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Exchange Rate Crises: How Pegs Work and How They Break

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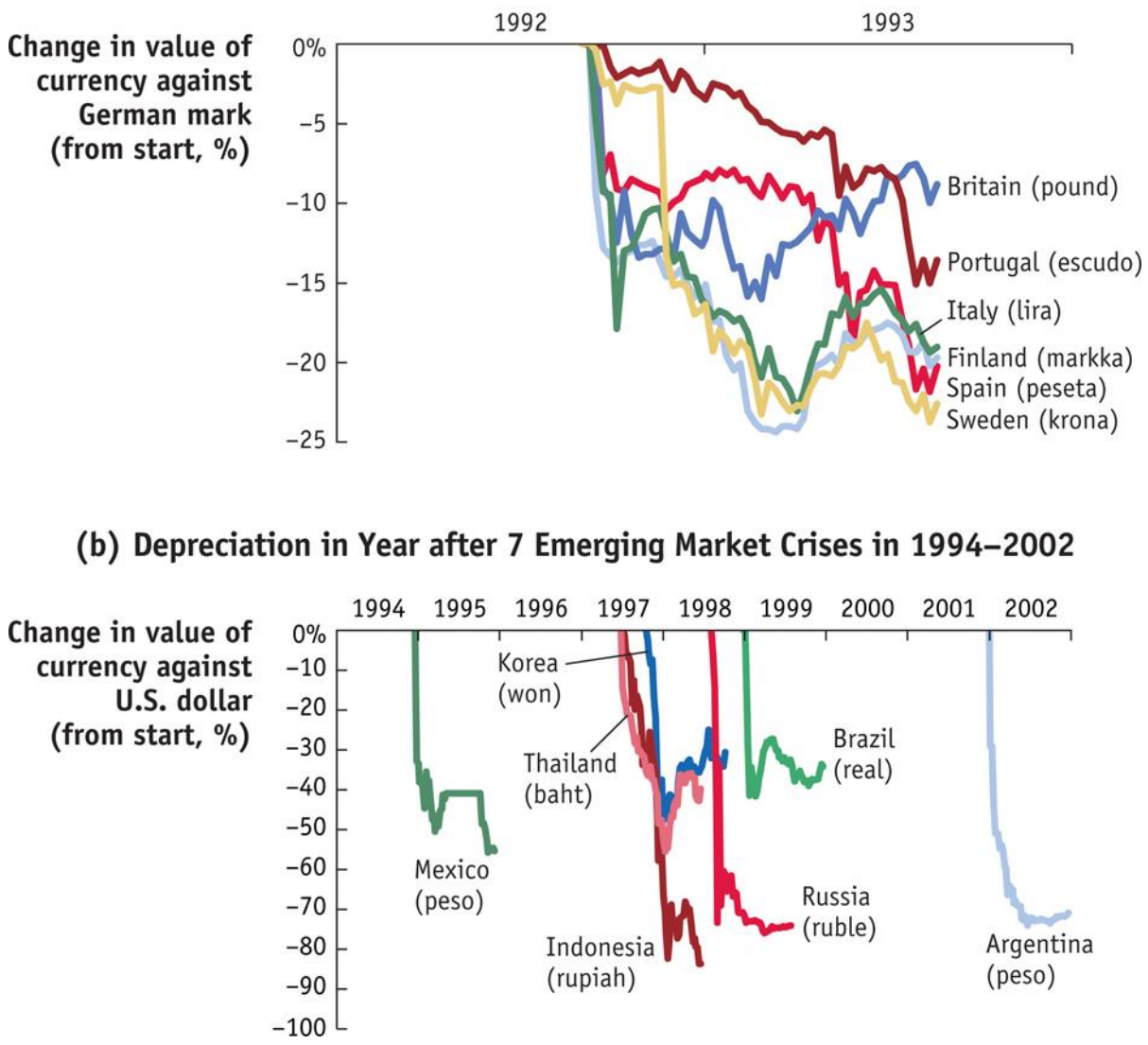
Introduction

- Recent history shows that the typical fixed exchange rate succeeds for a few years then breaks. One study found that the average duration of any peg was about five years.
- When the break occurs, there can be a large and sudden depreciation. This is known as an **exchange rate crisis**.
- Understanding the causes and consequences of exchange rate crises is a major goal of international macroeconomics because of the damage they do.
- There is an important asymmetry in regime changes: The shift from floating to fixed is generally smooth and planned, the shift from fixed to floating is usually unplanned and catastrophic.

What Is an Exchange Rate Crisis?

- A simple definition of an exchange rate crisis would be a "big" depreciation.
- In an advanced country, a 10% to 15% depreciation might be considered large. In emerging markets, the bar might be set higher, at 20% to 25%.
- Exchange rate crises can occur in advanced countries as well as in emerging markets and developing countries.
- The magnitude of the crisis, as measured by the subsequent depreciation of the currency, is often much greater in emerging markets and developing countries.

FIGURE 9-1



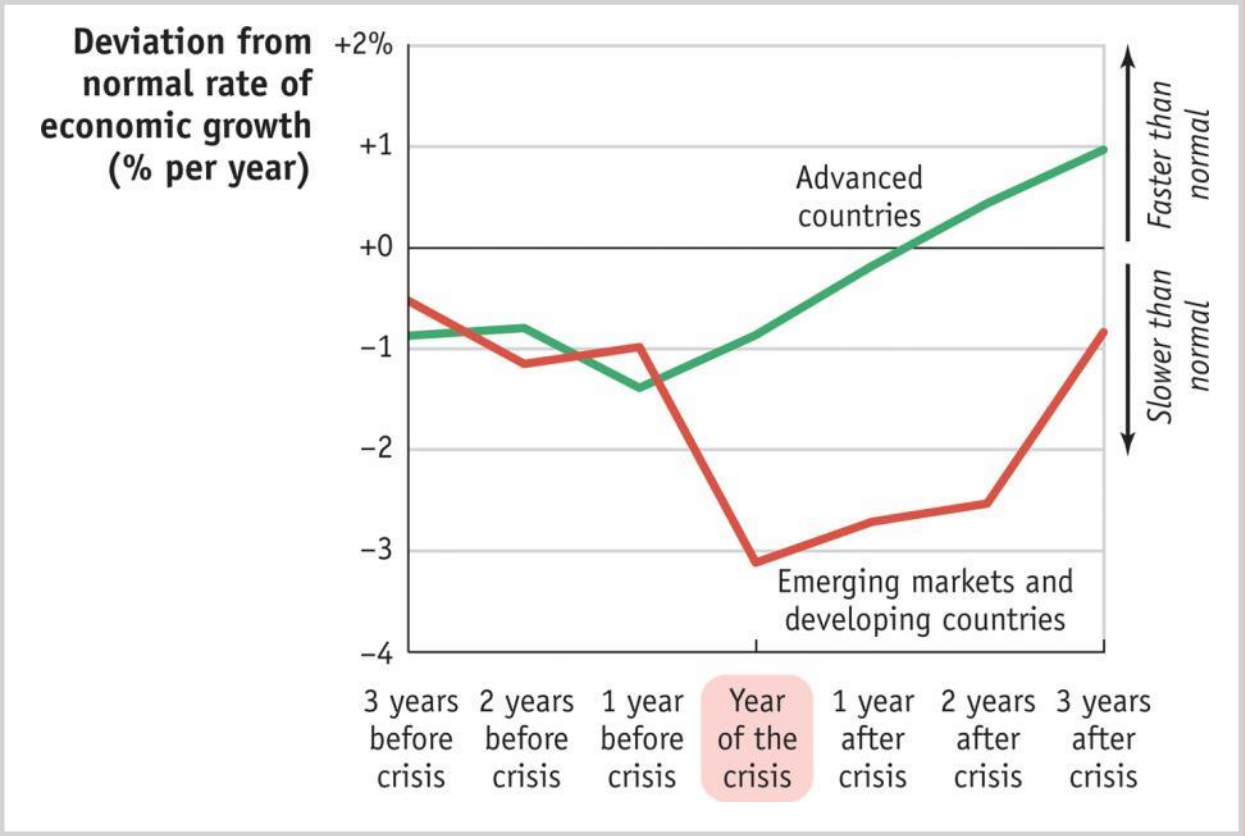
Currency Crashes In recent years, developed and developing countries have experienced exchange rate crises.

Panel (a) shows depreciations of six European currencies after crises in 1992.

Panel (b) shows depreciations of seven emerging market currencies after crises between 1994 and 2002.

How Costly Are Exchange Rate Crises?

FIGURE 9-2



The Economic Costs of Crises Exchange rate crises can impose large economic costs on a country.

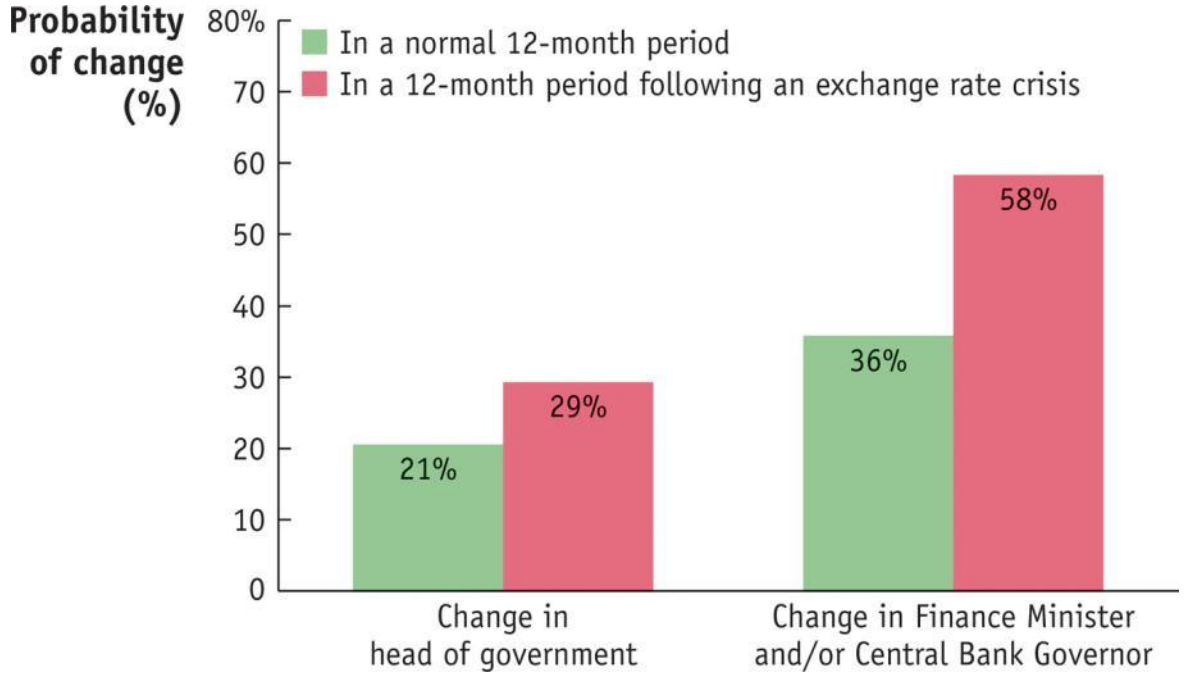
After a crisis, growth rates in emerging markets and developing countries are, on average, two to three percentage points lower than normal, an effect that persists for about three years.

In advanced countries, a depreciation is typically expansionary, and growth is, on average, faster just after the crisis than it was just before.

SIDE BAR

The Political Costs of Crises

FIGURE 9-3



The Political Costs of Crises Exchange rate crises usually impose large political costs on those in power. Compared with what is likely to happen during normal, noncrisis times, it is 22% more likely that one of the two main officials with economic responsibilities (the finance minister and the central bank governor) will be out of a job the year following a crisis. It is also 9% more likely that the head of government (such as a president, prime minister, or premier) will have to depart.

Causes: Other Economic Crises

- Exchange rate crises usually go hand in hand with other types of harmful financial crises, especially in emerging markets.

- If banks and other financial institutions face adverse shocks, they may become **insolvent**, causing them to close or declare bankruptcy; this is known as a **banking crisis**.

- In the public sector, if the government faces adverse shocks, it may default and be unable or unwilling to pay the principal or interest on its debts; this is known as a *sovereign debt crisis* or **default crisis**.

Causes: Other Economic Crises

International macroeconomists thus have three crisis types to consider: exchange rate crises, banking crises, and default crises. Evidence shows they are likely to occur simultaneously:

- *The likelihood of a banking or default crisis increases significantly when a country is having an exchange rate crisis.*
- *The likelihood of an exchange rate crisis increases significantly when a country is having a banking or default crisis.*

These findings show how crises are likely to happen in pairs, known as **twin crises**, or all three at once, known as **triple crises**, magnifying the costs of any one type of crisis.

TABLE 9-1 Costly Banking Crises

The table shows the estimated costs of major banking crises since 1991 in both advanced and emerging economies.

Country	Starting Year of the Crisis	Output Loss (% of GDP)*	Direct Fiscal Costs (% of GDP)**	Increase in Public Debt (% of GDP)***
Argentina	2001	71.0%	9.6%	81.9%
Brazil	1994	0.0	13.2	–33.8
China	1998	19.4	18.0	11.2
Denmark	2008	36.0	3.1	24.9
Finland	1991	69.6	12.8	43.6
France	2008	23.0	1.0	17.3
Germany	2008	11.0	1.8	17.8
Greece	2008	43.0	27.3	44.5
Iceland	2008	43.0	44.2	72.2
Indonesia	1997	69.0	56.8	67.6
Ireland	2008	106.0	40.7	72.8
Italy	2008	32.0	0.3	8.6
Japan	1997	45.0	14.0	41.7
Korea	1997	57.6	31.2	9.9
Luxembourg	2008	36.0	7.7	14.6
Malaysia	1997	31.4	16.4	0.2
Mexico	1994	13.7	19.3	16.4
Netherlands	2008	23.0	12.7	26.8
Norway	1991	5.1	2.7	19.2
Portugal	2008	37.0	0.0	33.6
Russia	1998	—	0.1	–7.1
Russia	2008	0.0	2.3	6.4
Sweden	1991	32.9	3.6	36.2
Sweden	2008	25.0	0.7	11.1
Switzerland	2008	0.0	1.1	–0.2
Thailand	1997	109.3	43.8	42.1
Turkey	2000	37.0	32.0	15.3
United Kingdom	2007	25.0	8.8	24.4
United States	2007	31.0	4.5	23.6
Average		*36.9*	*14.8*	*25.6*

2 How Pegs Work: The Mechanics of a Fixed Exchange Rate(1 of 8)

Preliminaries and Assumptions

- Let's assume Home's currency is the peso. The currency to which Home pegs is the U.S. dollar, and we assume the authorities have been maintaining a fixed exchange rate, with E fixed at $\bar{E} = 1$ (one peso per U.S. dollar).

- The country's central bank controls the money supply M by buying and selling **assets** in exchange for cash. The central bank trades domestic bonds (denominated in pesos), and foreign assets (denominated in dollars).

- The central bank stands ready to buy and sell foreign exchange **reserves** at the fixed exchange. If it has no reserves, it cannot do this and the exchange rate is free to float: The peg is broken.

2 How Pegs Work: The Mechanics of a Fixed Exchange Rate(2 of 8)

Preliminaries and Assumptions

- For now, we assume that the peg is credible. Uncovered interest parity then implies that the home and foreign interest rates are equal: $i = i^*$.
- We will also assume for now that output or income is exogenous and denoted Y.
- There is a stable foreign price level $\bar{P}^* = 1$ at all times. In the short run, the home country's price is sticky and fixed at a level $\bar{P} = 1$. In the long run, if the exchange rate is kept fixed at 1, then the home price level will be fixed at 1 as a result of purchasing power parity.

Preliminaries and Assumptions

- The home country's demand for real money balances M/P is determined by the level of output Y and the nominal interest rate i and takes the usual form, $M/P = L(i)Y$. The money market is in equilibrium.

- There is no financial system and the only money is currency, also known as M0 or the monetary base. The money supply is denoted M. We consider only the effects of the actions of a central bank.

The Central Bank Balance Sheet

- The home central bank's sole liability is the money in circulation.
- Suppose the central bank has purchased a quantity *B* pesos of domestic bonds. By, in effect, loaning money to the domestic economy, the central bank's purchases are usually referred to as **domestic credit** created by the central bank.
- These purchases generate part of the money supply and are also called the bank's *domestic assets.*
- The part of the home money supply created as a result of the central bank's issuing of domestic credit is denoted *B*.

The Central Bank Balance Sheet

- Now suppose the central bank also uses money to purchase a quantity *R* dollars of foreign exchange reserves, usually referred to as reserves.

- Because the central bank holds only two types of assets, the last two expressions add up to the total money supply in the home economy:

$$\underbrace{M}_{\text{Money Supply}} = \underbrace{B}_{\text{Domestic credit}} + \underbrace{R}_{\text{Reserves}} \qquad (9\text{-}1)$$

- Expressed not in levels but in changes:

$$\underbrace{\Delta M}_{\text{Change in money supply}} = \underbrace{\Delta B}_{\text{Change in domestic credit}} + \underbrace{\Delta R}_{\text{Change in reserves}} \qquad (9\text{-}2)$$

2 How Pegs Work: The Mechanics of a Fixed Exchange Rate(6 of 8)

The Central Bank Balance Sheet

The **central bank balance sheet** contains the central bank's assets, $B + R$, and the money supply, its **liabilities**.

SIMPLIFIED CENTRAL BANK BALANCE SHEET (MILLIONS OF PESOS)

Assets		Liabilities	
Reserves R	500	**Money supply** M	1,000
Foreign assets (dollar reserves)		*Currency in circulation*	
Domestic credit B	500		
Domestic assets (peso bonds)			

Fixing, Floating, and the Role of Reserves

We are assuming that the exchange rate is fixed if and only if the central bank holds reserves; the exchange rate is floating if and only if the central bank has no reserves.

How Reserves Adjust to Maintain the Peg

- What level of reserves must the central bank have to maintain the peg? If the central bank can maintain a level of reserves above zero, we know the peg will hold. If not, the peg breaks. Solving for the level of reserves:

$$R = M - B$$

- Since money supply equals money demand, given by $M = \bar{P}L(i)Y$, then:

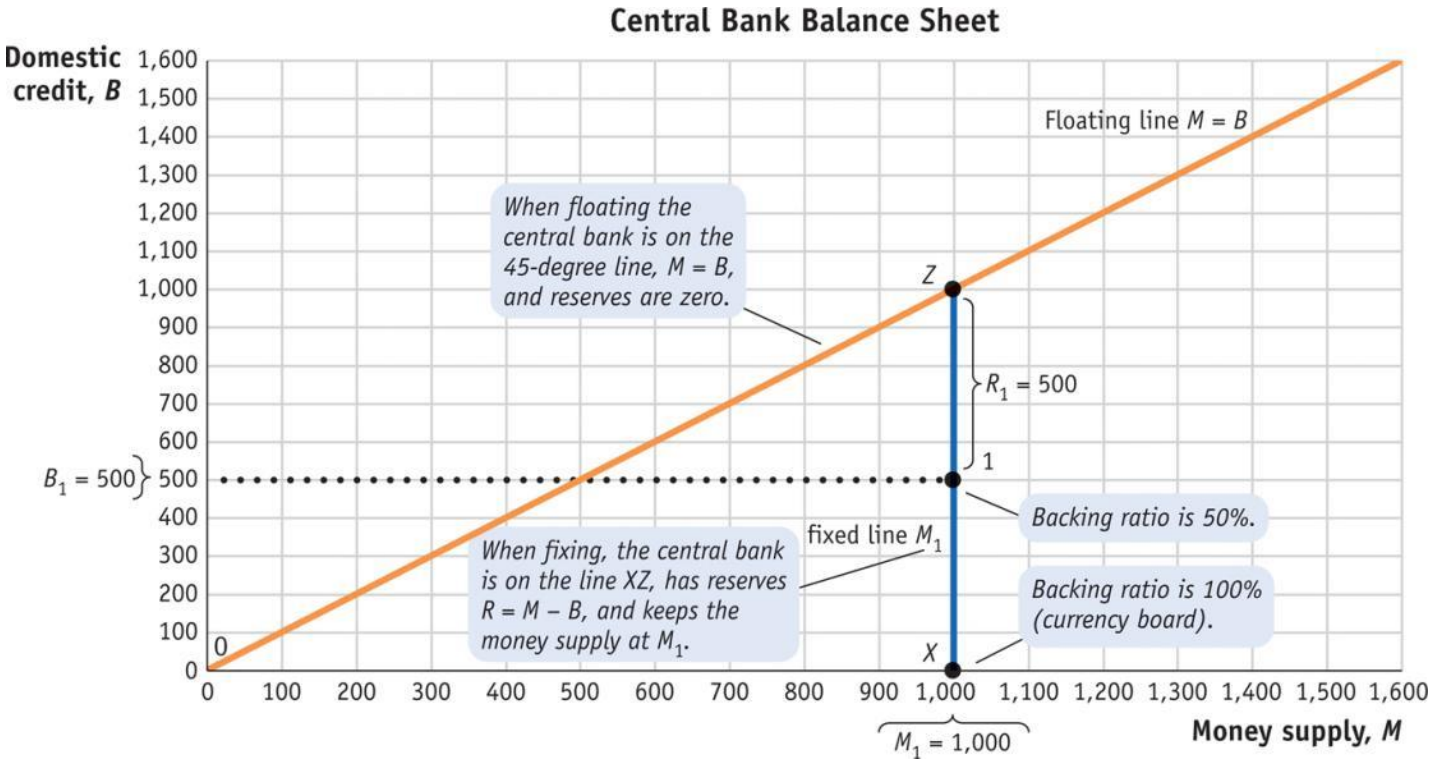
$$\underbrace{R}_{\text{Reserves}} = \underbrace{\bar{P}L(i)Y}_{\text{Money demand}} - \underbrace{B}_{\text{Domestic credit}} \qquad (9\text{-}3)$$

How Reserves Adjust to Maintain the Peg

- If the central bank bought more reserves than required by Equation (9-3), home money supply would expand and the home nominal interest rate would fall, the peso would depreciate, and the peg would break.
- To prevent this, the central bank would need to intervene in the forex market to offset its initial purchase of reserves, to keep the supply of pesos constant, and to keep the exchange rate steady.
- Similarly, if the central bank sells reserves for pesos, it would cause the peso to appreciate and would have to reverse course and buy back the reserves. The peg means that the central bank must keep the reserves at the level specified in Equation (9-3).

