

Chapter 15

Exchange Rates in the Short Run:
The Asset Approach

(updated 10/23/06)

Outline

- Motivation: PPP is good on long run, but does not provide a good basis for a theory of the exchange rate in the short run. We still care about this.
- Building Blocks
 - ◆ Purchasing Power Parity (PPP) as a long-run theory
 - Forecast expected future price levels hence expected future E
 - ◆ Uncovered Interest Parity (UIP) as a short-run theory
 - Use expected future E to obtain today's spot E , given interest rates
 - Begs the question where do interest rates come from?
 - Solve that and we have a complete theory
- The short-run model of money and forex markets
 - ◆ Same model of M demand: role of nominal interest rates
 - Short run assumption: prices are sticky
 - Interest rate adjusts to clear the money market
 - ◆ Same interest rate will prevail in forex market to determine E
 - Allows us to develop a unified graphical analysis of M and FX markets
- Putting the model to work
 - ◆ Predictions and evidence

Part 1: Building blocks of a short run theory: UIP as equilibrium condition for the FX market

- Fundamental equation of the asset approach

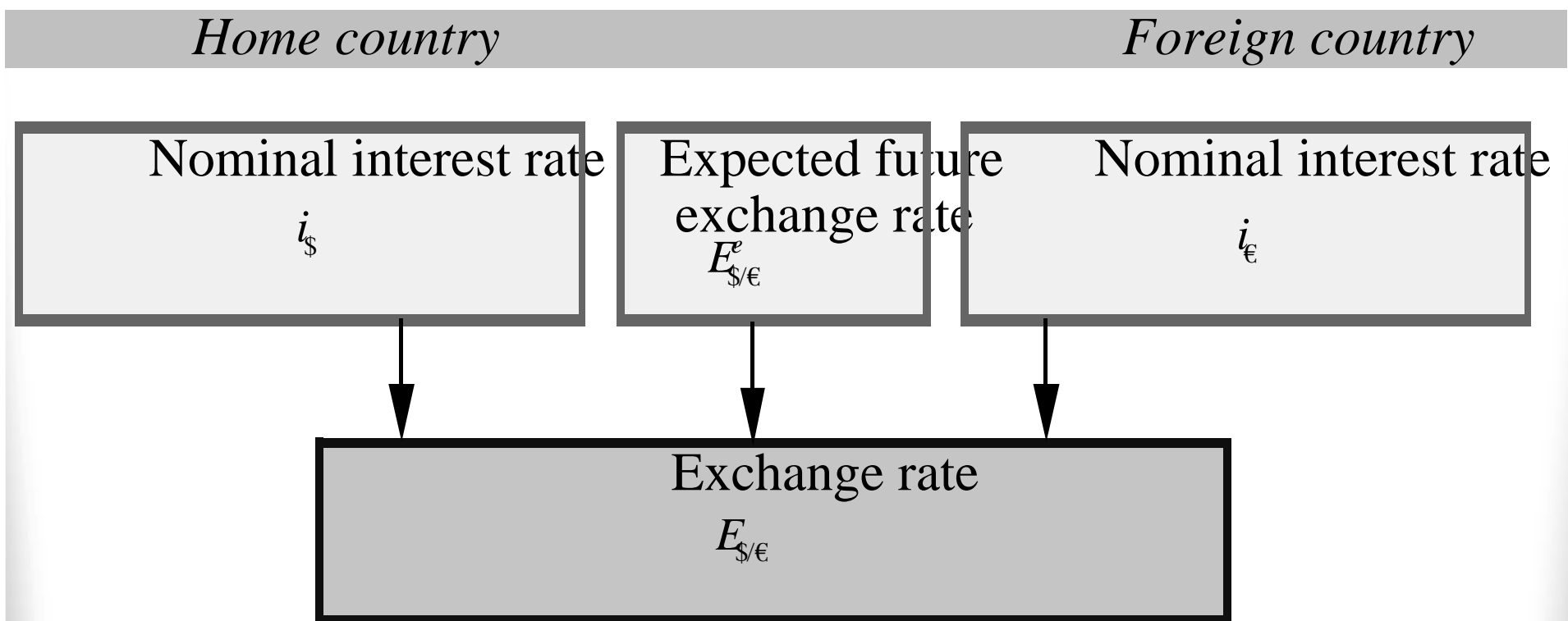
$$\underbrace{i_{\$}}_{\text{dollar interest rate}} = \underbrace{i_{\text{€}}}_{\text{euro interest rate}} + \underbrace{\left(\frac{E_{\$/\text{€}}^e - E_{\$/\text{€}}}{E_{\$/\text{€}}} \right)}_{\text{expected rate of depreciation of the dollar}}$$

$\underbrace{\hspace{10em}}$
 domestic dollar return

 $\underbrace{\hspace{15em}}$
 expected foreign dollar return

- ◆ Ee: Assume Ee known using model of Chap 14 to make a forecast
- ◆ Need to explain i\$ and i€ and how the forex market then adjusts so today's spot E is at the level given by UIP

UIP as a building block



FX market: equilibrium and adjustment

GRAPHICAL EXPOSITION

- We could do all this using equations
- But a clearer way to see what is going on is to use graphs.
- In this chapter we introduce
 - ◆ Graphical treatment of the short run money market
 - ◆ Graphical treatment of the forex market
- Bring them both together to provide a full graphical treatment of the short-run **asset approach to exchange rates**
- First, we take some time to familiarize ourselves with these graphical tools
- Then use them for prediction and policy analysis

FX market: equilibrium and adjustment

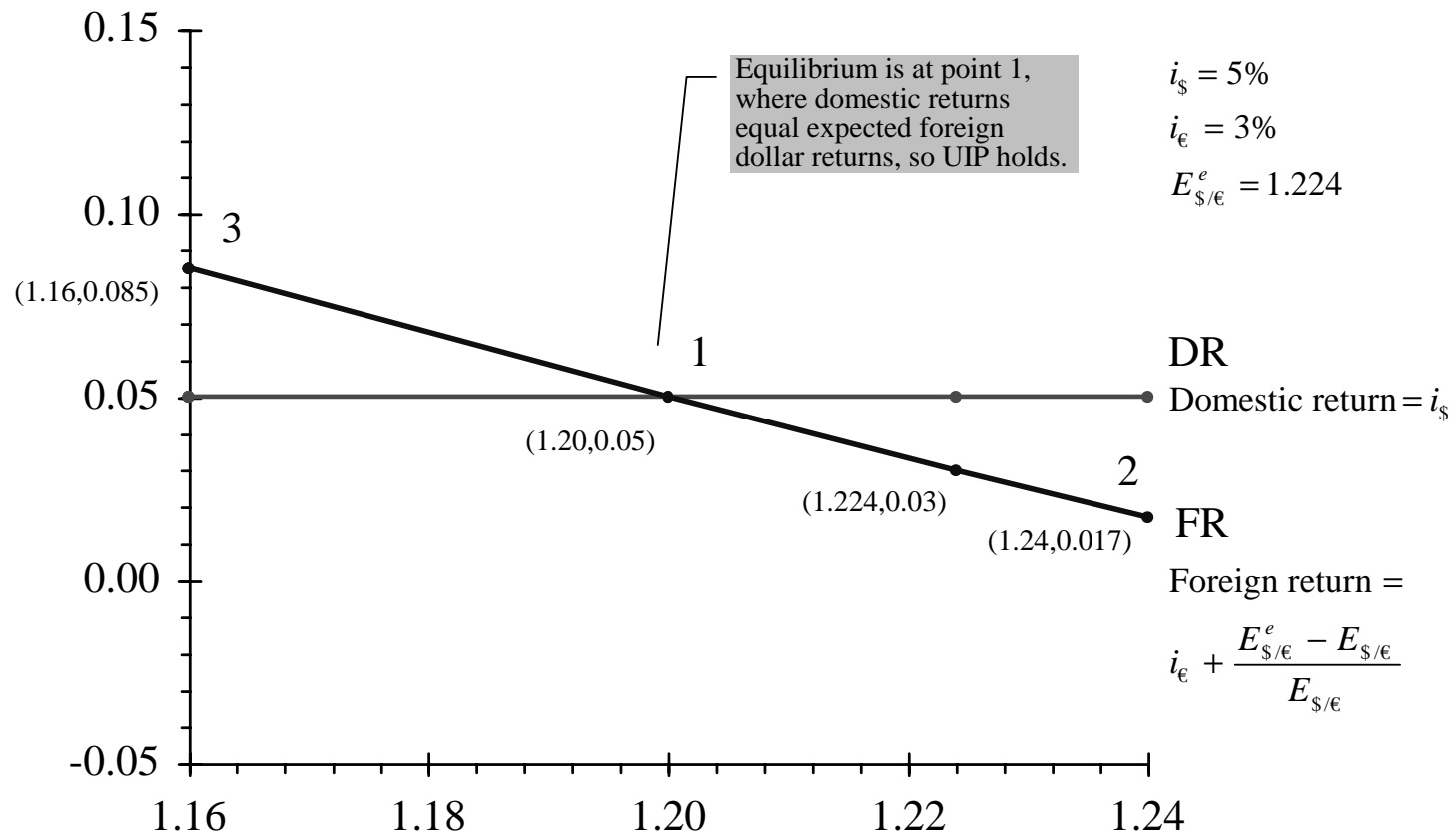
AN EXAMPLE

(1) Interest rate on dollar deposits (annual) domestic return (in dollars)	(2) Interest rate on euro deposits (annual)	(3) Spot exchange rate (today)	(4) Expected future exchange rate (in 1 year)	(5) Expected euro appreciation against dollar (in 1 year)	(6) Expected dollar return on euro deposits (annual) foreign expected return (in dollars)	
$i_{\$}$	$i_{\text{€}}$	$E_{\$/\text{€}}$	$E_{\$/\text{€}}^e$	$\frac{E_{\$/\text{€}}^e - E_{\$/\text{€}}}{E_{\$/\text{€}}}$	$i_{\text{€}} + \frac{E_{\$/\text{€}}^e - E_{\$/\text{€}}}{E_{\$/\text{€}}}$	
0.05	0.03	1.16	1.224	0.0552	0.0852	
0.05	0.03	1.18	1.224	0.0373	0.0673	
0.05	0.03	1.16	1.224	0.0552	0.0852	
0.05	0.03	1.20	1.224	0.02	0.05	market equilibrium
0.05	0.03	1.22	1.224	0.0033	0.0333	
0.05	0.03	1.24	1.224	-0.0129	0.0171	

FX market: equilibrium and adjustment

GRAPHICAL EXPOSITION

Expected return,
percent per annum



Today's dollar/euro
spot exchange rate, $E_{\$/\epsilon}$

Adjustment to FX market equilibrium

- Suppose $\text{€}/\text{\$}$ exchange rate is “too high” at point 2.
 - ◆ FR is below DR and arbitragers want to sell € and buy $\text{\$}$.
 - ◆ This puts the euro under selling pressure and bids down the price of the euro.
 - ◆ In other words the $\text{€}/\text{\$}$ exchange rate starts to fall (horizontal axis) and we move from point 2 toward point 1 causing FR to rise (vertical axis).
- Suppose $\text{€}/\text{\$}$ exchange rate is “too low” at point 3.
 - ◆ FR is above DR and arbitragers want to buy € and sell $\text{\$}$.
 - ◆ This puts the euro under buying pressure and bids up the price of the euro.
 - ◆ In other words the $\text{€}/\text{\$}$ exchange rate starts to rise (horizontal axis) and we move from point 3 toward point 1 causing FR to drop (vertical axis).

