Interest Rates and the Determination of the Exchange Rates

Thematic Area 5

MSc in ISFM

EXCHANGE RATES

- Exchange rates affect large flows of international trade by influencing the prices in different currencies.
- The foreign exchange market facilitates massive flows of international investment, which include direct investments as well as stock and bond trades.
- In the foreign exchange market, *trillions* of dollars are traded each day and the economic implications of shifts in the market can be dramatic.

- An **exchange rate (*E*)** is defined as the number of units of domestic currency that are required to buy one unit of foreign currency (i.e. it is the price of foreign currency).
- Because an exchange rate is the relative price of two currencies, it may be defined (or, quoted) in either of two ways:

1. The number of home currency units that are needed to buy one unit of foreign currency (i.e. you need 1.4 euros to buy one British pound).
2. The number of foreign currency units that are needed to buy one unit of home currency (i.e. you need about 0.714 (=1/1.4) British pounds to buy one euro.

- Note that sometimes the practice of quoting exchange rates differs between countries. For example, when a U.S. newspaper quotes the exchange rate between the U.S. dollar and the euro to be, e.g. 1.25, which is the number of dollars required to buy 1 euro, this is equivalent to a euro area resident thinking that the euro/dollar exchange rate is 1/1.25=0.8.
- Given the prominence of the U.S. in the global economy, there is a tacit agreement that exchange rates are quoted by treating the dollar as the home currency (per our definition 1, which is, the so-called, American definition).

Using the American definition, the following holds true:

- When the exchange rate $E_{€/\$}$ *rises,* more euros are needed to buy one dollar, and the euro experiences a depreciation.
- When the exchange rate $E_{€/\$}$ *falls,* fewer euros are needed to buy one dollar, and the euro experiences an appreciation.
- The exchange rate between two currencies is called a **bilateral** exchange rate

Multilateral and Effective Exchange Rates

To aggregate different trends in *bilateral* exchange rates into one measure, economists calculate ***multilateral*** exchange rate changes for baskets of currencies using trade weights to construct an average of all the bilateral changes for each currency in the basket.

The resulting measure is called the change in the **effective exchange rate**.

Calculating the Effective Exchange Rate

- For example, suppose 40% of Home (country's) trade is with country 1 and 60% is with country 2.
- Home's currency appreciates 10% against 1 but depreciates 30% against 2.
- To calculate the change in Home's effective exchange rate, we multiply each exchange rate change by the corresponding trade share and then add up:
- $(-10\% \bullet 40\%) + (30\% \bullet 60\%) = (-0.1 \bullet 0.4) + (0.3 \bullet 0.6) = -0.04 + 0.18 = 0.14 = +14\%$.
- In this example, Home's effective exchange rate has depreciated by 14%.

Example: Using Exchange Rates to Compare Prices in a Common Currency

Scenario		1	2	3	4
Cost of the tuxedo in local currency	London	£2,000	£2,000	£2,000	£2,000
	Hong Kong	HK$30,000	HK$30,000	HK$30,000	HK$30,000
	New York	$4,000	$4,000	$4,000	$4,000
Exchange rates	HK$/£	15	16	14	14
	$/£	2.0	1.9	2.1	1.9
Cost of the tuxedo in pounds	London	£2,000	£2,000	£2,000	£2,000
	Hong Kong	£2,000	£1,875	£2,143	£2,143
	New York	£2,000	£2,105	£1,905	£2,105

- Changes in the exchange rate cause changes in prices of foreign goods expressed in the home currency.
- Changes in the exchange rate cause changes in the relative prices of goods produced in the home and foreign countries.
- When the home country's exchange rate depreciates, home exports become less expensive as imports to foreigners, and foreign exports become more expensive as imports to home residents.
- When the home country's exchange rate appreciates, home export goods become more expensive as imports to foreigners, and foreign export goods become less expensive as imports to home residents.

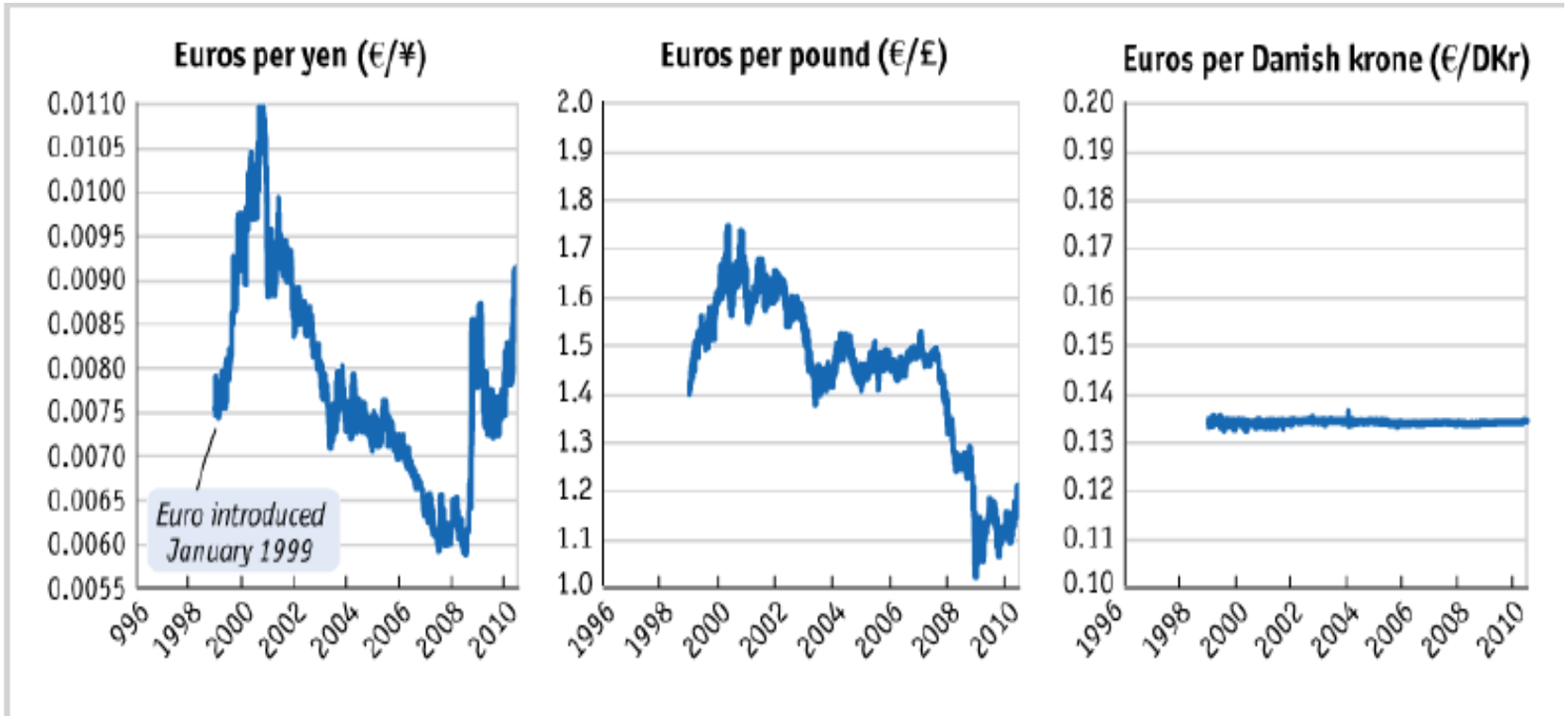
Fixed (or **pegged**) exchange rate regimes are those in which a country's exchange rate fluctuates in a narrow range (or not at all) against some *base currency* over a sustained period, usually a year or longer. A country's exchange rate can remain rigidly fixed for long periods only if the government/central bank intervenes in the foreign exchange market in one or both countries.

- **Floating** (or **flexible**) exchange rate regimes are those in which a country's exchange rate fluctuates in a wider range, and the government makes no attempt to fix it against any base currency. Appreciations and depreciations may occur from year to year, each month, by the day, or every minute.

Exchange Rate Volatility

Exchange rates in developing countries can be much more volatile than those in developed countries.

- India is an example of a middle ground, somewhere between a fixed rate and a free float, called a **managed float** (also known as dirty float, or a policy of limited flexibility.
- Dramatic depreciations, such as those of Thailand and South Korea in 1997, are called **exchange rate crises** and they are more common in developing countries than in developed countries.


Euros per yen (€/¥)
0.0110
0.0105
0.0100
0.0095
0.0090
0.0085
0.0080
0.0075
0.0070
0.0065
0.0060
0.0055
Euro introduced January 1999
996
1998
2000
2002
2004
2006
2008
2010
Euros per pound (€/£)
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
1996
1998
2000
2002
2004
2006
2008
2010
Euros per Danish krone (€/DKr)
0.20
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.10
1996
1998
2000
2002
2004
2006
2008
2010


Indian rupees per $
90
80
70
60
50
40
30
1996
1998
2000
2002
2004
2006
2008
2010
Thai baht per $
60
55
50
45
40
35
30
25
20
1996
1998
2000
2002
2004
2006
2008
2010
South Korean won per $
2,100
2,000
1,900
1,800
1,700
1,600
1,500
1,400
1,300
1,200
1,100
1,000
900
800
700
1996
1998
2000
2002
2004
2006
2008
2010


Argentine pesos per $
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
1996
1998
2000
2002
2004
2006
2008
2010
Colombian pesos per $
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
1996
1998
2000
2002
2004
2006
2008
2010
Ecuadorean sucres per $
29,000
27,000
25,000
23,000
21,000
19,000
17,000
15,000
13,000
11,000
9,000
7,000
5,000
3,000
Dollarization completed by end of 2000
1996
1998
2000
2002
2004
2006
2008
2010

Currency Unions and Dollarization

Under a **currency union** (or **monetary** union), there is some form of transnational structure such as a single central bank or monetary authority that is accountable to the member nations. The most prominent example of a currency union is the Eurozone (which is not yet a monetary union...despite the “EMU” adjective…)

Under “**dollarization”** one country unilaterally adopts the currency of another country. The reasons for this choice can vary. A small size, poor record of managing monetary affairs, or if people simply stop using the national currency and switch en masse to an alternative.

Foreign Exchange Market

•Day by day, and minute by minute, exchange rates the world over are set in the **foreign exchange market** (or **forex** or **FX** market), which, like any market, is a collection of private individuals, corporations, and some public institutions that buy and sell.

•The value of trades conducted in the FX market is to the order of trillion dollars per day!

The Spot Contract

- The simplest forex transaction is a contract for the immediate exchange of one currency for another between two parties. This is known as a **spot contract**.
- The exchange rate for this transaction is often called the **spot exchange rate**.
- In these lectures, the use of the term “exchange rate” always refers to the spot rate.
- The spot contract is the most common type of trade and appears in almost 90% of all forex transactions.

Derivatives

- In addition to the spot contract there are many other related forex contracts, including forwards, swaps, futures, and options. Collectively, all these related forex contracts are termed **derivatives**.
- The forex derivatives market is small relative to the entire global forex market.

Private Actors in the FX Market

- The key actors in the forex market are the traders. Most forex traders work for **commercial banks.**
- **Interbank trading** is highly concentrated: about three-quarters of all forex market transactions globally are handled by just ten banks.
- The vast majority of forex transactions are profit-driven interbank trades, and it is the exchange rates for these trades that underlie quoted market exchange rates.
- Some **corporations** may trade in the market if they are engaged in extensive transactions either to buy inputs or sell products in foreign markets. Similarly, some **nonbank financial institutions** such as mutual fund companies may favor setting up their own foreign exchange trading operations.

Central Banks

- Governments may allow the private market for foreign exchange function to operate but they may also try to fix or control forex prices in the market through **intervention,** a job typically given to a nation's central bank.
- To maintain a fixed exchange rate, the central bank must stand ready to buy or sell its own currency, in exchange for the base foreign currency, at a fixed price.
- In practice, keeping some foreign currency reserves may be costly and uncertain, as resources are tied up in foreign currency and reserves may run out.

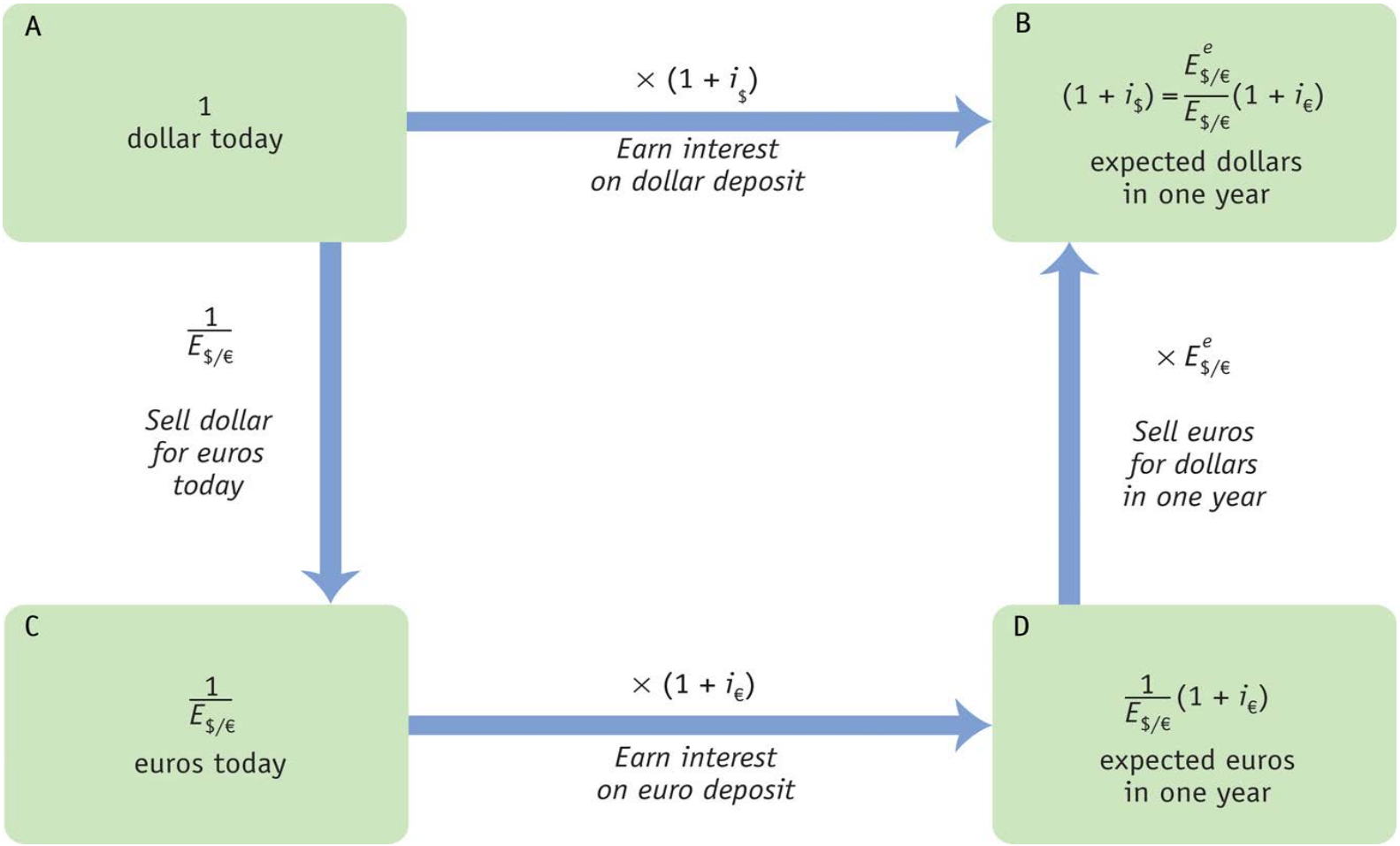
Cross Rates and Vehicle Currencies

- There are about 160 distinct currencies in the world today. However, the vast majority of the world's currencies trade directly with only one or two of the major currencies, such as the dollar, euro, yen, or pound, and perhaps a few other currencies from neighboring countries.
- Many countries do a lot of business in major currencies such as the U.S. dollar, so individuals always have the option to engage in a triangular trade at the cross rate.
- When a third currency, such as the U.S. dollar, is used in these transactions, it is called a **vehicle currency** because it is not the home currency of either of the parties involved in the trade and is just used for intermediation.

