Global imbalances

Lecture 5, ECON 4330

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Outline

Sovereign risk

Sovereign risk refers to the possibility of government default and seizure of foreign assets (in the country). Is a natural part of an inter-connected world economy since there is no institutional framework that exist to legally enforce countires to stand by their obligations.

Sovereign risk II

Still some ways to enfore payments:

- Reject defaulting countries access to credit markets in the future/higher interest rates due to default risk
- Trade sanctions

Sovereign risk III

Sanctions available to the creditors are for simplicitly assumed to involve a possibility to confiscate an η share of output and assets. Hence if the country defaults in period t, the creditors will manage to get

$$\eta(A_t F(K_t) + K_t)$$

back through different sanctions.

Two-period model with default

In the first part of the lecture, we will use a simple two-period model (potentially with uncertainty) to discuss various sovereign risk issues. The model from lecture 1 involved solving the problem:

$$\max_{C_1, K_2} u(C_1) + \beta u\left([1+r](Y_1 - C_1) + Y_2 + K_1 - r(K_2 - K_1)\right)$$

subject to $Y_2 = A_2 F(K_2)$ and given $Y_1 = A_1 F(K_1)$. The first-order conditions to this problem are:

- The standard Euler equation
- and the optimal investment condition: $A_2 F'(K_2) = r$

Two-period model with default II

But earlier we have implicitly assumed that there is no sovereign risk (no possibility to default). Assume instead that the period-by-period budget constraints are:

$$C_1 + (K_2 - K_1) + B_2 = A_1 F(K_1)$$
$$C_2 = A_2 F(K_2) + K_2 - R$$

where

$$R = \min\{-(1+r)B_2, \eta(A_2 F(K_2) + K_2)\}$$

Here we see that the country only repays the full loan with interest if it is less than the cost of not doing so. If η is very small, the country 'always' defaults.

Two-period model with default III

Will discuss four issues in light of this model

- Debt ceiling
- Debt overhang
- Debt Laffer curve
- Debt buy-backs

Outline

Debt ceiling

When there was no sovereign risk, the country could borrow unlimited amounts from aborad. With the possibility of default, the country will have a debt ceiling, $\bar{D}$, which foreign creditors are unwillling to exceed. The ceiling is defined as follows:

For any level of debt below the ceiling, $-\mathbf{B_2} = \mathbf{D_2} \leq \bar{\mathbf{D}}$, the creditors want to make sure that $\min\{(\mathbf{1}+\mathbf{r})\mathbf{D_2}, \eta(\mathbf{A_2F(K_2)} + \mathbf{K_2})\} = (\mathbf{1}+\mathbf{r})\mathbf{D_2}$ holds when the sovereign chooses K_2 optimally (to maximize domestic utility).

Debt ceiling II

Whether this holds or not depends on the optimal investment strategy, since the size of K_2 determines the size of $\eta(A_2 F(K_2) - K_2)$. For instance, consider the effect of increasing the debt marginally from some level $\hat{D}_2$. What is the minimum of $(1+r)D_2$ and $\eta(A_2 F(K_2) + K_2)$?

- The first term is raised by $1 + r$
- while the second term is raised by $\eta(1 + A_2 F'(K_2))$.

For high enough levels of K_2, and therefore most likely $\hat{D}_2$, the increase in the last term will be so small that the minimum-condition may fail to hold (since $F'(K_2)$ is likely to fall in K_2).

Debt ceiling III

We can calculate $\bar{D}$ for a given utility function, production function, etc. (as in Section 6.2.1). Steps you need to go through are:

- For a given level of $D_2 = -B_2$, what is the maximum utility of the country if it defaults $(= U^D(D_2))$?
- And what is the maximum level of utility if it repays the whole loan $(= U^N(D_2))$?
- Finally: Find the value $D_2 = \bar{D}$ for which $U^D(\bar{D}) = U^N(\bar{D})$.

