

Chapter 20. Output, the Interest Rate, and the Exchange Rate

In Chapter 19, we treated the exchange rate as one of the policy instruments available to the government. But the exchange rate is not a policy instrument. Rather, it is determined in the foreign–exchange market—a market where, as you saw in Chapter 18, there is an enormous amount of trading. This fact raises two obvious questions: What determines the exchange rate? How can policy makers affect it?

These are the questions that motivate this chapter. More generally, we examine the implications of equilibrium in both the goods market and financial markets, including the foreign exchange market. This allows us to characterize the joint movements of output, the interest rate, and the exchange rate in an open economy. The model we develop is an extension to the open economy of the *IS–LM* model you saw in Chapter 5, and is known as the **Mundell–Fleming model**—after the two economists, Robert Mundell and Marcus Fleming, who first put it together in the 1960s. (The model presented here keeps the spirit but differs in its details from the original Mundell–Fleming model.)

Section 20–1 looks at equilibrium in the goods market.

Section 20–2 looks at equilibrium in financial markets, including the foreign exchange market.

Section 20–3 puts the two equilibrium conditions together and looks at the

determination of output, the interest rate, and the exchange rate.

Section 20–4 looks at the role of policy under flexible exchange rates.

Section 20–5 looks at the role of policy under fixed exchange rates.

20–1. Equilibrium in the Goods Market

Equilibrium in the goods market was the focus of Chapter 19, where we derived the equilibrium condition (equation [19.4]):

$$Y = C(Y - T) + I(Y, r) + G - IM(Y, \epsilon) / \epsilon + X(Y^*, \epsilon)$$

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For the goods market to be in equilibrium, output (the left side of the equation) must be equal to the demand for domestic goods (the right side of the equation).¹ This demand is equal to consumption C , plus investment I , plus government spending G , minus the value of imports IM / ϵ plus exports X .

- Consumption C depends positively on disposable income $Y - T$.
- Investment I depends positively on output Y , and negatively on the real interest rate r .
- Government spending G is taken as given.
- The quantity of imports IM depend positively on both output Y , and the real exchange rate ϵ . The value of imports in terms of domestic goods is equal to the quantity of imports divided by the real exchange rate.

1. Goods market equilibrium (IS): Output = Demand for domestic goods

- Exports X depend positively on foreign output Y^* and negatively on the real exchange rate ϵ .

It will be convenient in what follows to regroup the last two terms under “net exports”, defined as exports minus the value of imports

$$NX(Y, Y^*, \epsilon) \equiv X(Y^*, \epsilon) - IM(Y, \epsilon)/\epsilon$$

It follows from our assumptions about imports and exports that net exports NX depend on domestic output Y , foreign output Y^* , and the real exchange rate ϵ : An increase in domestic output increases imports, thus decreasing net exports. An increase in foreign output increases exports, thus increasing net exports. An increase in the real exchange rate leads to a decrease in net exports.²

Using this definition of net exports, we can rewrite the equilibrium condition as

$$Y = C(Y - T) + I(Y, r) + G + NX(Y, Y^*, \epsilon) \quad (20.1)$$

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For our purposes, the main implication of equation (20.1) is the dependence of demand, and so of equilibrium output, on both the real interest rate and on the real exchange rate:

- An increase in the real interest rate leads to a decrease in investment spending, and so to a decrease in the demand for domestic goods. This leads, through the multiplier, to a decrease in output.
- An increase in the real exchange rate leads to a shift in demand towards foreign goods, and so to a decrease in net exports. The

2. I shall assume, throughout the chapter, that the Marshall–Lerner condition holds. Under this condition, an increase in the real exchange rate—a real appreciation—leads to a decrease in net exports (see Chapter 19).

decrease in net exports decreases the demand for domestic goods. This leads, through the multiplier, to a decrease in output.

For the remainder of the chapter, I shall make two simplifications to equation (20.1):

- Given our focus on the short run, we assumed in our previous treatment of the *IS-LM* model that the (domestic) price level was given. I shall make the same assumption here and extend this assumption to the foreign price level, so the real exchange rate ($\epsilon \equiv EP/P^*$) and the nominal exchange rate (E) move together. A decrease in the nominal exchange rate—a nominal depreciation—leads, one for one, to a decrease in the real exchange rate—a real depreciation. If, for notational convenience, we choose P and P^* so that $P/P^* = 1$ (and we can do so because both are index numbers), then $\epsilon = E$ and we can replace ϵ by E in equation (20.1).³
- As we take the domestic price level as given, there is no inflation, neither actual nor expected. Therefore, the nominal interest rate and the real interest rate are the same, and we can replace the real interest rate, r , in equation (20.1) by the nominal interest rate, i .⁴

With these two simplifications, equation (20.1) becomes

$$Y = C(Y - T) + I(Y, i) + G + NX(Y, Y^*, E) \quad (20.2)$$

(+) (+, -) (-, +, -)

Output depends on both the nominal interest rate and the nominal exchange rate.

3. First simplification: $P = P^* = 1$, so $\epsilon = E$

4. Second simplification: $\pi^e = 0$, so $r = i$

20–2. Equilibrium in Financial Markets

When we looked at financial markets in the *IS–LM* model, we assumed that people chose only between two financial assets, money and bonds. Now that we look at a financially open economy, we must also take into account the fact that people have a choice between domestic bonds and foreign bonds. Let’s consider each choice in turn.⁵

Money versus Bonds

When looking at the determination of the interest rate in the *IS–LM* model, we wrote the condition that the supply of money be equal to the demand for money as

$$\frac{M}{P} = Y L(i) \quad (20.3)$$

We took the real supply of money [the left side of equation (20.3)] as given. We assumed that the real demand for money [the right side of equation (20.3)] depended on the level of transactions in the economy, measured by real output (Y) and on the opportunity cost of holding money rather than bonds, the nominal interest rate on bonds (i).

How should we change this characterization now that the economy is open? You will like the answer: Not very much, if at all.

In an open economy, the demand for domestic money is still mostly a demand by domestic residents. There is not much reason for, say, the Japanese to hold U.S. currency or demand deposits. Transactions in Japan require payment in yens, not in dollars. If residents of Japan want to hold dollar-denominated assets, they are better off holding U.S. bonds, which at least

5. We leave aside the other choices—between short-term and long-term bonds, and between short-term bonds and stocks—studied in Chapter 15.

pay a positive interest rate. And the demand for money by domestic residents in any country still depends on the same factors as before: their level of transactions that we measure by domestic real output, and the opportunity cost of holding money, the nominal interest rate on bonds.⁶

Therefore, we can still use equation (20.3) to think about the determination of the nominal interest rate in an open economy. The interest rate must be such that the supply of money and the demand for money are equal.⁷ An increase in the money supply leads to a decrease in the interest rate. An increase in money demand, say as a result of an increase in output, leads to an increase in the interest rate.

Domestic Bonds versus Foreign Bonds

In looking at the choice between domestic bonds and foreign bonds, we shall rely on the assumption we introduced in Chapter 18: Financial investors, domestic or foreign, go for the highest expected rate of return. This implies that, in equilibrium, both domestic bonds and foreign bonds must have the same expected rate of return; otherwise, investors would be willing to hold only one or the other, but not both, and this could not be an equilibrium.

As we saw in Chapter 18 (equation [18.2]), this assumption implies that the following arbitrage relation—the *interest parity condition*—must hold

$$(1 + i_t) = (1 + i_t^*) \left(\frac{E_t}{E_{t+1}^e} \right)$$

where i_t is the domestic interest rate, i_t^* is the foreign interest rate, E_t is the current exchange rate, and E_{t+1}^e is the future expected exchange rate.

6. Two qualifications from Chapter 18: (1) the dollars used for illegal transactions abroad, and (2) dollars used for domestic transactions in countries with very high inflation. I shall ignore both qualifications here.

7. Financial markets equilibrium. Condition 1 (*LM*):

Supply of money = Demand for money

The left side gives the return, in terms of domestic currency, from holding domestic bonds. The right side gives the expected return, also in terms of domestic currency, from holding foreign bonds.⁸ In equilibrium, the two expected returns must be equal.