Exchange Rate Determination in the Short-Run: The Asset Market Approach

The spot exchange rate is determined through a condition (known as the **Uncovered Interest Parity, UIP**), which is a no-arbitrage condition that describes an equilibrium in which investors are indifferent between the returns on unhedged interest-bearing bank deposits in two currencies (where forward contracts are not employed).

The Choice of an Invesror

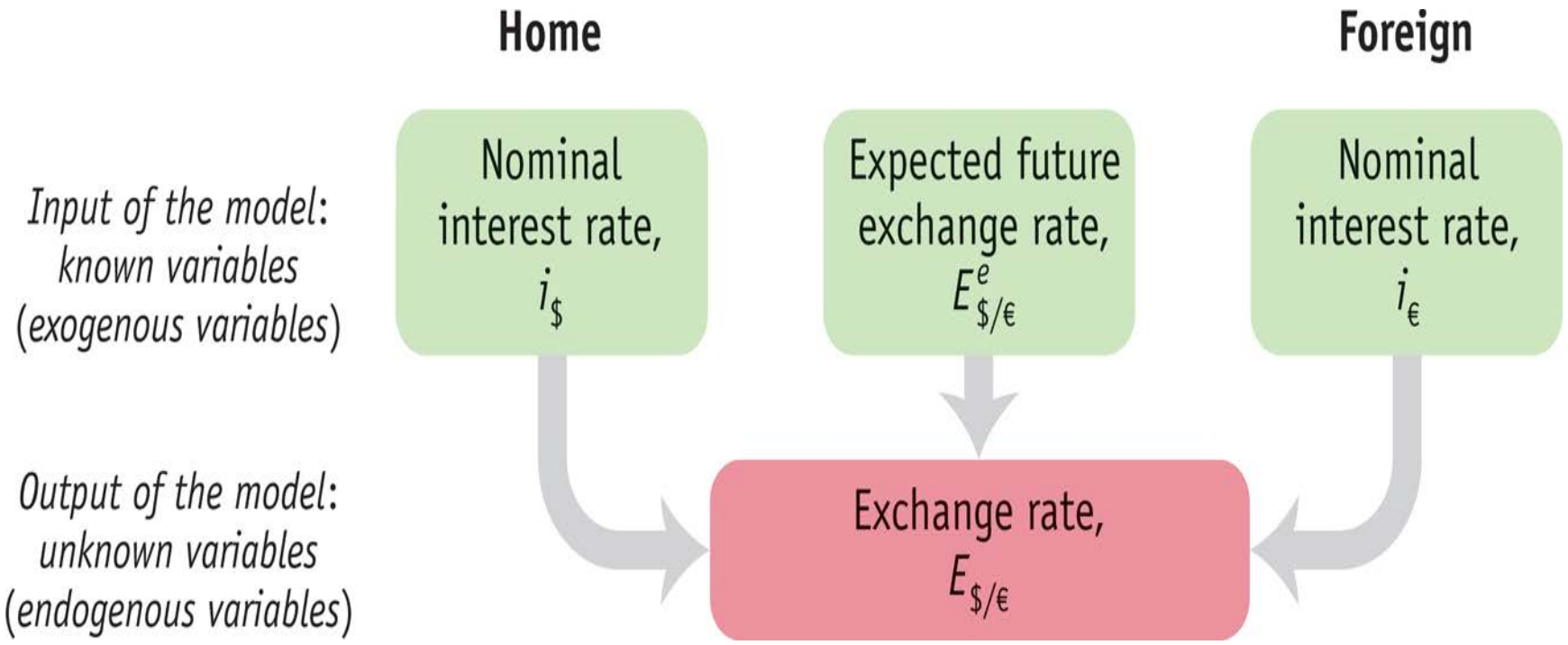


Assume that the dollar is the home currency.

The UIP approximation equation says that the home interest rate equals the foreign interest rate plus the expected rate of depreciation of the home currency.
For example, suppose the dollar interest rate is 4% per year and the euro interest rate 3% per year. If UIP is to hold, then the expected rate of dollar depreciation over a year must be 1%. The total dollar return on the euro deposit is approximately equal to the 4% that is offered by dollar deposits.

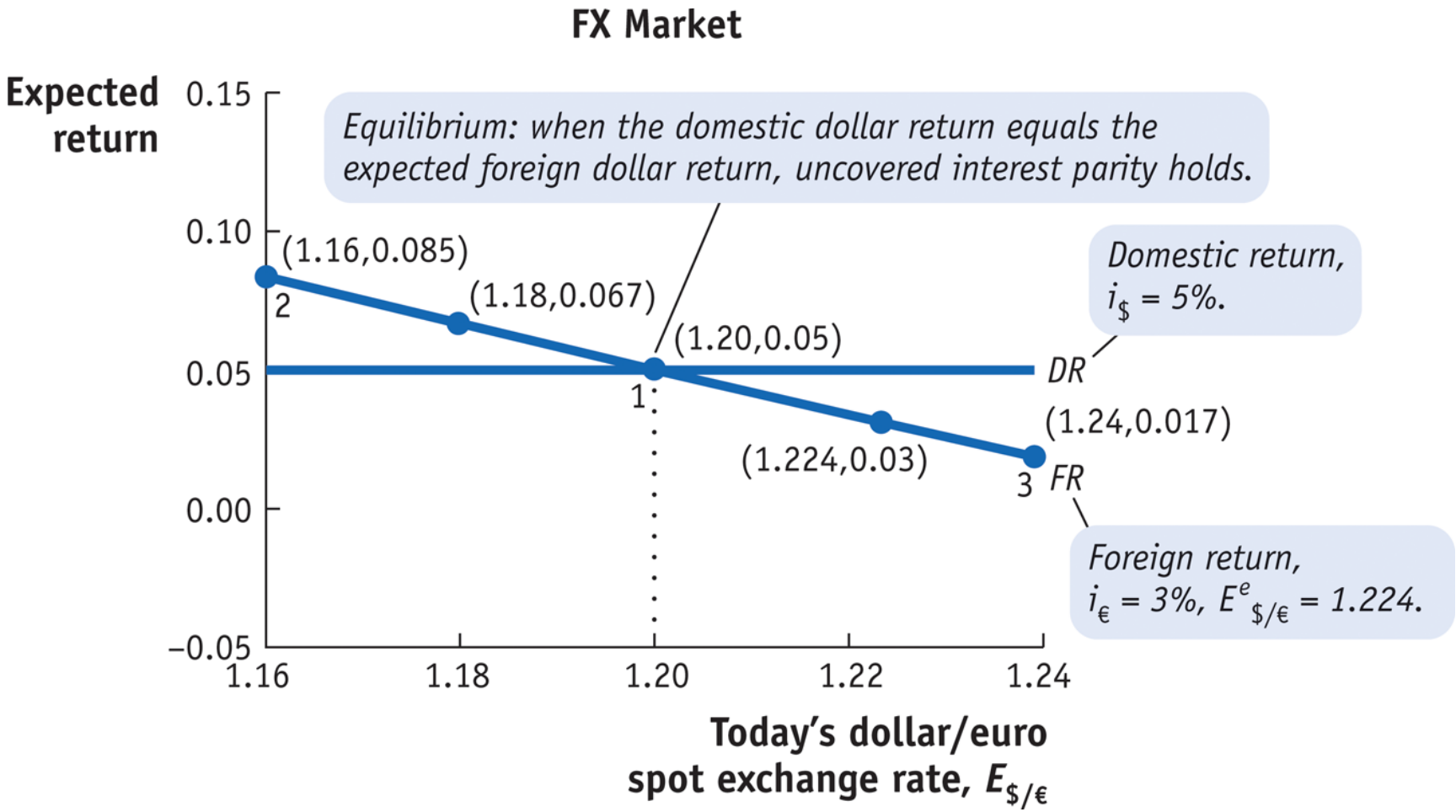
$$\underbrace{i_{\$}}_{\substack{\text{Interest rate}\\ \text{on dollar deposits}\\ =\\ \text{Dollar rate of return}\\ \text{on dollar deposits}}} = \underbrace{\underbrace{i_{€}}_{\substack{\text{Interest rate}\\ \text{on euro deposits}}} + \underbrace{\frac{\Delta E^{e}_{\$/€}}{E_{\$/€}}}_{\substack{\text{Expected rate of depreciation}\\ \text{of the dollar}}}}_{\substack{\text{Expected dollar rate of return}\\ \text{on euro deposits}}}$$

