CHAPTER 26

Supply and Inflation

Chapters 19 and 20 made the extreme classical assumption that output is fixed at potential output. Other chapters have made the opposite extreme assumption, that supply is infinitely elastic at a given price level. The latter assumption is relatively realistic in the very short run. The former assumption is realistic in the long run. But for many policy-making questions, we are interested in an intermediate time span. What happens over the first year, for example?

In this chapter we explore the supply side of the economy. Relative to earlier chapters we introduce two new variables: the wage rate, and expectations regarding future inflation. We use the model to examine such questions as the advisability of wage indexation, central bank independence, and monetary unions. The last section of the chapter considers how countries should choose their exchange rate regime. These choices influence whether a country will be prone to inflation.

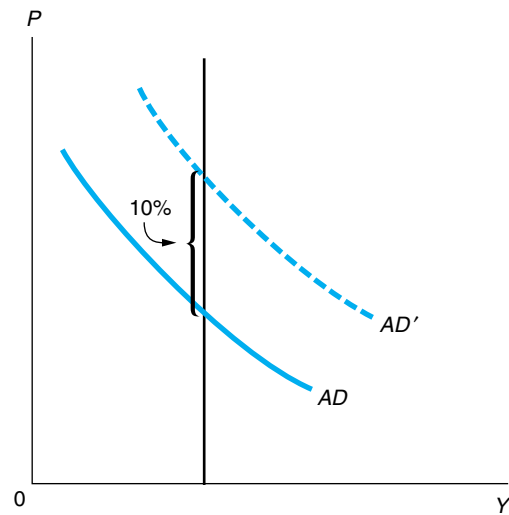## 26.1 The Aggregate Supply Relationship

If all wages and prices are perfectly flexible, a 10 percent monetary expansion is reflected in a 10 percent increase in prices, with no effect on real output. If wages and prices are fixed, an expansion of demand instead goes into higher output. This section and the next consider a more complete range of possible aggregate supply relationships, showing how changes in monetary policy are reflected in *both* output and prices.

To begin, we review the aggregate demand relationship familiar from introductory macroeconomics. Imagine that the price level rises for some reason (such as an oil price increase or other adverse supply shock). Then, for any given nominal money supply, M, the real money supply falls and the LM curve shifts left. The reduction in demand reduces output. This inverse relationship between P and Y is the downward-sloping AD curve drawn in Figure 26.1.

Now consider an exogenous increase in aggregate demand—for example, a monetary expansion. The AD curve shifts to the right. Equivalently, the curve shifts up. In fact, it can be determined precisely how much a 10 percent increase in the money supply shifts the curve vertically upward: 10 percent. Only if the increase in P were proportionate to the increase in M would Y be unchanged because only then would M/P and the LM curve be unchanged. Therefore, for any given level of output on the aggregate supply curve, the corresponding price level is now found at a point 10 percent higher than before. That does not mean that a 10 percent monetary expansion will

FIGURE 26.1

The Aggregate Demand Curve and an Upward Shift

The *AD* curve slopes down because a higher *P* implies a lower real money supply, *M*/*P*, and therefore lower income, *Y*. A 10 percent increase in the money supply, *M*, shifts the *AD* curve up by 10 percent.

in fact result in an immediate 10 percent increase in the price level. This depends on aggregate supply.

The aggregate supply relationship is less straightforward than the aggregate demand relationship. At least five alternative supply relationships have been proposed by various economists: (1) frictionless neoclassical, (2) Keynesian, (3) Friedman-Phelps "expectations augmented," (4) Lucas-Sargent-Barro "New Classical," and (5) indexed wages. Five may seem like a large number of alternative relationships to consider, but the following survey will place them all into a common overall framework.

The framework for these supply relationships is the following equation, which gives the level of output, *Y*, relative to potential output, $\overline{Y}$.

$$(Y/\overline{Y}) = (wP/W)^{\sigma} \tag{26.1}$$

The exponent σ is the elasticity of supply with respect to the price level, given the wage rate, *W*. In other words, it is the percentage increase in output that firms choose to supply when the price level goes up by 1 percent.

Equation 26.1 can be derived from the assumption that competitive firms choose employment so as to maximize profits. Figure 26.2(a) shows the firm's production function, giving output as a function of *N*, the number of workers employed. It begins steep and then becomes less so. The slope, which is the marginal product of labor, is graphed in Figure 26.2(b). With the real wage on the vertical axis, this curve also represents the firm's demand for labor. It slopes downward because when the real wage falls, it pays firms to hire more workers.[1] The additional workers produce more output, as we see returning to the upper graph.

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[1]The marginal product of labor falls until it equals the lower real wage. The relationship among *Y*, *N*, and *W*/*P* is explored more formally in Problem 2 at the end of this chapter.

FIGURE 26.2

The Demand for Labor

Firms' demand for labor, *N*, is a downward-sloping function of the real wage, *W/P*, because a profit-maximizing firm produces where the marginal product of labor, the slope of the firm's production function, is equal to the real wage.
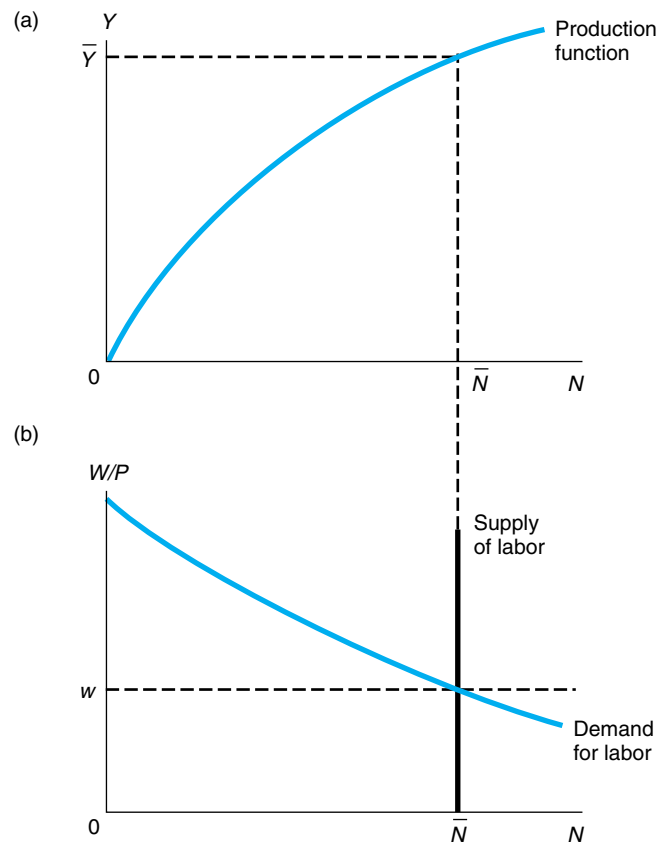
We thus have a very intuitive way to interpret Equation 26.1. When firms receive higher prices, relative to the cost of their variable input, the incentive provided by higher profits encourages them to produce more.

