

# INTERNATIONAL ECONOMICS

## (INTERNATIONAL FINANCE)

### Lecture 3

Department of Economics  
UoA

Readings:  
Feenstra and Taylor, *International Macroeconomics*:  
Ch. 3, 4

# Last time

- The law of one price
- Purchasing power parity
- Exchange rates in the long run
- The real exchange rate
- Overvaluation, undervaluation and the Big Mac index
- Interest rates and inflation in the long-run
- Empirical evidence
- Money, Prices, and Exchange Rates in the Long Run
- Money Growth, Inflation, and Depreciation

## ➤ Money Growth, Inflation, and Depreciation

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## Money Growth, Inflation, and Depreciation

In the last lecture we have seen how we can solve for the inflation differential in terms of monetary fundamentals and compute the rate of depreciation of the exchange rate:

$$\underbrace{\frac{\Delta E_{\$/\epsilon t}}{E_{\$/\epsilon, t}}}_{\text{Rate of depreciation of the nominal exchange rate}} = \underbrace{\pi_{US,t} - \pi_{EUR,t}}_{\text{Inflation differential}} = (\mu_{US,t} - g_{US,t}) - (\mu_{EUR,t} - g_{EUR,t}) \quad (3-6)$$
$$= \underbrace{(\mu_{US,t} - \mu_{EUR,t})}_{\text{Differential in nominal money supply growth rates}} - \underbrace{(g_{US,t} - g_{EUR,t})}_{\text{Differential in real output growth rates}}$$

# Money, Interest Rates, and Prices in the Long Run: A General Model

The trouble with the **quantity theory** we studied earlier is that it assumes that the *demand for money is stable*, and this is implausible.

- We will now explore a more general model that allows for money demand to vary with the nominal interest rate.
- We consider the links between inflation and the nominal interest rate in an open economy.
- We then return to the question of how best to understand what determines exchange rates in the long run.

## The Demand for Money: The General Model

- A rise in the nominal interest rate will cause the aggregate demand for money to fall.
- Dividing by  $P$ , we derive the demand for real money balances:

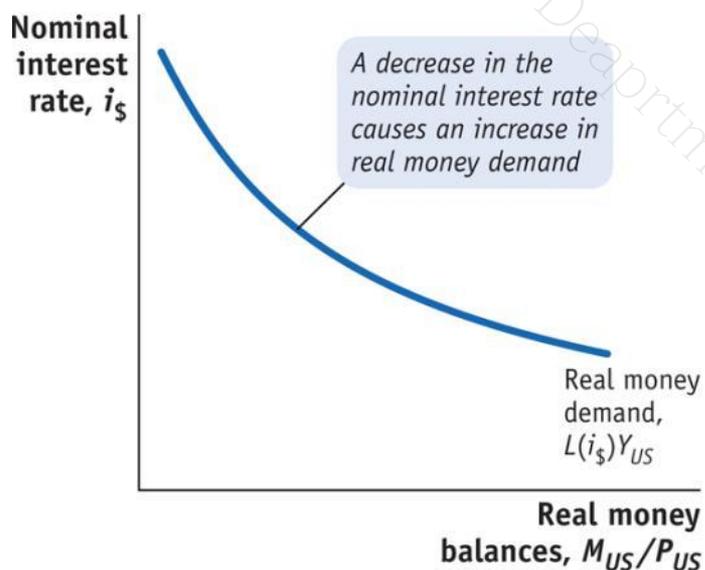
$$\underbrace{M^d}_{\text{Demand for money (\$)}} = \underbrace{L(i)}_{\substack{\text{A} \\ \text{decreasing} \\ \text{function}}} \times \underbrace{P \times Y}_{\text{Nominal income (\$)}}$$

$$\underbrace{\frac{M^d}{P}}_{\text{Demand for real money}} = \underbrace{L(i)}_{\substack{\text{A} \\ \text{decreasing} \\ \text{function}}} \times \underbrace{Y}_{\text{Real income}}$$

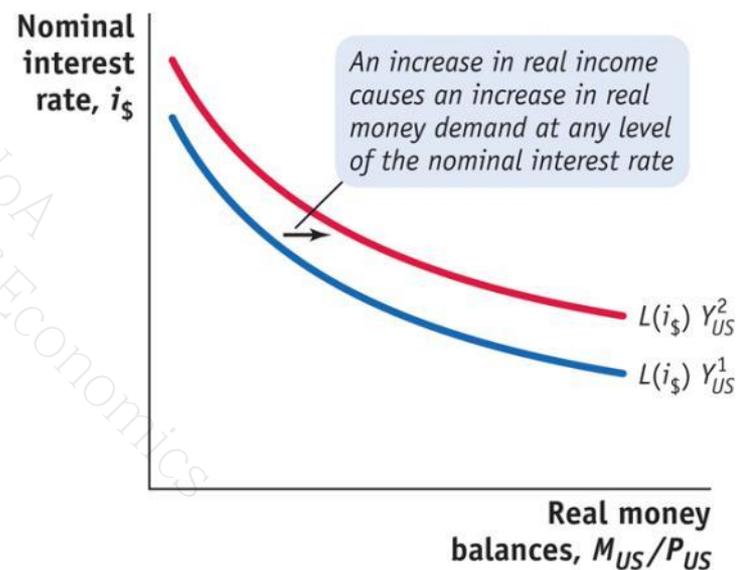
# The Demand for Money: The General Model

## The Standard Model of Real Money Demand

(a) Demand for Real Money Balances and the Interest Rate



(b) Effect of an Increase in Real Income on Real Money Demand



Panel (a) shows the **real money demand function** for the United States. The downward slope implies that the quantity of real money demand rises as the nominal interest rate  $i_s$  falls. Panel (b) shows that an increase in real income from  $Y_{US}^1$  to  $Y_{US}^2$  causes real money demand to rise at all levels of the nominal interest rate  $i_s$ .

## The Fundamental Equation Under the General Model

- This model differs from the simple model (the quantity theory) by allowing  $L$  to vary as a function of the nominal interest rate  $i$ .

$$\underbrace{E_{\$/\epsilon}}_{\text{Exchange rate}} = \frac{P_{US}}{\underbrace{P_{EUR}}_{\text{Ratio of price levels}}} = \frac{\left( \frac{M_{US}}{L_{US}(i_{\$})Y_{US}} \right)}{\left( \frac{M_{EUR}}{L_{EUR}(i)Y_{EUR}} \right)} = \frac{(M_{US} / M_{EUR})}{\underbrace{\left( L_{US}(i_{\$})Y_{US} / L_{EUR}(i)Y_{EUR} \right)}_{\substack{\text{Relative nominal money supplies} \\ \text{divided by} \\ \text{Relative real money demands}}} } \quad (3-10)$$

## The Fisher Effect

- The nominal interest differential equals the expected inflation differential:

$$\underbrace{i_{\$} - i}_{\text{Nominal interest rate differential}} = \underbrace{\pi_{US}^e - \pi_{EUR}^e}_{\text{Nominal inflation rate differential (expected)}} \quad (3-8)$$

- All else equal, a rise in the expected inflation rate in a country will lead to an equal rise in its nominal interest rate.
- This result is known as the **Fisher effect**.

## Real Interest Parity

- Rearranging the last equation, we find

$$i_{\$} - \pi_{US}^e = i_{\text{€}} - \pi_{EUR}^e$$

- Subtracting the inflation rate ( $\pi$ ) from the *nominal* interest rate ( $i$ ), results in a **real interest rate** ( $r$ ), the inflation-adjusted return on an interest-bearing asset. (3-9)

$$r_{US}^e = r_{EUR}^e$$

- This result states the following: *If PPP and UIP hold, then expected real interest rates are equalized across countries.* This powerful condition is called **real interest parity**.

