# Lecture 7: The Open Economy in the Long Run

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Readings: Gottfries, Chapter 13

# Where we've been

- Last week we developed a model of an open economy
- We took our standard closed economy and added in
  - Trade in goods and services (Net Exports)

    We showed that $\frac{\partial NX}{\partial \varepsilon}(\varepsilon, Y, Y^*) < 0$ in general
  - Capital flows across the border

    We derived the interest parity condition, and discussed its implications for monetary policy
- We showed that aggregate savings are tightly related to the change in net borrowing from foreigners (the current account)
- We figured out that we will probably need either real interest rates or the exchange rate to clear this market

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# Where we're going

- We need a coherent theory of how real interest rates are determined
  - We'll see that open financial markets mean that over the long run, they must be the same at home and abroad
  - The only price we have left to clear the savings market is the exchange rate
- We'll work through a simple long-run model of output, next exports, and the real exchange rate
  - Under what circumstances does a change in the **government deficit** will lead to a **current account deficit**
- We will characterize investment and growth in our open economy, when capital moves freely across borders
- We'll discuss whether we (the as the social planner) care about the current account

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# Section 1

## Real Interest Rates, Exchange Rates, and Net Exports

# Making interest real

- Let's go back to our interest parity condition:

$$\underbrace{i_t + \frac{\Delta e_t^e}{e_t}}_{\text{Expected Return at Home}} = \underbrace{i_t^\star}_{\text{Expected Return Abroad}} \tag{1}$$

- How does the nominal exchange rate change?
- **Assumption:** We are in the long run
  - Prices and wages adjust (output is at its natural level)
  - This means that the real exchange rate $\varepsilon$ is constant

    Real exchange rates can't be growing at a constant rate over time in the long run, since that means exporters could not compete, and exports would fall (i.e, we're not in the long run)
- We have a formula for the exchange rate:

$$e_t = \varepsilon \frac{P_t^\star}{P_t} \tag{2}$$

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# Making interest real

## Growth rate of $\varepsilon$

$$e = \varepsilon_t \frac{P^\star}{P} \tag{2}$$

- We want the growth rate of $e$. Two ways to get it:
  1. Rule of thumb for growth rates:

$$\frac{\Delta e_t}{e_t} \approx \underbrace{\frac{\Delta \varepsilon_t}{\varepsilon_t}}_{=0} + \underbrace{\frac{\Delta P_t^\star}{P_t^\star}}_{\text{Inflation Abroad}} - \underbrace{\frac{\Delta P_t}{P_t}}_{\text{Inflation at home}} \tag{3}$$

  2. Take logs and differentiate:

$$\log(e_t) = \log(\varepsilon_t) + \log(P_t^\star) - \log(P_t) \tag{4}$$

$$\Longrightarrow \frac{1}{e_t}\frac{\partial e_t}{\partial t} = \frac{1}{\varepsilon_t}\frac{\partial \varepsilon_t}{\partial t} + \frac{1}{P_t^\star}\frac{\partial P_t^\star}{\partial t} - \frac{1}{P_t}\frac{\partial P_t}{\partial t} \tag{5}$$

- No matter how you do it, we see that since real exchange rates are constant, we must have

$$\frac{\Delta e_t}{e_t} \approx \pi_t^\star - \pi_t \tag{6}$$

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- In the long run, expected change in the exchange rate must be the actual change
- So we can drop subscripts (long run) and combine eqs. (1) and (6) to obtain

$$i^\star - i = \pi^\star - \pi \implies \mathbf{r = r^\star} \tag{7}$$

- Free financial flows require that the real rate is the same everywhere
- Notice that savings are no longer tied to the real interest rate – if savings are too low to cover investments, the remainder is borrowed from foreigners

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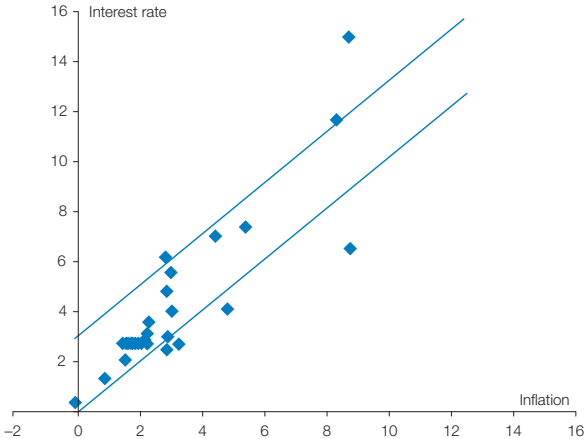
# Are real returns constant across countries?

- The spread between nominal interest and inflation ($r_t$) tends to be between 0 and 3% for most OECD countries
- Higher inflation is compensated by higher nominal rates
- We should expect that differences are mostly due to default risk

**Fig. 13.1** *Inflation and interest rates, averages, 2005–2010*




Source: *OECD Economic Outlook*, OECD, 13 October 2011, http://www.oecd-ilibrary.org/statistics.

