where Y is output, C^d is desired consumption spending, and G is government purchases. This way of writing the goods market equilibrium condition is equivalent to the condition in Eq. (5.4).[7]

We can rewrite Eq. (5.5) as

$$NX = Y - (C^d + I^d + G). \tag{5.6}$$

Equation (5.6) states that in goods market equilibrium the amount of net exports a country sends abroad equals the country's total output (gross domestic product), Y, less total desired spending by domestic residents, $C^d + I^d + G$. Total spending by domestic residents is called **absorption.** Thus Eq. (5.6) states that an economy in which output exceeds absorption will send goods abroad ($NX > 0$) and have a current account surplus and that an economy that absorbs more than it produces will be a net importer ($NX < 0$), with a current account deficit.

5.3 Saving and Investment in a Small Open Economy

To show how saving and investment are related to international trade and lending, we first present the case of a small open economy. A **small open economy** is an economy that is too small to affect the world real interest rate. The **world real interest rate** is the real interest rate that prevails in the international capital market—that is, the market in which individuals, businesses, and governments borrow and lend across national borders. Because changes in saving and investment in the small open economy aren't large enough to affect the world real interest rate, this interest rate is fixed in our analysis, which is a convenient simplification. Later in this chapter we consider the case of an open economy, such as the U.S. economy, that is large enough to affect the world real interest rate.

As with the closed economy, we can describe the goods market equilibrium in a small open economy by using the saving–investment diagram. The important new assumption that we make is that residents of the economy can borrow or lend in the international capital market at the (expected) world real interest rate, r^w, which for now we assume is fixed. If the world real interest rate is r^w, the domestic real interest rate must be r^w as well, as no domestic borrower with access to the international capital market would pay more than r^w to borrow, and no domestic saver with access to the international capital market would accept less than r^w to lend.[8]

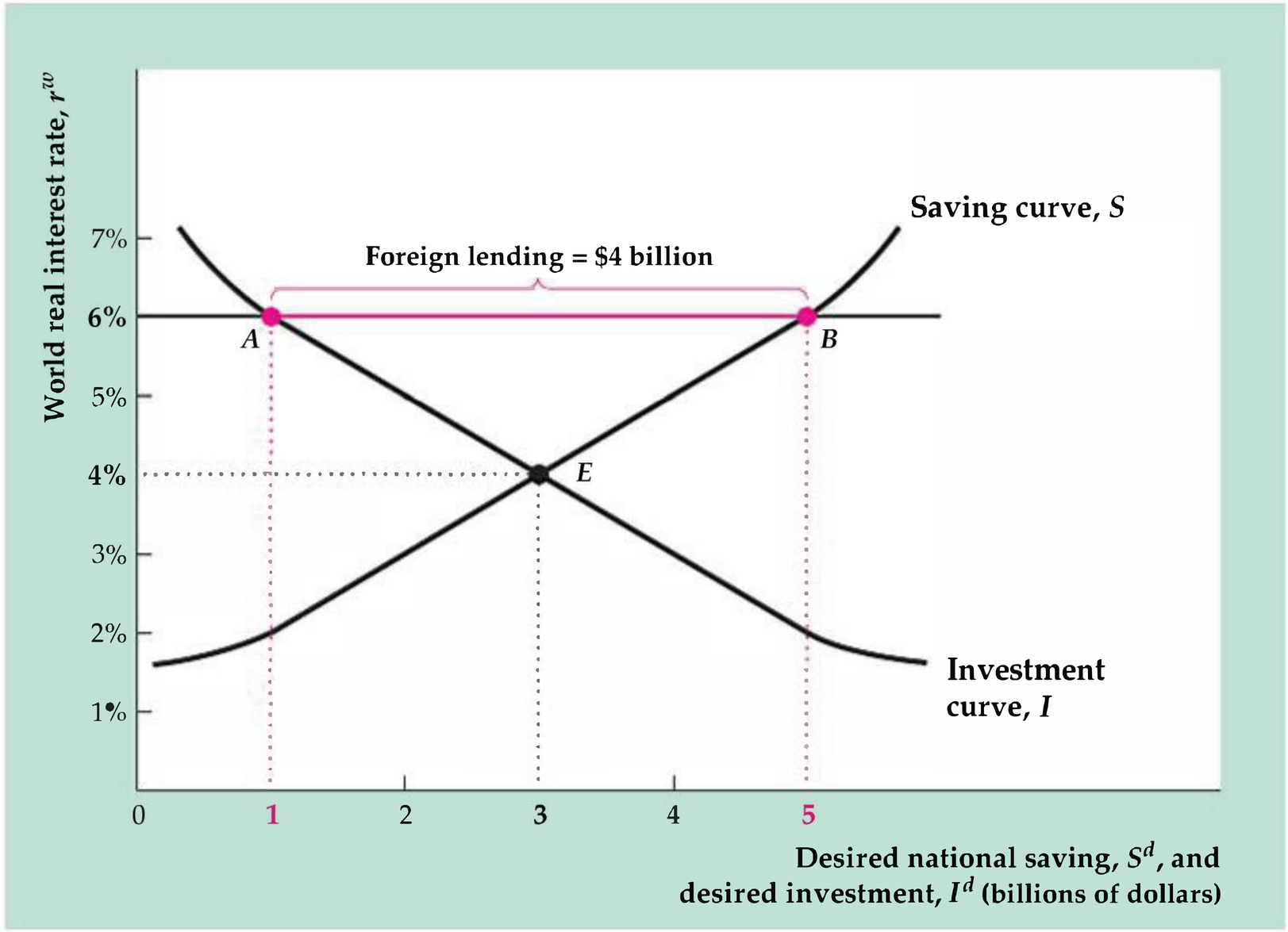
Figure 5.2 shows the saving and investment curves for a small open economy. In a closed economy, goods market equilibrium would be represented by point E, the intersection of the curves. The equilibrium real interest rate in the closed economy would be 4% (per year), and national saving and investment would be $3 billion (per year). In an open economy, however, desired national saving need not