Frictionless Neoclassical Supply Relationship

In the absence of frictions in either prices or wages, labor will be fully employed and output will be fixed at potential output, $\overline{Y}$. This implies an inelastic aggregate supply relationship. It could be interpreted as the vertical line in Figure 26.1, if it is drawn at $Y = \overline{Y}$.

In terms of the general supply relationship, Equation 26.1, the level of real wages, *W/P*, adjusts frictionlessly to equal *w*. As a result the available labor force is fully employed (or at least is employed up to the natural rate of employment):

$$N = \overline{N}$$

It then follows from the production function in Figure 26.2(a) that output, *Y*, is at the corresponding full-capacity level. If in Figure 26.2(b), $W/P > w$ and there is danger of

an excess supply of labor, then the wage rate is driven down instantly to increase the demand for labor. If $W/P < w$ and there is danger of excess demand for labor, then the wage rate rises instantly to choke off the demand for labor and restore equilibrium. In short, the real wage adjusts so that labor demand equals labor supply. This is why output is at the full-employment level irrespective of aggregate demand.

In the frictionless neoclassical model, any increase in aggregate demand goes entirely into prices and wages rather than output or employment. A 10 percent monetary expansion, for example, simply raises W and P by 10 percent, as in Figure 26.1.

Those subscribing to the frictionless model—and thus believing that Y is always equal to $\overline{Y}$—recognize that output does change over time. However, they interpret all changes in Y as changes in $\overline{Y}$. The aggregate supply curve is still vertical, but its location often shifts. Growth theory shows us how potential output changes gradually, over the course of decades. Growth proceeds in line with the accumulation of the capital stock (through investment), the labor force (through population growth and migration), and human capital (through education and training), and in line with improvements in productivity (through technological and managerial innovation) and the efficiency with which the economy is organized (through competitive markets, with government intervention only where appropriate, and good institutions, such as the clear property rights and absence of corruption).

Economists who subscribe to *real business cycle theory* view even short-run fluctuations as changes in $\overline{Y}$ attributed to changes in tastes and technology: supply shifts such as changes in productivity and increases in the labor force (or in the natural rate of employment of a given labor force, $\overline{N}$, due, for example, to "changes in workers' preference for leisure").[2]

Modified Keynesian Supply Relationship

The Keynesian view, of course, emphasizes wage and price rigidity, so that the aggregate supply curve is not vertical. Until now, we have been representing this view by the extreme opposite assumption, that the curve is horizontal: Firms simply set prices, $P = \overline{P}$, and then supply whatever output is demanded at that price. This may, in fact, be an adequate assumption to describe the very short run. To consider what happens in the slightly longer run (for example, in the course of a year) means allowing the supply relationship to have some upward slope.

One convenient way of allowing the supply curve to have some upward slope is to allow goods prices to be flexible, but to assume that wages, W, are predetermined. Wages may be set in contracts—for example, the outcome of bargaining between individual labor unions and firms, or between a national labor federation and the government in some more centralized economies. Such contracts often last for longer than one year; they may build in future step increases in the wage rate. The important point for present purposes is that the path of W is preset and exogenous for the life of the

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[2]International versions of the real business cycle approach include David Backus, Patrick Kehoe, and Finn Kydland, "International Business Cycles vs. Evidence," *Federal Reserve Bank of Minneapolis Quarterly Review,* 17, no. 4 (Fall 1993): 14–29.

contract. The contracts may even be implicit: Some employers, especially larger firms, establish a reputation for not trying to take advantage of their workers when the labor market is slack (i.e., by threatening to hire other workers at lower wages when there is a lot of unemployment) and the workers reciprocate by not taking advantage of the employer when the labor market is tight (i.e., by threatening to leave in order to get higher wages when there are a lot of unfilled vacancies).

Whatever the rationale, consider the wage set at some exogenous level, $W = \overline{W}$. Then the all-purpose supply relationship, Equation 26.1, becomes:

$$Y/\overline{Y} = (wP/\overline{W})^{\sigma} \tag{26.2}$$

The curve is graphed in Figure 26.3. Say we start at the full employment point, A, where $P = \overline{W}/w$, so that $Y = \overline{Y}$. A monetary expansion or other increase in demand equal to 1 percent now goes partly into output and partly into prices, as at point B. Think of the expansion as raising the level of output chosen by firms *because* their product price, P, rises relative to the cost of their variable input, W. They choose to expand in response to the incentive of more lucrative profit margins. Equivalently, output and employment rise because the real wage has fallen.[3]

An adverse supply shock can be viewed as a fall in productivity, causing a fall in the potential output term in Equations 26.1 and 26.2 from $\overline{Y}$ to $\overline{Y}'$. A prime example is the 1973–1974 increase in world oil prices, which caused the 1974–1975 world recession. Another example, mentioned in Section 25.1, might be the increase in oil prices faced by a country whose currency has depreciated sharply against the dollar. Other examples of supply shocks include technological booms, hurricanes, and good or bad harvests.

An adverse supply shock shifts the aggregate supply curve left. What happens then depends on the aggregate demand policy the country chooses, which in turn depends on the country's priorities. If it wishes to avoid inflation even at the cost of a loss in output, it can restrict demand to keep the country at point C. This is essentially what Switzerland did in 1974. After a blip of inflation related to the oil price increase, price stability was immediately restored. The cost was a large recession, although most of the reduction in employment was suffered by guest workers from southern European countries. The opposite extreme is to follow an expansionary demand policy to maintain the level of output and employment at point D, even at the cost of a large increase in the price level. This was essentially the choice that Sweden made in 1974. The intermediate possibility is to keep aggregate demand policy approximately unchanged, as at point F, suffering the adverse supply shift partly in the form of inflation and partly in the form of recession. This was the U.S. choice in 1974.

The wage rate stays fixed only for the life of the contract. Notice that an increase in the wage rate will shift the aggregate supply curve up: It will take a proportionately

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[3]One possible problem with this model of supply is shared with the other models discussed here, which assume firms to be always on their (short-run) neoclassical production functions. The problem is that it implies real wages and productivity are countercyclical, that is, they fall in economic booms and rise in recessions. The empirical evidence tends not to support this proposition for big countries. An alternative modeling approach to get an upward-sloping supply curve assumes that prices are sticky in the very short run but adjust partway within any given period in response to excess demand for goods. This approach is adopted in Section 27.4.