Graphical Analysis of the Central Bank Balance Sheet

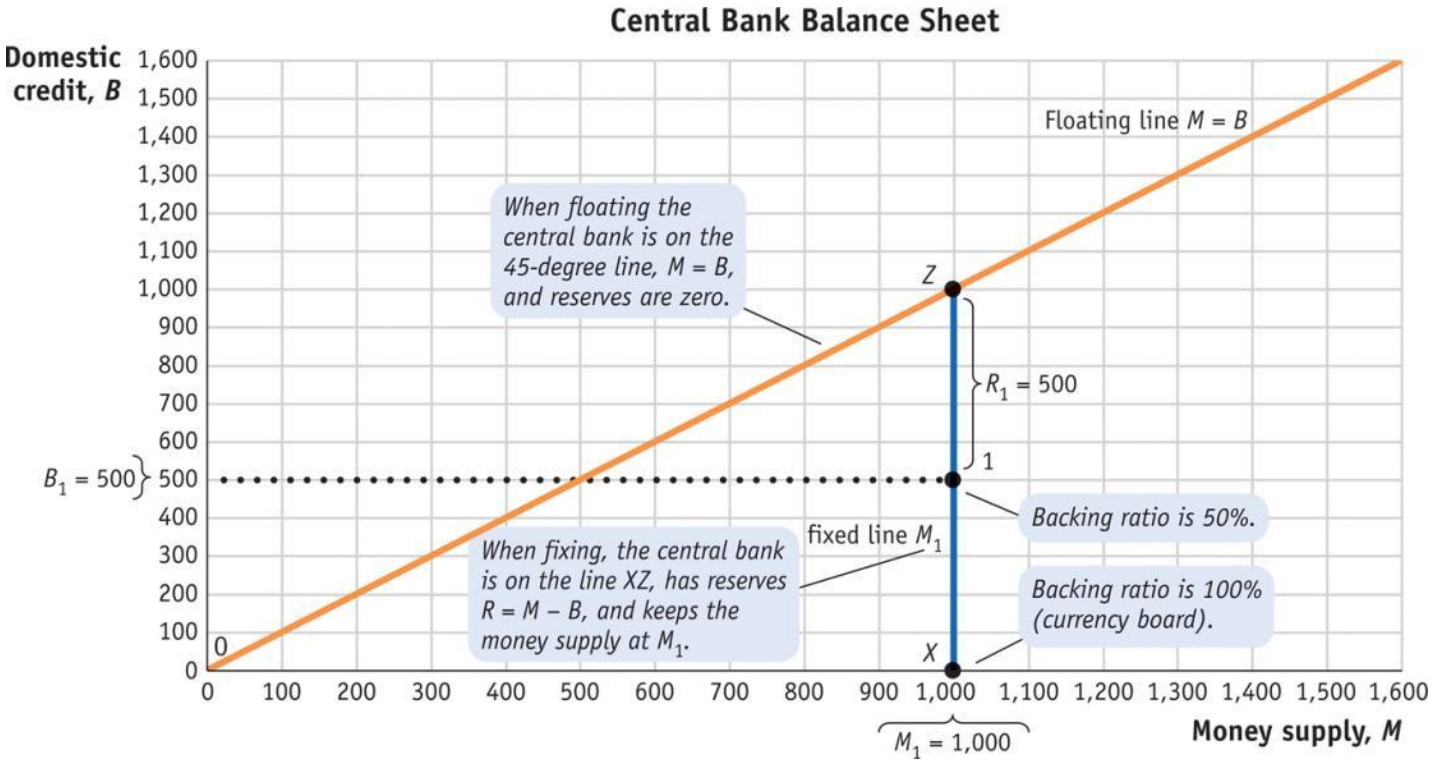
FIGURE 9-4 (1 of 2) The Central Bank Balance Sheet Diagram



This figure presents a simplified view of central bank operations. On the 45-degree line, reserves are at zero, and the money supply *M* equals domestic credit *B*. Variations in the money supply along this line would cause the exchange rate to float. There is a unique level of the money supply M_1 (here assumed to be 1,000) that ensures the exchange rate is at its chosen fixed value.

Graphical Analysis of the Central Bank Balance Sheet

FIGURE 9-4 (2 of 2) The Central Bank Balance Sheet Diagram (continued)



To fix the money supply at this level, the central bank must choose a mix of assets on its balance sheet that corresponds to points on line *XZ,* points at which domestic credit *B* is less than money supply *M*. At point *Z,* reserves would be at zero; at point *X,* reserves would be 100% of the money supply. Any point in between on *XZ* is a feasible choice. At point 1, for example, domestic credit is $B_1 = 500$, reserves are $R_1 = 500$, and $B_1 + R_1 = M_1 = 1{,}000$.

Graphical Analysis of the Central Bank Balance Sheet

To sum up:

- If the exchange rate is floating, the central bank balance sheet corresponds to a point on the 45-degree **floating line**.
- If the exchange rate is fixed, the central bank balance sheet corresponds to a point on the vertical **fixed line**.

In addition:

A fixed exchange rate that always operates with reserves equal to 100% of the money supply ($M = R$ and $B = 0$) is known as a **currency board** system.

Defending the Peg I: Changes in the Level of Money Demand

We first look at shocks to money demand and how they affect reserves by altering the level of money supply *M*.

A Shock to Home Output or the Foreign Interest Rate

- Suppose output falls or the foreign interest rate rises. We treat either of these events as an exogenous shock, all else equal.
- Suppose these shocks lead to an endogenous decrease in money demand by 10% at the current interest rate.
- A fall in the demand for money would lower the interest rate in the money market and put depreciation pressure on the home currency. To maintain the peg, the central bank must keep the interest rate unchanged. It must sell 100 million pesos ($100 million) of reserves, in exchange for cash.

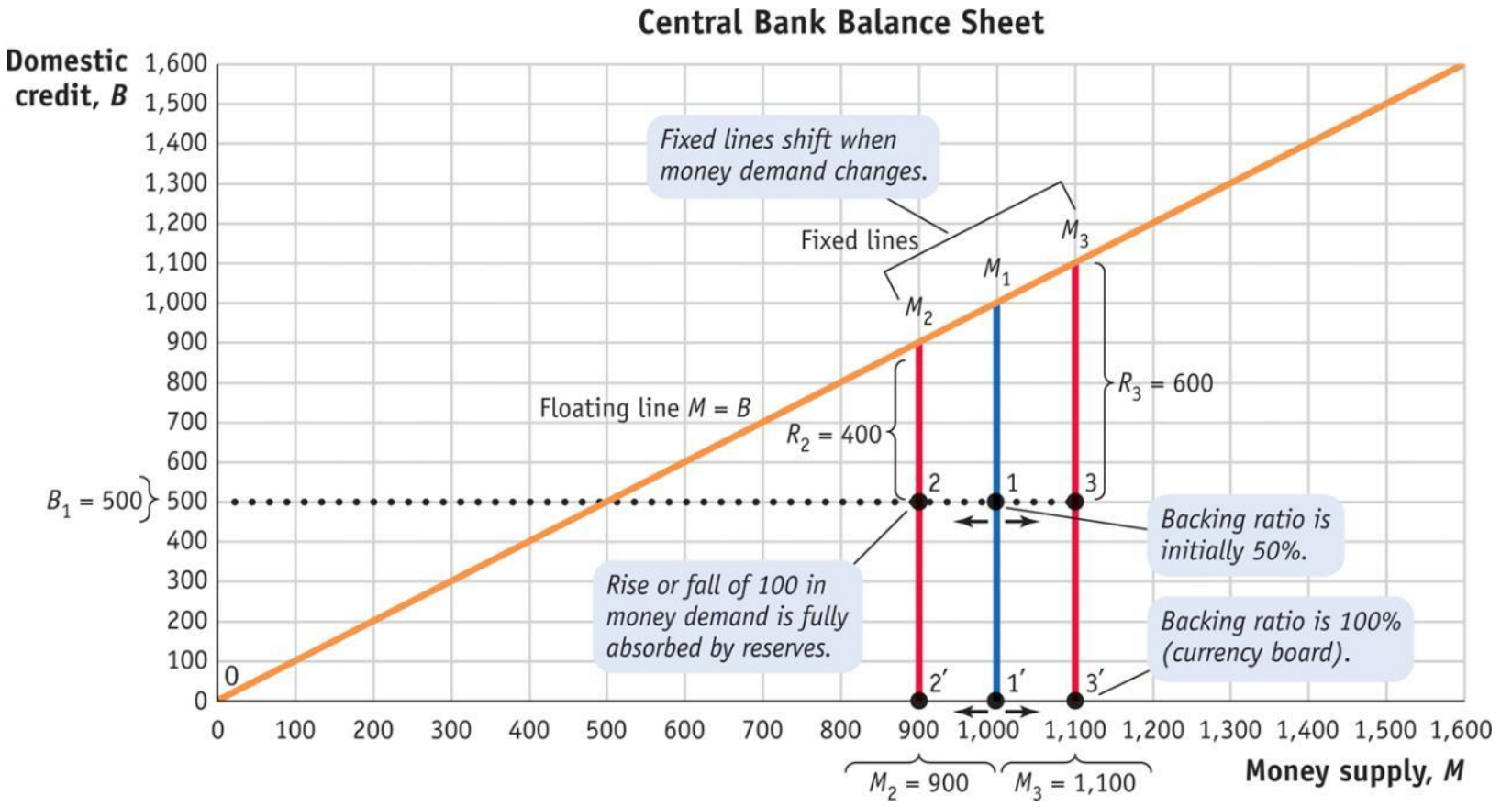
Defending the Peg I: Changes in the Level of Money Demand

The central bank's balance sheet will then be as follows:

SIMPLIFIED CENTRAL BANK BALANCE SHEET AFTER MONEY DEMAND FALLS (MILLIONS OF PESOS)

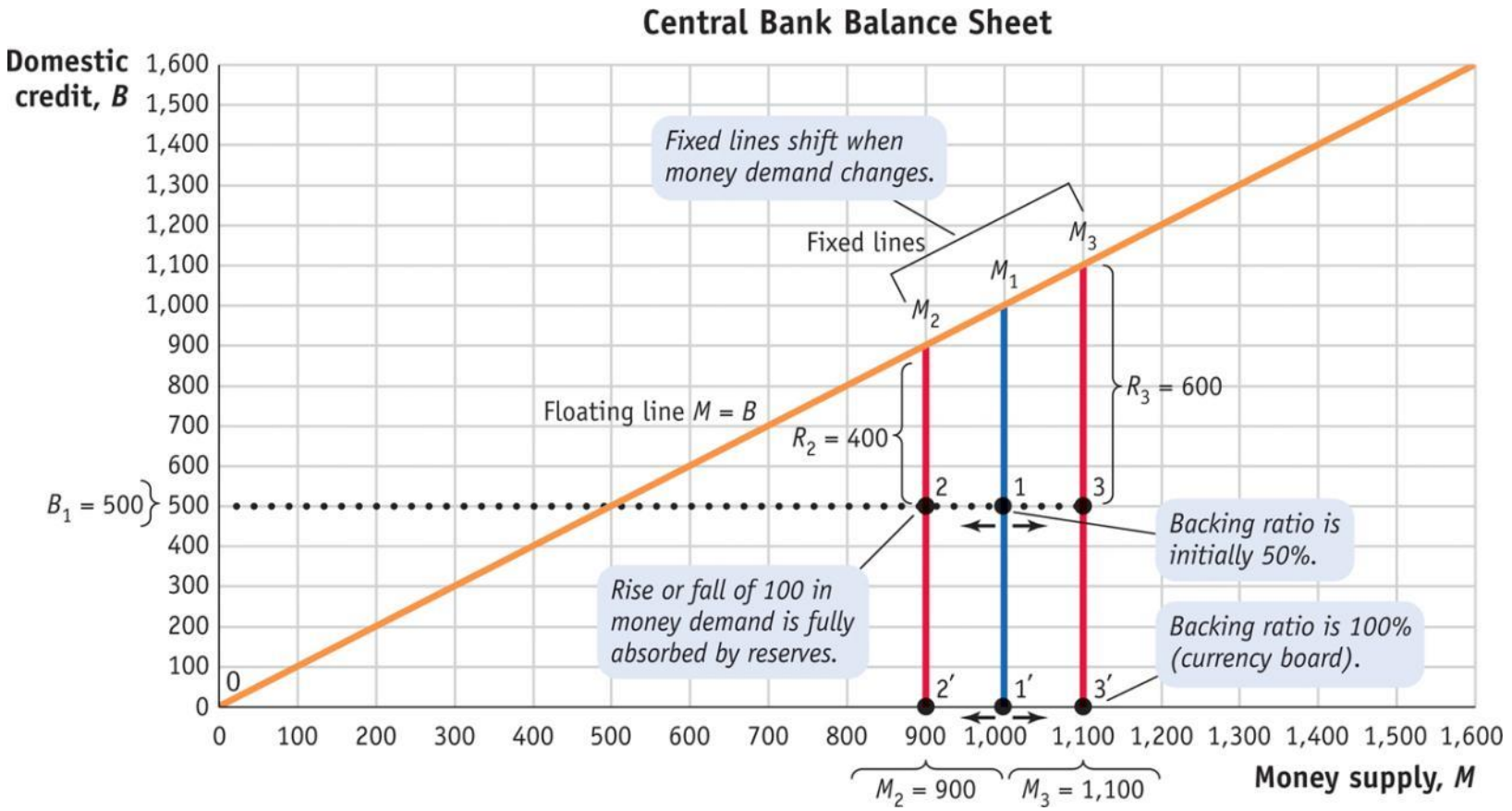
Assets		Liabilities	
Reserves *R*	400	**Money supply *M***	900
Foreign assets (dollar reserves)		*Currency in circulation*	
Domestic credit *B*	500		
Domestic assets (peso bonds)			

FIGURE 9-5 (1 of 3) Shocks to Money Demand



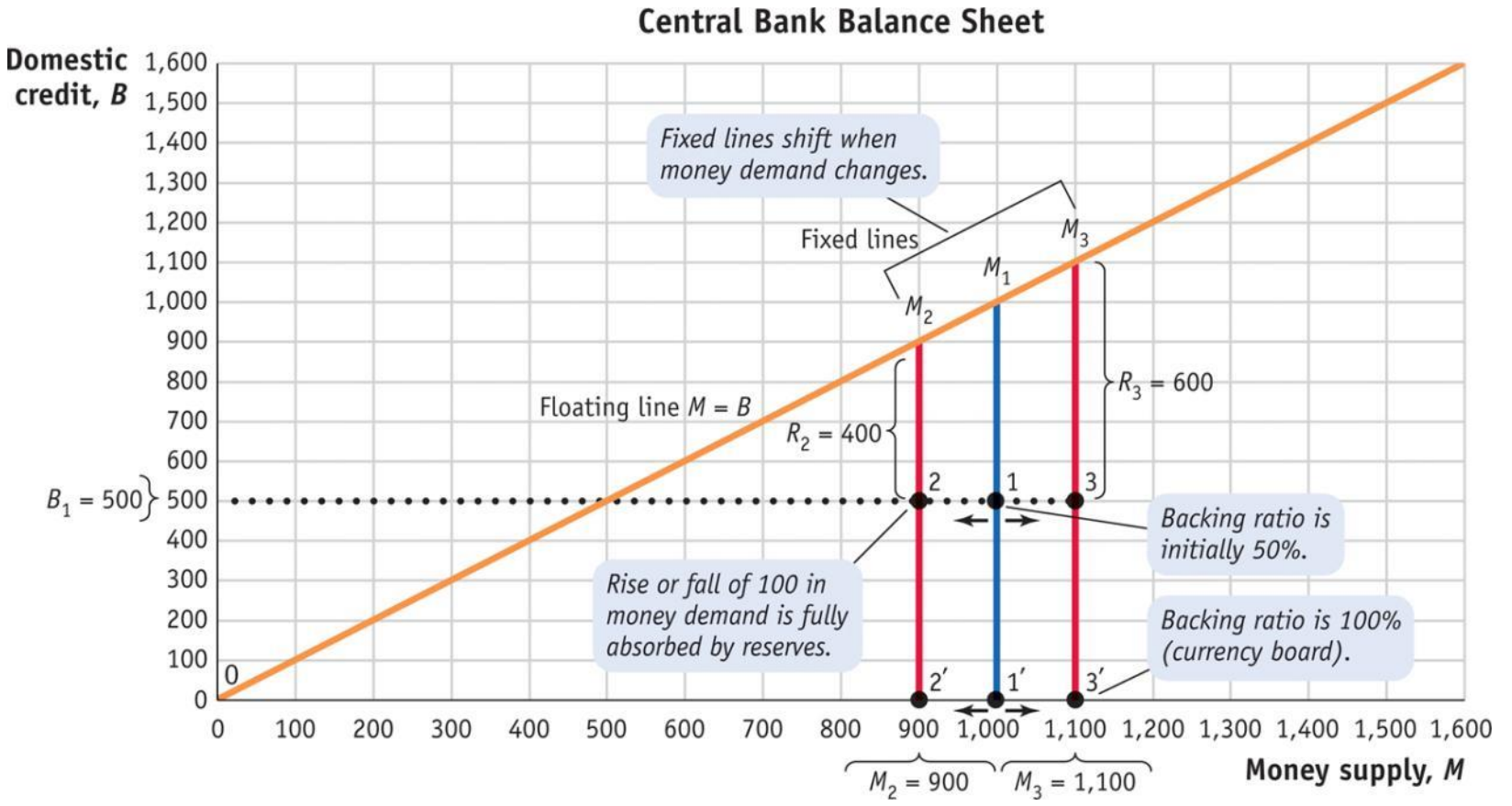
If money demand falls, interest rates tend to fall, leading to pressure for an exchange rate to depreciate. To prevent this, the central bank must intervene and defend the peg by selling reserves. This lowers the money supply. The bank's objective is to keep the interest rate fixed and to ensure that money supply equals money demand. As shown here, the money supply declines from M_1 = 1,000 to M_2 = 900.

FIGURE 9-5 (2 of 3) Shocks to Money Demand (continued)



If domestic credit is unchanged at $B_1 = 500$, the change in the central bank balance sheet is shown by a move from point 1 to point 2, and reserves absorb the money demand shock by falling from $R_1 = 500$ to $R_2 = 400$.

FIGURE 9-5 (3 of 3) Shocks to Money Demand (continued)



An opposite positive shock is shown by the move from point 1 to point 3, where $M_3 = 1{,}100$ and $R_3 = 600$. In a currency board system, a country maintaining 100% reserves will be on the horizontal axis with zero domestic credit, $B = 0$. A currency board adjusts to money demand shocks by moving from point 1′ to points 2′ or 3′.

Defending the Peg I: Changes in the Level of Money Demand

The Importance of the Backing Ratio

- The ratio R/M is called the **backing ratio**, and it indicates the fraction of the money supply that is backed by reserves on the central bank balance sheet.

- In general, *for a given size of a shock to money demand, a higher backing ratio will better insulate an economy against running out of reserves, all else equal*.

Defending the Peg I: Changes in the Level of Money Demand

Currency Board Operation

- A maximum backing ratio of 100% is maintained at all times by a currency board.
- In Figure 9-5, at points 2′ or 3′ reserves are equal to money supply and equal to money demand.
- A currency board keeps reserves at a maximum 100%, so the central bank can cope with any shock to money demand without running out of reserves.
- Currency boards are considered a hard peg because their high backing ratio ought to confer on them greater resilience in the face of money demand shocks.

