University of Warsaw
Faculty of Economic Sciences

Exchange Rates II: The Asset Approach in the Short Run

Łukasz Matuszczak, Phd

Introduction

- Deviations from purchasing power parity (PPP) occur in the short run: The same basket of goods generally does *not* cost the same everywhere at all times.

- Short-run failures of the monetary approach led economists to develop an alternative theory to explain exchange rates in the short run: **the asset approach to exchange rates**.

- It is called the asset approach because it is based on the idea that currencies are assets (i.e., stores of value).

- The price of the asset in this case is the spot exchange rate, the price of one unit of foreign exchange.

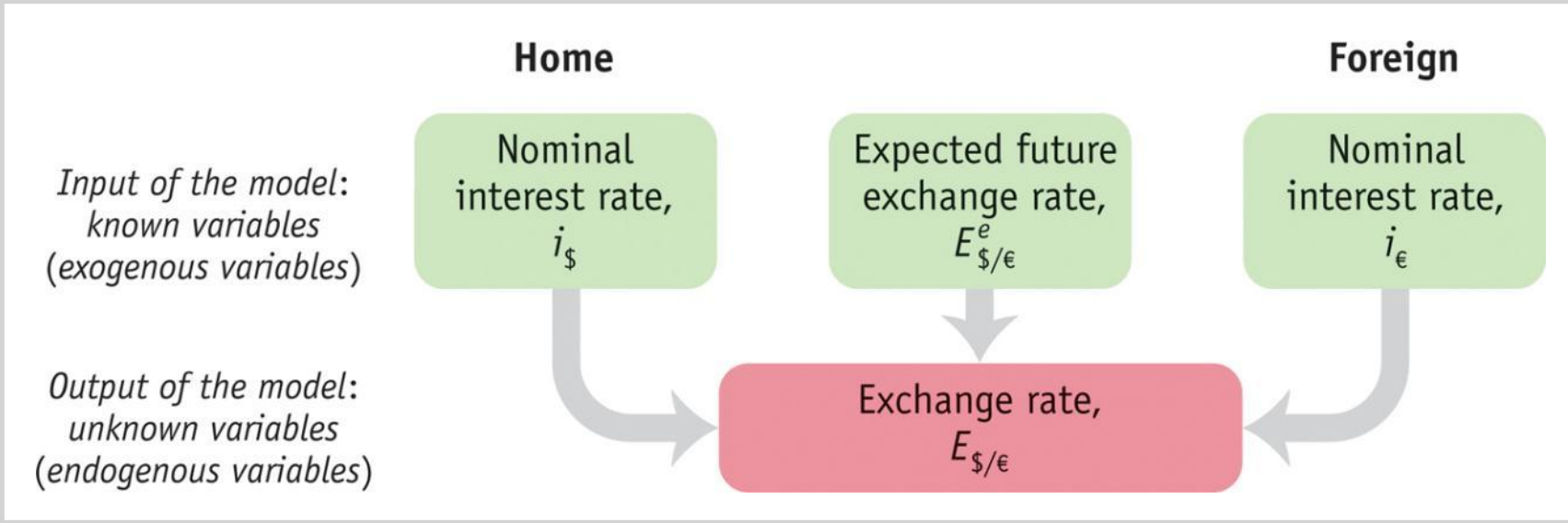
Risky Arbitrage

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

$$\underbrace{i_{\$}}_{\substack{\text{Interest rate}\\ \text{on dollar deposits}\\ =\\ \text{Dollar rate of return}\\ \text{on euro deposits}}} = \underbrace{\underbrace{i_{€}}_{\substack{\text{Interest rate}\\ \text{on euro deposites}}} + \underbrace{\frac{(E^{e}_{\$/€} - E_{\$/€})}{E_{\$/€}}}_{\substack{\text{Expected rate of depreciation}\\ \text{of the dollar}}}}_{\substack{\text{Expected dollar rate of return}\\ \text{on euro deposite}}} \qquad (4\text{-}1)$$

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

FIGURE 4-1



Building Block: Uncovered Interest Parity—The Fundamental Equation of the Asset Approach In this model, the nominal interest rate and expected future exchange rate are treated as known exogenous variables (in green). The model uses these variables to predict the unknown endogenous variable (in red), the current spot exchange rate.

Equilibrium in the FX Market: An Example

TABLE 4-1

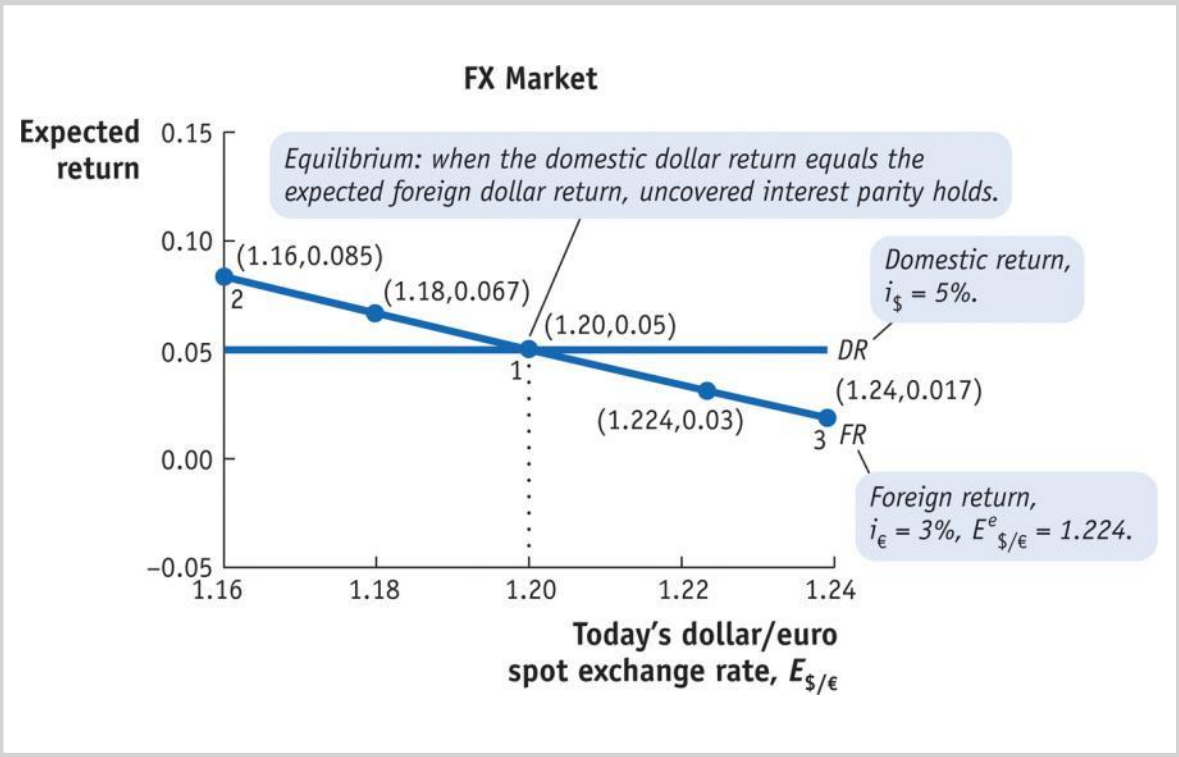
Interest Rates, Exchange Rates, Expected Returns, and FX Market Equilibrium: A Numerical Example

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) Interest Rate on Dollar Deposits (annual) Domestic Return ($) $i_\$$	(2) Interest Rate on Euro Deposits (annual) $i_€$	(3) Spot Exchange Rate (today) $E_{\$/€}$	(4) Expected Future Exchange Rate (in 1 year) $E^e_{\$/€}$	(5) Expected Euro Appreciation against Dollar (in 1 year) $\frac{E^e_{\$/€} - E_{\$/€}}{E_{\$/€}}$	(6) = (2) + (5) Expected Dollar Return on Euro Deposits (annual) Foreign Expected Return ($) $i_€ + \frac{E^e_{\$/€} - E_{\$/€}}{E_{\$/€}}$
	0.05	0.03	1.16	1.224	0.0552	0.0852
	0.05	0.03	1.18	1.224	0.0373	0.0673
Market equilibrium	0.05	0.03	1.20	1.224	0.02	0.05
	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

FIGURE 4-2



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 $/€.

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 $/€.

Changes in Domestic and Foreign Returns and FX Market Equilibrium

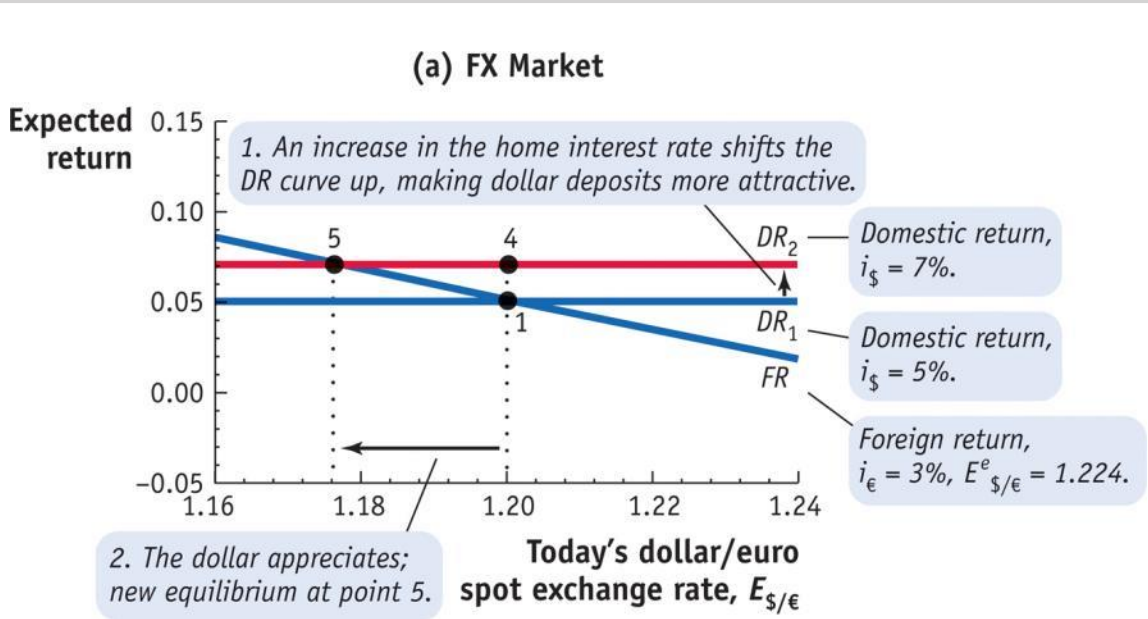
Let's see how the FX market example shown in Figure 4-2 responds to three separate shocks:

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

Changes in Domestic and Foreign Returns and FX Market Equilibrium

A Change in the Domestic Interest Rate

FIGURE 4-3 (1 of 3)



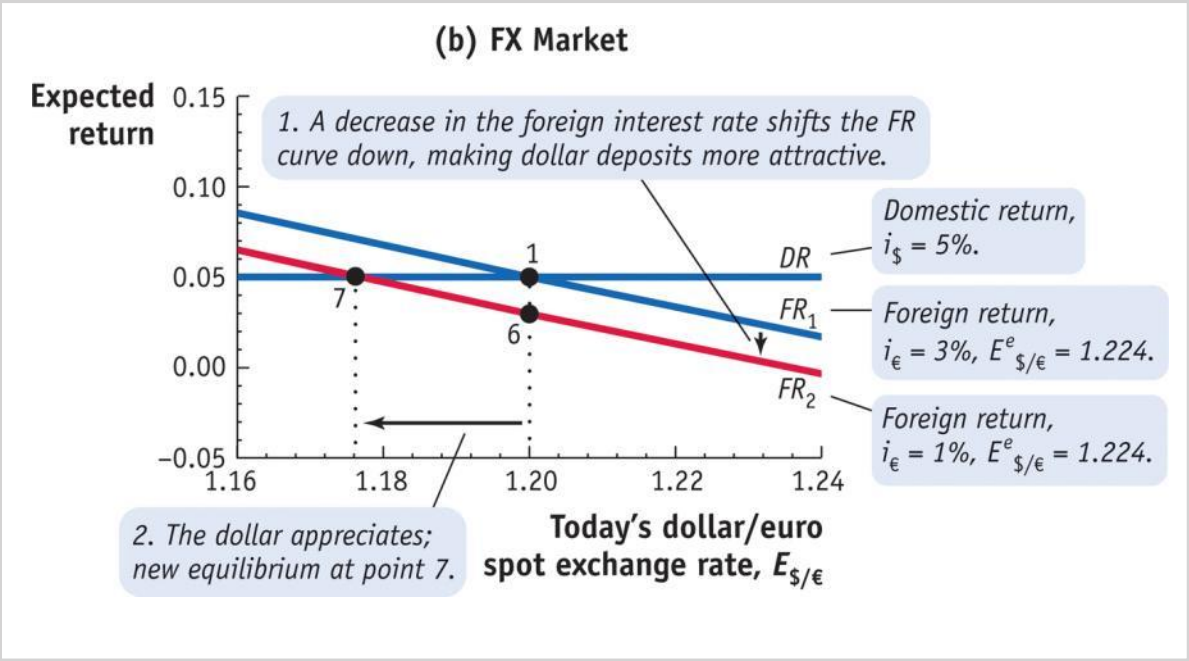
(a) A Change in the Home Interest Rate A rise in the dollar interest rate from 5% to 7% increases domestic returns, shifting the *DR* curve up from DR_1 to DR_2.

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

Changes in Domestic and Foreign Returns and FX Market Equilibrium

A Change in the Foreign Interest Rate

FIGURE 4-3 (2 of 3)

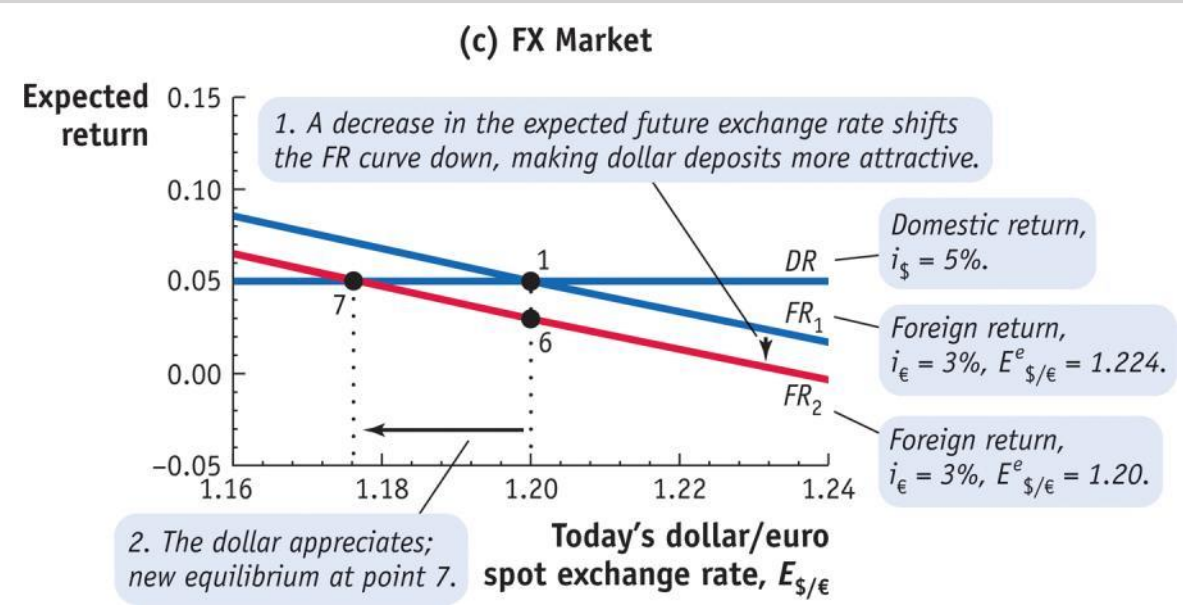


(b) A Change in the Foreign Interest Rate A fall in the euro interest rate from 3% to 1% lowers foreign expected dollar returns, shifting the *FR* curve down from FR_1 to FR_2. At the initial equilibrium exchange rate of 1.20 \$/€ on FR_2, foreign returns are below domestic returns at point 6. Dollar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

FIGURE 4-3 (3 of 3)



(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 \$/€ on FR_2, foreign returns are below domestic returns at point 6. Dollar deposits are more attractive, and the dollar **appreciates** from 1.20 \$/€ to 1.177 \$/€. The new equilibrium is at point 7.

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

The Assumptions

In this chapter, 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 predetermined or known variable, fixed at $P = \bar{P}$ (bar denotes 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 assumption of sticky prices, also called **nominal rigidity**, is very common in the study of macroeconomics in the short run.