Multiply both sides by E_{t+1}^e and reorganize to get

$$E_t = \frac{1 + i_t}{1 + i_t^*} E_{t+1}^e \quad (20.4)$$

For now, we shall take the expected future exchange rate as given and denote it as \bar{E}^e (we shall relax this assumption in Chapter 21). Under this assumption, and dropping time indexes, the interest parity condition becomes

$$E = \frac{1 + i}{1 + i^*} \bar{E}^e \quad (20.5)$$

This relation tells us that the current exchange rate depends on the domestic interest rate, on the foreign interest rate, and on the expected future exchange rate. An increase in the domestic interest rate leads to an increase in the exchange rate. An increase in the foreign interest rate leads to a decrease in the exchange rate. An increase in the expected future exchange rate leads to an increase in the current exchange rate. This relation plays a central role in the real world, and will play a central role in this chapter. To understand it further, consider the following example.

Consider the choice between U.S. bonds and Japanese bonds. Suppose that the one-year interest rate on U.S. bonds is 5%, and the one-year interest rate on Japanese bonds is also 5%. Suppose that the current exchange rate

8. The presence of E_t comes from the fact that, in order to buy the foreign bond, you must first exchange domestic currency for foreign currency. The presence of E_{t+1}^e comes from the fact that, in order to bring the funds back next period, you will have to exchange foreign currency for domestic currency.

is 100 (one dollar is worth 100 yens), and the expected exchange rate a year from now is also 100. Under these assumptions, both U.S. and Japanese bonds have the same expected return in dollars, and the interest parity condition holds.

Suppose that investors now expect the exchange rate to be 10% higher a year from now, so E^e is now equal to 110. At an unchanged current exchange rate, U.S. bonds are now much more attractive than Japanese bonds: U.S. bonds offer an interest rate of 5% in dollars. Japanese bonds still offer an interest rate of 5% in yens, but yens a year from today are now expected to be worth 10% less in terms of dollars. In terms of dollars, the return on Japanese bonds is therefore 5% (the interest rate) -10% (the expected depreciation of the yen vis a vis the dollar), so -5%.

So what will happen? At the initial exchange rate of 100, investors want to shift out of Japanese bonds into U.S. bonds. To do so, they must first sell Japanese bonds for yens, then sell yens for dollars, and then use the dollars to buy U.S. bonds. As investors sell yens and buy dollars, the dollar appreciates. By how much? Equation (20.5) gives us the answer: $E = (1.05/1.05)110 = 110$. The current exchange rate must increase in the same proportion as the expected future exchange rate. Put another way, the dollar must appreciate today by 10%. When it has appreciated by 10% so $E = \bar{E}^e = 110$, the expected returns on U.S. and Japanese bonds are again equal, and there is equilibrium in the foreign exchange market.

Suppose instead that, as a result of a U.S. monetary contraction, the U.S. interest rate increases from 5% to 8%. Assume that both the Japanese interest rate remains unchanged at 5%, and the expected future exchange rate remain unchanged at 100. At an unchanged current exchange rate, U.S. bonds are now again much more attractive than on Japanese bonds. U.S. bonds give a return of 8% in dollars. Japanese bonds give a return

of 5% in yens, and—as the exchange rate is expected to be the same next year as it is today—an expected return of 5% in dollars.

So what will happen? Again, at the initial exchange rate of 100, investors want to shift out of Japanese bonds into U.S. bonds. As they do so, they sell yens for dollars, and the dollar appreciates. By how much? Equation (20.5) gives the answer: $E = (1.08/1.05)110 \approx 103$. The current exchange rate increases by approximately 3%.

Why 3%? Think of what happens when the dollar appreciates. If, as we have assumed, investors do not change their expectation of the future exchange rate, then the more the dollar appreciates today, the more investors expect to depreciate in the future (as it is expected to return to the same value in the future). When the dollar has appreciated by 3% today, investors expect it to depreciate by 3% over the coming year. Equivalently, they expect the yen to appreciate vis a vis the dollar by 3% over the coming year. The expected rate of return in dollars from holding Japanese bonds is therefore 5% (the interest rate in yens) + 3% (the expected yen appreciation), so 8%. This expected rate of return is the same as the rate of return on holding U.S. bonds, so there is equilibrium in the foreign exchange market.⁹

Note that our argument relies heavily on the assumption that, when the interest rate changes, the expected exchange rate remains unchanged. This implies that an appreciation today leads to an expected depreciation in the future—as the exchange rate is expected to return to the same, unchanged, value. We shall relax the assumption that the future exchange rate is fixed in Chapter 21. But the basic conclusion will remain: *An increase in the domestic interest rate relative to the foreign interest rate leads to an appreciation.*

Figure 20–1 The Relation Between the Interest Rate and the Exchange

9. Make sure you understand the argument. Why doesn't the dollar appreciate by, say, 20%?

Rate Implied by Interest Parity. (Caption. A higher domestic interest rate leads to a higher exchange rate—an appreciation)

Figure 20–1 plots the relation between the domestic interest rate, i , and the exchange rate, E , implied by equation (20.5)—the interest parity relation. The relation is drawn for a given expected future exchange rate, \bar{E}^e , and a given foreign interest rate, i^* , and is represented by an upward sloping line: The higher the domestic interest rate, the higher the exchange rate. Equation (20.5) also implies that when the domestic interest rate is equal to the foreign interest rate ($i = i^*$), the exchange rate is equal to the expected future exchange rate ($E = \bar{E}^e$). This implies that the line corresponding to the interest parity condition goes through point A in the figure.¹⁰

20–3. Putting Goods and Financial Markets Together

We now have the elements we need to understand the movements of output, the interest rate, and the exchange rate.

Goods–market equilibrium implies that output depends, among other factors, on the interest rate and the exchange rate:

$$Y = C(Y - T) + I(Y, i) + G + NX(Y, Y^*, E)$$

The interest rate in turn is determined by the equality of money supply and money demand:

$$\frac{M}{P} = Y L(i)$$

10. What happens to the line if (1) i^* increases? (2) \bar{E}^e increases?

And the interest–parity condition implies a negative relation between the domestic interest rate and the exchange rate:

$$E = \frac{1 + i}{1 + i^*} \bar{E}^e$$

Together, these three relations determine output, the interest rate, and the exchange rate. Working with three relations is not very easy. But we can easily reduce them to two by using the interest parity condition to eliminate the exchange rate in the goods–market equilibrium relation. Doing this gives us the following two equations, the open–economy versions of our familiar *IS* and *LM* relations:

$$\begin{aligned} IS : \quad Y &= C(Y - T) + I(Y, i) + G + NX(Y, Y^*, \frac{1 + i}{1 + i^*} \bar{E}^e) \\ LM : \quad \frac{M}{P} &= Y L(i) \end{aligned}$$

Take the *IS* relation first and consider the effects of an increase in the interest rate on output. An increase in the interest rate now has two effects:

- The first effect, which was already present in a closed economy, is the direct effect on investment: A higher interest rate leads to a decrease in investment, a decrease in the demand for domestic goods and a decrease in output.
- The second effect, which is only present in the open economy, is the effect through the exchange rate: An increase in the domestic interest rate leads to an increase in the exchange rate—an appreciation. The appreciation, which makes domestic goods more expensive relative to foreign goods, leads to a decrease in net exports, so to a decrease in the demand for domestic goods and a decrease in output.

Both effects work in the same direction: An increase in the interest rate

decreases demand directly, and indirectly—through the adverse effect of the appreciation on demand.

The *IS* relation between the interest rate and output is drawn in Figure 20–2, panel (a), for given values of all the other variables in the relation—namely T, G, Y^*, i^* , and \bar{E}^e . The *IS* curve is downward sloping: An increase in the interest rate leads to a decrease in output. It looks very much the same as in the closed economy, but it hides a more complex relation than before: The interest rate affects output not only directly, but also indirectly through the exchange rate.¹¹

Figure 20–2. The IS-LM Model in the Open Economy. (Caption. An increase in the interest rate reduces output both directly and indirectly (through the exchange rate): The IS curve is downward sloping. Given the real money stock, an increase in income increases the interest rate: The LM curve is upward sloping.)