Defending the Peg I: Changes in the Level of Money Demand

Why Does the Level of Money Demand Fluctuate?

- Money demand shocks originate either in shocks to home output Y or the foreign interest rate i^* (because under a credible peg $i = i^*$).

- Since output fluctuations are more volatile in emerging markets and developing countries, the prudent level of reserves is likely to be higher in these countries.

- If the peg is not fully credible and simple interest parity fails to hold, the home interest rate will no longer equal the foreign interest rate, and additional disturbances to home money demand can be caused by the spread.

APPLICATION

Risk Premiums in Advanced and Emerging Markets

- Uncovered interest parity (UIP) requires that the domestic return equal the foreign interest rate plus the expected rate of depreciation of the home currency.

- When additional risks affect home bank deposits, a **risk premium** is added to compensate investors for the perceived risk of holding a home domestic currency deposit.

$$\underbrace{i}_{\text{Peso interest rate}} = \underbrace{i^*}_{\text{Dollar interest rate}} + \underbrace{\frac{\Delta E^e_{\text{peso/\$}}}{E_{\text{peso/\$}}} + \begin{bmatrix}\text{Exchange rate}\\ \text{risk premium}\end{bmatrix} + \begin{bmatrix}\text{Default}\\ \text{risk premium}\end{bmatrix}}_{\text{Interest rate spread (equal to zero if peg is credible and there are no risk premiums)}}$$

APPLICATION

Risk Premiums in Advanced and Emerging Markets

- The first part of the **interest rate spread** is the **currency premium**:

$$\text{Currency premium} = \frac{\Delta E^{e}_{\text{peso}/\$}}{E_{\text{peso}/\$}} + \begin{bmatrix}\text{Exchange rate}\\ \text{risk premium}\end{bmatrix}$$

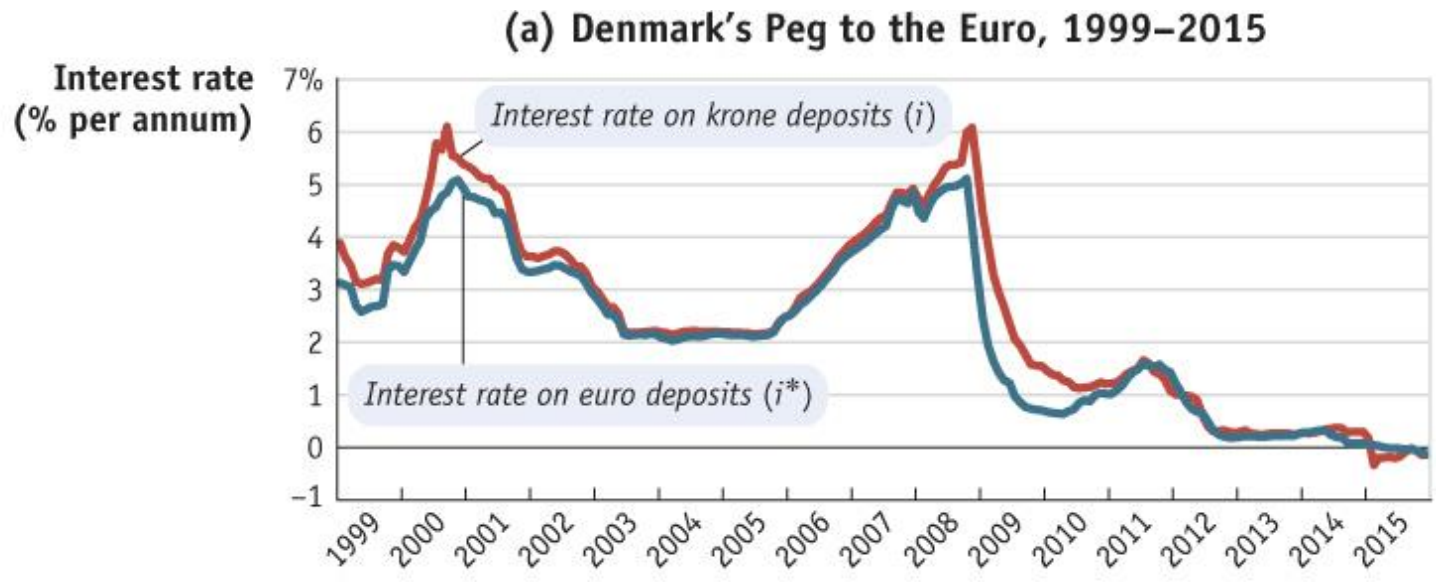
- The second part of the interest rate spread is known as the **country premium**:

$$\text{Country premium} = \begin{bmatrix}\text{Default}\\ \text{risk premium}\end{bmatrix}$$

APPLICATION

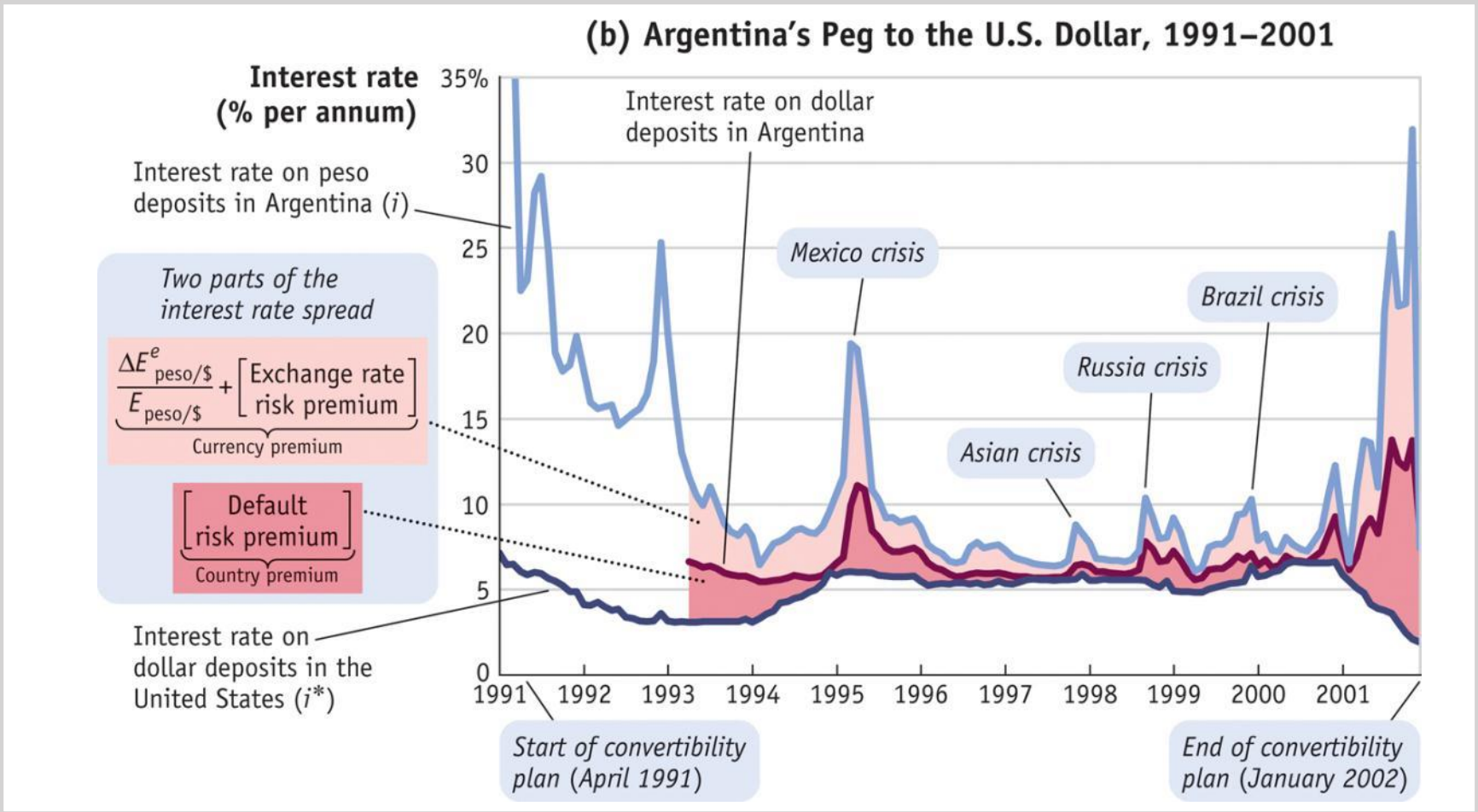
Risk Premiums in Advanced and Emerging Markets

FIGURE 9-6 (1 of 2) Interest Rate Spreads: Currency Premiums and Country Premiums



When advanced countries peg, the interest rate spread is usually close to zero, and we can assume $i = i^*$. An example is Denmark's peg to the euro in panel (a), where the correlation between the krone interest rate and euro interest rates is 0.99.

FIGURE 9-6 (2 of 2) Interest Rate Spreads: Currency Premiums and Country Premiums (continued)



When emerging markets peg, interest rate spreads can be large and volatile. An example is Argentina's peg to the U.S. dollar in panel (b), where the correlation between the peso interest rate and the U.S. interest rate is only 0.38.

APPLICATION

Risk Premiums in Advanced and Emerging Markets

Summary

- Because of fluctuations in interest rate spreads, pegs in emerging markets are subject to even greater interest rate shocks than the pegs of advanced countries, as a result of **credibility** problems.
- The credibility of monetary policy and credibility of property rights, which affect country premiums, cause currency premiums to fluctuate.
- Many economists refer to **contagion** in global capital markets when crises in some parts of the global capital markets trigger adverse changes in market sentiment in faraway places.

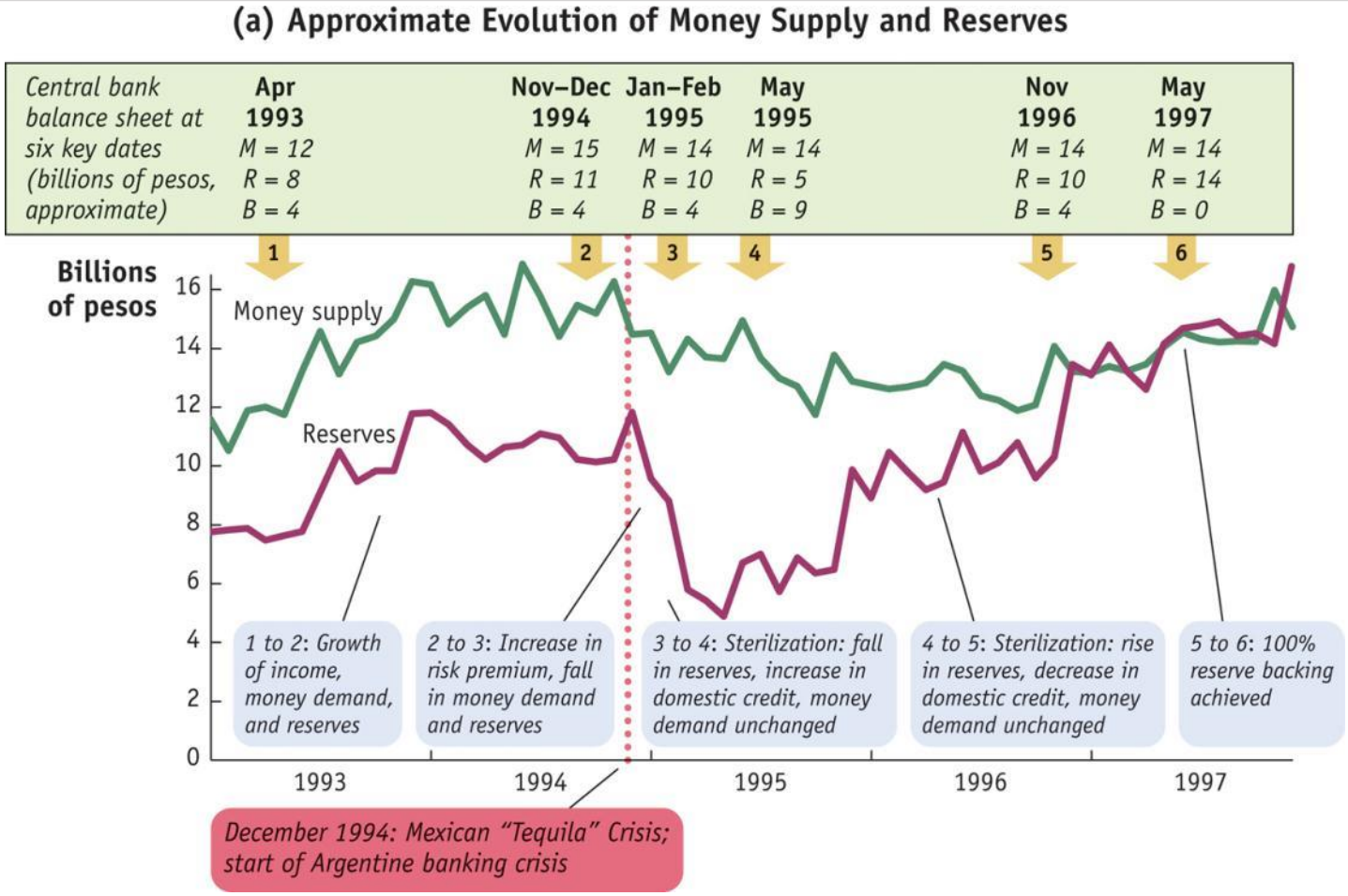
APPLICATION

The Argentine Convertibility Plan Before the Tequila Crisis

- The central bank balance sheet diagram helps us to see how a central bank manages a fixed exchange rate and what adjustments need to be made in response to a shock in money demand.
- With the aid of Figure 9-7, we will look at the fixed exchange rate system in Argentina known as the Convertibility Plan, which began in 1991 and ended in 2002.
- In this plan, a peg was maintained as one peso per dollar.

APPLICATION

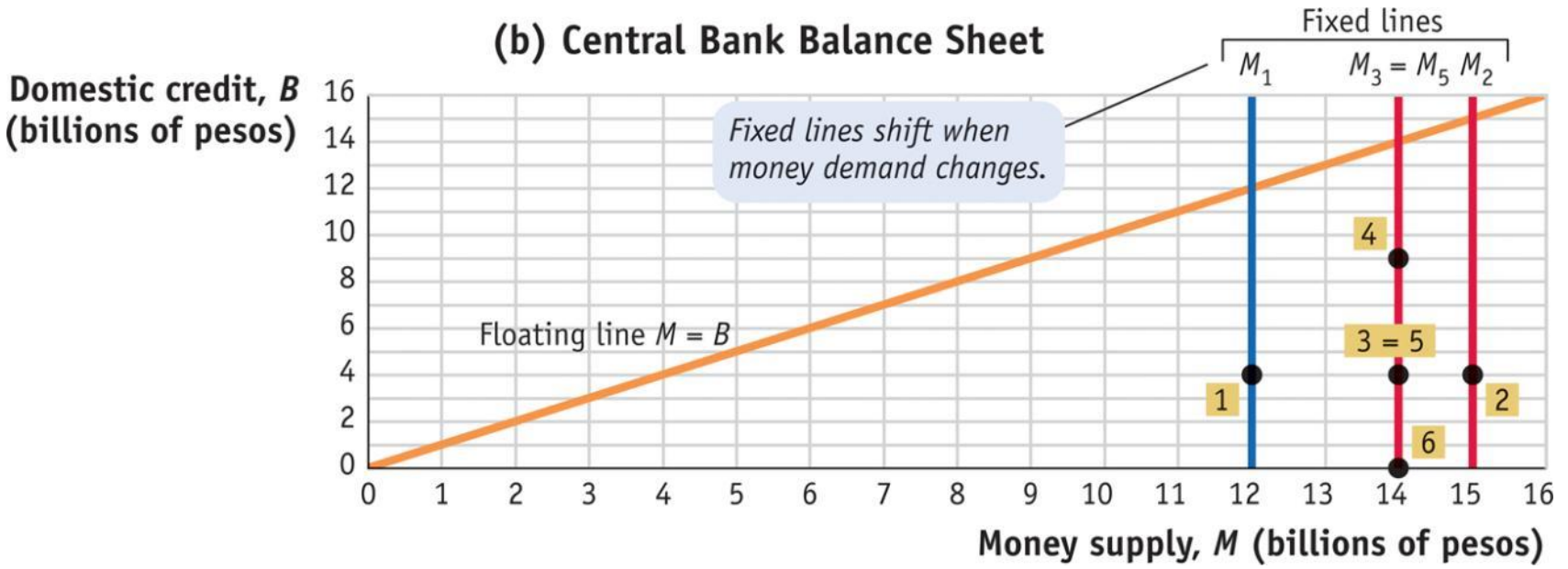
FIGURE 9-7 (1 of 5) Argentina's Central Bank Operations, 1993–1997



In this period, one peso was worth one U.S. dollar. Panel (a) shows the money supply and reserves. The difference between the two is domestic credit. Six key dates are highlighted around the Mexican Tequila crisis.

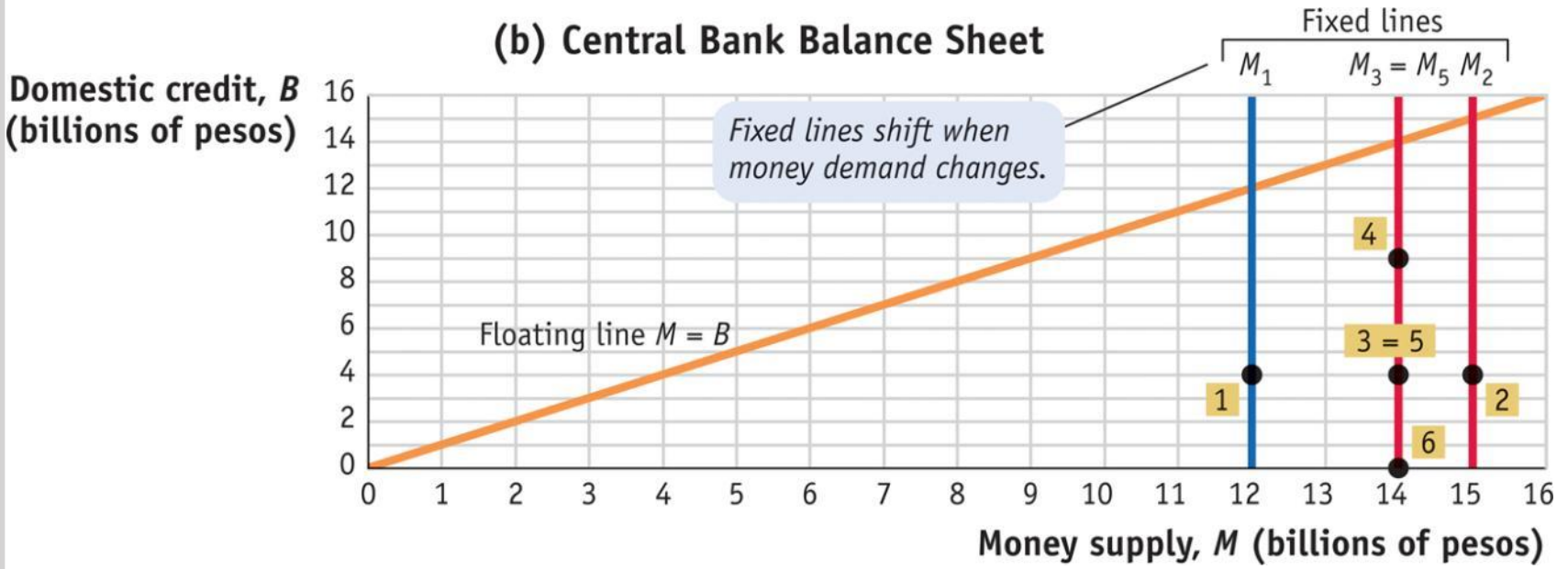
APPLICATION

FIGURE 9-7 (2 of 5) Argentina's Central Bank Operations, 1993–1997 (continued)



In panel (b), the balance sheet of the central bank at these key dates is shown. Prior to the crisis, domestic credit was essentially unchanged, and reserves grew from \$8 billion to \$11 billion as money demand grew from M_1 to M_2 in line with rapid growth in incomes (move from point 1 to 2).