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

The Model

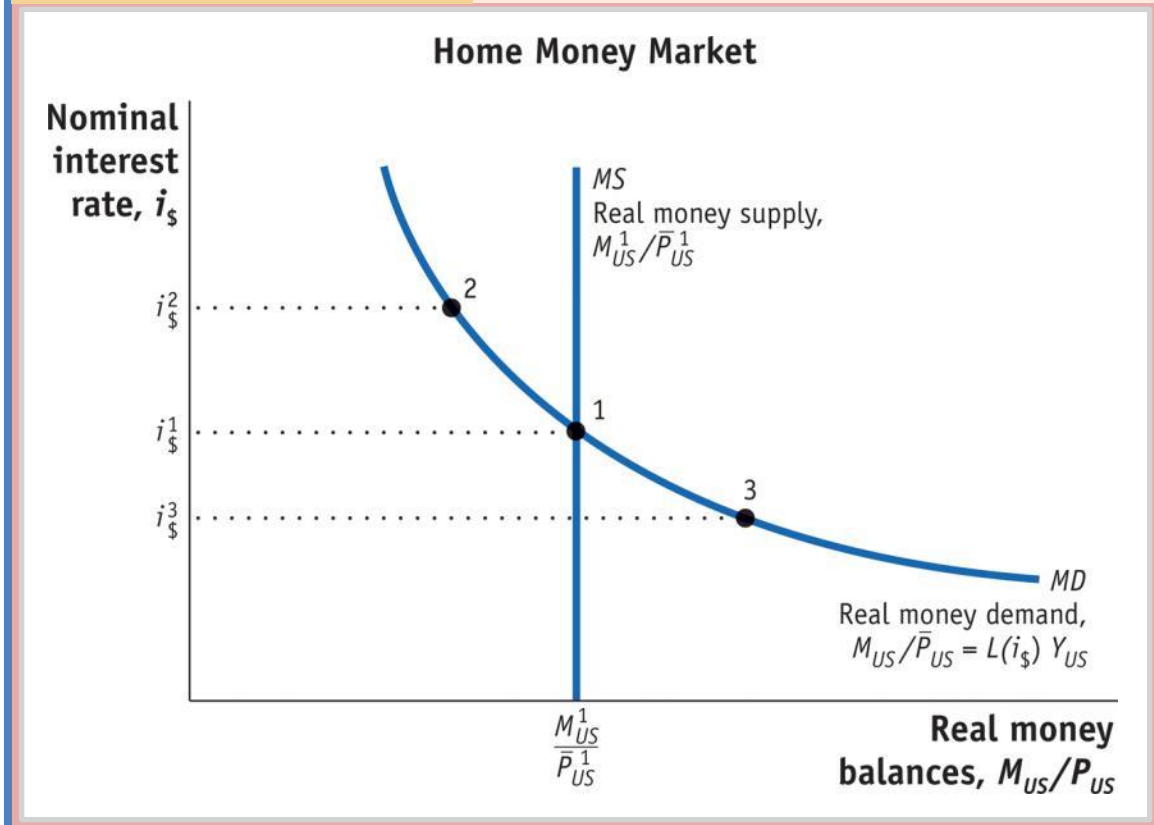
The expressions for money market equilibrium in the two countries are as follows:

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

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

Money Market Equilibrium in the Short Run: Graphical Solution

FIGURE 4-4 (1 of 2) Equilibrium in the Home Money Market



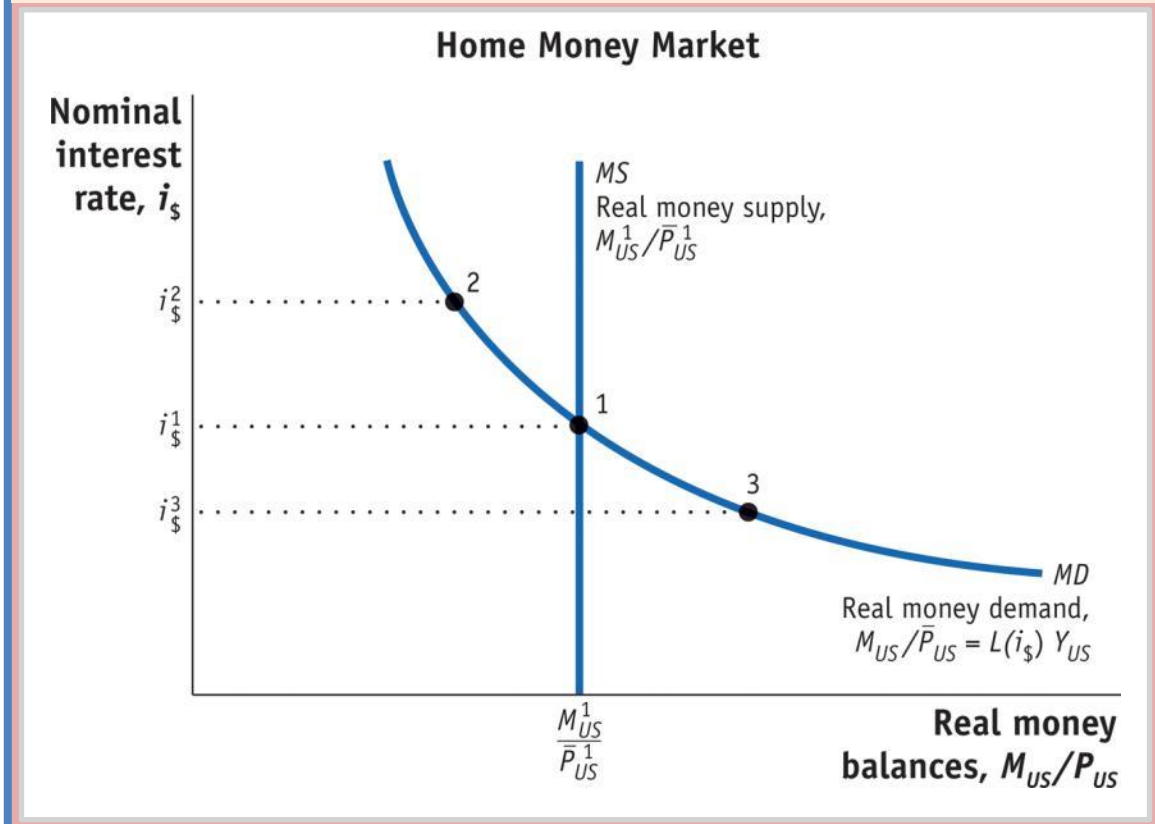
The supply and demand for real money balances determine the nominal interest rate.

The money supply curve (*MS*) is vertical at $M^1_{US}/\bar{P}_{US}$ because the quantity of money supplied does not depend on the interest rate.

The money demand curve (*MD*) is downward-sloping because an increase in the interest rate raises the cost of holding money.

Money Market Equilibrium in the Short Run: Graphical Solution

FIGURE 4-4 (2 of 2) Equilibrium in the Home Money Market (continued)

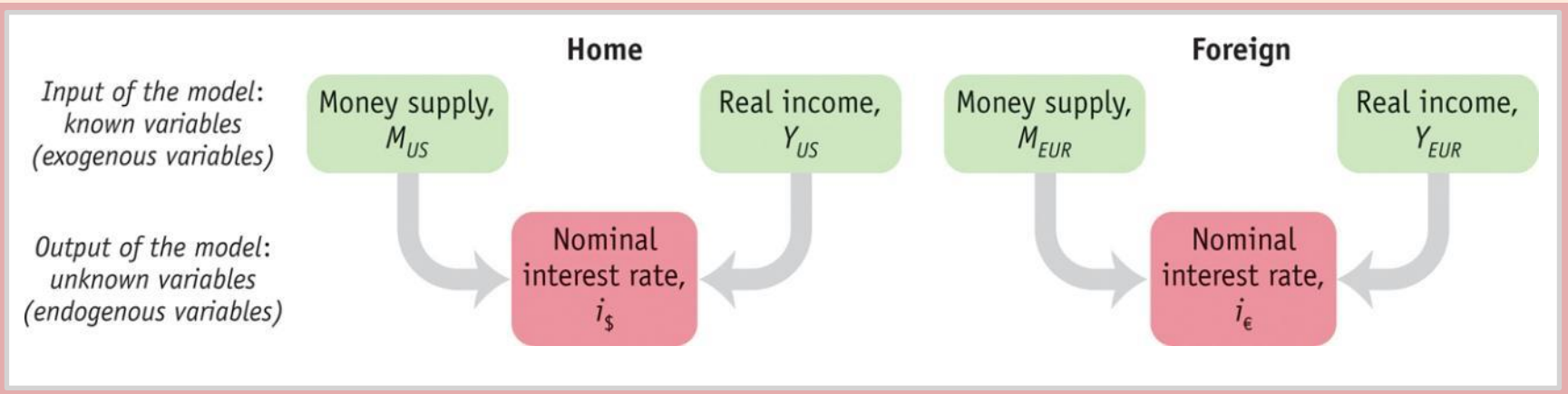


The money market is in equilibrium when the nominal interest rate $i^1_\$$ is such that real money demand equals real money supply (point 1).

At points 2 and 3, demand does not equal supply and the interest rate will adjust until the money market returns to equilibrium.

Another Building Block: Short-Run Money Market Equilibrium

FIGURE 4-5

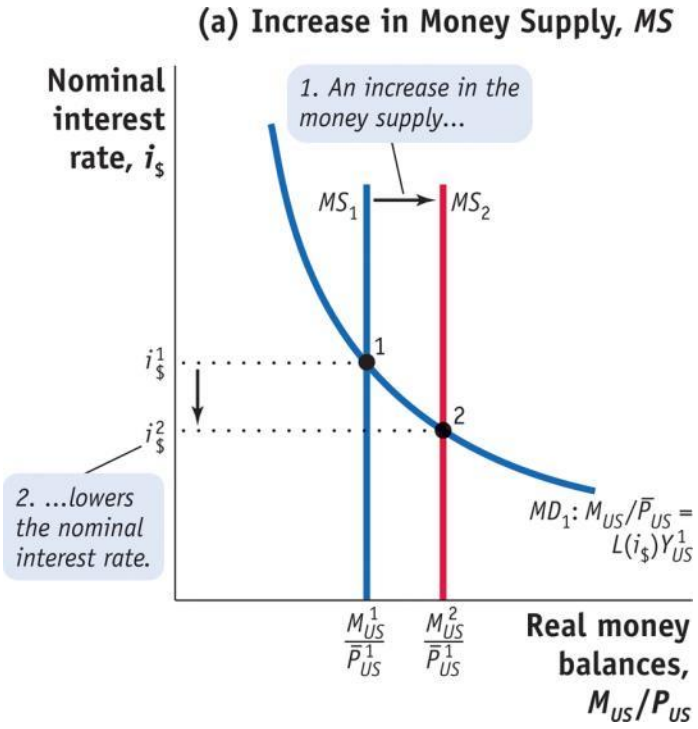


Building Block: The Money Market Equilibrium in the Short Run In these models, the money supply and real income are known exogenous variables (in green boxes).

The models use these variables to predict the unknown endogenous variables (in red boxes), the nominal interest rates in each country.

Changes in Money Supply and the Nominal Interest Rate

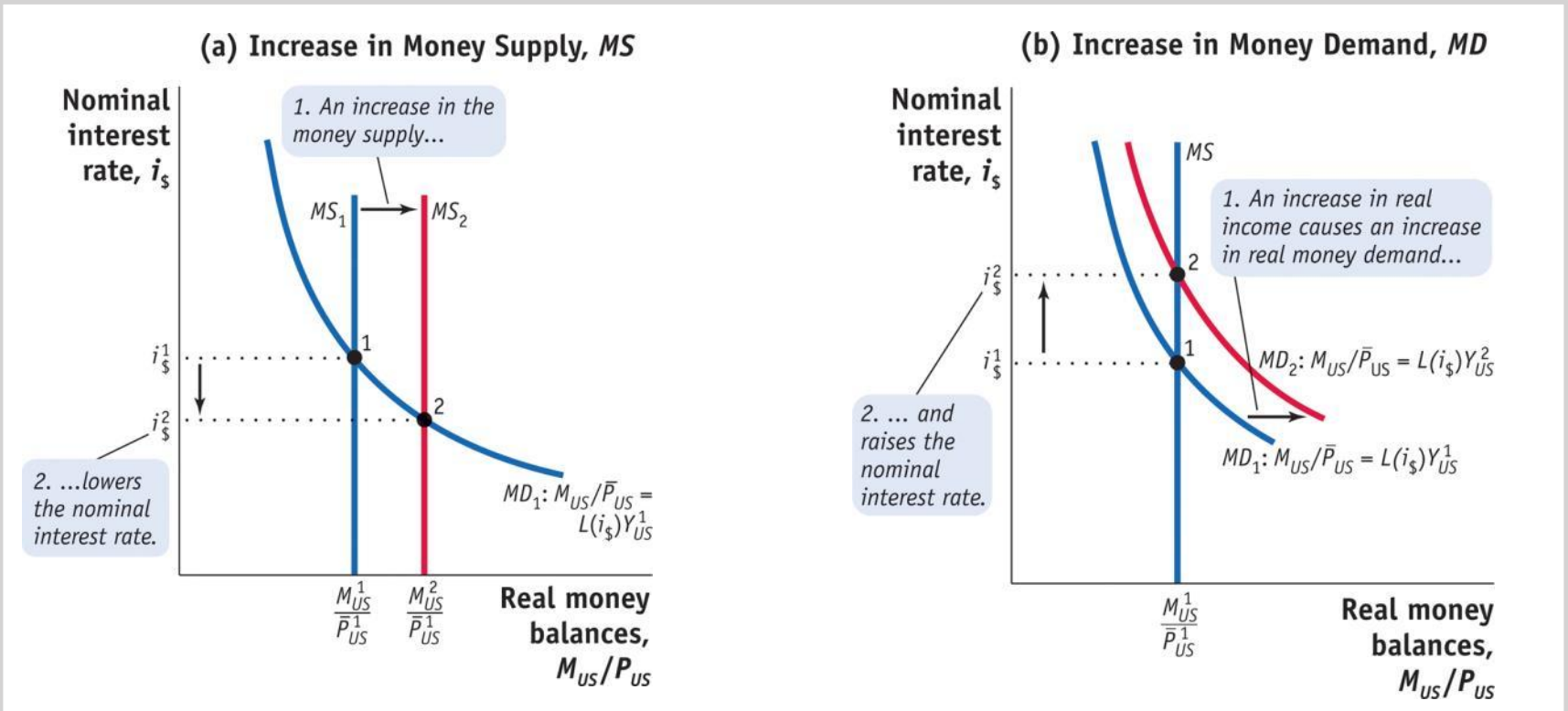
FIGURE 4-6 (1 of 2) Home Money Market with Changes in Money Supply and Money Demand



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

Changes in Money Supply and the Nominal Interest Rate

FIGURE 4-6 (2 of 2) Home Money Market with Changes in Money Supply and Money Demand (continued)



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

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

APPLICATION

Can Central Banks Always Control the Interest Rate? A Lesson from the Crisis of 2008–2009

- In the United States, the Federal Reserve sets as its *policy rate* the interest rate that it charges banks for overnight loans.
- In normal times, changes in this cost of short-term funds for the banks are usually passed through into the *market rates* the banks charge to borrowers as well as on interbank loans between the banks themselves.
- This process is one of the most basic elements in the so-called *transmission mechanism* through which the effects of monetary policy are eventually felt in the real economy.

APPLICATION

Can Central Banks Always Control the Interest Rate? A Lesson from the Crisis of 2008–2009

- In the recent crisis, although the Fed brought its policy rate all the way down from 5.25% to 0% in 2007 and 2008, there was no similar decrease in market rates.
- A second problem arose once policy rates hit the *zero-lower bound* (ZLB).
- At the ZLB, the central banks' capacity to lower interest rate further was exhausted. However, many central banks wanted to keep applying downward pressure to market rates to calm financial markets.
- The Fed's response was a policy of *quantitative easing*.

APPLICATION

Can Central Banks Always Control the Interest Rate? A Lesson from the Crisis of 2008–2009

The Fed engaged in a number of extraordinary policy actions to push more money out more quickly:

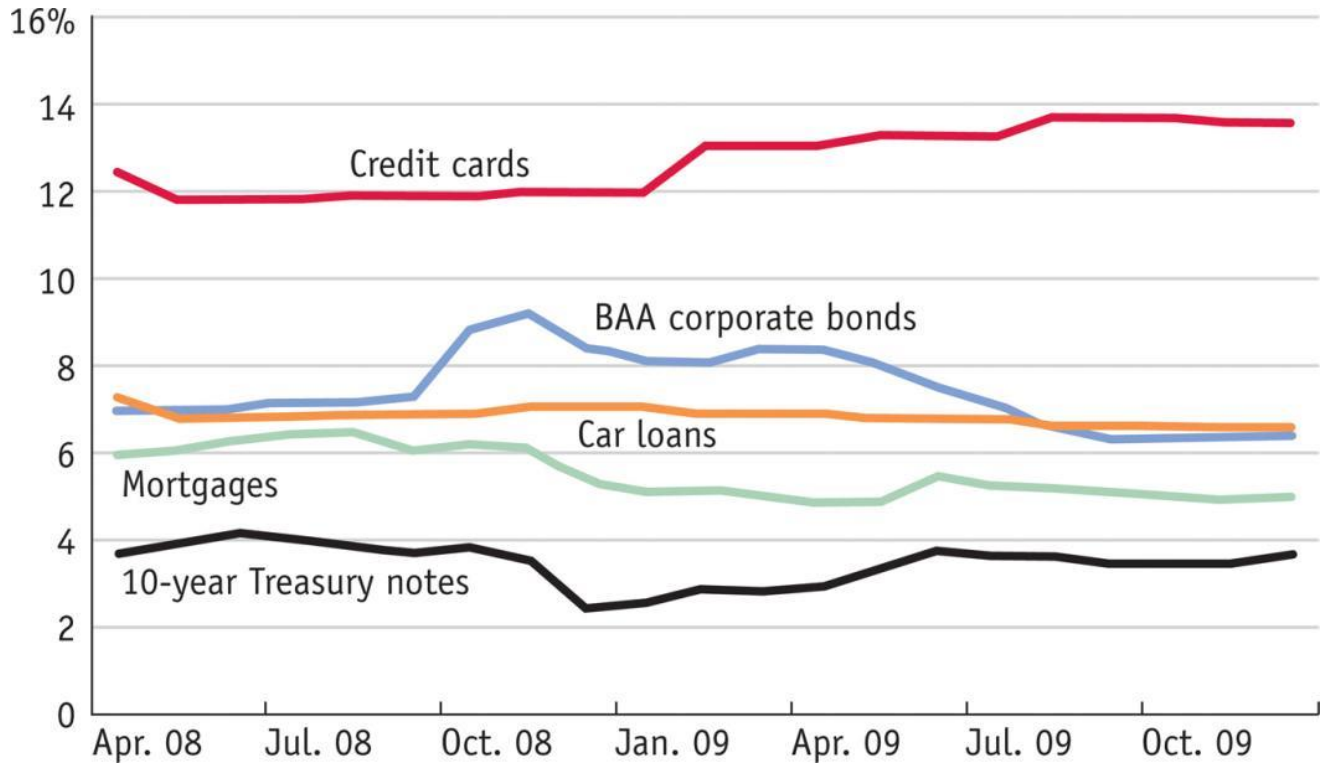
1. It expanded the range of credit securities it would accept as collateral to include lower-grade, private-sector bonds.