FX market diagram

- What the FX market diagram tells us
 - ◆ Knowing home interest rate (vertical axis) in the home market tells us the domestic return (DR)
 - ◆ Knowing E_e and foreign interest rate tells us the position of the foreign return (FR) curve
 - Both returns are measured in domestic currency terms
- FX market has a unique equilibrium where DR & FR intersect. This is where UIP holds.
 - ◆ From this point we trace down to the horizontal axis and read off the equilibrium spot rate E .
 - ◆ So all we need to do now is figure out the interest rate(s).
- For this we need the money market diagram

Short-run money market analysis

- The remaining tool we need
- Describes short run equilibrium in the money market
 - ◆ Applies to each country, but we focus on the home country
- For our short run analysis we assume
 - ◆ Price levels are sticky (use overbar notation)
 - ◆ Nominal interest rates adjust to clear the money market
- To proceed we need to know
 - ◆ Money supply and money demand
 - ◆ Use same model as Chapter 14 (standard model)

Key differences

- Important to understand the key difference between the way we approach money market equilibrium in the short run (here) and the way we approached it in the long run (chapter 14).
- In Chapter 14 we made the following long-run assumptions:
 - ◆ In the long run the price level P is fully flexible and adjusts to bring the money market to equilibrium;
 - ◆ In the long run the interest rate i is determined by the Fisher effect.
- In this chapter, we make quite different short-run assumptions:
 - ◆ In the short run the price level is sticky; it is treated as a known predetermined variable, fixed at \bar{P} (bar denotes a fixed value);
 - ◆ In the short run the interest rate i is fully flexible and adjusts to bring the money market to equilibrium.

Key differences

- First, why assume prices are now sticky? The “Keynesian” assumption of sticky prices is common to the study of macroeconomics in the short run. Economists have many explanations for price stickiness or so-called “nominal rigidity.” Nominal wages may be sticky due to long-term labor contracts. Nominal product prices may be sticky due to “menu costs,” whereby firms find it costly to frequently change their output prices. Thus, whilst we think it is reasonable to assume prices are flexible in the long run, this cannot be taken for granted in the short run.

Key differences

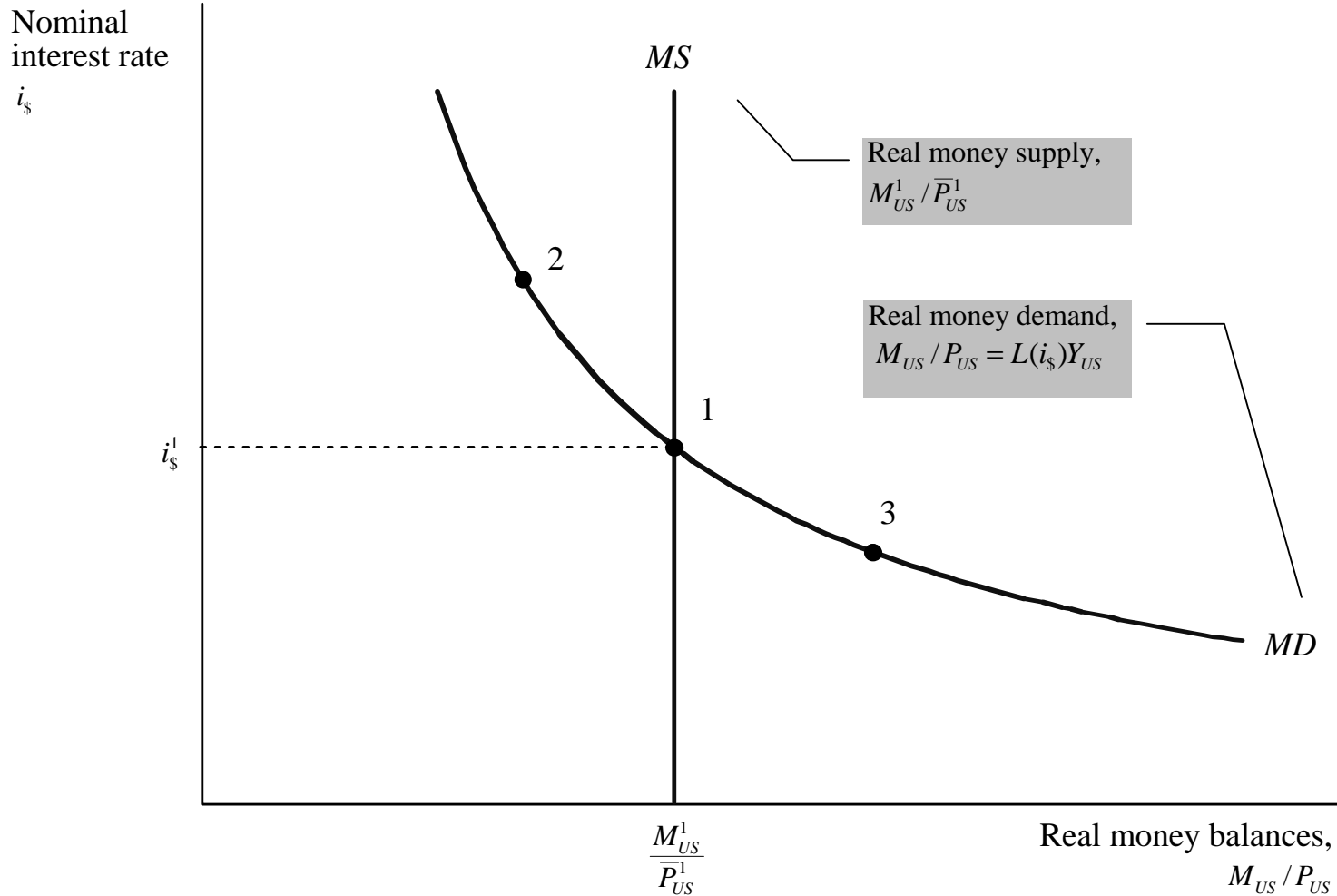
- Second, why assume that interest rates are now flexible? In the long run, we have shown in the last chapter that interest rates are pinned down by the Fisher effect (or RIP), but remember that this result does not hold in the short run. After all, it was derived from PPP, and PPP is a poor guide to the short run. And we saw ample evidence that real interest rates fluctuate in ways that deviate from simple RIP in the short run.

Short-run money market equations

$$\underbrace{\frac{M_{US}}{P_{US}}}_{\text{U.S. supply of real money balances}} = \underbrace{L(i_{\$}) \times Y_{US}}_{\text{U.S. demand for real money balances}}$$

$$\underbrace{\frac{M_E}{P_E}}_{\text{European supply of real money balances}} = \underbrace{L(i_{\text{€}}) \times Y_E}_{\text{European demand for real money balances}}$$

Short-run money market diagram

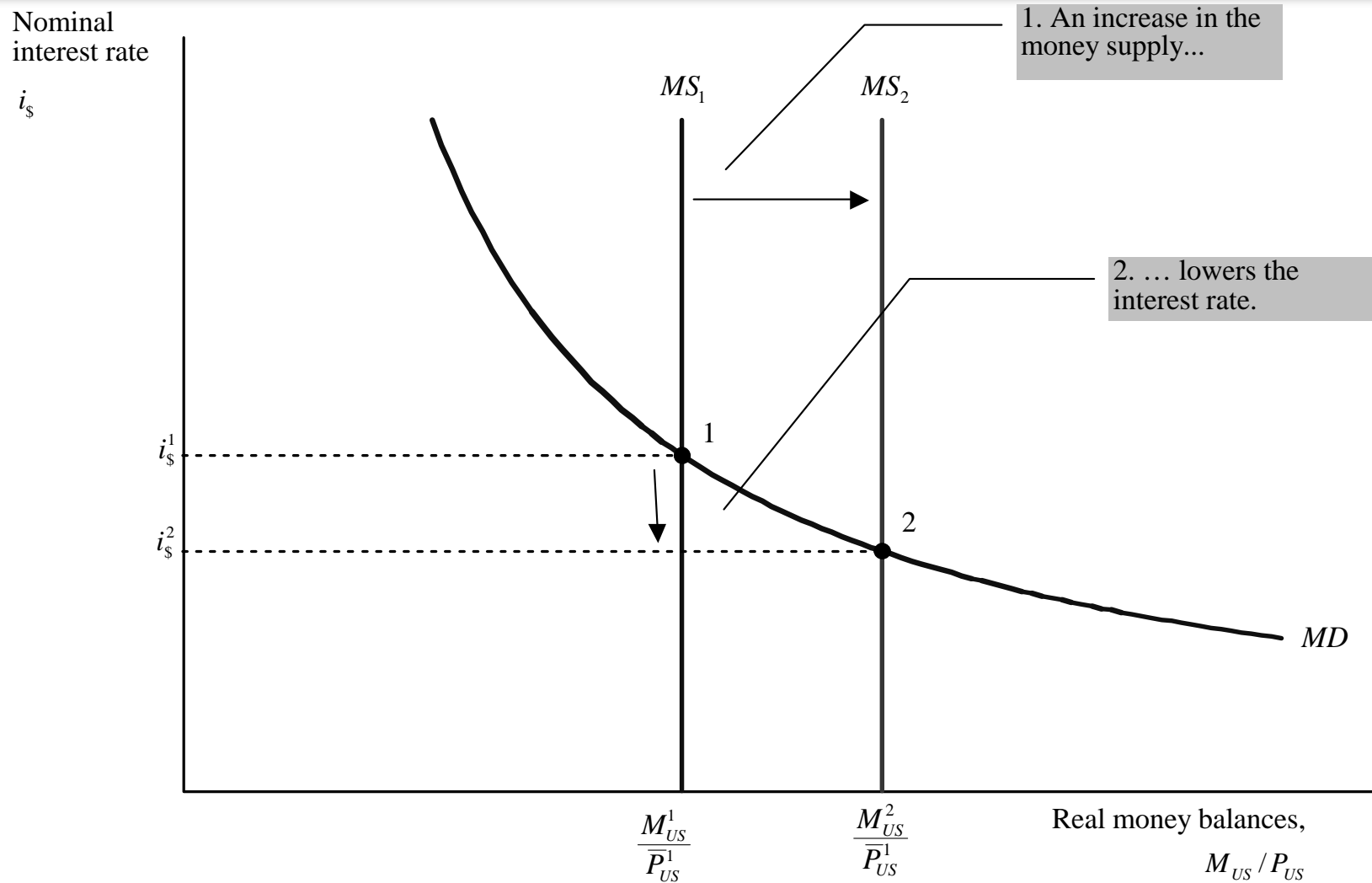


Adjustment to money market equilibrium

- Suppose interest rates are “too high” at point 2 on the real money demand curve. Real money demand is less than real money supply. Public attempts to offload cash—by exchanging it for alternative interest-bearing assets. But this will create an excess supply of loanable funds at the prevailing interest rate. Borrowers will not be inclined to borrow more unless the cost of borrowing falls. Thus, if the market for loanable funds is to remain in equilibrium, the interest rate must fall. We move from point 2 back towards equilibrium at point 1.
- A similar story can be told if interest rates are “too low” and the market is initially at point 3, where there is an excess demand for money. In this case, the public wishes to reduce interest bearing assets and turn them into cash. If everyone tries to do this, market for loanable funds suffers excess demand and interest rate go up.

