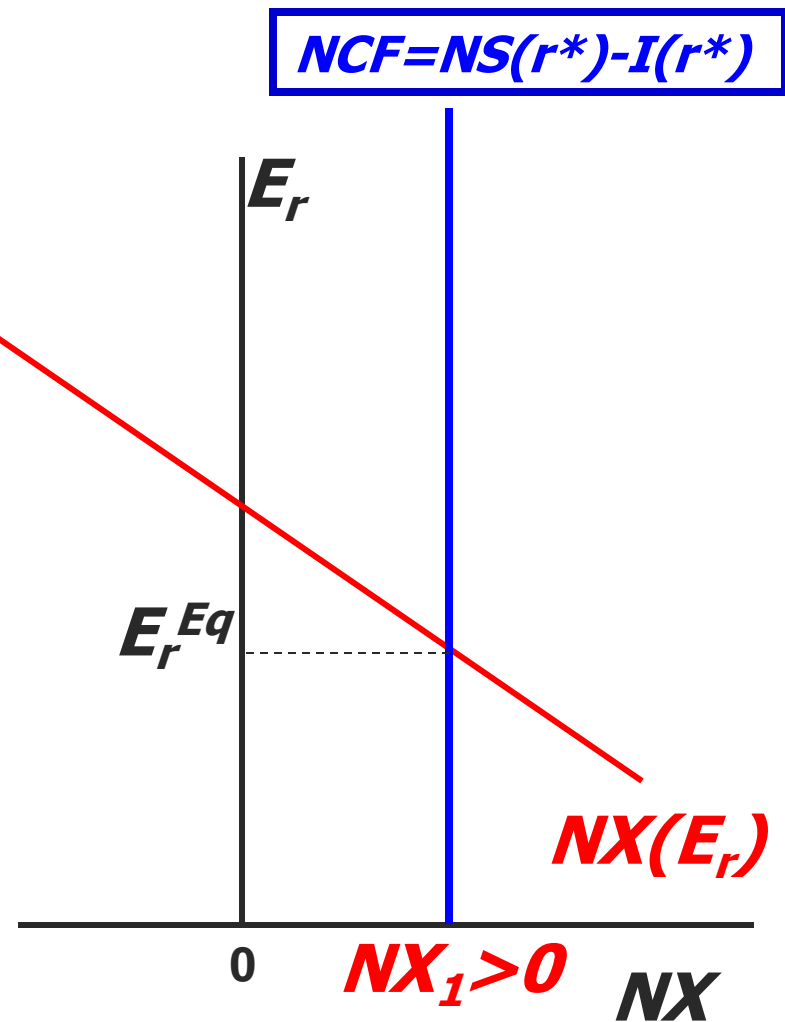
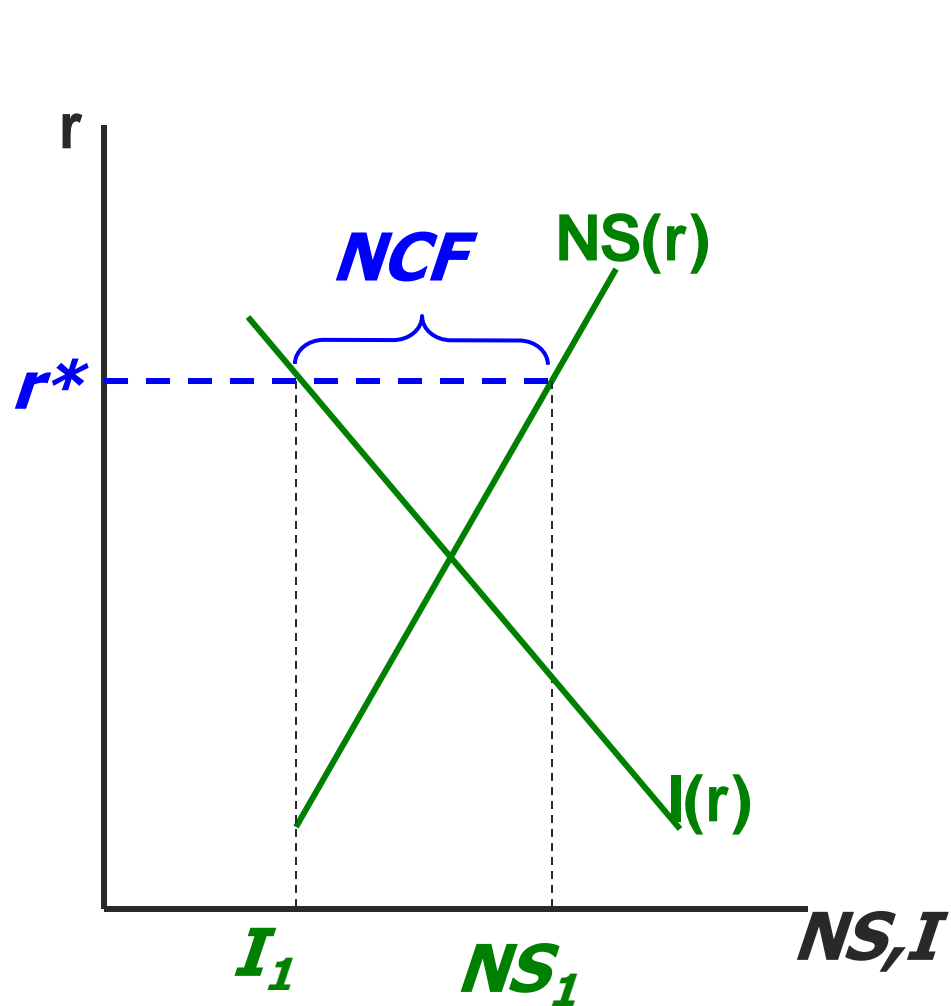
NS- I, represents the net capital outflow and thus the supply of CZK to be exchanged into foreign currency and invested abroad.