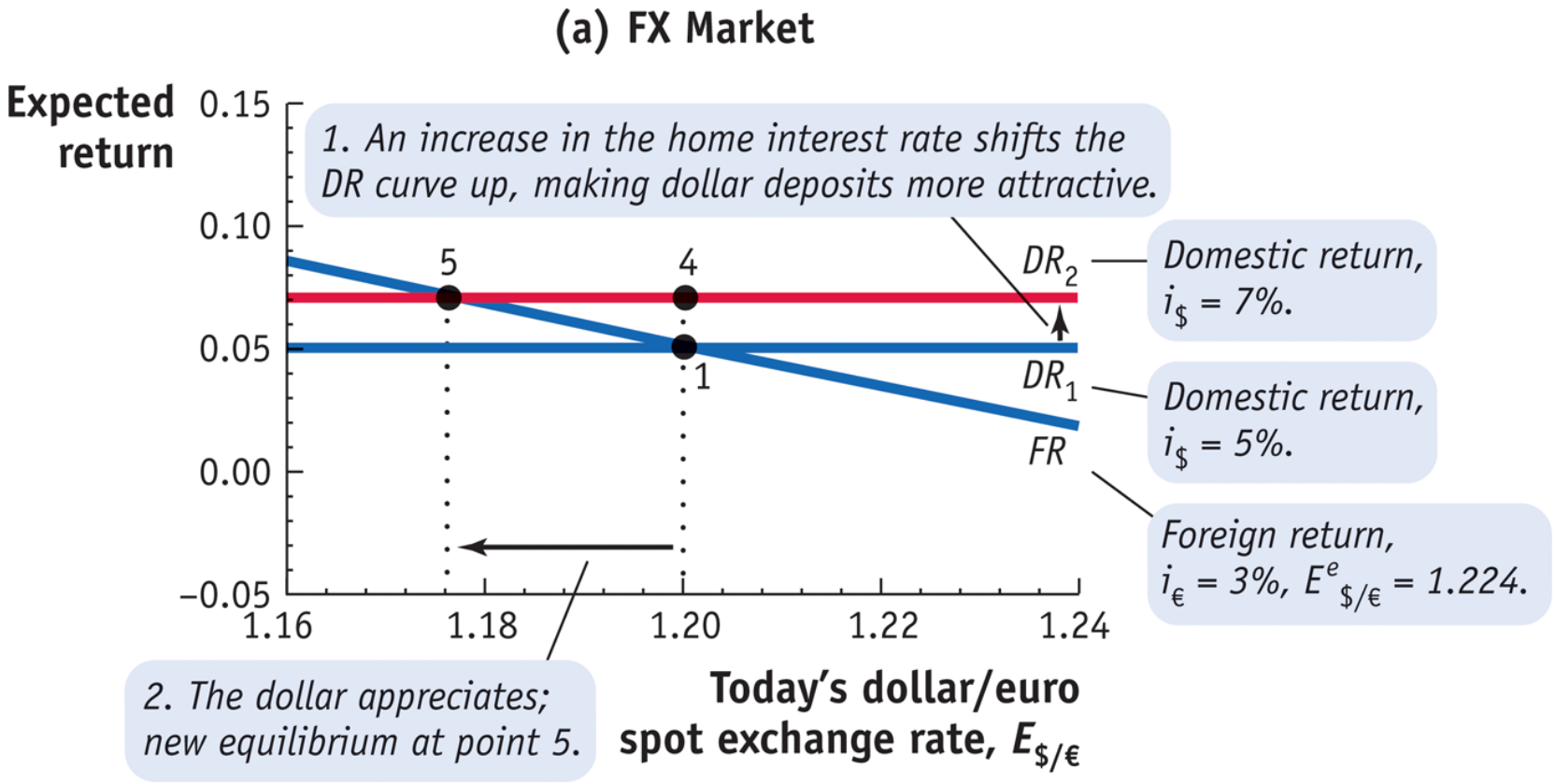
Structure of the Model

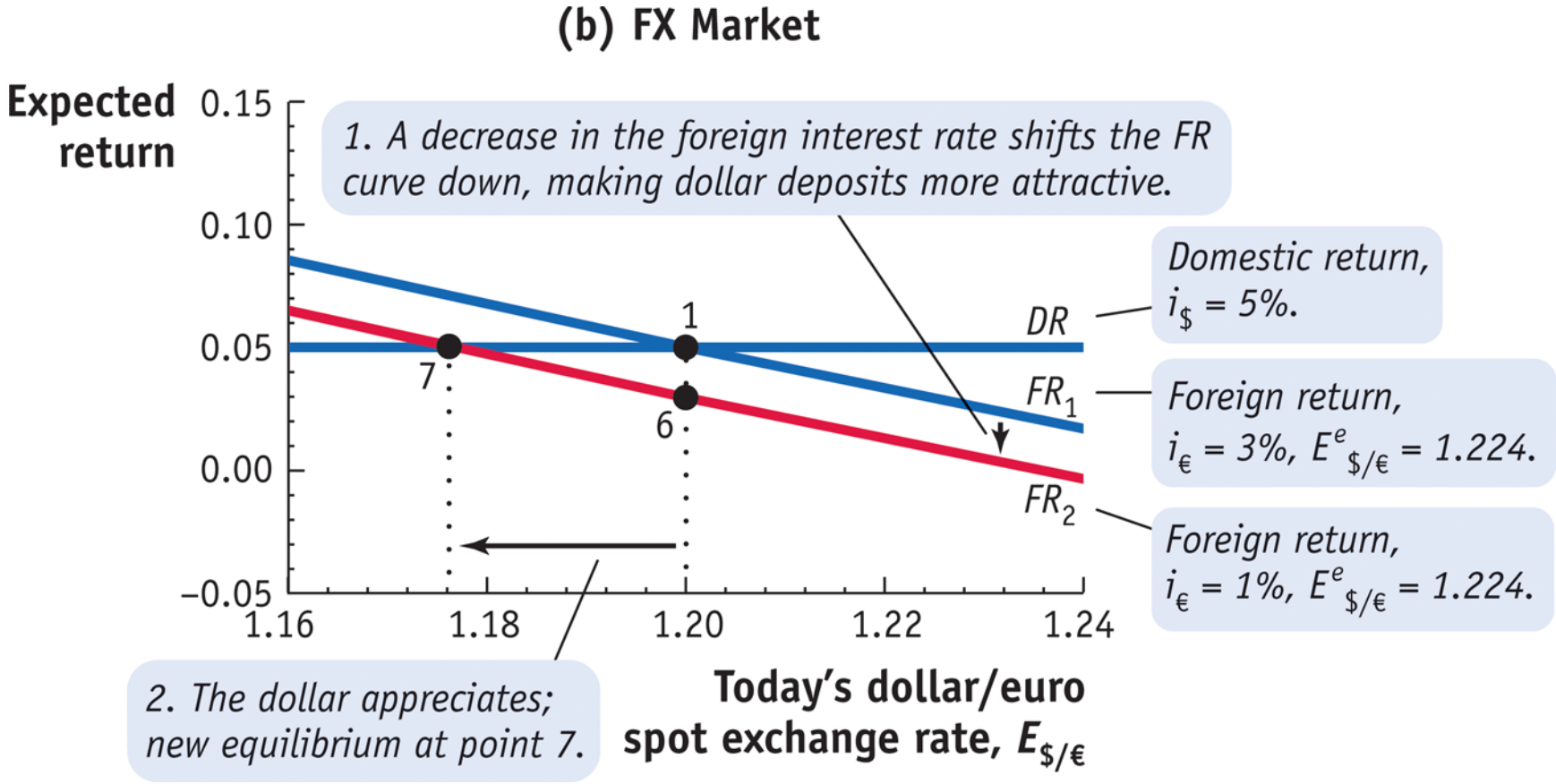


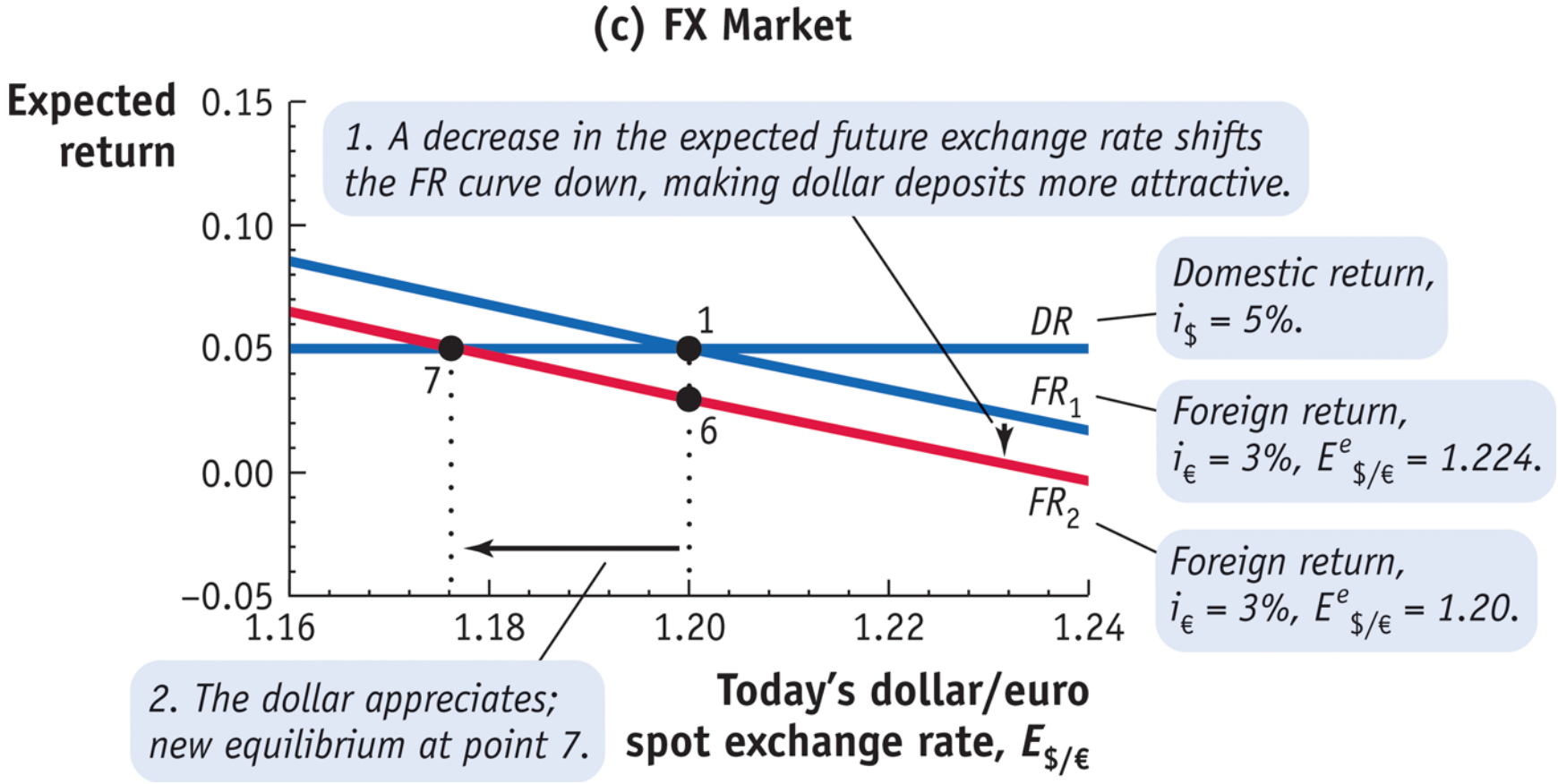
Example of Market Equilibrium

	(1) Interest Rate on Dollar Deposits (annual)	(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) = (2) + (5) Expected Dollar Return on Euro Deposits (annual)
	Domestic Return ($)					Foreign Expected Return ($)
	$i_{\$}$	$i_{€}$	$E_{\$/€}$	$E^{e}_{\$/€}$	$\frac{E^{e}_{\$/€} - E_{\$/€}}{E_{\$/€}}$	$i_{€} + \frac{E^{e}_{\$/€} - E_{\$/€}}{E_{\$/€}}$
	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


FX Market
Expected return
0.15
0.10
0.05
0.00
−0.05
1.16
1.18
1.20
1.22
1.24
Today's dollar/euro spot exchange rate, $E_{\$/€}$
Equilibrium: when the domestic dollar return equals the expected foreign dollar return, uncovered interest parity holds.
(1.16,0.085)
2
(1.18,0.067)
(1.20,0.05)
1
DR
Domestic return, $i_{\$} = 5\%$.
(1.24,0.017)
(1.224,0.03)
3
FR
Foreign return, $i_{€} = 3\%$, $E^{e}_{\$/€} = 1.224$.


(a) FX Market
Expected return
0.15
0.10
0.05
0.00
−0.05
1.16
1.18
1.20
1.22
1.24
1. An increase in the home interest rate shifts the DR curve up, making dollar deposits more attractive.
5
4
1
DR2
DR1
FR
Domestic return, i$ = 7%.
Domestic return, i$ = 5%.
Foreign return, i€ = 3%, E e $/€ = 1.224.
2. The dollar appreciates; new equilibrium at point 5.
Today's dollar/euro spot exchange rate, E$/€


(b) FX Market
Expected return
0.15
0.10
0.05
0.00
−0.05
1.16
1.18
1.20
1.22
1.24
1. A decrease in the foreign interest rate shifts the FR curve down, making dollar deposits more attractive.
DR
FR1
FR2
1
7
6
Domestic return, i$ = 5%.
Foreign return, i€ = 3%, E$/€e = 1.224.
Foreign return, i€ = 1%, E$/€e = 1.224.
2. The dollar appreciates; new equilibrium at point 7.
Today's dollar/euro spot exchange rate, E$/€


(c) FX Market
Expected return
0.15
0.10
0.05
0.00
−0.05
1.16
1.18
1.20
1.22
1.24
1
6
7
DR
FR1
FR2
1. A decrease in the expected future exchange rate shifts the FR curve down, making dollar deposits more attractive.
Domestic return, i$ = 5%.
Foreign return, i€ = 3%, E^e $/€ = 1.224.
Foreign return, i€ = 3%, E^e $/€ = 1.20.
2. The dollar appreciates; new equilibrium at point 7.
Today's dollar/euro spot exchange rate, E$/€

Other Influences on the Spot Exchange Rate

- The analysis did not take into account the existence of taxes. Changes in the taxation of interest income will affect the exchange rate, e.g. a *temporary* rise in the tax on interest income in the home country will reduce the net return on domestic deposits, and depreciate the spot exchange rate.
- It is important to keep in mind that the analysis above was conducted on the assumption that the changes in the exogenous (or, policy) variables were unanticipated. Had they been anticipated, market participants would have adjusted to the expected policy change before it actually took place. This may well explain why the recent (December 2015) rise in the Fed interest rate did not affect the euro/dollar exchange rate after the announcement was made (the euro was depreciating before the announcement on the expectation that the Fed would raise the interest rate).

Exchange Rate Determination in the Long Run

- If investors are to make forecasts of future exchange rates, they need a plausible theory of how exchange rates are determined in the long run (i.e. how the expected exchange rate is determined).
- The theory we develop in this section has two parts. The first part involves the theory of Purchasing Power Parity (PPP), which links the exchange rate to price levels in each country in the long run.
- In the second part we explore how price levels are related to monetary conditions in each country.
- Combining the monetary theory of price level determination with the purchasing power theory of exchange rate determination, we emerge with a long-run theory known as the monetary approach to exchange rates.
- We now develop the long-run relationships between money, prices, and exchange rates.

- Just as arbitrage occurs in the international market for financial assets, it also occurs in the international markets for goods.
- The result of goods market arbitrage is that the prices of goods in different countries expressed in a common currency tend to be equalized.
- Applied to a single good, this idea is referred to as the law of one price; applied to an entire basket of goods, it is called the theory of purchasing power parity.
- The **law of one price** (LOOP) states that in the absence of trade frictions (such as transport costs and tariffs), and under conditions of free competition and price flexibility (where no individual sellers or buyers have power to manipulate prices and prices can freely adjust), identical goods sold in different locations must sell for the same price when prices are expressed in a common currency.
- By definition, in a market equilibrium there are no arbitrage opportunities. If diamonds can be freely moved between New York and Amsterdam, both markets must offer the same price. Economists refer to this situation in the two locations as an integrated market.

The equation for price equality is:

$$E_{\$/€} P^{g}_{EUR} = P^{g}_{US}$$

Which can be rearranged so as to show that :

(Equation 1)

$$\underbrace{E_{\$/€}}_{\text{Exchange rate}} = \underbrace{P^{g}_{US} \,/\, P^{g}_{EUR}}_{\text{Ratio of goods' prices}}$$

The principle of purchasing power parity (PPP) just says that the exchange rate is the ratio of domestic prices (expressed in domestic currency) to foreign prices (expressed in foreign currency).

Thus **absolute** PPP (Equation 1) implies that the exchange rate at which two currencies trade equals the relative price levels of the two countries.

The relative price of the baskets (expressed in a common currency) is one of the most important variables in international macroeconomics, and it has a special name: it is known as the **real exchange rate**.

$$\underbrace{q_{US/EUR}}_{\text{Relative price of basket in Europe versus U.S.}} = \underbrace{(E_{\$/€} P_{EUR})}_{\text{European price of basket expressed in \$}} / \underbrace{P_{US}}_{\text{U.S. price of basket expressed in \$}}$$

The exchange rate for currencies is a nominal concept. The real exchange rate is a real concept; it says how many U.S. baskets can be exchanged for one European basket.