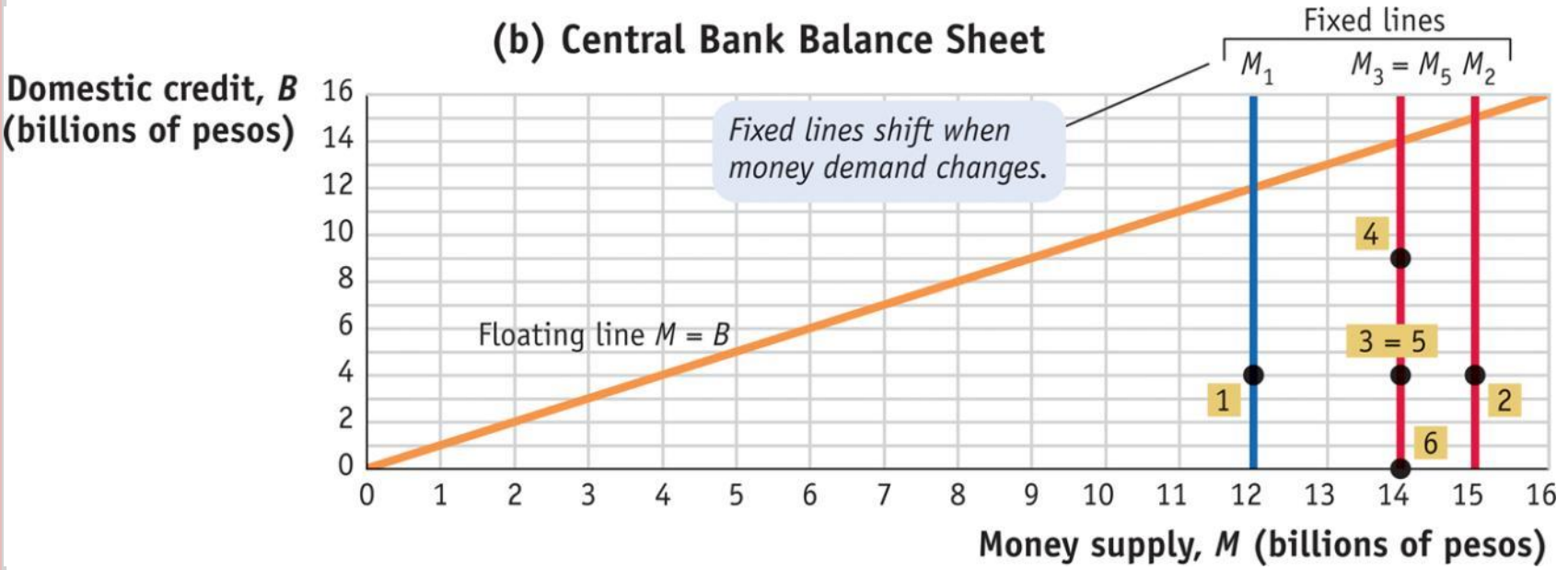
FIGURE 9-7 (3 of 5) Argentina's Central Bank Operations, 1993–1997 (continued)



After the crisis hit in December 1994, interest rate spreads widened, money demand fell from M_2 to M_3, but domestic credit stood still (to point 3) and $1 billion in reserves were lost.

APPLICATION

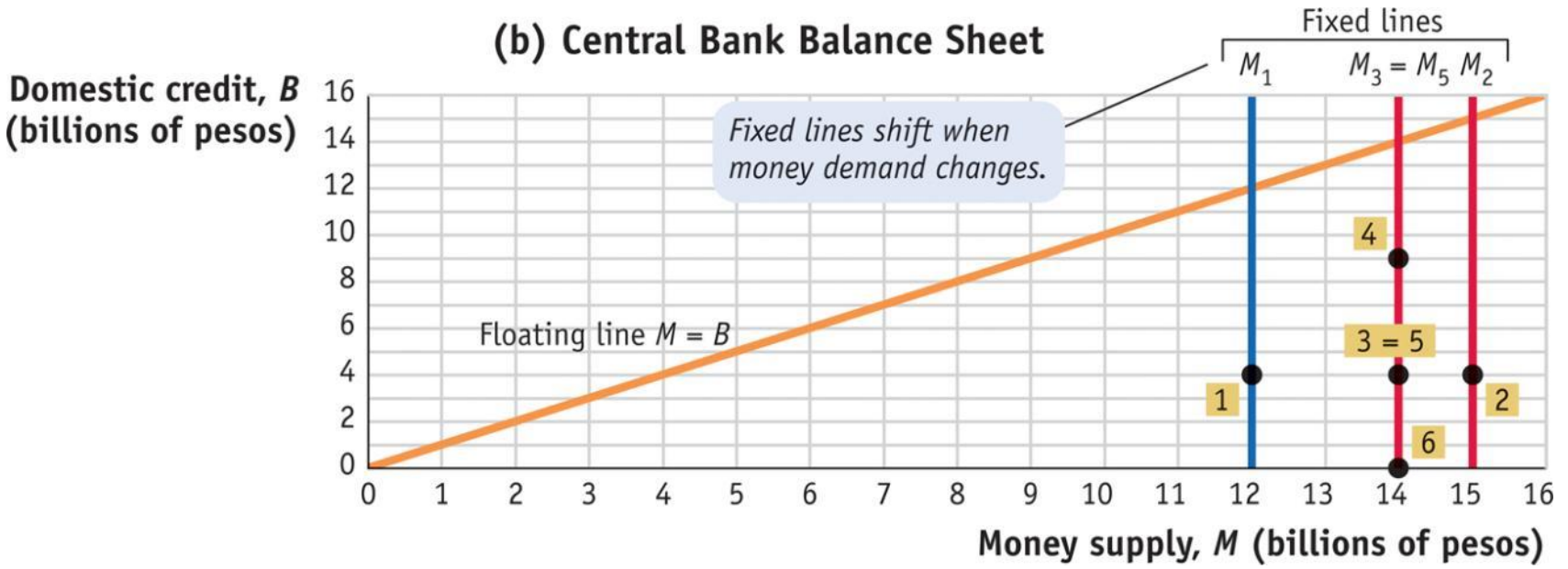
FIGURE 9-7 (4 of 5) Argentina's Central Bank Operations, 1993–1997 (continued)



In 1995 there was a run on banks and on the currency, and the central bank sterilized by expanding domestic credit by 5 billion pesos and selling $5 billion of reserves as money demand remained constant (to point 4). Reserves reached a low level of $5 billion.

APPLICATION

FIGURE 9-7 (5 of 5) Argentina's Central Bank Operations, 1993–1997 (continued)



By 1996 the crisis had passed and the central bank replenished its reserves, reversing the earlier **sterilization**. Domestic credit fell by 5 billion pesos and reserves increased by $5 billion (to point 5, same as point 3). Further sterilized purchases of $4 billion of reserves brought the backing ratio up to 100% in 1997 (to point 6).

Defending the Peg II: Changes in the Composition of Money Supply

- We now study shocks to domestic credit *B,* all else equal; and to isolate the effects of changes in domestic credit, we will assume that money demand is constant.
- If money demand is constant, then so is money supply. Therefore, the key lesson of this section will be that, on its own, a change in domestic credit cannot affect the level of the money supply, only its *composition* in terms of domestic credit and reserves.
- So we will also need to consider why such a policy is ever pursued.

Defending the Peg II: Changes in the Composition of Money Supply

A Shock to Domestic Credit

- We assume domestic output and the foreign interest rate are unchanged. The money supply is M_1 = 1,000 million pesos.
- Then, the bank expands domestic credit from $500 million pesos by buying ΔB = $100 million of peso bonds.
- With more money in circulation, the interest rate in the money market decreases, putting depreciation pressure on the exchange rate.
- To defend the peg, the central bank sells 100 million pesos ($100 million) of reserves, in exchange for cash, so the money supply and the interest rate remain unchanged.

Defending the Peg II: Changes in the Composition of Money Supply

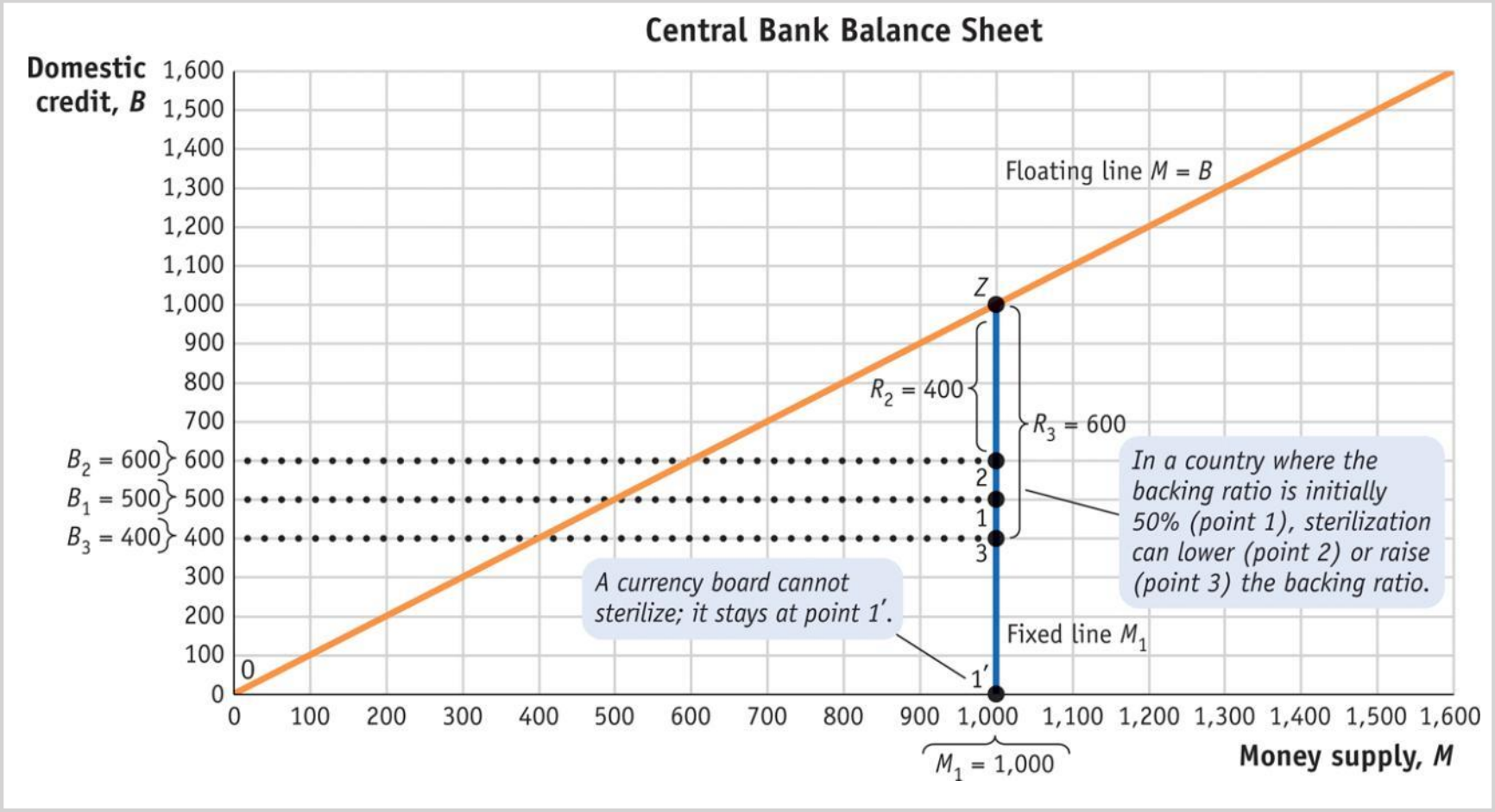
- The central bank's balance sheet will then be as follows:

SIMPLIFIED CENTRAL BANK BALANCE SHEET AFTER EXPANSION OF DOMESTIC CREDIT (MILLIONS OF PESOS)

Assets		Liabilities	
Reserves *R* *Foreign assets (dollar reserves)*	400	**Money supply** *M* *Money in circulation*	1,000
Domestic credit *B* *Domestic assets (peso bonds)*	600		

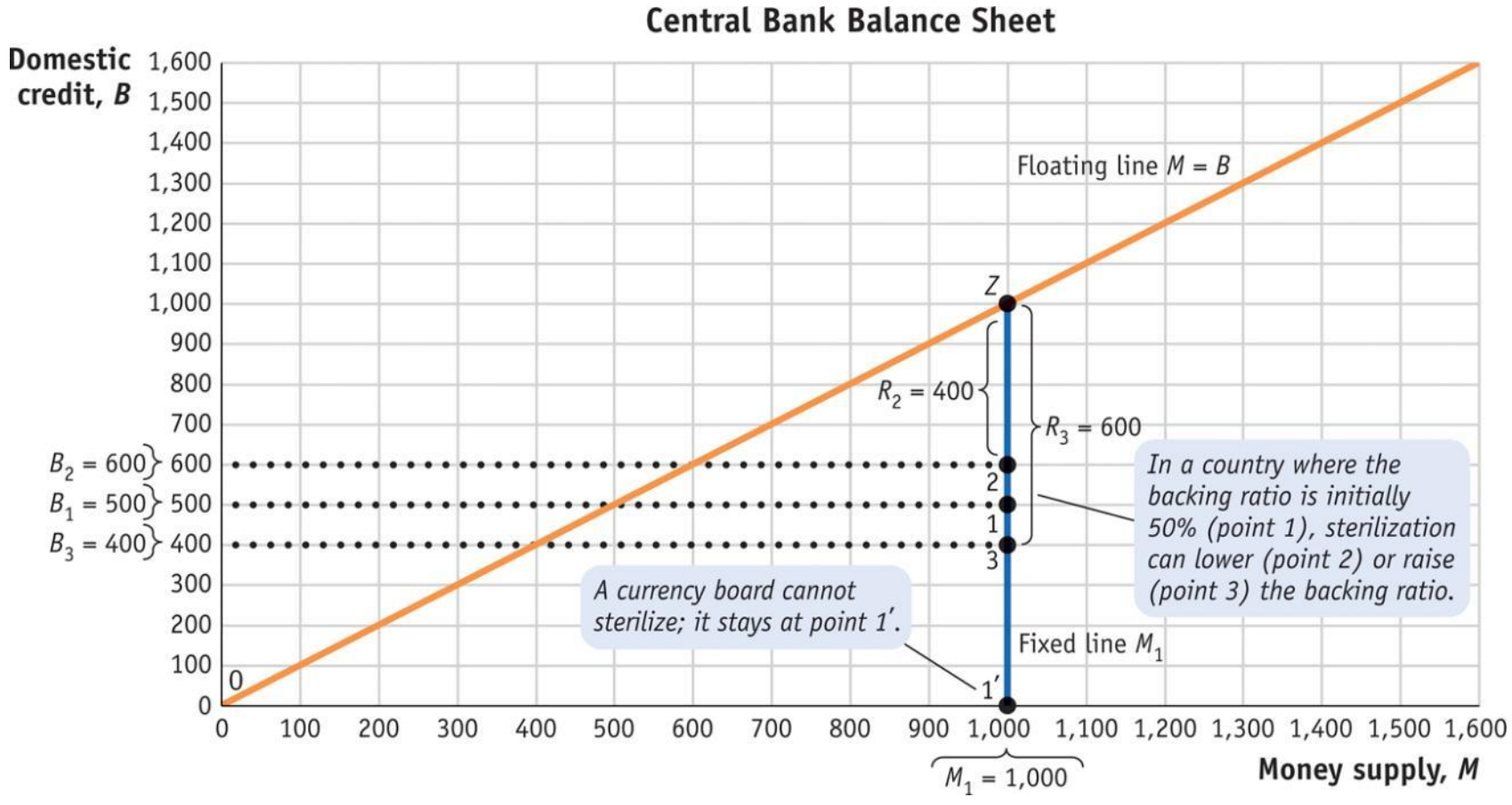
- There is no change in monetary policy as measured by home money supply because the sale and purchase actions by the central bank are perfectly offsetting.
- This type of central bank action is described as sterilization or a sterilized intervention, or a sterilized sale of reserves.

FIGURE 9-8 (1 of 2) Sterilization



If domestic credit rises, money supply rises, all else equal, and interest rates tend to fall, putting pressure on the exchange rate to depreciate. To prevent this depreciation, keep the peg, and stay on the fixed line, the central bank must intervene, a process known as sterilization, and defend the peg by selling reserves to keep the money supply fixed. As shown here, the money supply is $M_1 = 1{,}000$.

FIGURE 9-8 (2 of 2) Sterilization (continued)



If domestic credit increases from $B_1 = 500$ to $B_2 = 600$, the balance sheet moves from point 1 to point 2, and reserves fall from $R_1 = 500$ to $R_2 = 400$. An opposite shock is shown by the move from point 1 to point 3, where $B_3 = 400$ and $R_3 = 600$. If the country maintains 100% reserves, it has to stay at point 1′: A currency board cannot engage in sterilization.

Defending the Peg II: Changes in the Composition of Money Supply

- Sterilization is impossible in the case of a currency board because a currency board requires that domestic credit always be zero and that reserves be 100% of the money supply.

- If the change in money demand is zero, then $\Delta M = 0$; hence, the change in domestic credit, $\Delta B > 0$, must be offset by an equal and opposite change in reserves, $\Delta R = -\Delta B < 0$; see Equations (9-2) and (9-3).

- *Holding money demand constant, a change in domestic credit leads to an equal and opposite change in reserves, which is called a sterilization.*

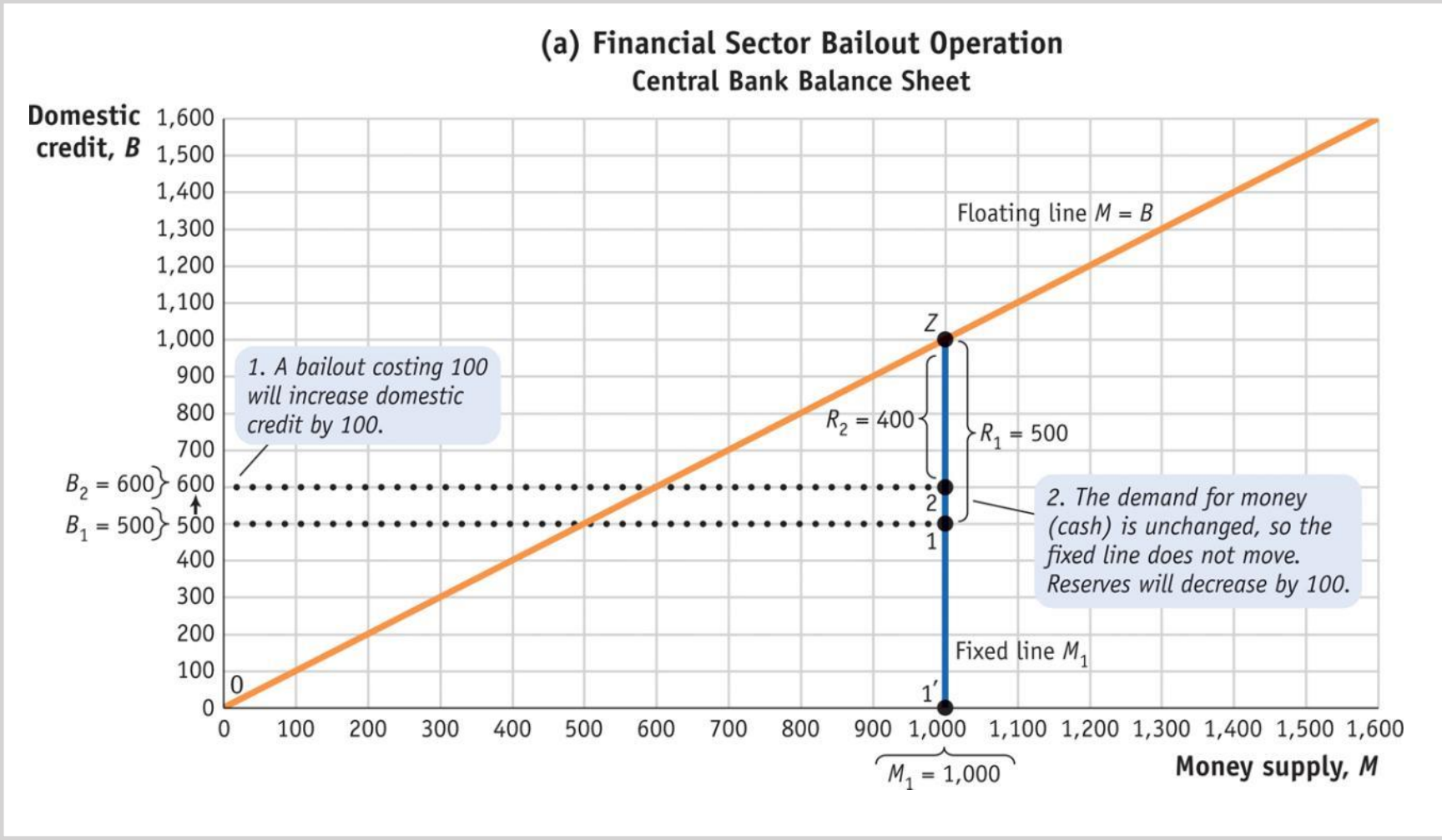
Defending the Peg II: Changes in the Composition of Money Supply

Why Does the Composition of the Money Supply Fluctuate?

Economists distinguish between banks that are **illiquid** and those that are insolvent.