Predictions

Change in home money supply

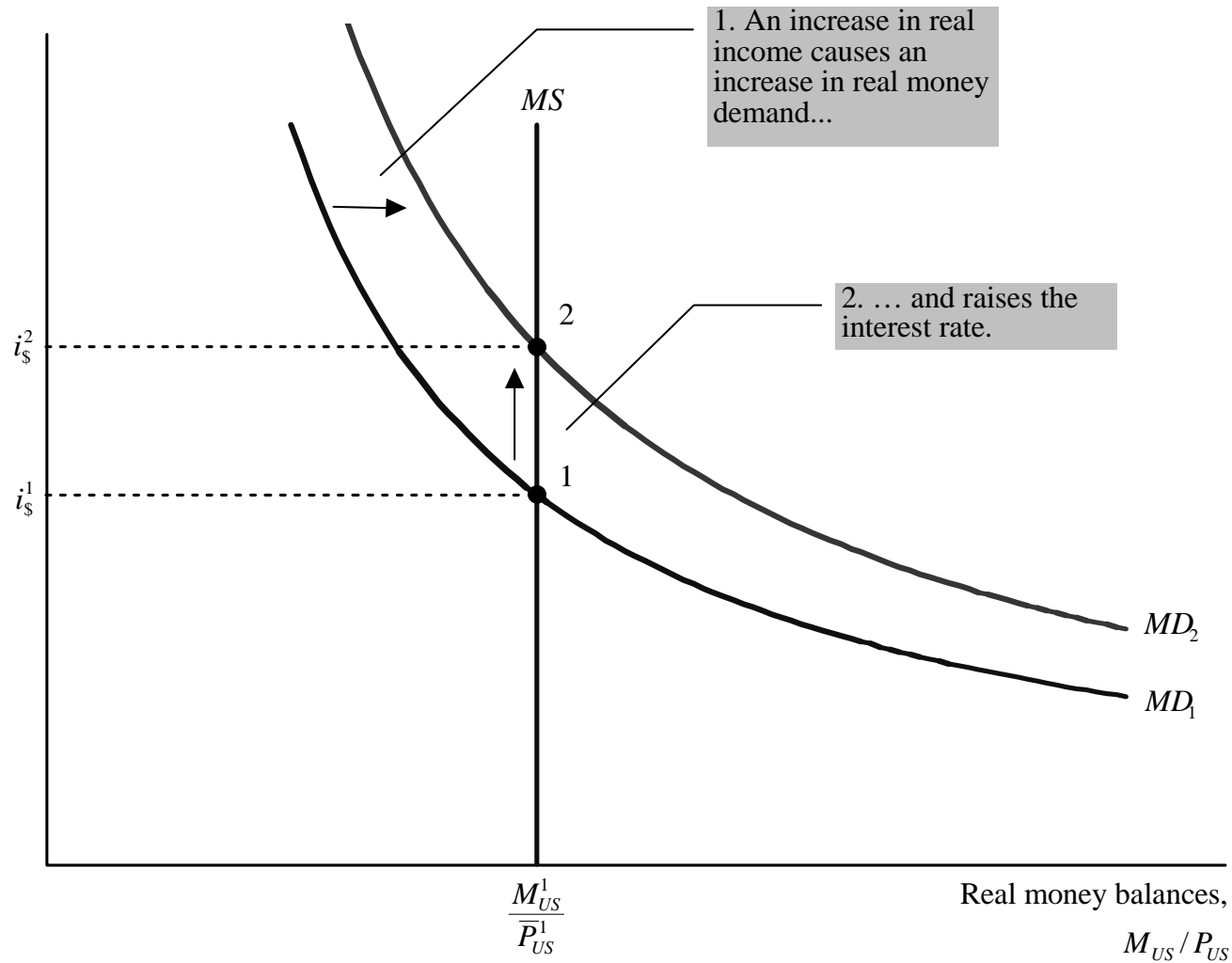


Predictions

Change in home real income

Nominal
interest rate

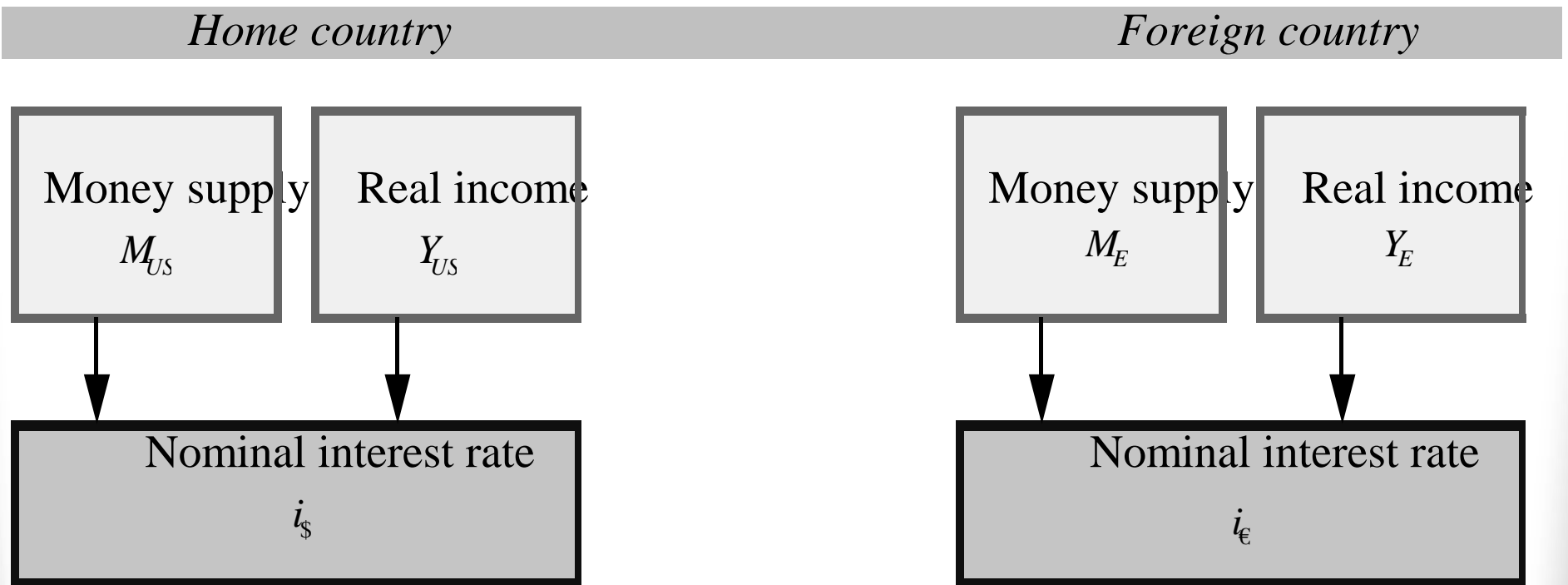
i_s



Predictions

- In the short run, all else equal, an increase in a country's money supply will lower the country's nominal interest rate; a decrease in a country's money supply will raise the country's nominal interest rate.
- In the short run, all else equal, an increase in a country's real income will raise the country's nominal interest rate; a decrease in a country's real income will lower the country's nominal interest rate.

Short run money market model: The final building block



Long run versus short run

- EXAMPLE
- A central bank that had previously kept the money supply constant, now lets M grow at 5% per year.
 - ◆ In the long run, the predictions of the **long-run** monetary model and Fisher effect are clear. All else equal, a 5 percentage point increase in the rate money growth causes a 5 percentage point increase in the rate of inflation, and a 5 percentage point increase in the nominal interest rate. The home interest rate will rise in the long run.
 - ◆ In the short run, the **short-run** model tells a very different story: if the money supply expands, the immediate effect is an excess supply of real money balances. The home interest rate will fall in the short run.

Long run versus short run

- These different outcomes illustrate the importance of the assumptions we make about price flexibility. They also underscore the importance of the nominal anchor in monetary policy formulation, and the limits that central banks have to confront.
 - ◆ In the short run, if we think the central bank can manipulate its money supply policies without triggering a change any price movements, then looser money means lower interest rates, which might be desirable for certain purposes.
 - ◆ But if the same policies persist in the long run, eventually looser money will mean higher interest rates and higher inflation rates.

Long run versus short run

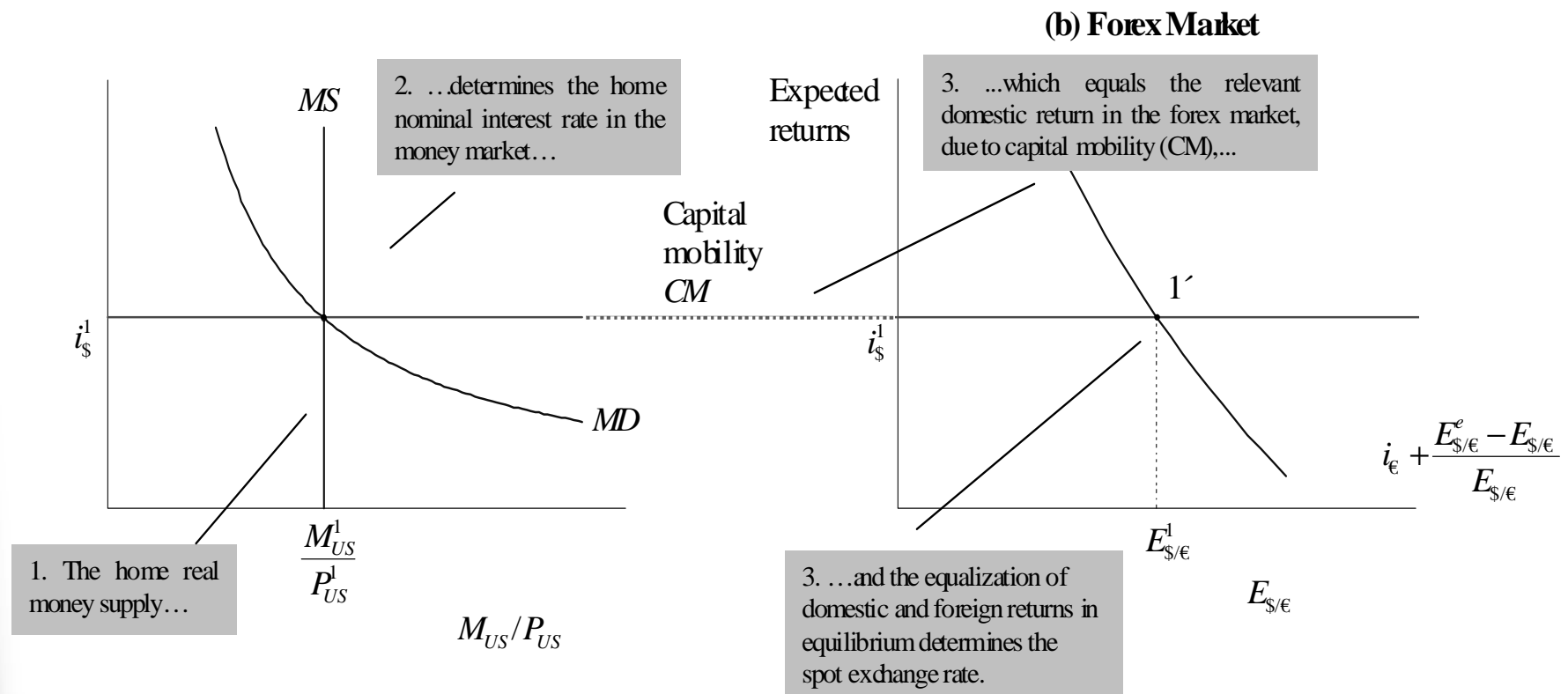
- Apparently puzzling linkages between money, interest rates and exchange rates.
 - ◆ In both of the above cases, a expanded money supply leads to a weaker currency. However: in the short run, low interest rates and a weak currency go together; whereas in the long run, high interest rates and a weak currency go together.
- What is the intuition for this?
 - ◆ In short run, when we study impact of a lower interest rate and we say “all else equal”, we assumed that expectations have not changed concerning future exchange rates. In other words, we envisage (implicitly) a temporary policy that does not tamper with the nominal anchor.
 - ◆ In the long run, if the policy turns out to be permanent, this assumption is inappropriate; prices are flexible and money growth, inflation, and expected depreciation now all move in concert—the “all else” is no longer equal.