FIGURE 26.3

Short-Run Supply Curve

If the nominal wage is fixed at $\overline{W}$, then the aggregate supply curve slopes upward: An increase in the price level P in response to higher demand (e.g., at point B) reduces W/P and so encourages firms to raise Y. An adverse supply shift causes the curve to shift up to AS'.
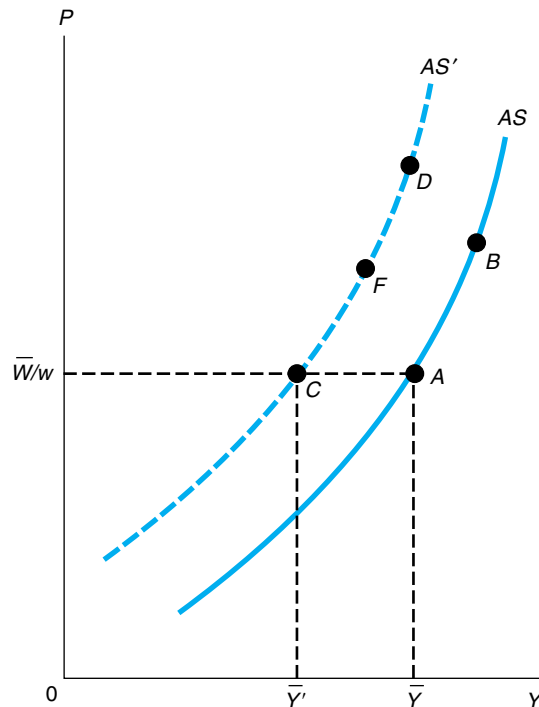
higher P to call forth any given level of Y. If the increase in W is exogenous because of increased militancy by labor unions, for example, then it is another example of a supply shock. W will also tend to rise endogenously—over time—if there has been an increase in demand leading to a tight labor market. A tight labor market means that unemployment is low, the number of job vacancies is unusually high, and many workers are working overtime; in other terms, $N > \overline{N}$. As W rises in response to the high demand for labor, the gradually shifting aggregate supply curve will cause P to rise as well.[4] Thus an expansion of demand that raises prices only fractionally during the life of the contract will have a greater effect on prices thereafter. This point was neglected by Keynesians in the 1960s and leads to the next model.

Friedman-Phelps Supply Relationship

Milton Friedman and Edmund Phelps added expected inflation to the supply relationship. They pointed out that the wage rate $\overline{W}$ set by workers and employers should reflect any inflation expected to take place during the life of the contract. They set

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[4]In an open economy under floating exchange rates, the rise in P may be more rapid. A monetary expansion will cause the currency to depreciate and import prices to rise. Firms may pass on to consumers the higher prices they have to pay for oil and other imported inputs, in the same way that they pass on higher labor costs. Staff of the Federal Reserve Board estimate that a 10 percent depreciation of the dollar raises the U.S. price level by 1.5 percent over the next few years. The effect is certainly greater in smaller, more open countries.

$\overline{W} = wP^e$, where P^e represents the expected price level at the time the contract was signed. Substituting into Equation 26.2, the aggregate supply relationship becomes:

$$Y/\overline{Y} = (P/P^e)^\sigma \tag{26.3}$$

The short-run AS curve always passes through the reference point ($P = P^e$ and $Y = \overline{Y}$), as is illustrated at point A in Figure 26.4. In other words, if the price level in a given period turns out to be what was expected, $P = P^e$, then the real wage will be at the correct level, w, to clear the labor market ($N = \overline{N}$), and the economy will be at full capacity ($Y = \overline{Y}$). If the price level turns out to be higher than expected, however, then Y will turn out higher than $\overline{Y}$. That is, the economy will turn out to be at some point along the upper portion of the AS curve. The reason firms decide to step up their level of activity is the same as seen earlier: ex post, the real wage has fallen. If a surprise monetary expansion raises the price level unexpectedly ($P_1 > P_0^e$), then output will rise ($Y_1 > \overline{Y}$), again shown at point B. If the unexpected rise in the price level is 1 percent, then by Equation 26.3 the rise in output is σ percent.

Along with the introduction of price expectations, the other half of the Friedman-Phelps relationship is the proposition that expected inflation adjusts to actual inflation, with the passage of time. The expected future price level is heavily influenced by whatever price level is observed most recently. In the second period the AS curve still passes through the reference point ($P = P^e$, $Y = \overline{Y}$), but because workers have raised their P^e in response to the higher P observed in the previous period (P_1), this reference

FIGURE 26.4

Friedman-Phelps Supply Curve, in the Short and Long Run

If the nominal wage is proportional to the expect price level, P^e, then AS again slopes up, so an outward shift of demand to AD' raises output Y to B—but only in the short run. Over time, workers update P^e to reflect the actual P; as a result W and P rise and Y falls back toward the level of potential output.
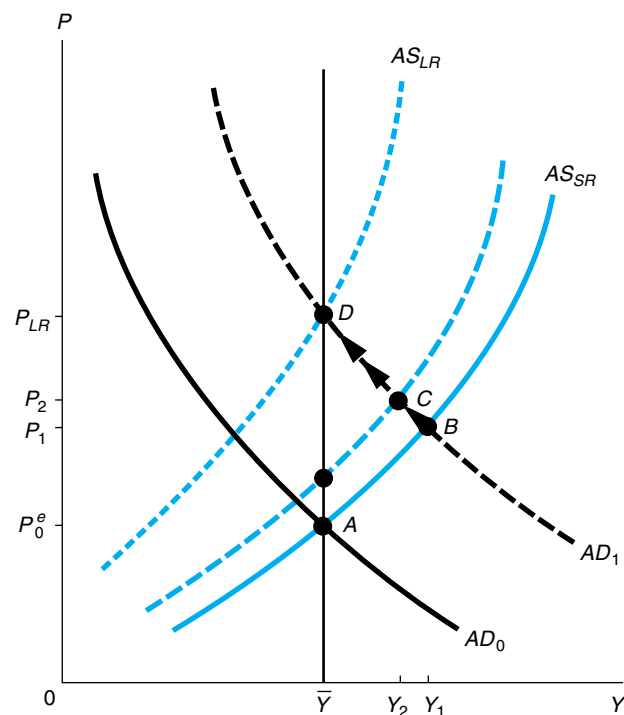
point is now higher than it was before. It follows that the short-run curve has shifted up in the second period. If demand remains at AD_1, there is a move to a point like C. More of the higher level of aggregate demand takes the form of higher wages and prices (P_2), and less takes the form of higher output (Y_2). It is again true in the second period that the price level is higher than the expected level, P^e, which has two implications: (1) Y is still above $\overline{Y}$, and (2) P^e will then have to rise still further, shifting the AS curve up again in the third period. The logic is repeated in subsequent periods. As long as the economy is operating beyond normal full capacity, the price level keeps rising. The reason is that for Y to be greater than $\overline{Y}$, it must be true (by Equation 26.3) that the price level is higher than was expected in that period, from which it follows that workers will adjust their expected price level further, and higher wages will be passed through to higher actual prices. This process of adjustment will continue until Y is restored to $\overline{Y}$, because Equation 26.3 shows that only then will $P^e = P$. In other words, in the long run the aggregate supply curve is vertical at $Y = \overline{Y}$. P, P^e, and W have all gone up by the same percentage as the money supply, so all real variables have returned to their original levels: M/P, P/P^e, W/P, and Y. This is the neutrality proposition again.