## Real Interest Parity

- In the long run, all countries will share a common expected real interest rate, the long-run expected **world real interest rate** denoted  $r^*$ , so

$$r_{US}^e = r_{EUR}^e = r^*$$

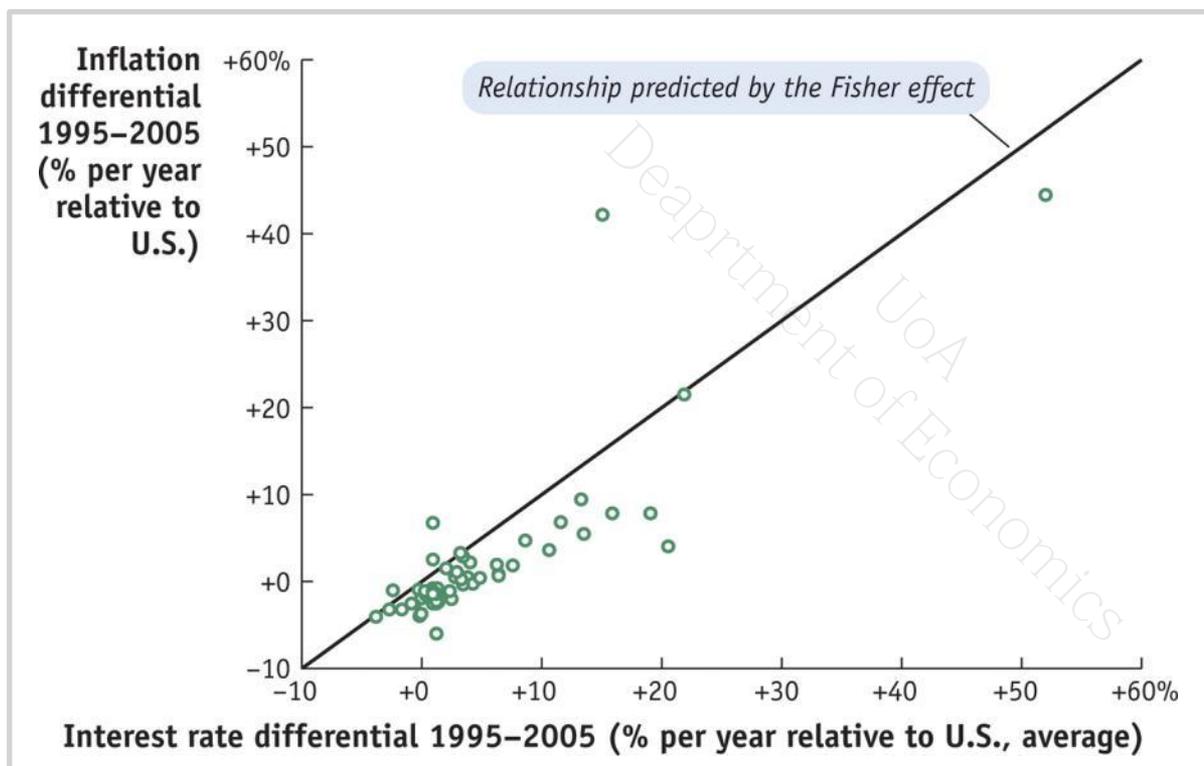
- We treat  $r^*$  as an exogenous variable, something outside the control of a policy maker in any particular country.
- Under these conditions, the Fisher effect is even clearer, because, by definition,

$$i_{\$} = r_{US}^e + \pi_{US}^e = r^* + \pi_{US}^e,$$

$$i_{\text{€}} = r_{EUR}^e + \pi_{EUR}^e = r^* + \pi_{EUR}^e.$$

# APPLICATION

## Evidence on the Fisher Effect



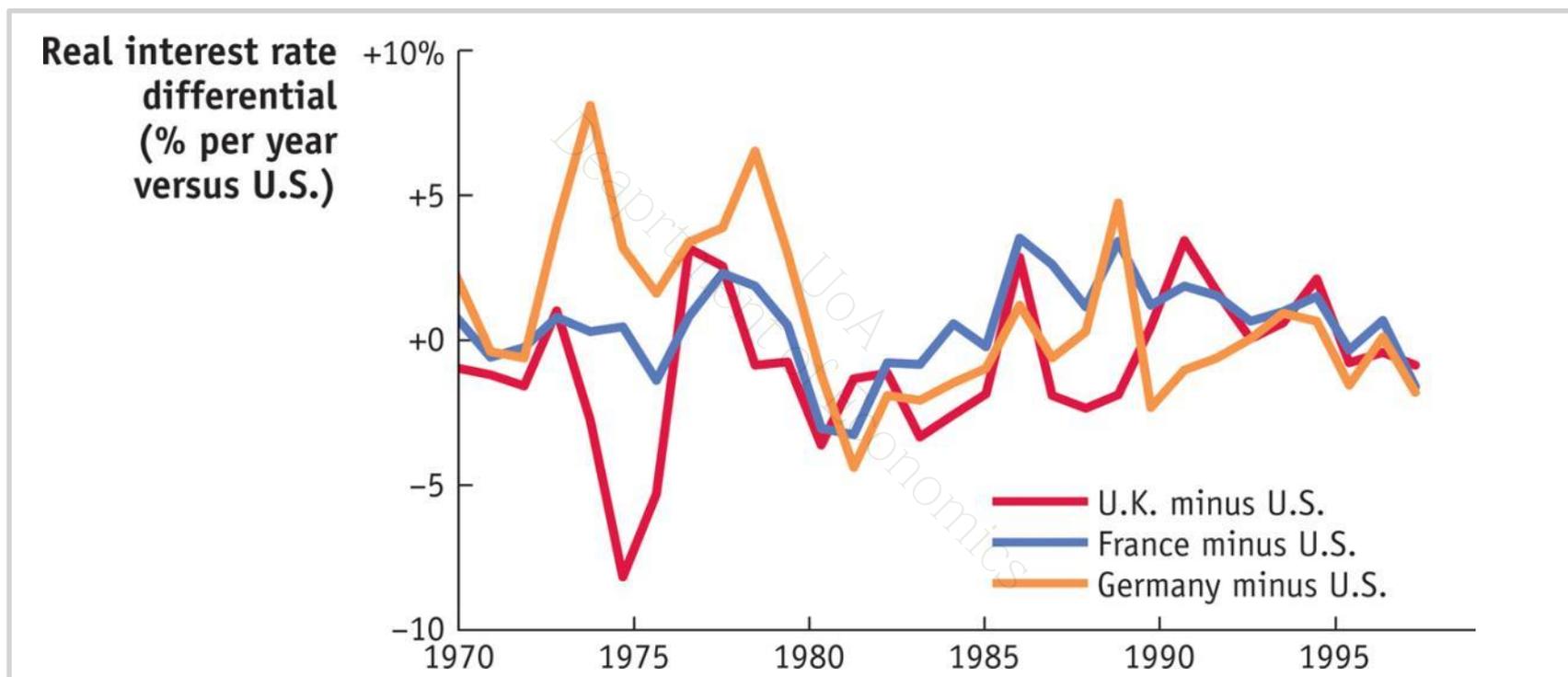
**Inflation Rates and Nominal Interest Rates, 1995–2005** This scatterplot shows the relationship between the average annual nominal interest rate differential and the annual inflation differential relative to the United States over a ten-year period for a sample of 62 countries.

The correlation between the two variables is strong and bears a close resemblance to the theoretical prediction of the Fisher effect that all data points would appear on the 45-degree line.

# APPLICATION

## Evidence on the Fisher Effect

Real Interest Rate Differentials, 1970–1999



This figure shows actual real interest rate differentials over three decades for the United Kingdom, Germany, and France relative to the United States. These differentials were not zero, so real interest parity did not hold continuously. But the differentials were on average close to zero, meaning that real interest parity (like PPP) is a general long-run tendency in the data.

The material of chapter 4 starts here.

## **Exchange Rates II: The Asset Approach in the Short Run**

- **Exchange Rates and Interest Rate in Short Run: UIP and FX Market Equilibrium**
- **Interest Rates in the Short Run: Money Market Equilibrium**

# Exchange Rates and Interest Rates in the Short Run: UIP and FX Market Equilibrium

## Risky Arbitrage

The uncovered interest parity (UIP) equation is the **fundamental equation of the asset approach to exchange rates**.

$$\underbrace{i_{\$}}_{\text{Interest rate on dollar deposits}} = \underbrace{i_{\text{€}}}_{\text{Interest rate on euro deposits}} + \underbrace{\frac{(E_{\$/\text{€}}^e - E_{\$/\text{€}})}{E_{\$/\text{€}}}}_{\text{Expected rate of depreciation of the dollar}} \tag{4-1}$$