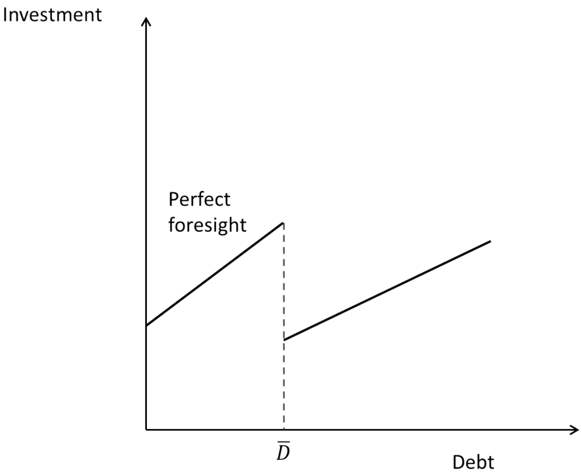
Debt ceiling IV

With the assumptions of O&R, the ceiling is

- Increasing in η
- Decreasing in r
- Increasing in the discount factor β

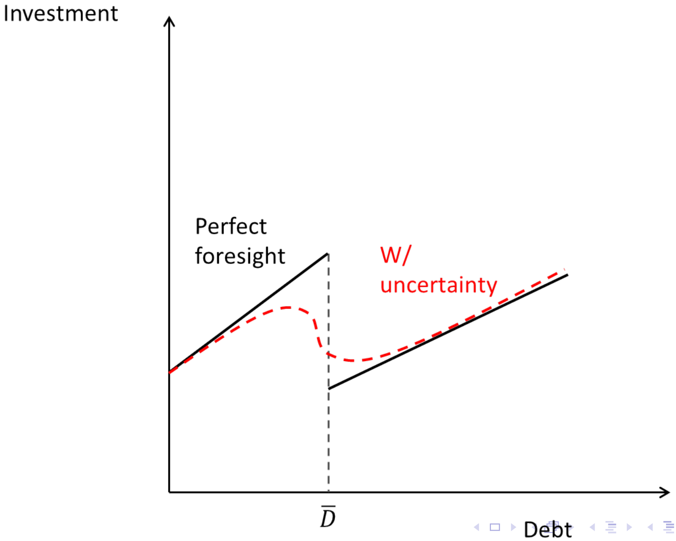
Debt ceiling V

What happens if the country gets to borrow $\bar{D} + \Delta$? The optimal rate of investment will fall (a lot), since the country willl default in any case, making it less attractive to have period 2 output and assets. The fall will be discontinuous.



Debt ceiling VI

If future productivity, A_2, is stochastic, this may make the investment function continuous (see Figure 6.5 in O&R).



Debt ceiling VII

If the country can credibly commit to a given level of investment *before* creditors are granting loans, this will partly ease the problems, but not fully. The fact that commitment may help is an example of **dynamic inconsistency**. The country may promise a high level of investment beforehand, but once the loans are granted, it is tempting to consume more instead. Rational creditors do not accept this, of course. Limits the possibility for pre-commitments.

Effect of a debt ceiling

A debt ceiling illustrates that presence of sovereign risk may limit a country's access to international borrowing. This will cause inefficiency if the debt ceiling is binding, since then the country is unable to invest the optimal amount.

Outline

Debt overhang

The second issue we'll discuss is the effect of starting out with a huge debt burden, and how sovereign risk will then impede growth. In our two-period model, assume therefore that $-B_1 = D > 0$, so the country starts out with a given level of debt. Let the utility function be (the very simple)

$$U = C_1 + E(C_2)$$

and take period 1 output as given, while period 2 output is $A_2 F(K_2)$, where $K_2 = I_1$ (capital depreciates completely after one period) and A_2 is random. Further, assume that the world interest rate is zero ($r = 0$).