The *LM* relation is exactly the same as in the closed economy. The *LM* curve is upward sloping. For a given value of the real money stock, (M/P) , an increase in output leads to an increase in the demand for money, and to an increase in the equilibrium interest rate.

Equilibrium in the goods and financial markets is attained at point *A* in panel (a), with output level Y and interest rate i . The equilibrium value of the exchange rate cannot be read directly from the graph. But it is easily obtained from panel (b), which replicates Figure 20–1, and gives the exchange rate associated with a given interest rate. The exchange rate associated with the equilibrium interest rate i is equal to E .

Let's summarize: We have derived the *IS* and the *LM* relations for an open economy:

11. An increase in the interest rate leads, both directly and indirectly (through the exchange rate), to a decrease in output.

The *IS* curve is downward sloping: An increase in the interest rate leads directly, and indirectly through the exchange rate, to a decrease in demand and a decrease in output.

The *LM* curve is upward sloping: An increase in income increases the demand for money, requiring an increase in the equilibrium interest rate.

Equilibrium output and the equilibrium interest rate are given by the intersection of the *IS* and the *LM* curves. Given the foreign interest rate and the expected future exchange rate, the equilibrium interest rate determines the equilibrium exchange rate.

20–4. The Effects of Policy in an Open Economy

Having derived the *IS–LM* model for the open economy, we now put it to use and look at the effects of policy.

The Effects of Fiscal Policy in an Open Economy

Let's look, again, at a change in government spending. Suppose that, starting from a balanced budget, the government decides to increase defense spending without raising taxes, and so runs a budget deficit. What happens to the level of output? To the composition of output? To the interest rate? To the exchange rate?

Figure 20–3. The Effects of an Increase in Government Spending. (Caption. An increase in government spending leads to an increase in output, an increase in the interest rate, and an appreciation.)

The answers are given in Figure 20–3. The economy is initially at point *A*. The increase in government spending by, say, $\Delta G > 0$, increases output at

a given interest rate, shifting the IS curve to the right, from IS to IS' in panel (a). Because government spending does not enter the LM relation, the LM curve does not shift.¹² The new equilibrium is at point A' , with a higher level of output and a higher interest rate. In panel (b), the higher interest rate leads to an increase in the exchange rate—an appreciation. So *an increase in government spending leads to an increase in output, an increase in the interest rate, and an appreciation.*

In words: An increase in government spending leads to an increase in demand, leading to an increase in output. As output increases, so does the demand for money, leading to upward pressure on the interest rate. The increase in the interest rate, which makes domestic bonds more attractive, leads to an appreciation. The higher interest rate and the appreciation both decrease the domestic demand for goods, offsetting some of the effect of government spending on demand and output.

Can we tell what happens to the various components of demand?

- Clearly, consumption and government spending both go up—consumption goes up because of the increase in income, government spending goes up by assumption.
- What happens to investment is ambiguous. Recall that investment depends on both output and the interest rate: $I = I(Y, i)$. On the one hand, output goes up, leading to an increase in investment. But on the other, the interest rate also goes up, leading to a decrease in investment. Depending on which of these two effects dominates, investment can go up or down. In short: The effect of government spending on investment was ambiguous in the closed economy; it remains ambiguous in the open economy.
- Recall, net exports depend on domestic output, foreign output, and the exchange rate: $NX = NX(Y, Y^*, E)$. Thus, both the appreci-

¹². An increase in government spending shifts the IS curve to the right. It shifts neither the LM curve nor the interest-parity line.

ation and the increase in output combine to decrease net exports: The appreciation decreases exports and increases imports, and the increase in output further increases imports. So the budget deficit leads to a deterioration of the trade balance. If trade is balanced to start, then the budget deficit leads to a trade deficit. Note that, while an increase in the budget deficit increases the trade deficit, the effect is far from mechanical. It works through the effect of the budget deficit on output and on the exchange rate, and, in turn, on the trade deficit.

The Effects of Monetary Policy in an Open Economy

The effects of our other favorite policy experiment, a monetary contraction, are shown in Figure 20–4. Look at panel (a). At a given level of output, a decrease in the money stock by, say, $\Delta M < 0$, leads to an increase in the interest rate: The LM curve shifts up, from LM to LM' . Because money does not directly enter the IS relation, the IS curve does not shift.¹³ The equilibrium moves from point A to point A' . In panel (b), the increase in the interest rate leads to an appreciation.

Figure 20–4. The Effects of a Monetary Contraction. (Caption. A monetary contraction leads to a decrease in output, an increase in the interest rate, and an appreciation.)

So a monetary contraction leads to a decrease in output, to an increase in the interest rate, and to an appreciation. The story is easy to tell. A monetary contraction leads to an increase in the interest rate, making domestic bonds more attractive and triggering an appreciation. The higher interest

13. A monetary contraction shifts the LM curve up. It shifts neither the IS curve nor the interest-parity curve.

rate and the appreciation both decrease demand and output. As output decreases, money demand decreases, leading to a decrease in the interest rate, offsetting some of the initial increase in the interest rate and some of the initial appreciation.¹⁴

This version of the *IS–LM* model for the open economy was first put together in the 1960s by two economists, Robert Mundell, at Columbia University, and Marcus Fleming, at the IMF. For this reason, it is called the *Mundell–Fleming model*.¹⁵ How well does it fit the facts? The answer is: Typically very well, and this is why the model is still very much in use today. (To test the predictions of the model, one could hardly design a better experiment than the sharp monetary and fiscal policy changes the U.S. economy went through in the late 1970s and early 1980s. This is the topic taken up in the Focus box “Monetary Contraction and Fiscal Expansion: The United States in the Early 1980s.” The Mundell–Fleming model and its predictions pass with flying colors.)

Focus. Monetary Contraction and Fiscal Expansion: The United States in the Early 1980s

The early 1980s in the United States were dominated by sharp changes both in monetary policy and in fiscal policy.

We have already discussed the origins of the change in monetary policy in Chapter 9. By the late 1970s, the Chairman of the Fed, Paul Volcker, concluded U.S. inflation was too high and had to be reduced. Starting in late 1979, Volker embarked on a path of sharp monetary contraction,

14. Can you tell what happens to consumption, to investment, and to net exports?

15. Robert Mundell received the Nobel Prize in Economics in 1999.

realizing this might lead to a recession in the short-run, but would lead to lower inflation in the medium run.

The change in fiscal policy was triggered by the election of Ronald Reagan in 1980. Reagan was elected on the promise of more conservative policies, namely a scaling down of taxation and the government's role in economic activity. This commitment was the inspiration for the Economic Recovery Act of August 1981. Personal income taxes were cut by a total of 23%, in three installments from 1981 to 1983. Corporate taxes were also reduced. These tax cuts were not, however, accompanied by corresponding decreases in government spending, and the result was a steady increase in budget deficits, which reached a peak in 1983 at 5.6% of GDP. Table 1 gives spending and revenue numbers for 1980–1984.

Table 1. The Emergence of Large U.S. Budget Deficits, 1980–1984

	1980	1981	1982	1983	1984
Spending	22.0	22.8	24.0	25.0	23.7
Revenues	20.2	20.8	20.5	19.4	19.2
Personal taxes	9.4	9.6	9.9	8.8	8.2
Corporate taxes	2.6	2.3	1.6	1.6	2.0
Budget surplus (–: deficit)	–1.8	–2.0	–3.5	–5.6	–4.5

Numbers are for fiscal years, which start in October of the previous calendar year. All numbers are expressed as a percentage of GDP. Source: Historical Tables, Office of Management and Budget.

What were the Reagan administration's motivations for cutting taxes without implementing corresponding cuts in spending? These are still being debated today, but there is agreement that there were two main motivations.

One motivation came from the beliefs of a fringe, but influential, group of economists called the **supply siders**, who argued that a cut in tax

rates would lead people and firms to work much harder and more productively, and that the resulting increase in activity would actually lead to an increase, not a decrease, in tax revenues. Whatever the merits of the argument appeared to be then, it proved wrong: Even if some people did work harder and more productively after the tax cuts, tax revenues decreased and the fiscal deficit increased.