2. It expanded the range of securities that it would buy outright to include private-sector credit instruments such as commercial papers and mortgage-backed securities.

3. It expanded the range of counterparties from which it would buy securities to include some nonbank institutions such as primary dealers and money market funds.

APPLICATION

Can Central Banks Always Control the Interest Rate? A Lesson from the Crisis of 2008–2009



A broken transmission: The Fed's extraordinary interventions did little to change private credit market interest rates in 2008–2009.

The Monetary Model: The Short Run Versus the Long Run

Consider the following: the home central bank that previously kept the money supply constant switches to an expansionary policy, allowing the money supply to grow at a rate of 5%.

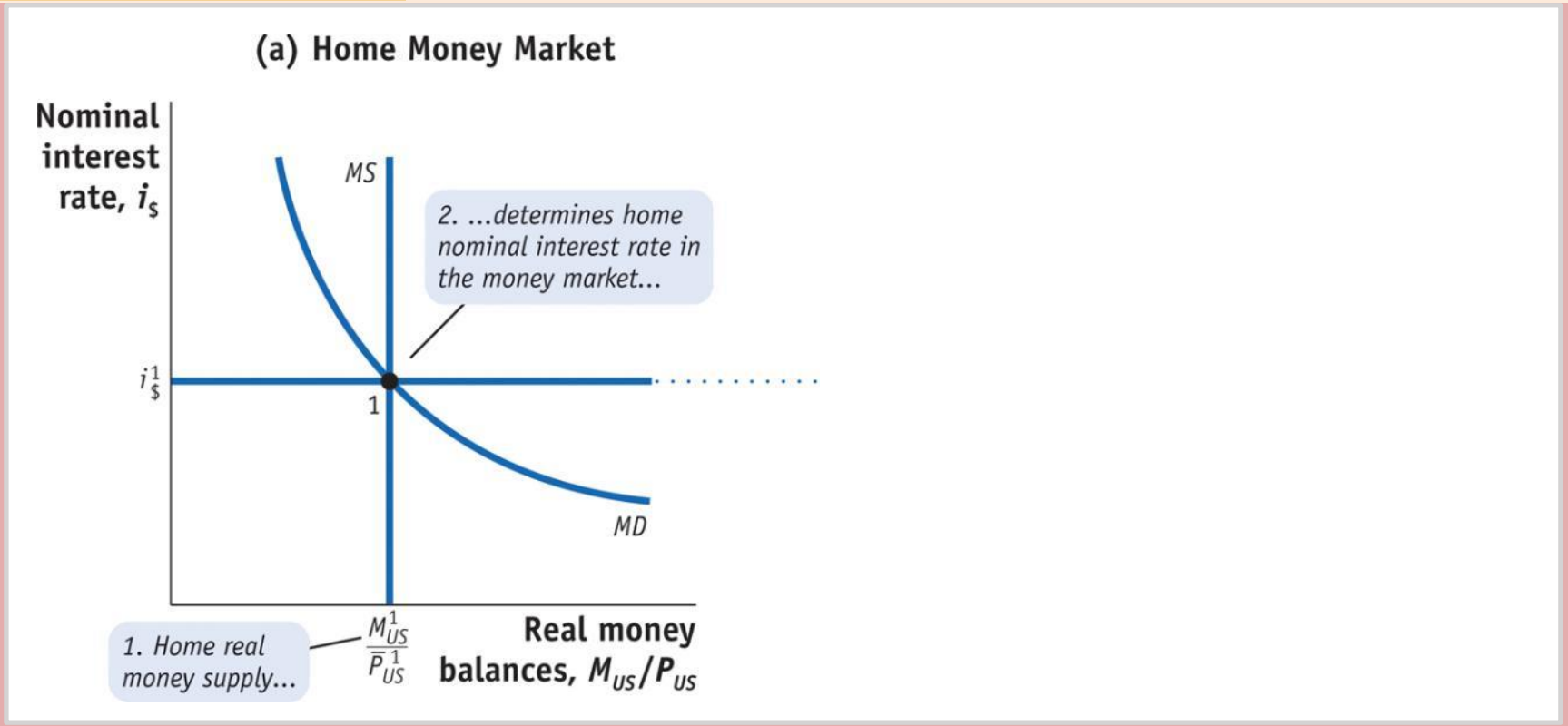
- If this expansion is expected to be permanent, the predictions of the long-run monetary approach and Fisher effect are clear. The Home interest rate *rises* in the long run.

- If this expansion is expected to be temporary, all else equal, the immediate short-run effect in the asset approach is an excess supply of real money balances. The home interest rate will then *fall* in the short run.

It is important to grasp the difference between these two forces.

The Asset Approach to Exchange Rates: Graphical Solution

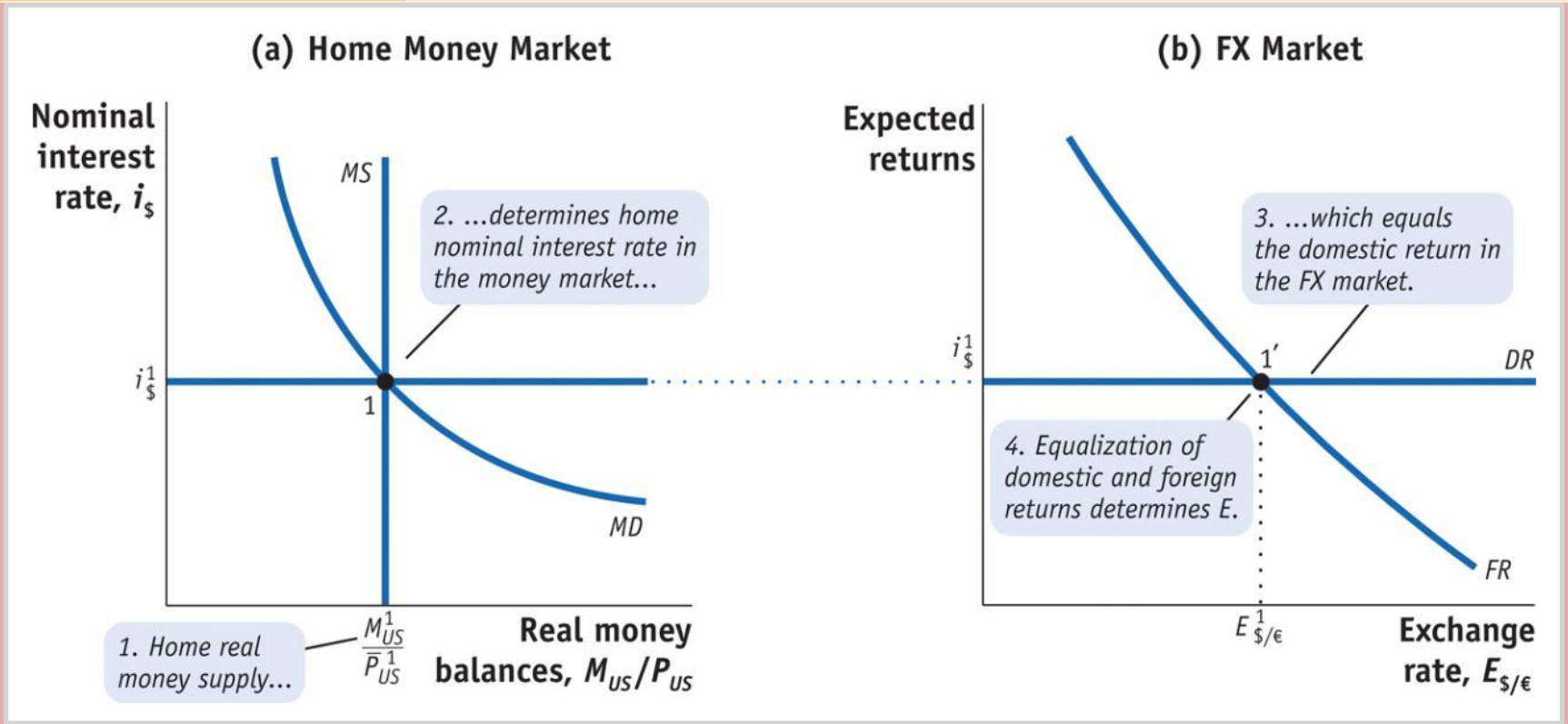
FIGURE 4-7 (1 of 2) Equilibrium in the Money Market and the FX Market



The figure summarizes the equilibria in the two asset markets in one diagram. In panel (a), in the home (U.S.) money market, the home nominal interest rate $i^1_\$$ is determined by the levels of real money supply *MS* and demand *MD* with equilibrium at point 1.

The Asset Approach to Exchange Rates: Graphical Solution

FIGURE 4-7 (2 of 2) Equilibrium in the Money Market and the FX Market (continued)



In panel (b), in the dollar–euro FX market, the spot exchange rate $E^1_{\$/€}$ is determined by foreign and domestic expected returns, with equilibrium at point 1′. Arbitrage forces the domestic and foreign returns in the FX market to be equal, a result that depends on capital mobility.

Capital Mobility Is Crucial

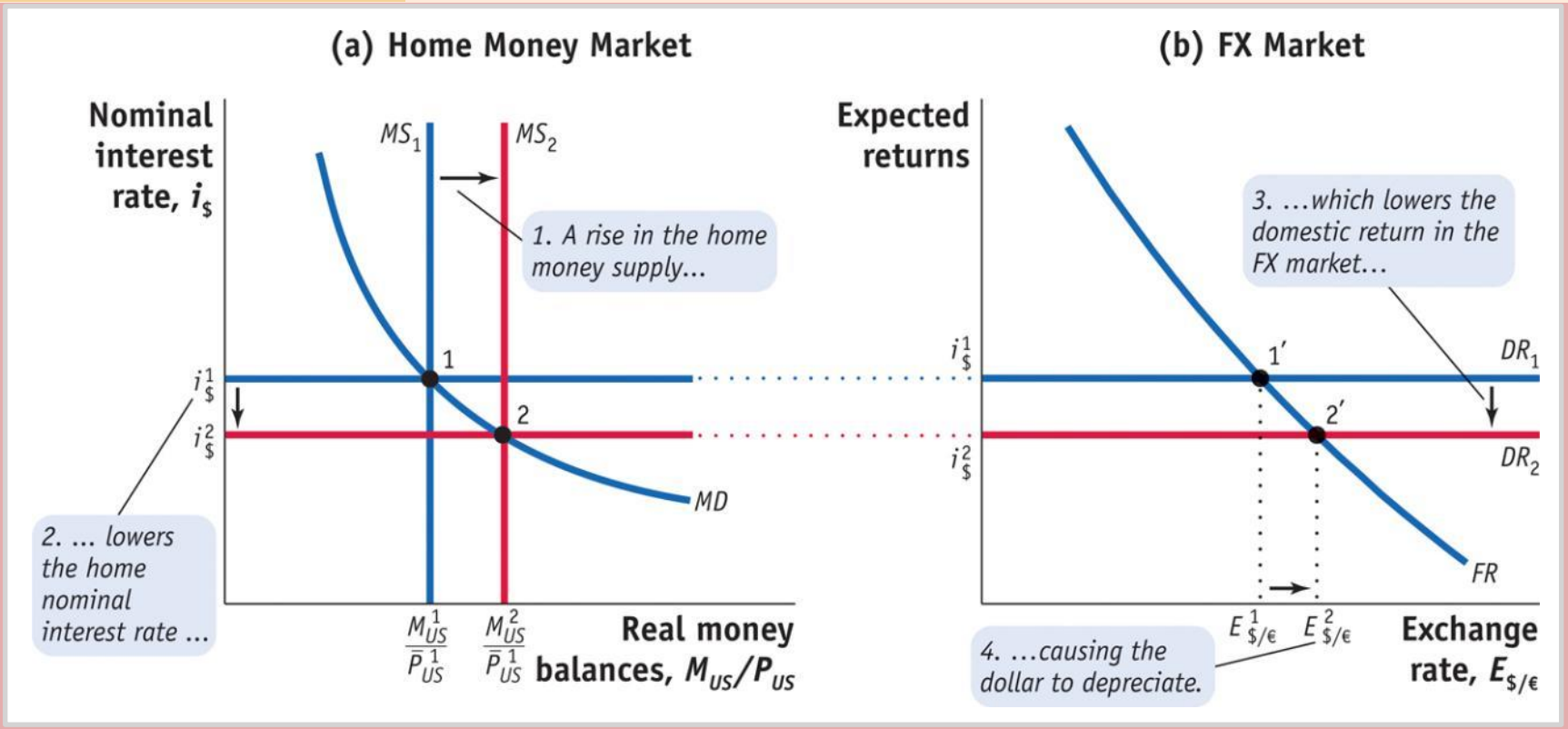
Remember that our assumption that *DR* equals *FR* depends on capital mobility. If capital controls are imposed, there is no arbitrage, and no reason *DR* has to equal *FR*.

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

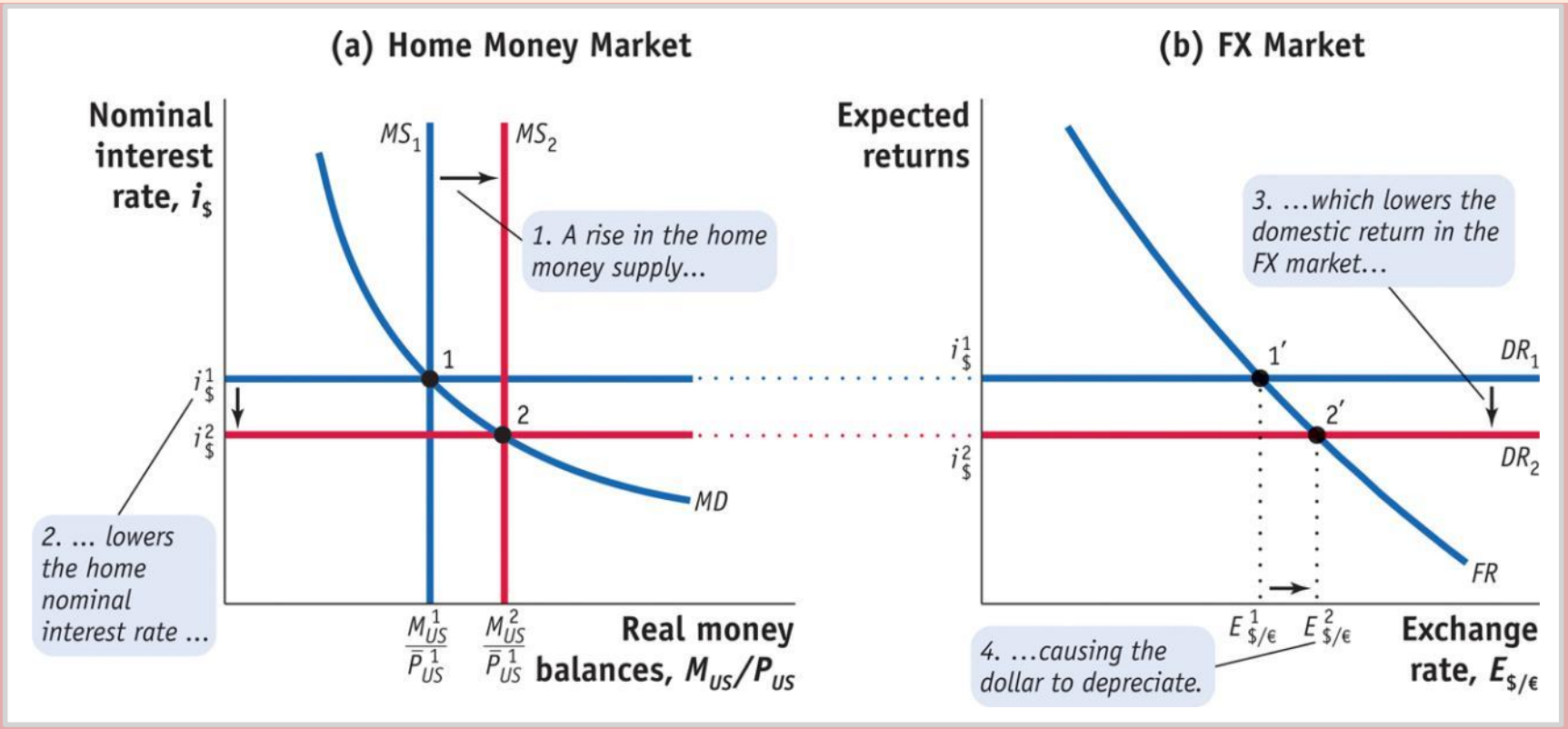
FIGURE 4-8 (1 of 2) Temporary Expansion of the Home Money Supply



In panel (a), in the Home money market, an increase in Home money supply from M^1_{US} to M^2_{US} causes an increase in real money supply from M^1_{US}/P^1_{US} to M^2_{US}/P^1_{US}. To keep real money demand equal to real money supply, the interest rate falls from to $i^1_\$$ to $i^2_\$$, and the new money market equilibrium is at point 2.