# What clears the market for savings?

- We now know that $r_t$ cannot clear the market for savings in our economy?
- So where do the excess savings go?
- Let's go back to basics: the **natural level of production** is determined just like in our closed economy

$$Y^n = F(K, E(1-u^n)L) \tag{8}$$

- Aggregate demand is determined by the IS equation:

$$Y = C(Y^d, Y^e - T^e, r^\star, A) + I(r^\star, Y^e, K) + NX(\varepsilon, Y^\star, Y) \tag{9}$$

  - Where disposable income $Y^d = Y^n - T + r^\star(D + F)$
  - Note we've set $r = r^\star$ everywhere

- If production is at the natural level (long run) then we must have:

$$NX(\varepsilon, Y^\star, Y^n) = Y^n - C(Y^d, Y^e - T^e, r^\star, A) - I(r^\star, Y^e, K) - G \tag{10}$$

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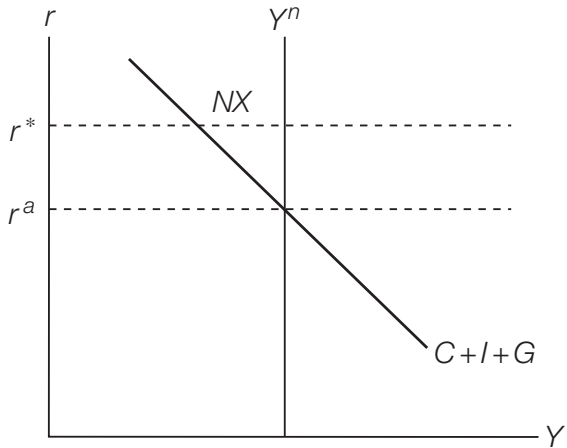
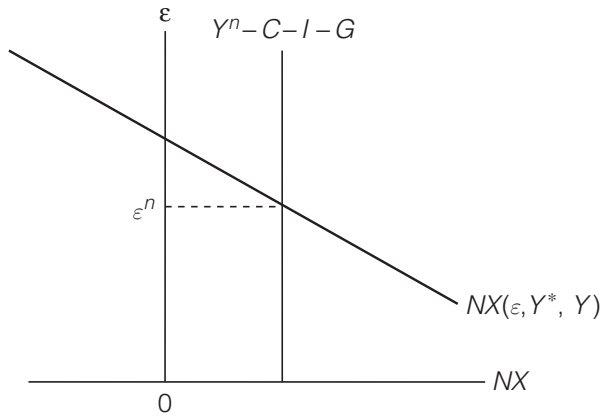
# Net exports are the residual (in equilibrium)

- Open economy version of what we've seen before
- $r^a$ is the interest rate that would prevail in **autarky** (no trade)
  This is what prevailed in our closed economy
- Net exports are the horizontal gap between $Y^n$ and $C + I + G$ at $r = r^\star$
- Note: There's no equilibrium in this picture – need to think in $\varepsilon$ space instead



# What real exchange rate clears the market for goods?

- Now we can figure out the **natural real exchange rate**
- It is the rate that causes net exports to clear the goods market the natural level
- $\varepsilon^n$ is the sensible analogue of $r^n$ in a small open economy
- Now we start to say something useful about how a change in aggregate demand impacts the long run exchange rate



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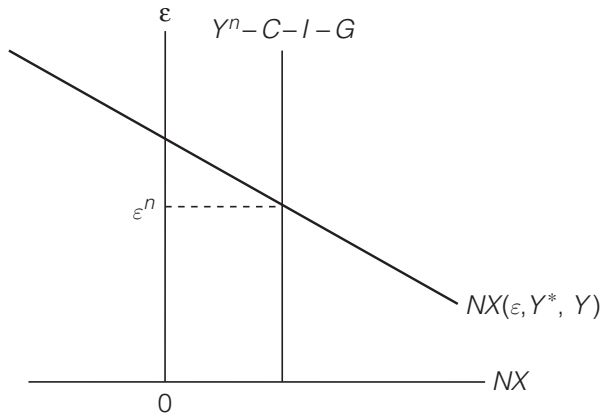
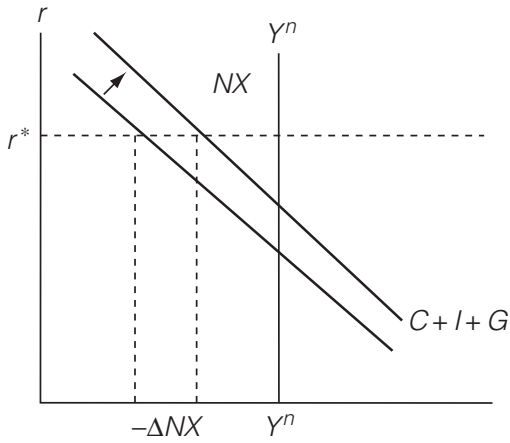
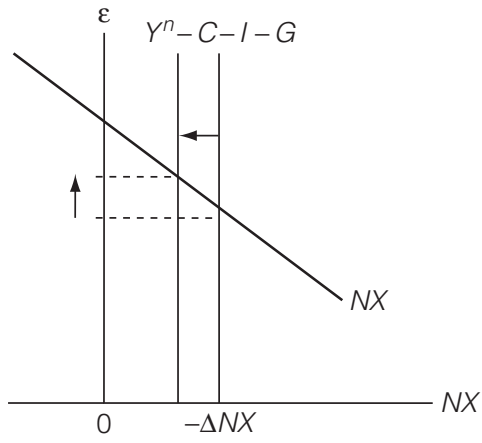


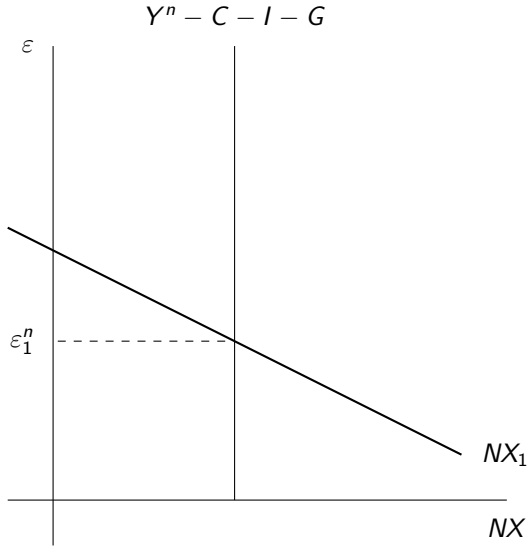
# What happens if investment increases?