Debt overhang II

The period-by-period budget constraints facing the country are:

$$C_1 + K_2 = Y_1$$
$$C_2 = A_2 F(K_2) - \min[\eta A_2 F(K_2), D]$$

(Since utility is linear, it will never bother to borrow any extra from abroad)
Inserting for these conditions, the country will choose K_2 in order to maximize:

$$Y_1 - K_2 + \mathbf{E_t}\left\{A_2 F(K_2) - \min[\eta A_2 F(K_2), D]\right\}$$

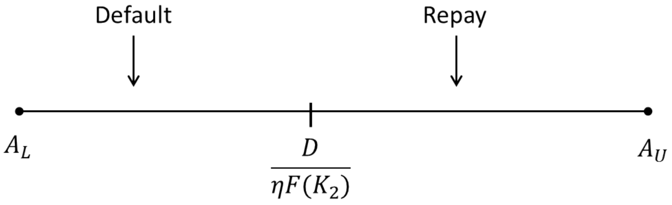
Debt overhang III

Assume that A_2 has distribution $\pi(A_2)$ over $A_2 \in [A_L, A_U]$ with $\mathbf{E_t}(A_2) = 1$. This makes $\mathbf{E_t}\left\{A_2 F(K_2)\right\} = F(K_2)$, such that the maximization problem is simply:

$$\max_{K_2} Y_1 - K_2 + F(K_2) - \mathbf{E_t}\left\{\min[\eta A_2 F(K_2), D]\right\}$$

Debt overhang IV

What is this expected value? For a given level of K_2, we understand that whether the country defaults or repays depends on A_2:



Debt overhang V

When it defaults, the creditors get $\eta A_2 F(K_2)$. If it repays, they get D. The expected value is therefore given by the function $V(D, K_2)$:

$$V(D, K_2) = \eta F(K_2) \int_{A_L}^{\frac{D}{\eta F(K_2)}} A_2 \pi(A_2) dA_2 + D \int_{\frac{D}{\eta F(K_2)}}^{A_U} \pi(A_2) dA_2$$

Interpretation? If productivity is high enough, debt is repaid and everything is fine. But if productivity is low, the country ends up defaulting. In those cases a share η of output is 'taxed' by foreign creditors.

Debt overhang VI

The effect of debt overhang can be seen from the first-order condition for K_2:

$$F'(K_2)\left[1-\eta\int_{A_L}^{\frac{D}{\eta F(K_2)}} A_2\pi(A_2)dA_2\right]=1$$

(see p. 393 and footnote 43 in O&R).
The possibility of default makes the country invest less than the optimal amount (which would give $F'(K_2)=1$). This is because what the creditors get is proportional to output when there's default.

Debt overhang VII

This shows how a large initial stock of debt depresses investment activity. Possibility of default creates an uncertain investment environment.

Outline

Debt Laffer curve

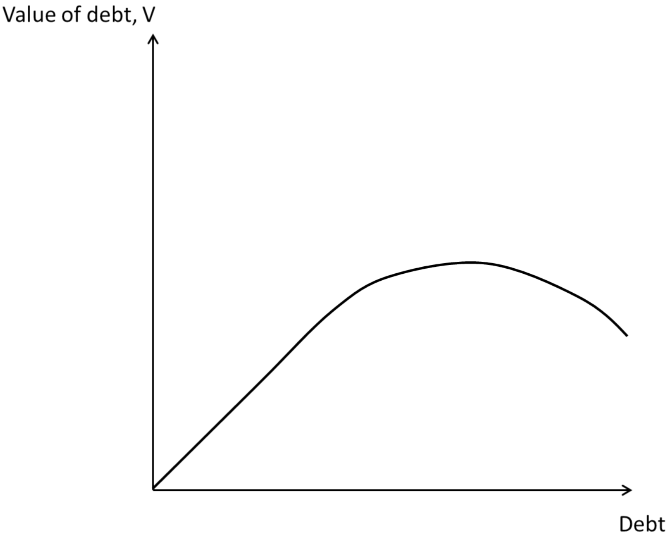
Realizing that countries may suffer from a debt overhang effect; what is it optimal for creditors to do? Consider the creditors of Greece. If they cut the debt by Δ:

- They have a direct loss of Δ if the loan is repaid
- But this may reduce the overhang effect, and make default less likely

The last effect can dominate!