Short-Run Policy Analysis

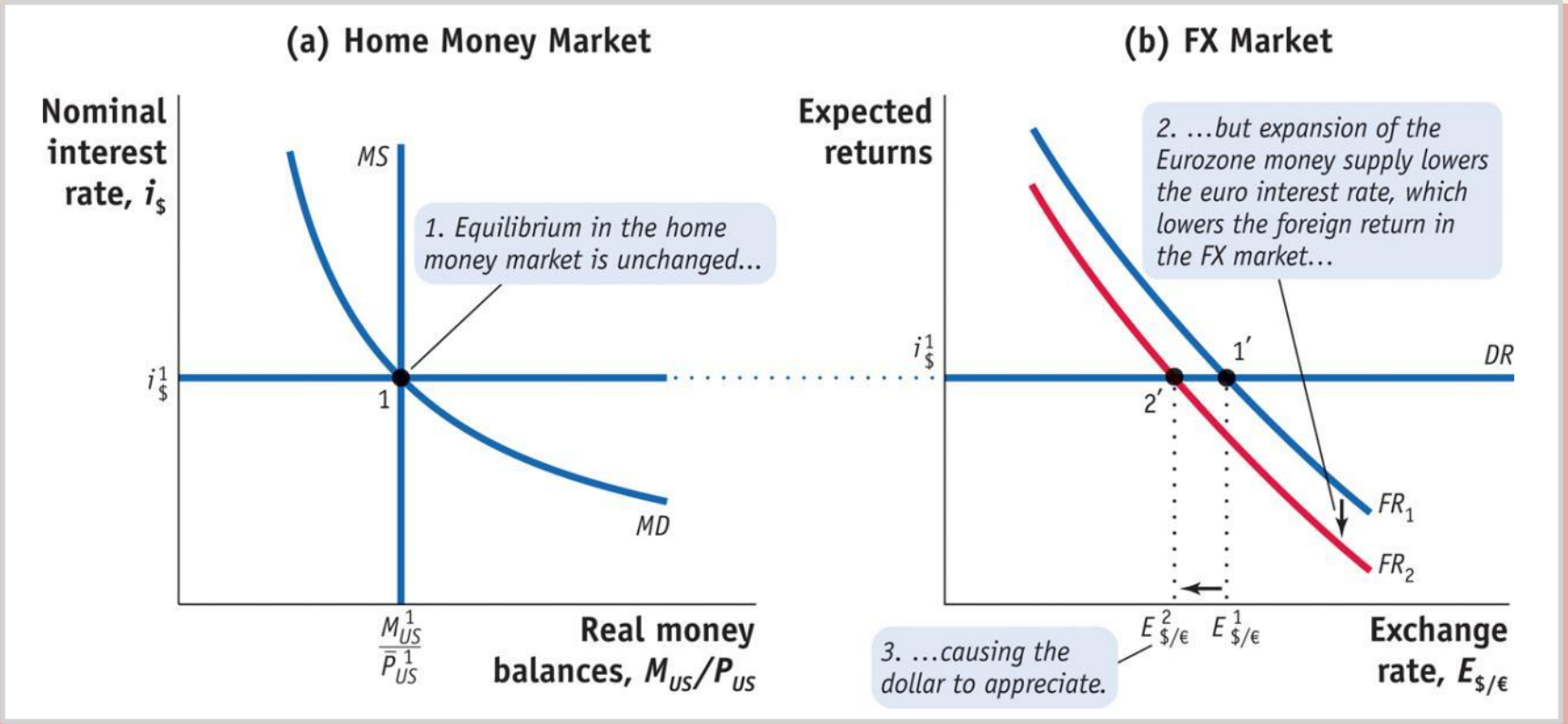
FIGURE 4-8 (2 of 2) Temporary Expansion of the Home Money Supply (continued)



In panel (b), in the FX market, to maintain the equality of domestic and foreign expected returns, the exchange rate rises (the dollar depreciates) from $E^1_{\$/€}$ to $E^2_{\$/€}$, and the new FX market equilibrium is at point 2′.

Short-Run Policy Analysis

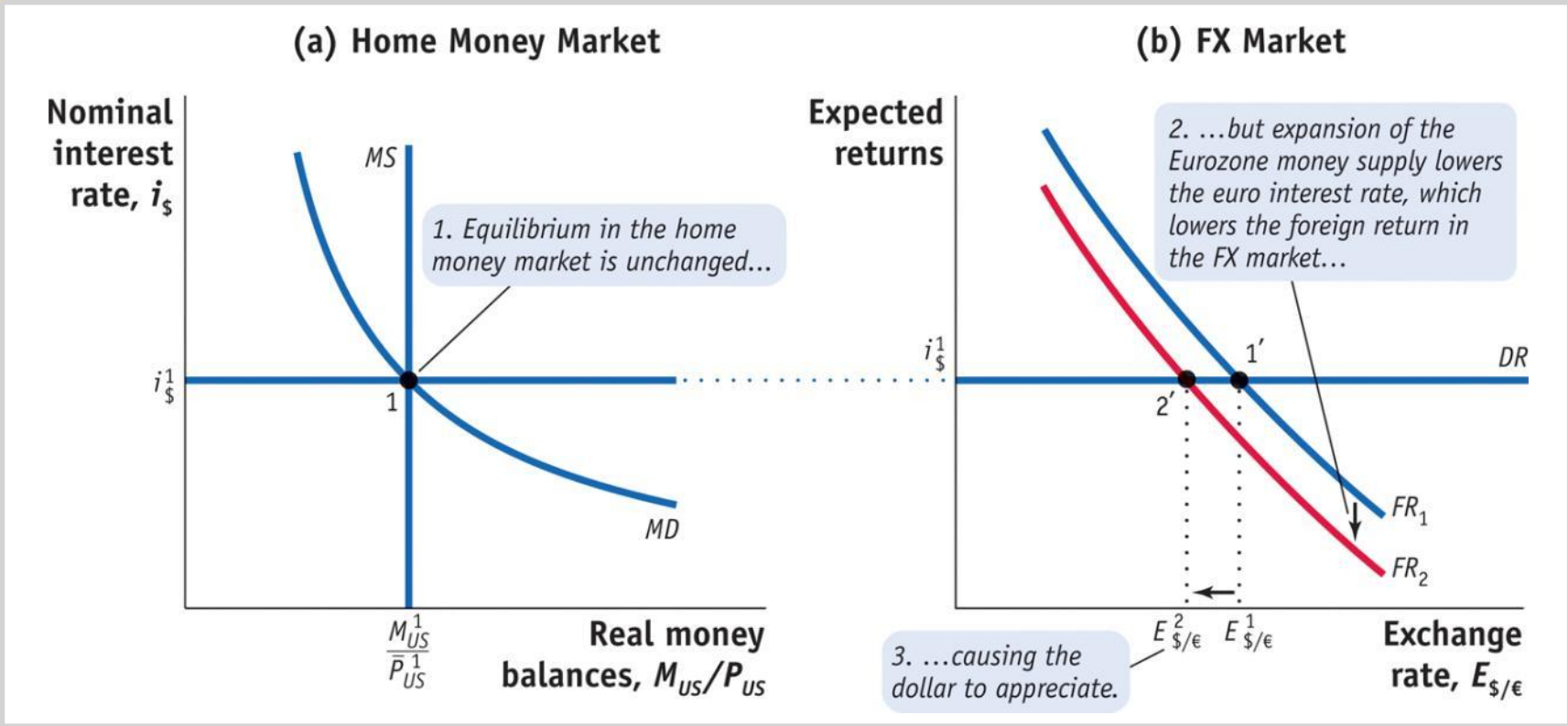
FIGURE 4-9 (1 of 2) Temporary Expansion of the Foreign Money Supply



In panel (a), there is no change in the Home money market. In panel (b), an increase in the Foreign money supply causes the Foreign (euro) interest rate to fall from $i^1_€$ to $i^2_€$.

Short-Run Policy Analysis

FIGURE 4-9 (2 of 2) Temporary Expansion of the Foreign Money Supply (continued)

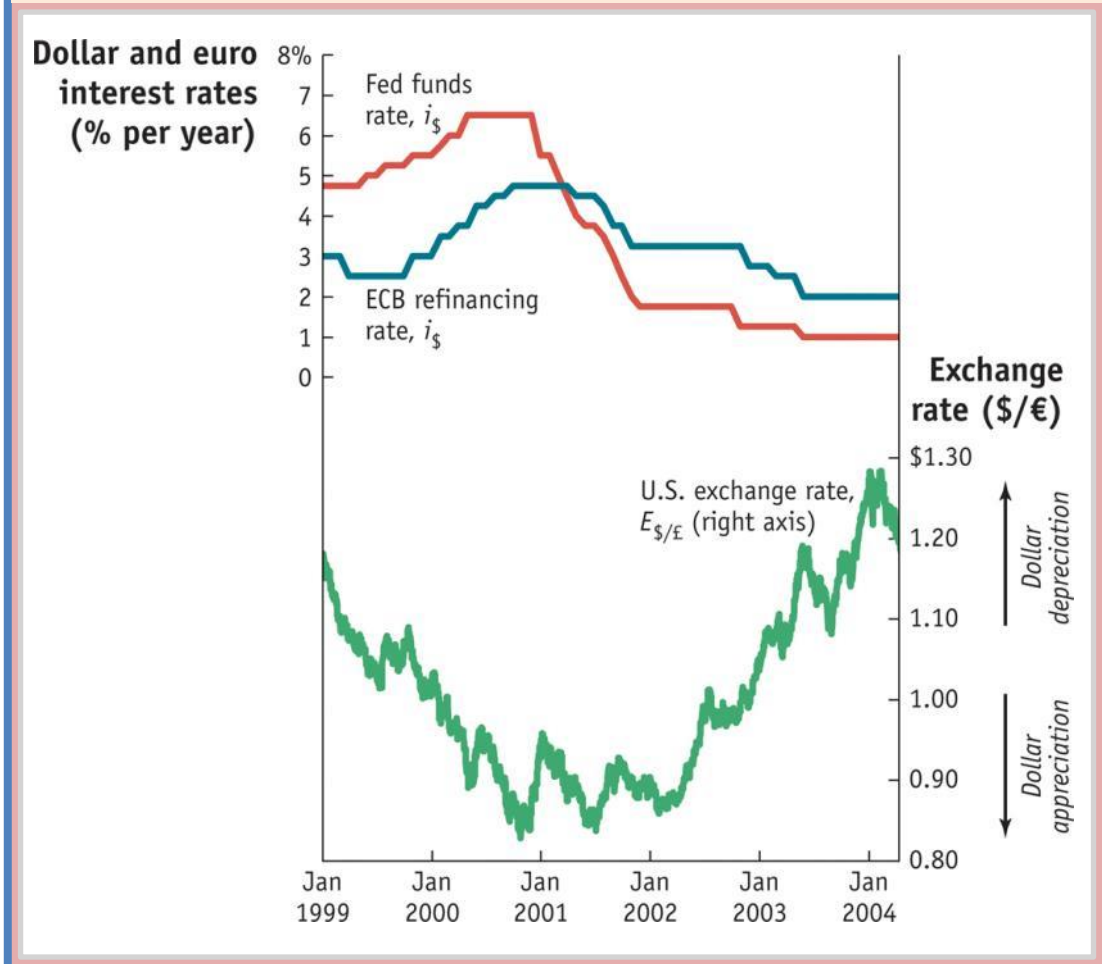


For a U.S. investor, this lowers the foreign return $i_€ + (E^e_{\$/€} - E_{\$/€})/E_{\$/€}$, all else equal. To maintain the equality of domestic and foreign returns in the FX market, the exchange rate falls (the dollar appreciates) from $E^1_{\$/€}$ to $E^2_{\$/€}$, and the new FX market equilibrium is at point 2′.

APPLICATION

The Rise and Fall of the Dollar, 1999–2004

FIGURE 4-10 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. Theory predicts a dollar appreciation (1999–2001) when U.S. interest rates were relatively high, followed by a dollar depreciation (2001–2004) when U.S. interest rates were relatively low. Looking at the figure, you will see that this is what occurred.

4 A Complete Theory: Unifying the Monetary and Asset Approaches

For a complete theory of exchange rates:

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

$$\bar{P}_{US} = M_{US} / [L_{US}(i_{\$})\, Y_{US}]$$

$$\bar{P}_{EUR} = M_{EUR} / [L_{EUR}(i_{€})\, Y_{EUR}]$$

$$i_{\$} = i_{€} + \frac{E^{e}_{\$/€} - E_{\$/€}}{E_{\$/€}}$$

} The asset approach (4-4)

4 A Complete Theory: Unifying the Monetary and Asset Approaches

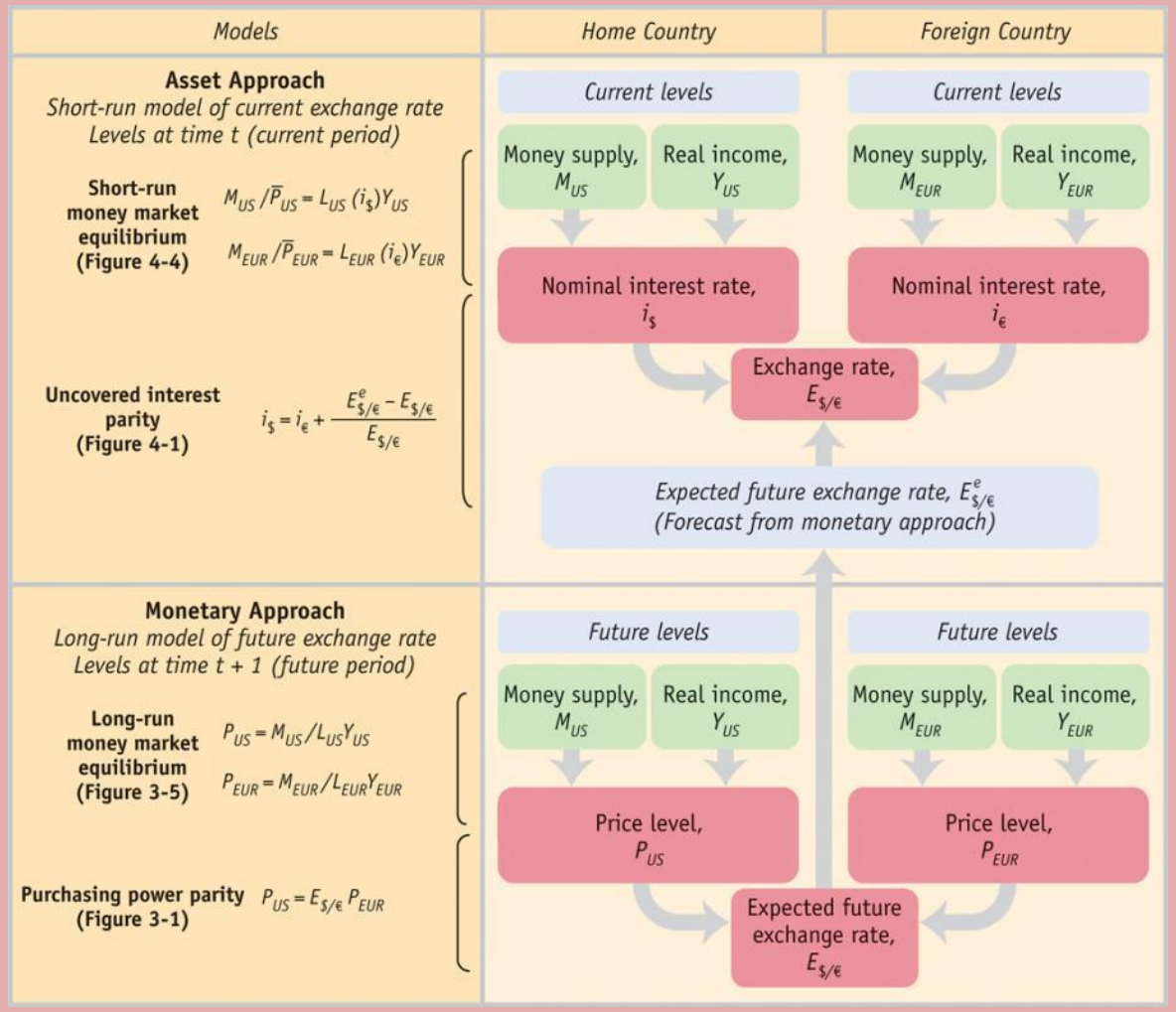
- To forecast the future expected exchange rate, we also need the long-run monetary approach from the previous lecture—a long-run monetary model and purchasing power parity:

$$\left.\begin{aligned} P^e_{US} &= M^e_{US} \,/\, [L_{US}(i^e_{\$})\, Y^e_{US}] \\ P^e_{EUR} &= M^e_{EUR} \,/\, [L_{EUR}(i^e_{€})\, Y^e_{EUR}] \\ E^e_{\$/€} &= P^e_{US} \,/\, P^e_{EUR} \end{aligned}\right\} \text{The monetary approach} \qquad (4\text{-}5)$$

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

4 A Complete Theory: Unifying the Monetary and Asset Approaches

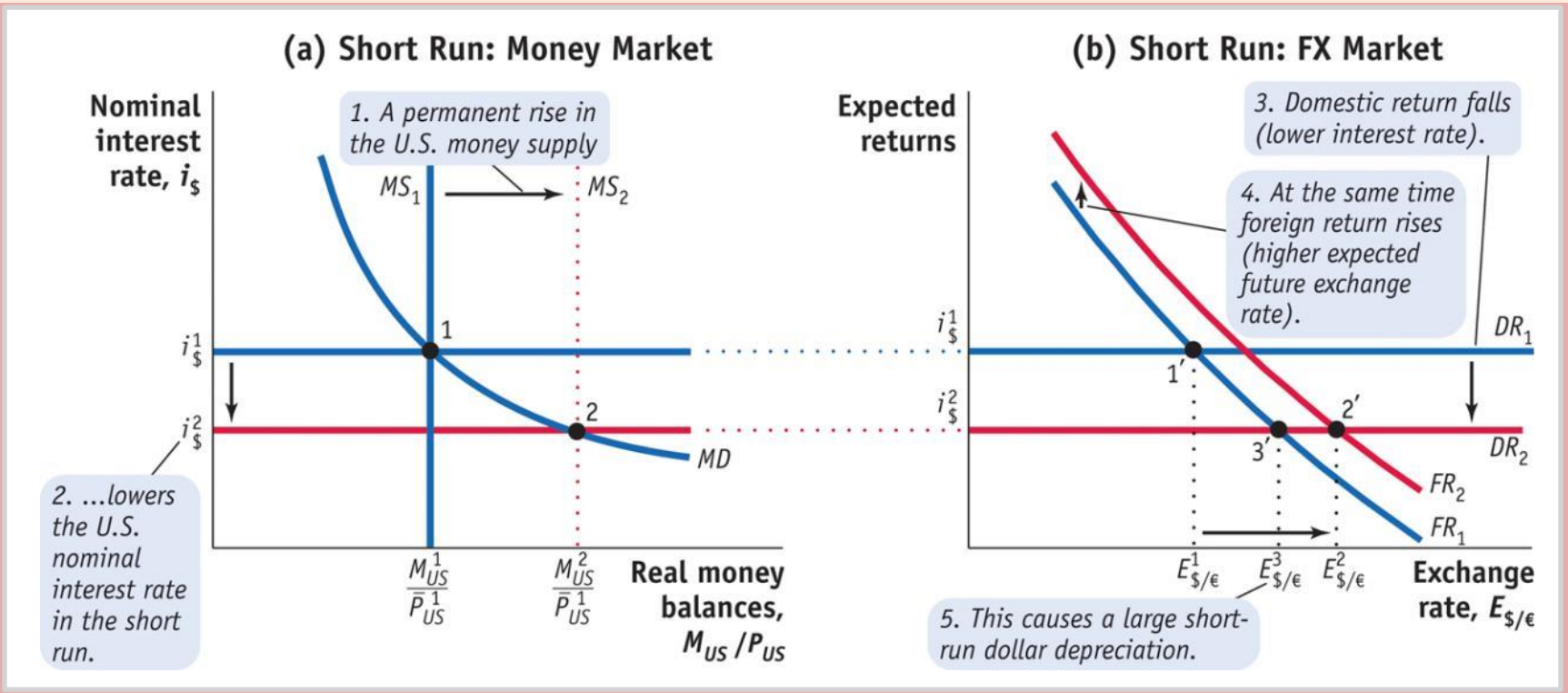
FIGURE 4-11



A Complete Theory of Floating Exchange Rates: All the Building Blocks Together Inputs to the model are known exogenous variables (in green boxes). Outputs of the model are unknown endogenous variables (in red boxes). The levels of money supply and real income determine exchange rates.