# Protectionist Trade Policy

- What if government prohibits imports of foreign steel?
- For any given $\varepsilon$: imports are lower after the policy, so $NX$ **curve shifts out**
- Note: aggregate demand stays the same, so $NX$ stays the same in the long run
  - $\varepsilon$ adjusts up to clear the market
  - Lower imports of steel must be offset by lower exports of other things
  - Trade falls, but both $NX$ and $Y$ remain constant: there is no macroeconomic justification for trade policy
  - Moreover, with gains from trade, this policy probably decreases welfare



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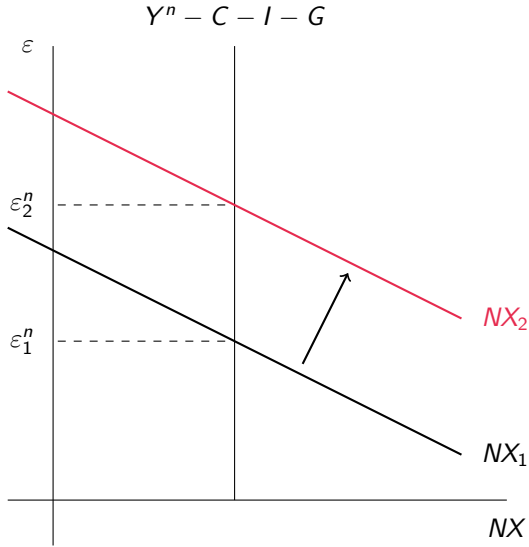

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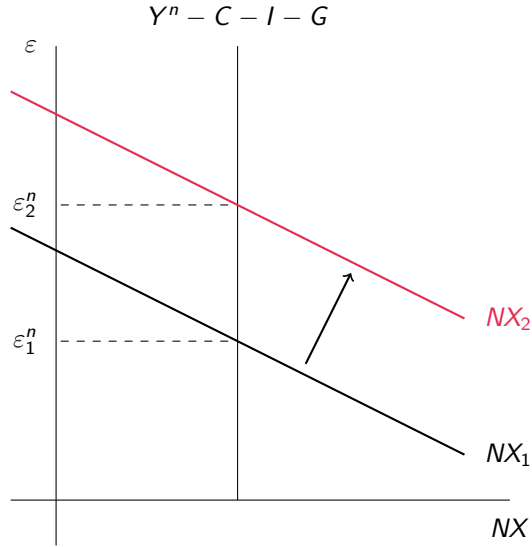

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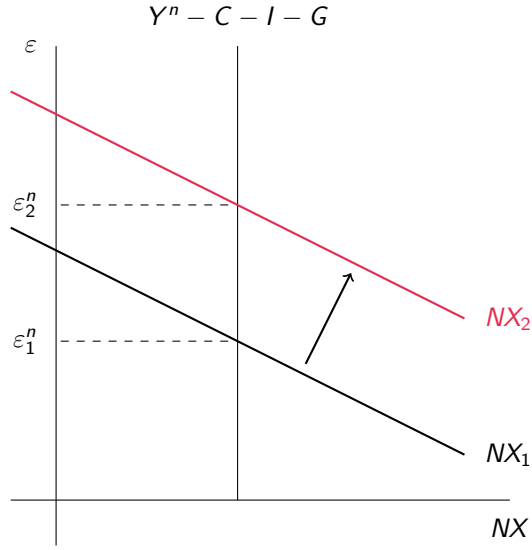

# Who actually sets $\varepsilon$?

Recall that

$$\varepsilon = \frac{eP}{P^\star}$$

Which nominal variable adjusts depends on monetary policy

1. **Fixed Exchange Rate:** since $e$ cannot adjust, the price level $P$ must move instead
   - Increased investment leads to inflation
   - Price level rises until net exports have declined enough that production is at its natural level
2. **Floating Exchange Rate:** nominal rate $e$ can adjust
   - If central bank targets inflation, then $P$ stays constant
   - Since aggregate demand has increased, that means central bank raised nominal interest rate
   - Nominal exchange rate must rise, otherwise interest parity would not hold

# Who actually sets $\varepsilon$?

Recall that

$$\varepsilon = \frac{eP}{P^\star}$$

Which nominal variable adjusts depends on monetary policy

1. **Fixed Exchange Rate:** since $e$ cannot adjust, the price level $P$ must move instead
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   - Price level rises until net exports have declined enough that production is at its natural level
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# The Current Account and the Government Budget

- People often talk as though the government budget deficit moves the current account.
- To make sense of this, let's rewrite aggregate savings:

$$\underbrace{Y^d - C - I}_{\text{Private net saving}} = \underbrace{\Delta F}_{\text{Current Account}} + \underbrace{\Delta D}_{\text{Budget Deficit}} \tag{11}$$

- If you save £100, there's only two places it can go:
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# Savings effect depends on Ricardian Equivalence

$$\underbrace{Y^d - C - I}_{\text{Private net saving}} = \underbrace{\Delta F}_{\text{Current Account}} + \underbrace{\Delta D}_{\text{Budget Deficit}} \tag{11}$$

**What is your view on Ricardian equivalence?**

1. Assume Net Savings is **constant**:
   - If you lend the government more, you must be lending foreigners less
   - Current account offsets $\Delta D$ one for one
   - Real exchange rate will adjust to clear the market for goods
2. Assume full **Ricardian Equivalence:**
   - Consumers know that an increase in $D$ will have to be offset by higher taxes in the future
   - Savings increase 1:1 to pay the future taxes
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Reality probably lies somewhere in between...