Expected dollar rate of return on euro deposits

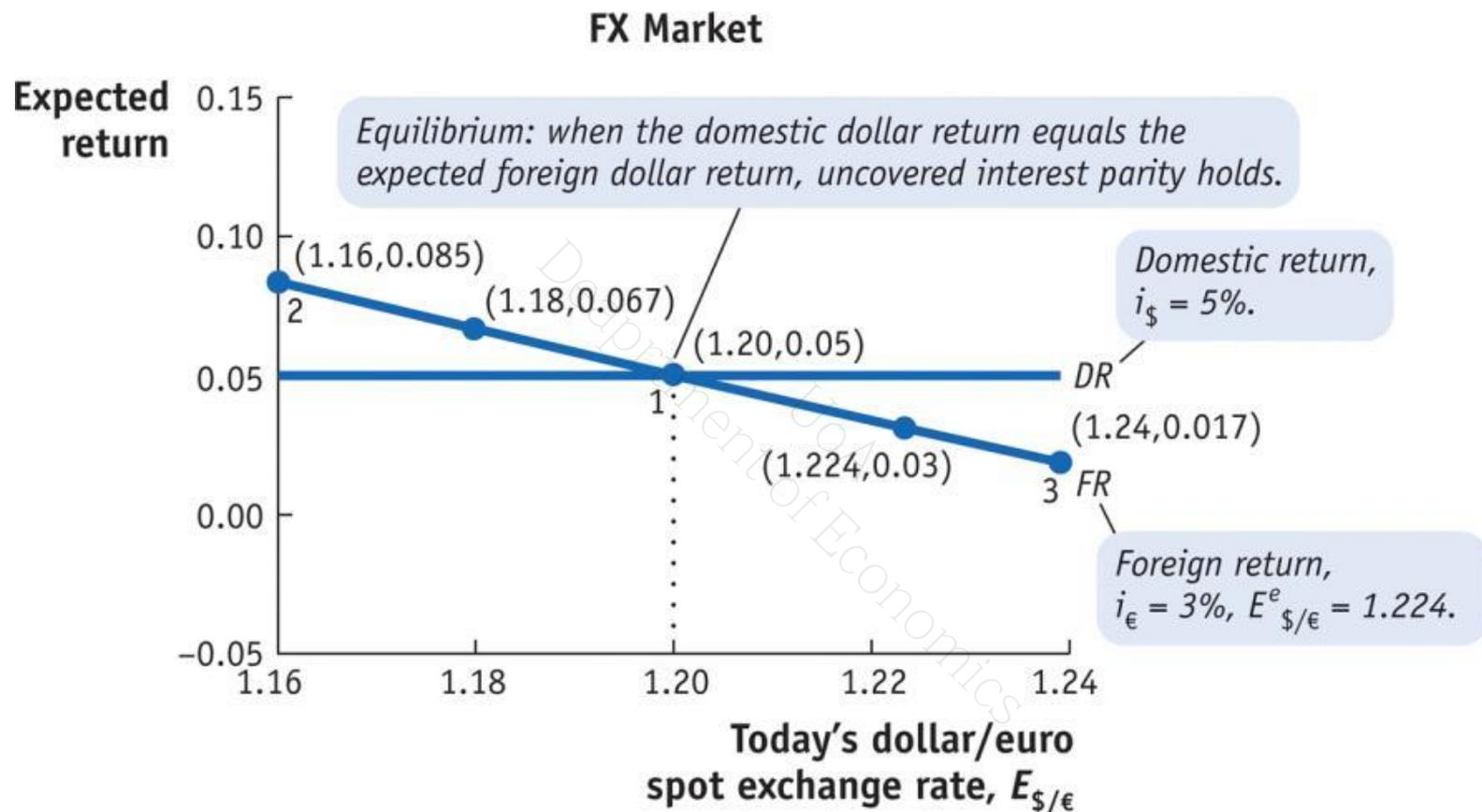
# Exchange Rates and Interest Rates in the Short Run: UIP and FX Market Equilibrium

## Equilibrium in the FX Market: An Example

Interest Rates, Exchange Rates, Expected Returns, and FX Market Equilibrium: A Numerical Example The foreign exchange (FX) market is in equilibrium when the domestic and foreign returns are equal. In this example, the dollar interest rate is 5%, the euro interest rate is 3%, and the expected future exchange rate (one year ahead) is = 1.224 \$/€. The equilibrium is highlighted in bold type.

(1)	(2)	(3)	(4)	(5)	(6) = (2) + (5)
Interest Rate on Dollar Deposits (annual)	Interest Rate on Euro Deposits (annual)	Spot Exchange Rate (today)	Expected Future Exchange Rate (in 1 year)	Expected Euro Appreciation against Dollar (in 1 year)	Expected Dollar Return on Euro Deposits (annual)
Domestic Return (\$)					Foreign Expected Return (\$)
$i_s$	$i_e$	$E_{\$/\text{€}}$	$E_{\$/\text{€}}^e$	$\frac{E_{\$/\text{€}}^e - E_{\$/\text{€}}}{E_{\$/\text{€}}}$	$i_e + \frac{E_{\$/\text{€}}^e - E_{\$/\text{€}}}{E_{\$/\text{€}}}$
0.05	0.03	1.16	1.224	0.0552	0.0852
0.05	0.03	1.18	1.224	0.0373	0.0673
<b>0.05</b>	<b>0.03</b>	<b>1.20</b>	<b>1.224</b>	<b>0.02</b>	<b>0.05</b>
0.05	0.03	1.22	1.224	0.0033	0.0333
0.05	0.03	1.24	1.224	-0.0129	0.0171

# Equilibrium in the FX Market: An Example



## FX Market Equilibrium: A Numerical Example

The returns calculated in Table 4-1 are plotted in this figure. The dollar interest rate is 5%, the euro interest rate is 3%, and the expected future exchange rate is 1.224  $\$/\epsilon$ .

The foreign exchange market is in equilibrium at point 1, where the domestic returns  $DR$  and expected foreign returns  $FR$  are equal at 5% and the spot exchange rate is 1.20  $\$/\epsilon$ .

# Changes in Domestic and Foreign Returns and FX Market Equilibrium

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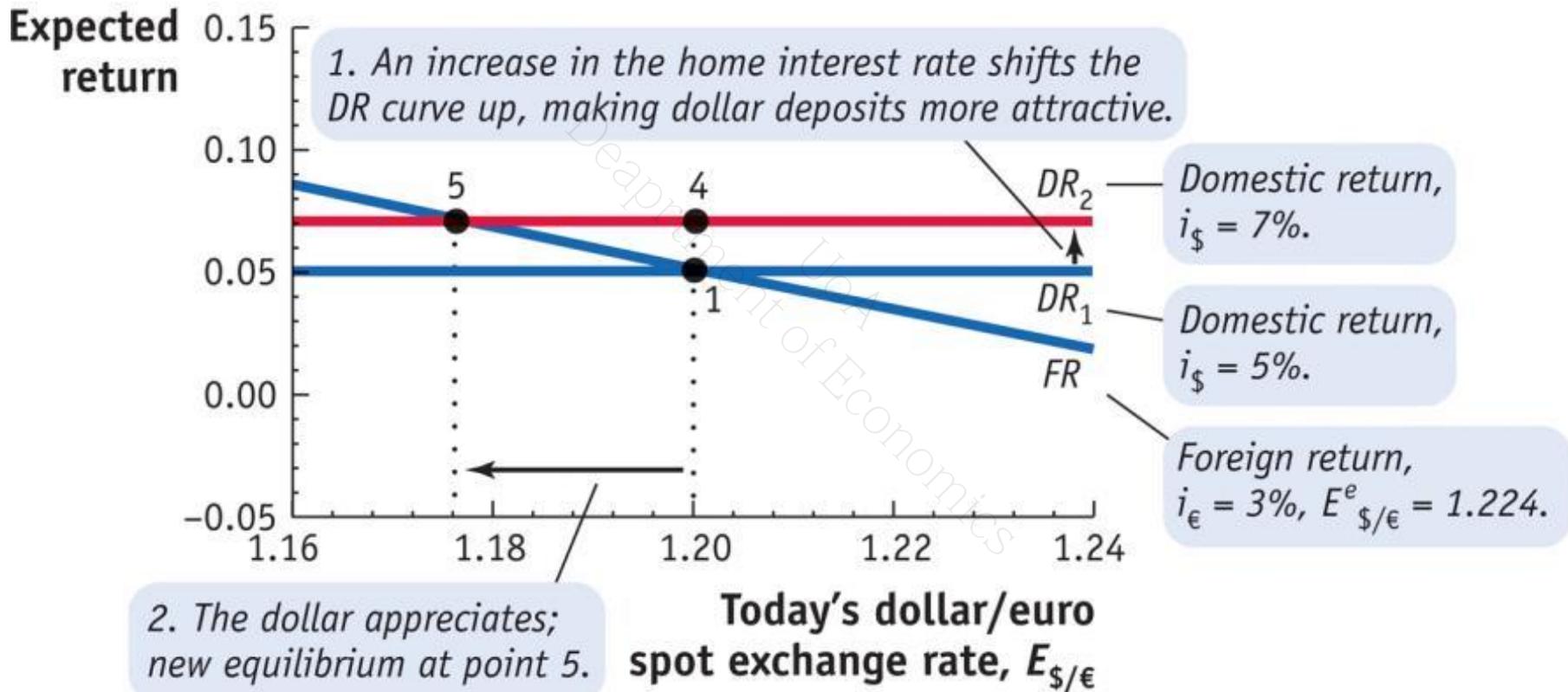
To gain greater familiarity with the model, let's see how the FX market example shown in Figure 4-2 responds to three separate shocks:

- A higher domestic interest rate,  $i_{\$} = 7\%$
- A lower foreign interest rate,  $i_{\text{€}} = 1\%$
- A lower expected future exchange rate,  $E^e_{\$/\text{€}} = 1.20 \text{ \$/€}$