[7]To see that Eq. (5.5) is equivalent to Eq. (5.4), subtract $C^d + G$ from both sides of Eq. (5.5) to obtain $Y - C^d - G = I^d + NX$. The left side of this equation equals desired national saving, S^d, so it is the same as Eq. (5.4).

[8]For simplicity, we ignore factors such as differences in risk or taxes that might cause the domestic real interest rate to differ from the world rate. We also assume that there are no legal barriers to international borrowing and lending (when they exist, such barriers are referred to as capital controls).

Figure 5.2

A small open economy that lends abroad
The graph shows the saving–investment diagram for a small open economy. The country faces a fixed world real interest rate of 6%. At this real interest rate, national saving is $5 billion (point *B*) and investment is $1 billion (point *A*). The part of national saving not used for investment is lent abroad, so foreign lending is $4 billion (distance *AB*).



equal desired investment. If the small open economy faces a fixed world real interest rate, r^w, higher than 4%, desired national saving will be greater than desired investment. For example, if r^w is 6%, desired national saving is $5 billion and desired investment is $1 billion, so desired national saving exceeds desired investment by $4 billion.

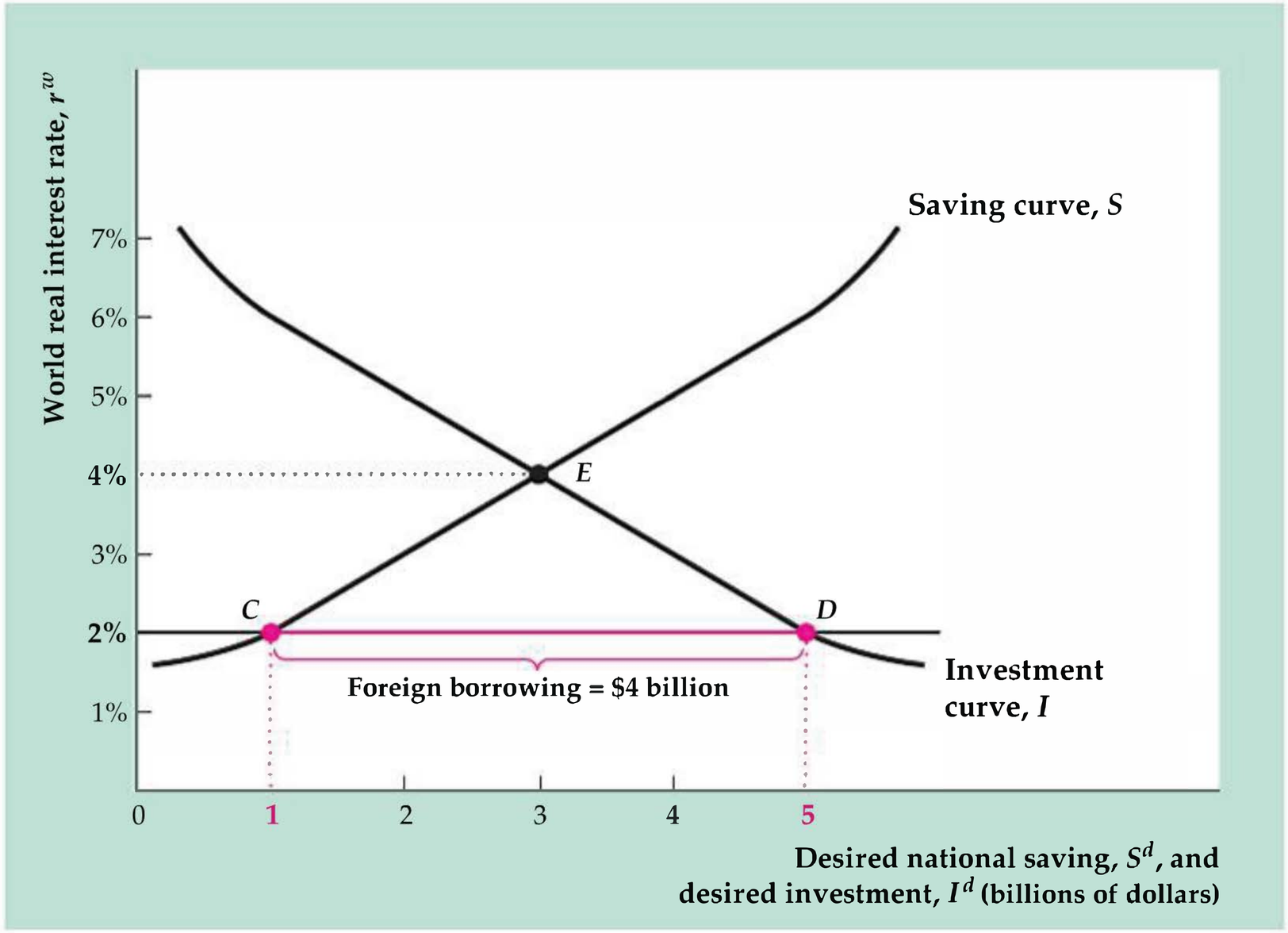
Can the economy be in equilibrium when desired national saving exceeds desired investment by $4 billion? In a closed economy it couldn't. The excess saving would have no place to go, and the real interest rate would have to fall to bring desired saving and desired investment into balance. However, in the open economy the excess $4 billion of saving can be used to buy foreign assets. This financial outflow uses up the excess national saving so that there is no disequilibrium. Instead, the goods market is in equilibrium with desired national saving of $5 billion, desired investment of $1 billion, and net foreign lending of $4 billion (see Eq. 5.4 and recall that net exports, NX, and net foreign lending are the same).