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# $\Delta D$ and $\Delta F$

- In some countries they seem to move together
  - High deficits in the US in the 1980s and 2000s show up clearly in the current account
- In others, not so much: Japan and Italy have high deficits and current account surpluses
- The UK seems to have almost a negative correlation
- This looks like **weak evidence** of a systematic correlation
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- **Confounding Shocks:** business cycle booms drive $C$, $I$ and $\Delta D$ at the same time

**Fig. 13.5** *Government net lending and the current account*

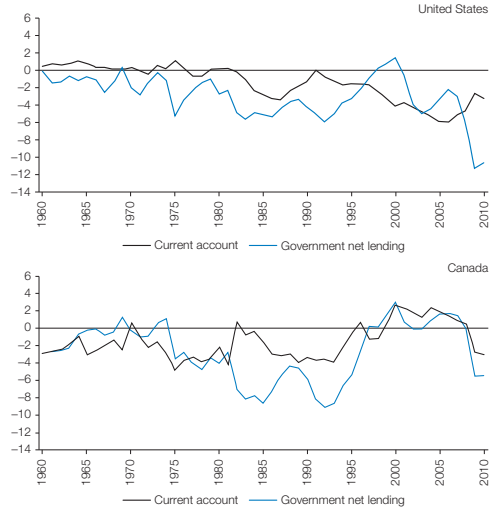

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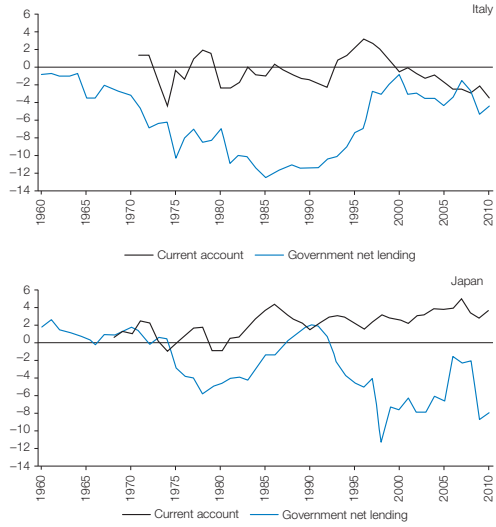
**Fig. 13.5** *(Continued)*




Source: *OECD Economic Outlook*, OECD, 14 October 2011, http://www.oecd-ilibrary.org/statistics.

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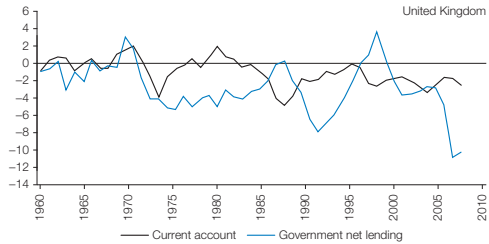

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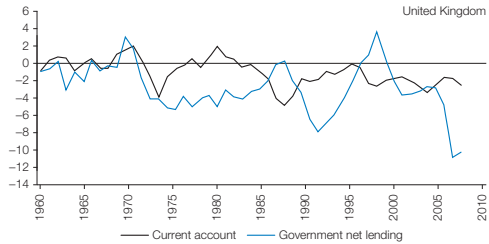

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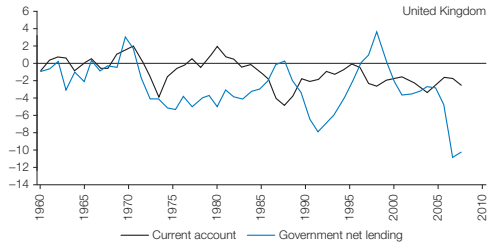
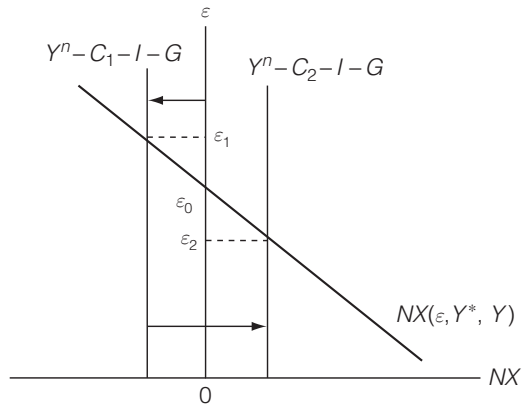


# What about a depreciation of the currency?

- Does a current account deficit lead to a depreciating currency?
- Consider starting from $NX = 0$ and $F = 0$
- Suppose that $C$ goes up to $C_1$: next exports decrease, and $\varepsilon \uparrow$
- At some point however, consumers must pay back loans. $C$ falls to $C_2$ and the exchange rate falls even below $\varepsilon_0$
- Large current account deficits *may* predict future depreciations, but...
- **When will that happen?** Very hard to predict in general



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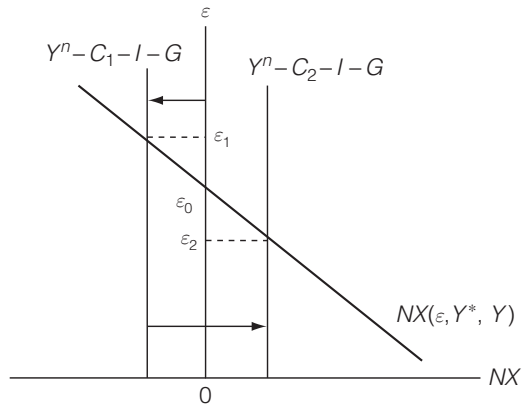

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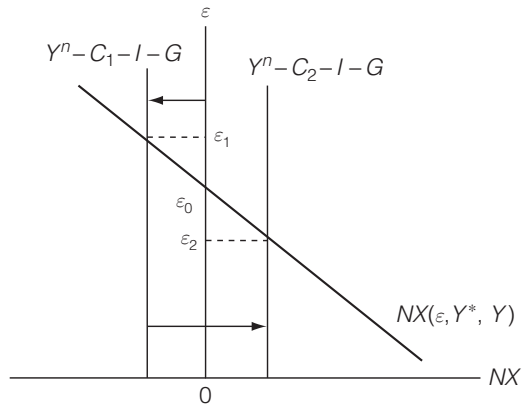