The other motivation was the hope that the cut in taxes, and the resulting increase in deficits, would scare Congress into cutting spending, or at the very least, into not increasing spending further. This motivation turned out to be partly right; Congress found itself under enormous pressure not to increase spending, and the growth of spending in the 1980s was surely lower than it would have been otherwise. Nonetheless, the adjustment of spending was not enough to offset the shortfall in taxes and avoid the rapid increase in deficits.

Whatever the reason for the deficits, the effects of the monetary contraction and fiscal expansion were in line with what the Mundell–Fleming model predicts. Table 2 gives the evolution of the main macroeconomic variables from 1980 to 1984.

Table 2. Major U.S. Macroeconomic Variables, 1980–1984

	1980	1981	1982	1983	1984
GDP growth (%)	−0.5	1.8	−2.2	3.9	6.2
Unemployment rate (%)	7.1	7.6	9.7	9.6	7.5
Inflation (CPI) (%)	12.5	8.9	3.8	3.8	3.9
Interest rate (nominal) (%)	11.5	14.0	10.6	8.6	9.6
(real) (%)	2.5	4.9	6.0	5.1	5.9
Real exchange rate	85	101	111	117	129
Trade surplus (−: deficit) (% of GDP)	−0.5	−0.4	−0.6	−1.5	−2.7

Inflation: rate of change of the CPI. The nominal interest rate is the three–

month T-bill rate. The real interest rate is equal to the nominal rate minus the forecast of inflation by DRI, a private forecasting firm. The real exchange rate is the trade-weighted real exchange rate, normalized so that 1973 = 100.

From 1980 to 1982, the evolution of the economy was dominated by the effects of the monetary contraction. Interest rates, both nominal and real, increased sharply, leading both to a large dollar appreciation and to a recession. The goal of lowering inflation was achieved, although not right away; by 1982, inflation was down to about 4%. Lower output and the dollar appreciation had opposing effects on the trade balance (lower output leading to lower imports and an improvement in the trade balance; the appreciation of the dollar leading to a deterioration in the trade balance), resulting in little change in the trade deficit before 1982.

From 1982 on, the evolution of the economy was dominated by the effects of the fiscal expansion. As our model predicts, these effects were strong output growth, high interest rates, and further dollar appreciation. The effects of high output growth and the dollar appreciation were an increase in the trade deficit to 2.7% of GDP by 1984. By the mid-1980s, the main macroeconomic policy issue had become that of the **twin deficits**, the budget deficit and the trade deficit. It was to remain one of the central macroeconomic issues throughout the 1980s and early 1990s.

20-5. Fixed Exchange Rates

We have assumed so far that the central bank chose the money supply and let the exchange rate adjust in whatever manner was implied by equilibrium

in the foreign–exchange market. In many countries, this assumption does not reflect reality: Central banks act under implicit or explicit exchange–rate targets and use monetary policy to achieve those targets. The targets are sometimes implicit, sometimes explicit; they are sometimes specific values, sometimes bands or ranges. These exchange–rate arrangements (or *regimes* as they are called) come under many names. Let’s first see what these names mean.

Pegs, Crawling Pegs, Bands, The EMS, and The Euro

At one end of the spectrum are countries with flexible exchange rates such as the United States and Japan. These countries have no explicit exchange–rate targets. While their central banks surely do not ignore movements in the exchange rate, they have shown themselves quite willing to let their exchange rates fluctuate considerably.¹⁶

At the other end are countries that operate under *fixed exchange rates*. These countries maintain a fixed exchange rate in terms of some foreign currency. Some **peg** their currency to the dollar. For example, from 1991 to 2001, Argentina pegged its currency, the peso, at the highly symbolic exchange rate of one dollar for one peso (more on this in Chapter 21). Others used to peg their currency to the French Franc (most of these are former French colonies in Africa); as the French Franc has been replaced by the Euro, they are now pegged to the Euro. Yet, others peg to a basket of currencies, with the weights reflecting the composition of their trade.

The label “fixed” is a bit misleading: It is not the case that the exchange rate in countries with fixed exchange rates actually never changes. But changes are rare. An extreme case is that of the African countries pegged

16. Like the “dance of the dollar” in the 1980s (Chapter 18), there was a “dance of the yen” in the 1990s, with a sharp appreciation of the yen in the first half of the 1990s, followed by a sharp depreciation later in the decade.

to the French franc. When their exchange rates were readjusted in January 1994, this was the first adjustment in 45 years. Because these changes are rare, economists use specific words to distinguish them from the daily changes that occur under flexible exchange rates. A decrease in the exchange rate under a regime of fixed exchange rates is called a *devaluation* rather than a depreciation, and an increase in the exchange rate under a regime of fixed exchange rates is called a *revaluation* rather than an appreciation.

Between these extremes are countries with various degrees of commitment to an exchange rate target. For example, some countries operate under a **crawling peg**. The name describes it well: These countries typically have inflation rates that exceed the U.S. inflation rate. If they were to peg their nominal exchange rate against the dollar, the more rapid increase in their domestic price level over the U.S. price level would lead to a steady real appreciation and rapidly make their goods noncompetitive.¹⁷ To avoid this effect, these countries choose a predetermined rate of depreciation against the dollar. They choose to “crawl” (move slowly) vis-à-vis the dollar.

Yet another arrangement is for a group of countries to maintain their bilateral exchange rates (the exchange rate between each pair of countries) within some bands. Perhaps the most prominent example was the **European Monetary System (EMS)**, which determined the movements of exchange rates within the European Union from 1978 to 1998. Under the EMS rules, member countries agreed to maintain their exchange rate vis-à-vis the other currencies in the system within narrow limits or **bands** around a **central parity**—a given value for the exchange rate. Changes

17. Recall the definition of the real exchange rate $\epsilon = EP/P^*$.

If domestic inflation is higher than foreign inflation:

P increases faster than P^*

If E is fixed, EP/P^* steadily increases

Equivalently: There is a steady real appreciation. Domestic goods become steadily more expensive relative to foreign goods.

in the central parity and devaluations or revaluations of specific currencies could occur, but only by common agreement among member countries. After a major crisis in 1992, which led a number of countries to drop out of the EMS altogether¹⁸, exchange rate adjustments became more and more infrequent, leading a number of countries to move one step further and adopt a common currency, the **Euro**.¹⁹ Conversion from domestic currencies to the Euro started on January 1, 1999, and was completed in early 2002. We shall return to the implications of the move to the Euro in Chapter 21.

We shall discuss the pros and cons of different exchange regimes in the next chapter. But first, you must understand how pegging the exchange rate affects monetary policy and fiscal policy. This is what we do in the rest of this section.

Pegging the Exchange Rate, and Monetary Control

Suppose a country decides to peg its exchange rate at some chosen value, call it \bar{E} . How does it actually achieve this? The government cannot just announce the value of the exchange rate and stand there. Rather, it must take measures so that its chosen exchange rate will prevail in the foreign–exchange market. Let’s look at the implications and mechanics of pegging.

Pegging or no pegging, the exchange rate and the nominal interest rate must satisfy the interest parity condition

$$(1 + i_t) = (1 + i_t^*) \left(\frac{E_t}{E_{t+1}^e} \right)$$

18. We will look at the 1992 crisis in Chapter 21.

19. You can think of countries adopting a common currency as adopting an extreme form of fixed exchange rates: Their “exchange rate” is fixed at one-to-one between any pair of countries.