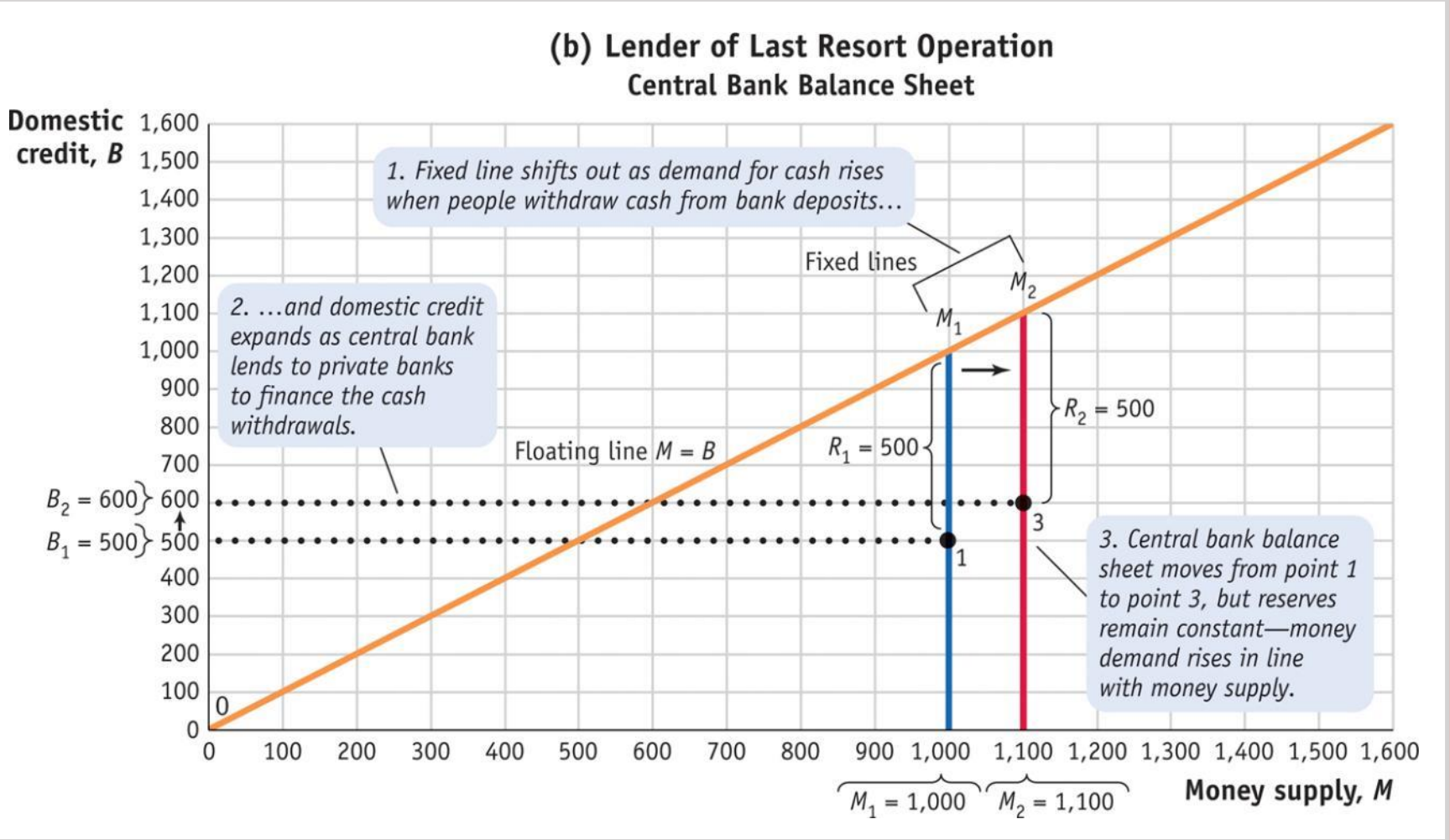
- *Insolvency and **bailouts**.* A private bank is insolvent if the value of its liabilities (e.g., customers' deposits) exceeds the value of its assets (e.g., loans, other securities, and cash on hand).
- *Illiquidity and **bank runs**.* A private bank may be solvent, but it can still be illiquid: it holds some cash, but its loans cannot be sold (liquidated) quickly at a high price and depositors can withdraw at any time.

FIGURE 9-9 (1 of 2) The Central Bank and the Financial Sector



In panel (a), a bailout occurs when the central bank prints money and buys domestic assets—the bad assets of insolvent private banks. There is no change in demand for base money (cash), so the expansion of domestic credit leads to a decrease of reserves.

FIGURE 9-9 (2 of 2) Bank and the Financial Sector (The Central continued)



In panel (b), private bank depositors want to shift from holding deposits to holding cash. If the central bank acts as a **lender of last resort** and temporarily lends the needed cash to illiquid private banks, both the demand and supply of base money (cash) rise, so the level of reserves is unchanged.

Defending the Peg II: Changes in the Composition of Money Supply

Why Does the Composition of the Money Supply Fluctuate?

- If depositors fear that banks are either insolvent or illiquid, a bank run may occur, and if the problem spreads to other banks, the panic may lead to a flight from domestic deposits to foreign bank deposits.

- As depositors demand foreign currency, they drain reserves and make it more likely that devaluation will happen. Devaluation leads to a higher-risk premium, worsening economic conditions, and a flight from the currency.

APPLICATION

The Argentine Convertibility Plan After the Tequila Crisis

Banking Crisis, 1995

- After the Mexican Tequila crisis in December 1994, higher interest rates, a budget deficit, and damage to commercial banks' balance sheets, Argentina faced a banking crisis.

- Reserves drained, casting more doubt on the viability of the fixed exchange rate, raising the currency premium, and draining more reserves. Given the fears of a banking crisis *and* exchange rate crisis, cash and bank deposits denominated in pesos were switched into dollars and moved to banks in offshore locations. People now ran from the currency, too.

- The country was getting perilously close to the floating line, the dangerous place where reserves run out.

APPLICATION

The Argentine Convertibility Plan After the Tequila Crisis

Help From the IMF and Recovery

- After the Tequila crisis, the United States advanced a large assistance package to Mexico, and the IMF took a more lenient view of the Argentine situation, fearing the possibility of a global financial crisis if Argentina crashed, too.
- The economy recovered, capital flows resumed, and eventually the central bank's emergency loans were paid back.
- By 1996 economic growth had picked up, interest rate spreads eased, and confidence returned.

The Central Bank Balance Sheet and the Financial System

A More General Balance Sheet

GENERAL CENTRAL BANK BALANCE (MILLIONS OF PESOS)

Assets		Liabilities	
Foreign assets	**950**	**Foreign liabilities**	**50**
of which:		of which:	
Foreign reserves (all currencies)	950	*Foreign currency debt issued by the central bank*	50
Gold	0		
Domestic assets	**500**	**Domestic liabilities**	**400**
of which:		of which:	
Domestic government bonds bought	300	*Domestic currency debt issued by the central bank*	400
Loans to commercial banks	200		
		Money supply *M*	**1,000**
		of which:	
		Currency in circulation	900
		Reserve liabilities to commercial banks	100

In general, money supply is equal to *net foreign assets* plus *net domestic assets.* The only real difference here is the ability of the central bank to borrow by issuing nonmonetary liabilities, whether domestic or foreign.

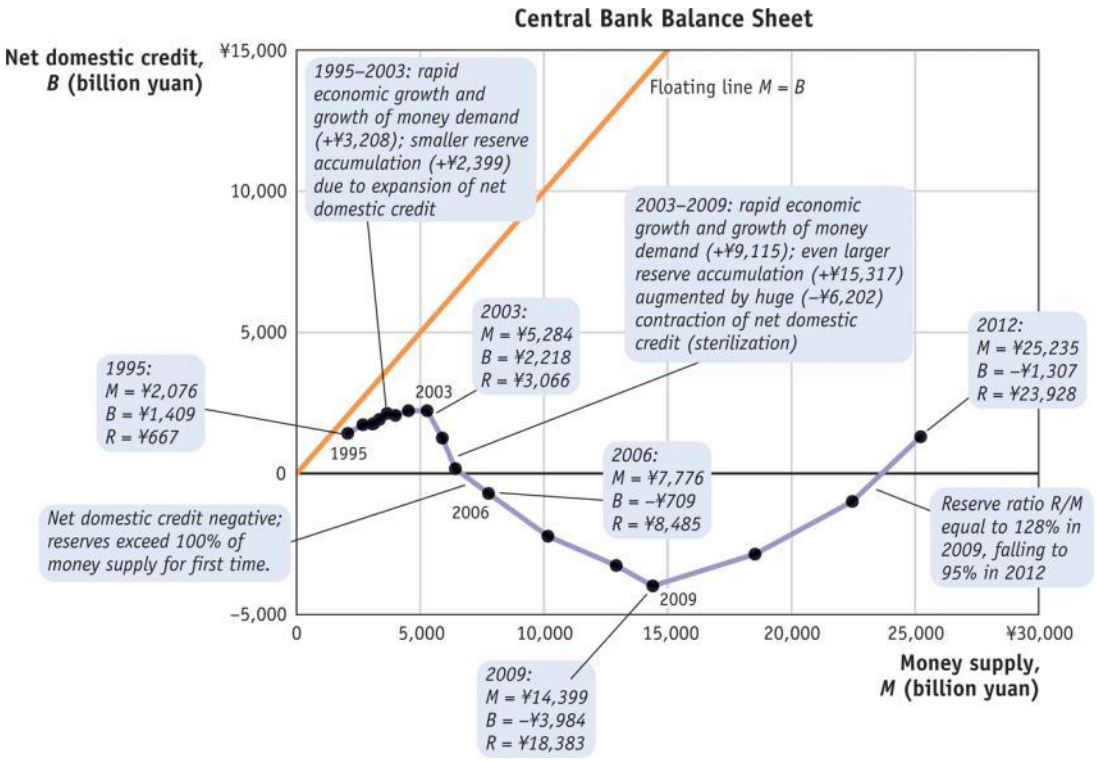
The Central Bank Balance Sheet and the Financial System

Sterilization Bonds

- What borrowing to buy reserves achieves is not a change in monetary policy (money supply and interest rates are unchanged, given the peg) but an increase in the backing ratio.
- Sterilization is just a way to change the backing ratio, all else equal.
- By issuing **sterilization bonds**, central banks can borrow from domestic residents to buy more reserves. With sufficient borrowing, the central bank can end up with negative net domestic credit and reserves in excess of the money supply.
- This has happened in China in recent years.

SIDE BAR The Great Reserve Accumulation in Emerging Markets

FIGURE 9-10



Sterilization in China From 1995 to 2003 net domestic credit in China was steady, and so reserve growth was almost entirely driven by money demand growth (large movement to the right). From 2003 to 2009 extensive sterilization (large movement down) sent net domestic credit below zero, and, despite still-strong money demand growth, sterilization accounts for about 40% of the reserve growth in the later period.

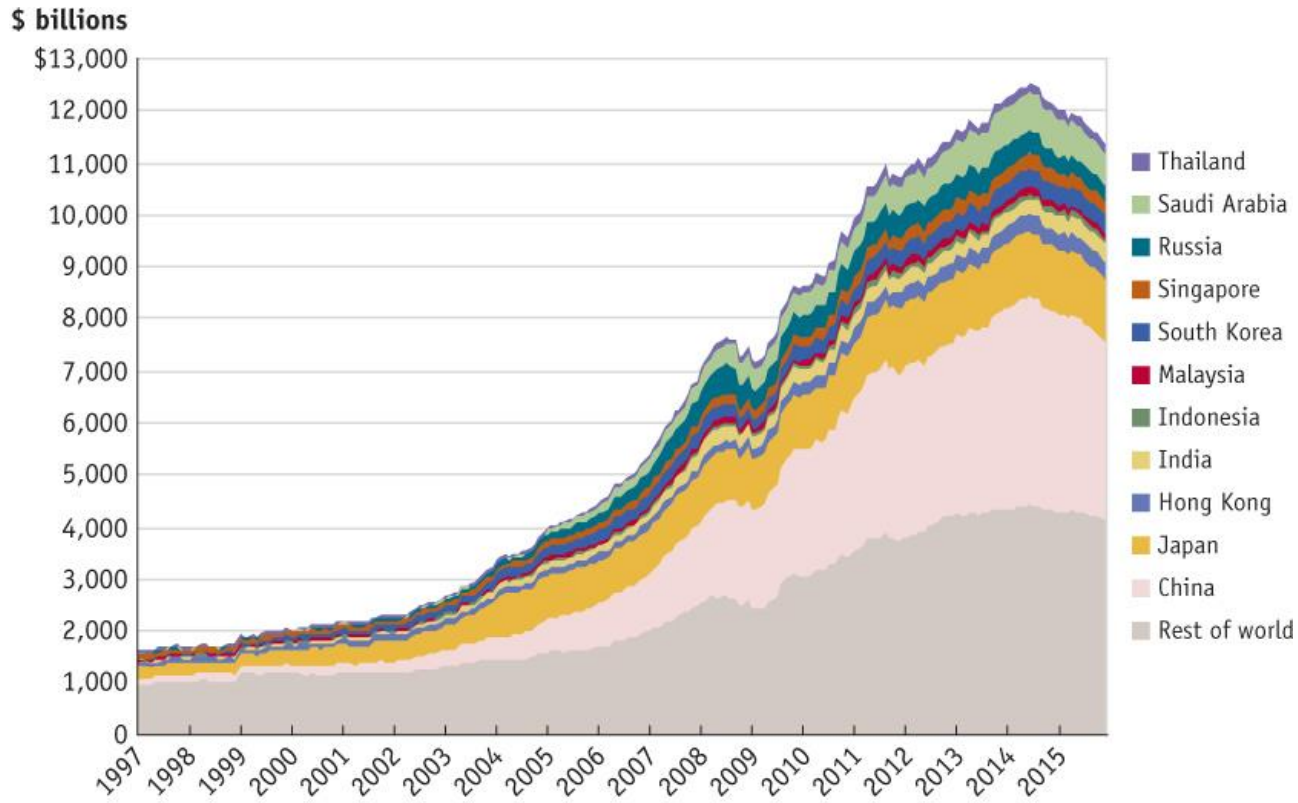
Causes of the Reserve Accumulation

- There are various motivations for reserve hoards, besides wanting a greater backing ratio to absorb larger shocks to money demand.

- Countries accumulate large reserves if they fear a sudden stop, when access to foreign capital markets dries up. If reserves are on hand, the central bank can temporarily cover the shortfall.

- Also if the financial sector is fragile. If there is a major banking crisis with a flight of deposits to foreign banks, then a central bank may need a far greater level of reserves, adequate to cover some or all of M2.

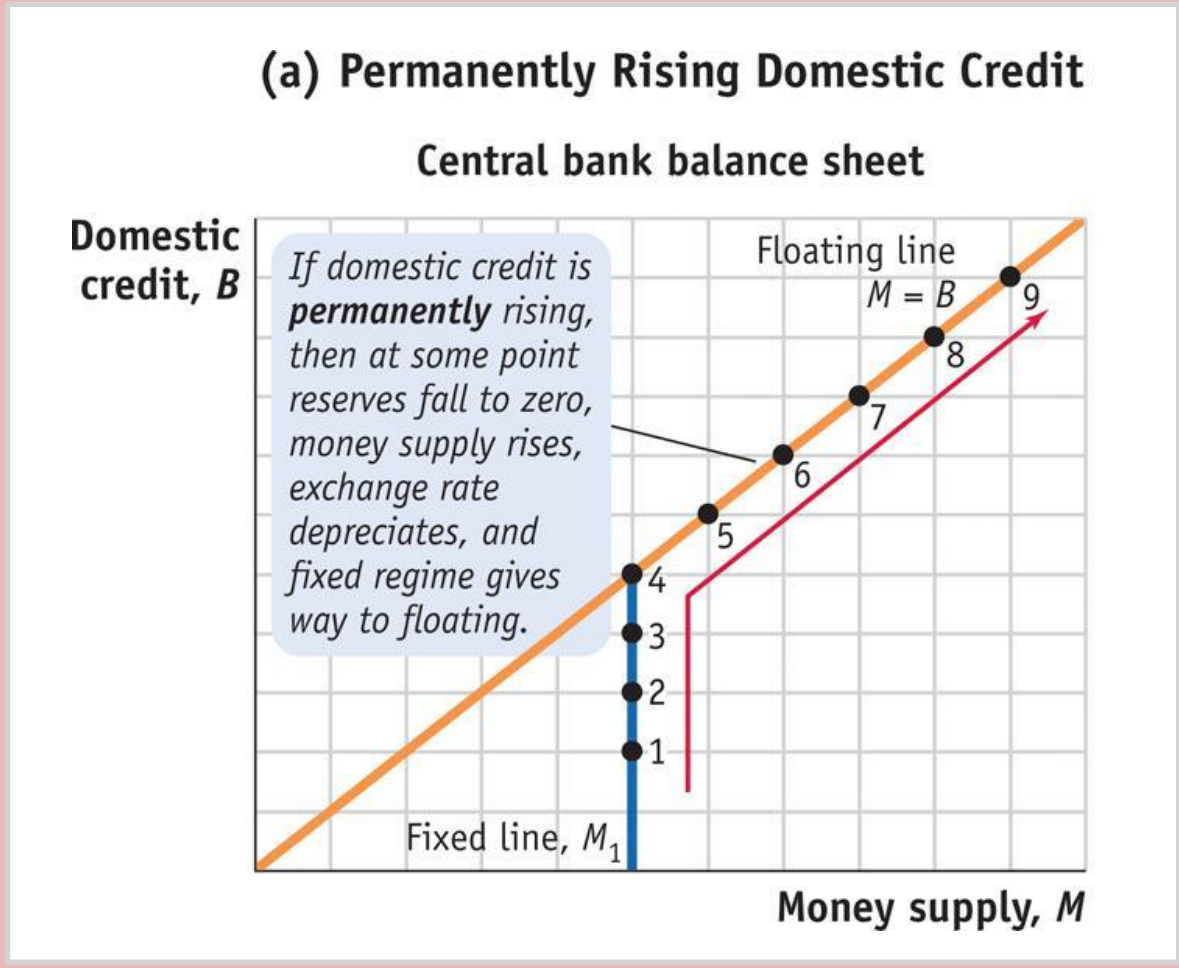
FIGURE 9-11



Reserve Accumulation, 1997–2015 By the end of 2015, reserve holdings worldwide exceeded $10,000 billion, more than five times their level in 1997. Most of the growth occurred in emerging markets, especially Asia. Much of these additional reserves were acquired through sterilization and have caused several countries' holdings of foreign exchange reserves to exceed 100% of the monetary base.

Two Types of Exchange Rate Crises

FIGURE 9-12 (1 of 2) Two Types of Exchange Rate Crisis

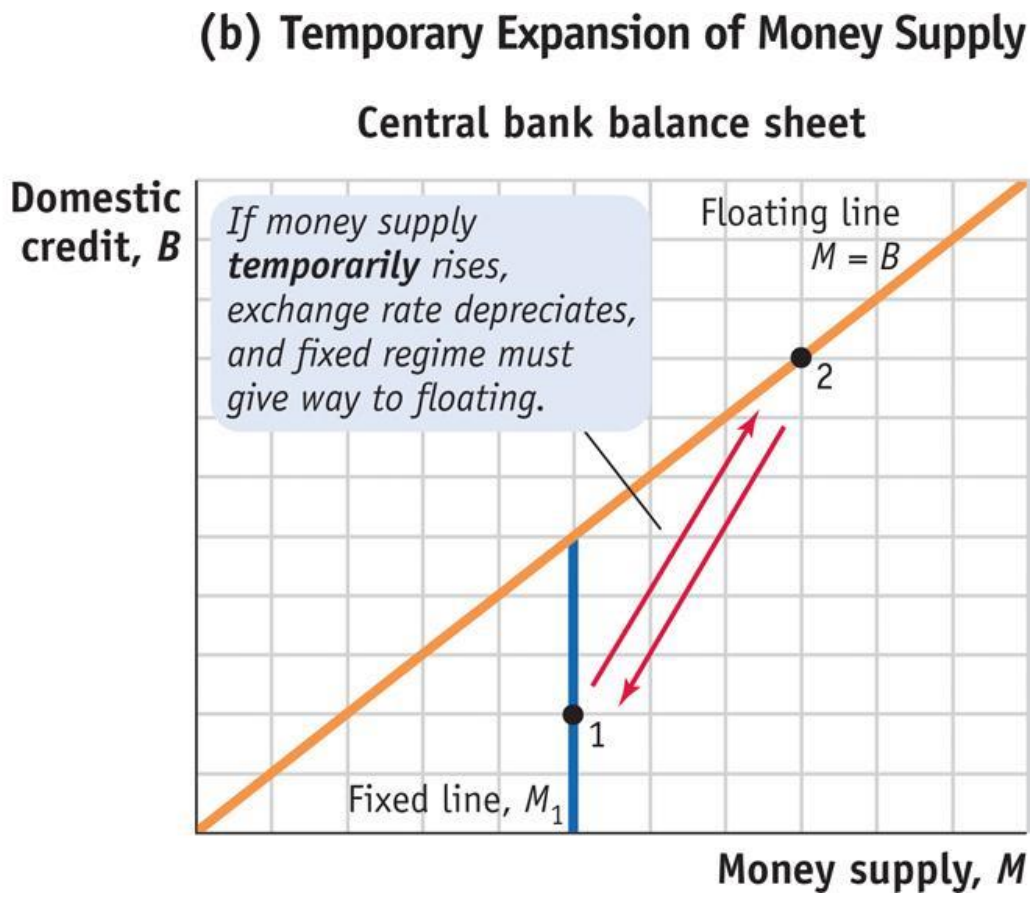


The central bank balance sheet diagram gives us a way to think about what actions will cause the peg to break.