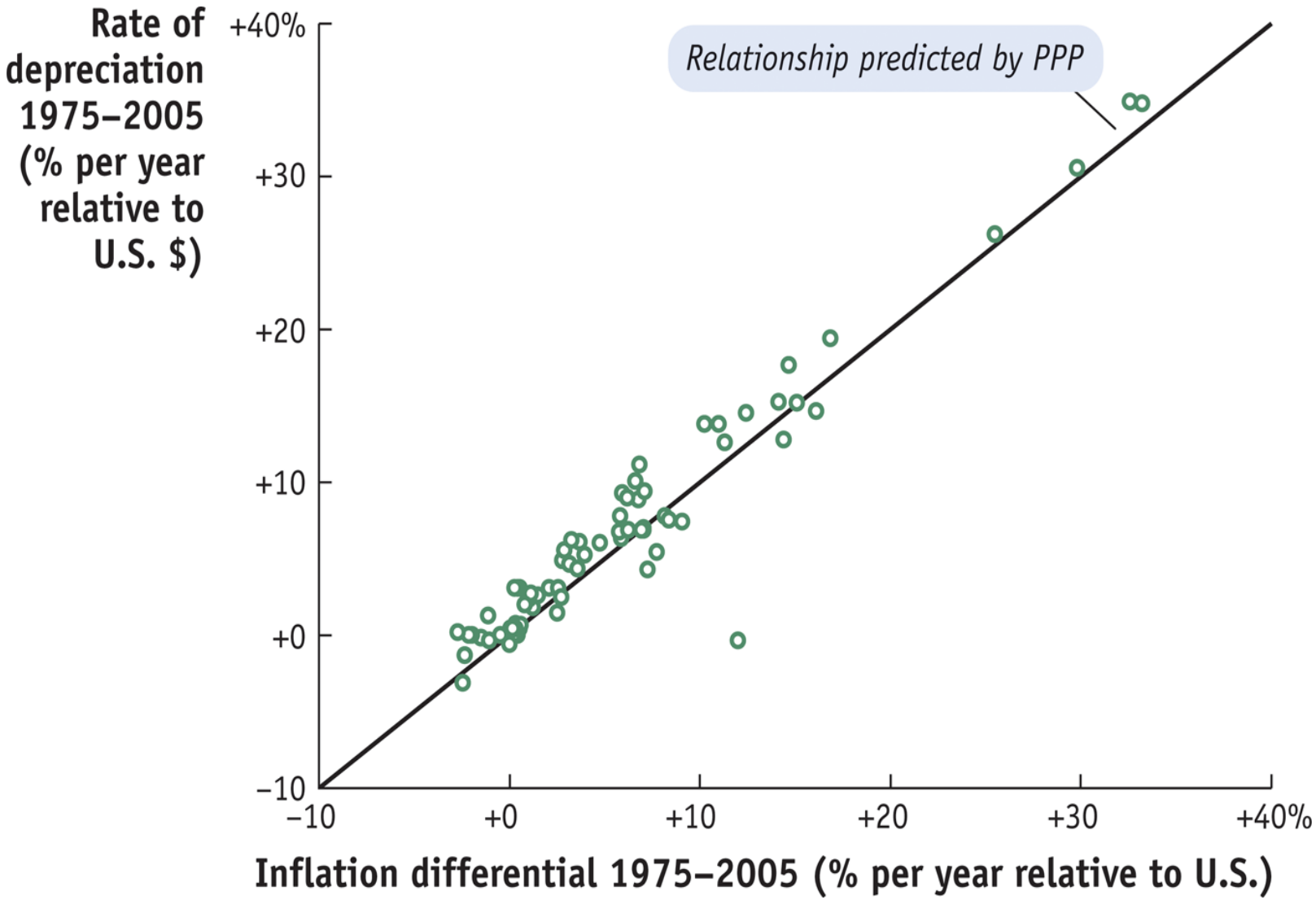
- *If the real exchange rate rises (more Home goods are needed in exchange for Foreign goods), we say Home has experienced a real depreciation.*
- *If the real exchange rate falls (fewer Home goods are needed in exchange for Foreign goods), we say Home has experienced a real appreciation.*

*IF PPP HELD AT ALL TIMES, THEN THE REAL EXCHANGE RATE WOULD ALWAYS BE EQUAL TO 1. THIS IS NOT THE CASE IN THE SHORT-RUN, BUT IT HOLDS IN THE LONG-RUN… OR, IN **RELATIVE** TERMS...*

If Equation (1) (absolute PPP) holds for levels of exchange rates and prices, then it must also hold for rates of change in these variables. Thus,

$$\underbrace{\frac{\Delta E_{\$/€,t}}{E_{\$/€,t}}}_{\text{Rate of depreciation of the nominal exchange rate}} = \underbrace{\pi_{US,t} - \pi_{EUR,t}}_{\text{Inflation differential}}$$

This way of expressing PPP is called **relative PPP**, and it implies that the rate of depreciation of the nominal exchange rate equals the difference between the inflation rates of two countries (the inflation differential). Some evidence in favour of relative PPP in the next diagram…


Rate of depreciation 1975–2005 (% per year relative to U.S. $)
+40%
+30
+20
+10
+0
–10
Relationship predicted by PPP
–10
+0
+10
+20
+30
+40%
Inflation differential 1975–2005 (% per year relative to U.S.)

- We assume that PPP holds in the long run. This implies that in the long run the exchange rate is determined by the ratio of the price levels in two countries.
- But this prompts a question: What determines those price levels in the long-run?
- Monetary theory supplies an answer: in the long run, price levels are determined in each country by the interaction of money demand and money supply.
- How is the supply of money determined? In practice, a country's central bank controls the money supply.
- In our analysis, we make the simplifying assumption that the central bank's policy tools are sufficient to allow it to control indirectly, but accurately, the level of the money supply, M.

- A simple theory of household money demand is motivated by the assumption that the need to conduct transactions is in proportion to an individual's income.
- We can infer that the aggregate money demand will behave similarly.
- All else equal, a rise in national dollar income (nominal income) will cause a proportional increase in transactions and, hence, in aggregate money demand.
- A simple model in which the demand for money is proportional to dollar income is known as the quantity theory of money:

$$\underbrace{M^d}_{\substack{\text{Demand} \\ \text{for money (\$)}}} = \underbrace{\overline{L}}_{\text{A constant}} \times \underbrace{PY}_{\substack{\text{Nominal} \\ \text{income (\$)}}}$$

- Dividing the previous equation by *P*, the price level, we can derive the *demand for real money balances*:

$$\underbrace{\frac{M^d}{P}}_{\substack{\text{Demand} \\ \text{for real} \\ \text{money}}} = \underbrace{\overline{L}}_{\text{A constant}} \times \underbrace{Y}_{\text{Real income}}$$

- Real money balances are simply a measure of the purchasing power of the stock of money in terms of goods and services. The demand for real money balances is strictly proportional to real income.

The condition for equilibrium in the money market is that the demand for money , M^d , must equal the supply of money, M , i.e. M^d =M.

M is assumed to be under the control of the central bank.

Imposing the equilibrium condition, we have:

$$M = \bar{L}PY$$

or, equivalently…

Equation (2)

$$\frac{M}{P} = \bar{L}Y$$

…which, just states, that real money supply is equal to real money demand. .

If real income (Y) is exogenous in the long run, then equation (2) implies that in the long run prices are proportional to the money supply ...

…and we can write the price levels in the U.S. and Europe as:

$$P_{US} = \frac{M_{US}}{\overline{L}_{US} Y_{US}} \qquad P_{EUR} = \frac{M_{EUR}}{\overline{L}_{EUR} Y_{EUR}}$$

These two equations are examples of the fundamental equation of the monetary model of the price level. It states that, all else equal, price levels are proportional to the money supply.

In the long run, we assume prices are flexible and will adjust to put the money market in equilibrium.

These two equations can be combined with equation (1), which is the absolute PPP, to give us …

$$E_{\$/€} = \frac{P_{US}}{P_{EUR}} = \frac{M_{US}/M_{EUR}}{L_{US} Y_{US}/L_{EUR} Y_{EUR}}$$

$$E_{\$/€} = \frac{P_{US}}{P_{EUR}} = \frac{M_{US}/M_{EUR}}{L_{US}Y_{US}/L_{EUR}Y_{EUR}}$$

This is the fundamental equation of the monetary approach to exchange rates, and it states that the exchange rate depends on the ratio of relative money supplies and relative money demands.

- Suppose the U.S. money supply increases, all else equal. The right-hand side increases, causing the exchange rate to increase (the U.S. dollar depreciates against the euro).
- Now suppose the U.S. real income level increases, all else equal. Then the right-hand side decreases, causing the exchange rate to decrease (the U.S. dollar appreciates against the euro).

- Another way to state the joint implications of PPP and the monetary theory of the price level is to notice that, for given levels of the foreign country variables, a – once-an-for-all - rise in the domestic money supply will cause an equi-proportionate change in the domestic prices and in the exchange rate, i.e.

$$\Delta M/M=\Delta P/P=\Delta E/E.$$

- Note that in this case, once the new long-run equilibrium is reached, M, P, and E, will remain constant if no further changes in other (exogenous) variables take place.

- We turn now to cases in which there is continuous growth in domestic and foreign variables…

Money Growth, Inflation, and Depreciation

The U.S. money supply is M_{US}, and its growth rate is μ_{US}:

$$\mu_{US,t} = \underbrace{\frac{M_{US,t+1} - M_{US,t}}{M_{US,t}}}_{\text{Rate of money supply growth in U.S.}}$$

The growth rate of real income in the U.S. is g_{US}:

$$g_{US,t} = \underbrace{\frac{Y_{US,t+1} - Y_{US,t}}{Y_{US,t}}}_{\text{Rate of real income growth in U.S.}}$$

Putting all the pieces together, the growth rate of $P_{US} = M_{US}/\bar{L}_{US}Y_{US}$ equals the money supply growth rate μ_{US} minus the real income growth rate g_{US}. The growth rate of P_{US} is the inflation rate π_{US}. Thus, we know that:

$$\pi_{US,t} = \mu_{US,t} - g_{US,t} \qquad (14\text{-}4)$$

The rate of change of the European price level is calculated similarly:

$$\pi_{EUR,t} = \mu_{EUR,t} - g_{EUR,t} \qquad (14\text{-}5)$$

When money growth is higher than income growth, we have “more money chasing fewer goods” and this leads to inflation.

Combining Equation (14-4) and Equation (14-5), we can now solve for the inflation differential in terms of monetary fundamentals and finish our task of computing the rate of depreciation of the exchange rate:

$$\underbrace{\frac{\Delta E_{\$/€t}}{E_{\$/€,t}}}_{\text{Rate of depreciation of the nominal exchange rate}} = \underbrace{\pi_{US,t} - \pi_{EUR,t}}_{\text{Inflation differential}} = \left(\mu_{US,t} - g_{US,t}\right) - \left(\mu_{EUR,t} - g_{EUR,t}\right) \quad \textbf{(14-6)}$$

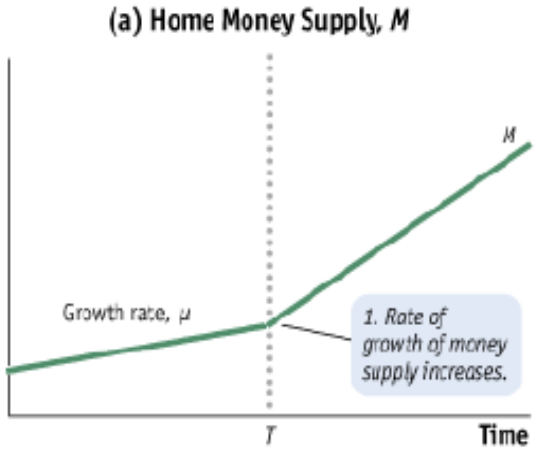
$$= \underbrace{\left(\mu_{US,t} - \mu_{EUR,t}\right)}_{\substack{\text{Differential in} \\ \text{nominal money supply} \\ \text{growth rates}}} - \underbrace{\left(g_{US,t} - g_{EUR,t}\right)}_{\substack{\text{Differential in} \\ \text{real output} \\ \text{growth rates}}}.$$

The intuition behind Equation (14-6) is as follows:

- If the United States runs a looser monetary policy in the long run measured by a faster money growth rate, the dollar will depreciate more rapidly, all else equal.
- If the U.S. economy grows faster in the long run, the dollar will appreciate more rapidly, all else equal.

A Diagrammatic Example of a Permanent Increase in the Growth Rate of the Money Supply

FIGURE 14-6 (1 of 4)

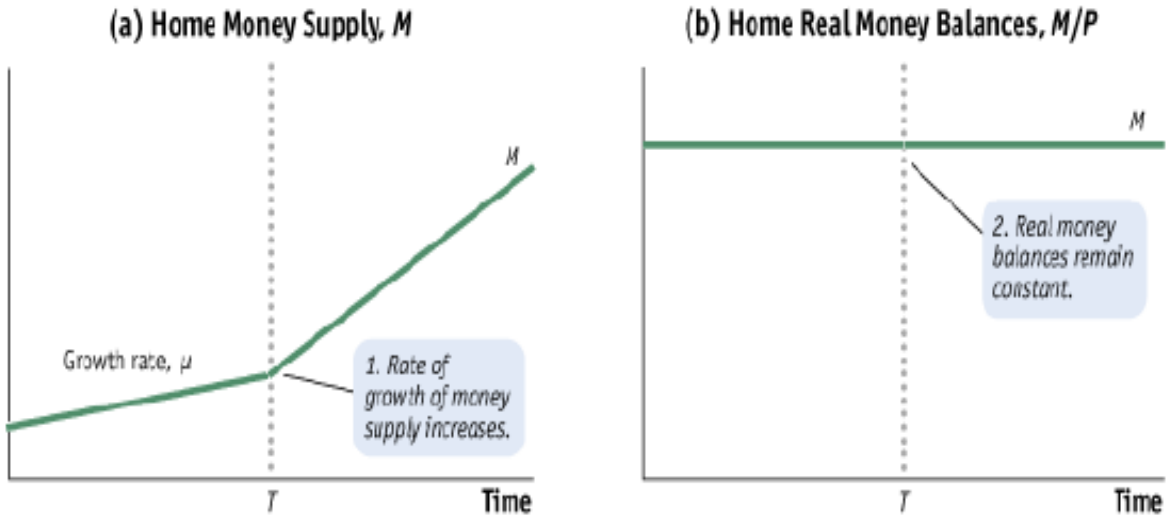


An Increase in the Growth Rate of the Money Supply in the Simple Model

Before time T, money, prices, and the exchange rate all grow at rate μ. Foreign prices are constant.

In panel (a), we suppose at time T there is an increase $\Delta\mu$ in the rate of growth of home money supply M.