Alternatively, suppose that the world real interest rate, r^w, is 2% instead of 6%. As Fig. 5.3 shows, in this case desired national saving is $1 billion and desired investment is $5 billion so that desired investment exceeds desired saving by $4 billion. Now firms desiring to invest will have to borrow $4 billion in the international capital market. Is this also a goods market equilibrium? Yes it is, because desired national saving ($1 billion) again equals desired investment ($5 billion) plus net foreign lending (minus $4 billion). Indeed, a small open economy can achieve goods market equilibrium for any value of the world real interest rate. All that is required is that net foreign lending equal the difference between the country's desired national saving and its desired investment.

A more detailed version of the example illustrated in Figs. 5.2 and 5.3 is presented in Table 5.3. As shown in the top panel, we assume that in this small country gross domestic product, Y, is fixed at its full-employment value of $20 billion

Figure 5.3

A small open economy that borrows abroad
The same small open economy shown in Fig. 5.2 now faces a fixed world real interest rate of 2%. At this real interest rate, national saving is $1 billion (point *C*) and investment is $5 billion (point *D*). Foreign borrowing of $4 billion (distance *CD*) makes up the difference between what investors want to borrow and what domestic savers want to lend.



and government purchases, *G*, are fixed at $4 billion. The middle panel shows three possible values for the world real interest rate, r^w, and the assumed levels of desired consumption and desired investment at each of these values of the real interest rate. Note that higher values of the world real interest rate imply lower levels of desired consumption (because people choose to save more) and lower desired investment. The bottom panel shows the values of various economic quantities implied by the assumed values in the top two panels.