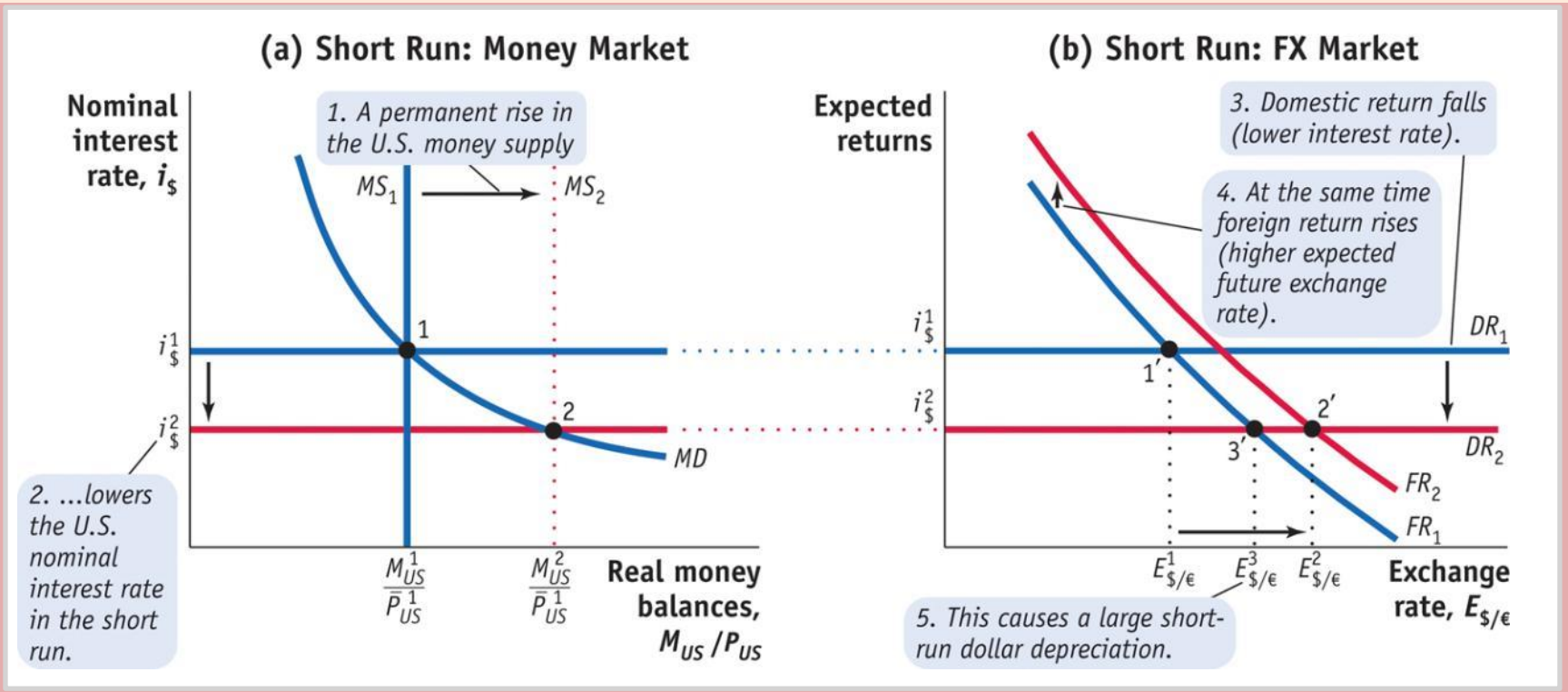
4 A Complete Theory: Unifying the Monetary and Asset Approaches

FIGURE 4-12 (1 of 4) Permanent Expansion of the Home Money Supply, Short-Run Impact



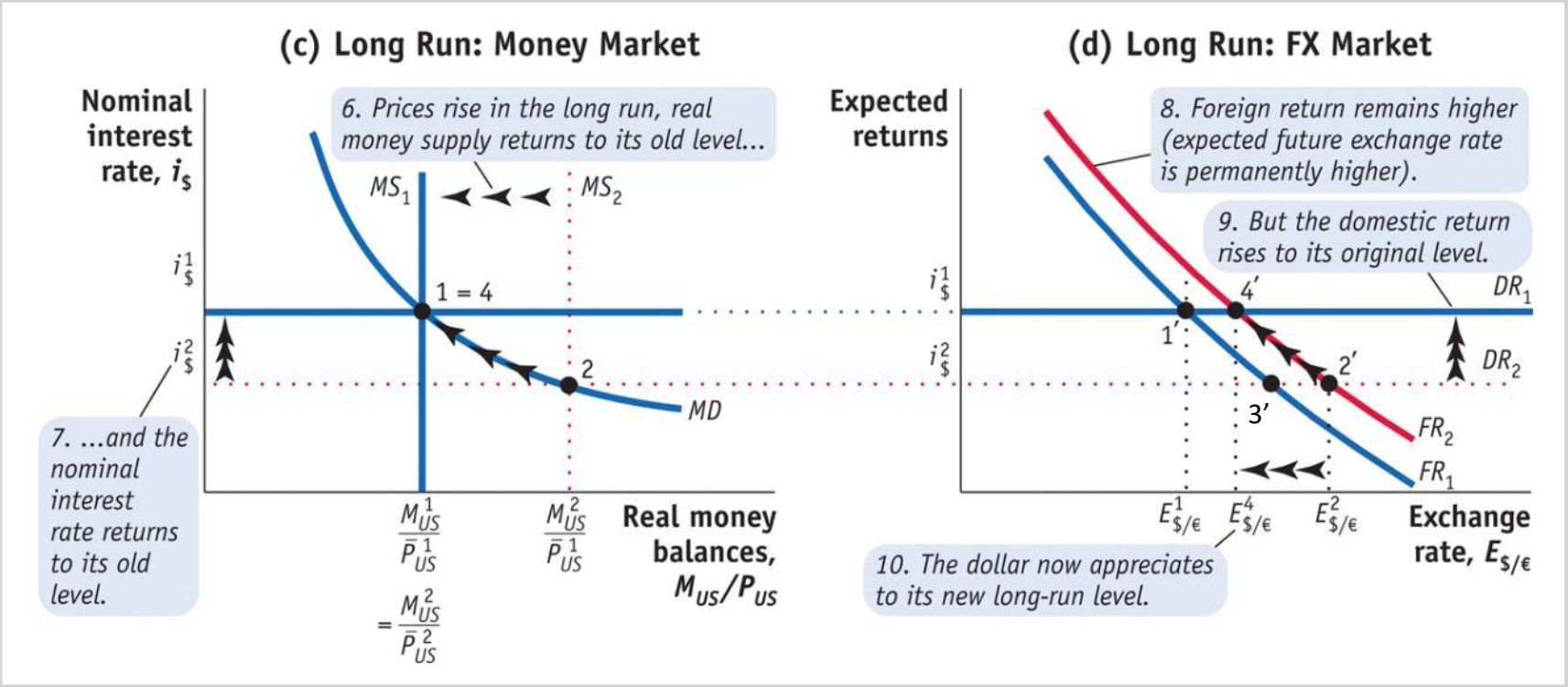
In panel (a), the home price level is fixed, but the supply of dollar balances increases and real money supply shifts out. To restore equilibrium at point 2, the interest rate falls from $i^1_\$$ to $i^2_\$$. In panel (b), in the FX market, the home interest rate falls, so the domestic return decreases and *DR* shifts down. In addition, the permanent change in the home money supply implies a permanent, long-run depreciation of the dollar.

FIGURE 4-12 (2 of 4) Permanent Expansion of the Home Money Supply, Short-Run Impact (continued)



Hence, there is also a permanent rise in $E^e_{\$/€}$, which causes a permanent increase in the foreign return $i_€ + (E^e_{\$/€} - E_{\$/€})/E_{\$/€}$, all else equal; *FR* shifts up from FR_1 to FR_2. The simultaneous fall in *DR* and rise in *FR* cause the home currency to depreciate steeply, leading to a new equilibrium at point 2′ (and not at 3′, which would be the equilibrium if the policy were temporary).

FIGURE 4-12 (3 of 4) Permanent Expansion of the Home Money Supply, Short-Run Impact (continued)

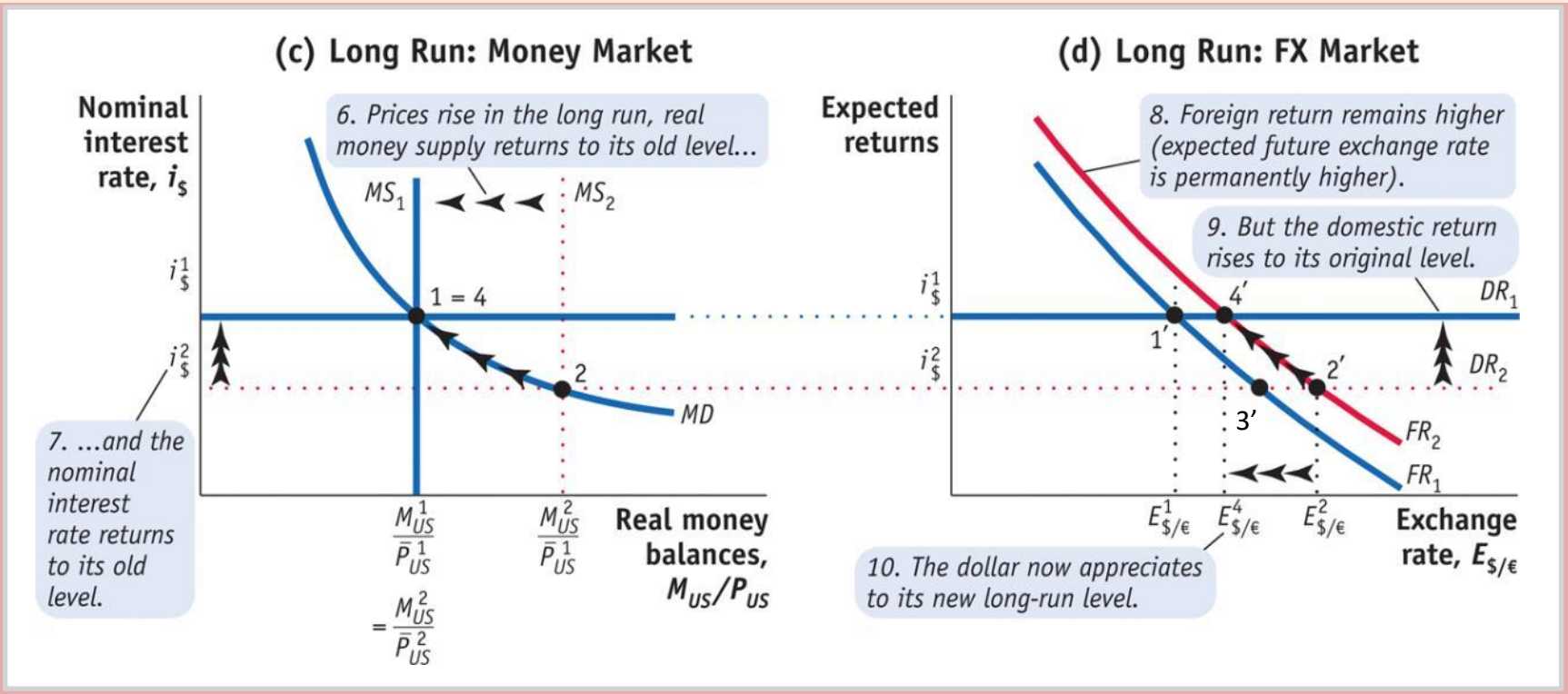


Long-Run Adjustment In panel (c), in the long run, prices are flexible, so the home price level and the exchange rate both rise in proportion with the money supply. Prices rise to P^2_{US}, and real money supply returns to its original level M^1_{US}/P^1_{US}.

The money market gradually shifts back to equilibrium at point 4 (the same as point 1).

4 A Complete Theory: Unifying the Monetary and Asset Approaches

FIGURE 4-12 (4 of 4) Permanent Expansion of the Home Money Supply, Short-Run Impact (continued)

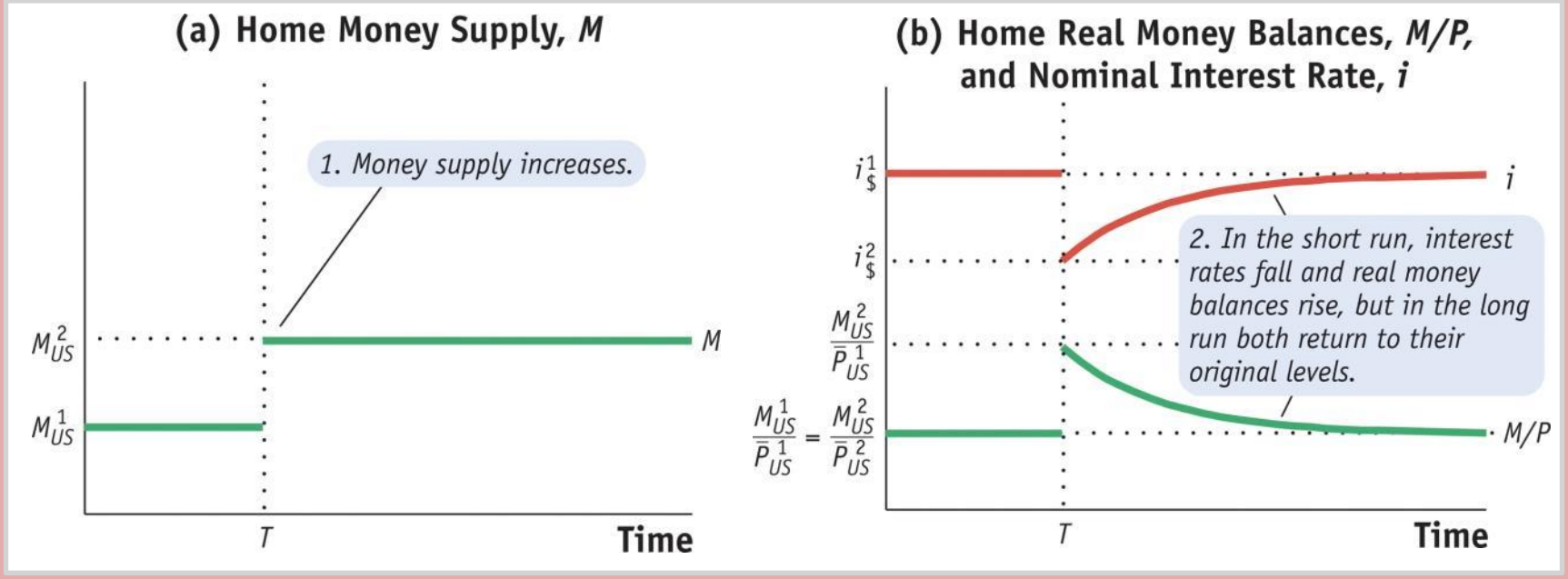


Long-Run Adjustment (continued) In panel (d), in the FX market, the domestic return *DR*, which equals the home interest rate, gradually shifts back to its original level. The foreign return curve *FR* does not move at all: There are no further changes in the foreign interest rate or in the future expected exchange rate. The FX market equilibrium shifts gradually to point 4′. The exchange rate falls (and the dollar appreciates) from $E^2_{\$/€}$ to $E^4_{\$/€}$. Arrows in both graphs show the path of gradual adjustment.