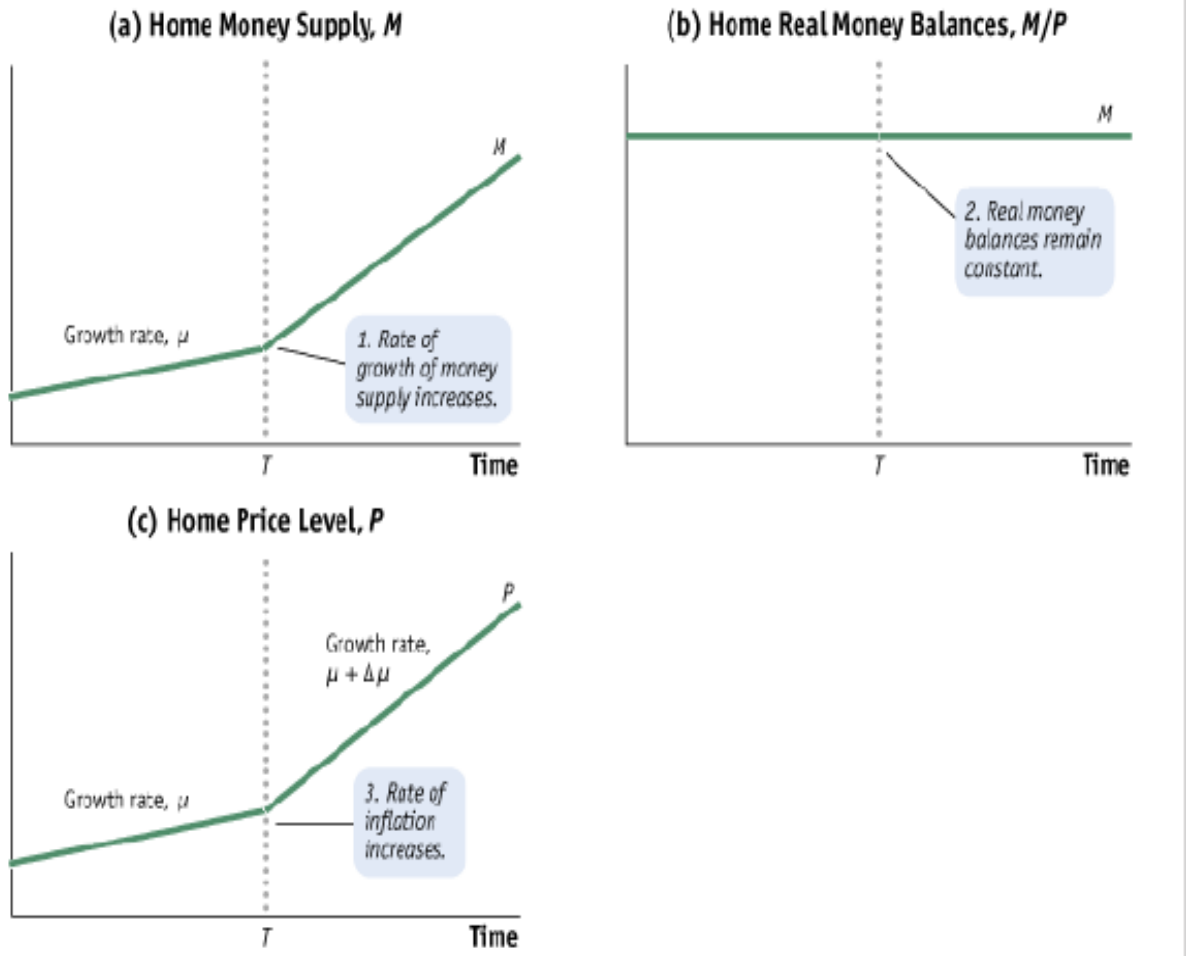
FIGURE 14-6 (2 of 4)



An Increase in the Growth Rate of the Money Supply in the Simple Model (continued)

In panel (b), the quantity theory assumes that the level of real money balances remains unchanged.

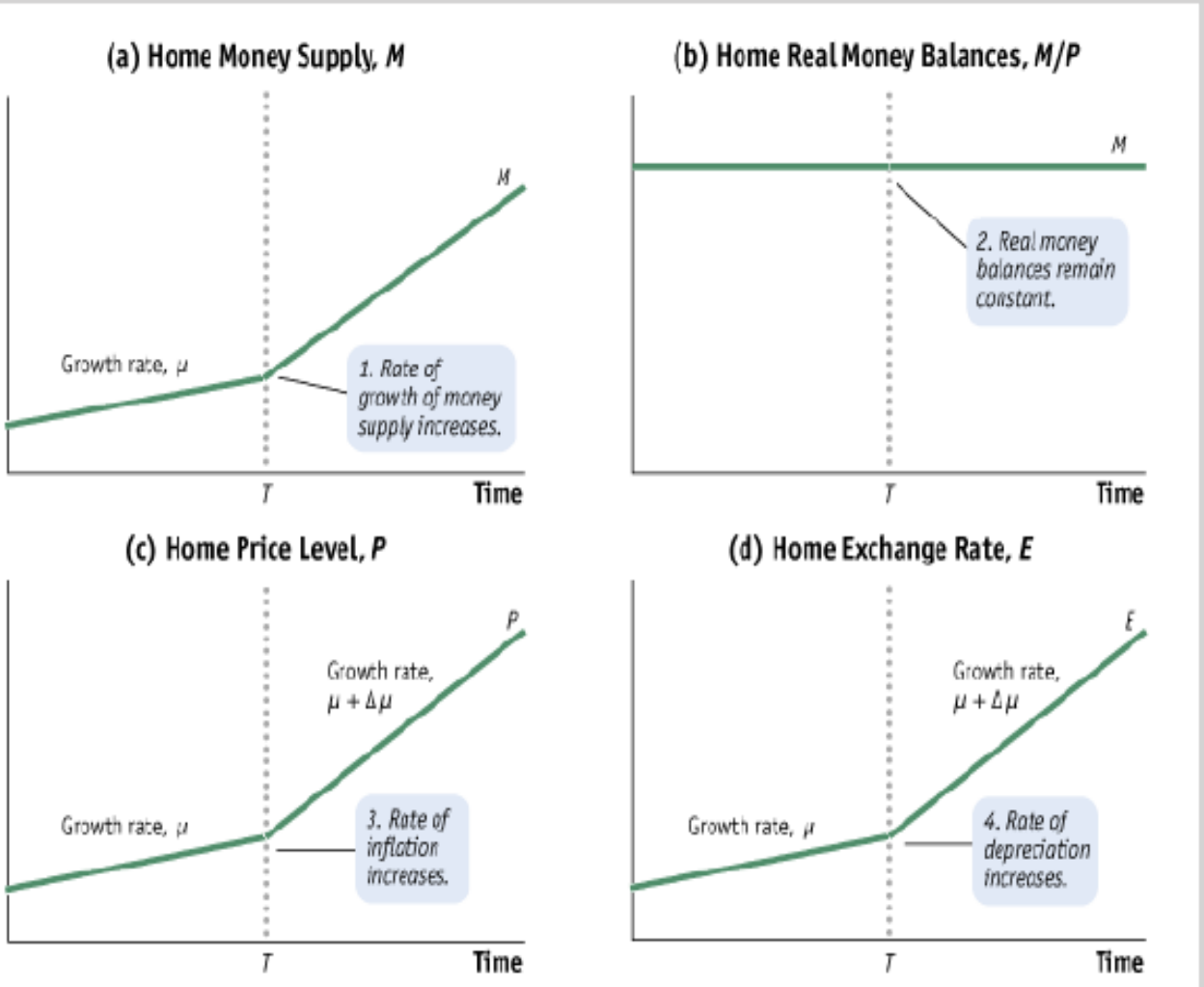
FIGURE 14-6 (3 of 4)



An Increase in the Growth Rate of the Money Supply in the Simple Model (continued)

After time *T*, if real money balances (*M*/*P*) are constant, then money *M* and prices *P* still grow at the same rate, which is now $\mu + \Delta\mu$, so the rate of inflation rises by $\Delta\mu$, as shown in panel (c).

FIGURE 14-6 (4 of 4)

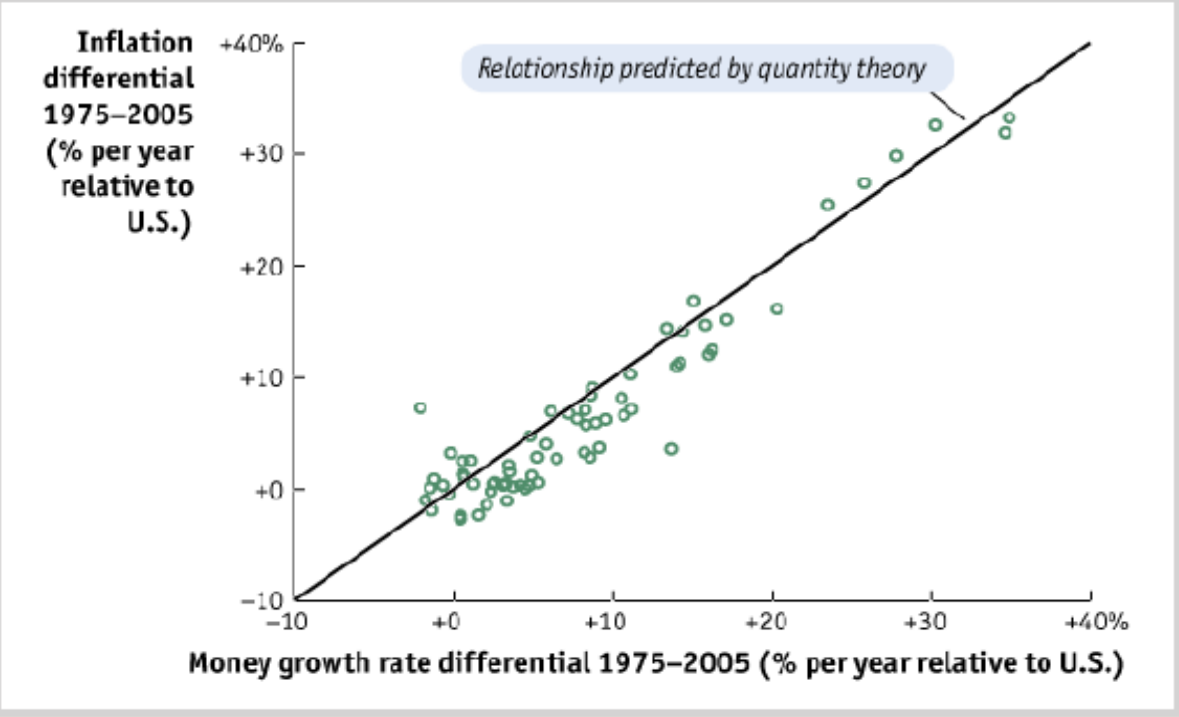


An Increase in the Growth Rate of the Money Supply in the Simple Model (continued)

PPP and an assumed stable foreign price level imply that the exchange rate will follow a path similar to that of the domestic price level, so *E* also grows at the new rate $\mu + \Delta\mu$, and the rate of depreciation rises by $\Delta\mu$, as shown in panel (d).

Evidence for the Monetary Approach

FIGURE 14-7

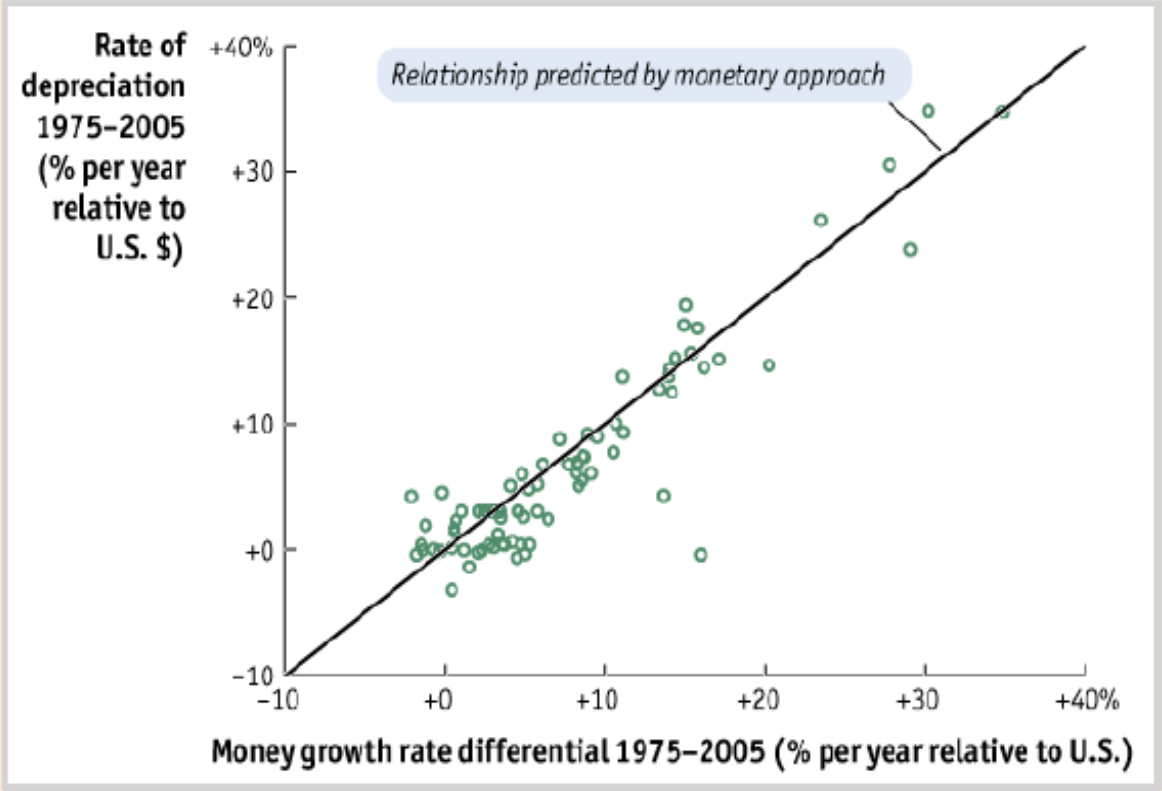


Inflation Rates and Money Growth Rates, 1975–2005

This scatterplot shows the relationship between the rate of inflation and the money supply growth rate over the long run, based on data for a sample of 76 countries.