The equilibrium in this example depends on the value of the world real interest rate, r^w. Suppose that $r^w = 6\%$, as shown in Fig. 5.2. Column (3) of Table 5.3

Table 5.3

Goods Market Equilibrium in a Small Open Economy: An Example (Billions of Dollars)

Given			
Gross domestic product, Y	20		
Government purchases, G	4		
Effect of real interest rate on desired consumption and investment			
	(1)	(2)	(3)
(1) World real interest rate, r^w (%)	2	4	6
(2) Desired consumption, C^d	15	13	11
(3) Desired investment, I^d	5	3	1
Results			
(4) Desired absorption, $C^d + I^d + G$	24	20	16
(5) Desired national saving, $S^d = Y - C^d - G$	1	3	5
(6) Net exports, $NX = Y -$ *desired absorption*	−4	0	4
(7) Desired foreign lending, $S^d - I^d$	−4	0	4

Note: We assume that net factor payments, *NFP*, and net unilateral transfers equal zero.

shows that, if $r^w = 6\%$, desired consumption, C^d, is \$11 billion (row 2) and that desired investment, I^d, is \$1 billion (row 3). With C^d at \$11 billion, desired national saving, $Y - C^d - G$, is \$5 billion (row 5). Desired net foreign lending, $S^d - I^d$, is \$4 billion (row 7)—the same result illustrated in Fig. 5.2.

If $r^w = 2\%$, as in Fig. 5.3, column (1) of Table 5.3 shows that desired national saving is \$1 billion (row 5) and that desired investment is \$5 billion (row 3). Thus desired foreign lending, $S^d - I^d$, equals $-\$4$ billion (row 7)—that is, foreign borrowing totals \$4 billion. Again, the result is the same as illustrated in Fig. 5.3.

An advantage of working through the numerical example in Table 5.3 is that we can also use it to demonstrate how the goods market equilibrium, which we've been interpreting in terms of desired saving and investment, can be interpreted in terms of output and absorption. Suppose again that $r^w = 6\%$, giving a desired consumption, C^d, of \$11 billion and a desired investment, I^d, of \$1 billion. Government purchases, G, are fixed at \$4 billion. Thus when r^w is 6%, desired absorption (the desired spending by domestic residents), $C^d + I^d + G$, totals \$16 billion (row 4, column 3).

In goods market equilibrium a country's net exports—the net quantity of goods and services that it sends abroad—equal gross domestic product, Y, minus desired absorption (Eq. 5.6). When r^w is 6%, Y is \$20 billion and desired absorption is \$16 billion so that net exports, NX, are \$4 billion. Net exports of \$4 billion imply that the country is lending \$4 billion abroad, as shown in Fig. 5.2. If the world real interest rate drops to 2%, desired absorption rises (because people want to consume more and invest more) from \$16 billion to \$24 billion (row 4, column 1). Because in this case absorption (\$24 billion) exceeds domestic production (\$20 billion), the country has to import goods and services from abroad ($NX = -\$4$ billion). Note that desired net imports of \$4 billion imply net foreign borrowing of \$4 billion, as shown in Fig. 5.3.