Debt Laffer curve II

Implies a debt Laffer curve, as discussed by Krugman (1989) and Sachs (1989).



Debt Laffer curve III

Challenges:

- How to coordinate the debt writedown?
- No proper coordinator on the international level
- Even in Europe: very difficult

Debt buy-back

What about debt buy-backs? Is that a good solution for heavily indebted countries? Not necessarily because:

- The country has to pay the 'average' price for its debt,
- while it only gains the 'marginal' price of debt, which is lower
- Still there is a positive overhang effect, so net effect may be positive, but not necessarily

Should be accompanied by creditor-concessions.

Debt buy-back II

The example of Bolivia from O&R is a good illustration.

	Pre	Post
Face value of debt	$670 million	$362 million
Price per dollar	0.06	0.11
Total market value	$40.2 million	$39.8 million

Since the market value is almost unchanged, the market evaluated Bolivia's position to be virtually unchanged.
Missing points that work in favor of debt-buy back:

- External effects of default
- Depressed govt bond markets may not give the correct prices

Outline

Exchange rates

Time to turn to Rødseth's book.

Basics

In the lectures, we will follow Rødseth's convention in refering to foreign currency as dollars, while the domestic currency is kroner.

- The exchange rate, E, is the price dollars in units of kroner

For the Norwegian audience: E er valutakursen. $1/E$ er kronekursen.

Basics II

Roughly speaking, we can divide the participants in the FX market into two groups. On the one hand, the general public (home and abroad), and on the other the central bank. We ignore the foreign central bank for now. The equilibrium value of E is determined in many ways just as a normal market. The price is E. But what is the quantity? Old theories used to think of the *flow* of currency. However, it is more appropriate to think in terms of the *stock* of currencies. Remember that:

- The krone appreciates when it becomes worth relatively more: $E\downarrow$
- and it depreciates when it becomes worth relatively less: $E\uparrow$

Balance sheet

To keep track of all the variables, let us put up the balance sheet. This also makes it clear which sectors we consider, and what notation we use for the different variables.

		Sector		
Assets	Government	Private	Foreign	Sum
Kroner assets	B_g	B_p	B_*	0
Dollar assets	F_g	F_p	B_*	0
Sum in kroner	$B_g + EF_g$	$B_p + EF_p$	$B_* + EF_*$	0

In the table we've incorporated the assumption that all assets sum to zero:

$$B_g + B_p + B_* = 0 \tag{1}$$

$$F_g + F_p + F_* = 0 \tag{2}$$

One sector's asset is another's liability.

Balance sheet II

To introduce the exchange rate was one novelty. Another is to consider explicit price levels. Let P be that of home, and P_* that of foreign. Real wealth of the three sectors:

$$W_g = \frac{B_g + EF_g}{P} \tag{3}$$

$$W_p = \frac{B_p + EF_p}{P} \tag{4}$$

$$W_* = \frac{B_*/E + F_*}{P_*} \tag{5}$$

Furthermore, from the two market clearing assumptions, it follows that

$$W_g + W_p + QW_* = 0$$

(as indicated by the balance sheet), where $Q = \frac{EP_*}{P}$ is the real exchange rate.

Timing

In our models, we will think of any period as relatively short, such that capital accumulation is ignored and all trades take place at the same price. Hence each sector is only able to re-balance its portfolio, and the end-of-period wealth must have the same value as initial wealth. Formally:

$$B_i + EF_i = B_{i0} + EF_{i0}$$

for $i = g, p, *$. Hence within one period investors can change the composition of its portfolio, but its total nominal value can only be affected by exchange rate movements. (Changes in the price level will affect the real value.)

Demand for currencies

To discuss demand for currencies, the most relevant variables are:

- The kroner rate of interest i
- The dollar rate of interest i_*
- The rate of deprecitation $e_e = \dot{E}/E$

Measured in kroner, the rate of return from investing in kroner is i, while the return from dollars is $i_* + e$.