Linking FX and money markets

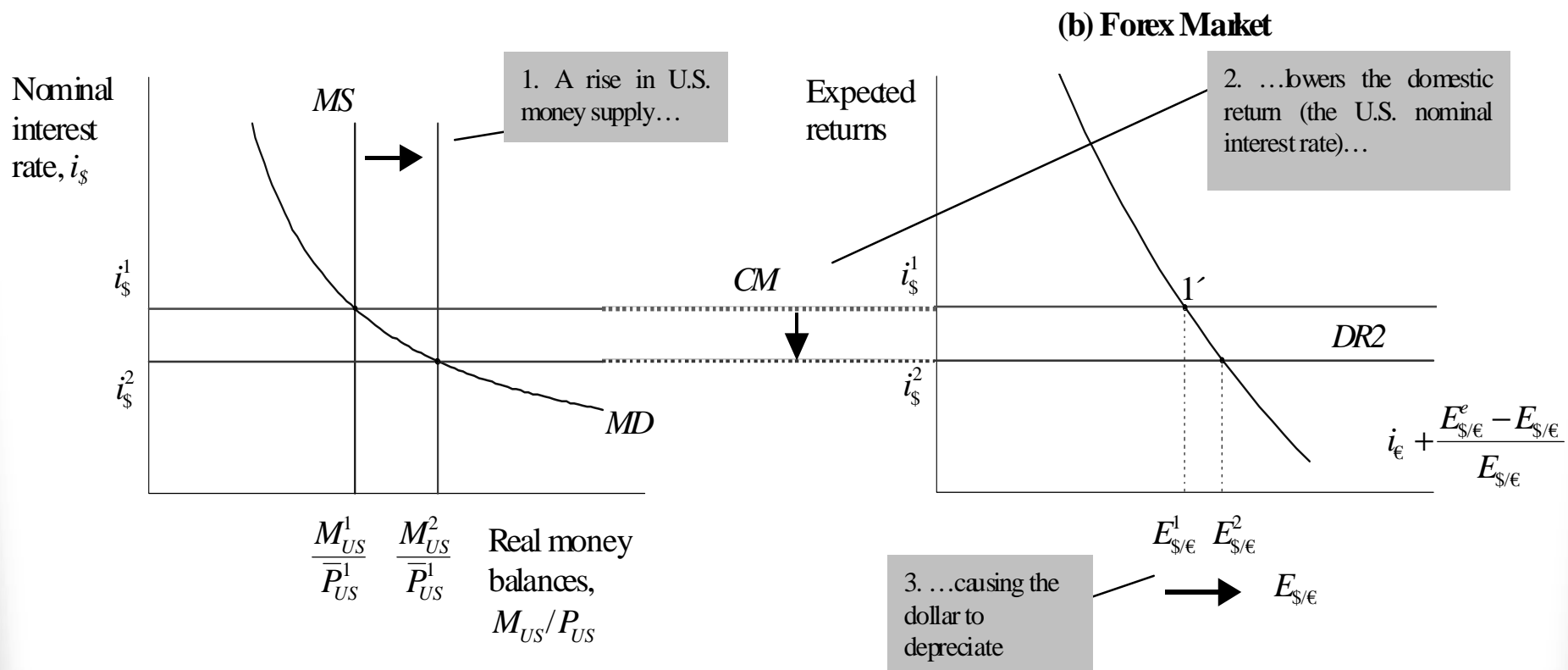
- A combined graph can be used to summarize the FX and money markets.
- FX market diagram
 - ◆ Horizontal axis E
 - ◆ Vertical axis i
- Money market diagram
 - ◆ Horizontal axis M/P
 - ◆ Vertical axis i
- Since i is common on vertical axis of both diagrams we place them side by side

Linking FX and money markets

- ◆ CM line links the two: capital mobility (arbitrage) ties the home interest rate i to the domestic return (DR) demanded by arbitrageurs.



Part 2: a combined theory of the exchange rate: Temporary increase in home money supply



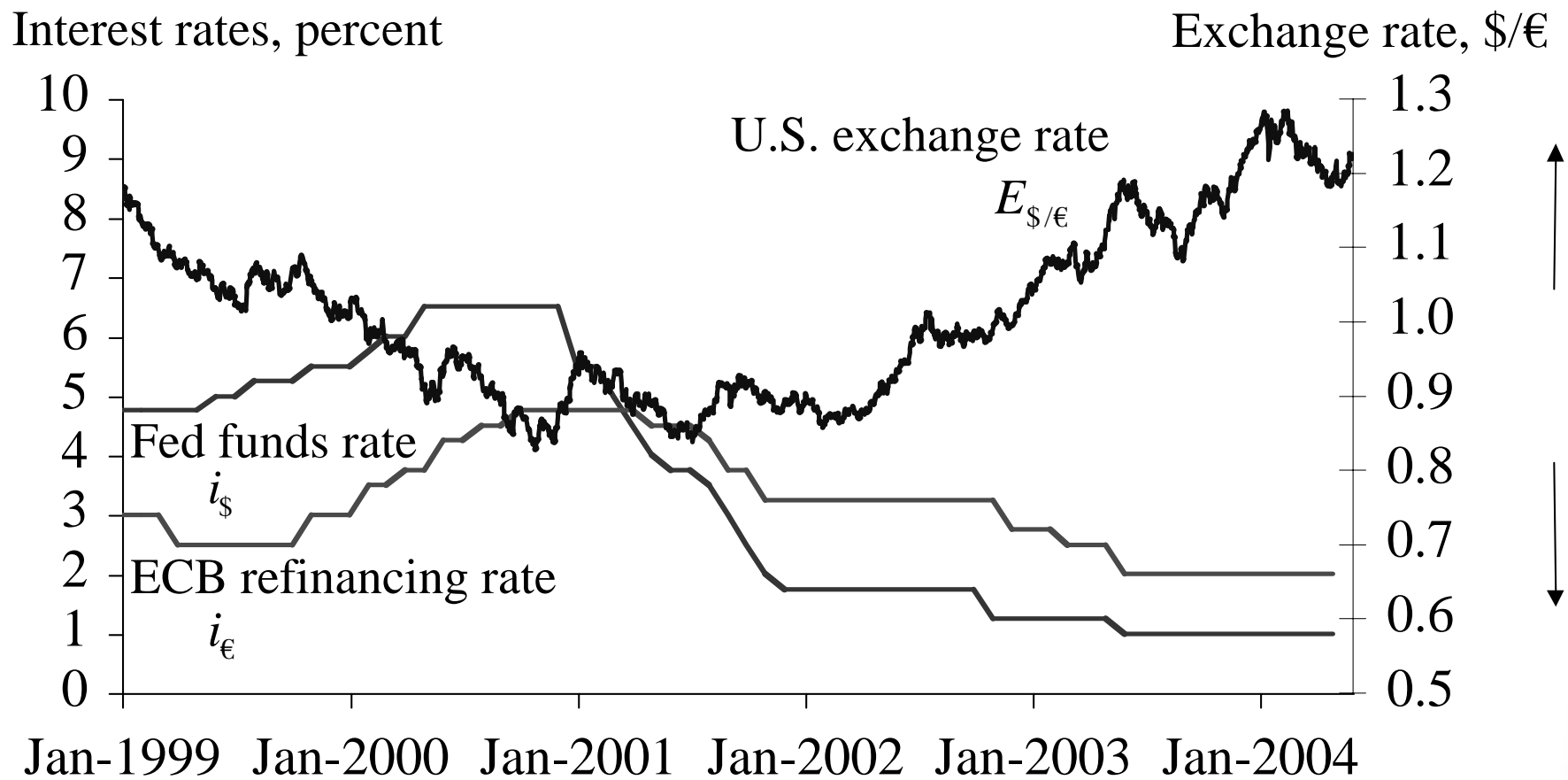
Predictions

Temporary increase in home money supply

- The result is intuitive, and we have seen each of the steps previously. We now just put them all together:
 - ◆ A home monetary expansion lowers the home nominal interest rate; this is also the domestic return; this makes foreign deposits more attractive; because capital mobility allows it, traders wish to sell home deposits and buy foreign deposits; the home exchange rate increases (the home currency depreciates); but this depreciation makes foreign deposits less attractive (all else equal), so that the equality of foreign and domestic returns is restored, UIP holds, and the forex market moves back to equilibrium.

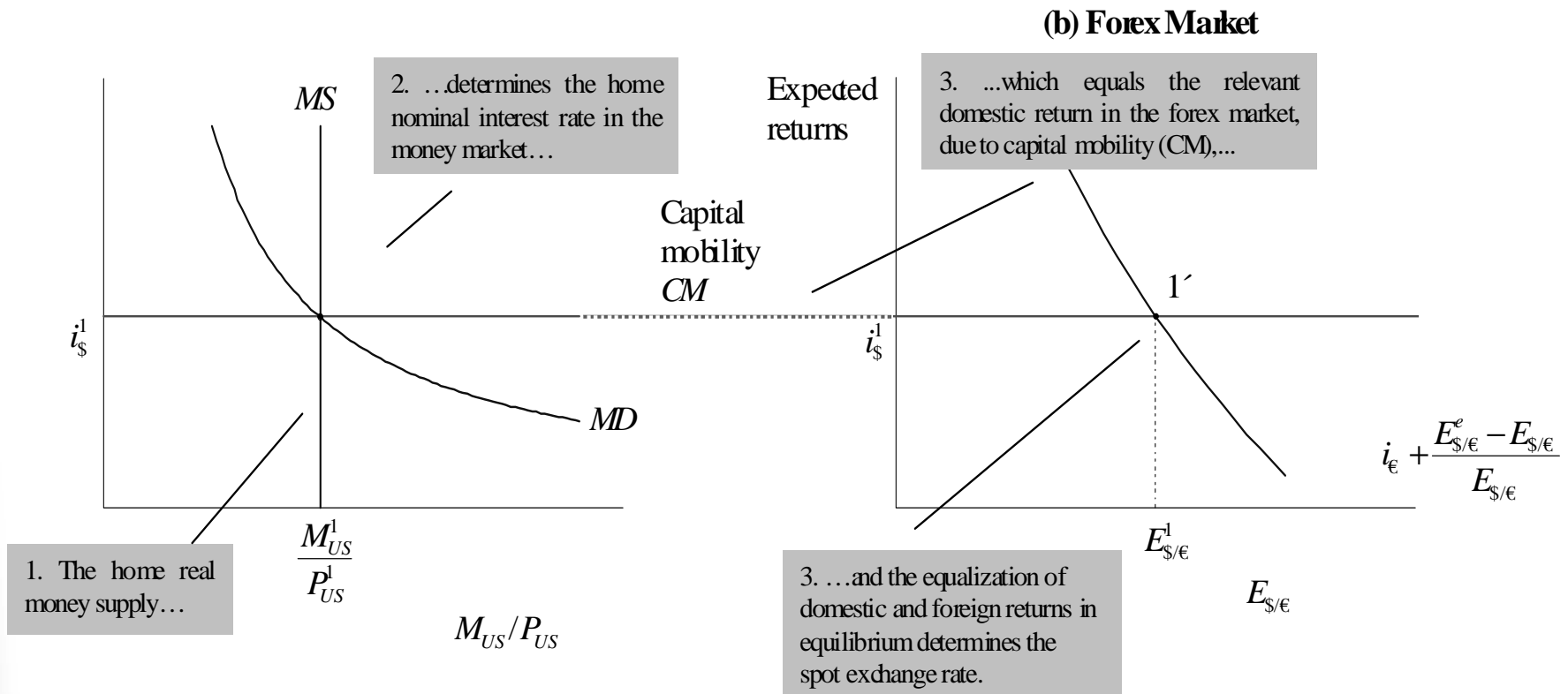
Application of the model

The fall of the US dollar 2000–04



Linking FX and money markets

- ◆ CM line links the two: capital mobility (arbitrage) ties the home interest rate i to the domestic return (DR) demanded by arbitrageurs.