NX function represents the net demand for CZK coming from foreigners who want CZK to buy our goods.

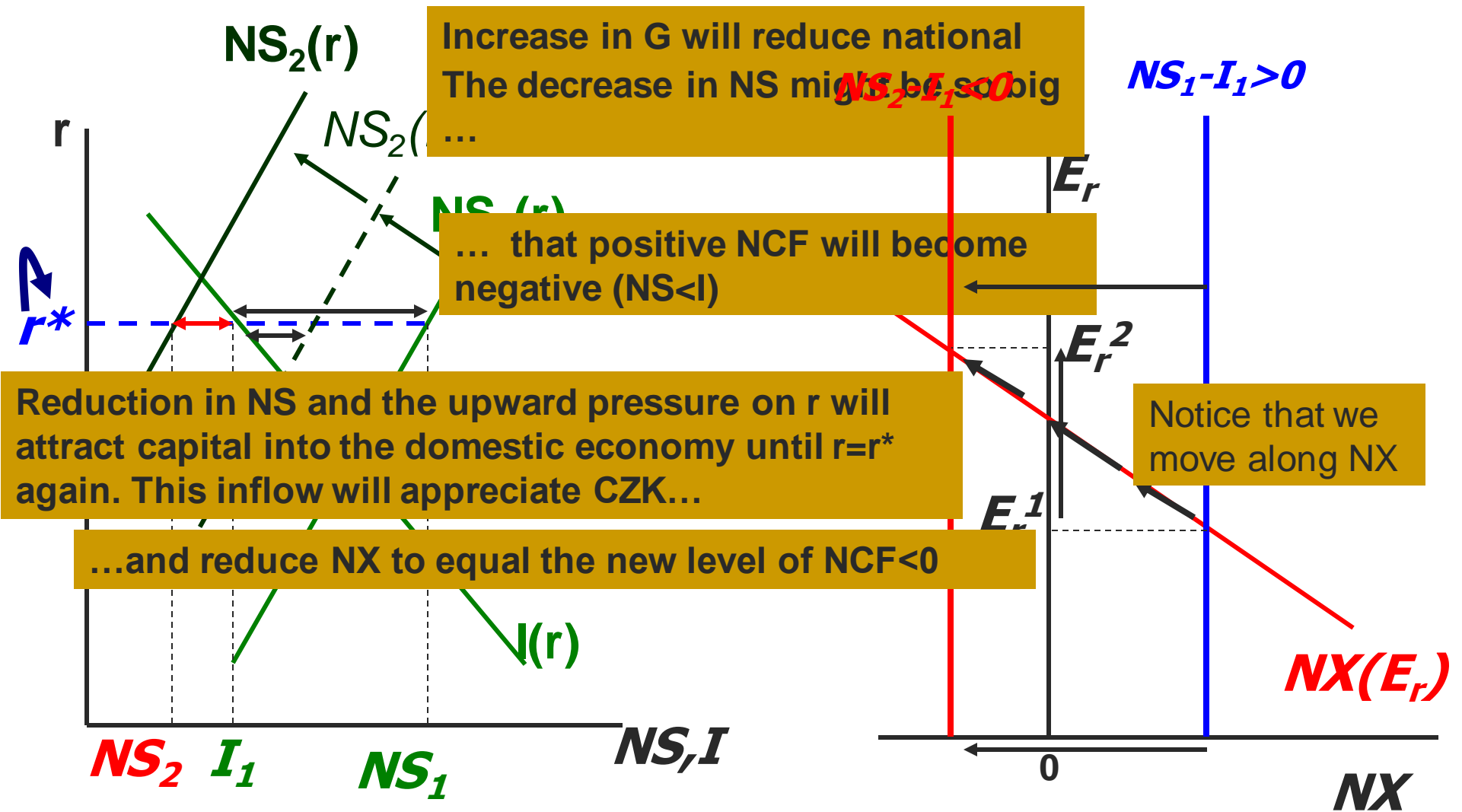
If E_r is above equilibrium (CZK is too strong), NCF exceeds NX (supply of CZK exceeds demand).
 At the equilibrium real exchange rate, the supply of CZK available from the net capital outflow balances the demand for CZK by foreigners buying our net exports.