# Changes in Domestic and Foreign Returns and FX Market Equilibrium

## A Change in the Domestic Interest Rate

(a) FX Market



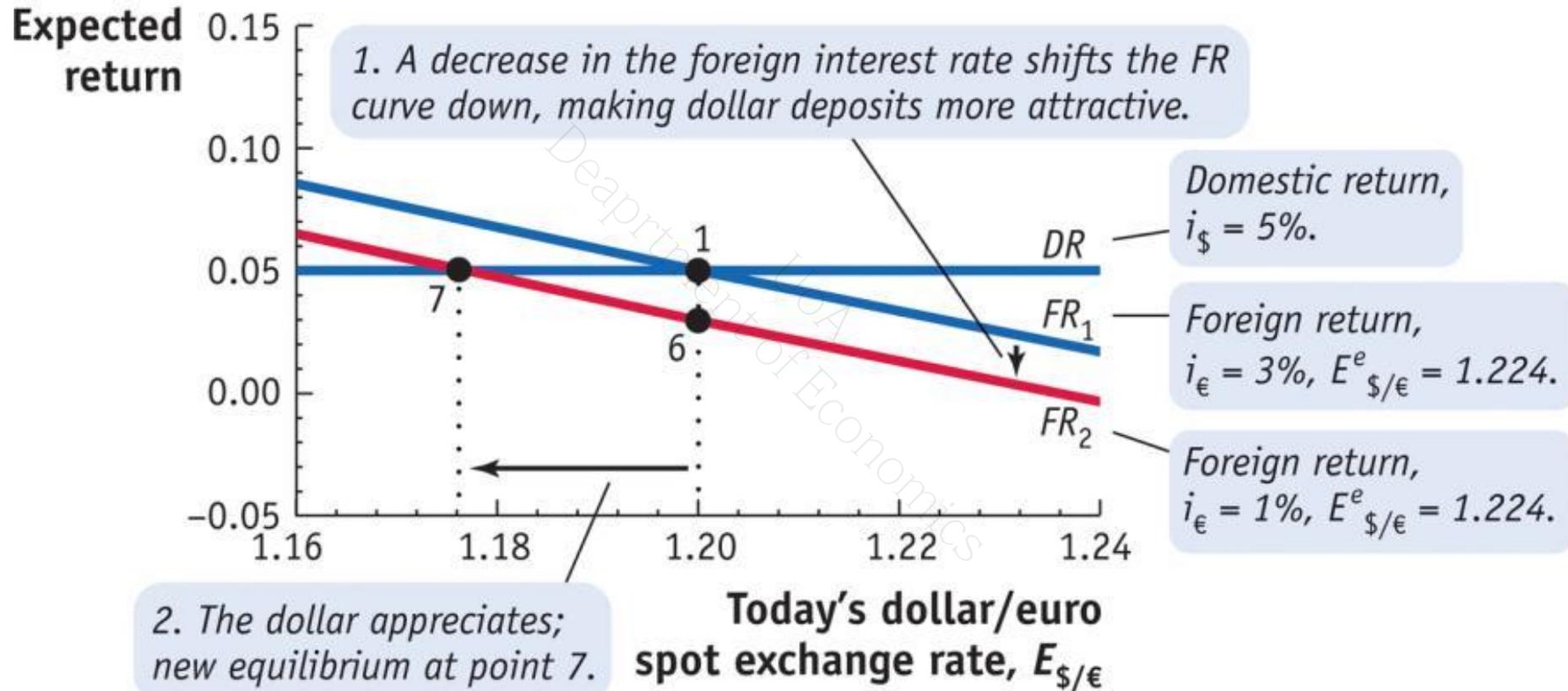
(a) **A Change in the Home Interest Rate** A rise in the dollar interest rate from 5% to 7% increases domestic returns, shifting the  $DR$  curve up from  $DR_1$  to  $DR_2$ .

At the initial equilibrium exchange rate of 1.20  $\$/\epsilon$  on  $DR_2$ , domestic returns are above foreign returns at point 4. Dollar deposits are more attractive and the dollar appreciates from 1.20  $\$/\epsilon$  to 1.177  $\$/\epsilon$ . The new equilibrium is at point 5.

# Changes in Domestic and Foreign Returns and FX Market Equilibrium

## A Change in the Foreign Interest Rate

(b) FX Market

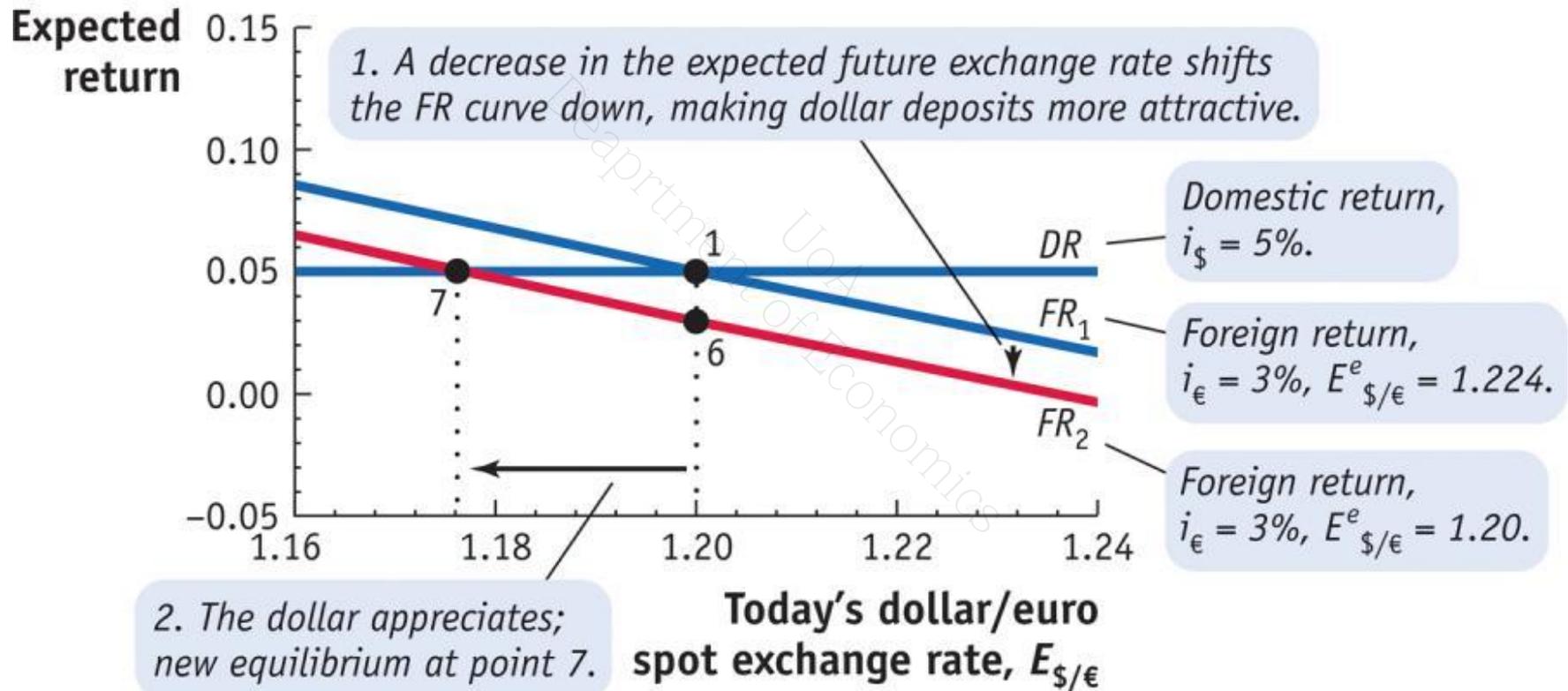


(b) A Change in the Foreign Interest Rate A fall in the euro interest rate from 3% to 1% lowers foreign expected dollar returns, shifting the *FR* curve down from  $FR_1$  to  $FR_2$ . At the initial equilibrium exchange rate of 1.20  $\$/\text{€}$  on  $FR_2$ , foreign returns are below domestic returns at point 6. Dollar deposits are more attractive and the dollar appreciates from 1.20  $\$/\text{€}$  to 1.177  $\$/\text{€}$ . The new equilibrium is at point 7.

# Changes in Domestic and Foreign Returns and FX Market Equilibrium

## A Change in the Expected Future Exchange Rate

(c) FX Market



(c) A Change in the Expected Future Exchange Rate A fall in the expected future exchange rate from 1.224 to 1.20 lowers foreign expected dollar returns, shifting the  $FR$  curve down from  $FR_1$  to  $FR_2$ . At the initial equilibrium exchange rate of 1.20  $\$/\epsilon$  on  $FR_2$ , foreign returns are below domestic returns at point 6. Dollar deposits are more attractive and the dollar appreciates from 1.20  $\$/\epsilon$  to 1.175  $\$/\epsilon$ . The new equilibrium is at point 7.

# Interest Rates in the Short Run: Money Market Equilibrium

## Money Market Equilibrium in the Short Run: How Nominal Interest Rates Are Determined

### The Assumptions

In this section, we make *short-run* assumptions that are quite different from the long-run assumptions:

- In the short run, the price level is sticky; it is a known predetermined variable, fixed at  $P = \bar{P}$  (the bar indicates a fixed value).
- In the short run, the nominal interest rate  $i$  is fully flexible and adjusts to bring the money market to equilibrium.