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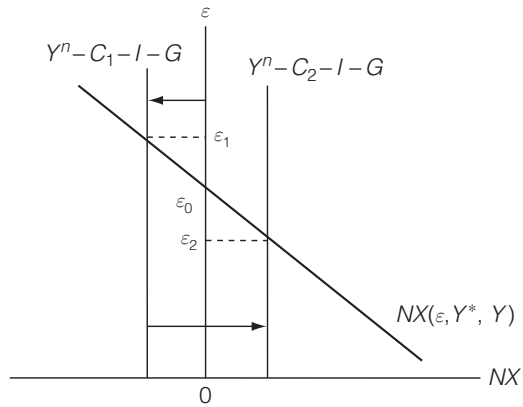

# Section 2

## Investment and Growth

# What determines investment?

$$\frac{f'(k^\star)}{1+\mu} - \delta = r^\star \tag{12}$$

- Here $k = K/(EN)$ as before
- Like in our closed economy, firms keep investing until the marginal return to a unit of capital (net of depreciation) equals the financing cost
  - In our closed economy, the financing cost was $\bar{r}$: determined in equilibrium
  - But now, the relevant interest rate is the international rate $r^\star$
- Production is given as

$$Y = Y^n = F(K, EN^n) = \underbrace{F\left(\frac{K}{EN^n}, 1\right) EN^n}_{\text{Constant returns to scale}} = \underbrace{f(k^\star)EN^n}_{\text{Def of } f} \tag{13}$$

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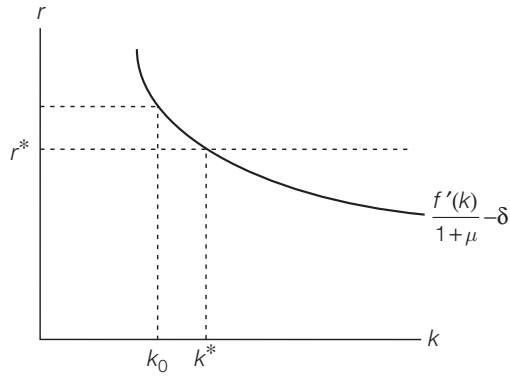
# What determines investment?

- Suppose $k_0$ is lower than $k^\star$. How is the additional investment financed?
  - Use domestic savings
  - If not sufficient, borrow from international capital markets
- As long as the net return on capital $f'(k)/(1+\mu) - \delta$ is above $r^\star$, it will be a profitable loan, and a good business decision for firms
- **Question:** How quickly does the capital stock adjust?
  - In our model, it's instantaneous
  - In the real world there are many reasons it might be slow

Think about complementary forms of capital (roads, human capital), time required to build factories/machines, financing constraints, etc...



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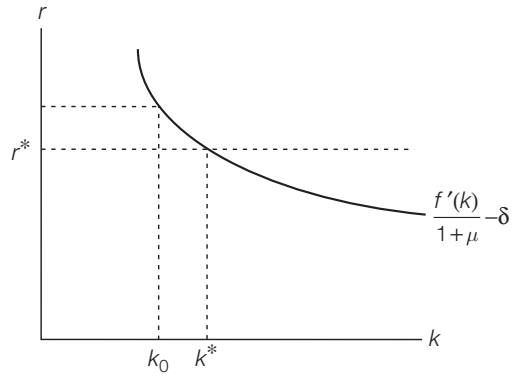

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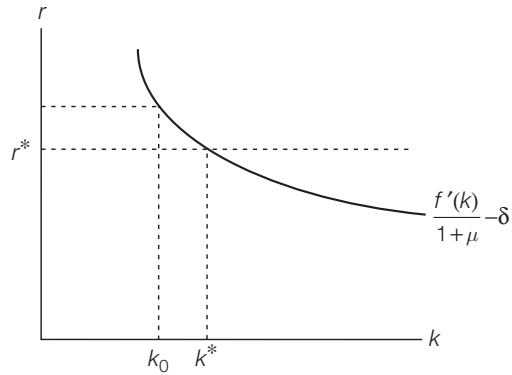

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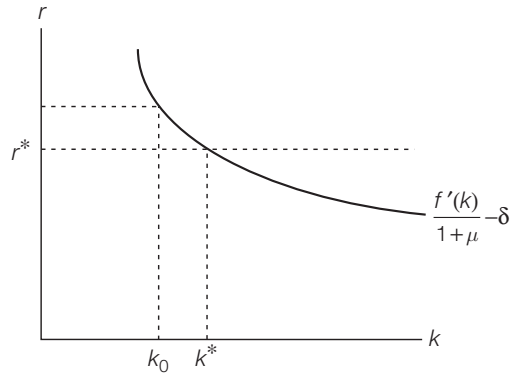
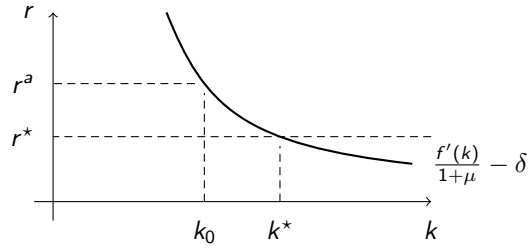


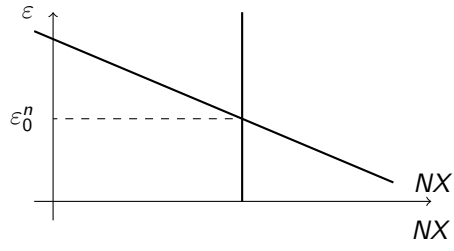
# Financing investment

- Suppose you live in a closed economy – real interest rate is $r^a$, set so that

$$Y^n - C(Y^d, Y^e - T^e, r^a, A) - G = I(r^a, Y^e, K)$$

- Now let's open the economy: world interest rate is lower $r^\star < r^a$
- **Implication 1:** Steady state capital is higher
- **Implication 2:** Investment goes up, but so does consumption, so savings go down
- The extra investment is financed by **borrowing from abroad**!
- Whether $r^a$ is higher or lower than $r^\star$ depends on domestic factors (incentives to save)