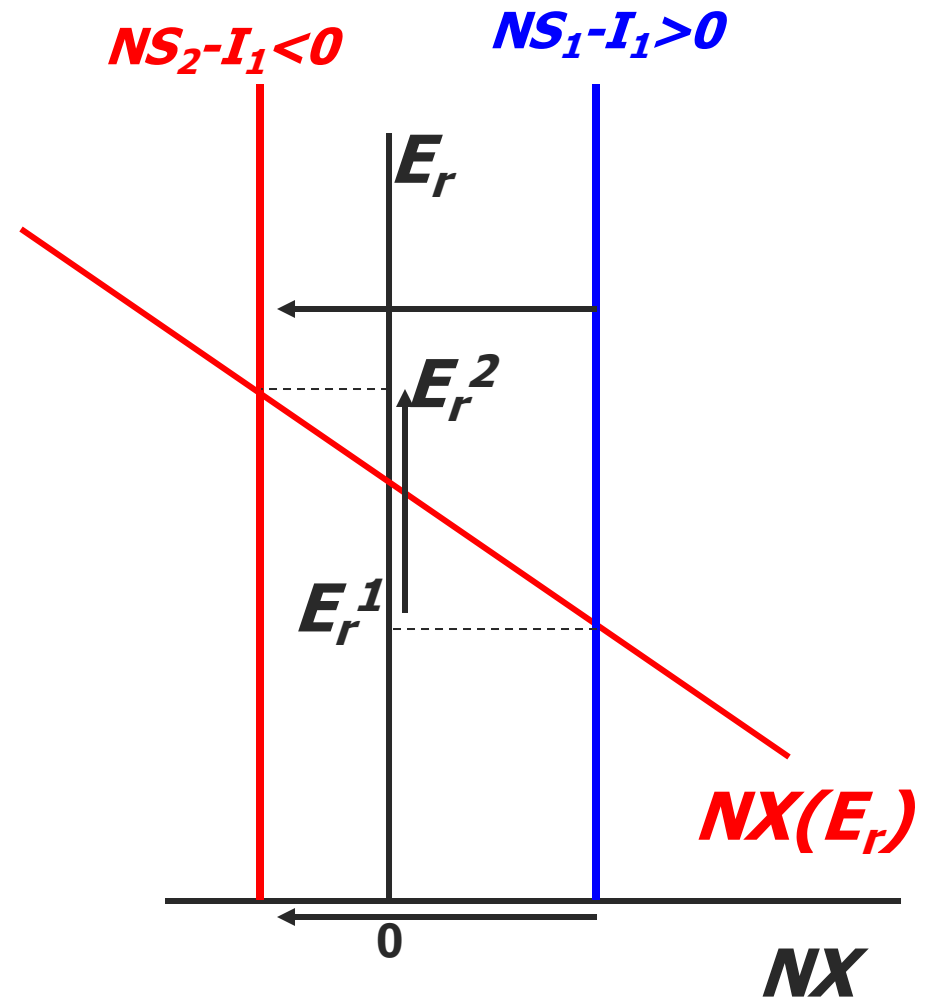
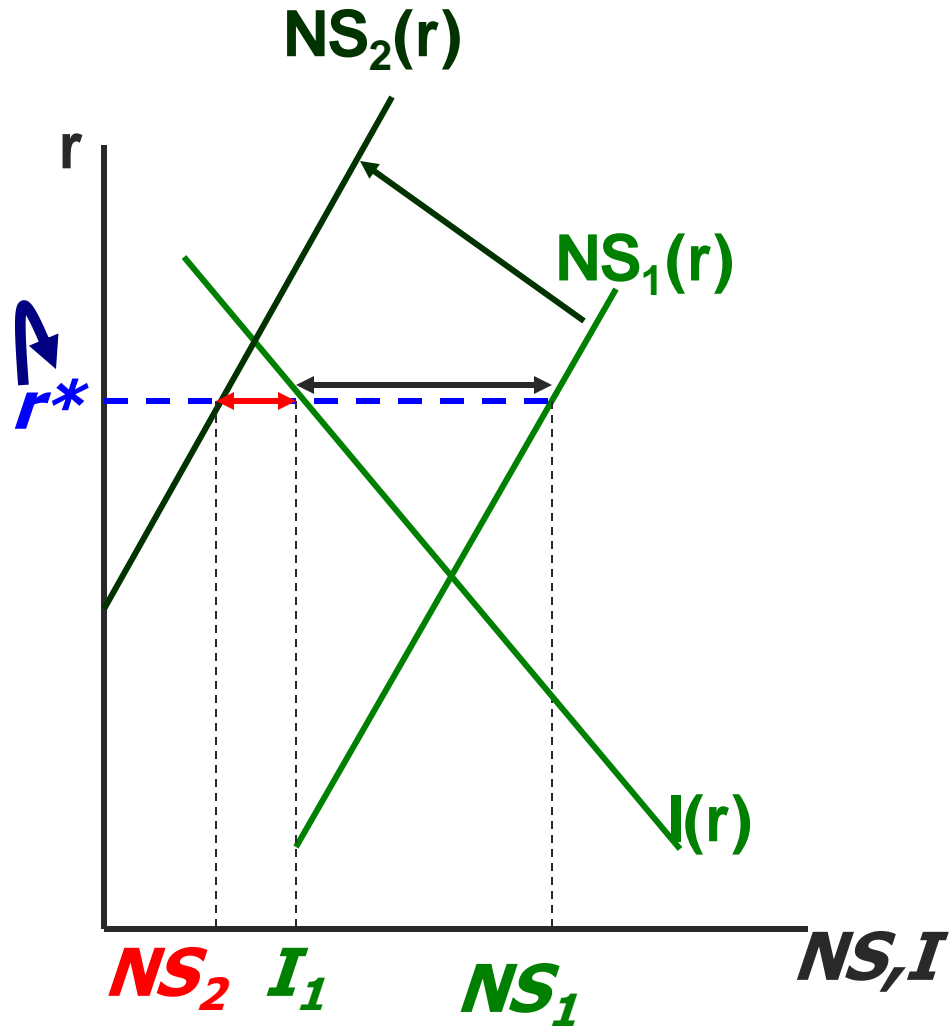
Small open economy