Lucas-Sargent-Barro Supply Relationship

Members of the "New Classical" macroeconomic school, such as Robert Lucas, Thomas Sargent, and Robert Barro, adopted the Friedman-Phelps assumption that only unanticipated increases in the price level could raise Y above $\overline{Y}$. However, they carried further the idea that people are smart enough to adjust their expectations in an intelligent way. They objected to the idea that people could be so foolish as persistently to underestimate (or overestimate) the price level for many consecutive periods. This reasoning led them to the conclusion that output could not exceed (or fall short of) potential output for many consecutive periods.

To understand the new classical model, consider first what would happen if people magically had perfect foresight, that is, if they could anticipate any increase in aggregate demand with precise accuracy. Then P^e would always equal P. Thus Y would always equal $\overline{Y}$. In the period that the AD curve shifts up, the short-run AS curve shifts up by precisely the same distance, so that all intersections occur on the same vertical line (the same as point D in Figure 26.4, only it holds not just in the long run but also in the short run).

Now we follow Lucas, Sargent, and Barro in making the assumption of rational expectations, the phrase most often associated with this school of thought.[5] Expectations are said to be rational if the variable in question, in this case P, can differ from what was expected only by a random error in term, ε:

$$P/P^e = 1 + \varepsilon \tag{26.4}$$

When we say that the expectational error, ε, is random, we mean that it is uncorrelated with all information available at the time the expectation was formed. The argument is

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[5]The name "New Classical" is sometimes preferred because the assumption of rational expectations means little in this context without the prior assumption that only unanticipated increases in the price level raise output.

that a rational worker will already have made use of such information in making his or her optimum forecast of the future price level. Sometimes ε will be positive and sometimes negative, but on average it will equal zero, in which case $P^e = P$.

Substituting Equation 26.4 into 26.3,

$$Y/\overline{Y} = (1 + \varepsilon)^\sigma \qquad (26.5)$$

We see that Y can sometimes deviate from $\overline{Y}$, for example, when an unexpected monetary expansion raises P. But this can only happen randomly, implying that the government cannot vary policy in any useful way. If monetary policy cannot have systematic effects, then it is of little use to the policy maker. The government wants to be able to expand at certain times, such as when a recession threatens or prior to an election. Yet, if it follows systematic practices, the public will anticipate such expansions. If a recession threatens or an election approaches, P^e will go up just at the moment when the government expands. The result will be no change in P/P^e, and therefore no change in Y. Only random changes in policy can effect P/P^e, and therefore output, and they are not useful from the standpoint of policy-making.

In each of the four aggregate supply cases we have considered so far, no special significance attaches to whether the economy is open or closed. An increase in demand for domestic goods, whether from the domestic side or the foreign side, simply goes into output or prices depending on what is assumed about the supply behavior of domestic firms. In the following case, however, more depends on whether the economy is open or closed.

26.2 Supply Relationship with Indexed Wages

Some economies, particularly those with a record of price instability, have adopted an arrangement whereby wages are automatically indexed to the price level. Whatever the increase in the price level during the life of the labor contract, the wage rate would automatically increase by a corresponding amount, whether the increase in the price level was accurately foreseen or not. If the wage indexation was complete, then wages would go up by the same percentage as the price level; in other words, a given real wage was assured. In the United States the indexation feature of a wage contract was known as COLA or "cost of living adjustment" clause, but the indexation to the CPI was usually less than 100 percent, and such contracts are no longer in widespread use. Italy for years had its *scala mobile* (moving stairway), which automatically compensated much of the industrialized work force for any increases in the CPI. Chapter 21 noted that two middle-income countries, Brazil and Israel, went the furthest toward fully indexing their economies in the 1970s and early 1980s.

Wages Indexed to Prices of Domestic Goods

An important issue is the selection of the good or goods used in determining the price index to which the wage is tied. Consider what happens when wages are indexed only to the price of domestically produced goods, either because trade is not important to

the economy or because the producers do not wish to accept the risk of having their wage bill fluctuate with import prices. The wage indexation equation is $W = \overline{w}P$, where $\overline{w}$ is the target real wage negotiated by workers and employers. Then Equation 26.1 becomes

$$(Y/\overline{Y}) = (w/\overline{w})^{\sigma} \tag{26.6}$$

Assuming that the target real wage is indeed the one appropriate to clear the labor market, $\overline{w} = w$, then the economy always operates at full employment: $N = \overline{N}$ and $Y = \overline{Y}$. When there is an increase in the monetary supply, it does not matter whether the increase was anticipated beforehand or not. The increase in the price level is automatically incorporated into wages by the indexation mechanism, so that there is no effect on real wages. Although protecting real wages is the usual motivation behind wage indexation, it also ensures there is no effect on the demand for labor and other real magnitudes. Equation 26.6 states that output is the same regardless of the price level. In other words, indexation duplicates the vertical aggregate supply curve, although here it derives its verticality through a route quite different from the frictionless neoclassical model.

Is it a good idea for a country to adopt wage-indexation arrangements? Two advantages are apparent. First, they protect workers' incomes. Second, they help stabilize output and employment in the face of monetary disturbances and other disturbances to aggregate demand. Indexation automatically insulates the real economy from such fluctuations.