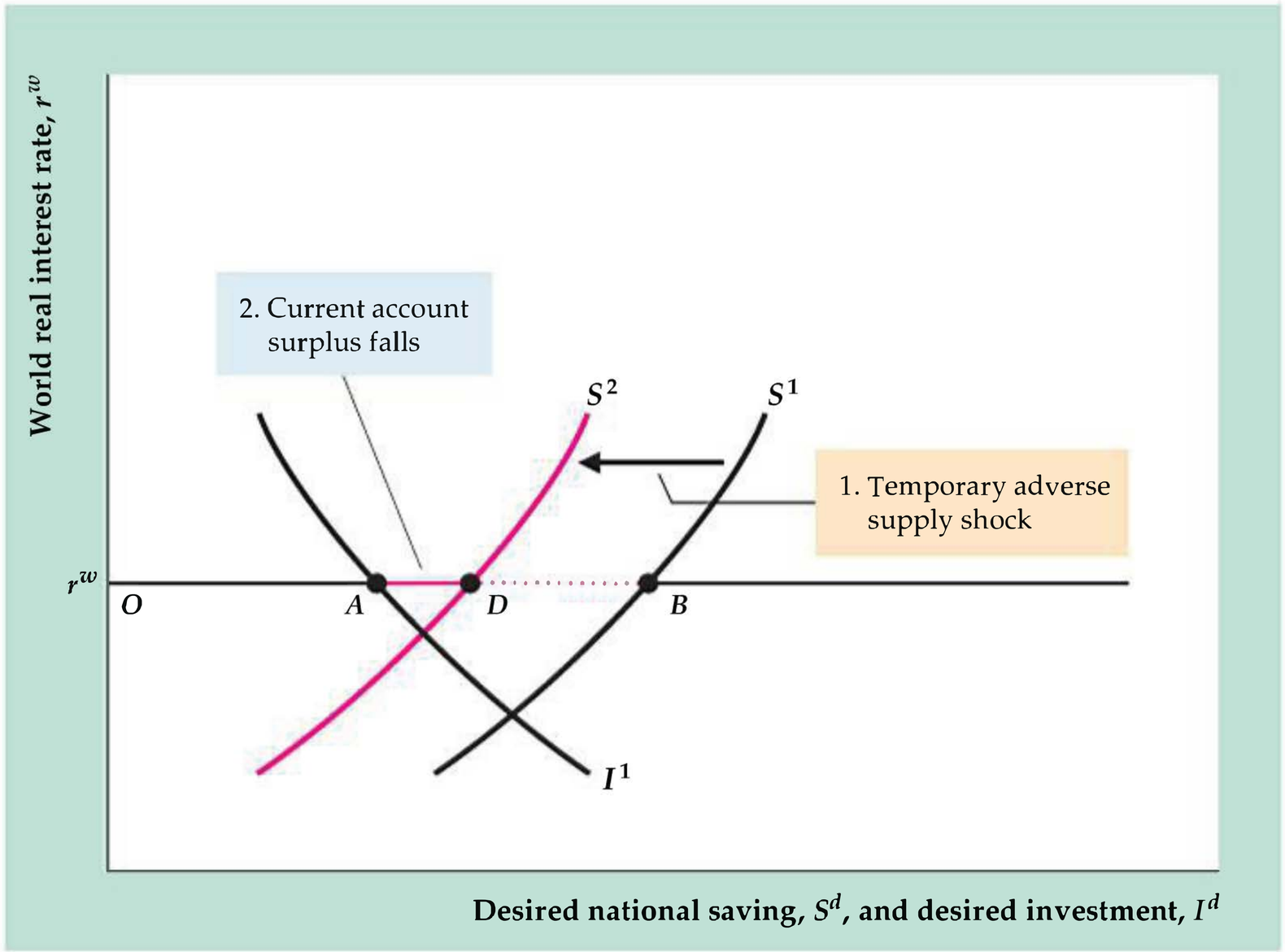
The Effects of Economic Shocks in a Small Open Economy

The saving–investment diagram can be used to determine the effects of various types of economic disturbances in a small open economy. Briefly, any change that increases desired national saving relative to desired investment at a given world real interest rate will increase net foreign lending, the current account balance, and net exports, which are all equivalent under our assumption that net factor payments from abroad and net unilateral transfers are zero. A decline in desired national saving relative to desired investment reduces those quantities. Let's look at two examples that arise frequently in various countries.

Example 1: A Temporary Adverse Supply Shock. Suppose that a small open economy is hit with a severe drought—an adverse supply shock—that temporarily lowers output. The effects of the drought on the nation's saving, investment, and current account are shown in Fig. 5.4. The initial saving and investment curves are S^1 and I^1, respectively. For the world real interest rate, r^w, initial net foreign lending (equivalently, net exports or the current account balance) is distance AB.

The drought brings with it a temporary decline in income. A drop in current income causes people to reduce their saving at any prevailing real interest rate, so the saving curve shifts left, from S^1 to S^2. If the supply shock is temporary, as we have assumed, the expected future marginal product of capital is unchanged. As a result, desired investment at any real interest rate is unchanged, and the investment curve does not shift. The world real interest rate is given and does not change.

Figure 5.4



A temporary adverse supply shock in a small open economy Curve S^1 is the initial saving curve, and curve I^1 is the initial investment curve of a small open economy. With a fixed world real interest rate of r^w, national saving equals the distance OB and investment equals distance OA. The current account surplus (equivalently, net foreign lending) is the difference between national saving and investment, shown as distance AB. A temporary adverse supply shock lowers current output and causes consumers to save less at any real interest rate, which shifts the saving curve left, from S^1 to S^2. National saving decreases to distance OD, and the current account surplus decreases to distance AD.