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

FIGURE 14-8

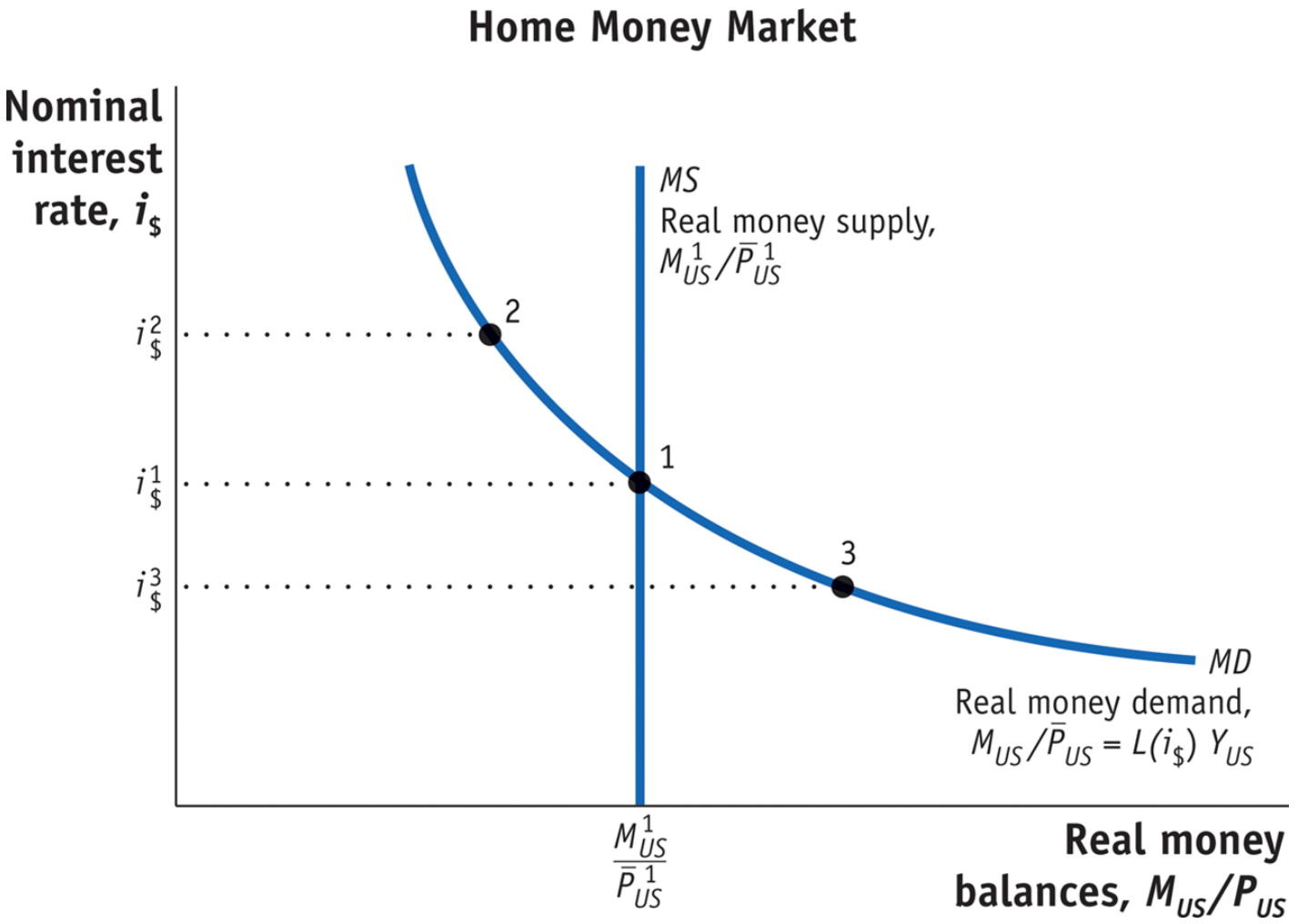


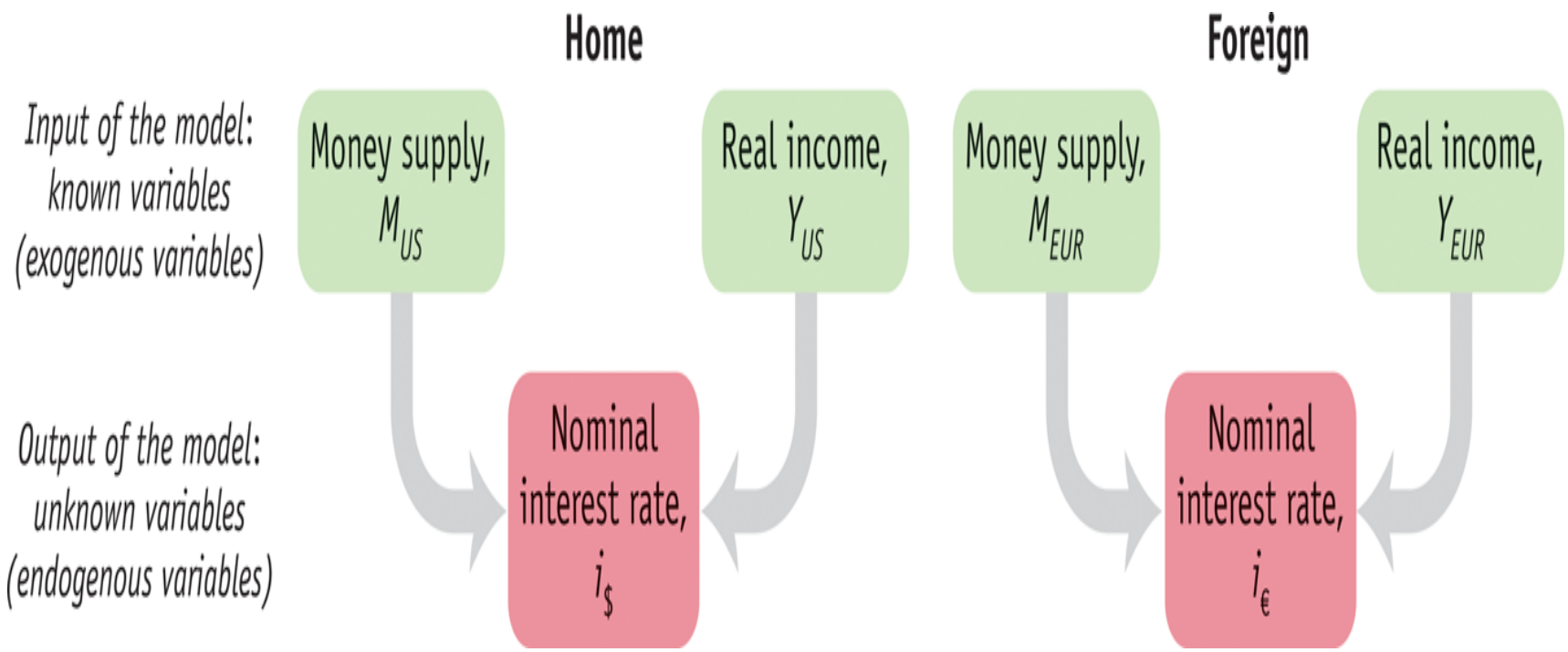
Money Growth Rates and the Exchange Rate, 1975–2005

This scatterplot shows the relationship between the rate of exchange rate depreciation and the money growth rate differential relative to the United States over the long run, based on data for a sample of 82 countries.

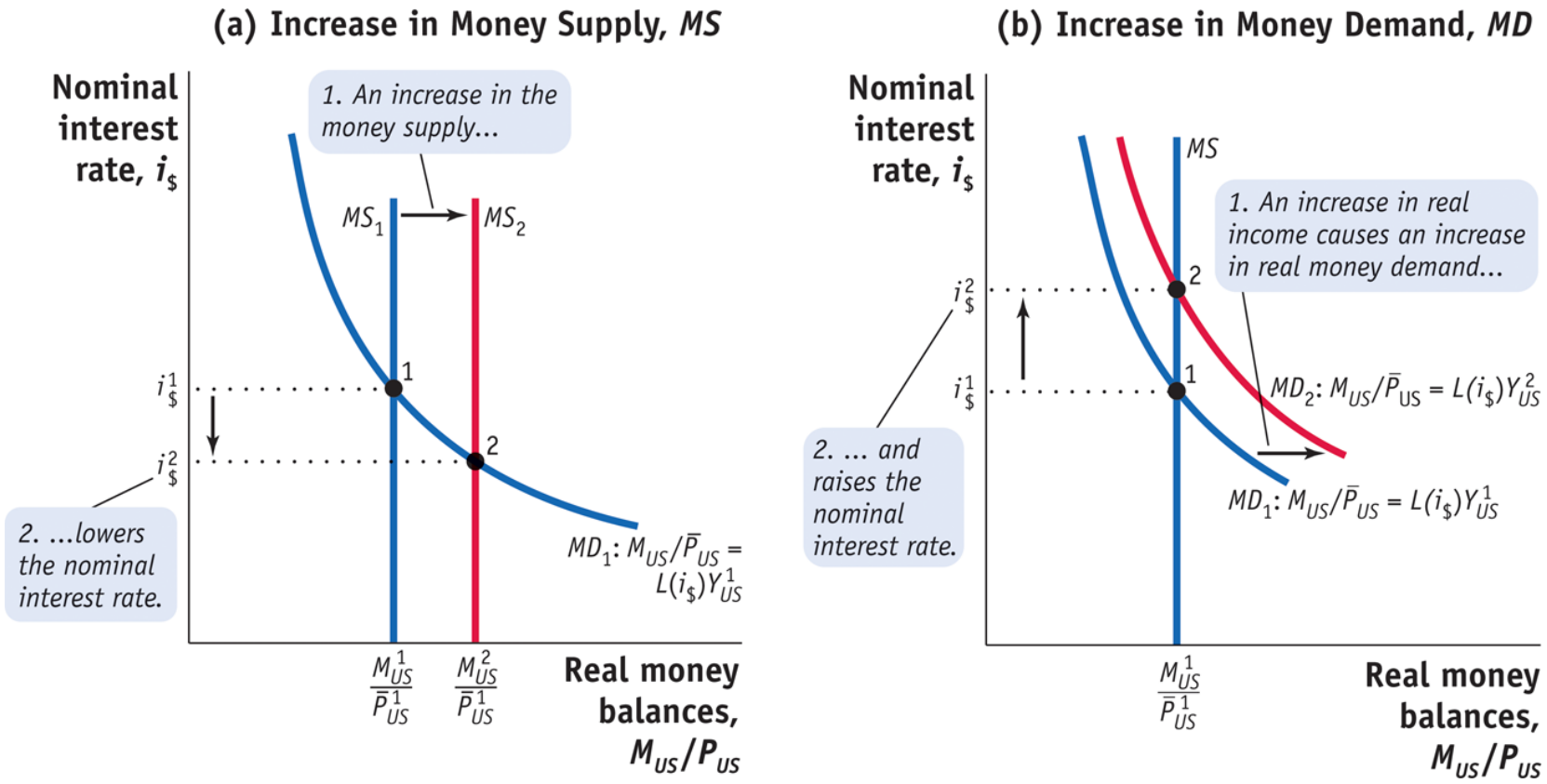
The data show a strong correlation between the two variables and a close resemblance to the theoretical prediction of the monetary approach to exchange rates, which would predict that all data points would appear on the 45-degree line.