There are also two good arguments against indexation, however. First, precisely because it makes any given level of inflation easier to live with, indexation can undermine the will to fight inflation.[6] For this reason, some high-inflation countries that undertook monetary stabilization plans in the mid-1980s reduced their degree of indexation, such as Israel in 1985. Brazil tried to end indexation as part of its Cruzado plan in 1986, and it succeeded in its more successful *real* stabilization of 1994. Argentina legally abolished indexation in 1991, and Italy decided to abolish the *scala mobile* in 1993.

Second, indexation can be harmful in the face of supply disturbances. This possibility arises because the real wage frozen into the system, $\overline{w}$, may be the wrong one. Imagine that $\overline{w}$ is originally set at the level thought to guarantee employment at the natural rate, $N = \overline{N}$, but that there is subsequently an adverse shift in productivity—caused, for example, by an increase in the price of oil. Then the new real wage consistent with the natural rate of unemployment, called the "warranted" real wage, w, may turn out to be lower than $\overline{w}$. Because wage indexation prevents unemployment from lowering the real wage, there will now be unemployment above the natural rate. Furthermore, monetary or fiscal expansion won't help because the problem is that the real wage is frozen at the wrong level. In terms of Equation 26.6, as long as $\overline{w}$ remains above the current w, then Y will be less than $\overline{Y}$. Such a disequilibrium in the labor market is termed *classical unemployment,* as opposed to *Keynesian unemployment,* which results from inadequate aggregate demand.

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[6]Stanley Fischer and Lawrence Summers, "Should Governments Learn to Live with Inflation?" *American Economic Review,* 79, no. 2 (May 1989): 382–387.

Many continental European countries are characterized by wage indexation and other forms of real wage rigidity to a greater extent than the United States. Often, such as in Germany, there is little in the way of formal indexation, but there is rather what might be called "implicit" indexation: a tacit understanding or social compact not to reduce real wages. American labor markets in general operate more freely. Furthermore, to the extent that U.S. wages *are* rigid, they are more likely to be rigid in *nominal* terms than in real terms.[7] It has been suggested that in the late 1970s the warranted real wage, w, fell behind the real wage embodied in European labor contracts, $\overline{w}$, and that this explains why European unemployment remained so high even long after the 1970s oil shocks and recessions. In the 1970s the six core members of the European Union employed almost the same number of workers combined as did the United States. By 2005 employment among the six had increased only 28 percent, cumulatively. During the same twenty-five years, U.S. employment increased 80 percent.

Wages Indexed to the CPI Basket

In practice, when wages are indexed, they are usually indexed to the CPI, which represents the basket of goods consumed by the workers, rather than to the prices of the products being produced. Thus imports can affect indexation if they constitute a significant part of consumption. Assume that the CPI gives a weight of α to imports and a weight of $(1 - \alpha)$ to domestically produced goods, and that the price of imports, P_M, exhibits full pass-through of changes in the exchange rate. Then a 1 percent increase in the euro/dollar rate raises the German CPI by α percent, even without any change in the price level, P, of goods produced in Germany. If wages are even partially indexed to the CPI, the nominal wage, W, will rise relative to P. Even though workers care about the CPI, firm managers care only about the product they are producing. They raise or lower their demand for labor depending on its marginal product relative to W/P, *the real wage expressed in terms of the product price*. If indexation to the CPI is complete, then even with no change in P, there will be an increase of α percent in W, and therefore in W/P. Figure 26.2(b) shows that the increase in the real wage in terms of the product price, P, lowers firms' demand for labor because their profit margins are reduced. Figure 26.2(a) shows how the lower demand for labor translates into lower output. The aggregate supply curve shifts backward and output falls. Thus a depreciation of the euro is contractionary for Europe.

If a German fiscal contraction is the original source of the increase in the euro/dollar rate, then the fall in German output provides an interesting result: Fiscal policy is an effective tool despite perfect capital mobility.[8]

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[7]Japan traditionally represents yet a third arrangement. At large Japanese corporations, a substantial proportion of an employee's annual compensation takes the form of a semiannual bonus, whose size varies depending in part on how profitable the year has been. Some observers believe that this form of "profit sharing" keeps real wages in Japan close to the productivity of labor, and thus may account for stability in employment in that country.

[8]Chapter 25 began by pointing out that in a large country, a fiscal expansion affects output even if capital is perfectly mobile. The new result, however, is that if wages are indexed to the CPI, fiscal expansion also works even in a small country.

Thus changes in fiscal policy have real effects on an *open* indexed economy, even though they have no real effects on a *closed* indexed economy: When a change in fiscal policy changes the real exchange rate, the change in import prices opens up a gap between the CPI and the domestic-produced price level, P. That is why, even when the wages are fully indexed to the CPI, a change in fiscal policy changes the real wage and has real effects.[9]

26.3   Inflation

The conclusion that emerges from our consideration of aggregate supply relationships is rather pessimistic with regard to the prospects for discretionary monetary policy, that is, monetary policy as a tool to be applied by the government as seems best year by year. Although the government can succeed in raising output and employment in a given year, the cost is higher inflation that gets built into expectations. A period of growth in excess of potential will have to be "paid back" in the future, with a period when growth is *less* than potential, to get the expected inflation rate back down. In the long run, there is no stable usable trade-off between output and inflation. Years when inflation is unexpectedly high must be offset by years when it is unexpectedly low.

Most countries have positive inflation rates most of the time. Some suffer from chronic high inflation rates, although far fewer today than was true in the 1970s and 1980s. Why is inflation so common? What are the costs? And what can be done about it?

Why Is There Inflation?

Let us begin with the question: Why do central banks inflate, given that gains in output have to be repaid by losses later? There are three possible reasons.

1. *The government has a low discount rate,* meaning it puts little weight on the future relative to the present. It believes it has to deliver strong growth in output and employment today, to satisfy voters. Even if it is aware of the eventual cost posed by rising inflation, it figures that it must first win the upcoming election, or it won't be around tomorrow.

2. *The government can't credibly commit not to inflate*. The public knows that a government with discretionary monetary policy will always be tempted to expand. After all, most people most of the time would like growth and employment to be higher than they are, if this were possible. The public's fears that the government will give in to temptation become incorporated into expectations of inflation, and thereby into actual wages and prices. As a result, the government has to engage in a certain monetary casing just to accommodate these expectations—just to bring output up to potential. The outcome is the worst of both worlds: chronic inflation with no gain in real output. The government should proclaim that it is giving up on trying to affect out-

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[9]Jeffrey Sachs, "Wages, Flexible Exchange Rates, and Macroeconomic Policy," *Quarterly Journal of Economics* (1980): 731–747.

put and will concentrate on trying to achieve zero inflation. If this proclamation is believed, then it will lower expectations of inflation, and shift the *AS* curve down, as desired. But such proclamations are not in themselves generally credible. This is known as the problem of *time inconsistency*.