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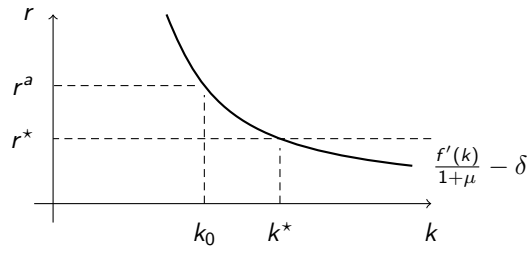


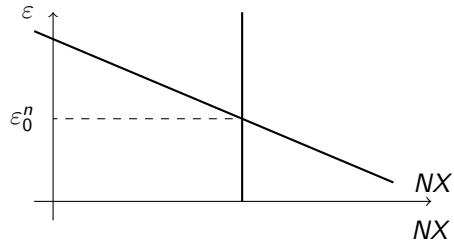

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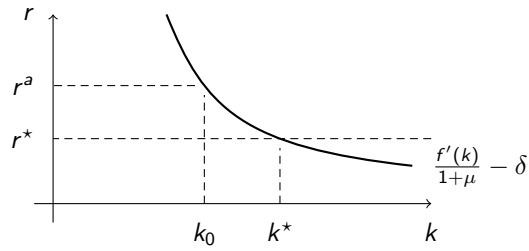


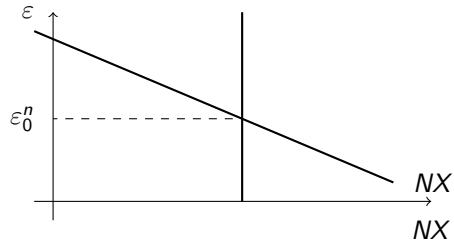

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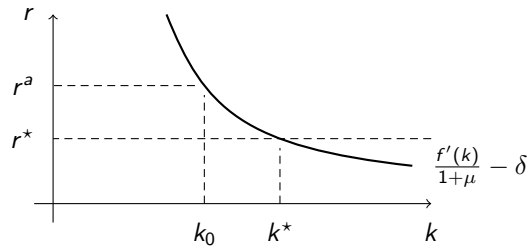


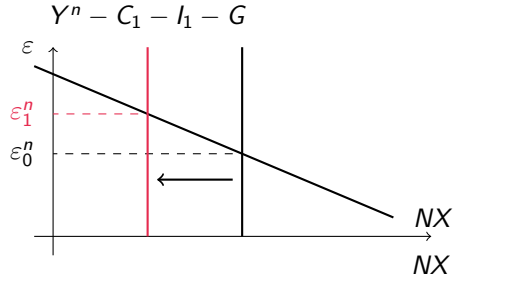

# Financing investment

- Suppose you live in a closed economy – real interest rate is $r^a$, set so that

$$Y^n - C(Y^d, Y^e - T^e, r^a, A) - G = I(r^a, Y^e, K)$$

- Now let's open the economy: world interest rate is lower $r^\star < r^a$
- **Implication 1:** Steady state capital is higher
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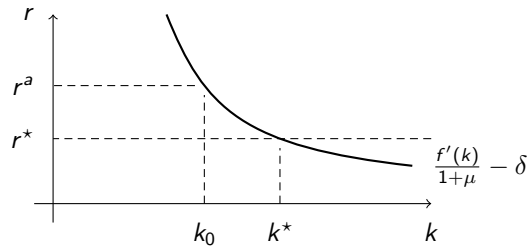


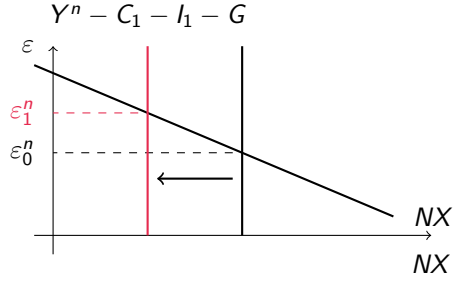

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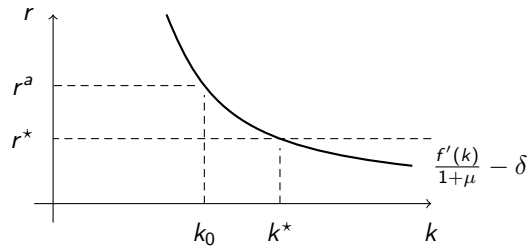


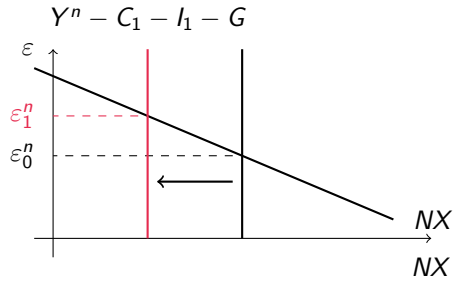

# Where does capital flow?

- This analysis tells us that countries with savings that are too high for their "natural" capital stock will export their capital abroad (i.e, invest in foreign countries)
- If financial markets are open, then capital flows to wherever the returns are highest
- Our model says that this only stops when returns are **equalized across countries**

  This is a sharp empirical prediction!

- **Question:** Do countries care that they're exporting capital?

$$Y = Y^n = F(K, EN^n) = f(k^\star)EN^n \tag{14}$$

  If you export your capital, then won't your long run production be lower?

- Yes! But what you care about is **national income** $Y^n + r^\star F$ not production
- Fall in output is more than made up by higher income on loans made abroad

  The converse is also true for capital importing countries

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# Where does capital flow?