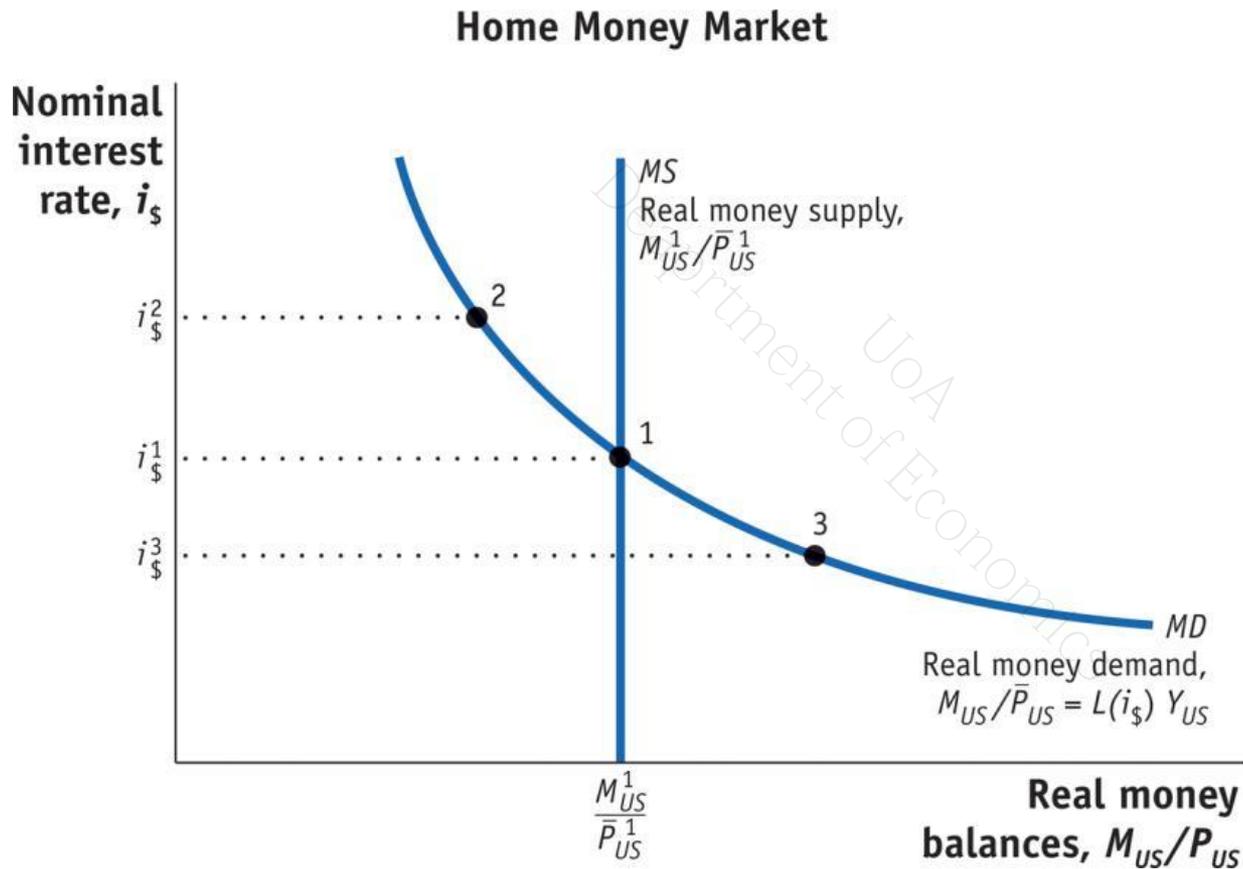
## The Model

The expressions for money market equilibrium in the two countries are as follows:

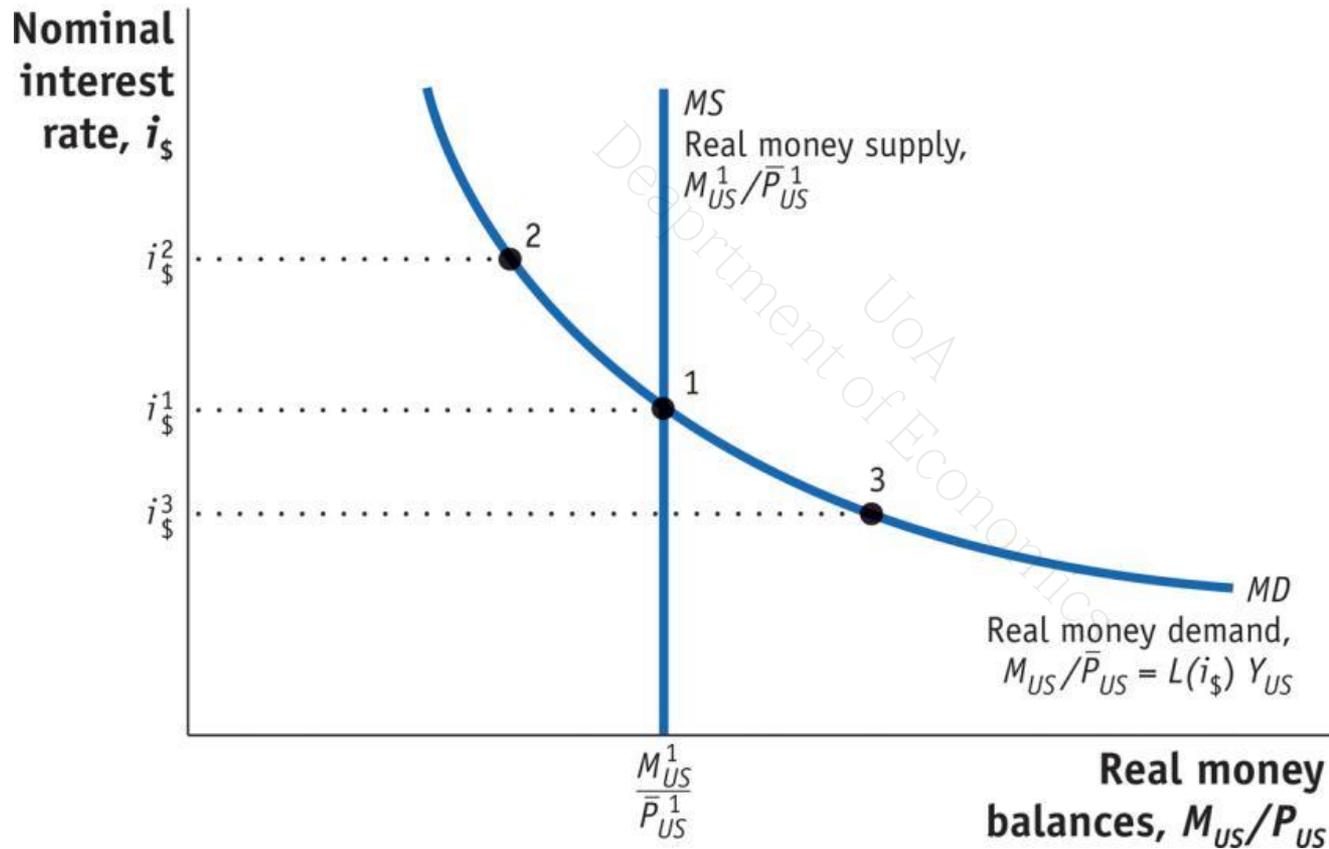
$$\underbrace{\frac{M_{US}}{\bar{P}_{US}}}_{\text{U.S. supply of real money balances}} = \underbrace{L(i_{\$}) \times Y_{US}}_{\text{U.S. demand for real money balances}} \quad (4-2)$$

$$\underbrace{\frac{M_{EUR}}{\bar{P}_{EUR}}}_{\text{European supply of real money balances}} = \underbrace{L(i) \times Y_{EUR}}_{\text{European demand for real money balances}} \quad (4-3)$$

The supply and demand for real money balances determine the nominal interest rate.

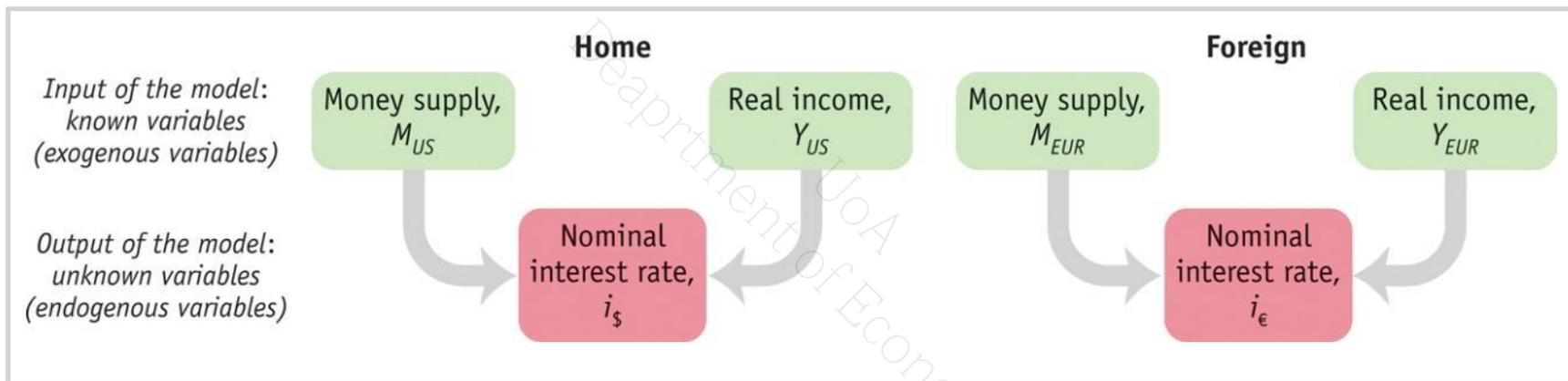


## Home Money Market



The money market is in equilibrium when the nominal interest rate  $i_{\$}^1$  is such that real money demand equals real money supply (point 1).