Demand for currencies II

With perfect capital mobility, the well-known condition **uncovered interest rate parity** (UIP) must hold:

$$i = i_* + e_e \tag{6}$$

This is because a situation with $i \neq i_* + e$ will cause infinite demand for one of the currencies. (6) must hold in any equilibrium.
Q: What is 'covered interest rate parity'? Is the equivalent no-arbitrage condition between spot and foward contracts. More likely to hold than UIP.

Demand for currencies III

However, there are also many reasons to think that capital mobility is imperfect.

- Exchange rate risk
- Risk aversion'
- Transaction costs
- Liquidity considerations
- (Exchange controls)

Demand for currencies IV

In the imperfect mobility case, it makes sense to assume that there exist well-defined demand functions for stocks of currencies. Let

$$r = i - i_* - e_e \tag{7}$$

denote the expected rate of return differential. Assume that the domestic public sector has real demand for dollars given by

$$\frac{EF_p}{P} = f(r, W_p) \tag{8}$$

while its demand for kroner follows from the 'budget constraint':

$$\frac{B_p}{P} = W_p - f(r, W_p) \tag{9}$$

We can think of $f(r, W_p)$ as coming out of the problem where the public sector chooses an optimal portfolio-combination given its total wealth. 'Reasonable' restrictions on f are:

$$0 < f_W < 1$$
$$f_r < 0$$

Demand for currencies V

Assume that the foreigners face a similar portfolio-problem, only in foreign and not domestic terms. Hence their demand for kroner in real terms is:

$$\frac{B_*}{EP*} = b(r, W_p) \tag{10}$$

while their dollar demand follows as

$$\frac{F_*}{P_*} = W_* - b(r, W_*) \tag{11}$$

where we also add that

$$\begin{aligned} 0 < b_W &< 1 \\ b_r &> 0 \end{aligned}$$

Expectations

We are already starting to see how the modeling approach differs from O&R. Another characteristic difference is how expectations are dealt with. In general, we will here assume that the expected rate of depreciation is given by a well-defined function

$$e_e = e_e(E) \tag{12}$$

This differs dramatically from rational expectations (RE). RE has now come to dominate the academic literature, but I think models with simpler expectational assumptions may be just as useful.

Expectations II

We will refer to expectations as:

- *Regressive* when $e_e' < 0$
- *Extrapolative* when $e_e' > 0$
- and constant when $e_e' = 0$

Simple portfolio model

Connecting the dots, we have a portfolio model for the exchange rate (when floating) or the central bank's FX reserves (when fixed). First, (4) and (5) give the definitions of financial wealth at the beginning of the period:

$$W_p = \frac{B_{p0} + EF_{p0}}{P}$$
$$W_* = \frac{B_{*0}/E + F_{*0}}{P_*}$$

Again: The levels of wealth are 'almost' exogenously given, but they can be affected by changes in E.

Second, we need the definition of r in (7), and e_e from (12)

$$r = i - i_* - e_e$$
$$e_e = e_e(E)$$

Simple portfolio model II

Thirdly, we add the demand for dollars from (8) and (11):

$$\frac{EF_p}{P} = f(r, W_p)$$
$$\frac{F_*}{P_*} = W_* - b(r, W_*)$$

The equilibrium condition

$$F_g + F_p + F_* = 0$$

will be the final condition we need.

Simple portfolio model III

The model has 7 equations and will determined 7 variables: $W_p, W_*, F_p, F_*, r, e_e$ and E or F_g. If the government decides to fix E, then F_g will have to adjust in order to secure market clearing at this exchange rate. If on the other hand E is floating, the government stands free to do whatever it likes with F_g. Note that both interest rates are assumed to be fixed by the respective central banks (although the foreign central bank is not explicitly modeled elsewhere). The price levels are also taken as given.