## Supply Side

$$\frac{f'(k^\star)}{1+\mu} - \delta = r^\star$$

- Another way to think about this is in terms of the marginal product of capital
- Our analysis suggests that in open financial markets, capital will flow from countries with a low MPK (large capital stocks) to countries with a high MPK (low capital stocks)
- In principle, this is an efficient outcome:
  - You don't want to keep building factories and machines where the marginal return is low
  - Instead, you want them built in the places where the MPK is high
- This implies that capital stocks should converge over time

  In practice, convergence may not be uniform, and it may be quite slow

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# Section 3

## Current account and long-run foreign debt

# Income vs. Production

- In our closed economy, income and production are the same thing
- However, in an open economy, foreign income from abroad means that national income is

$$Y^n + r^\star F$$

- Savings do not determine investment, but they do determine the **long run path of national income**
- In principle, savings depend on the relative interest rate $r^\star$ and the subjective discount rate $\rho$:
  - If $\rho = r^\star$ then savings will stay constant
  - If $\rho > r^\star$ then savings will decrease (households value the present more than capital and investment markets do)
  - If $\rho < r^\star$ then savings will accumulate

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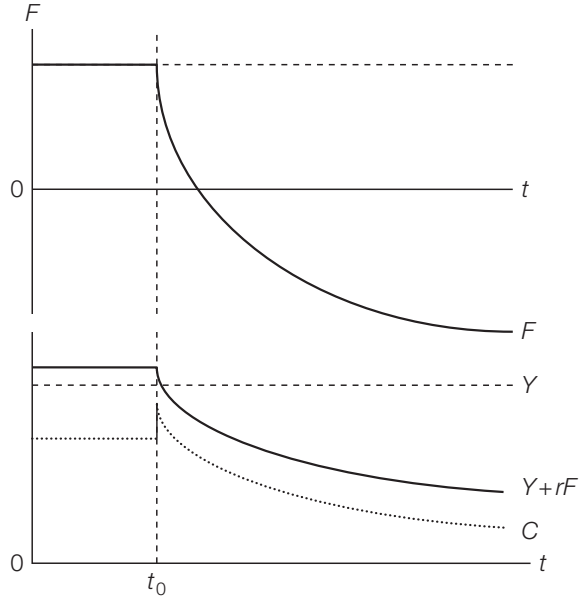
# Effects of Impatience

- Recall the **Euler Equation** from earlier this year:

$$\frac{u'(C_t)}{u'(C_{t+1})} = \frac{1+r^\star}{1+\rho} \qquad (15)$$

- This means that (in our model) if $\rho > r^\star$, debt will rise forever, and consumption falls to zero.
- In practice, eventually households would simply default on their debt.
- Lenders, knowing this, would eventually stop lending to them

The real return on the loan, accounting for default risk, would be lower than $r^\star$



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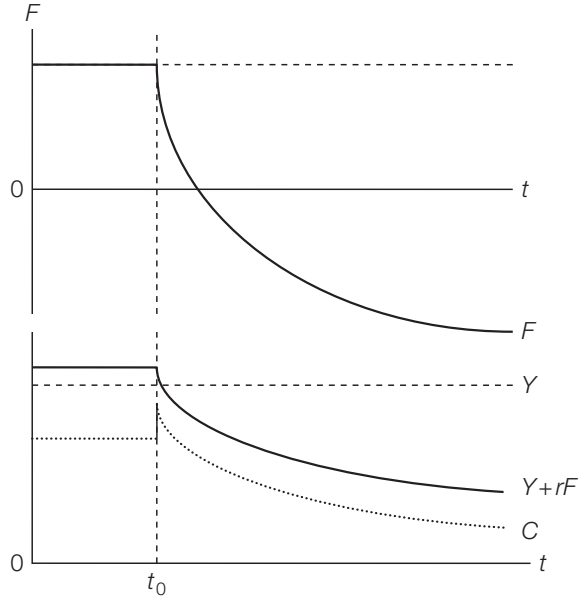
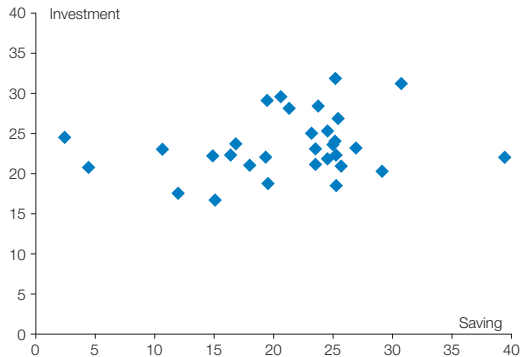


# How integrated are financial markets really?

- In a closed economy, savings and investment are tightly linked
- In an open economy with well integrated financial markets, they do not need to be related
- What do we see in the data?
  - **Weak correlation** between savings and investment
  - Huge variance in savings rates, but not much in investment

Determinants of willingness to save across countries is not well understood

**Fig. 13.9** *Savings and investment across countries 2008, percent of GDP*




Source: *OECD Economic Outlook*, OECD, 18 January 2012, http://www.oecd-ilibrary.org/statistics.