In the new equilibrium, net foreign lending and the current account have shrunk to distance AD. The current account shrinks because the country saves less and thus is not able to lend abroad as much as before.

In this example, we assumed that the country started with a current account surplus, which is reduced by the drought. If, instead, the country had begun with a current account deficit, the drought would have made the deficit larger. In either case the drought reduces (in the algebraic sense) net foreign lending and the current account balance.

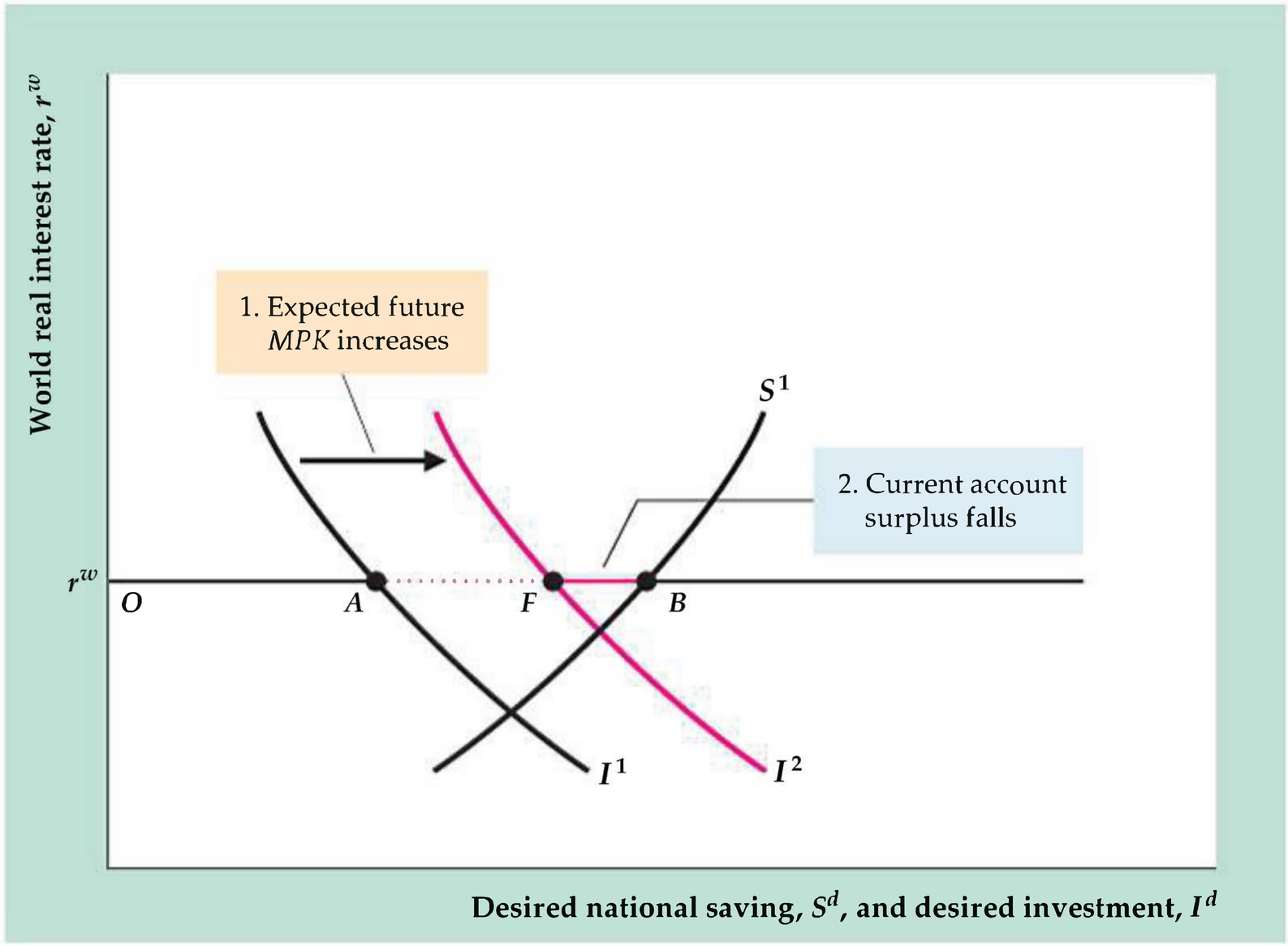
Example 2: An Increase in the Expected Future Marginal Product of Capital.