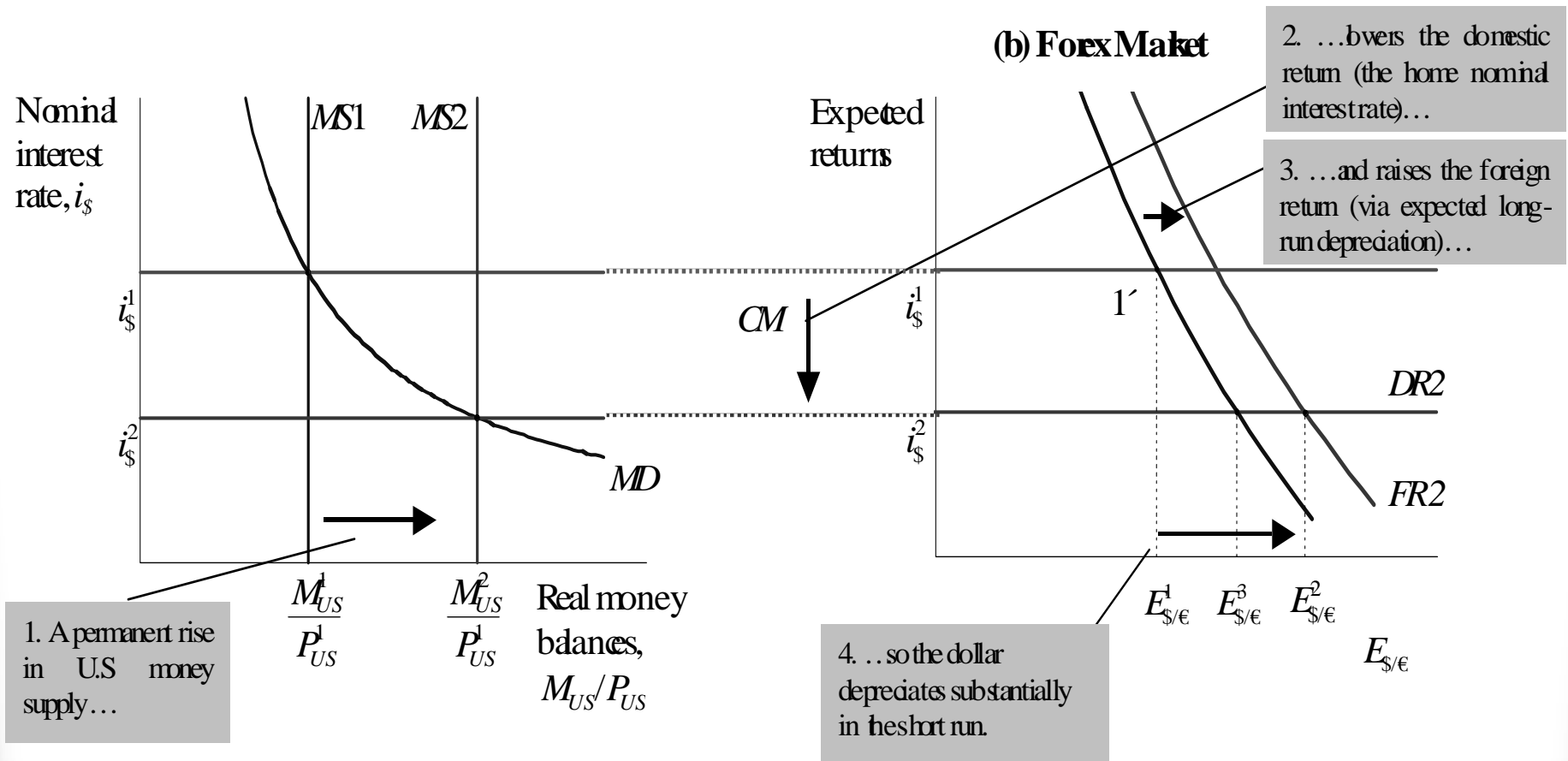
Long run policy analysis

- Our model can be used for analysis of short run policy experiments
 - ◆ Key assumption: Temporary policy
 - ◆ Hence E_e is unchanged
- Can it also be used for analysis of long run policy?
 - ◆ Yes, can study permanent monetary policy shocks
 - ◆ As long as we remember that E_e will change
 - This will shift the FR curve
 - ◆ Note: these shocks will violate the nominal anchor, all else equal

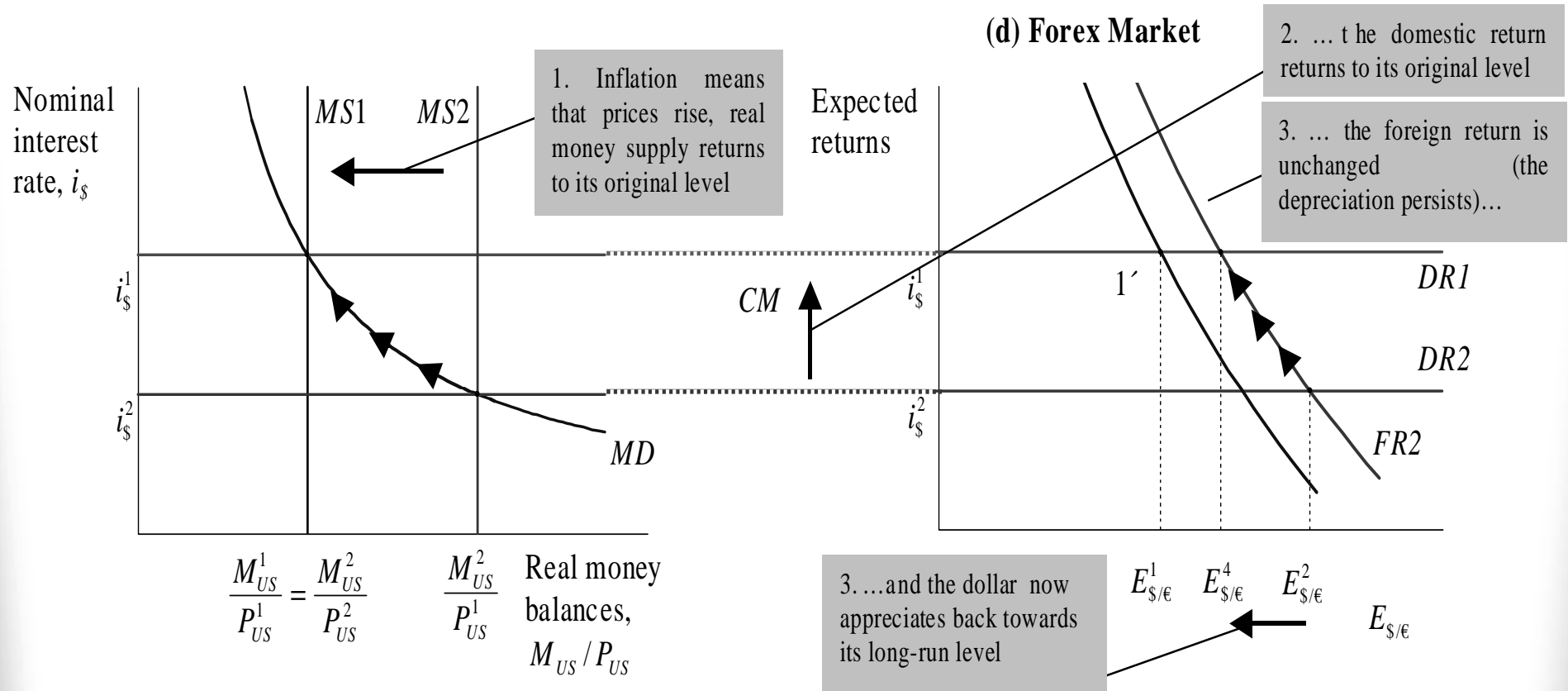
Permanent increase in money supply

- Assumptions (as before)
 - ◆ Identical economies, output Y fixed
 - ◆ Start in long run equilibrium
 - ◆ Home money supply increases $x\%$ at time T
 - ◆ Unexpected
 - ◆ Price level P sticky in the short run
- Solution?
 - ◆ Must work backwards
 - ◆ First figure out what happens in the long run
 - How does E_e change?
 - ◆ Why?
 - Because E_e also affects the short run
 - ◆ Answer?
- One of the more complex problems we'll study

Permanent increase in money supply SHORT RUN RESPONSE



Permanent increase in money supply LONG RUN RESPONSE



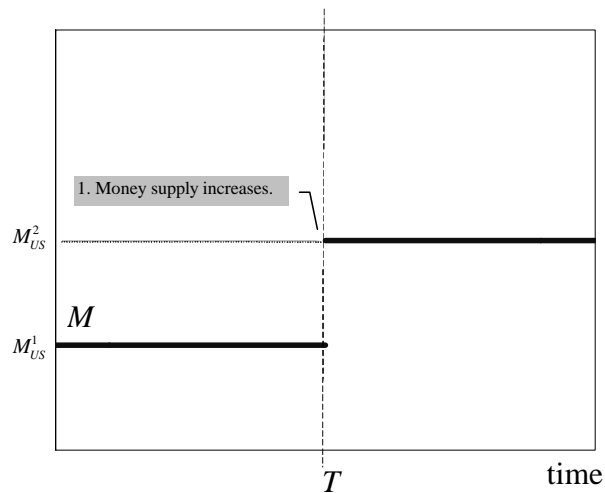
Overshooting

- The exchange rate E **overshoots** its long run equilibrium after a permanent M shock
 - ◆ What's going on?
- Short run: a double whammy
 - ◆ Home interest rate falls (MS shifts out)
 - ◆ Plus a rise in E_e of home currency (FR shifts out)
 - 2 reasons to dump home currency deposits!
 - Compared to initial level, E rises (depreciates) a great deal
- Long run: only a single whammy
 - ◆ Home interest rate back to normal (MS back to normal)
 - ◆ But rise in E_e of home currency remains (FR shift remains)
 - Only 1 reason to dump home currency deposits!
 - Compared to initial level, E rises (depreciates) a bit less

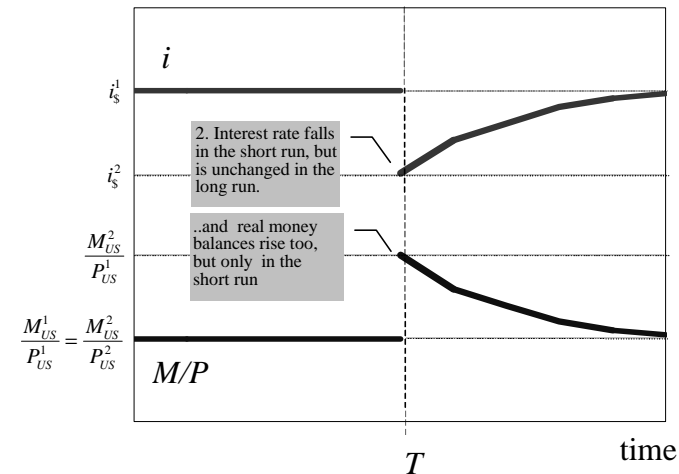
Permanent increase in money supply

TIME SERIES DIAGRAMS

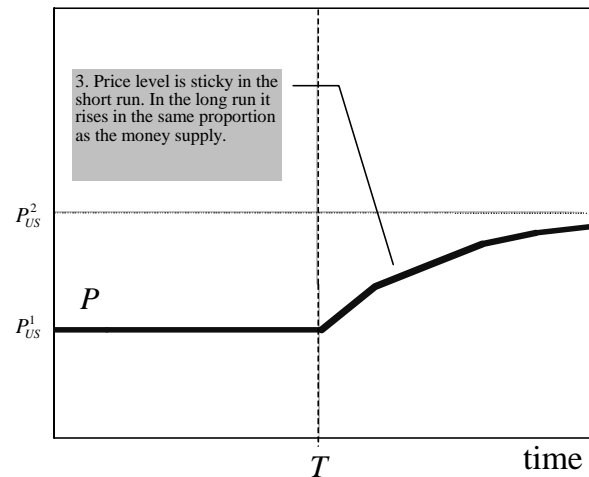
(a) home money supply



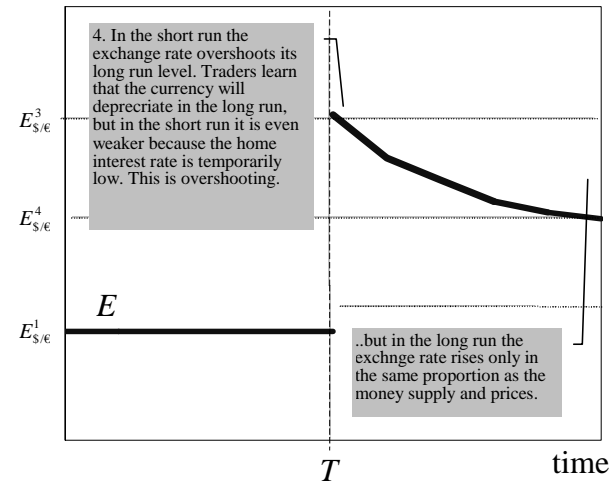
(b) home real money balances and nominal interest rate