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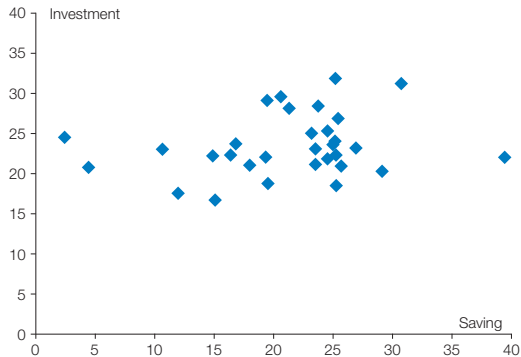


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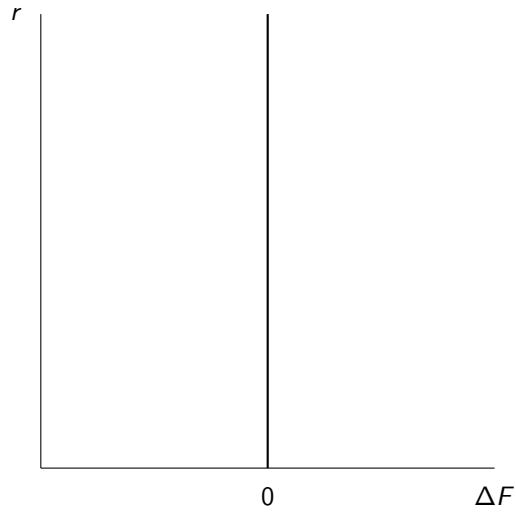
Section 4

# Large Open Economy

# What happens if our economy isn't small?

- Closed Economy: $r$ determined by $S = I$
- Small Open Economy: $r^\star$ is fixed
- **Large Open Economy**: $r$ depends on our country
- The net savings in our large open economy can impact the whole world:
  - Excess savings relative to investment decreases $r^\star$
  - Deficit of savings increases $r^\star$



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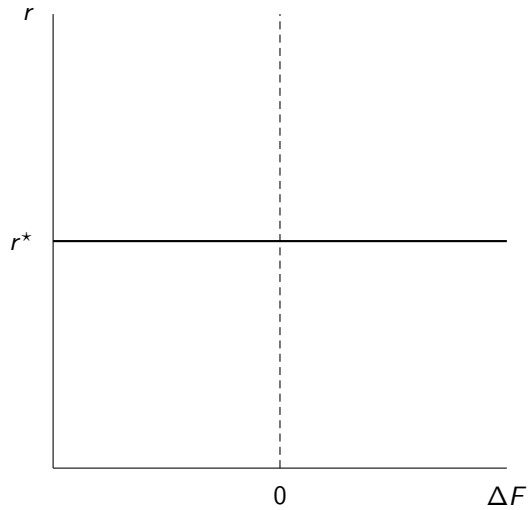

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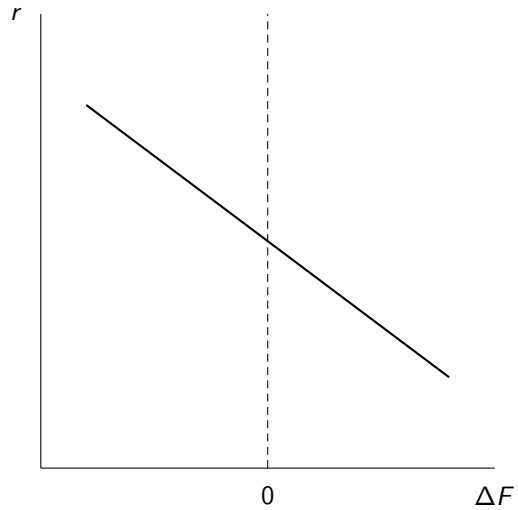


# Clearing Markets

- Start with $F = 0$
- Market clearing for savings requires:

$$\Delta F(r) = Y^n - C(Y^d, Y^e - T^e, r, A) - I(r, Y^e, K) - G \tag{16}$$

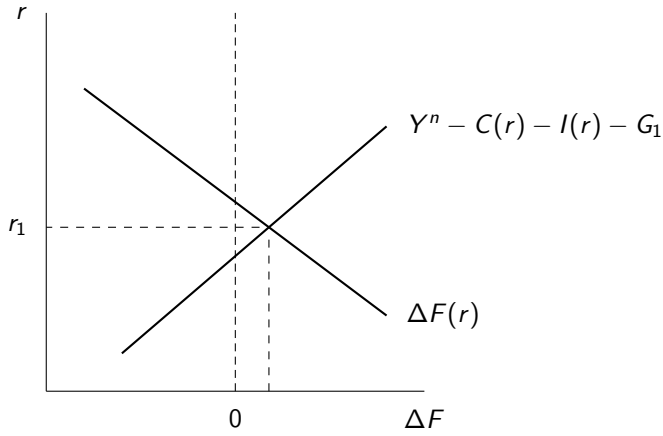
- But also we have to clear the goods market:

$$NX(\varepsilon, Y, Y^\star) = \Delta F(r) = Y^n - C(Y^d, Y^e - T^e, r, A) - I(r, Y^e, K) - G \tag{17}$$

- Now, both prices adjust!

# Government spending crowds out investing again

- Suppose $G \uparrow$ in large open economy
- For any given $NX$ level, the interest rate required to implement it goes up (so $Y^n - C(r) - I(r) - G$ shifts up)
- That means that in equilibrium, interest rate moves from $r_1$ to $r_2$
- Higher rates crowd out some consumption/investment
- Net lending to foreigners falls (and so do net exports)
- $NX$ decreases and $\varepsilon$ increases



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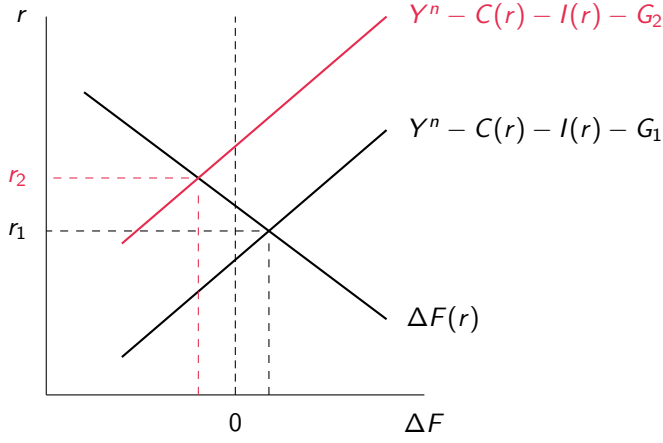

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