Fiscal expansion ($\uparrow G$)



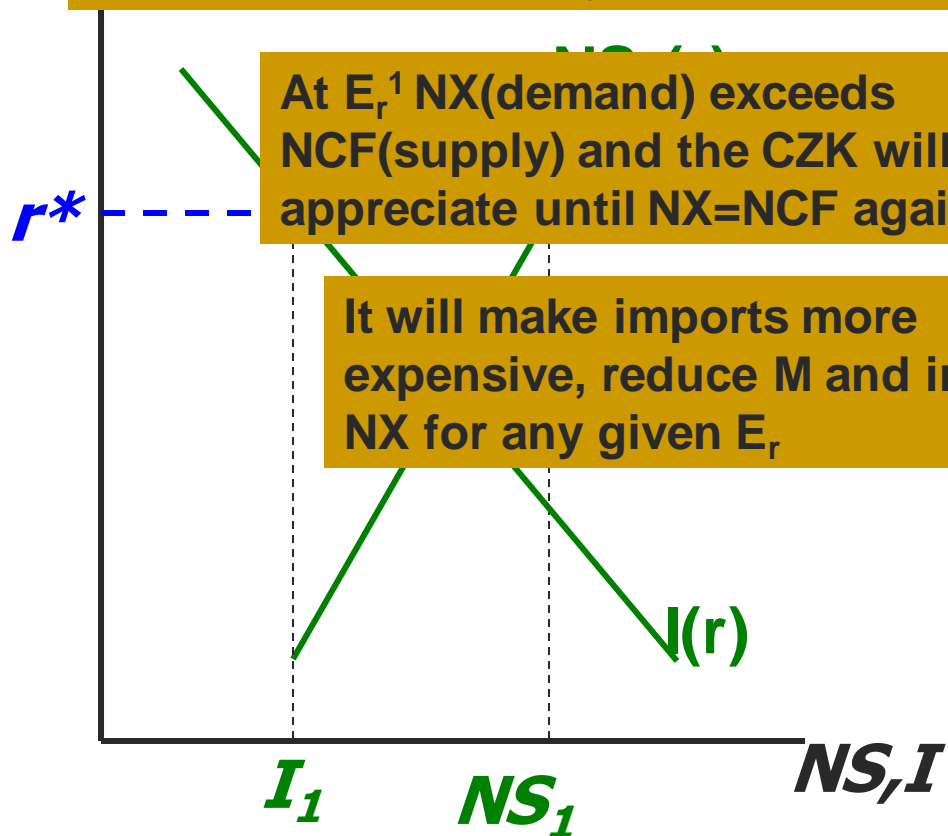
Fiscal expansion ($\uparrow G$)