(c) home price level



(d) home exchange rate

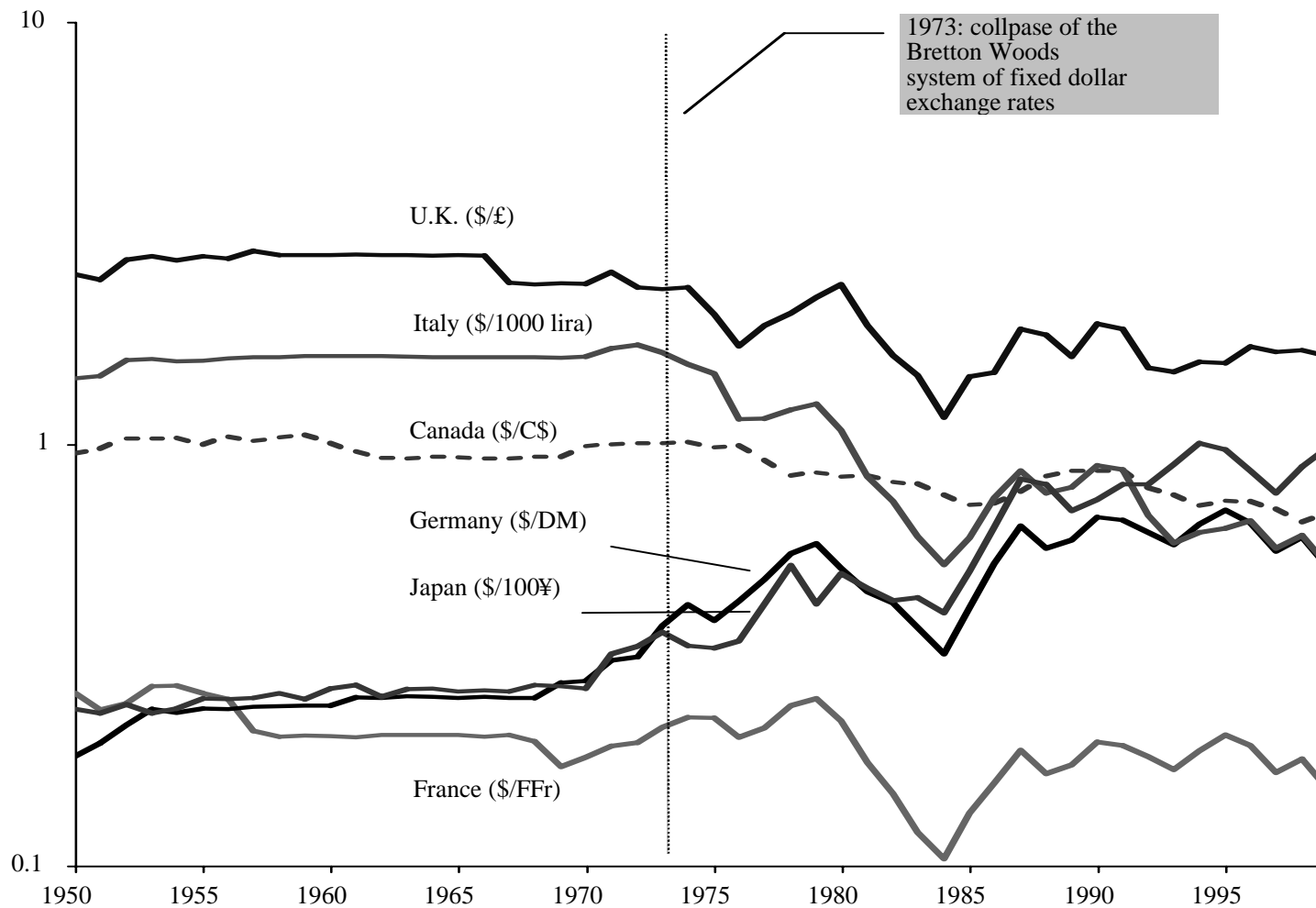


“Dornbusch Overshooting”

- The exchange rate E **overshoots** its long run equilibrium after a permanent M shock
 - ◆ E is more volatile than the standard monetary model would predict
 - ◆ Result discovered in 1970s by the distinguished economist Rudi Dornbusch (1942-2002)
- Why this matters
 - ◆ In the 1970s the fixed exchange rates (of the “Bretton Woods system”) collapsed globally
 - ◆ Nobody could understand why floating rates were so volatile, given the very small changes in monetary fundamentals
 - ◆ The Dornbusch model supplied an explanation where none existed

The Collapse of Bretton Woods

Exchange rate
(\$ per local currency unit)

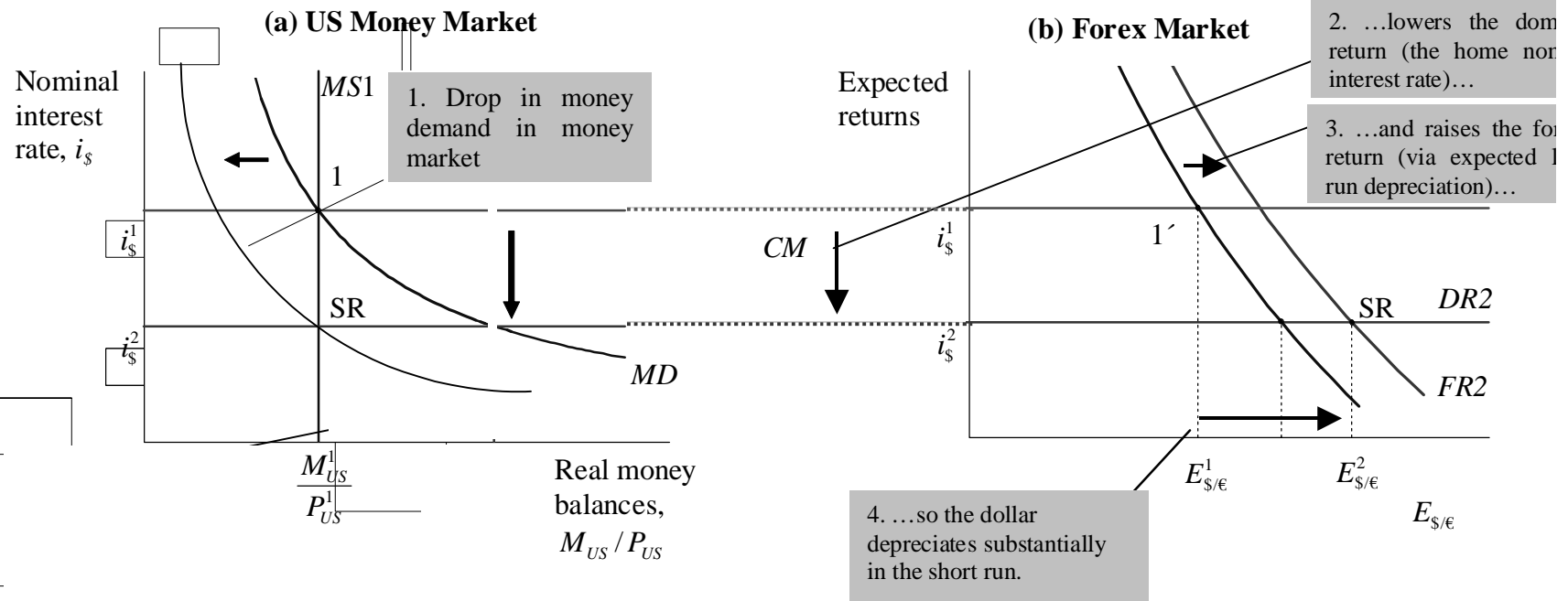


Permanent decrease in money demand

- Experiment: suppose a fall in real money demand (perhaps due to a recession lowering output).
- Short-run effects (see figure on next page):
 - ◆ US domestic money market: Fall in money demand shifts equilibrium point from point 1 to point SR, lowering the equilibrium interest rate.
 - ◆ In the foreign exchange market, this lowers the return on dollar assets, which shifts down the US returns line.
 - ◆ Since the change in money demand is permanent, this alters expectations for the future. According to the monetary approach, this should lead to a fall in the value of the dollar in proportion to the fall in real money demand (rise in expected E). This shifts the expected euro returns curve to the right.
 - ◆ The equilibrium in the foreign exchange market moves from point 1 to point SR, indicating a substantial fall in the equilibrium value of the dollar (rise in current equilibrium $E(\$/\text{euro})$).
 - ◆ This equilibrium reflects an excess supply of dollar foreign exchange assets, both because the dollar interest rate is low, and because expectations for the future value of the dollar have fallen.

Permanent fall in money demand

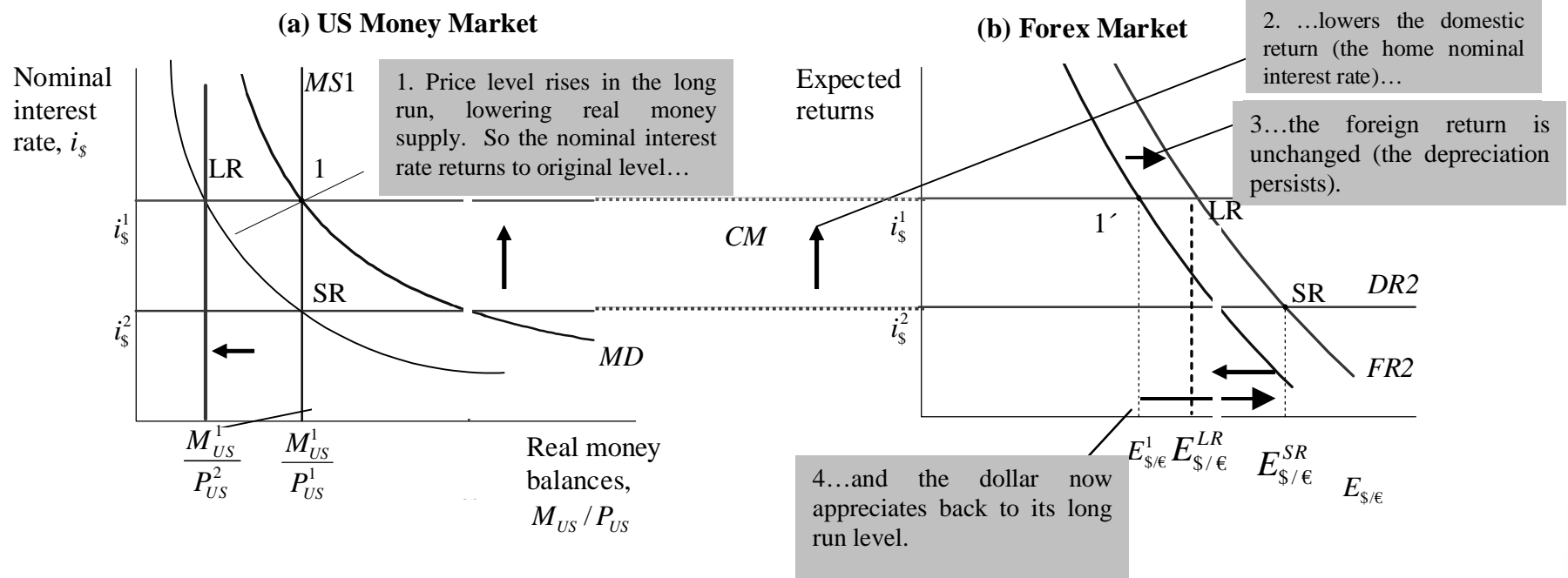
SHORT RUN RESPONSE



Permanent decrease in money demand

- Long-run effects (see figure on next page):
 - ◆ US domestic money market: prices rise over time in response to the fall in money demand. This lowers the real value of the money supply, so there no longer is an excess supply of money, and the interest rate returns to its original level. Equilibrium in the money market moves from point SR to point LR.
 - ◆ In the foreign exchange market, this rise in the interest rate moves the dollar returns line back to its original position
 - ◆ Since the change in money demand is permanent, the expectations for the exchange rate are unaffected. The expected euro returns curve remains at its new position.
 - ◆ The equilibrium in the foreign exchange market moves from point SR to point LR, indicating that the value of the dollar appreciates some relative to the short run value.
 - ◆ So the exchange rate backtracks partly, indicating that the short run equilibrium exchange rate overshoot the long run equilibrium value. This behavior of the exchange rate is consistent with the UIP condition: if the value of the dollar falls enough in the short run, then the expected appreciation of the dollar over time as prices adjust serves to compensate investors for the lower dollar interest rate in the short run.