Exchange Rate Determination in the Long Run

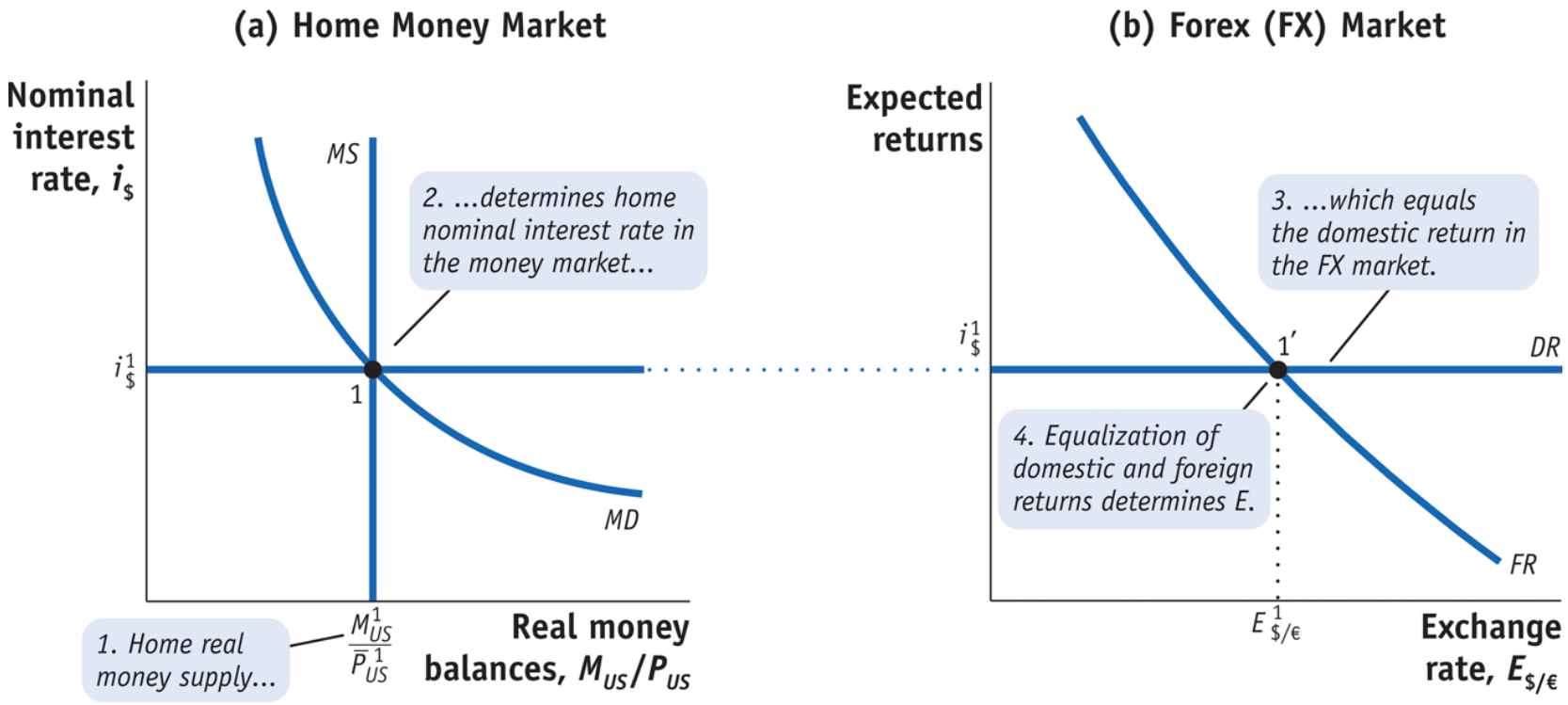




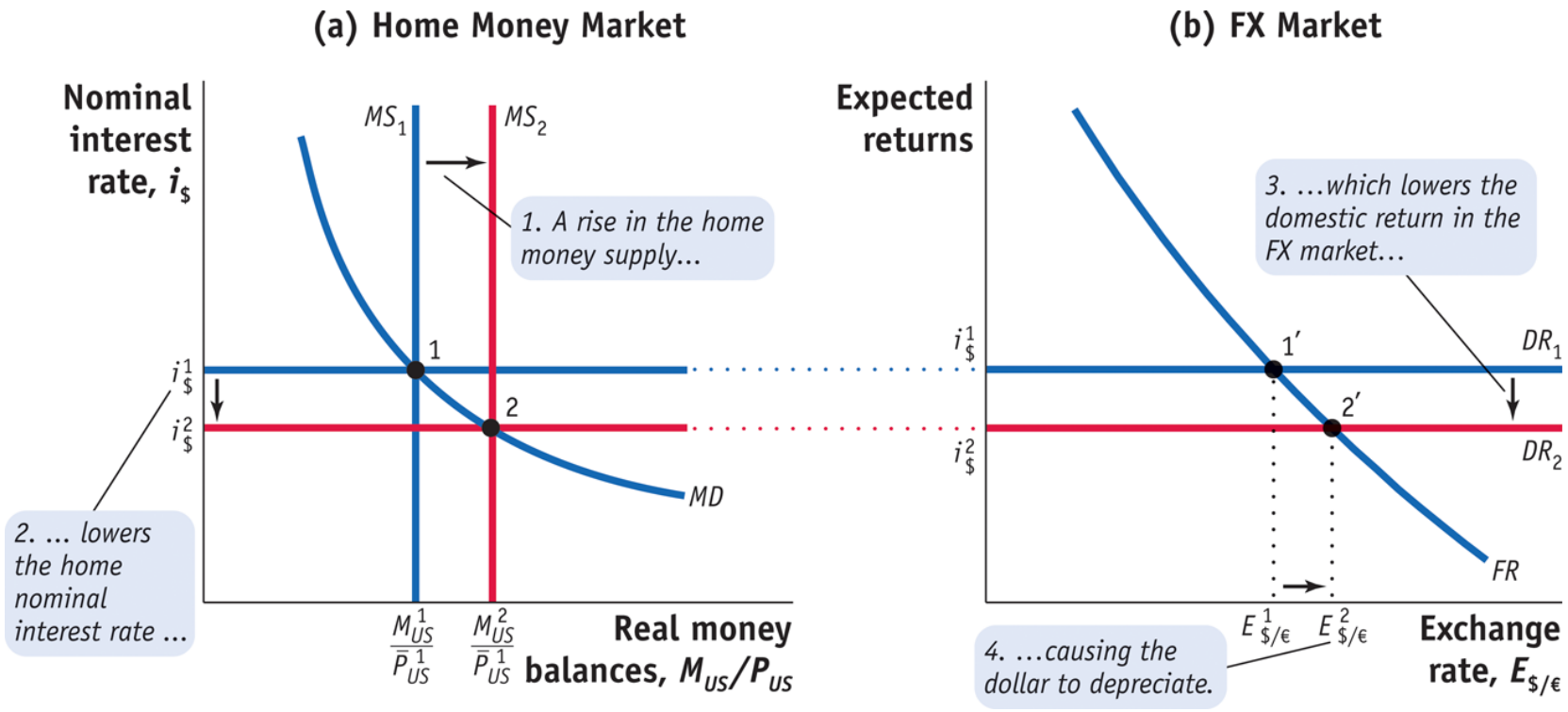
Effects of Changes in Money Supply and Money Demand



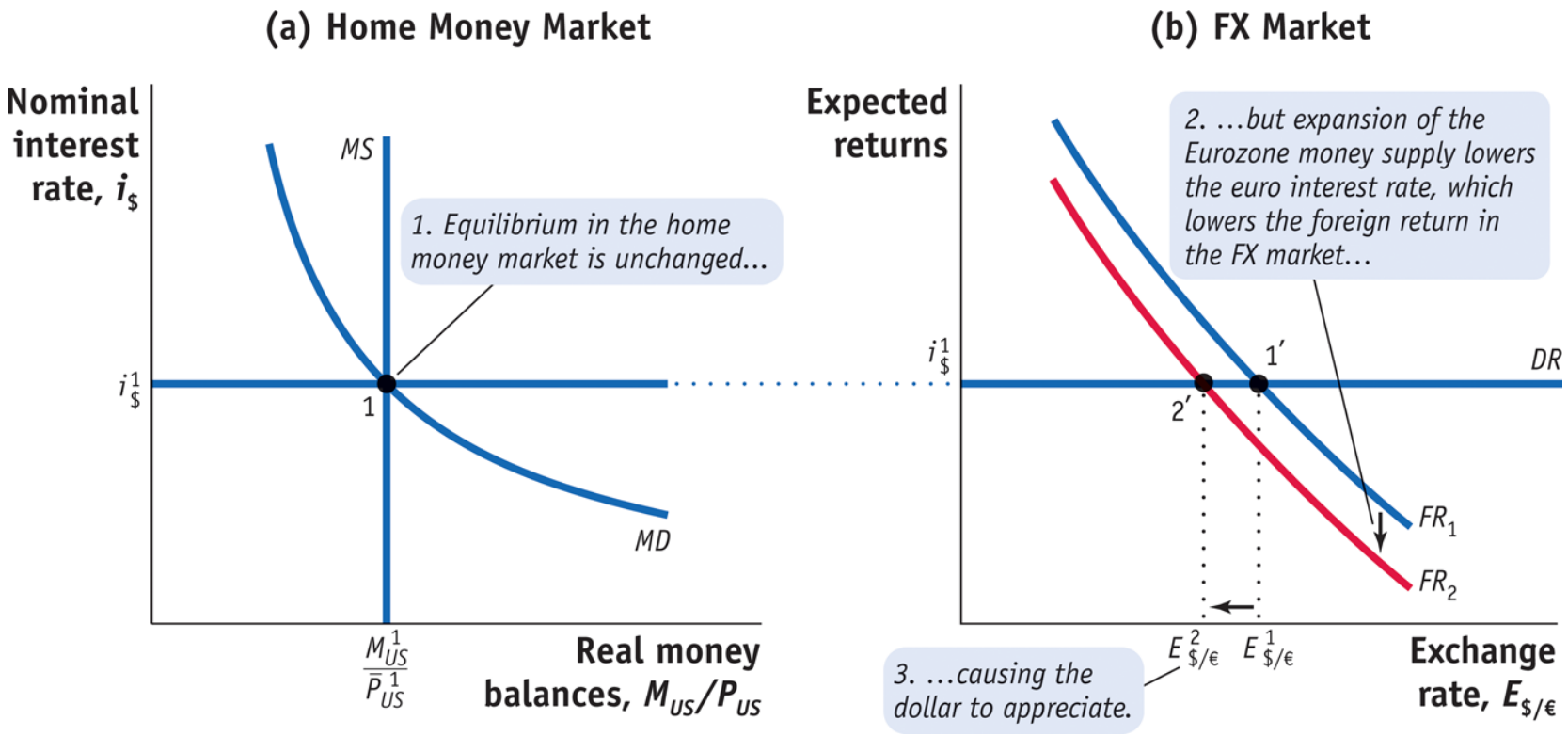
Equilibrium in the Money and FX Markets (SR)



Domestic money supply expansion

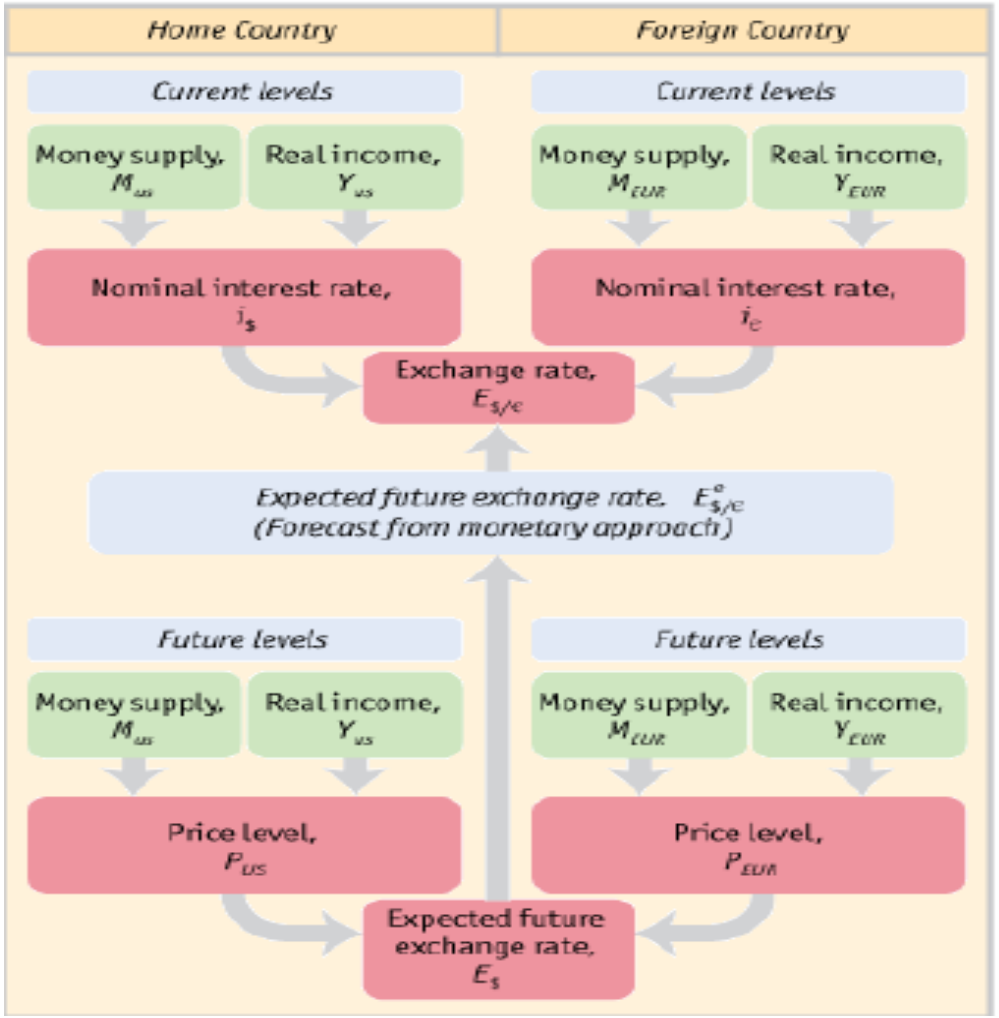


Increase in Foreign Money Supply



Putting the asset and monetary approaches together

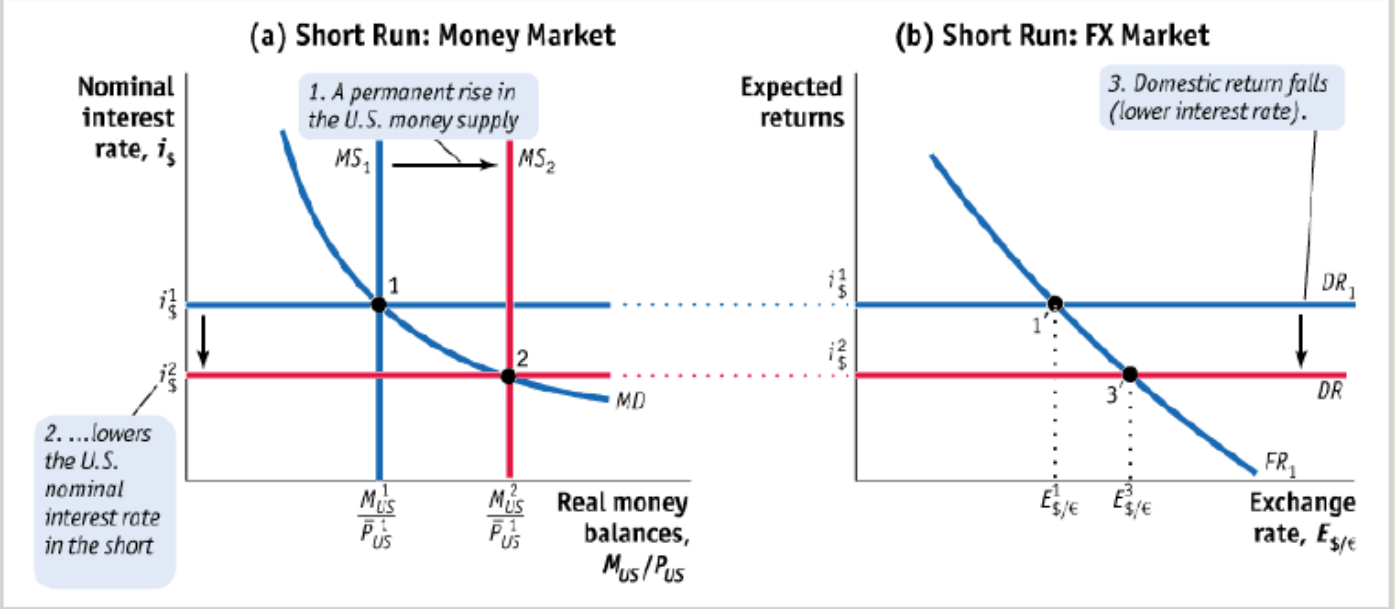
The expected future exchange rate is now endogenous and depends on changes in domestic (and foreign) policy variables…



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.