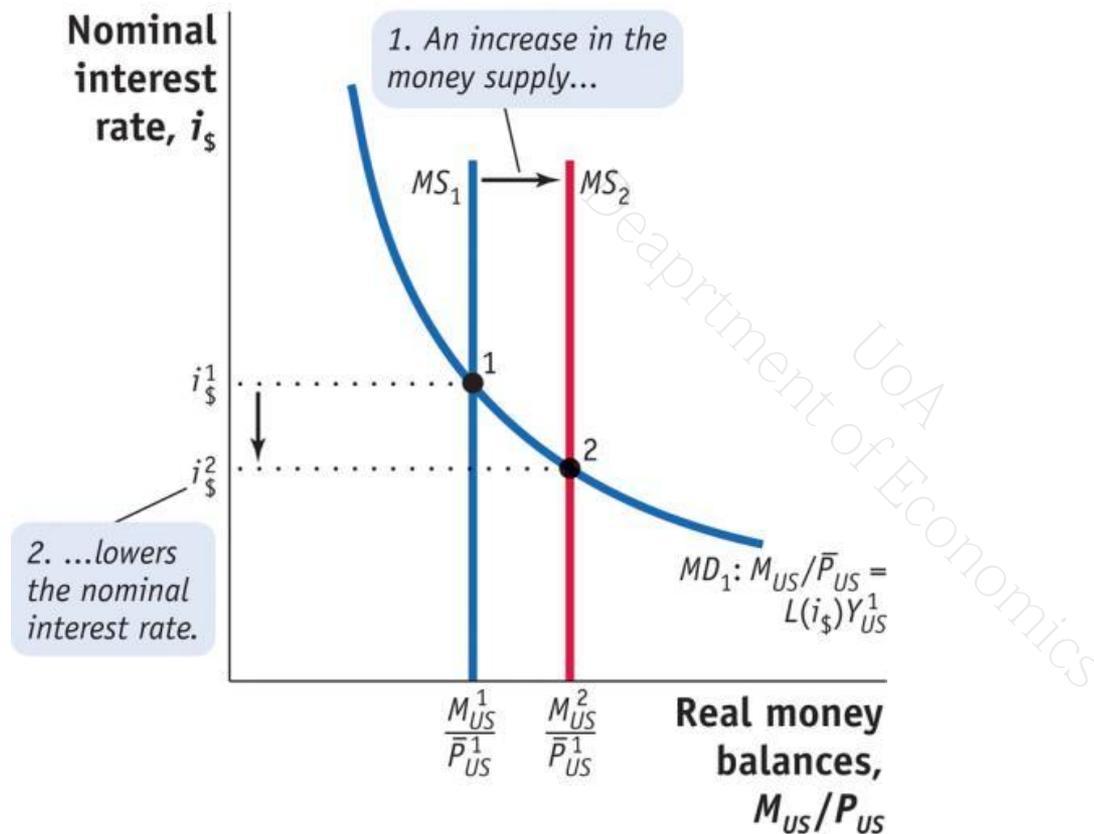
## Another Building Block: Short-Run Money Market Equilibrium



# Changes in Money Supply and the Nominal Interest Rate

Home Money Market with Changes in Money Supply and Money Demand

(a) Increase in Money Supply,  $MS$

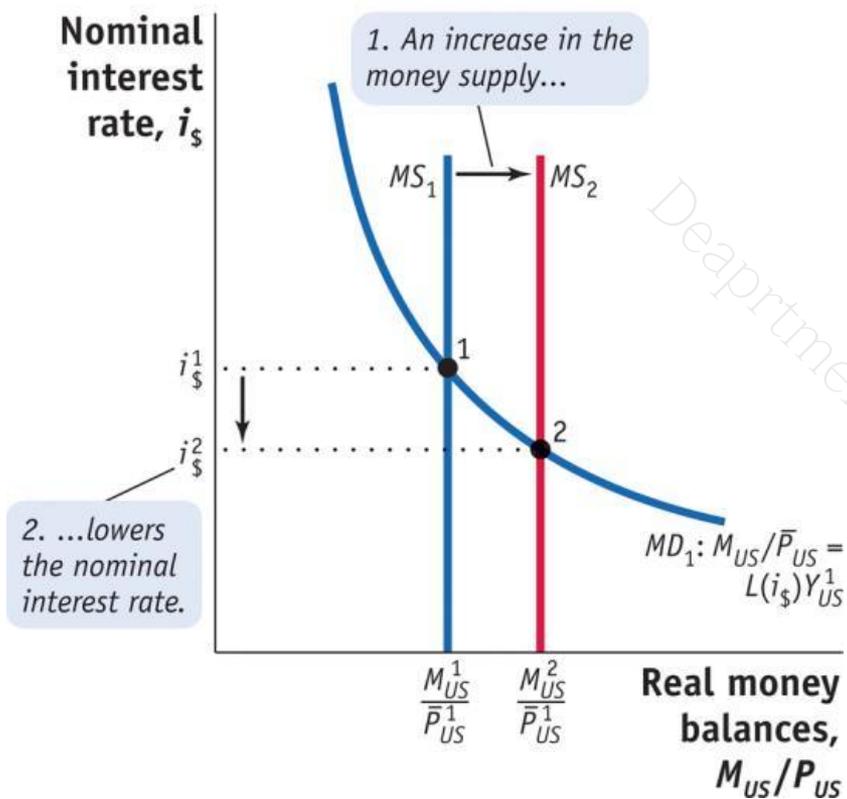


In panel (a), with a fixed price level  $P_{US}^1$ , an increase in nominal money supply from  $M_{US}^1$  to  $M_{US}^2$  causes an increase in real money supply from  $M_{US}^1/P_{US}^1$  to  $M_{US}^2/P_{US}^1$ . The nominal interest rate falls from  $i_s^1$  to  $i_s^2$  to restore equilibrium at point 2.

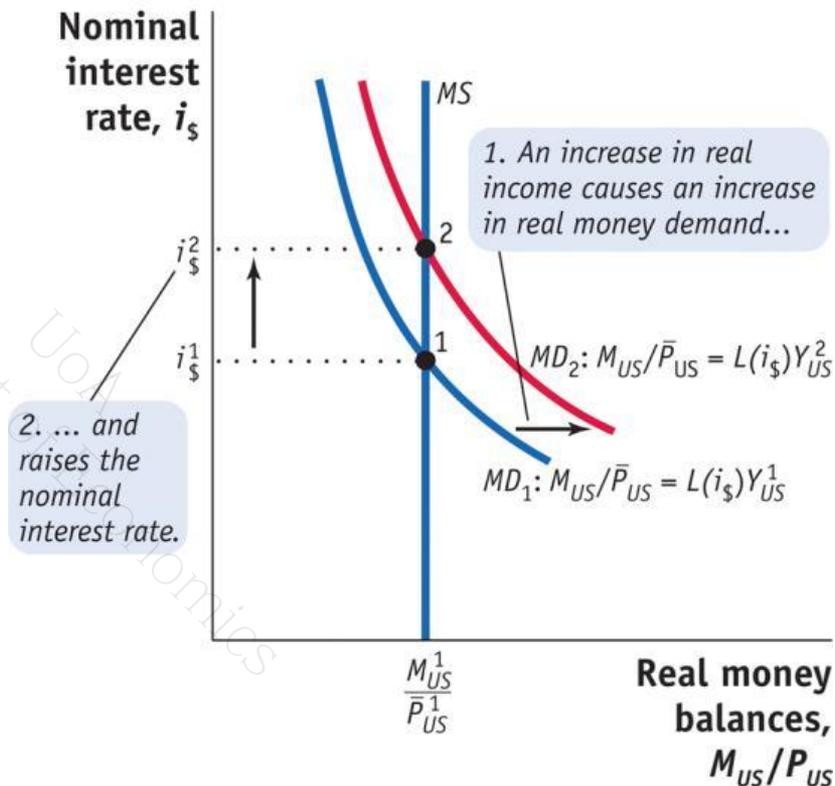
# Changes in Money Supply and the Nominal Interest Rate

Home Money Market with Changes in Money Supply and Money Demand (continued)