In panel (a), a permanent and ongoing expansion of domestic credit is incompatible with a fixed exchange rate regime because, sooner or later, reserves will be reduced to zero, and then the money supply starts to expand.

Two Types of Exchange Rate Crises

FIGURE 9-12 (2 of 2) Two Types of Exchange Rate Crisis (continued)



In panel (b), a temporary expansion of domestic credit and the money supply will lower interest rates and depreciate the exchange rate, even if a reversal of this policy is expected in the future. Both policies take the country off the fixed line and onto the floating line.

The Basic Problem: Fiscal Dominance

- We begin with a **first-generation crisis model** of inconsistent fiscal policies.
- We assume that output is fixed, and we allow the price level to change, according to purchasing power parity (PPP).
- The government runs a persistent deficit (DEF) and is unable to borrow from any creditor. It turns to the central bank for financing.
- In this type of environment, economists speak of a situation of **fiscal dominance** in which the monetary authorities ultimately have no independence.

The Basic Problem: Fiscal Dominance

- Domestic credit B increases by an amount $\Delta B = DEF$ every period and is growing at a constant positive rate, $\Delta B/B = \mu$.
- Every change in the level of domestic credit leads to an equal and opposite change in the level of reserves. Reserves must eventually run out.
- At that point, the peg breaks and the central bank shifts from a fixed exchange rate regime to a floating regime, in which the money supply equals domestic credit, $M = B$.
- The crisis happens because authorities are willing to let it happen because of overriding fiscal priorities.

The Myopic Case

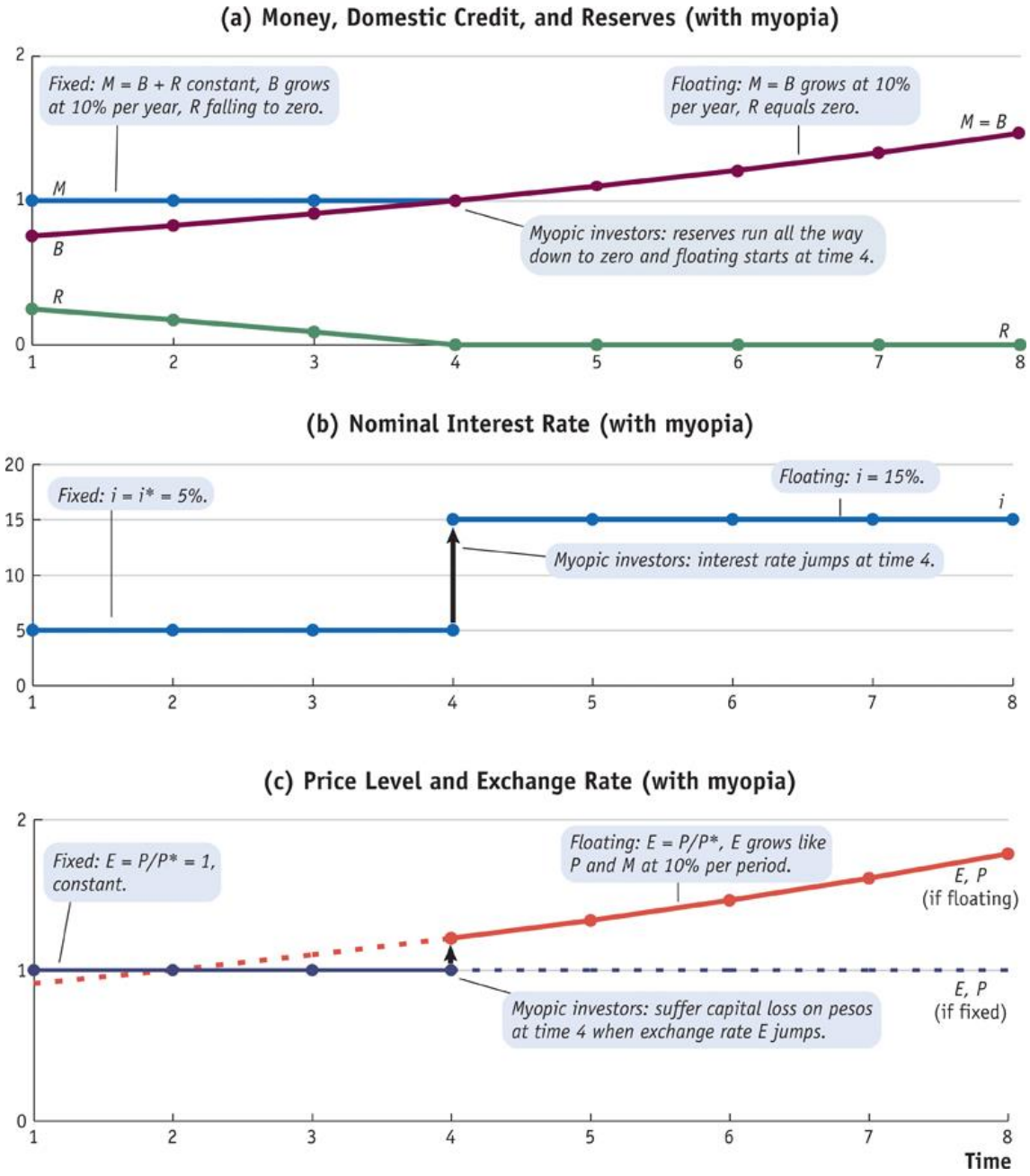
FIGURE 9-13 (1 of 3)

An Exchange Rate Crisis Due to Inconsistent Fiscal Policies: Myopic Case

In the fixed regime, money supply *M* is fixed, but expansion of domestic credit *B* implies that reserves *R* are falling to zero.

Suppose the switch to floating occurs when reserves run out at time 4.

Thereafter, the monetary model tells us that *M*, *P*, and *E* will all grow at a constant rate (here, 10% per period).



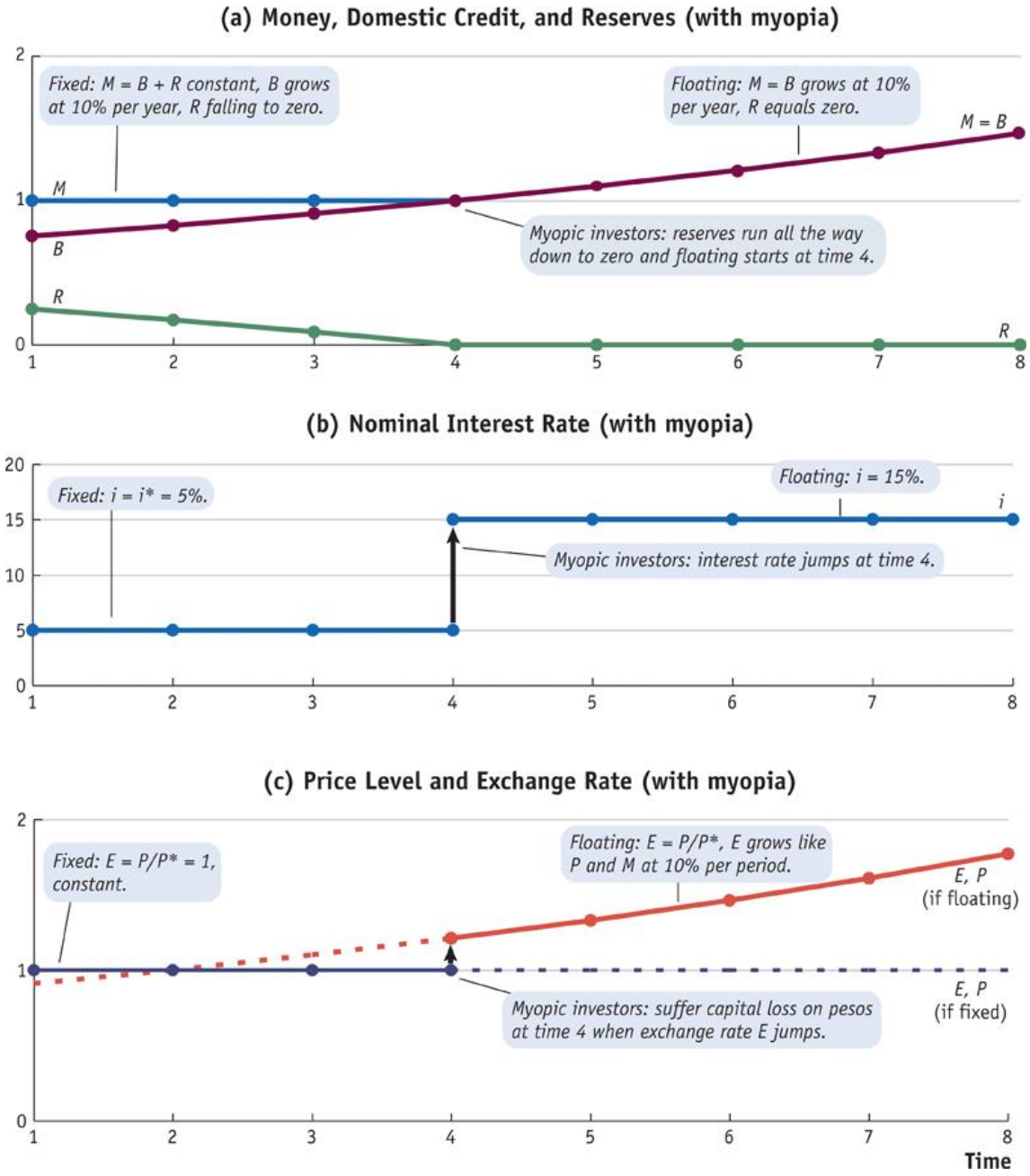
The Myopic Case

FIGURE 9-13 (2 of 3)

An Exchange Rate Crisis Due to Inconsistent Fiscal Policies: Myopic Case (continued)

The expected rates of inflation and depreciation are now positive, and the Fisher effect tells us that the interest rate must jump up at period 4 (by 10 percentage points).

The interest rate increase means that real money demand $M/P = L(i)Y$ falls instantly at time 4.



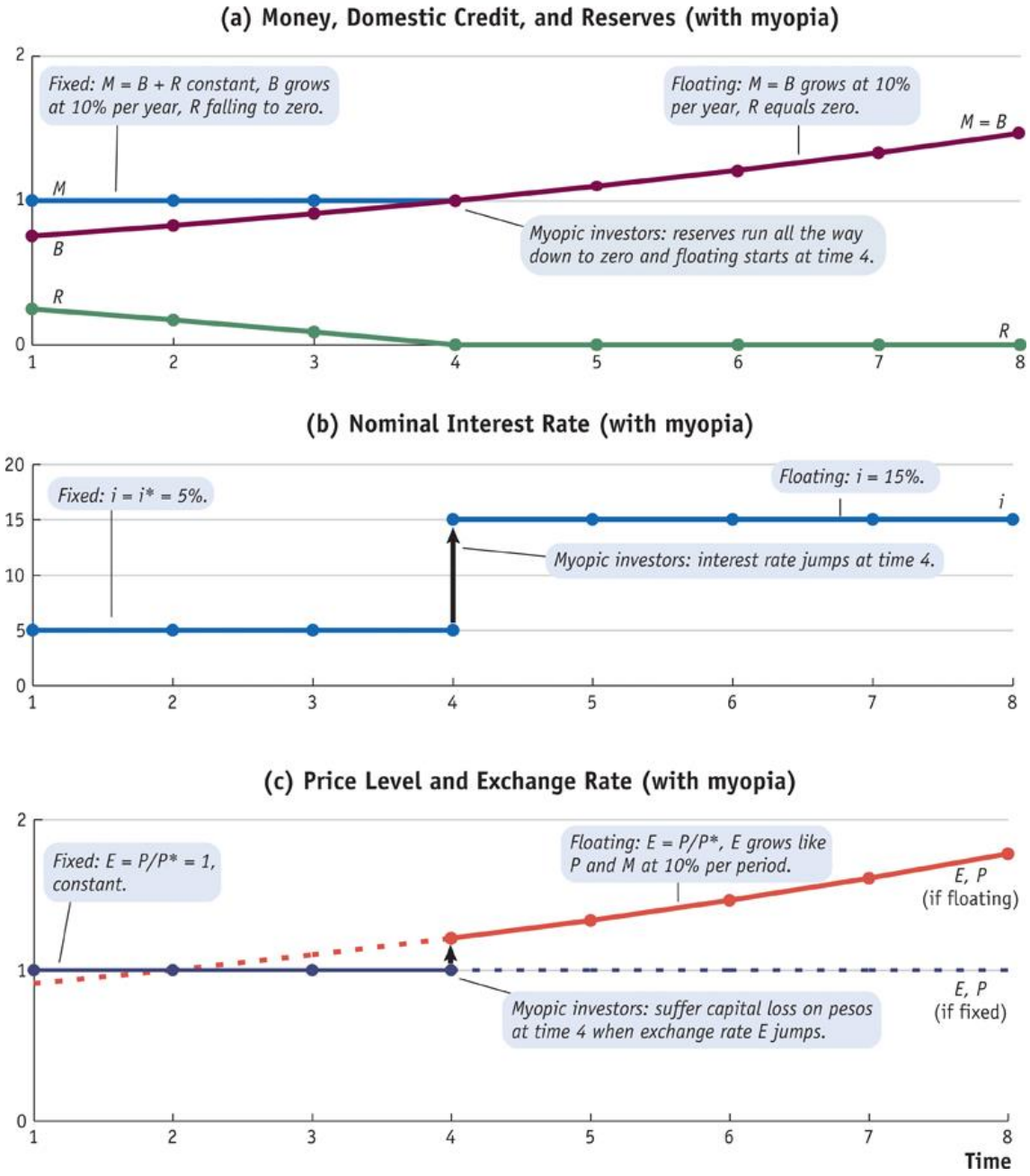
The Myopic Case

FIGURE 9-13 (3 of 3)

An Exchange Rate Crisis due to Inconsistent Fiscal Policies: Myopic Case (continued)

The money supply does not adjust immediately, so this jump in M/P must be accommodated by a jump in prices P.

To maintain purchasing power parity, E must also jump at the same time. Hence, myopic investors face a capital loss on pesos at time 4.



A Simple Model

The Forward-Looking Case

When investors are forward-looking, they will move earlier than under myopia. How does this pin down a speculative attack at time 2?

- At any time later than 2, there must be a jump up in the exchange rate, a *discontinuous depreciation.* If peso holders wait to attack until time 3, they will suffer a capital loss and they have waited too long.
- An attack before time 2 implies a *discontinuous appreciation* of the peso. But if that were so, any individual peso holder would enjoy capital gains (in dollars) from holding on to pesos rather than exchanging them for reserves at the prior fixed rate.
- They would then desire to wait and let everyone else attack and pocket the gains. But if one person thinks like that, all do, and the attack cannot materialize.

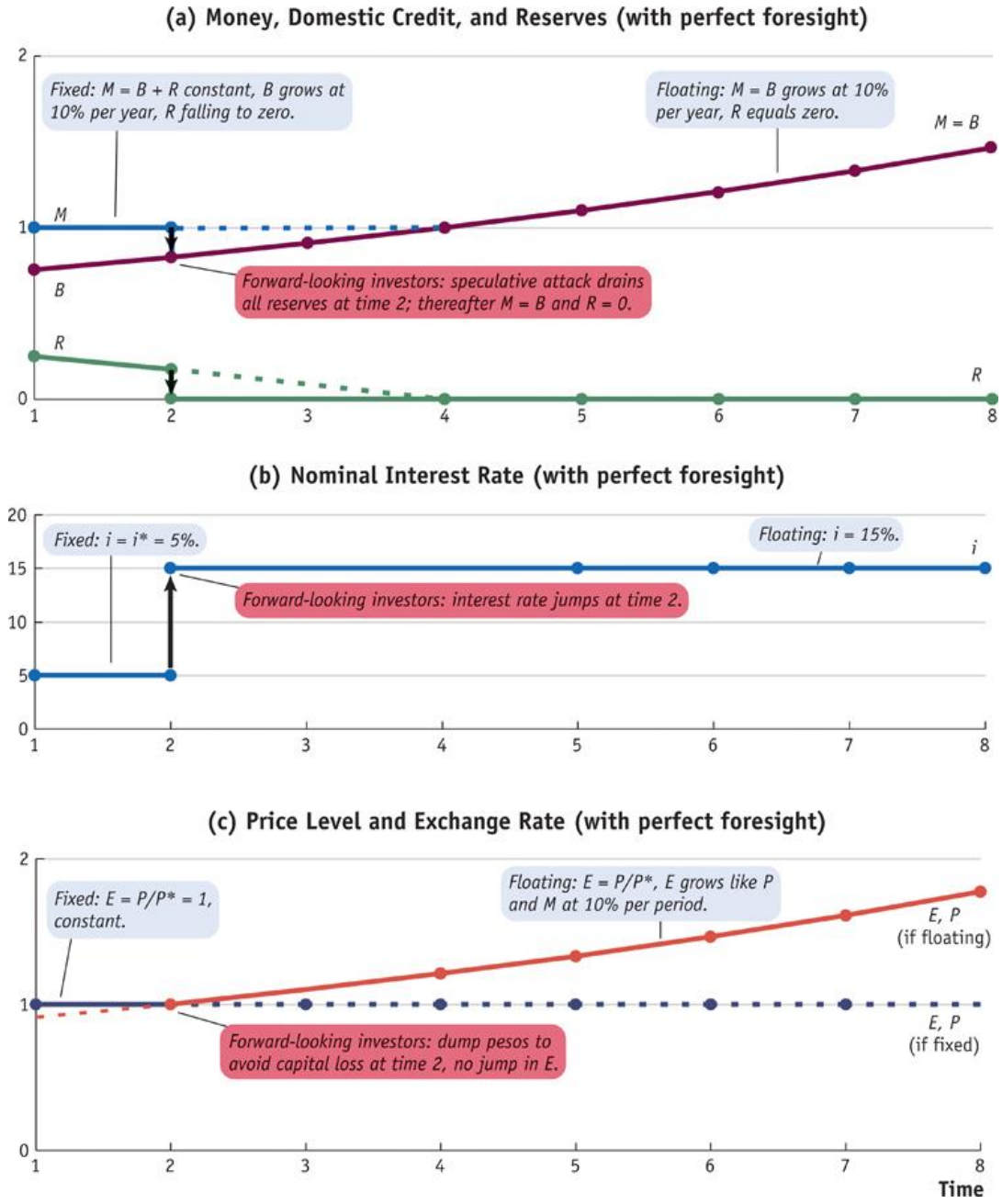
FIGURE 9-14

An Exchange Rate Crisis Due to Inconsistent Fiscal Policies: Perfect-Foresight Case

If investors anticipate a crisis, they will seek to avoid losses by converting pesos to dollars before period 4.

The rational moment to attack is at time 2, the point at which the switch from fixed to floating is achieved without any jumps in *E* or *P*.

At time 2, the drop in money demand (due to the rise in the interest rate) exactly equals the decline in the money supply (the reserve loss), and money market equilibrium is maintained without the price level having to change.



The Forward-Looking Case

The **speculative attack** model teaches an important lesson.

- One moment, a central bank may have a pile of reserves on hand, draining away fairly slowly, giving the illusion that there is no imminent danger. The next moment, the reserves are all gone.
- The model explains why fixed exchange rates sometimes witness a sudden collapse rather than a long, lingering death.

APPLICATION

The Peruvian Crisis of 1986

An example of a crisis driven by inconsistent fiscal policies and excessive expansion of domestic credit is provided by the events in Peru from 1985 to 1986.

- In the early 1980s Peru's political and economic conditions were highly unfavorable. The government had an enormous external debt burden. Government deficits grew.
- At the same time, world interest rates sharply increased.
- President Alan García Pérez was elected to office in 1985. One important economic measure he instituted immediately was a fixed exchange rate.
- With domestic credit exploding, the central bank was continually selling reserves to defend the peg.