Now suppose the country pegs the exchange rate at \bar{E} , so the current exchange rate $E_t = \bar{E}$. If financial and foreign exchange markets believe that the exchange rate will remain pegged at this value, then their expectation of the future exchange rate, E_{t+1}^e , is also equal to \bar{E} , and the interest parity relation becomes

$$(1 + i_t) = (1 + i_t^*) \Rightarrow i_t = i_t^*$$

In words: If financial investors expect the exchange rate to remain unchanged, they will require the same nominal interest rate in both countries. *Under a fixed exchange rate and perfect capital mobility, the domestic interest rate must be equal to the foreign interest rate.*

This condition has one further important implication. Return to the equilibrium condition that the supply of money and demand for money be equal. Now that $i = i^*$, this condition becomes:

$$\frac{M}{P} = Y L(i^*) \tag{20.6}$$

Suppose an increase in domestic output increases the demand for money. In a closed economy, the central bank could leave the money stock unchanged, leading to an increase in the equilibrium interest rate. In an open economy, and under flexible exchange rates, the central bank can still do the same: The result will be both an increase in the interest rate and an appreciation. But under fixed exchange rates, the central bank cannot keep the money stock unchanged. If it did, the domestic interest rate would increase above the foreign interest rate, leading to an appreciation. To maintain the exchange rate, the central bank must increase the supply of money in line with the increase in the demand for money so the equilibrium interest rate does not change. Given the price level, P , nominal money M must adjust so that equation (20.6) holds.

Let's summarize: *Under fixed exchange rates, the central bank gives up*

monetary policy as a policy instrument. A fixed exchange rate implies a domestic interest rate equal to the foreign rate. And the money supply must adjust so as to maintain the interest rate.²⁰

Fiscal Policy under Fixed Exchange Rates

If monetary policy can no longer be used under fixed exchange rates, what about fiscal policy? To answer, we use Figure 20–5.

Figure 20–5 starts by replicating panel (a) of Figure 20–3, which we used earlier to analyze the effects of fiscal policy under flexible exchange rates. In that case, we saw that a fiscal expansion ($\Delta G > 0$) shifted the *IS* curve to the right. Under flexible exchange rates, the money stock remained unchanged, leading to a movement in the equilibrium from point *A* to point *B*, with an increase in output from Y_A to Y_B , an increase in the interest rate, and an appreciation.

However, under fixed exchange rates the central bank cannot let the currency appreciate. As the increase in output leads to an increase in the demand for money, the central bank must accommodate this increased demand for money by increasing the money supply. In terms of Figure 20–5, the central bank must shift the *LM* curve down as the *IS* curve shifts to the right, so as to maintain the same interest rate, and thus the same exchange rate. The equilibrium therefore moves from *A* to *C*, with higher output Y_C and unchanged interest and exchange rates. So, *under fixed exchange rates, fiscal policy is more powerful than it is under flexible exchange rates. This is because fiscal policy triggers monetary accommodation.*²¹

20. These results depend very much on the interest rate parity condition, which in turn depends on the assumption of perfect capital mobility (Financial investors go for the highest expected rate of return.) The case of fixed exchange rates with imperfect capital mobility, which is more relevant for middle-income countries, such as in Latin America or Asia, is treated in the appendix to this chapter.

21. Is the effect of fiscal policy stronger in a closed economy or in an open economy with fixed exchange rates? (Hint: The answer is ambiguous.)

Figure 20–5. The Effects of a Fiscal Expansion Under Fixed Exchange Rates. (Caption. Under flexible exchange rates, a fiscal expansion increases output from Y_A to Y_B . Under fixed exchange rates, output increases from Y_A to Y_C .)

As this chapter comes to an end, a question should have started to form in your mind. Why would a country choose to fix its exchange rate? You have seen a number of reasons why this appears to be a bad idea:

- By fixing the exchange rate, a country gives up a powerful tool for correcting trade imbalances or changing the level of economic activity.
- By committing to a particular exchange rate, a country also gives up control of its interest rate. Not only that, but the country must match movements in the foreign interest rate, at the risk of unwanted effects on its own activity. This is what happened in the early 1990s in Europe. Because of the increase in demand due to the reunification of West and East Germany, Germany felt it had to increase its interest rate. To maintain their parity with the Deutsche Mark, other countries in the European Monetary System were forced to also increase their interest rate, something that they would rather have avoided (This is the topic of the Focus box “German Unification, Interest Rates, and the EMS.”)
- While the country retains control of fiscal policy, one policy instrument is not enough. As you saw in Chapter 19, for example, a fiscal expansion can help the economy get out of a recession, but only at the cost of a larger trade deficit. And a country that wants, for example, to decrease its budget deficit cannot, under fixed exchange rates, use monetary policy to offset the contractionary effect of its fiscal policy on output.

So why do some countries fix their exchange rate? Why have twelve Eu-

European countries adopted a common currency? To answer these questions, we must do some more work. We must look at what happens not only in the short run—which is what we did in this chapter—but also in the medium run, when the price level can adjust. We must look at the nature of exchange rate crises. Once we have done this, we shall then be able to give an assessment of the pros and cons of exchange rate regimes. These are the topics we take up in Chapter 21.

Focus. German Unification, Interest Rates, and the EMS

Under a fixed exchange rate regime such as the European Monetary System (EMS) (let's ignore here the degree of flexibility which was afforded by the bands), no individual country can change its interest rate if the other countries do not change theirs as well. So, how do interest rates actually change? Two arrangements are possible. One is for all the member countries to coordinate changes in their interest rates. Another is for one of the countries to take the lead and for the other countries to follow—this is in effect what happened in the EMS, with Germany as the leader.

During the 1980s, most European central banks shared similar goals and were happy to let the Bundesbank (the German central bank) take the lead. But in 1990, German unification led to a sharp divergence in goals between the Bundesbank and the other EMS nations' central banks. Large budget deficits, triggered by transfers to people and firms in Eastern Germany, together with an investment boom, led to a large increase in demand in Germany. The Bundesbank's fear that this shift would generate too strong an increase in activity led it to adopt a restrictive monetary policy. The result was strong growth in Germany together with a large increase in interest rates.

This may have been the right policy mix for Germany. But for the other

European countries, this policy mix was much less appealing. They were not experiencing the same increase in demand, but to stay in the EMS, they had to match German interest rates. The net result was a sharp decrease in demand and in output in the other countries. These results are presented in Table 1, which gives nominal interest rates, real interest rates, inflation rates, and GDP growth from 1990 to 1992 for Germany and for two of its EMS partners, France and Belgium.

Table 1. German Unification, Interest Rates, and Output Growth: Germany, France and Belgium, 1990–1992

	Nominal Interest Rates (%)			Inflation (%)		
	1990	1991	1992	1990	1991	1992
Germany	8.5	9.2	9.5	2.7	3.7	4.7
France	10.3	9.6	10.3	2.9	3.0	2.4
Belgium	9.6	9.4	9.4	2.9	2.7	2.4
	Real Interest Rates (%)			GDP Growth (%)		
	1990	1991	1992	1990	1991	1992
Germany	5.7	5.5	4.8	5.7	4.5	2.1
France	7.4	6.6	7.9	2.5	0.7	1.4
Belgium	6.7	6.7	7.0	3.3	2.1	0.8

The nominal interest rate is the short-term nominal interest rate. The real interest rate is the realized real interest rate over the year—that is, the nominal interest rate minus actual inflation over the year. All rates are annual. Source: OECD Economic Outlook.

Note first how the high German nominal interest rates were matched by both France and Belgium. Nominal interest rates were actually higher in France than in Germany in all three years! This is because France needed higher interest rates than Germany to maintain the DM/franc parity; the reason is that financial markets were not sure that France would actually

keep the parity of the franc vis-à-vis the DM. Worried about a possible devaluation of the franc, financial investors asked for a higher interest rate on French bonds than on German bonds.

While France and Belgium had to match—or, as we have just seen, more than match—German nominal rates, both countries had less inflation than Germany. The result was very high real interest rates, much higher than in Germany. In both France and Belgium, average real interest rates from 1990 to 1992 were close to 7%. And in both countries, the period 1990–1992 was characterized by slow growth and rising unemployment. Unemployment in France in 1992 was 10.4%, up from 8.9% in 1990. The corresponding numbers for Belgium were 12.1% and 8.7%.

While we have looked at only two of Germany’s EMS partners, a similar story was unfolding in the other EMS countries. By 1992, average unemployment in the European Union, which had been 8.7% in 1990, had increased to 10.3%. The effects of high real interest rates on spending were not the only source of this slowdown, but they were the main one.