4 A Complete Theory: Unifying the Monetary and Asset Approaches

Overshooting

FIGURE 4-13 (1 of 2) Responses to a Permanent Expansion of the Home Money Supply

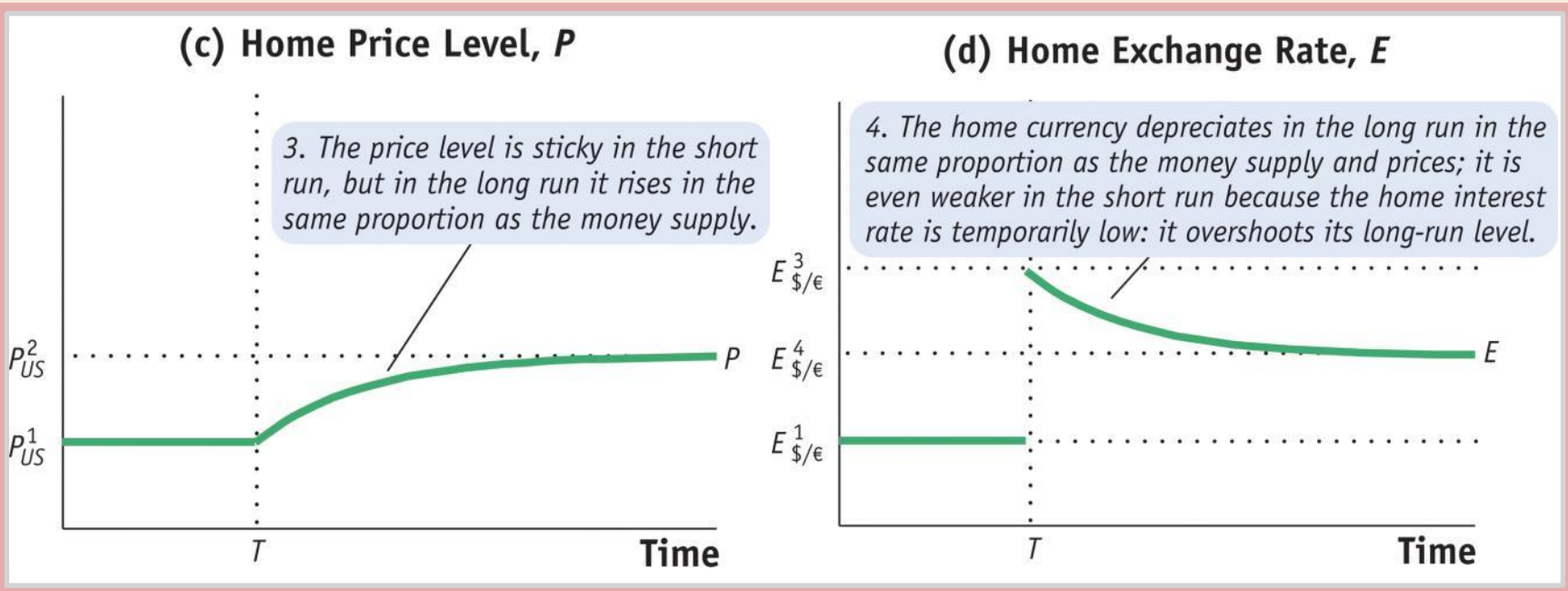


In panel (a), there is a one-time permanent increase in home (U.S.) nominal money supply at time *T*.

In panel (b), prices are sticky in the short run, so there is a short-run increase in the real money supply and a fall in the home interest rate over time.

Overshooting

FIGURE 4-13 (2 of 2) Responses to a Permanent Expansion of the Home Money Supply (continued)

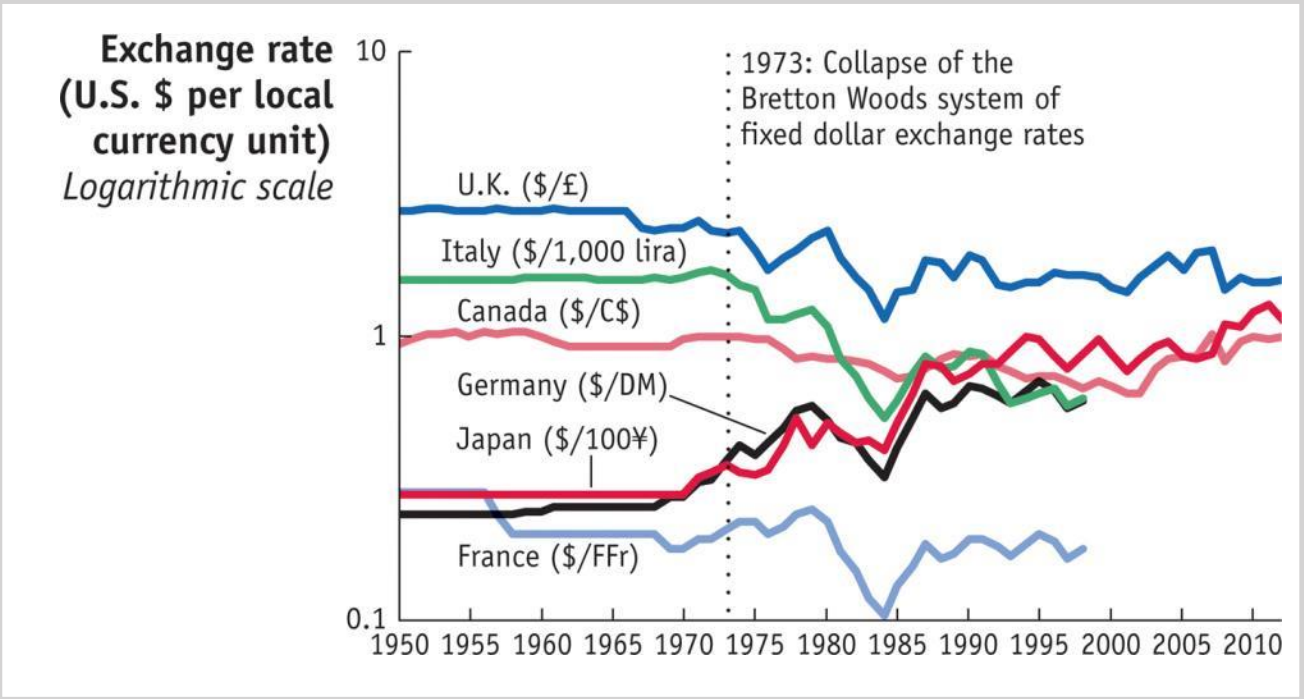


In panel (c), in the long run, prices rise in the same proportion as the money supply.

In panel (d), in the short run, the exchange rate overshoots its long-run value (the dollar depreciates by a large amount), but in the long run, the exchange rate will have risen only in proportion to changes in money and prices.

Overshooting in Practice

FIGURE 4-14



Exchange Rates for Major Currencies Before and After 1973

Under the Bretton Woods system of fixed but adjustable dollar pegs, exchange rates were mostly stable from 1950 until 1970.

The system was declared officially dead in 1973. From then on, all of these currencies have fluctuated against the dollar.

What Is a Fixed Exchange Rate Regime?

- Here we focus on the case of a fixed rate regime without controls so that capital is mobile (*no capital controls*), and arbitrage is free to operate in the foreign exchange market.
- Central banks buy and sell foreign currency at a fixed price, thus holding the market exchange rate at a fixed level $\bar{E}$.
- We examine the implications of Denmark's decision to peg its currency, the krone, to the euro at a fixed rate: $\bar{E}_{DKr/€}$
- The foreign country remains the Eurozone, and the home country is now Denmark.

What Is a Fixed Exchange Rate Regime?

- In the long run, fixing the exchange rate is one kind of nominal anchor. Even if it allowed the krone to float but had some other nominal anchor, Denmark's monetary policy would still be constrained in the long run by its chosen nominal target.
- *What we now also show is that a country with a fixed exchange rate faces monetary policy constraints not just in the long run but also in the short run.*

Pegging Sacrifices Monetary Policy Autonomy in the Short Run: Example

The Danish central bank must set its interest rate equal to $i_{€}$, the rate set by the European Central Bank (ECB):

$$i_{DKr} = i_{€} + \underbrace{\frac{E^{e}_{DKr/€} - E_{DKr/€}}{E_{DKr/€}}}_{\text{Equals zero for a credible fixed exchange rate}} = i_{€}$$

Denmark has lost control of its monetary policy: it cannot independently change its interest rate under a peg.

$$M_{DEN} = \bar{P}_{DEN}\, L_{DEN}(i_{DKr})\, Y_{DEN} = \bar{P}_{DEN}\, L_{DEN}(i_{€})\, Y_{DEN}$$

Pegging Sacrifices Monetary Policy Autonomy in the Short Run: Example

Our short-run theory still applies, but with a different chain of causality.

- **Under a float**:
  - The home monetary authorities pick the money supply *M*.
  - In the short run, the choice of *M* determines the interest rate *i* in the money market; in turn, via UIP, the level of *i* determines the exchange rate *E*.
  - The money supply is an input in the model (an exogenous variable), and the exchange rate is an output of the model (an endogenous variable).

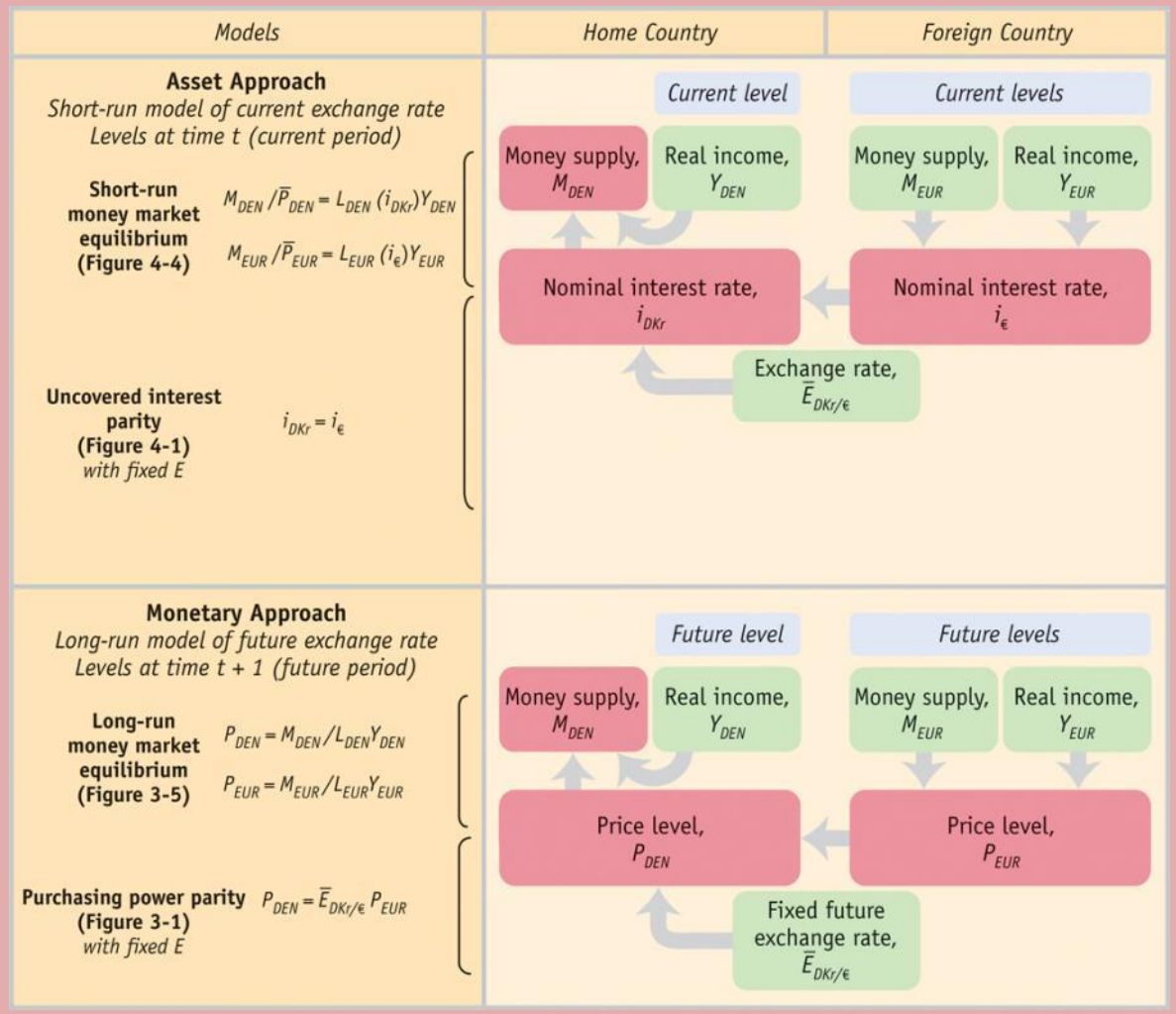
Pegging Sacrifices Monetary Policy Autonomy in the Short Run: Example

Our short-run theory still applies, but with a different chain of causality.

- **Under a fix**, this logic is reversed:
  - Home monetary authorities pick the fixed level of the exchange rate *E*.
  - In the short run, a fixed *E* pins down the home interest rate *i* via UIP ($i = i^*$, the foreign interest rate); in turn, this *i* determines the money supply *M* necessary to meet money demand.
  - The exchange rate is an input in the model (an exogenous variable), and the money supply is an output of the model (an endogenous variable).

5 Fixed Exchange Rates and the Trilemma

FIGURE 4-15



A Complete Theory of Fixed Exchange Rates: Same Building Blocks, Different Known and Unknown Variables

Unlike in Figure 4-11, the home country is now assumed to fix its exchange rate with the foreign country.

The levels of real income and the fixed exchange rate determine the home money supply levels, given outcomes in the foreign country.

Pegging Sacrifices Monetary Policy Autonomy in the Long Run: Example

- The price level in Denmark is determined in the long run by PPP. But if the exchange rate is pegged, we can write long-run PPP for Denmark as:

$$P_{DEN} = \bar{E}_{DKr/€} P_{EUR}$$

- With the long-run nominal interest and price level outside of Danish control, monetary policy autonomy is impossible. We just substitute $i_{DKr} = i_€$ and $P_{DEN} = \bar{E}_{DKr/€} P_{EUR}$ into Denmark's long-run money market equilibrium to obtain:

$$M_{DEN} = P_{DEN} L_{DEN}(i_{DKr}) \; Y_{DEN} = \bar{E}_{DKr/€} \, P_{EUR} \, L_{DEN}(i_€) Y_{DEN}$$

Pegging Sacrifices Monetary Policy Autonomy in the Long Run: Example

Our long-run theory still applies, but with a different chain of causality.

- **Under a float**:
  - The home monetary authorities pick the money supply *M*.
  - In the long run, the growth rate of *M* determines the interest rate *i* via the Fisher effect and also the price level *P*; in turn, via PPP, the level of *P* determines the exchange rate *E*.
  - The money supply is an input in the model (an exogenous variable), and the exchange rate is an output of the model (an endogenous variable).

Pegging Sacrifices Monetary Policy Autonomy in the Long Run: Example

Our long-run theory still applies, but with a different chain of causality.

- **Under a fix**, this logic is reversed:
  - Home monetary authorities pick the exchange rate *E*.
  - In the long run, the choice of *E* determines the price level *P* via PPP, and also the interest rate *i* via UIP; these, in turn, determine the necessary level of the money supply *M*.
  - The exchange rate is an input in the model (an exogenous variable), and the money supply is an output of the model (an endogenous variable).

The Trilemma

Consider the following three equations and parallel statements about desirable *policy goals*.

1.

$$\frac{E^e_{DKr/€} - E_{DKr/€}}{E_{DKr/€}} = 0$$

A fixed exchange rate

- May be desired as a means to promote stability in trade and investment
- Represented here by zero expected depreciation

2.

$$i_{DKr} = i_€ + \frac{E^e_{DKr/€} - E_{DKr/€}}{E_{DKr/€}}$$

International capital mobility

- May be desired as a means to promote integration, efficiency, and risk sharing
- Represented here by uncovered interest parity, which results from arbitrage

The Trilemma

Consider the following three equations and parallel statements about desirable *policy goals*.