~~Permanent increase in money supply~~ LONG RUN RESPONSE



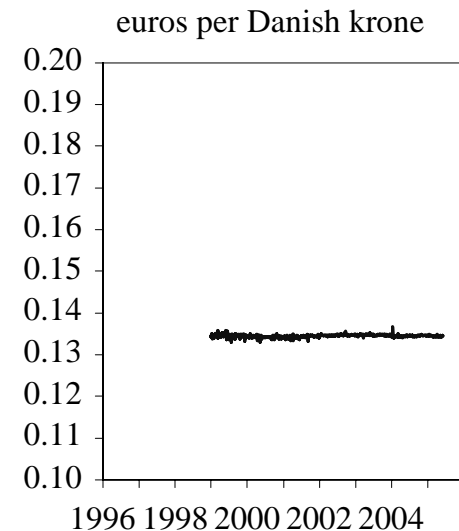
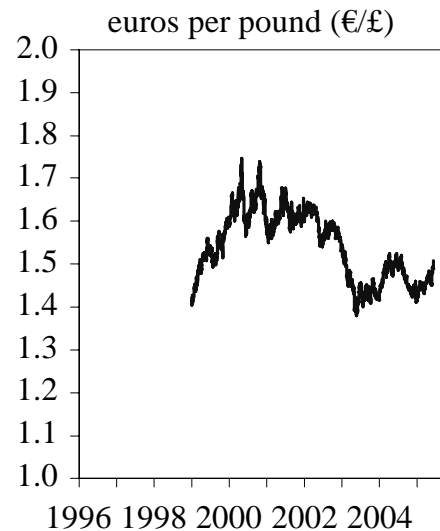
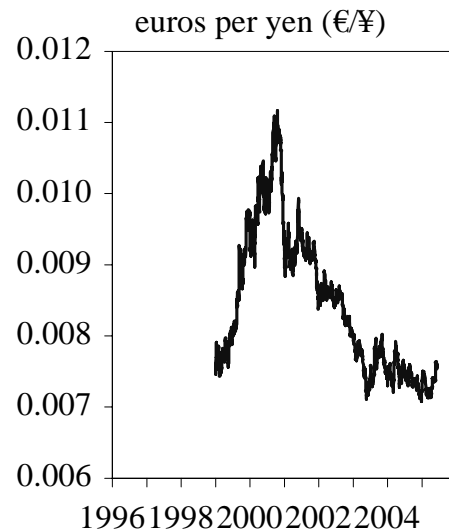
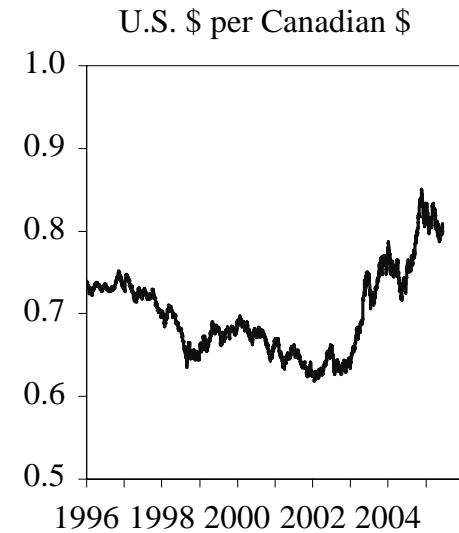
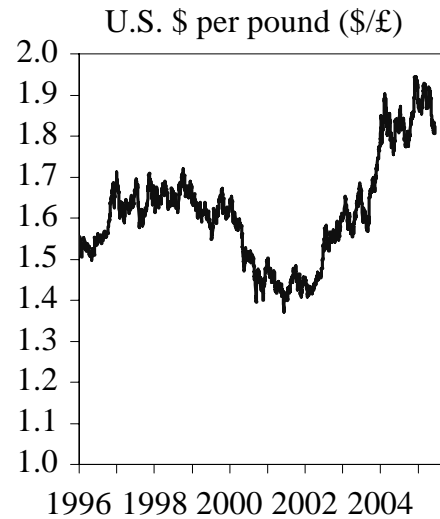
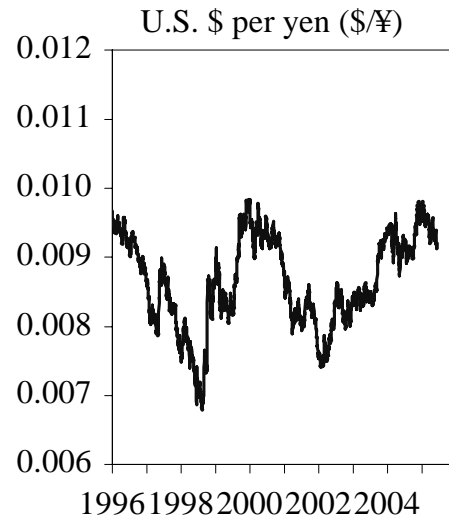
Part 3: Exchange rate regimes

- Looking at the exchange rates on the next two slides, you will note that some appear to not fluctuate much for certain periods of time. (note Denmark, and the Asian countries prior to 1997)
- This indicates that the governments are taking policy actions to stabilize or even fix the exchange rate.
- We classify countries into two broad classifications for now:
 - ◆ Flexible exchange rate regimes: when a government allows market forces in the foreign exchange market to determine the value of the exchange rate
 - ◆ Fixed exchange rate regimes: when a government intervenes in the foreign exchange market to make the equilibrium value of the currency equal some desired level.
- Note that some countries claim to follow flexible exchange rate regimes, even though they in practice appear to fix their rates to some degree (as shown in subsequent slide).

Exchange rate regimes: examples 1

**Selected
developed
countries**

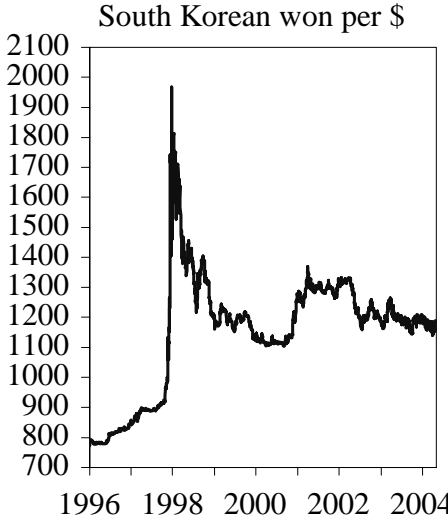
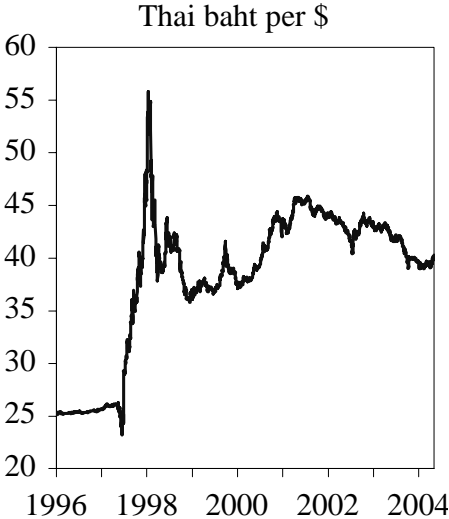
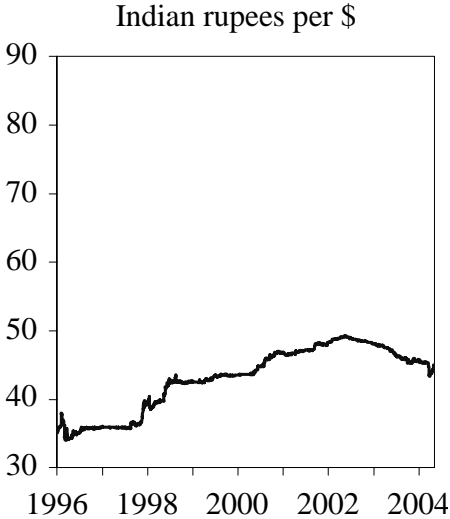
Scale x2



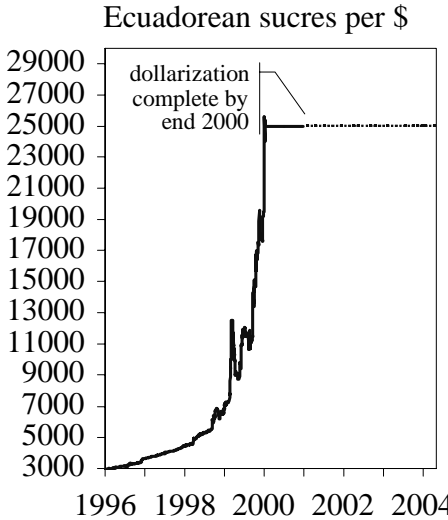
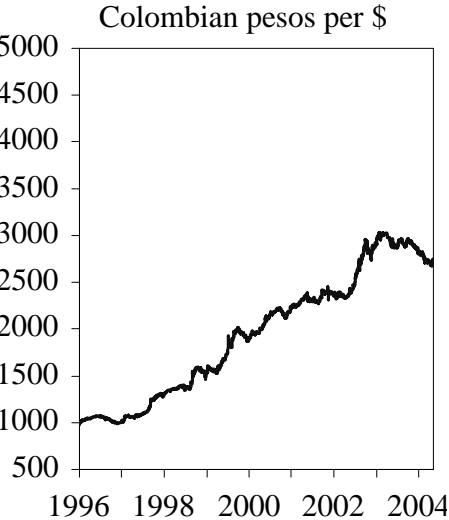
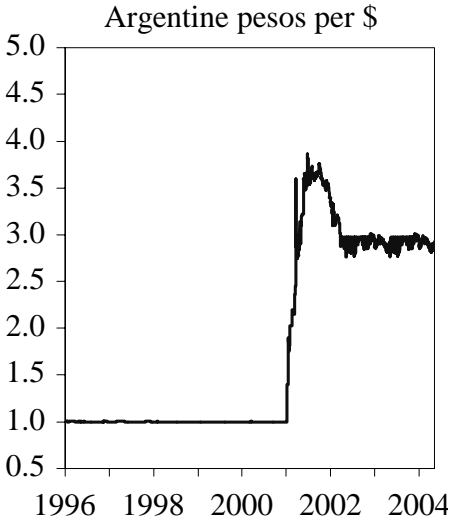
Exchange rate regimes: examples 2

**Selected
developing
countries**

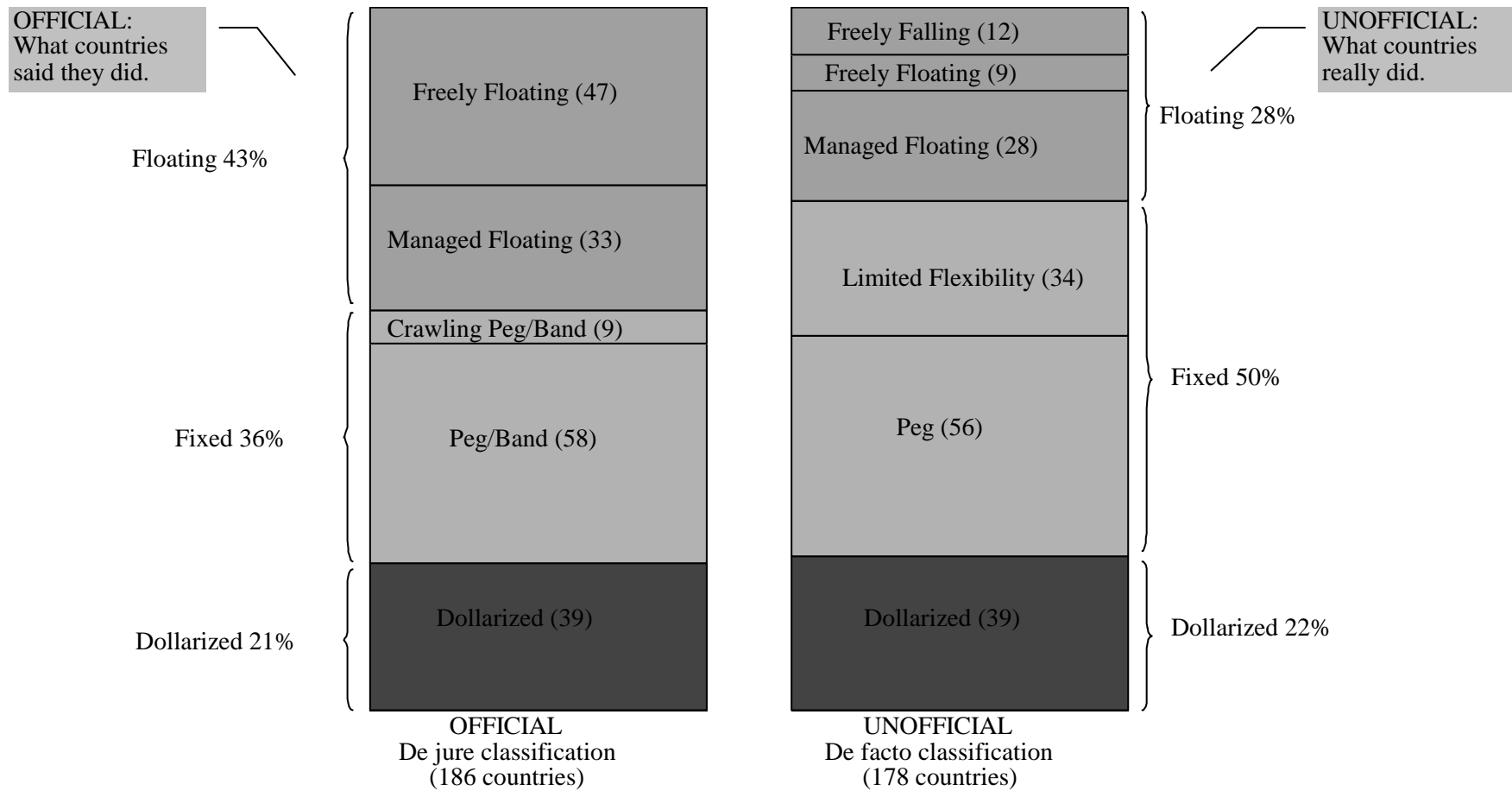
Asia
Scale x3



Latin America
Scale x10



Exchange rate regimes: de jure v de facto



Lesson: Many countries say they're floating, but some are really fixing.