By 1992, an increasing number of countries were wondering whether to keep defending their EMS parity or to give it up and lower their interest rates. Worried about the risk of devaluations, financial markets started to ask for higher interest rates in those countries where they thought devaluation was more likely. The result was two major exchange rate crises, one in the fall of 1992 and the other in the summer of 1993. By the end of these two crises, two countries, Italy and the United Kingdom, had left the EMS. We shall look at these crises, their origins and their implications, in Chapter 21.

Summary

- In an open economy, the demand for goods depends both on the interest rate and on the exchange rate. An increase in the interest rate decreases the demand for goods. An increase in the exchange rate—an appreciation—also decreases the demand for goods.
- The interest rate is determined by the equality of money demand and money supply. The exchange rate is determined by the interest parity condition, which states that domestic and foreign bonds must have the same expected rate of return in terms of domestic currency.
- Given the expected future exchange rate and the foreign interest rate, increases in the domestic interest rate lead to an increase in the exchange rate—an appreciation. Decreases in the domestic interest rate lead to a decrease in the exchange rate—a depreciation.
- Under flexible exchange rates, an expansionary fiscal policy leads to an increase in output, an increase in the interest rate, and an appreciation. A contractionary monetary policy leads to a decrease in output, an increase in the interest rate, and an appreciation.
- There are many types of exchange-rate arrangements. They range from fully flexible exchange rates to crawling pegs, to fixed exchange rates (or pegs), to the adoption of a common currency. Under fixed exchange rates, a country maintains a fixed exchange rate in terms of a foreign currency or a basket of currencies.
- Under fixed exchange rates and the interest parity condition, a country must maintain an interest rate equal to the foreign interest rate. The central bank loses the use of monetary policy as a policy instrument. Fiscal policy becomes more powerful than under flexible exchange rates, however, because fiscal policy triggers monetary accommodation and so does not lead to offsetting changes in the domestic interest rate and exchange rate.

Key terms

- Mundell–Fleming model
- supply siders
- twin deficits
- peg
- crawling peg
- European Monetary System (EMS)
- bands
- central parity
- Euro

Further readings

A fascinating account of the politics behind fiscal policy under the Reagan administration is given by David Stockman—who was then the director of the Office of Management and Budget (OMB)—*The Triumph of Politics: Why the Reagan Revolution Failed* (New York: Harper & Row, 1986).

A good book on the evolution of exchange rate arrangements in Europe is *European Monetary Integration: From the European Monetary System to Economic and Monetary Union*, by Daniel Gros and Niels Thygesen (New York: Addison–Wesley–Longman, 2nd ed, 1998).

Appendix: Fixed Exchange Rates, Interest Rates, and Capital Mobility

The assumption of perfect capital mobility is a good approximation to what happens in countries with highly developed financial markets and few capital controls, such as the United States, the United Kingdom, and Japan. But the assumption is more questionable in countries that have less developed financial markets or have capital controls in place. There, domestic financial investors may have neither the savvy nor the legal right to buy foreign bonds when domestic interest rates are low. The central bank may be able both to decrease interest rates while maintaining a given exchange rate.

To look at these issues, we need to have another look at the the balance sheet of the central bank. In Chapter 4, we assumed the only asset held by the central bank was domestic bonds. In an open economy, the central bank actually holds two types of assets: (1) domestic bonds and (2) **foreign–exchange reserves**, which we shall think of as foreign currency—although they also take the form of foreign bonds or foreign interest–paying assets. Think of the balance sheet of the central bank as represented in Figure 20–A1:

Figure A1. Balance Sheet of the Central Bank.

On the asset side are bonds and foreign exchange reserves, and on the liability side is the monetary base. There are now two ways in which the central bank can change the monetary base: either by purchases or sales of bonds in the bond market, or by purchases or sales of foreign currency in the foreign–exchange market. (If you did not read Section 4–3 in the core, replace “monetary base” by “money supply”, and you will still get the basic argument.)

Perfect Capital Mobility and Fixed Exchange Rates

Consider first the effects of an open market operation under the joint assumptions of perfect capital mobility and fixed exchange rates (the assumptions we made in the last section of this chapter).

- Assume the domestic interest rate and the foreign interest rate are initially equal, so $i = i^*$. Suppose the central bank embarks on an expansionary open-market operation, buying bonds in the bond market in amount ΔB , and creating money—increasing the monetary base—in exchange. This purchase of bonds leads to a decrease in the domestic interest rate, i . This is, however, only the beginning of the story.
- Now that the domestic interest rate is lower than the foreign interest rate, financial investors prefer to hold foreign bonds. To buy foreign bonds, they must first buy foreign currency. They go to the foreign exchange market and sell domestic currency for foreign currency.
- If the central bank did nothing, the price of domestic currency would fall, and the result would be a depreciation. Under its commitment to a fixed exchange rate, the central bank cannot allow the currency to depreciate. So it must intervene in the foreign-exchange market and sell foreign currency for domestic currency. As it sells foreign currency and buys domestic money, the monetary base decreases.
- How much foreign currency must the central bank sell? It must keep selling until the monetary base is back to its pre-open market operation level, so the domestic interest rate is again equal to the foreign interest rate. Only then are financial investors willing to hold domestic bonds.

How long do all these steps take? Under perfect capital mobility, all this may happen within minutes or so of the original open market operation. After these steps, the balance sheet of the central bank looks as represented in Figure 20–A2. Bond holdings are up by ΔB , reserves of foreign currency

are down by ΔB , and the monetary base is unchanged, having gone up by ΔB in the open market operation and down by ΔB as a result of the sale of foreign currency in the foreign exchange market.

Let's summarize: Under fixed exchange rates and perfect capital mobility, the only effect of the open market operation is to change the *composition* of the central bank's balance sheet but not the monetary base (nor the interest rate.)

Figure A2. Balance Sheet of the Central Bank After an Open Market Operation, and the Induced Intervention in the Foreign-Exchange Market.

Imperfect Capital Mobility and Fixed Exchange Rates

Let's now move away from the assumption of perfect capital mobility. Suppose it takes some time for financial investors to shift between domestic bonds and foreign bonds.

Now an expansionary open market operation can initially bring the domestic interest rate below the foreign interest rate. But over time, investors shift to foreign bonds, leading to an increase in the demand for foreign currency in the foreign-exchange market. To avoid a depreciation of the domestic currency, the central bank must again stand ready to sell foreign currency and buy domestic currency. Eventually, the central bank buys enough domestic currency to offset the effects of the initial open market operation. The monetary base is back to its pre-open market operation level, and so is the interest rate. The central bank holds more domestic bonds and smaller reserves of foreign currency.

The difference between this case and the case of perfect capital mobility is that, by accepting a loss in foreign-exchange reserves, the central bank is now able to decrease interest rates *for some time*. If it takes just a few days for financial investors to adjust, the trade-off can be very unattractive—as

many countries, who have suffered large losses in reserves without much effect on the interest rate, have discovered at their expense. But, if the central bank can affect the domestic interest rate for a few weeks or months, it may, in some circumstances, be willing to do so.

Now let's deviate further from perfect capital mobility. Suppose, in response to a decrease in the domestic interest rate, financial investors are either unwilling or unable to move much of their portfolio into foreign bonds. For example, there are administrative and legal controls on financial transactions, making it illegal or very expensive for domestic residents to invest outside the country. This is the relevant case for a number of middle-income countries, from Latin America, to Eastern Europe, and to Asia.

After an expansionary open market operation, the domestic interest rate decreases, making domestic bonds less attractive. Some domestic investors move into foreign bonds, selling domestic currency for foreign currency. To maintain the exchange rate, the central bank must buy domestic currency and supply foreign currency. However, the foreign-exchange intervention by the central bank may now be small compared to the initial open-market operation. And if capital controls truly prevent investors from moving into foreign bonds at all, there may be no need at all for such a foreign-exchange intervention.