Tariffs imposed on imported goods

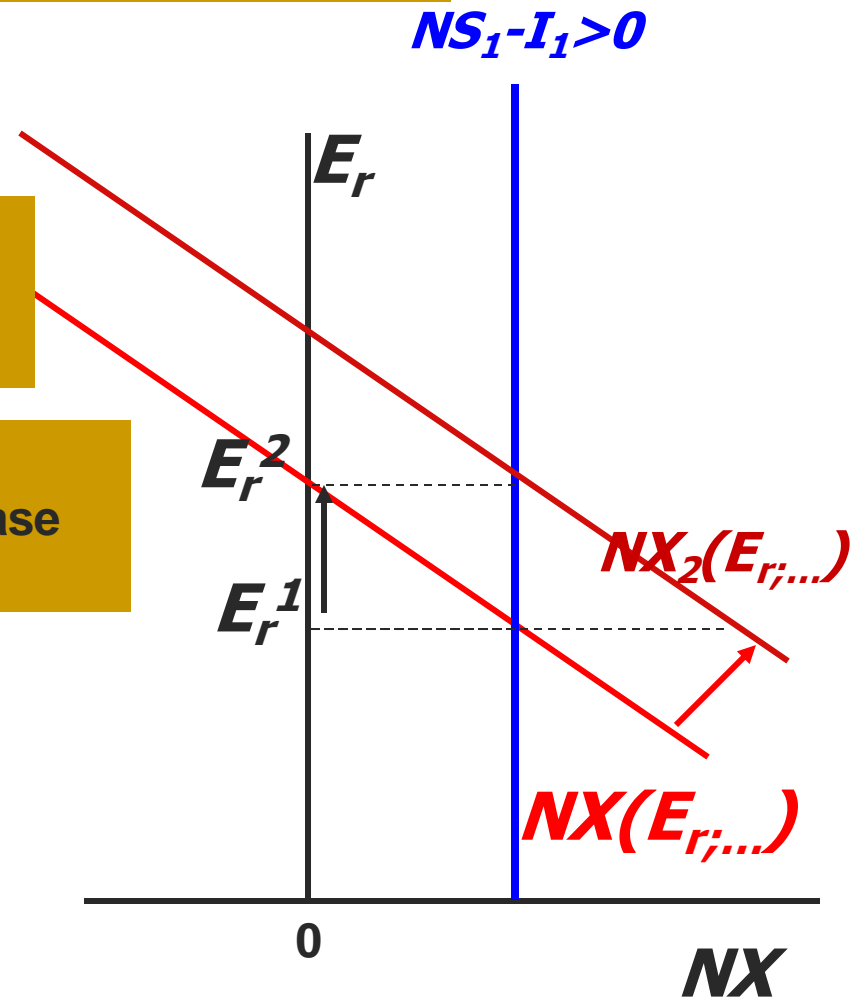
Tariffs are imposed to lower imports of goods from abroad.

NS and I are most probably unaffected.
=> NCF (the net supply of CZK) as well.