(a) Increase in Money Supply,  $MS$



(b) Increase in Money Demand,  $MD$

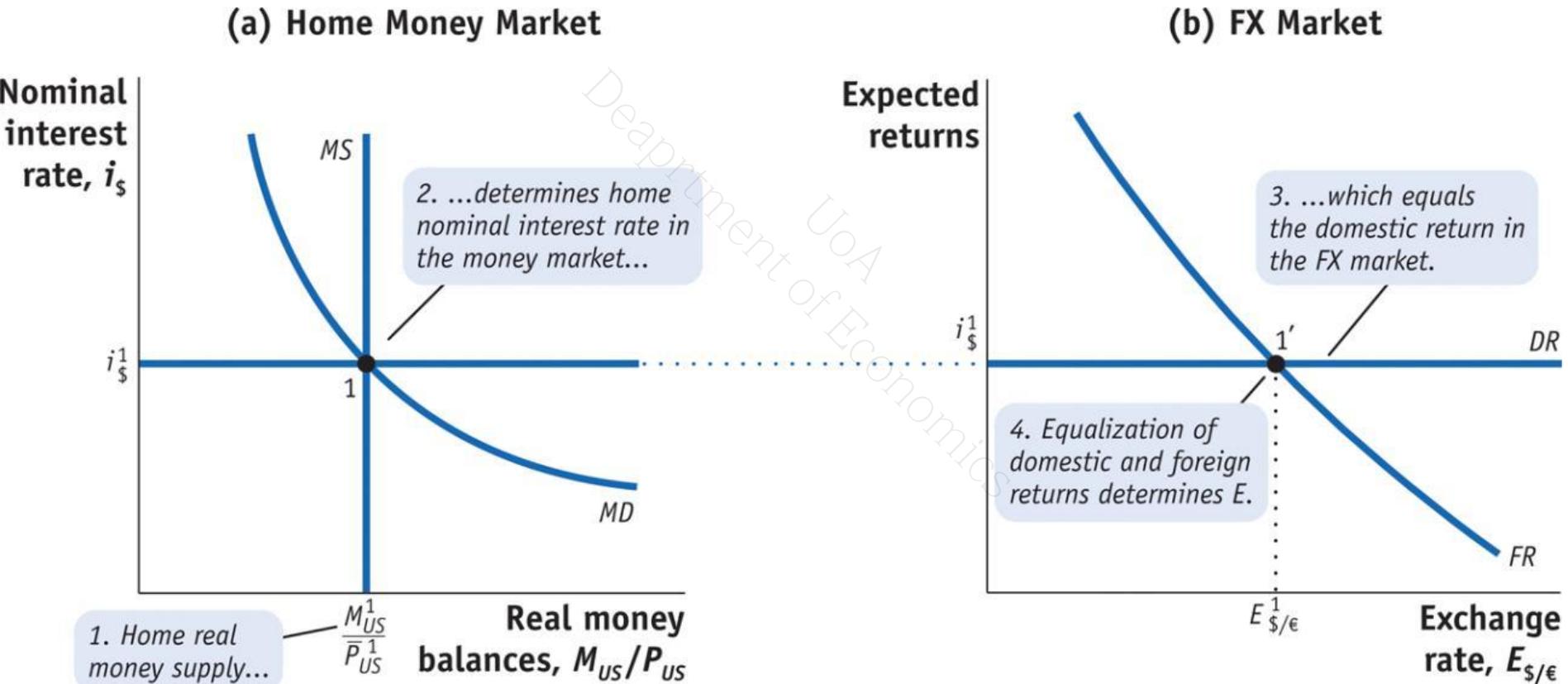


In panel (b), with a fixed price level  $P_{US}^1$ , an increase in real income from  $Y_{US}^1$  to  $Y_{US}^2$  causes real money demand to increase from  $MD_1$  to  $MD_2$ .

To restore equilibrium at point 2, the interest rate rises from  $i_s^1$  to  $i_s^2$ .

# The Asset Approach: Applications and Evidence

## The Asset Approach to Exchange Rates: Graphical Solution



# The Asset Approach: Applications and Evidence

## Capital Mobility Is Crucial

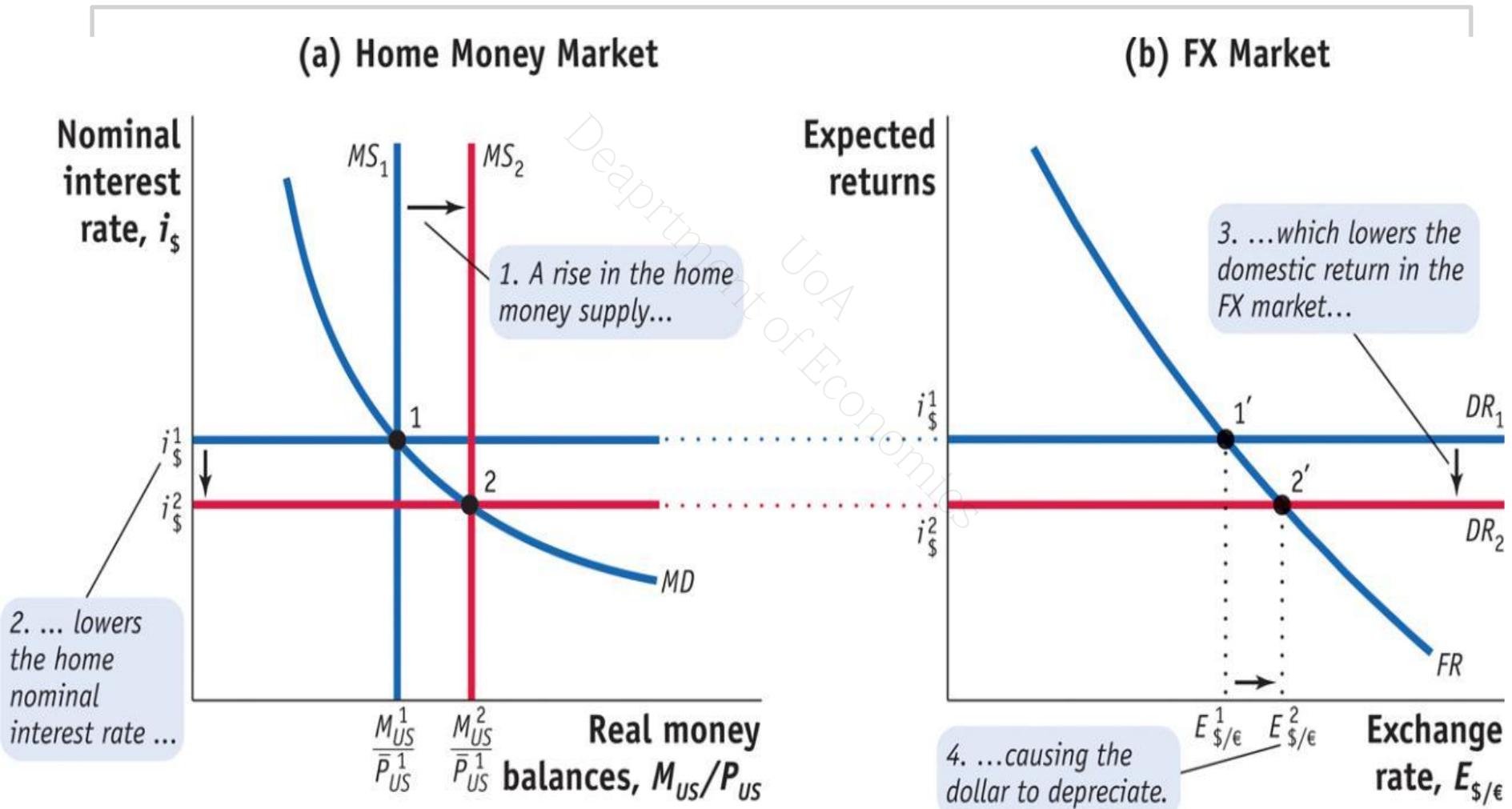
Our assumption that  $DR$  equals  $FR$  depends on capital mobility.

## Putting the Model to Work

With this graphical apparatus in place, it is relatively straightforward to solve for the exchange rate given all the known (exogenous) variables we have specified previously.