3. *Seignorage.* The government gets to spend the money it prints. Imagine a government that feels it must maintain a certain level of spending but cannot finance it by either taxation or borrowing. Then the only alternative is printing money. But there are drawbacks, and they become increasingly severe as the central bank abuses its ability to print money. It is not just that the resulting high inflation may be bad for the economy. At high inflation rates, the population will lose its willingness to hold the money that is being printed. Even a government that cares only about its own revenue needs must worry about "killing the goose that lays the golden egg" when the goose is given only worthless paper to eat.

Costs of Inflation

At low rates of inflation, inflation is not very harmful. An economy can live with it, especially if the price increases are spread uniformly around the economy and the inflation has been fully built into expectations. But low inflation can lead to higher inflation. At high rates of inflation, the costs can be substantial. Severe monetary instability can have very negative consequences for the economy. One estimate is that the costs begin to show up as a negative effect on long-term real growth when inflation exceeds a threshold of around 40 percent.

What are these costs? We know that the demand for real money balances depends negatively on the opportunity cost of holding money. This opportunity cost goes up when inflation goes up. Households and firms find that they have to devote a higher fraction of their time and energy managing the finances ("trips to the bank")—time and energy that could otherwise be spent engaged in more productive activities. We also know that the advantage of having money in the first place, as opposed to barter, is that it facilitates exchanges of goods and services. This breaks down at high inflation rates. Prices can no longer do their job of signaling demand and supply in individual markets because consumers and producers have trouble distinguishing changes in relative prices from the general increase in the price level.

How to Achieve Credibility

The trick is for the central bank to establish credibility, to create expectations that it will not inflate. Such expectations should allow low actual inflation, without loss of output. There are three ways of seeking credibility.

1. *Central bank independence.* The government can *delegate* monetary policy to an independent central banker who believes in fighting inflation and do so inside an institutional structure where he or she is shielded from political pressures. This recommendation from monetary theory has been put into practice by many countries in recent years. The central bank is given independence by setting it up as an agency outside of

the finance ministry and the rest of the government, letting it determine its own budget, setting long terms for the governors, and making it impossible to remove them for political reasons.

2. *Reputation.* A central bank can establish a reputation for monetary rectitude. Usually it must earn the reputation via a track record, which may mean proving a willingness to have the country suffer high interest rates and recession. The German central bank, the Bundesbank, had a good "hard money" reputation throughout the postwar period because its explicit mandate was to fight inflation, and everyone considered this credible because Germans were known historically to have developed a strong aversion to inflation.

3. *Rules.* A third way to enhance credibility is to commit publicly to a fixed rate of growth in some nominal magnitude—such as the money supply, price level, or exchange rate. We consider such rules in the next section.

26.4   Alternative Anchors for a Country's Money

For policy makers to achieve credibility may require tying their hands in some way so that in the future they cannot follow expansionary policies even if they want to. Otherwise, they may be tempted in a particular period (such as an election year) to reap the short-run output and employment gains from expansion, knowing that the major inflationary costs will not be borne until the future. It may seem surprising that policy makers can raise economic welfare by *giving up* the ability to use monetary policy freely. Yet Equation 26.3 shows that if the authorities make a credible commitment that convinces the public they will not be inflating the future, the downward shift in P^e will mean the country can enjoy a lower level of P for any given level of Y. A central bank that would like to constrain itself, so that in the future it can resist the political pressures and economic temptations of expansion, is like Odysseus in the Greek myth. As his ship was approaching the rocks from where the seductive Sirens lured weak-willed sailors to their doom, Odysseus had his sailors tie him to the mast. But how can a central bank make such a binding commitment?

Monetarists and Gold Bugs

A government can tie its hands, committing to a near-zero inflation rate, by means of what is called a *nominal anchor*. This is a commitment to base monetary policy on some fixed nominal magnitude, thus eliminating the danger of runaway money growth and inflation.

Two examples of nominal anchors are the money supply and the price of gold. The monetarists argue for a system under which the central bank rigidly commits to a fixed (low) rate of growth of the money supply. The advantage of such a commitment is a reduction in the average inflation rate. The disadvantage is that this prevents the monetary authorities from responding to future disturbances. For example, if there is an exogenous upward shift in the demand for money (shifting the *LM* curve to the left)

and the central bank is constrained from accommodating it with an increase in the money supply, then it will cause an undesired deflation, perhaps a recession. Such velocity shocks are often severe. For this reason, the Federal Reserve Board abandoned its policy of pursuing targets for the M1 money supply a few years after adopting it in 1979.

The appendix to Chapter 19 explored the gold standard of the nineteenth century. "Gold bugs" have argued for a return to a system under which the central bank rigidly commits to a fixed price of gold, standing ready to buy gold if its price threatens to fall and to sell gold if its price threatens to rise. The problem with such a system is that a shift in the demand for gold will be needlessly transmitted to the general economy, much like shifts in the demand for money. Shifts in the demand for gold have been large in recent years. In both cases, committing monetary policy either to a fixed money growth rule or to a fixed price of gold, the disadvantage of allowing needless disturbances in the economy seems large.

The Exchange Rate as a Nominal Anchor

A solution for some countries is to choose a fixed exchange rate as the nominal anchor. Many smaller countries peg their currencies to a major country's currency they believe to be stable, partly as a way of resisting future temptations to expand.

Let us make this point concrete. Imagine that purchasing power parity (PPP) held well enough that, even if the domestic price level, P, were not tied to the exchange rate in the very short run, the public at the beginning of a given year anticipated that the price level would obey PPP during the coming year: $P^e = (SP^*)^e$. Then a pre-announced commitment to fixing the exchange rate $(S = \bar{S})$ would effectively induce the public to expect an inflation rate during the coming year no higher domestically than abroad: $P^e = \bar{S}P^{*e}$. Assuming the foreign country is expected to have a low inflation rate, the expected inflation rate would be low at home as well.[10] Then domestic workers would moderate their wage demands, and prices would follow suit. In terms of Equation 26.3, P^e would shift downward, with the result that a lower P could be achieved even without a loss in Y.

As we have seen, there is a cost to committing to a fixed exchange rate: A small country that opts to peg its currency to that of a larger country will lose the ability to conduct a monetary policy that is independent from its partner's. What sort of country would be willing to pay that cost? One answer to this question is a country that has a history of chronic monetary instability, in the form of high and variable inflation rates. There the priority on a credible anti-inflationary policy may be high enough to justify giving up monetary independence.