Suppose that technological innovations increase the expected future marginal product, MPK^f, of current capital investment. The effects on a small open economy are shown in Fig. 5.5. Again, the initial national saving and investment curves are S^1 and I^1, respectively, so that the initial current account surplus equals distance AB.

An increase in the MPK^f raises the capital stock that domestic firms desire to hold so that desired investment rises at every real interest rate. Thus the investment curve shifts to the right, from I^1 to I^2. The current account and net foreign lending shrink to length FB. Why does the current account fall? Because building capital has become more profitable in the home country, more of the country's output is absorbed by domestic investment, leaving less to send abroad.[9]

[9] A possibility that we have neglected so far is that technological innovations also cause savers to expect a higher future income, which would reduce current saving at every level of the world real interest rate. A leftward shift of the saving curve would further reduce the current account balance. This effect would only reinforce the effect on the country's current account of the rightward shift of the investment curve, so for simplicity we continue to ignore this potential change in desired saving.

Figure 5.5



An increase in the expected future *MPK* in a small open economy As in Fig. 5.4, the small open economy's initial national saving and investment curves are S^1 and I^1, respectively. At the fixed world real interest rate of r^w, there is an initial current account surplus equal to the distance AB. An increase in the expected future marginal product of capital (MPK^f) shifts the investment curve right, from I^1 to I^2, causing investment to increase from distance OA to distance OF. The current account surplus, which is national saving minus investment, decreases from distance AB to distance FB.

5.4 Saving and Investment in Large Open Economies

Although the model of a small open economy facing a fixed real interest rate is appropriate for studying many of the countries in the world, it isn't the right model to use for analyzing the world's major developed economies. The problem is that significant changes in the saving and investment patterns of a major economy can and do affect the world real interest rate, which violates the assumption made for the small open economy that the world real interest rate is fixed. Fortunately, we can readily adapt the analysis of the small open economy to the case of a **large open economy,** that is, an economy large enough to affect the world real interest rate.

To begin, let's think of the world as comprising only two large economies: (1) the home, or domestic economy, and (2) the foreign economy (representing the economies of the rest of the world combined). Figure 5.6 shows the saving–investment diagram that applies to this case. Figure 5.6(a) shows the saving curve, S, and the investment curve, I, of the home economy. Figure 5.6(b) displays the saving curve, S_{For}, and the investment curve, I_{For}, of the foreign economy. These saving and investment curves are just like those for the small open economy.

Instead of taking the world real interest rate as given, as we did in the model of a small open economy, we determine the world real interest rate within the model for a large open economy. What determines the value of the world real interest rate? Remember that for the closed economy the real interest rate was set by the condition that the amount that savers want to lend must equal the amount that investors want to borrow. Analogously, in the case of two large open economies, *the world real interest rate will be such that desired international lending by one country equals desired international borrowing by the other country.*