Even leaving this extreme case aside, the net effects of the initial open market operation and the following foreign exchange interventions are likely to be *an increase in the monetary base; a decrease in the domestic interest rate; an increase in the central bank's bond holdings; and some—but limited—loss in reserves of foreign currency.* With imperfect capital mobility, a country has some freedom to move the domestic interest rate while maintaining its exchange rate. This freedom depends primarily on three factors:

- The degree of development of its financial markets, and the willingness of domestic and foreign investors to shift between domestic assets and foreign assets.
- The degree of capital controls it is able to impose on both domestic and foreign investors.
- The amount of foreign–exchange reserves it holds: The higher the reserves, the more it can afford the loss in reserves it is likely to sustain if it decreases the interest rate at a given exchange rate.

Key Terms

- foreign–exchange reserves

Figure 20-1. The Relation Between the Interest Rate and the Exchange Rate implied by Interest Parity

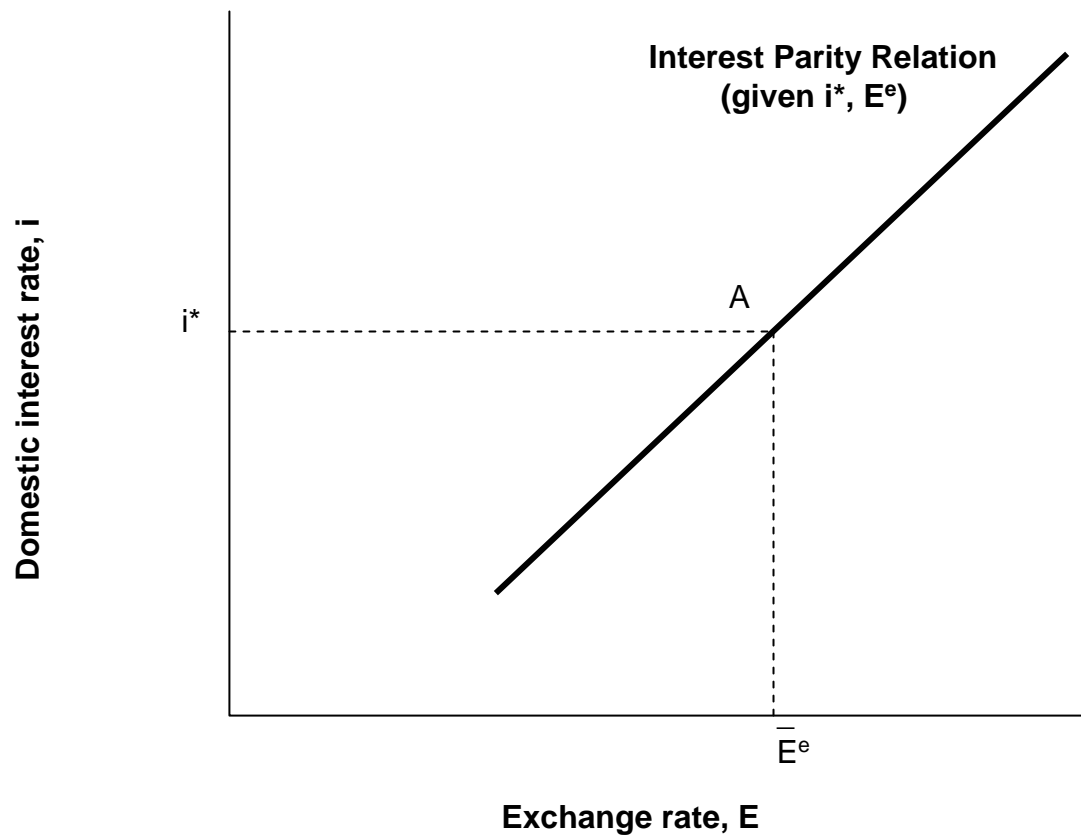


Figure 20-4. The Effects of a Monetary Contraction

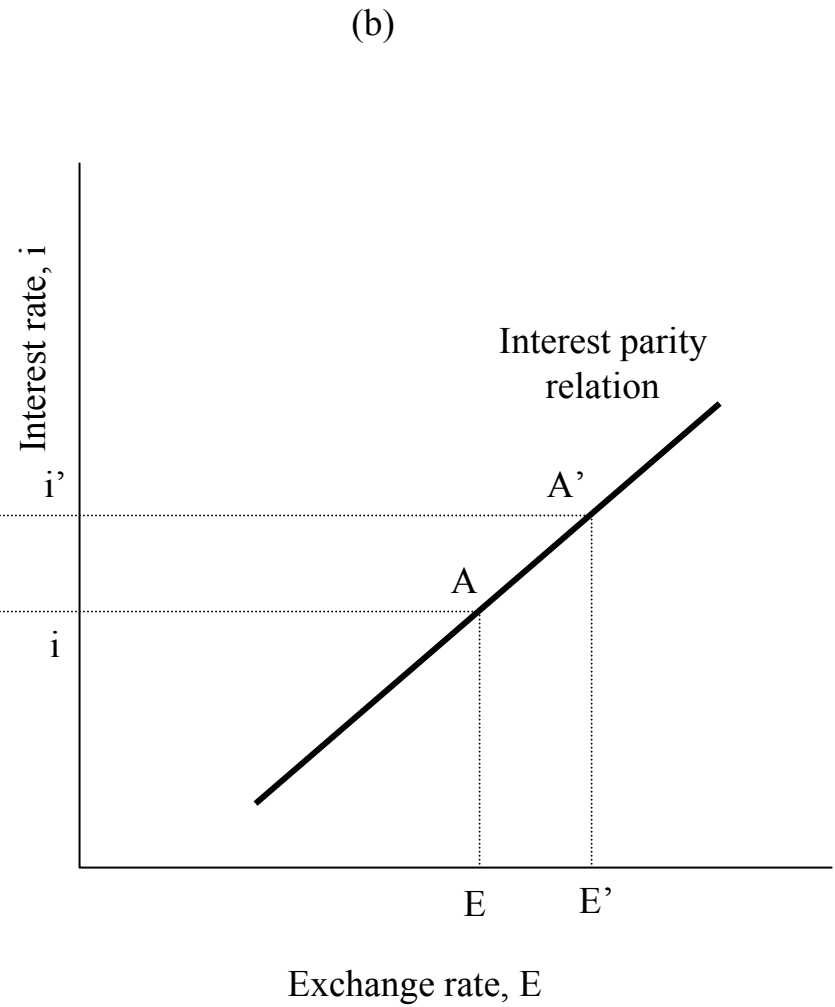
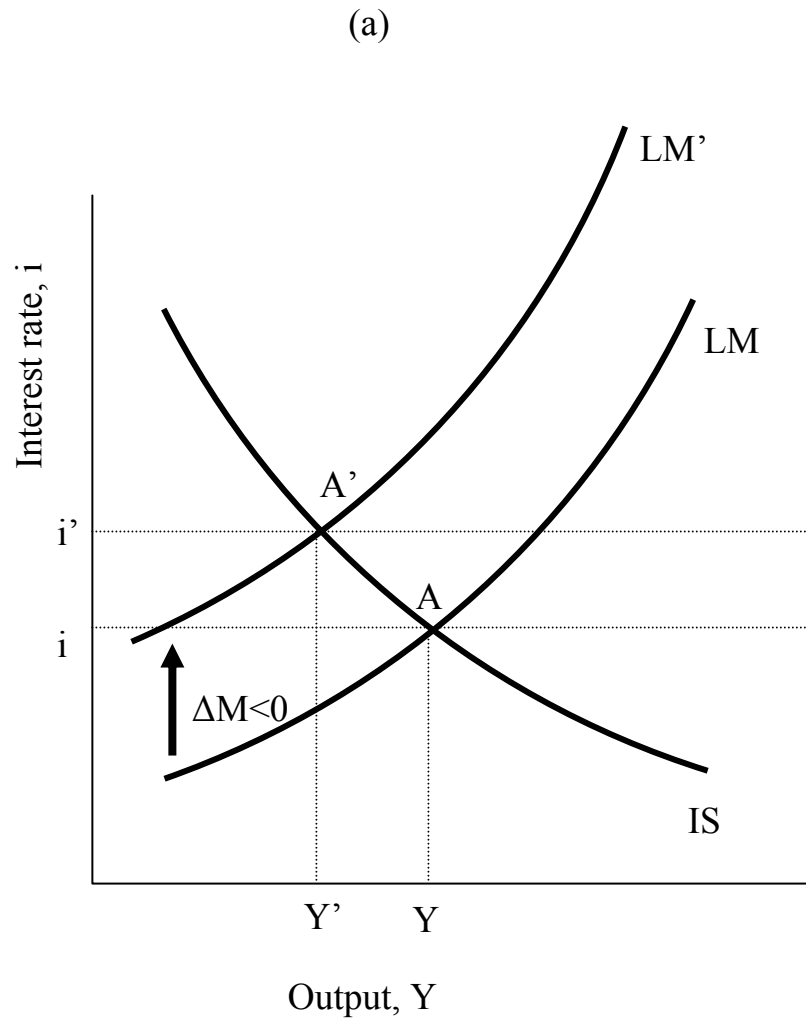
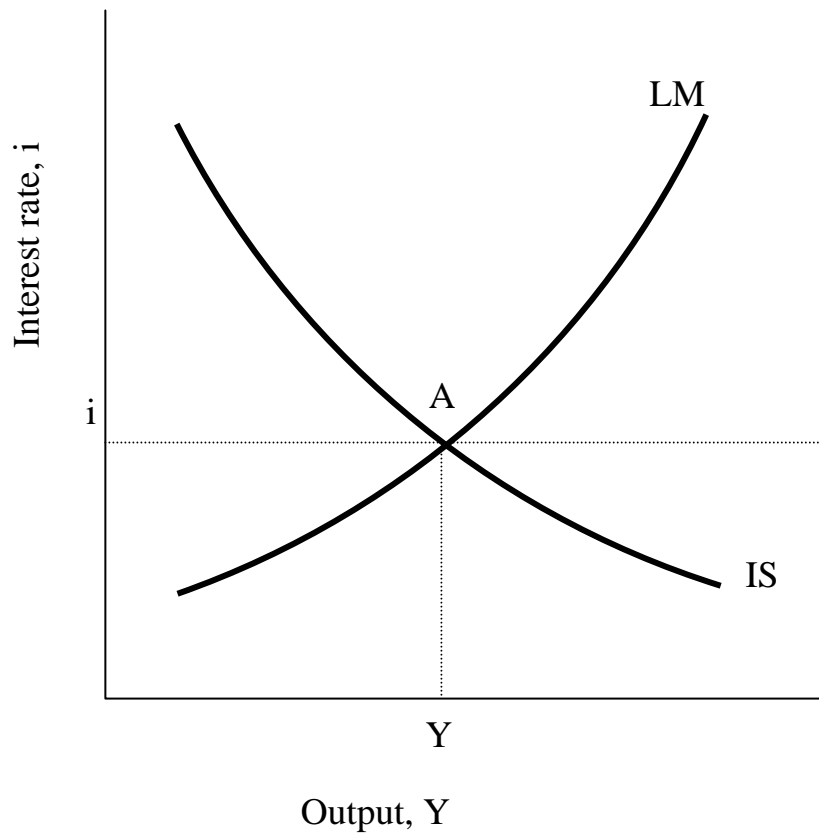