3.

$$i_{DKr/€} \neq i_{€}$$

Monetary policy autonomy

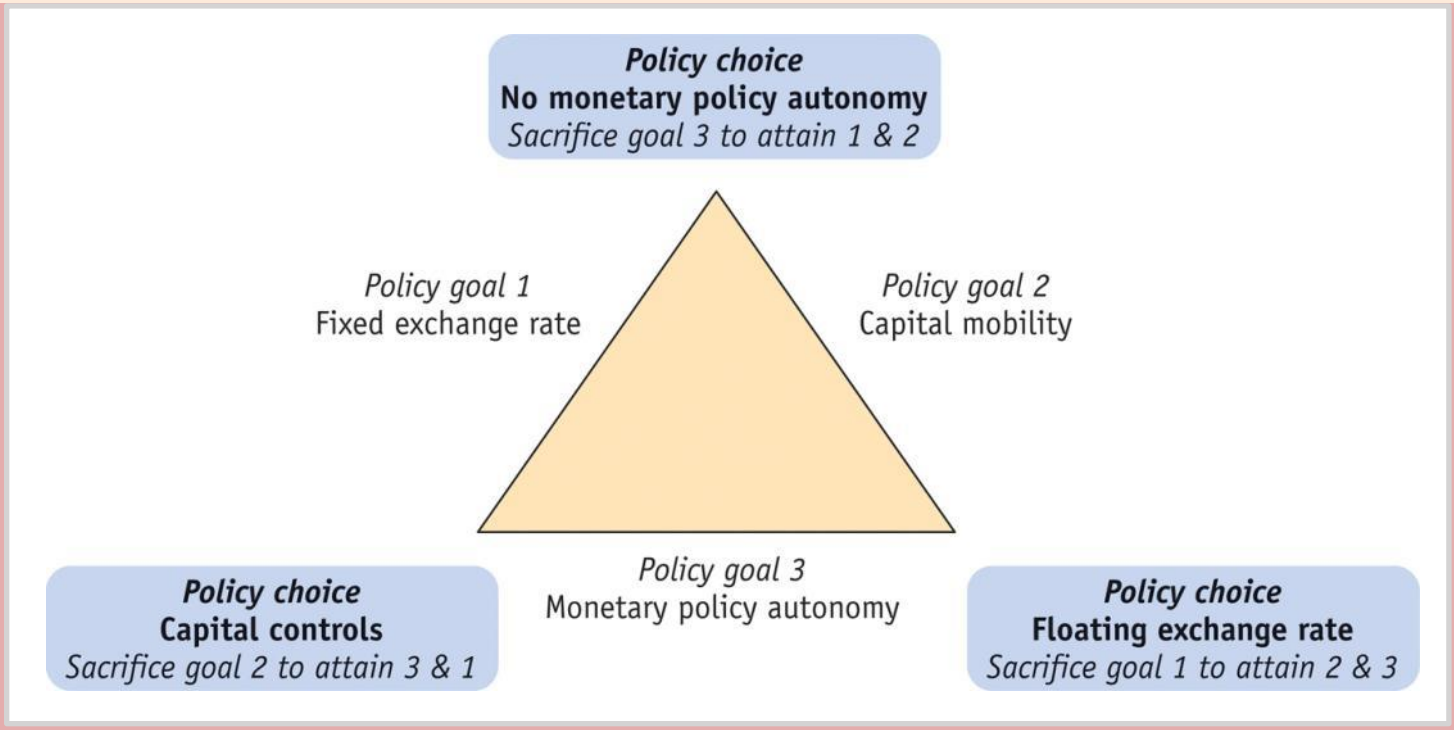
- May be desired as a means to manage the Home economy's business cycle
- Represented here by the ability to set the Home interest rate independently of the foreign interest rate

The Trilemma

- Formulae 1, 2, and 3 show that achieving all three policy goals at the same time is a *mathematical impossibility,* since:
  - 1 and 2 imply not 3 (1 and 2 imply interest equality, contradicting 3).
  - 2 and 3 imply not 1 (2 and 3 imply an expected change in *E,* contradicting 1).
  - 3 and 1 imply not 2 (3 and 1 imply a difference between domestic and foreign returns, contradicting 2).
- This result, known as the **trilemma**, is one of the most important ideas in international macroeconomics.

The Trilemma

FIGURE 4-16



The Trilemma Each corner of the triangle represents a viable policy choice. The labels on the two adjacent edges of the triangle are the goals that can be attained; the label on the opposite edge is the goal that has to be sacrificed.

SIDE BAR

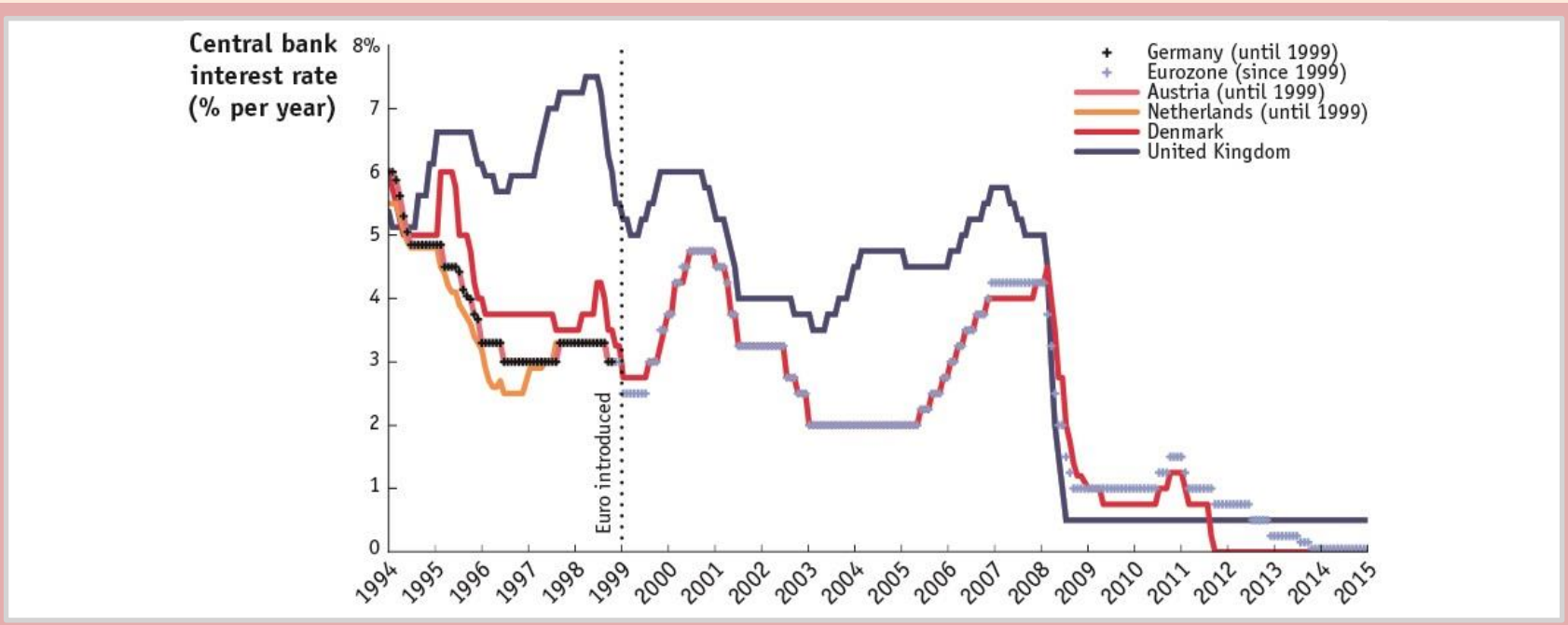
Intermediate Regimes

- The lessons of the Trilemma most clearly apply when the policies are at the ends of a spectrum:
  - A hard peg or a float
  - Perfect capital mobility or immobility
  - Complete autonomy or none at all
- But sometimes a country may not be fully in one of the three corners: The rigidity of the peg, the degree of capital mobility, and the independence of monetary policy could be partial rather than full.

APPLICATION

The Trilemma in Europe

FIGURE 4-17 (1 of 2) The Trilemma in Europe



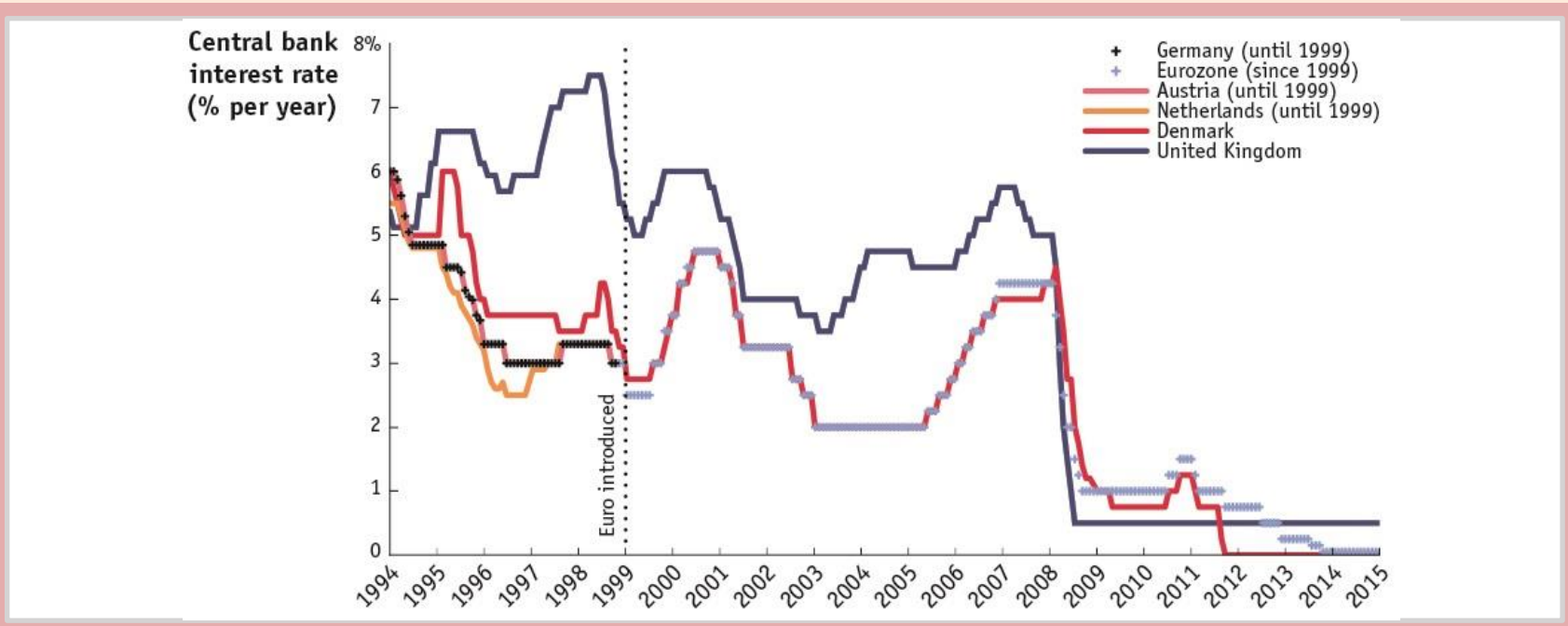
The figure shows selected central banks' base interest rates for the period 1994–2015 with reference to the German mark and euro base rates.

In this period, the British made a policy choice to float against the German mark and (after 1999) against the euro. This permitted monetary independence because interest rates set by the Bank of England could diverge from those set in Frankfurt.

APPLICATION

The Trilemma in Europe

FIGURE 4-17 (2 of 2) The Trilemma in Europe (continued)



No such independence in policy making was afforded by the Danish decision to peg the krone first to the mark and then to the euro. Since 1999 the Danish interest rate has moved in line with the ECB rate. Similar forces operated pre-1999 for other countries pegging to the mark, such as the Netherlands and Austria. Until they joined the Eurozone in 1999, their interest rates, like that of Denmark, closely tracked the German rate.

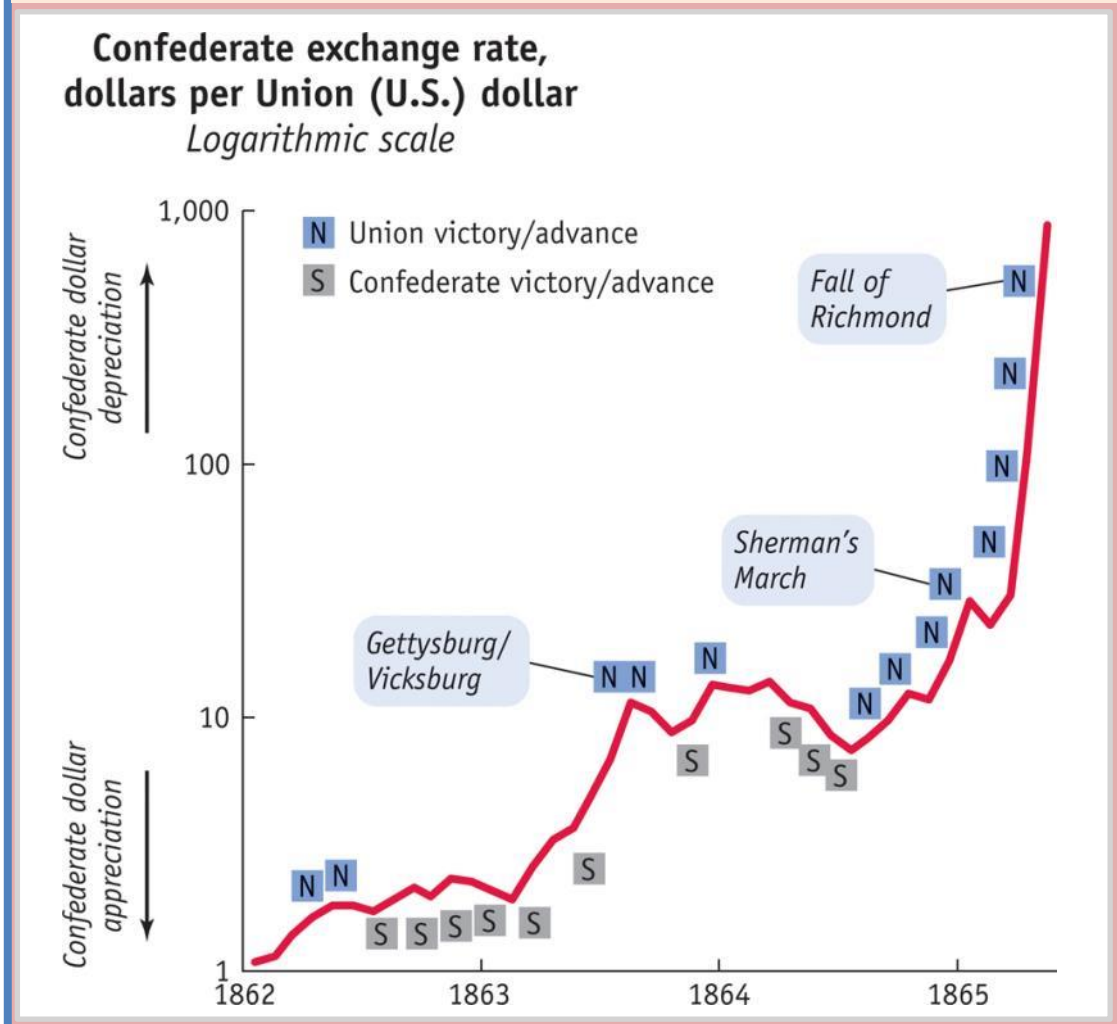
APPLICATION

News and the Foreign Exchange Market in Wartime

- War raises the risk that a currency may depreciate in value rapidly in the future, possibly all the way to zero.
- Investors in the foreign exchange market are continually updating their forecasts about a war's possible outcomes.
- As a result, the path of an exchange rate during wartime usually reveals a clear influence of the effects of news.

APPLICATION

FIGURE 4-18



Exchange Rates and News in the U.S. Civil War The value of the Confederate dollar fluctuated against the U.S. dollar and is shown on a logarithmic scale.

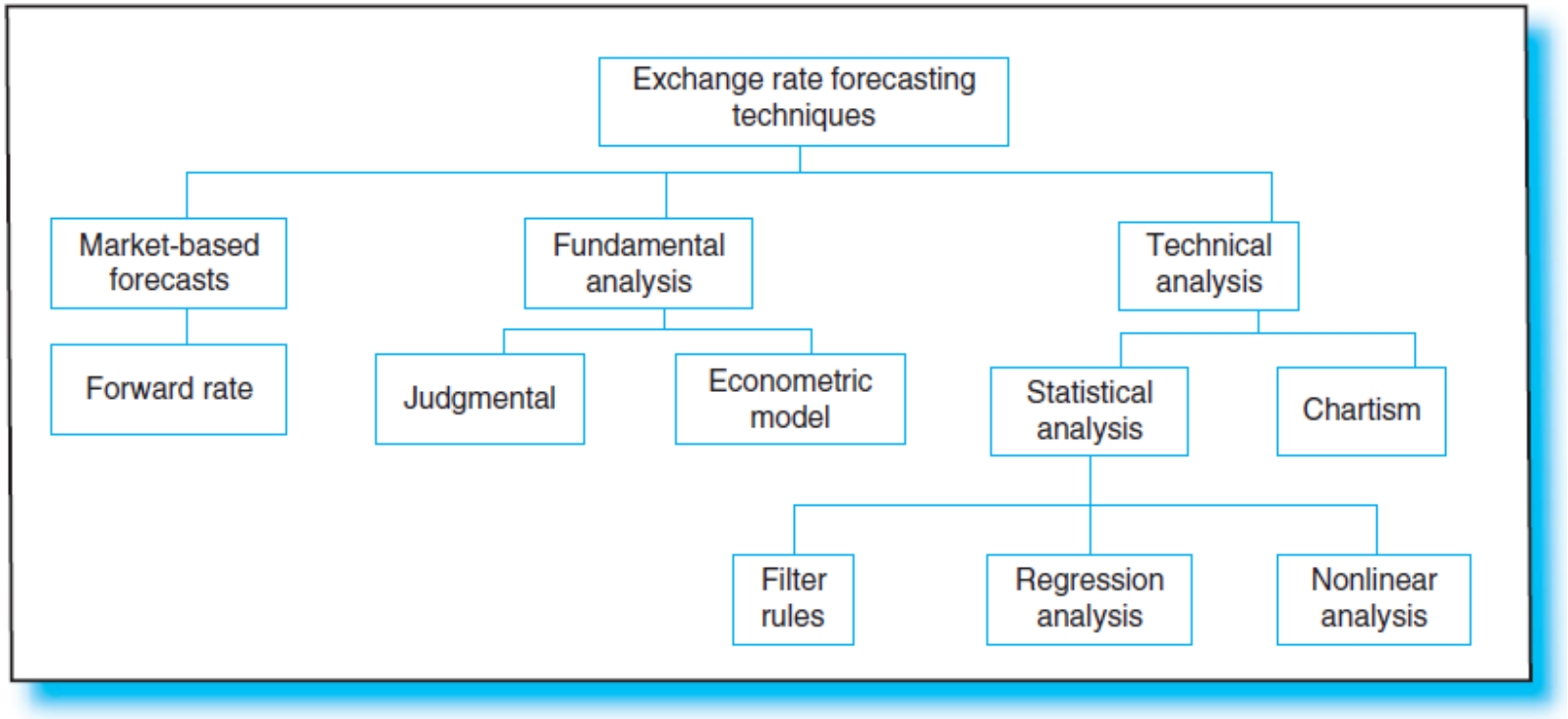
Against the backdrop of a steady trend, victories and advances by the North (N) were generally associated with faster depreciation of the Confederate currency, whereas major Southern successes (S) usually led to a stronger Confederate currency.