# Short-Run Policy Analysis

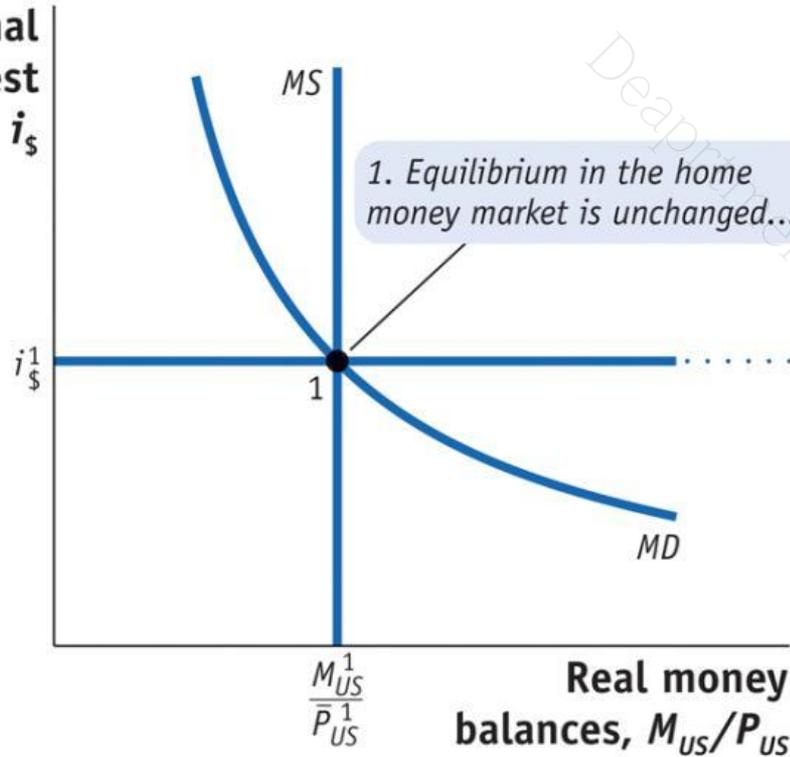
## Temporary Expansion of the Home Money Supply



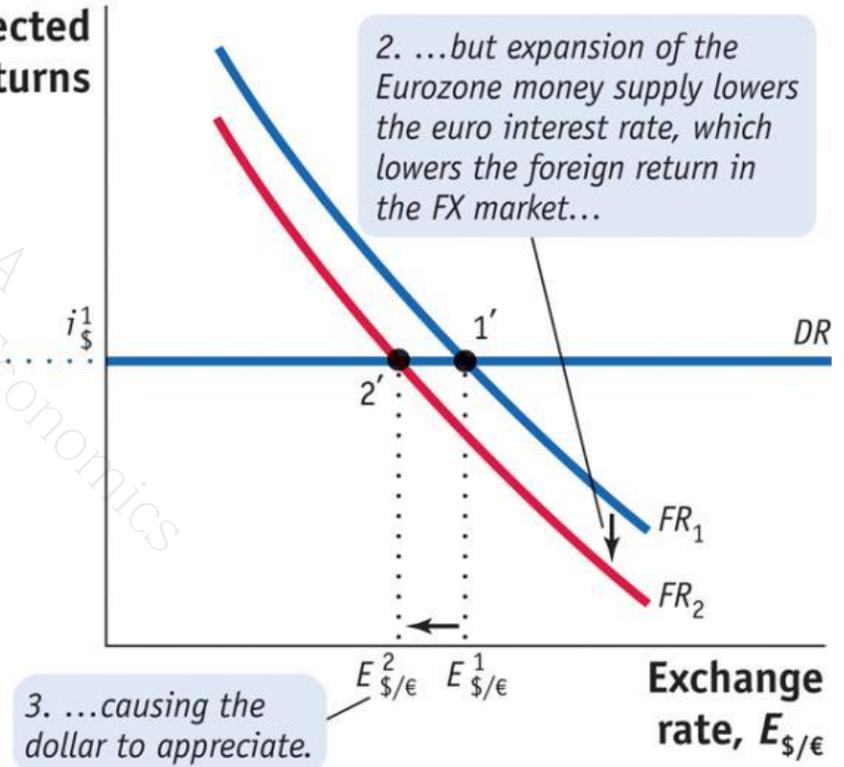
# Short-Run Policy Analysis

## Temporary Expansion of the Foreign Money Supply

(a) Home Money Market



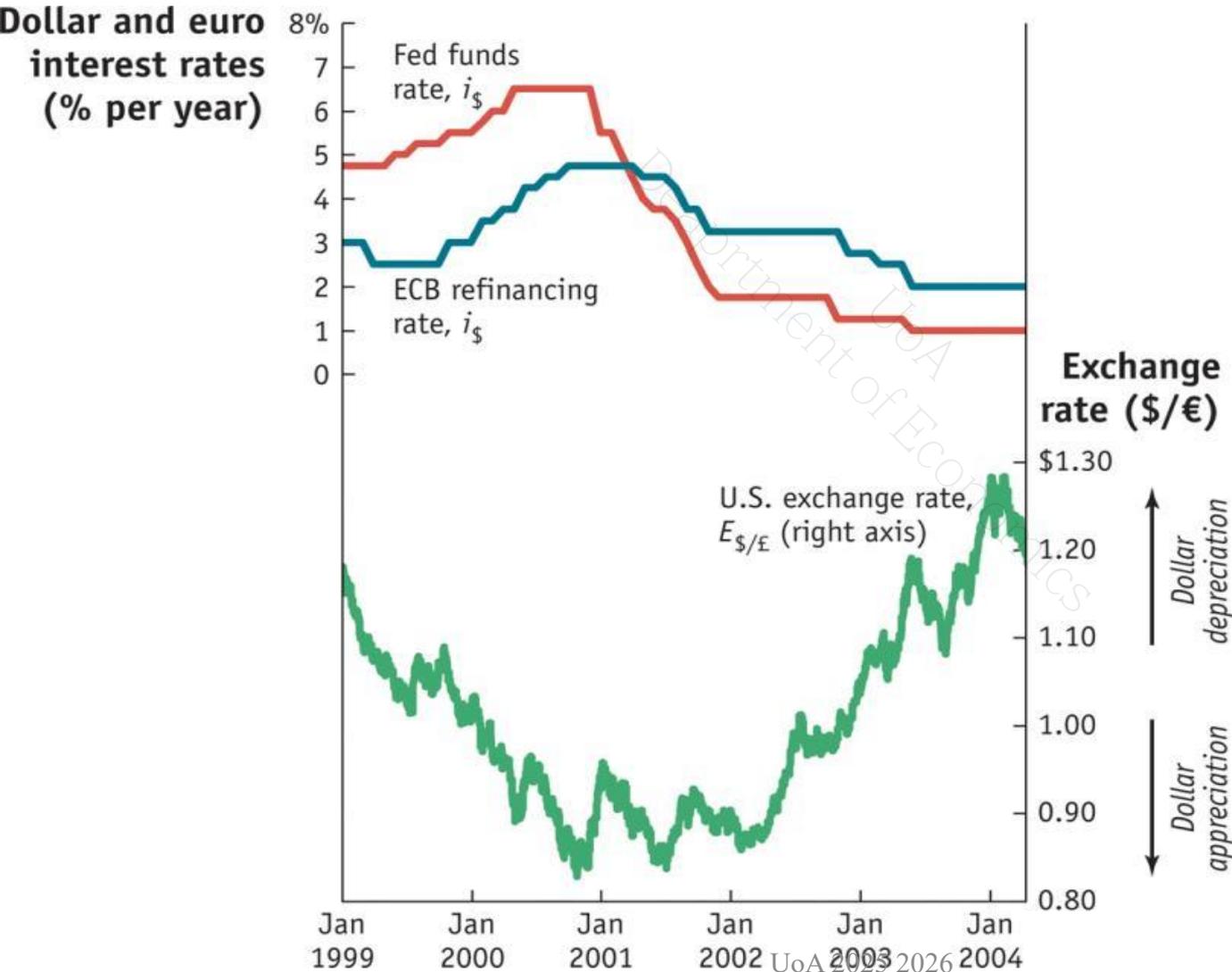
(b) FX Market



# APPLICATION

## The Rise and Fall of the Dollar, 1999-2004

### U.S.–Eurozone Interest Rates and Exchange Rates, 1999-2004



From the euro's birth in 1999 until 2001, the dollar steadily appreciated against the euro, as interest rates in the United States were raised well above those in Europe.

In early 2001, however, the Federal Reserve began a long series of interest rate reductions. By 2002 the Fed Funds rate was well below the ECB's refinancing rate.

## A Complete Theory: Unifying the Monetary and Asset Approaches

For a complete theory of exchange rates:

- We need the asset approach —short-run money market equilibrium and uncovered interest parity:

$$\left. \begin{aligned} \bar{P}_{US} &= M_{US} / [L_{US}(i_{\$}) Y_{US}] \\ \bar{P}_{EUR} &= M_{EUR} / [L_{EUR}(i) Y_{EUR}] \\ i_{\$} &= i_{\text{€}} + \frac{E_{\$/\text{€}}^e - E_{\$/\text{€}}}{E_{\$/\text{€}}} \end{aligned} \right\} \text{The asset approach}$$

## A Complete Theory: Unifying the Monetary and Asset Approaches

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- To forecast the future expected exchange rate, we also need the long-run monetary approach from the previous chapter—a long run monetary model and purchasing power parity:

$$\left. \begin{aligned} P_{US}^e &= M_{US}^e / [L_{US}(i_{\$}^e)Y_{US}^e] \\ P_{EUR}^e &= M_{EUR}^e / [L_{EUR}(i^e)Y_{EUR}^e] \\ E_{\$/\epsilon}^e &= P_{US}^e / P_{EUR}^e \end{aligned} \right\} \text{The monetary approach (4-5)}$$

- Combining the asset and monetary approach, we can see how the two key mechanisms of *expectations* and *arbitrage* determine exchange rates in both the short run and the long run.

The end