Supply side

The easiest way to think about the model is to use the first 6 equations to define the supply of foreign currency as

$$\begin{aligned} S &= -F_p - F_* \\ &= -\frac{P}{E} f(r, W_p) - P_*[W_* - b(r, W_*)] \\ &= -\frac{P}{E} f(i - i_* - e_e(E), \frac{B_{p0} + EF_{p0}}{P}) \\ &- P_*[\frac{B_{*0}/E + F_{*0}}{p_*} - b\left(i - i_* - e_e(E), \frac{B_{*0}/E + F_{*0}}{P_*}\right)] \end{aligned}$$

(see equation 1.18 in Rødseth).

Supply side II

The slope of the supply curve is:

$$\frac{\partial S}{\partial E} = \frac{1}{E}[F_p - f_W F_{p0} + (1 - b_W)B_{*0}/E] + [(P/E)f_r - P_* b_r]e_e'$$

To interpret the slope, it is often wise to consider the slope at the intial point ($F_p = F_{p0}$, $B_* = B_{*0}$). In that case:

$$\frac{\partial S}{\partial E}^0 = \frac{P}{E^2}\gamma - \frac{P}{E}\kappa e_e'$$

where

$$\gamma = (1 - f_W)\frac{EF_{p0}}{P} + (1 - b_W)\frac{B_{*0}}{P}$$

$$\kappa = -f_r + \frac{EP_*}{P}b_r$$

Supply side III

$$\gamma = (1 - f_W)\frac{EF_{p0}}{P} + (1 - b_W)\frac{B_{*0}}{P}$$

γ measures the portfolio composition effect.
We've already assumed that f_W and b_W are between zero and one (which also limits speculative behavior). The sign of γ is nevertheless ambiguous.

- If both the domestic private and foreign sectors gain from a depreciation, then $\gamma > 0$ for sure. Requires $F_{p0} > 0$ and $B_{*0} < 0$ since then the depreciation makes the domestic portfolio worth more in kroner, and the foreign portfolio worth more in dollars. Why positive? Higher wealth alone will want the investors to hold more of both currrencies. But since the increase in wealth was caused by a higher value of its positive dollar/negative kroner position, the net effect is that they will sell dollar/buy less kroner. Hence the supply of foreign currency rises.
- But if either the domestic sector is heavily indebted in dollars, or the foreigners own a lot of kroner, we migh have $\gamma < 0$ (discuss somewhat more later).

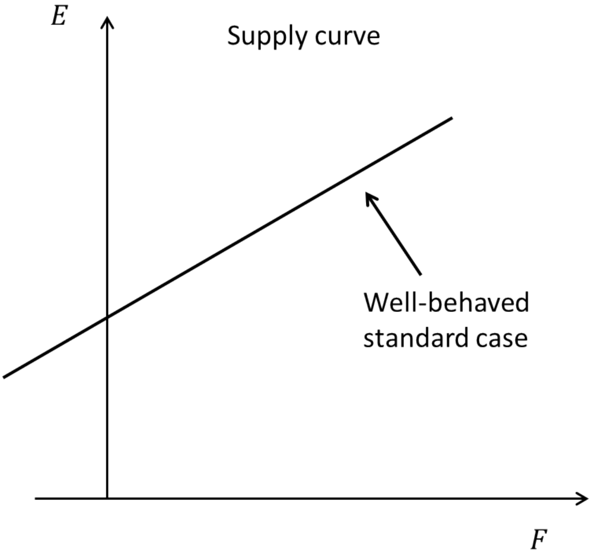
Supply side IV

$$-\kappa e'_e = [-f_r + \frac{EP_*}{P} b_r] e'_e$$

$-\kappa e'_e$ is the expectations effect. κ is always positive, since we have assumed that $f_r < 0$ and $b_r > 0$.

- If expectations are regressive, then expectations are contributing to an upward sloping supply curve
- But extrapolative elements ($e'_e > 0$) will in the same way as $\gamma < 0$ potentially make the supply curve downward sloping!