6 Exchange rate forecasting

The Trilemma

While forecasters use a wide variety of forecasting techniques, most can be classified into three distinct approaches:

1. Efficient market approach
2. Fundamental approach
3. Technical approach



Efficient market approach (EMH)

- Financial markets are said to be efficient if the current asset prices fully reflect all the available and relevant information.

- Suppose that foreign exchange markets are efficient:
  - The current exchange rate has already reflected all relevant information, such as money supplies, inflation rates, trade balances, and output growth.
  - The exchange rate will then change only when the market receives new information. Since news by definition is unpredictable, the exchange rate will change randomly over time.
  - In a word, incremental changes in the exchange rate will be independent of the past history of the exchange rate.

- If the exchange rate indeed follows a **random walk**, the future exchange rate is expected to be the same as the current exchange rate

$$S_t = E(S_{t+1})$$

Efficient market approach (EMH)

- Researchers found it difficult to reject the random walk hypothesis for exchange rates on empirical grounds
- There is no theoretical reason why exchange rates should follow a pure random walk.
- The parity relationships we discussed previously indicate that the current forward exchange rate can be viewed as the market's consensus forecast of the future exchange rate based on the available information ($I\,t$) if the foreign exchange markets are efficient

$$F_t = E(S_{t+1}|I_t)$$

- To the extent that interest rates are different between two countries, the forward exchange rate will be different from the current spot exchange rate.
- The **future exchange rate** should be **expected to be different** from the **current spot exchange rate**.
- Predicting the exchange rates using the efficient market approach **has two advantages:**
  - The **efficient market** approach is based on market-determined prices, it is costless to generate forecasts. Both the current spot and forward exchange rates are public information. As such, everyone has free access to it.
  - The efficiency of foreign exchange markets, it is difficult to outperform the market-based forecasts unless the forecaster has access to private information that is not yet reflected in the current exchange rate.

Fundamental approach

- This in forecasting uses various models. For example, the monetary approach to exchange rate determination suggests that the exchange rate is determined by three independent (explanatory) variables:
  i. relative money supplies,
  ii. relative velocity of monies,
  iii. relative national outputs

One can thus formulate the monetary approach in the following empirical form:

$$s = \alpha + \beta_1(m - m^*) + \beta_2(v - v^*) + \beta_3(y^* - y) + \epsilon \text{ ,where} \quad (4.6)$$

$s \rightarrow$ natural logarithm of the spot exchange rate.
m - m * $\rightarrow$ natural logarithm of domestic/foreign money supply.
v - v * $\rightarrow$ natural logarithm of domestic/foreign velocity of money.
y * - y $\rightarrow$ natural logarithm of foreign/domestic output.
$\epsilon \rightarrow$ random error term, with mean zero.

Fundamental approach

Generating forecasts using the fundamental approach would involve three steps:

- Step 1: Estimation of the structural model like (4.6) to determine the numerical values for the parameters such as α and β's.
- Step 2: Estimation of future values of the independent variables like $(m - m^*)$, $(v - v^*)$, and $(y^* - y)$.
- Step 3: Substituting the estimated values of the independent variables into the estimated structural model to generate the exchange rate forecasts.

The fundamental approach to exchange rate forecasting difficulties:

I. One has to forecast a set of independent variables to forecast the exchange rates. Forecasting the former will certainly be subject to errors and may not be necessarily easier than forecasting the latter.
II. The parameter values, that is, α and β's, that are estimated using historical data may change over time because of changes in government policies and/or the underlying structure of the economy. Either difficulty can diminish the accuracy of forecasts even if the model is correct.
III. The model itself can be wrong. Not surprisingly, researchers found that the fundamental models failed to more accurately forecast exchange rates than either the forward rate model or the random walk model.

Technical approach

1. Pure Technical Analysis: Chartism

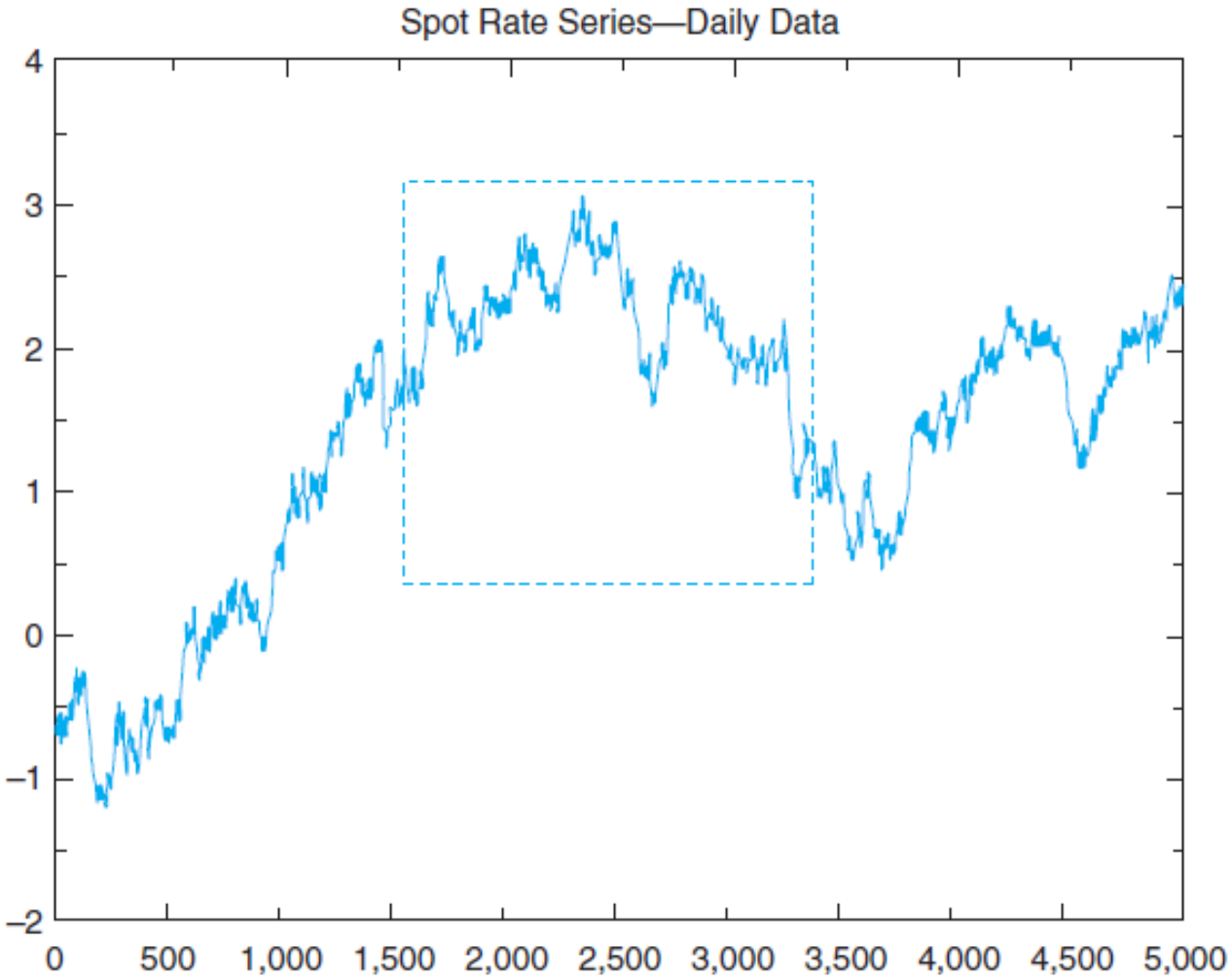
- Chartists graphically record the actual trading history of an exchange rate and then try to infer possible future trends based on that information alone.

a) A **support level** is any chart formation in which the price has trouble falling below a particular level.

b) A **resistance level** is any chart formation in which the price of an instrument has trouble rising above a particular level.

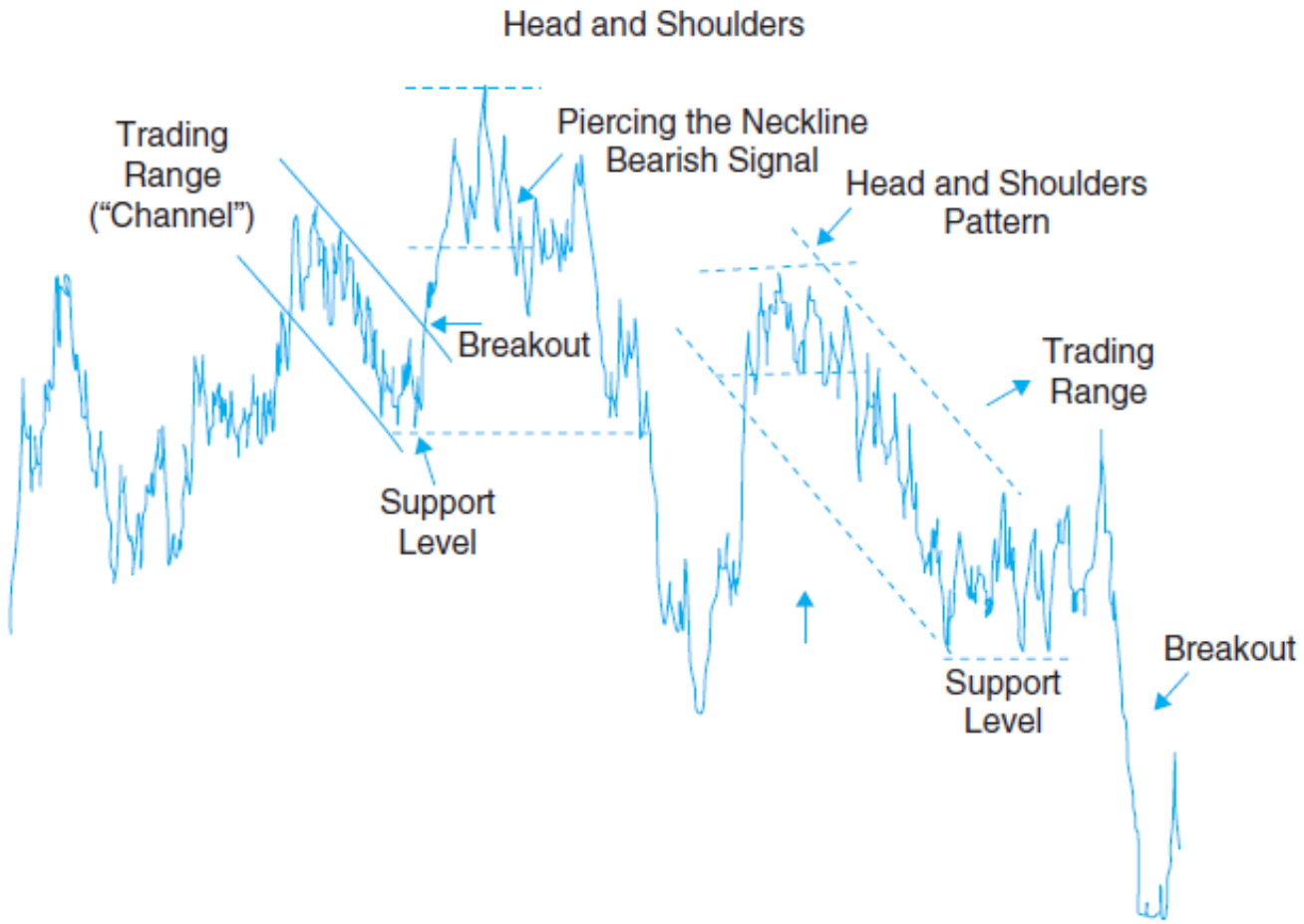
Support levels and resistance levels define a trading range, which might be short term, medium term, or long term. When a trading range is broken, a sudden rise or fall in prices is expected and is called a **breakout**

Technical approach



Notes : The top graph shows a daily exchange rate series (about 250 days per year) over a time span of 20 years. The graph appears to display some clear trends.

Technical approach



Notes : The panel investigates these short-term trends more closely by lifting the part in the box at the top and blowing it up. The apparent trends are then interpreted using chartist jargon.

Technical approach

1. Pure Technical Analysis: *Does Charting Work?*

- The recommendations of chartists are very subjective. As seen from the graph - it is possible for the eye to pick up what seem to be predictable patterns that are simply not there.
- Moreover, it is difficult to statistically analyze the predictions chartists make. For example, we must formalize what it means to see a head-and-shoulders pattern or another rule in a formula that can be applied to the data.

One interesting study by Chang and Osler (1999) compared the profitability of the head-and-shoulders pattern with other trend-predicting rules. Although Chang and Osler found that trading on the head-and-shoulders patterns is profitable, the profitability is dominated by other, simpler trading rules, which we discuss below:

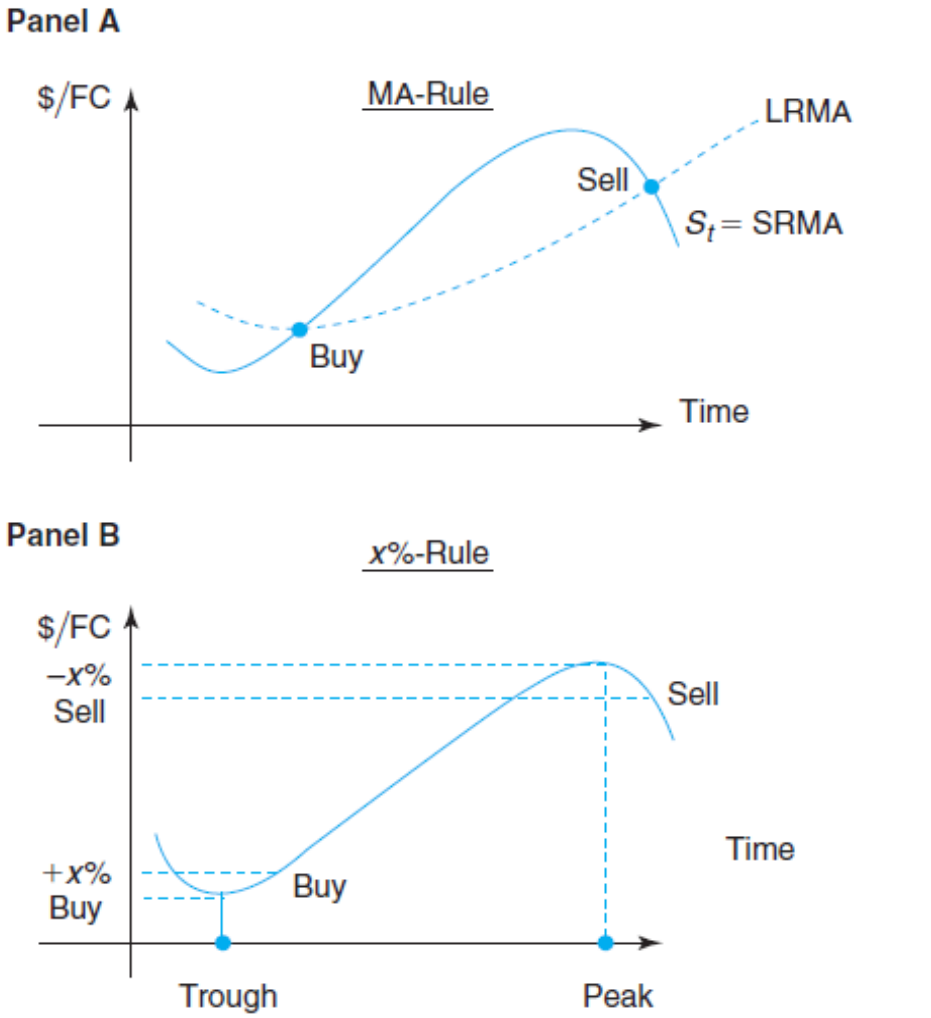
2. Technical Analysis: Statistical analysis:

x% Rules - states that you should go long (buy) in foreign currency after the foreign currency has appreciated relative to the dollar by *x* % above its most recent trough (or support level) and that you should go short (sell) in foreign currency whenever the currency falls *x* % below its most recent peak (or resistance level). Common *x* % rules are 1%, 2%, and so forth.

Technical approach

Moving-Average Crossover Rules - use moving averages of the exchange rate. An n -day moving average is just the sample average of the last n trading days, including the current rate. A (y , z) moving-average crossover rule uses averages over a short period (y days) and over a long period (z days).

The strategy states that you should go long (short) in the foreign currency when the short-term moving average crosses the long-term moving average from below (above). Common rules use 1 and 5 days (1, 5), 1 and 20 days (1, 20), and 5 and 20 days (5, 20).



Notes : In Panel A, the solid line represents the actual exchange rate, S (t), which serves as the short-run moving average (SRMA). The dashed line is the long-run moving average (LRMA), averaging the current and past exchange rates.

In Panel B, we graph only the exchange rate and illustrate the use of an x % filter rule.

Technical approach

Non-Linear Models:

- Researchers have, for example, tried to model the idea that as currencies move further from fundamentals (such as their PPP values) or as the volatility of the exchange rate increases, interest rate differentials may work less well as predictors of future exchange rate changes (see, respectively, Jordŕ and Taylor, 2009; and Clarida et al., 2009).
- Going beyond simply prespecifying the trading rules, more recent studies have applied sophisticated computer techniques, such as genetic algorithms, to search for optimal trading rules. Without going into details, these techniques apply a Darwinian-like, natural selection process to filter rules applied to past data that eventually breeds the "best" trading rules.

Neely et al. (1997) found that adhering to such trading rules was, indeed, profitable. In a subsequent study conducted in 2001, Neely and Weller found that additional information about central bank interventions further improved profitability.

Conclusions

- In this chapter, we drew together everything we have learned so far about exchange rates.
- We built on the concepts of arbitrage and equilibrium in the foreign exchange (FX) market in the short run, taking expectations as given and applying uncovered interest parity.
- We also relied on the purchasing power parity theory as a guide to exchange rate determination in the long run.
- Putting together all these building blocks provides a complete and internally consistent theory of exchange rate determination.

Thank You for your attention!