When the major currencies began to float against each other in 1973, the initial reaction among most smaller and developing countries was to continue to peg toward

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[10]The qualification can be important. After the breakup of the Soviet Union in 1991, many of the newly independent republics at first thought they might remain in the ruble zone, anchoring their new currencies to the Russian currency. As Russian money creation and inflation accelerated, however, it quickly became apparent to the republics that attempting to use the ruble as an anchor would be like a rowboat attempting to anchor itself to a moving ship.

one of the major currencies, such as the former colonial power in the case of many African countries or the dollar in the case of most Latin American countries. Devaluations followed, however, and most of these links have long since been broken. Even the French-speaking countries of West and Central Africa, which had been the most steadfast in keeping their currencies pegged to a major currency, the French franc (largely because France granted them large subsidies to do so), devalued in 1994.

After some unpleasant experiences with high inflation rates in the 1970s, a number of countries sought to reestablish credible exchange rate targets as cornerstones of anti-inflation programs. They included Italy and other previously inflation-prone European countries that in effect tied their currencies to the deutschemark in the 1980s, either as formal members of the European Monetary System (Italy, France, Ireland, Spain, and Portugal) or through unilaterally declared pegs (Sweden).[11]

They also included a number of Latin American countries that have tried to reestablish a link with the dollar as the basis of monetary stabilization programs. Argentina's austral plan and Brazil's cruzado plan were both introduced in 1985. In both cases, the governments failed to back up the plans with adequate monetary restraint, with the result that inflation and balance-of-payments deficits soon returned and the pegs to the dollar had to be abandoned.

An Israeli plan, also instituted in 1985, met with more success. Argentina introduced its convertibility plan in 1991, and Brazil its "real" plan in 1994. Both can be judged successes in light of the many previous disinflation attempts that had failed in those countries. Why do some exchange-rate-based plans succeed while others fail? The first key to success is supplementing the exchange rate target with budget and monetary discipline (a strategy that is known as an *orthodox* stabilization plan), rather than relying on direct wage and price controls to do all the work (a strategy known as the *heterodox* plan).

Even when the government sincerely intends to adopt sufficiently strict fiscal and monetary policies, workers may ask for higher wages nonetheless. They are particularly likely to do so if inflation has been high in the past, or if they are skeptical that the government's disinflation plan will be sustained in the future. Higher wages will in turn lead to higher prices. The fixed exchange rate in fact does not prevent this. (PPP does not in fact hold at a one-year horizon.) As the currency becomes progressively overvalued in real terms, the trade deficit will widen. A balance-of-payments deficit may result, depleting the central bank's reserves over time. If speculators are skeptical that the plan will be sustained, capital will leave the country, thereby accelerating the balance-of-payments problem. In this case the loss of reserves will eventually force a devaluation, and therefore the end of the plan. This was exactly the sort of crisis that hit the Mexican peso in December 1994. Russia was forced to abandon its exchange rate target in 1998 and Brazil in 1999. Turkey's exchange-rate-based stabilization came to a similar end in 2001.

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[11]Francesco Giavazzi and Marco Pagano, "The Advantage of Tying One's Hands: EMS Discipline and Central Bank Credibility," *European Economic Review,* 32 (June 1988): 105–182. Some authors, however, see from the evidence no sign that the costs (lost output) to a small European country of a program to reduce inflation were any lower when joining the EMS was part of the program. Susan Collins, "Inflation and the European Monetary System," in F. Giavazzi, S. Micossi, and M. Miller, eds., *The European Monetary System* (Cambridge, UK: Cambridge University Press, 1988).

That so many exchange rate targets ultimately have had to be abandoned does not mean that the strategy of using them as part of the original disinflation plan was a mistake. Economists often recommend as an *exit strategy* that the central bank abandon a fixed exchange rate, in favor of a more flexible arrangement, at a time when demand for the currency is strong. This advice makes sense if the alternative might in the future be that it is forced to abandon the peg at a more difficult time, when confidence is under attack.

Inflation Targeting

When a country moves toward more flexible exchange rates, something else should take the place of the exchange rate target as the nominal anchor of monetary policy, so as to keep expectations aligned with a low-inflation monetary path. Recall the goal of keeping expected inflation low and stable in Equation 26.3, so as to deliver lower actual inflation for any given level of output. With monetarism and the gold standard largely discredited as nominal anchors, what does that leave?

The new popular choice is inflation targeting.[12] The central bank publicly commits to announced targets for the yearly increase in the CPI itself. If the central bank misses the target that has been announced, the governor is required to give the government an official explanation. Early adopters of inflation targeting included New Zealand, Canada, the United Kingdom, and Sweden. Many emerging market countries began to follow suit in the years 1998 to 2000: Israel, the Czech Republic, Poland, Brazil, Chile, and South Africa.

One problem with setting a rigid target for the CPI is that abiding by it would prove onerous in the face of a supply shock such as the increase in the price of oil that hit many oil-importing countries in 2005. In practice, central banks allow a temporary deviation from their target range in such cases, giving an explanation for the cause. Some explicitly target "core inflation," which leaves out the more volatile prices of food and energy (but does not specifically accomplish the goal of distinguishing import shocks from export shocks). There are other reasons as well that a government may wish ex post to deviate from the inflation target that was announced ex ante. In practice, many central banks follow a very flexible form of inflation targeting called the Taylor rule: The interest rate instrument is used so as to try to correct, not just deviations of inflation from the announced target, but also deviations of output from its desired level.

26.5   The Choice of Exchange Rate Regime

The question of what exchange rate regime to choose—fixed, floating, or something else—is an old one. But it has been faced anew by many countries in recent years, from emerging market countries responding to currency crises to European countries deciding whether to join the EMU.

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[12]For example, Lars Svensson, "Inflation Targeting as a Monetary Policy Rule," *Journal of Monetary Economics,* 43 (1999): 607–654.

We have seen a variety of arguments in this text in favor of fixed exchange rates and a variety of arguments against them. To summarize the arguments in favor of fixed exchange rates: (1) They reduce the transactions costs and uncertainty facing importers, exporters, and international borrowers and lenders;[13] and (2) they can provide a nominal anchor for monetary policy. The argument against fixed exchange rates is that they reduce the ability of the government to pursue independent monetary policy (especially if capital market integration is high) and to accommodate terms of trade shocks. Which side of the debate should dominate?