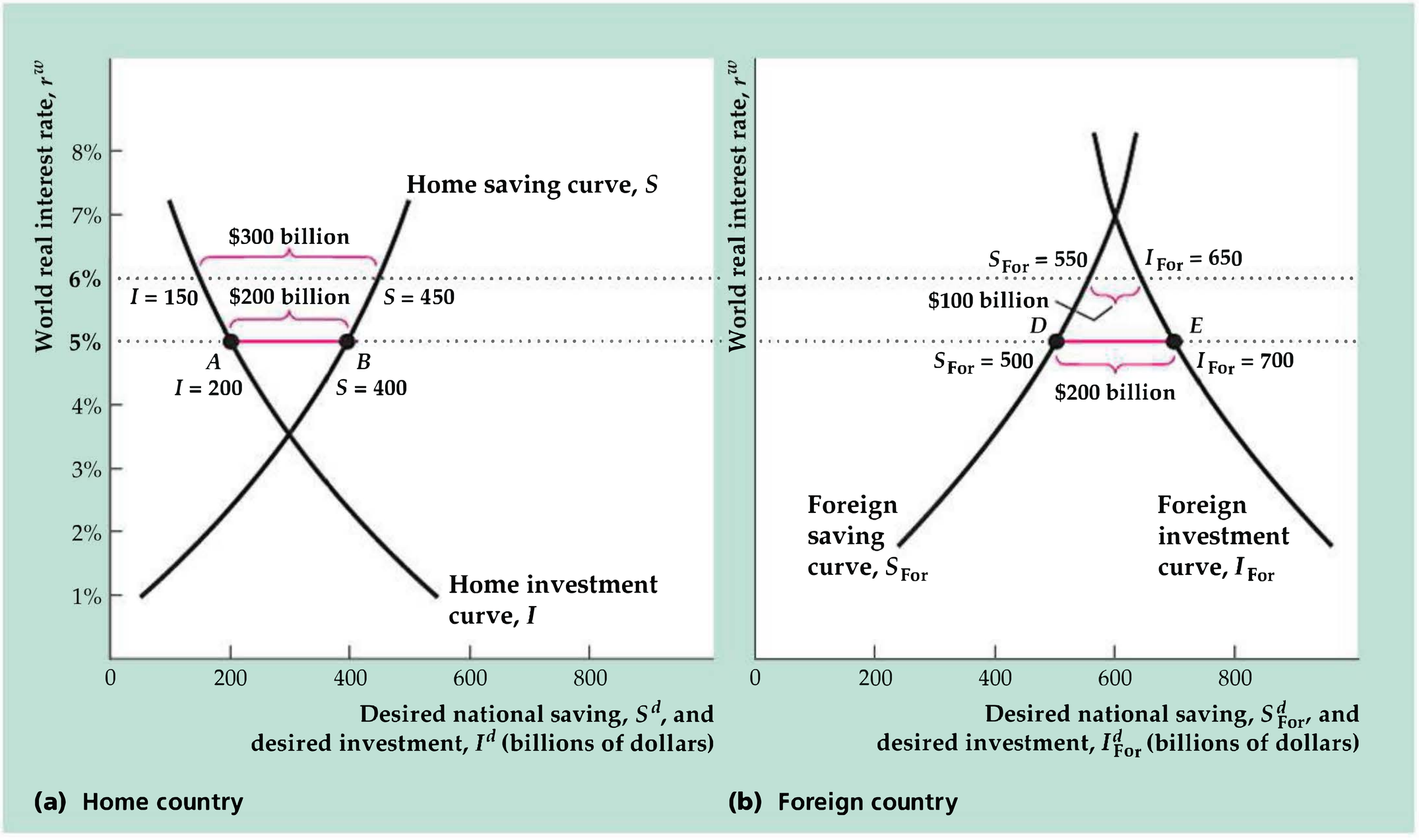


Figure 5.6

The determination of the world real interest rate with two large open economies
The equilibrium world real interest rate is the real interest rate at which desired international lending by one country equals desired international borrowing by the other country. In the figure, when the world real interest rate is 5%, desired international lending by the home country is $200 billion ($400 billion desired national saving less $200 billion desired investment, or distance *AB*), which equals the foreign country's desired international borrowing of $200 billion ($700 billion desired investment less $500 billion desired national saving, or distance *DE*). Thus 5% is the equilibrium world real interest rate. Equivalently, when the interest rate is 5%, the current account surplus of the home country equals the current account deficit of the foreign country (both are $200 billion).

To illustrate the determination of the equilibrium world real interest rate, we return to Fig. 5.6. Suppose, arbitrarily, that the world real interest rate, r^w, is 6%. Does this rate result in a goods market equilibrium? Figure 5.6(a) shows that, at a 6% real interest rate, in the home country desired national saving is $450 billion and desired investment is $150 billion. Because desired national saving exceeds desired investment by $300 billion, the amount that the home country would like to lend abroad is $300 billion.

To find how much the foreign country wants to borrow, we turn to Fig. 5.6(b). When the real interest rate is 6%, desired national saving is $550 billion and desired investment is $650 billion in the foreign country. Thus at a 6% real interest rate the foreign country wants to borrow $100 billion ($650 billion less $550 billion) in the international capital market. Because this amount is less than the $300 billion the home country wants to lend, 6% is *not* the real interest rate that is consistent with equilibrium in the international capital market.

At a real interest rate of 6%, desired international lending exceeds desired international borrowing, so the equilibrium world real interest rate must be less than 6%. Let's try a real interest rate of 5%. Figure 5.6(a) shows that at that interest rate desired national saving is $400 billion and desired investment is $200 billion in