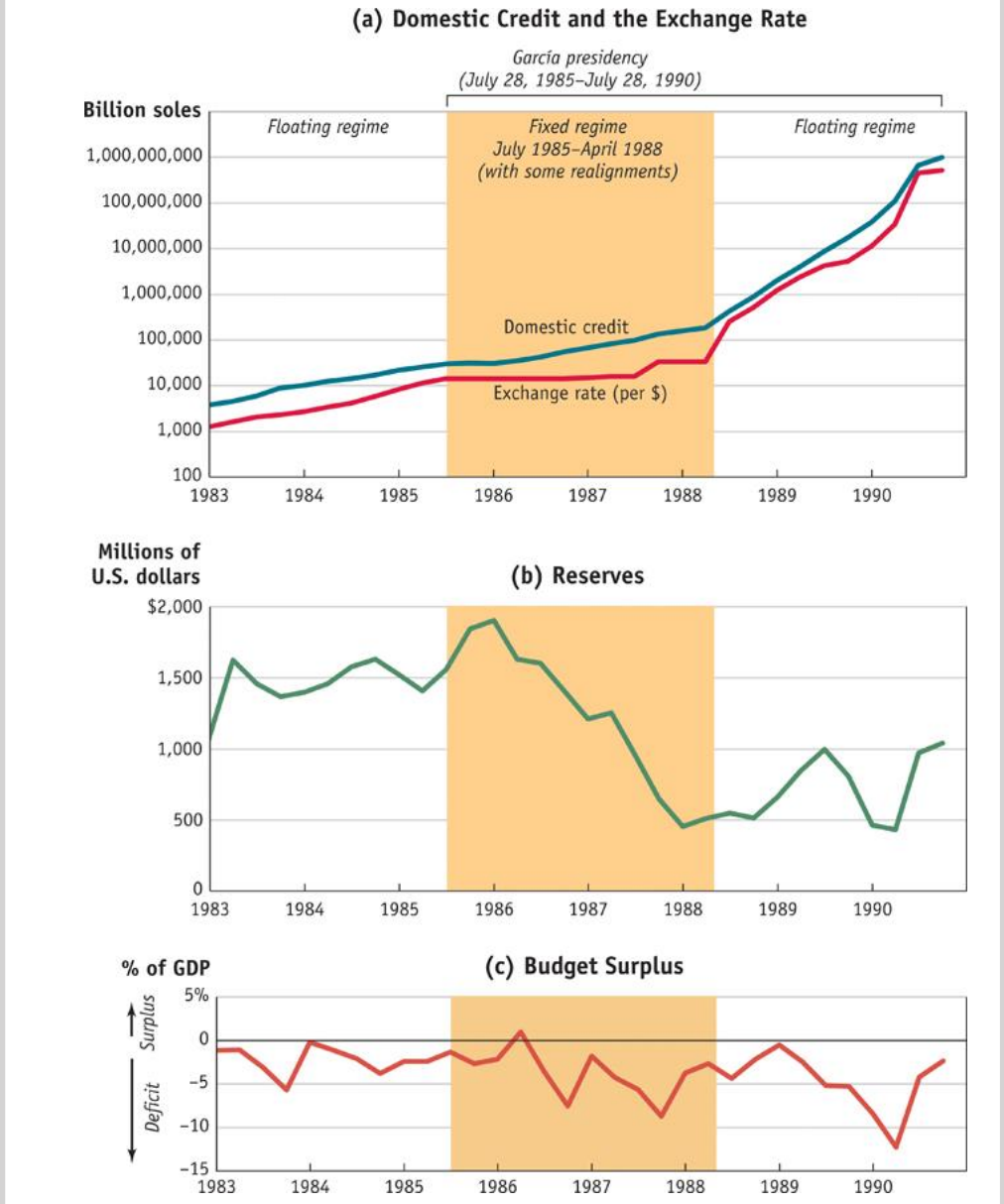
APPLICATION The Peruvian Crisis of 1986

FIGURE 9-15

A Crisis in Peru: The Inconsistent Policies of the García Administration

Government budget problems required significant monetization of budget deficits. Monetary and fiscal policies were inconsistent: A peg was in place, but domestic credit grew exponentially.

The central bank lost three-quarters of its reserves in two years, and the peg had to be abandoned.



Expectations and the Critical Level of Reserves

What determines the *critical level of reserves* R_c at which the crisis occurs?

- The reserves R_c lost at the moment of crisis will depend on how much money investors want to convert into reserves when they attack.
- This, in turn, depends on how much money demand shrinks as we move from fixed to floating, and that is driven by the change in the interest rate.

$$\underbrace{\frac{R_c}{M}}_{\text{Critical backing ratio when attack occurs}} = -\frac{\Delta M}{M} = \underbrace{\emptyset}_{\text{Responsiveness of money demand to interest rate changes}} \times \underbrace{\mu}_{\text{Future rate of growth of domestic credit}}$$

Summary

- The first-generation crisis model tells us that inconsistent fiscal policies can destroy a fixed exchange rate.
- Yet it is not actual fiscal policy that matters, but *beliefs* and *expectations* about future fiscal policy.
- Beliefs about future deficits may or may not be justified, so the model opens up the possibility that countries will be punished for crimes they do not intend to commit.

4 How Pegs Break II: Contingent Monetary Policies

- In countries with apparently sound economic policies, foreign currency speculators went for the attack and pegs broke.
- Economists therefore developed alternative models of crises, with the pioneering work on the **second-generation crisis model** being done by Maurice Obstfeld.
- These types of models can explain how, even when policy making is rational and purposeful—rather than incompetent and inconsistent—there may still be situations in which pegs break for no apparent reason.

The Basic Problem: Contingent Commitment

- In these models policy makers are not committed to the peg under all circumstances.
- Defending the peg is a **contingent commitment**: If things get "bad enough," the government will let the exchange rate float.
- The problem is that everyone—notably, investors in the forex market—knows it and will adjust their expectations accordingly.
- In 1992, the German central bank raised interest rates to deal with the fiscal expansion arising from German unification after 1989. This left Britain with a higher interest rate and a lower output level than desired. What would Britain do in response?

The Basic Problem: Contingent Commitment

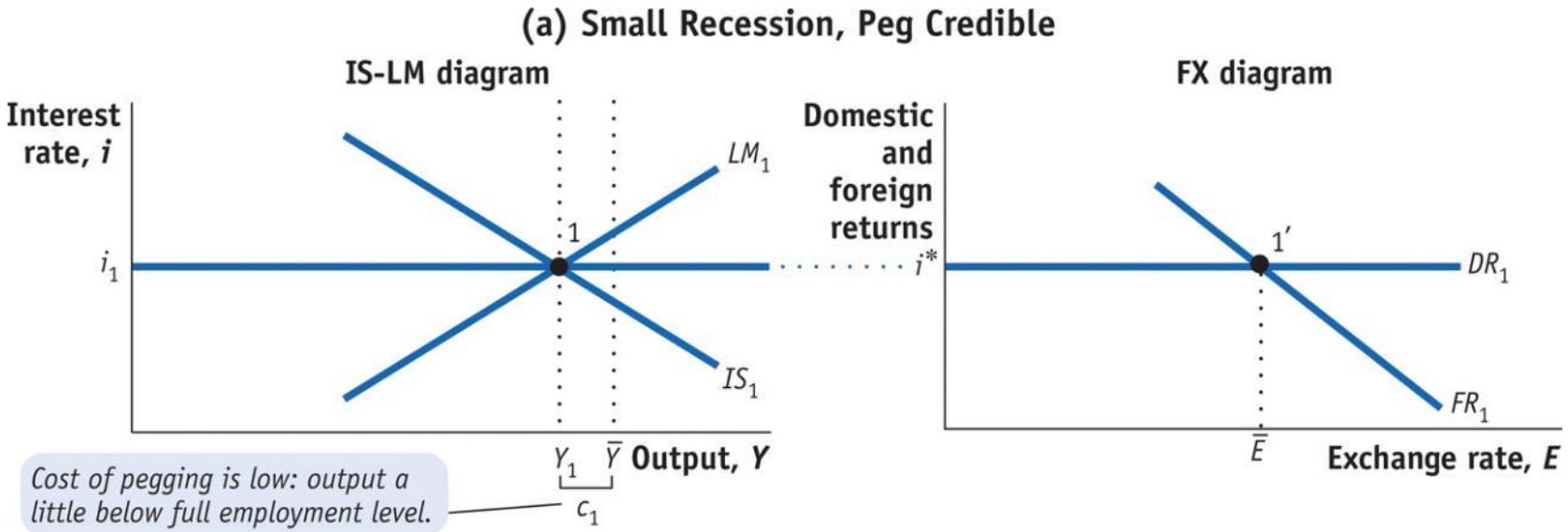
- If German interest rates are low, so too are British interest rates, output costs in Britain are low, and nobody expects Britain to leave the peg. The peg is *credible.*
- But if German interest rates rise, output in Britain falls, and nobody expects Britain to stay on the peg. Everyone thinks Britain will float and use expansionary monetary policy to boost output and depreciate the pound. The peg is *not credible*.
- The problem for Britain is that an expected depreciation will introduce a *currency premium*. Investors will demand even higher interest rates in Britain to compensate for the imminent depreciation—meaning even lower output and higher pain for Britain!

A Simple Model

- We now develop an economic model with such *self-fulfilling expectations.* In this model we may not always find a single, unique equilibrium but rather **multiple equilibria**.
- The cost of maintaining the peg is the deviation of output Y in the short run below its full employment level. Output will be variable, and prices will be sticky and treated as given.
- There are *some* benefits from pegging, say, the gains from increased trade. Let these benefits be $b > 0$ and constant.
- If costs exceed benefits, we assume that the government will elect to float next period and use monetary policy to restore full employment output.

Small Recession, Peg Credible

FIGURE 9-16 (1 of 4) Contingent Commitments and the Cost of Maintaining a Peg

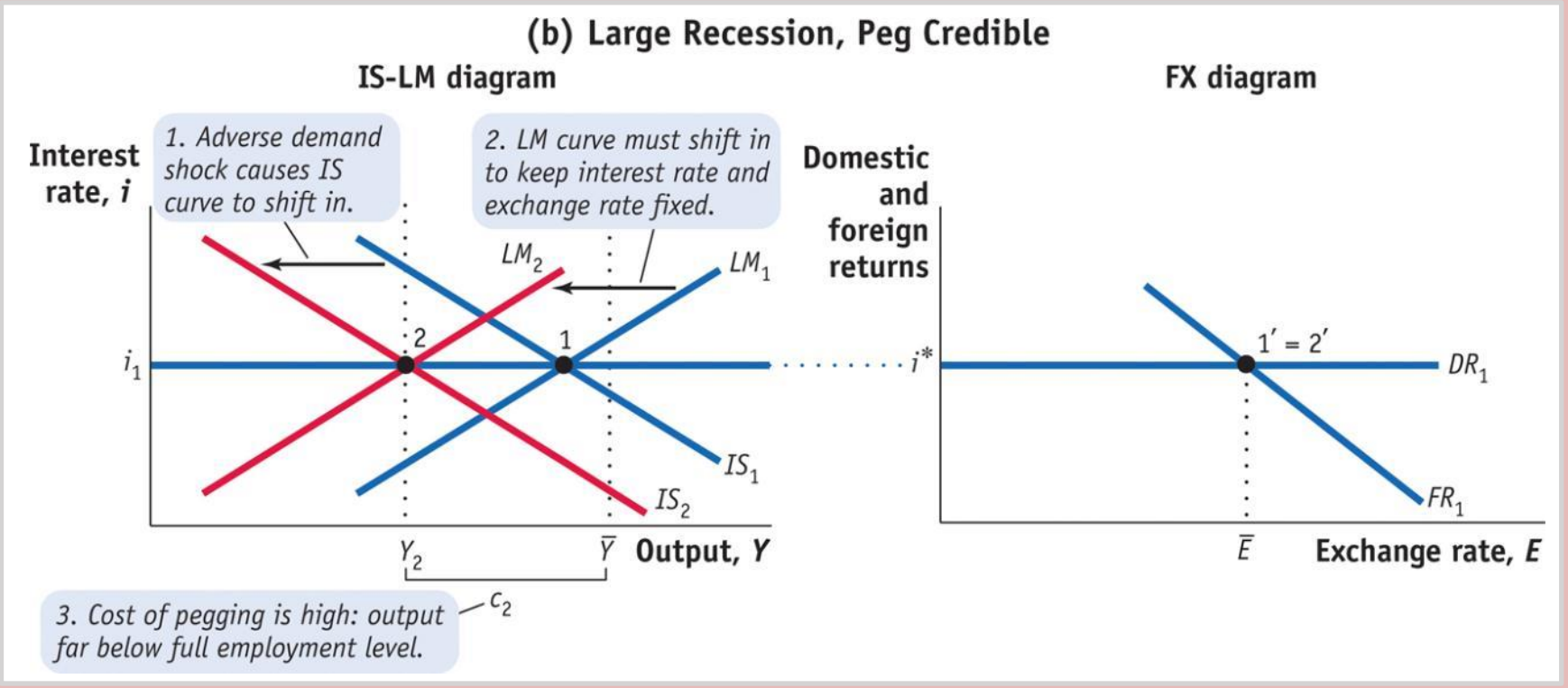


This figure describes how the IS–LM–FX equilibrium changes as demand shocks occur and as the credibility of the peg weakens. The economy is pegging at a fixed exchange rate $\bar{E}$.

In panel (a), the economy is at IS–LM equilibrium at point 1, with the FX market at point 1′. Output is a little below desired output, so the cost of pegging c_1 is small.

Large Recession, Peg Credible

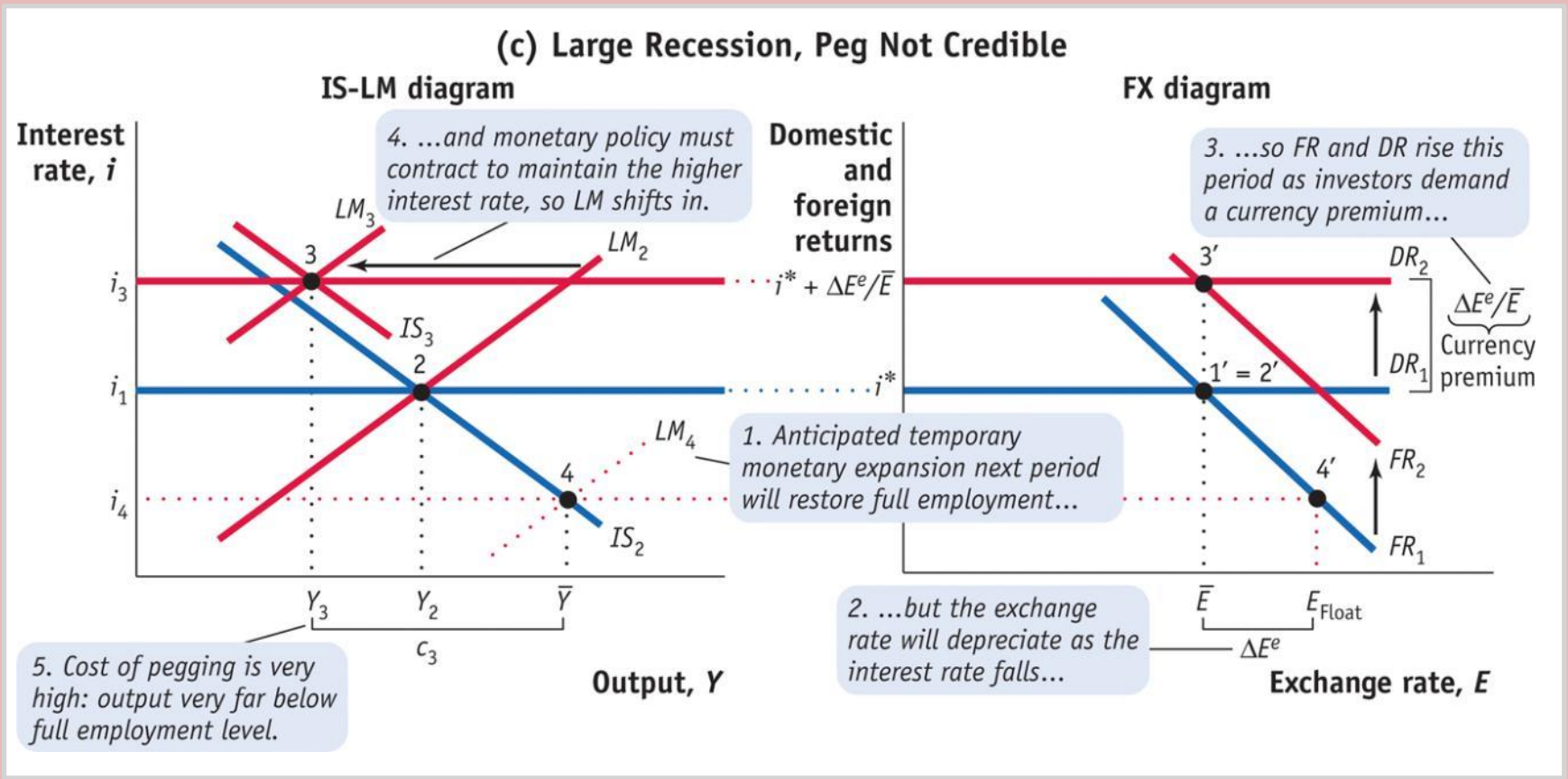
FIGURE 9-16 (2 of 4) Contingent Commitments and the Cost of Maintaining a Peg (continued)



In panel (b), there is an adverse shock to domestic demand, and the IS curve shifts in. LM shifts in, too, to maintain the peg. The new IS–LM equilibrium occurs at point 2, with FX market equilibrium at point 2′ (same as 1′). The cost of pegging c_2 is higher.

Large Recession, Peg Not Credible

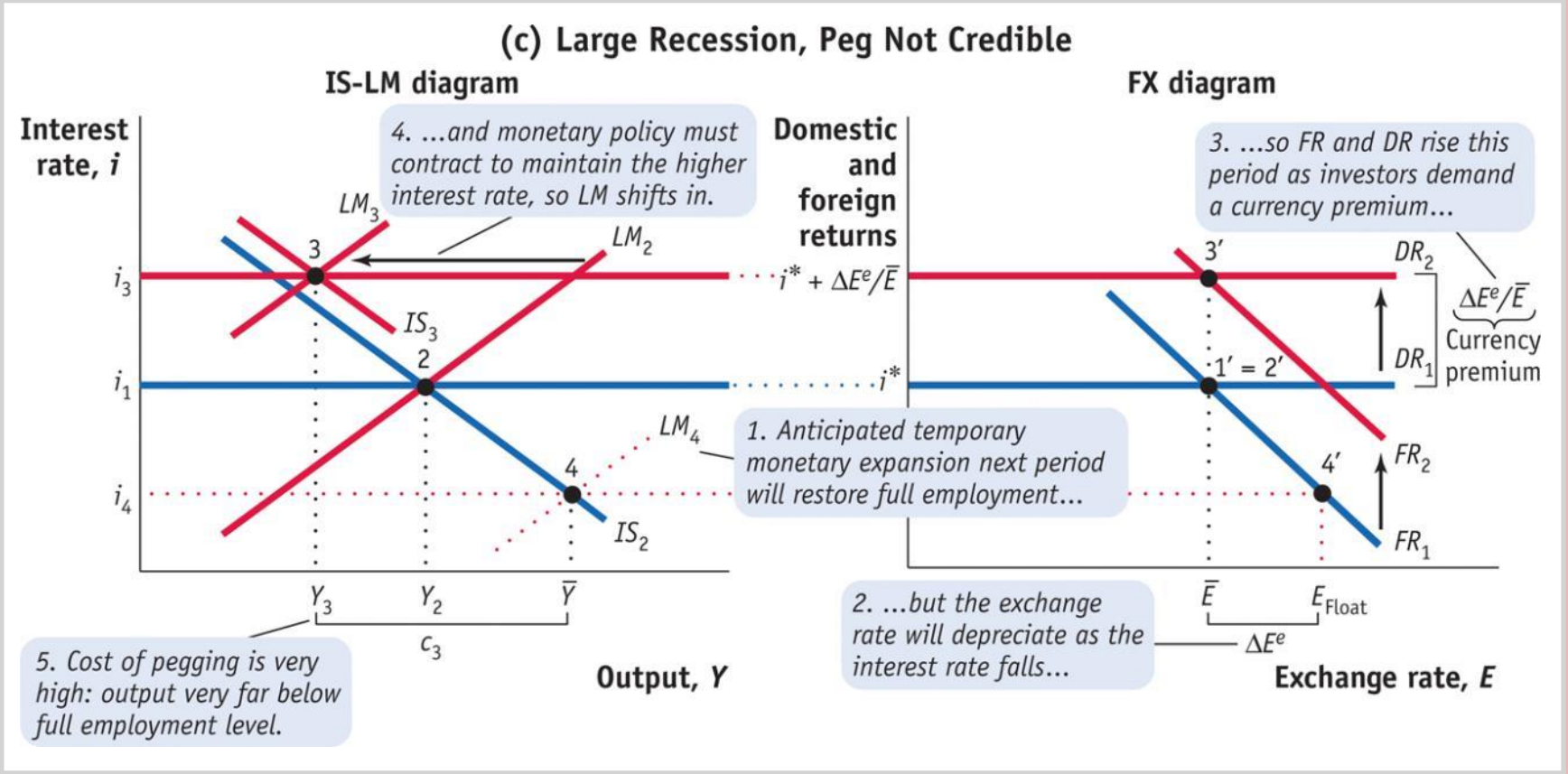
FIGURE 9-16 (3 of 4) Contingent Commitments and the Cost of Maintaining a Peg (continued)



Panel (c) shows that if the country wants to attain full employment output next period, it must move to point 4, shifting the LM curve out and allowing the FX market to settle at point 4' with the exchange rate depreciating to E_{float}. The peg would still be in operation today, but, by definition, it would no longer be credible if such a policy change were anticipated.