How a country fixes

- The standard method of fixing an exchange rate: the central bank maintains a commitment to always being willing to trade national currency for foreign currency with anyone in the foreign exchange market at the official rate:
- This implies that it responds to excess supply of its currency in the foreign exchange market by buying domestic currency in exchange for foreign currency.
- Or if there is excess demand for domestic currency in the foreign exchange market, the central bank will sell domestic currency in exchange for foreign currency.
- Note that this requires that central banks have holdings of reserves of foreign currency assets that they can sell when needed.

How a country fixes

- For example, suppose the market forces in the foreign exchange market indicate a value of the Danish krone relative to the euro that is lower than what the Danish government sets as the official exchange rate.
- Traders in the private market will see they can make a profit by using euros to buy krones cheaply in the private market and selling them to the Danish central bank at a higher price, thereby ending up with more euros than they started.
- The fixed exchange rate commitment obligates the Danish central bank to accommodate this excess supply of krones (excess demand for euros) by buying up the excess supply brought to them.
- As progressively more krones are taken out of the market, the value of the krone in the private market will rise. Eventually the equilibrium value in the private market will equal the official exchange rate set by the government.

Bank balance sheets

- We can see the mechanics of foreign exchange market intervention by looking at the balance sheet of a central bank.
- Assets: These include domestic bonds (treasury bills - get paid a certain number of dollars in future), as well as bonds issued by foreign governments, denominated in foreign currency
- Liabilities: Private banks give deposits, which private banks own and can withdraw. Also domestic currency in circulation .
- Suppose the following central bank balance sheet:

<u>Assets</u>		<u>Liabilities</u>	
Foreign assets	kr1000	Deposits held by private banks	kr500
Domestic assets	kr1500	Currency in circulation	kr2000

Bank balance sheets

- This balance sheet can be used to show a monetary policy action aimed at lowering the domestic money supply. Consider an “open market operation” sale of domestic bond assets in the domestic money market, where they buyers pay with domestic currency. As the central bank takes the currency as payment, it implicitly is removing the currency from circulation in the economy. (familiar from previous macro classes?)

<u>Assets</u>		<u>Liabilities</u>	
Foreign assets	kr1000	Deposits held by private banks	kr500
Domestic assets	kr1400	Currency in circulation	kr1900

Bank balance sheets

- Now instead use the balance sheet to show the case of a foreign exchange intervention aimed at eliminating an excess demand for foreign currency assets. This is a sale of foreign assets in the foreign exchange market, where the buyers pay the central bank in domestic currency.

<u>Assets</u>		<u>Liabilities</u>	
Foreign assets	kr900	Deposits held by private banks	kr500
Domestic assets	kr1500	Currency in circulation	kr1900

- Note that the impact on domestic currency is the same in either case: kr100 of domestic currency is removed from circulation.
- This implies that foreign exchange intervention has implications for money supply similar to monetary policy actions.

Implication for monetary autonomy

- An important implication is that for a country to fix its exchange rate this way, it loses control over its national monetary policy.
- An easy way to see this is to look at the asset approach equation that determines the equilibrium exchange rate...
- If the government credibly fixes the exchange rate at some level for now and the future, say 0.14 ,then...

$$\underbrace{i_{kr}}_{\text{danish interest rate}} = \underbrace{i_{\epsilon}}_{\text{euro interest rate}} + \underbrace{\left(\frac{E_{kr/\epsilon}^e - E_{kr/\epsilon}}{E_{kr/\epsilon}} \right)}_{\text{expected rate of depreciation of the kroner}} = i_{\epsilon} + \underbrace{\left(\frac{0.14 - 0.14}{0.14} \right)}_{=0} = i_{\epsilon}$$

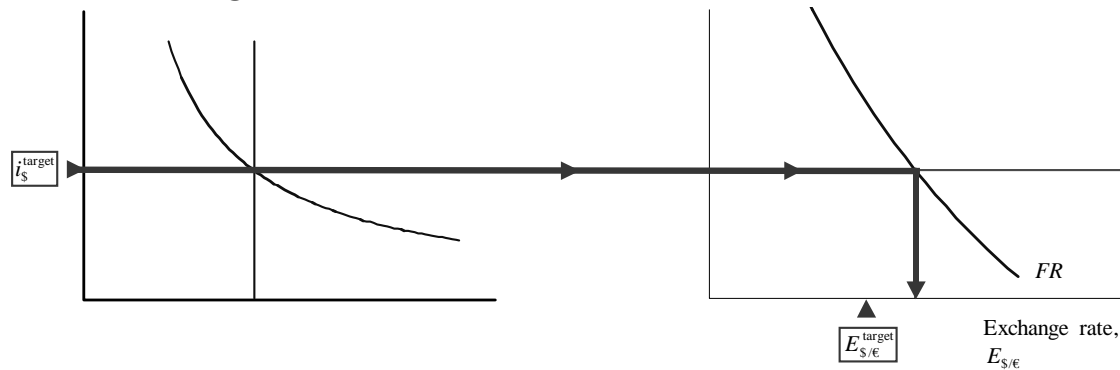
- This indicates that the central bank must adjust the interest rate to mimic that in the EU.
- Since the interest rate is set by the government's monetary policy, this means that a country that fixes the exchange rate necessarily loses freedom over its monetary policy.

Implication for monetary autonomy

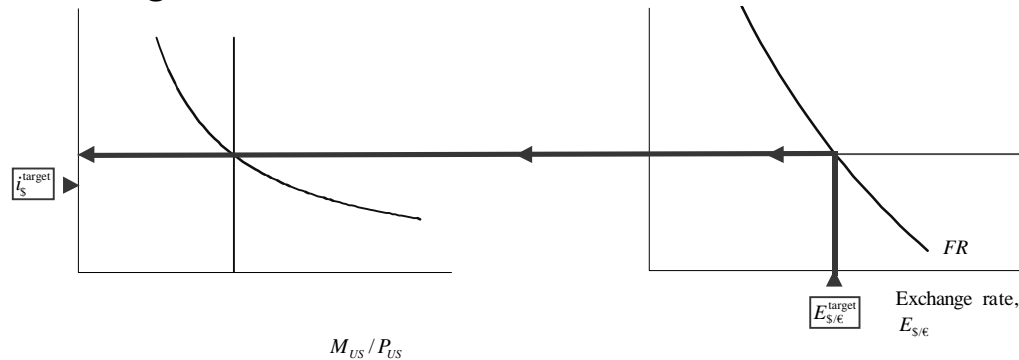
- Imagine what would happen if Denmark tried to expand its money supply and lower its interest rate...
- We know the lower return would make krone assets less attractive, so people would sell them off and this would make the value of the krone begin to fall in the private foreign exchange market.
- But as this happens, traders will see an opportunity to buy kronas cheap in the private market and sell them to the central bank at the higher official rate.
- This process will continue until all the excess supply of kronas are removed from the market. This means all the kronas that the central bank issued to increase the money supply will all be taken back out of circulation by the central bank.
- In the end, the central bank is not able to increase the money supply and maintain its fixed exchange rate commitment at the same time.

Implications for monetary autonomy

- This implies that for the case of a fixed exchange rate country, our grand theory of exchange rate determination becomes a theory of what interest rate, and hence what monetary policy, that country must set.
- Flexible exchange rate case:



- Fixed exchange rate case:

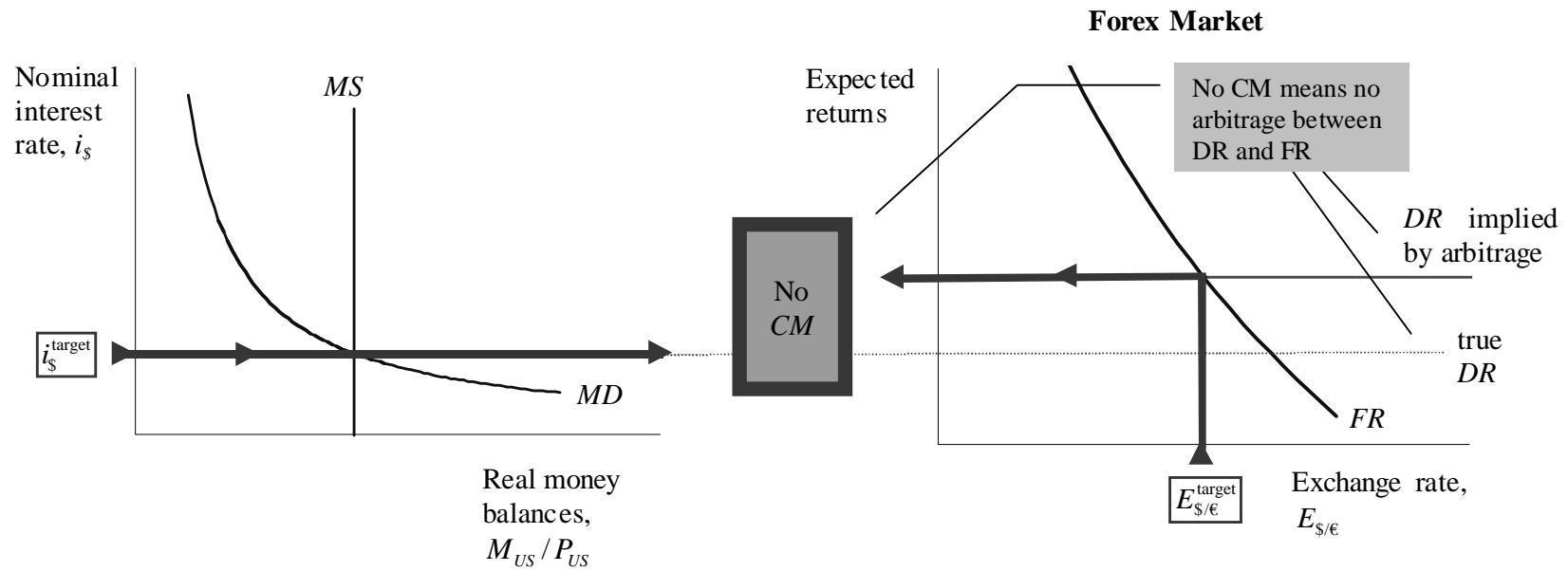


An alternative trade-off

- Another way of dealing with this tension between exchange rate and monetary policies, is that some countries legally prevent the traders in the market from taking advantage of the profit opportunity.
- Some countries impose capital controls: legal restrictions on the ability to buy and sell assets internationally.
- Examples include many developed countries in the middle 20th century, and China today.
- In this case, a country can require by law that currency transactions take place at this level, and outlaw any trader from trying to arbitrage gaps between the official and private market rates.
- This separates the domestic money market from the private foreign exchange market in our theory (see graph on next slide).
- One problem with this approach is that it can lead to black markets for currencies.

The Trilemma

2. NOT OPEN + PEGGED + AUTONOMY



The Trilemma tradeoff

- We conclude that among the following three objectives:
 - ◆ Exchange rate stability
 - ◆ Monetary policy autonomy
 - ◆ Capital mobilityonly two are possible at one time.
- Countries must give up on one of the three objectives.
- Examples:
 - ◆ Members of the European Monetary Union gave up on monetary autonomy, coordinating on a single monetary policy (more on this in a later lecture).
 - ◆ Britain chose to allow the exchange rate to remain volatile (not join the monetary union), in order to keep its monetary policy autonomy
 - ◆ China chose to impose capital controls on international transactions.

The Trilemma: Examples