Supply side V



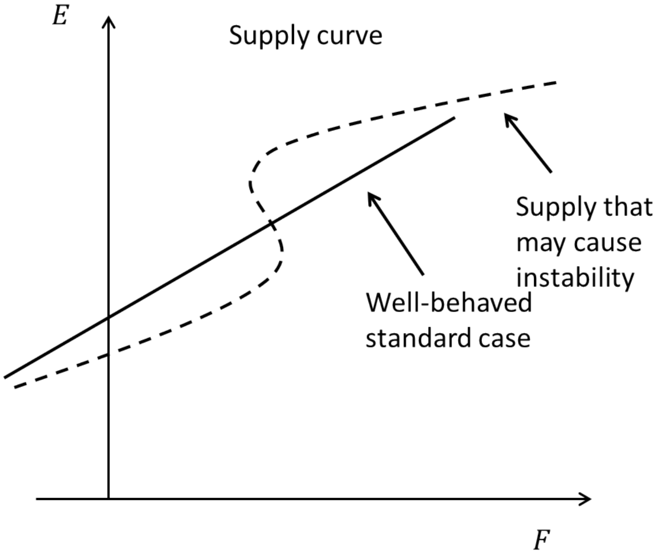
Supply side VI

Suffiicent conditions for the well-behaved case are:

$$F_{p0} > 0, \;\; B_{*0} > 0, \;\; f_W < 1, \;\; b_W < 1, \;\; e'_e < 0$$

In general we assume that these hold, or at least that enough of them hold (it is not the set of necessary conditions!).

Supply side VII



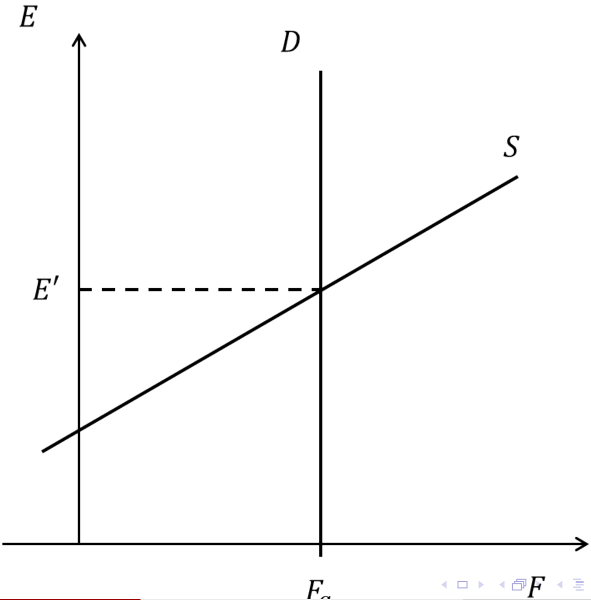
Equilibrium when E floats

Supply side is independent of exchange rate regime. If E floats, the demand for foreign currency coincides with the central bank's FX reserves.

$$D = F_g$$

Intersection between supply and demand gives the equilibrium exchange rate E'.

Equilibrium when E floats II

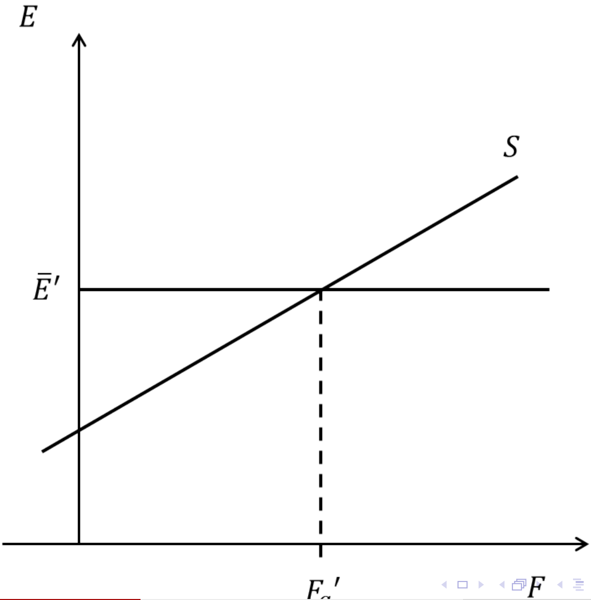


Equilibrium when E is fixed

If E is to be fixed at $\bar{E}$, then the CB must have an infinite demand for FX at this exchange rate. Gives a horizontal line at $E = \bar{E}$. Intersection between supply and demand gives the equilibrium levels of FX reserves F_g'.