Figure 20-2. The IS-LM Model in the Open Economy

(a)



(b)

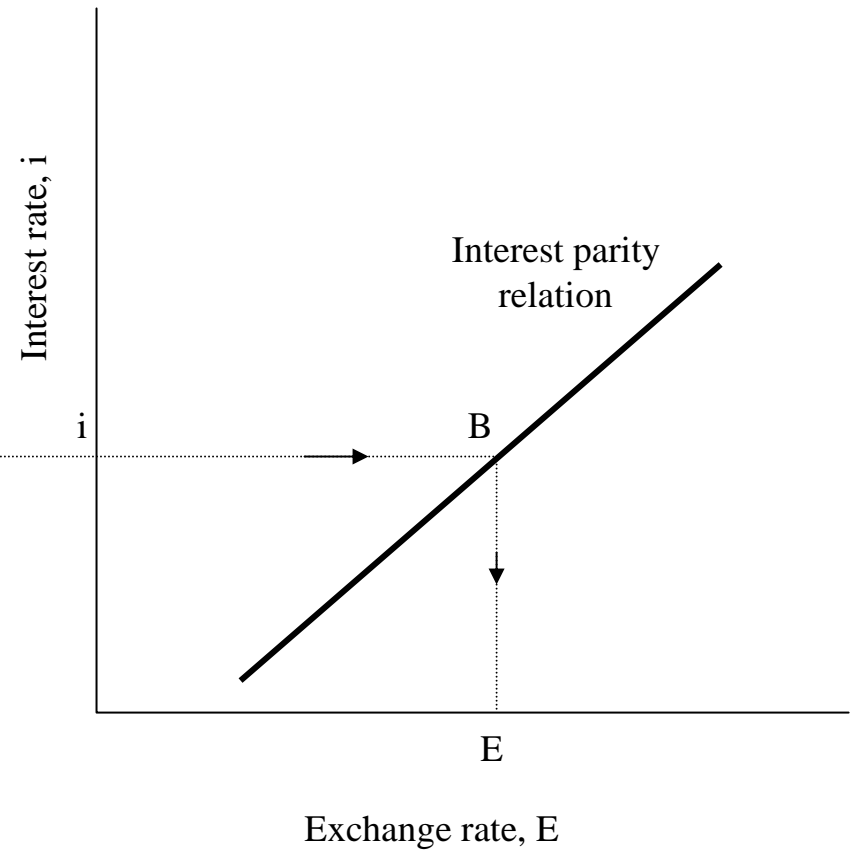
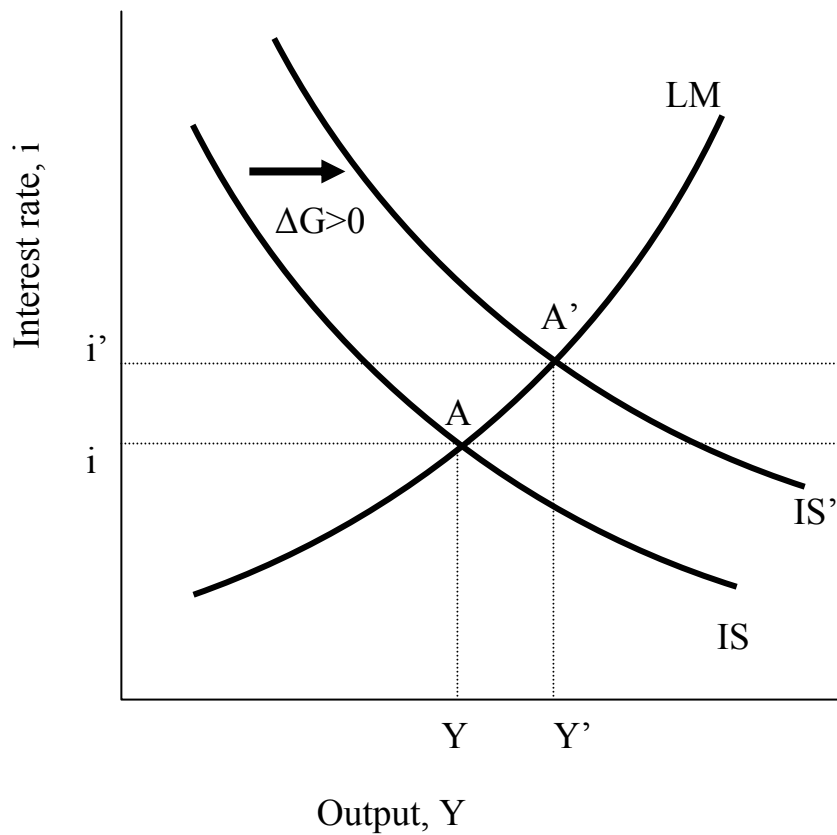


Figure 20-3. The Effects of an Increase in Government Spending

(a)



(b)