Large Recession, Peg Not Credible

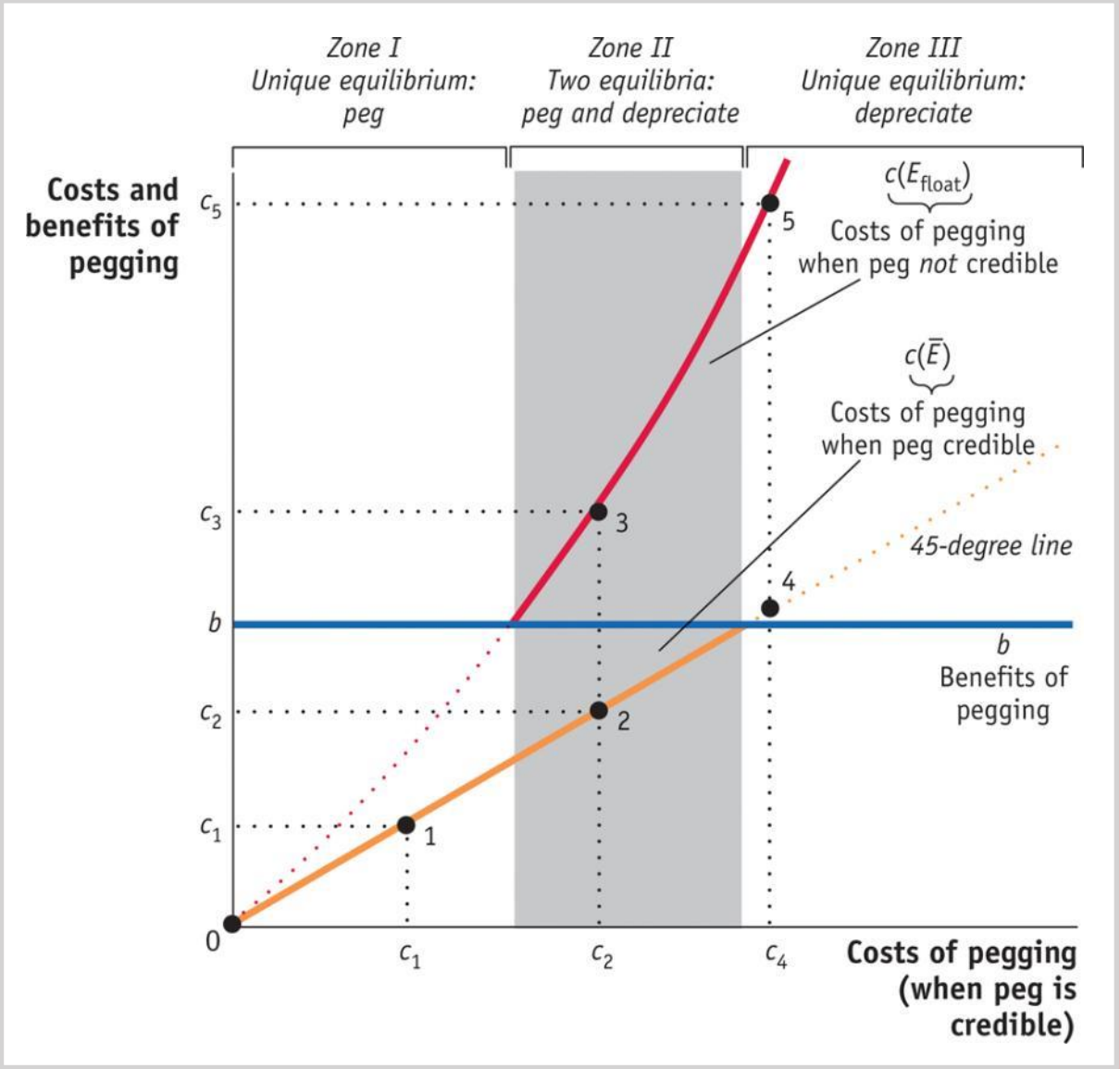
FIGURE 9-16 (4 of 4) Contingent Commitments and the Cost of Maintaining a Peg (continued)



Because of the lack of credibility, investors would insist on receiving a positive currency premium *today,* and the home interest rate would rise to i_3, squeezing demand even more and moving the IS–LM equilibrium to point 3 and the FX market to point 3′. Now the cost of pegging c_3 is even higher: Having a noncredible peg is more costly than having a credible peg.

The Costs and Benefits of Pegging

FIGURE 9-17 (1 of 3) Contingent Policies and Multiple Equilibria

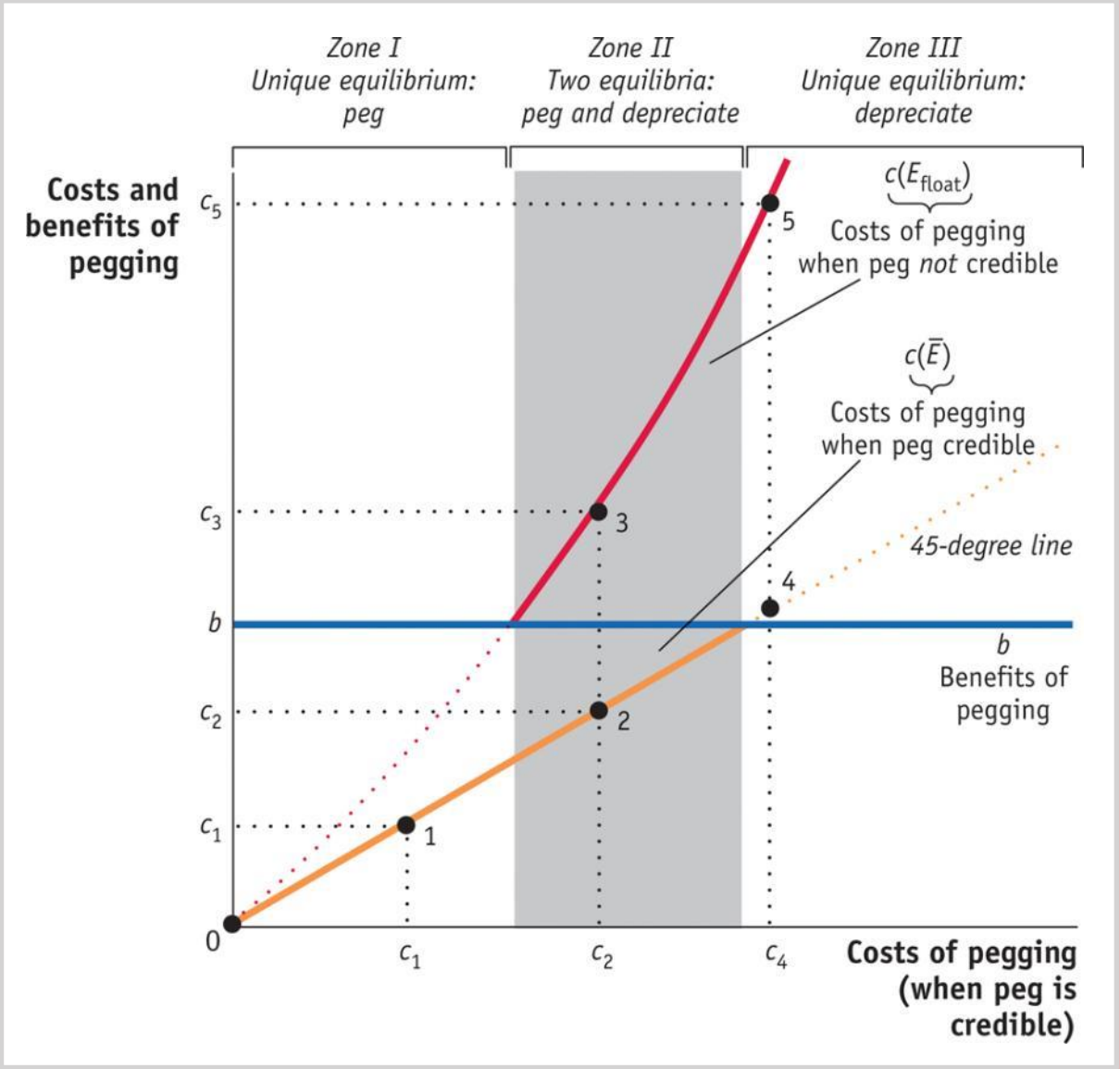


The costs of pegging when the peg is not credible will be even higher (the red line, dotted or solid), because costs rise when investors do not believe in the peg.

We assume the government believes the benefits of pegging (e.g., lower trade costs) are fixed and equal to *b*. Equilibria in this world correspond to points on the *solid segments* of the red and orange cost lines.

The Costs and Benefits of Pegging

FIGURE 9-17 (2 of 3) Contingent Policies and Multiple Equilibria (continued)



The peg is always credible in Zone I, where benefits always exceed costs: The government never wants to depreciate and investors know it.

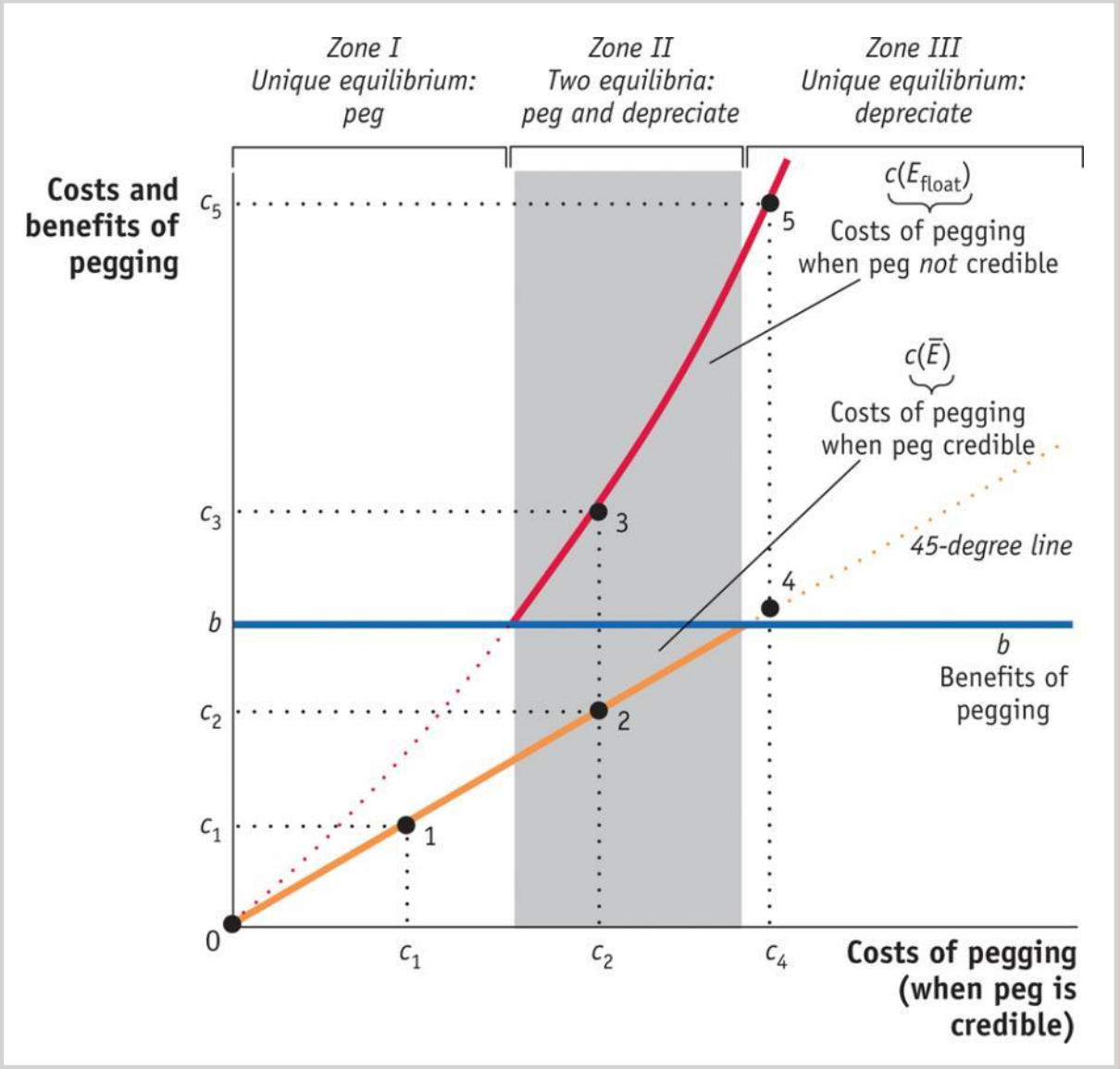
$$b > c(E_{float}) > c(\bar{E})$$

The peg is always noncredible in Zone III, where costs always exceed benefits: The government always wants to depreciate and investors know it.

$$c(E_{float}) > c(\bar{E}) > b$$

The Costs and Benefits of Pegging

FIGURE 9-17 (3 of 3) Contingent Policies and Multiple Equilibria (continued)



Zone II is the gray area: If investors believe the peg is credible, costs are low and the peg will hold; if investors believe the peg is noncredible, costs are higher and the peg will break.

$$c(E_{float}) > b > c(\bar{E})$$

APPLICATION

The Man Who Broke the Bank of England

- Changes in market sentiment, often called "animal spirits," emerge from a model based on rational actors.
- In some circumstances, the instability problem is much worse than anticipated. One reason is that as the time frame shrinks, the currency premium explodes. Another is how beliefs are formed in the first place.
- Investor George Soros likes to use the term "reflexivity" to describe how markets shape events, as well as vice versa.

Sipa/Sipa USA

George Soros: "Reflexivity is, in effect, a two-way feedback mechanism in which reality helps shape the participants' thinking and the participants' thinking helps shape reality."

APPLICATION

The Man Who Broke the Bank of England

- Soros's firm borrowed billions of pounds and parked all the money in German mark deposits. "It was an obvious bet, a one-way bet," he later recalled.
- The Bank of England, under orders from the U.K. Treasury, was intervening furiously, selling marks to prop up the pound at the limits of the ERM band.
- The sudden increase in the currency premium was inducing a massive reserve drain. On the morning of September 16, 1992, the pressure on the pound became intense. It was all over by lunchtime, with the bulk of the reserves lost, and an estimated £4 billion spent in a futile defense.

Summary

- Our results are striking. If government policies are contingent, then they will depend on market sentiment. But market sentiment, in turn, depends on what the market believes the government will do.

- If costs of pegging are "low," then pegs hold when they "should"—when the government has no desire to exit. If costs of pegging are "high," then crises happen when they "should"—when the government clearly wants to exit.

- But in between these extremes, an ambiguity arises in the form of multiple equilibria because for some "medium" range of costs, a crisis occurs if and only if the market expects a crisis.

5 Conclusions

In this chapter, we studied two kinds of fixed exchange rate crises.

- Adverse fiscal conditions can send the money supply out of control.
- And changes in the real economy can weaken the commitment to a peg.
- Expectations matter in each case—shifts in investor sentiment can make the crises occur "sooner" (i.e., when economic fundamentals are better), leading to worries that some crises are an unnecessary and undeserved punishment.

Can We Prevent Crises?

Below are some of the proposed solutions.

- *The case for capital controls.* For some examples (Malaysia after 1997, Spain after 1992), a case can be made that controls resulted in a positive difference in a time of crisis, but in large samples, the effects are weak or negative.

- *The case against intermediate regimes.* Economists conclude that intermediate regimes are very risky. Countries should get out of the middle and move to the corners. This view came to be known as the **corners hypothesis** or the *missing middle.* In this "bipolar" view, only the two extremes of a hard peg or a true float were recommended.

Can We Prevent Crises?

Below are some of the proposed solutions.

- *The case for floating.* There can be powerful reasons to peg if emerging markets have *fear of floating*, but empirically, the floating corner has not attracted all that many countries in practice.
- *The case for hard pegs.* The lesson here is that all fixed exchange rates can end up being cheap talk, no matter how much armor they appear to have.
- *The case for improving the institutions of macroeconomic policy and financial markets.* Improvements in the macroeconomic and financial structure in a country are the foundations on which any successful fixed exchange rate regime must be built.

Can We Prevent Crises?

Below are some of the proposed solutions.

- *The case for an international lender of last resort.* The **International Monetary Fund (IMF)** can help countries in difficulty if it thinks they can restore stability in a timely fashion with the help of a loan. But making the right judgments is far from easy.

  Many worry that the prospect of IMF bailouts, like any kind of insurance, may encourage lax behavior (*moral hazard*), which could worsen the crisis problem.

AP Photo/Hun Jai-hyaung

After what happened in 1997, some Asian countries may not turn to the IMF again—and with their reserve accumulation, they may not need to.

Can We Prevent Crises?

Below are some of the proposed solutions.

- *The case for self-insurance.* What if a country wants to peg, but none of the above ideas offers much comfort? What if controls are unattractive, floating too risky, and currency boards too much of a straightjacket?

The vast reserve buildup of recent years may be seen as a giant exercise in saving for a rainy day to protect emerging market countries against the vicissitudes of global finance.

KEY POINTS

1. An exchange rate crisis is a large and sudden depreciation that brings to an end a fixed exchange rate regime.

KEY POINTS

2. Such crises are common. The typical fixed exchange rate lasts only a few years. History shows that crises can affect all types of countries—advanced, emerging, and developing.

KEY POINTS

3. Crises have economic costs that tend to be very large in emerging markets and developing countries. Political costs are also large.

KEY POINTS

4. To avoid a crisis, the central bank in a country with a fixed exchange rate regime must have the ability to peg the exchange rate. In practice, this means the central bank needs foreign currency reserves, which can be bought or sold in the forex market at the fixed rate.

KEY POINTS

5. In a simple model of a central bank, the money supply consists of domestic credit and foreign reserves. Money demand is exogenous and is determined by interest rates and output levels that we assume are beyond the control of the authorities when the exchange rate is pegged. In this model, reserves are simply money demand minus domestic credit.

KEY POINTS

6. If money demand rises (falls), holding domestic credit fixed, reserves rise (fall) by the same amount.

KEY POINTS

7. If domestic credit rises (falls), holding money demand fixed, reserves fall (rise) by the same amount and the money supply is unchanged. The combined result is called sterilization.

KEY POINTS

8. When the central bank gives assistance to the financial sector, it expands domestic credit. If it is a bailout, money demand is unchanged, and reserves drain. If it is a loan to satisfy depositors' demand for cash, then reserves stay constant.

KEY POINTS

9. A first-generation crisis occurs when domestic credit grows at a constant rate forever, usually due to the monetization of a chronic fiscal deficit. Eventually, reserves drain and the money supply grows at the same rate, causing inflation and depreciation. Myopic investors do not anticipate the drain, and when reserves run out, they see a sudden jump (depreciation) in the exchange rate. Investors with foresight will try to sell domestic currency before that jump happens and by doing so will cause a speculative attack and a sudden drain of reserves.

KEY POINTS

10. A second-generation attack occurs when the authorities' commitment to the peg is contingent. If the domestic economy is suffering too high a cost from pegging, the authorities will consider floating and using expansionary monetary policy to boost output by allowing the currency to depreciate, thus breaking the peg. If investors anticipate that the government will break the peg, they will demand a currency premium, making interest even higher under the peg and raising the costs of pegging still further. In this setup, at some intermediate costs, the authorities will maintain the peg as long as investors find the peg credible, but they will allow their currency to depreciate if investors find the peg not credible. This creates multiple equilibria and self-fulfilling crises.

KEY TERMS

exchange rate crisis
banking crisis
default crisis
twin crises
triple crises
domestic credit
reserves
central bank balance sheet
assets
liabilities
floating line
fixed line
currency board
backing ratio
risk premium
interest rate spread
currency premium
country premium
credibility
contagion
sterilization
insolvent
bailout
illiquid
bank run
lender of last resort
sterilization bonds
first-generation crisis model
fiscal dominance
speculative attack
second-generation crisis model
contingent commitment
multiple equilibria
self-confirming equilibrium
corners hypothesis
International Monetary Fund (IMF)

Thank You for your attention!