Note: So far we have assumed that the interest rate peg can be maintained by changes in FX reserves. Not always feasible. Then the interest rate must be used as an instrument. More on that soon.

Equilibrium when E is fixed II



Market for kroner?

What about the market for kroner? By Walras' law, we know the kroner market clears as well. Why? Since there are two goods (kroner and dollar), all agents obey their budget constraints, and the dollar market clears. It follows that the kroner market must clear. In that market the private sector will *demand* kroner, while the central bank supplies kroner. Any shift in the supply of foreign currency will have an equal signed shift in the demand for kroner of the same amount.

Capital mobility

Recall: The portfolio model relies on assuming imperfect capital mobility, since with perfect capital mob. we only need the UIP condition (plus assumptions regarding expectations). How can we discuss the effect of *increased* capital mobility in the portfolio model?

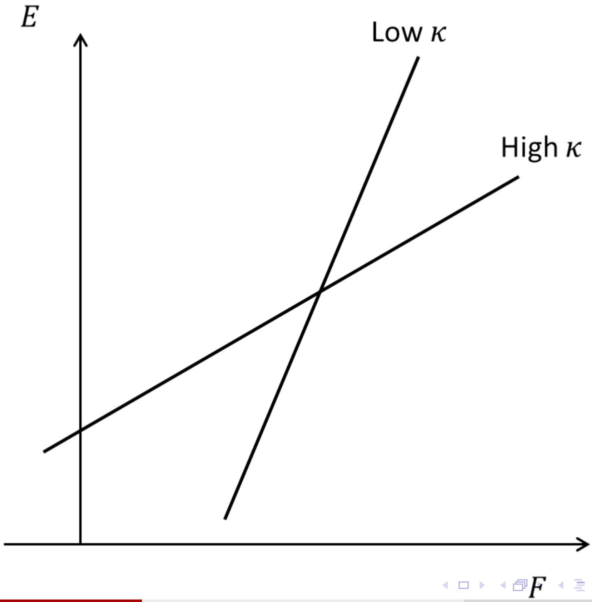
Capital mobility II

We can interpret κ as measuring the degree of capital mobility.

$$\kappa = -f_r + \frac{EP_*}{P} b_r$$

A larger value of κ means that the supply of foreign currency reacts stronger to changes in r. We therefore expect greater capital mobility to make κ larger.

Capital mobility III



Capital mobility IV

Q: How does differences in capital mobility change the effect of the interest rate?

Capital mobility V

Perfect mobility is therefore some sort of a limiting case where $\kappa \to \infty$. In that case an increase in r causes supply to be infinite, and it is necessary for E to adjust to keep r unchanged. In other words: UIP must hold (the portfolio model has 'collapsed' into this simple condition).

Perfect capital mobility when E floats

The equilibrium exchange rate is impliciitly defined by

$$i = i_* + e_e(E)$$

where i and i_* are given exogenously. E will have to adjust to the (hopefully unique, potentially not) level that makes

$$e_e(E) = i - i_*$$

Perfect capital mobility when E is fixed

What about the fixed exchange rate regime? If it is fully credible, then $e_e(\bar{E}) = 0$. From the UIP we get:

$$i = i_*$$

If there is perfect capital mobility, a fixed exchange rate can only be maintained if the interest rate is set equal to the foreign rate. Varying FX reserves is no longer sufficient. An extension of this argument is that the more mobile is, the harder is it to control E by means of F_g. If capital is very immobile, you might fare well with only F_g (making it possible to use i for other purposes), but if capital is sufficiently mobile, you most likely need to use the interest rate in order to maintain the peg.

Next lecture

- Seminar two weeks from now. Note updated seminar dates (see course webpage)
- No lecture next week
- For the lecture in two weeks: prepare by reading chapters 2 and 3 in Rødseth