FIGURE 15-12 (1 of 4)

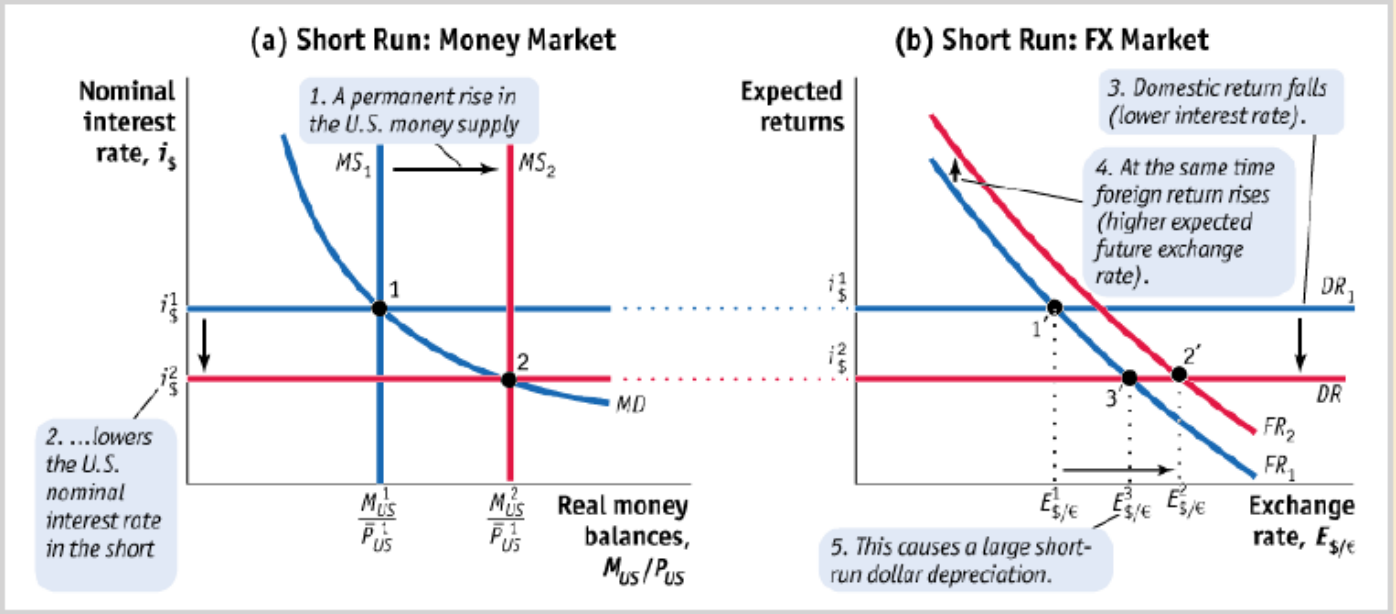


Permanent Expansion of the Home Money Supply Short-Run Impact:

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 15-12 (2 of 4)

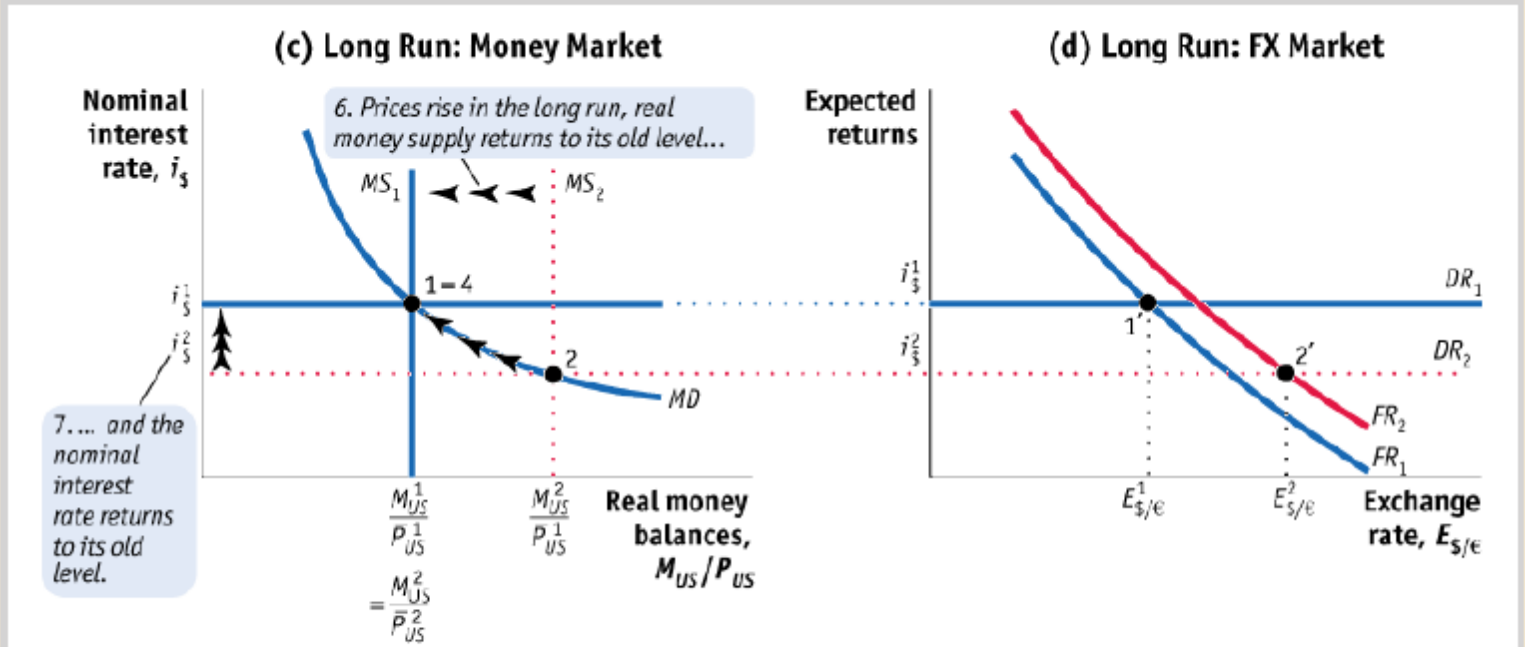


Permanent Expansion of the Home Money Supply Short-Run Impact: (continued)

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 15-12 (3 of 4)

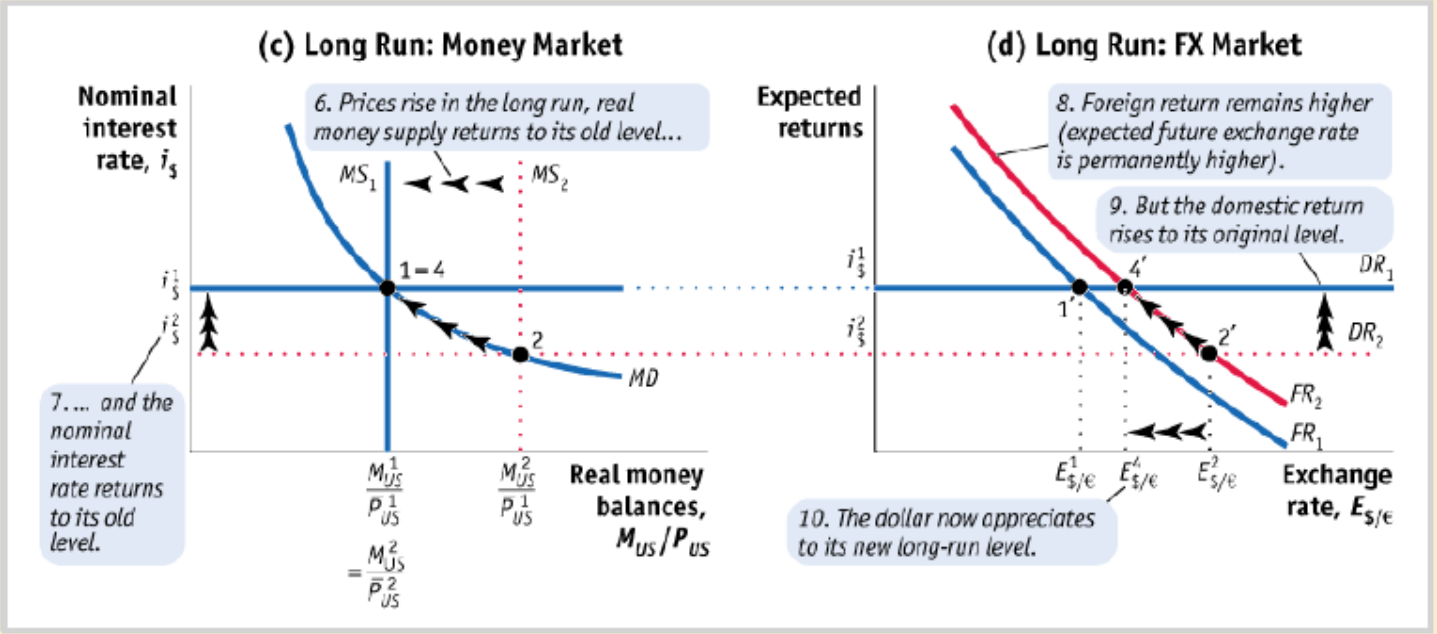


Long-Run Adjustment:

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 $\overline{P}^2_{US}$, and real money supply returns to its original level $M^1_{US}/\overline{P}^1_{US}$.

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

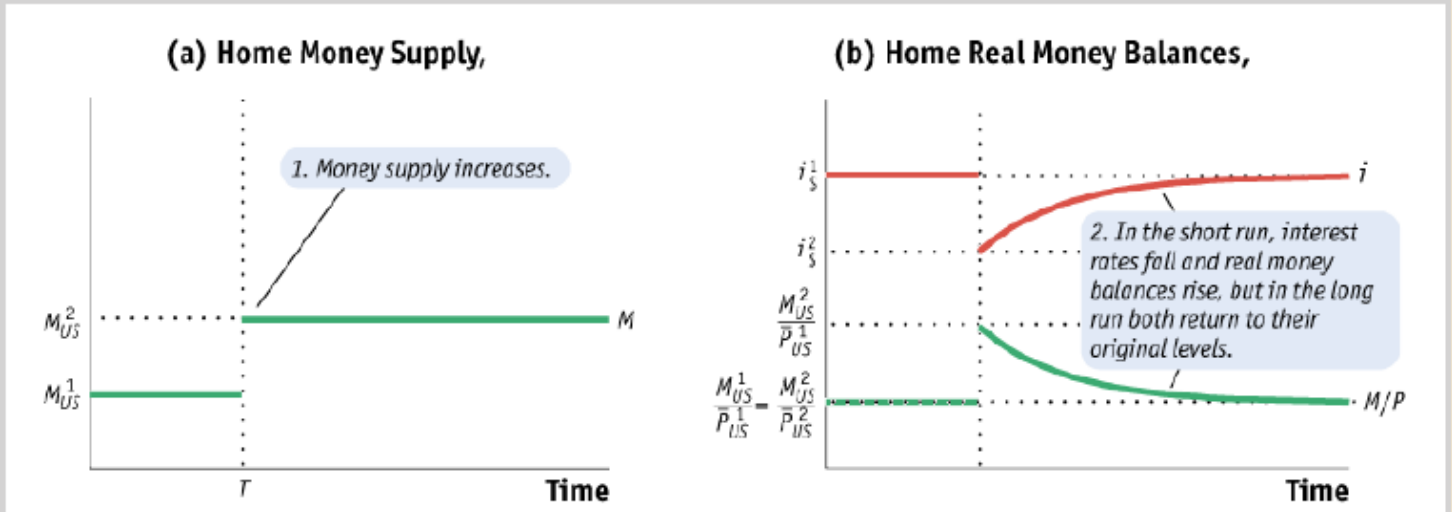
FIGURE 15-12 (4 of 4)



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.

FIGURE 15-13 (1 of 2)



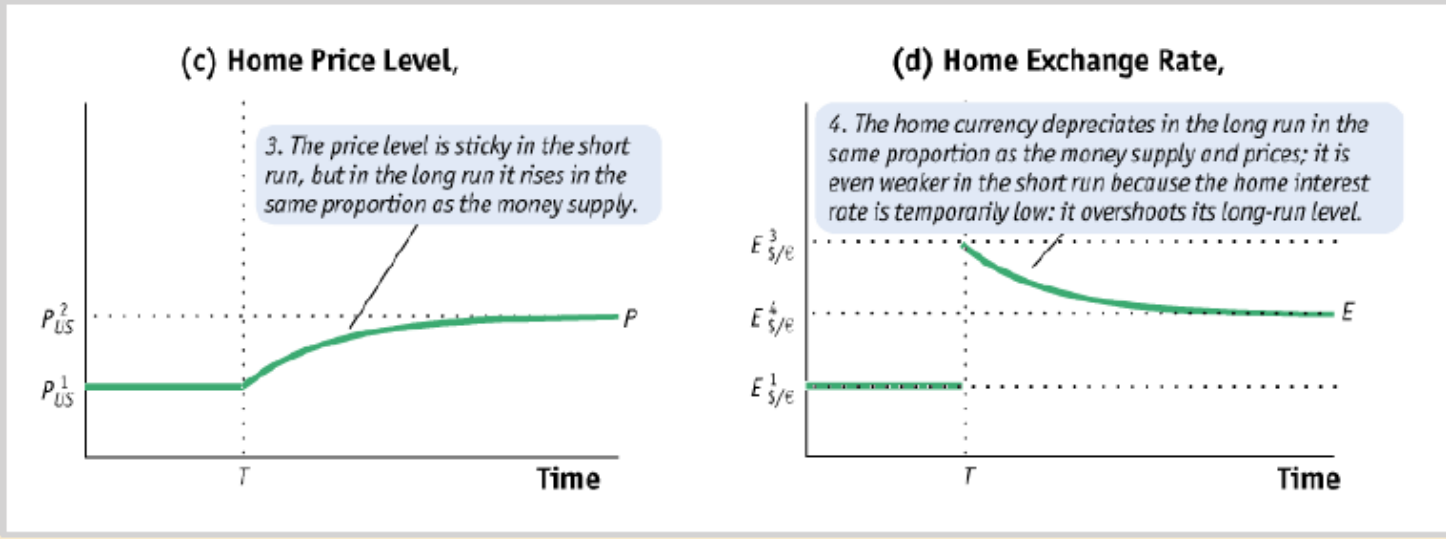
Responses to a Permanent Expansion of the Home Money Supply

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.

Overshooting

FIGURE 15-13 (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.

*The implication of overshooting is that in the short run PPP does not hold: during the adjustment towards the new long run equilibrium domestic prices are **rising and** the exchange rate is **appreciating.***