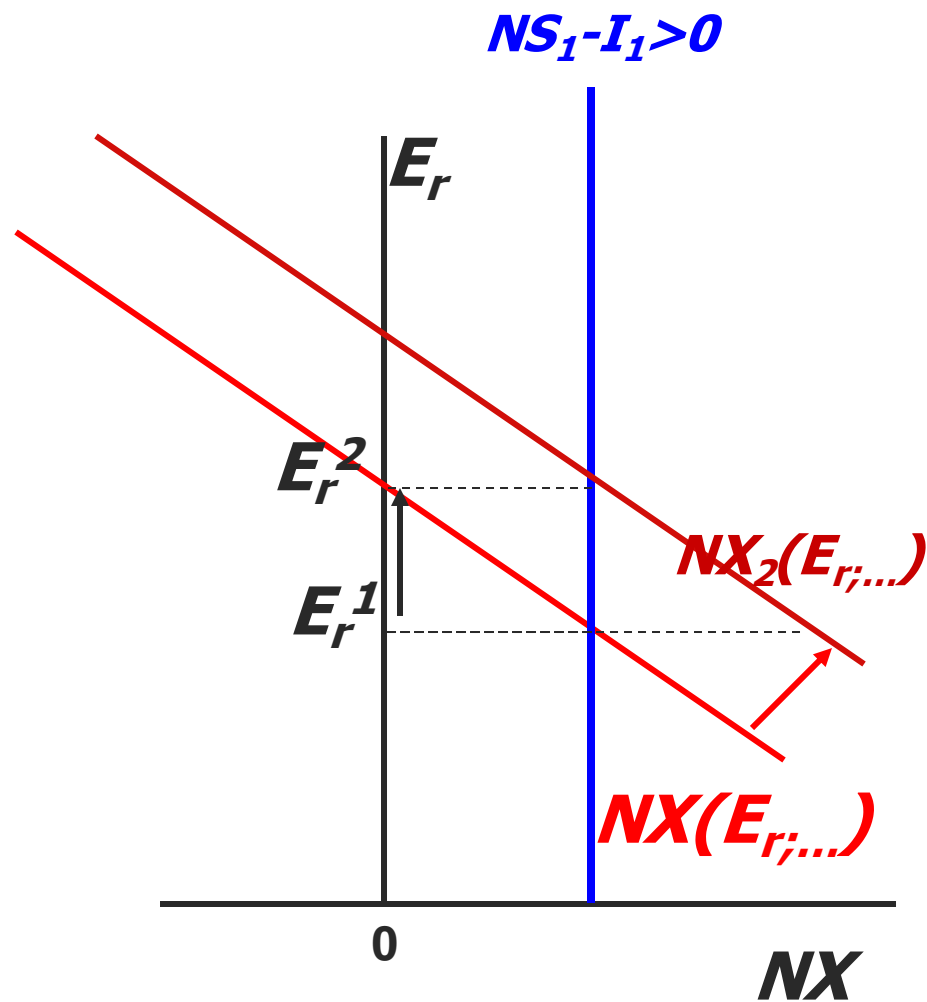
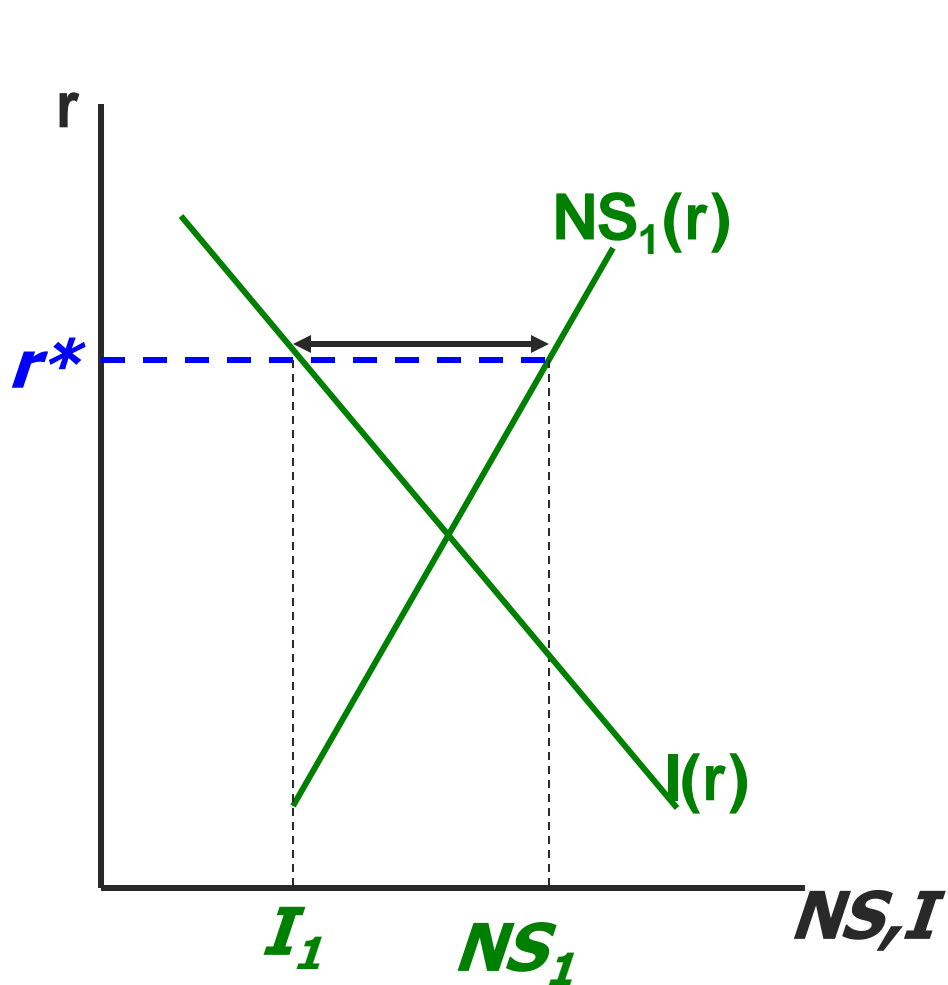


At E_r^1 NX(demand) exceeds NCF(supply) and the CZK will appreciate until $NX=NCF$ again.

It will make imports more expensive, reduce M and increase NX for any given E_r



Tariffs imposed on imported goods





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