Intermediate Exchange Rate Regimes

There is in reality a continuum of exchange rate regimes. In between fixed and floating are four intermediate regimes:

1. *Target zone, or band.* The central bank announces a central parity and margins around it. It is prepared to intervene to keep the exchange rate within that range. A target zone with narrow bands is almost the same as a fixed exchange rate; wide bands approach floating. There are two versions of target zone. In one, the central parity is adjusted in line with inflation or other economic fundamentals. In the other, the central parity is fixed, to preserve a nominal anchor. (Section 27.3 explores the theory of target zones.)

2. *Crawling peg.* The central bank follows a policy of devaluing the currency a small amount each week. The goal is to offset inflation, to avoid becoming overvalued in real terms. In one version, full *indexation of the exchange rate,* the aim is specifically to hold the real exchange rate constant. In another version, the *tablita,* the preannounced rate of crawl is less than the inflation rate. The aim of the latter arrangement, popularized by Argentina in the late 1970s, is to use the exchange rate to continue putting some downward pressure on inflation.

3. *Basket peg.* In some cases, countries decide not to peg to a major currency because, in a world where the major currencies are floating against each other, fixing the exchange rate vis-à-vis one currency means incurring variability against the others. This may not be an issue for a country that trades mostly with the United States or mostly with Europe. But for a country that trades with many partners, a simple policy of pegging to one of them will result in a variable effective (i.e., trade-weighted) exchange rate. An alternative is pegging to a weighted basket of currencies. Such *basket pegs* have been popular with some East Asian and Middle Eastern countries. Despite the theoretical advantage of this exchange rate arrangement, governments in practice may find it a strong temptation to devalue a bit under a basket peg, especially when the weights in the basket have been kept secret.

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[13]Some empirical studies have found a negative effect of exchange rate uncertainty on the volume of trade. If a country goes beyond fixing its exchange rate and actually adopts the currency of a neighbor, then it not only eliminates exchange rate uncertainty vis-à-vis that neighbor but eliminates transaction costs as well. Andrew Rose found a surprisingly large effect of currency unions in his influential paper, "One Money, One Market: Estimating the Effect of Common Currencies on Trade," *Economic Policy*, 15 (April 2000): 7–45.

4. *Adjustable peg.* Many fixed exchange rates do not last for long. In some cases, as under the Bretton Woods system, the official policy is that the peg will be adjusted in the event of a fundamental disequilibrium. In theory, an *escape clause* could specify that the currency will be devalued if there is a sufficiently large adverse shift in the terms of trade or a sufficiently large loss of reserves. In practice, the circumstances that will trigger the realignment are seldom made explicit.

The Corners Hypothesis

Each of the countries in East Asia and elsewhere that underwent currency crises in the late 1990s had been following an exchange rate target at the time. Most of the targets were combinations of the intermediate regimes just listed. Most of the countries, under intense speculative attack, abandoned their targets and moved to a regime of increased flexibility—full-fledged floating in the case of Mexico, Brazil, and Chile. Ecuador in 1999 moved in the opposite direction, to full-fledged dollarization. A new conventional wisdom was born: Intermediate exchange rate regimes are no longer viable. Countries under speculative pressure must move to one corner or the other.

At one polar extreme is free floating. Managed floating is also considered in the flexible corner, provided no specific target is set for the exchange rate.

The other corner is an institutionally fixed exchange rate. This is a legal or institutional commitment, something beyond the simple declaration of a fixed exchange rate, which after all can always be abandoned in the future. What is needed for full credibility is a commitment that is seen by the public to be so binding that it would be difficult or impossible to undo in the future even if desired. The firm-fix corner includes three cases.

1. *Currency union* is the polar extreme. Member countries share a common currency and a common central bank. The EMU is the important example.

2. *Dollarization* is when a country officially adopts the dollar as its legal tender. The country does not get a vote on the Federal Reserve Board. Official dollarization is more extreme than private dollarization. Official dollarization is certainly easier if the private economy is already heavily dollarized, however, which is the case in much of Latin America. (This regime could as easily be applied with respect to the euro or some other currency.)

3. *Currency board* was defined in Section 19.1. Argentina, Hong Kong, and some Eastern European countries already had versions of currency boards in place when speculative pressures hit emerging markets in the late 1990s. Hong Kong and others managed successful defenses, preserving their fixed exchange rate arrangements. Of course any country that adopts a confining straightjacket may live to regret it. The cost of maintaining such a commitment in the event of reserve loss can be a severe recession.

Both corners—floating and fixing—offer the central bank a sort of immunity from speculative attack against its reserves. Under floating the central bank is under no obligation to pay out foreign exchange reserves—or even to hold any. Under monetary

union the central bank and its reserves go out of existence. Speculators cannot attack something that does not exist. Only time can test the prediction that countries will increasingly move toward the corners of either floating or institutionally fixed exchange rates. In practice, most self-declared floaters exhibit a "fear of floating" in that they continue to intervene regularly in the foreign exchange market to dampen big movement. In the opposite corner, ardor for the currency board option began to cool when Argentina was forced to abandon its convertibility plan in 2001. Intermediate regimes, it seems, are still very much with us. But it is clear that the high capital mobility of the modern system does sharpen the trade-off between the advantages of exchange rate stability and those of monetary independence.

Optimum Currency Areas

No single exchange rate arrangement is right for all countries. The desirable arrangement depends on specific characteristics of the country in question. The characteristic most important for this choice is the country's degree of openness. The advantages of a fixed exchange rate tend to be greater for a small open country; the advantages of a flexible exchange rate tend to be smaller.

   Consider the two advantages of a fixed exchange rate stated earlier, regarding uncertainty and the nominal anchor. If traded goods constitute a large proportion of the economy, then exchange rate uncertainty is a more serious issue for the country in the aggregate. Such an economy may be too small and too open to have an independently floating currency. At the same time, because fixing the exchange rate in such a country goes further toward fixing the entire price level, the credibility of benefits discussed in the preceding section are likely to be larger. In terms of Equation 26.3, an exchange rate anchor is more likely to tie down P^e in an open country than in a relatively closed one, and thus more likely to reduce actual P without a loss in Y.[14]

   Furthermore, the chief advantage of a floating exchange rate, the ability to pursue an independent monetary policy, is in many ways weaker for an economy that is highly integrated with its neighbors. This is because there are ways that such a country or region can cope with an adverse shock even in the absence of discretionary changes in macroeconomic policy. Consider first, as the criterion for openness, the marginal propensity to import. In terms of the model of Chapter 17, variability in output under a fixed exchange rate is low when the marginal propensity to import is high. In other words, openness acts as an automatic stabilizer.[15]

   Consider next, as the criterion of openness, the ease of movement of labor between the country or region in question and neighboring regions. If the economy is highly integrated with its neighbors by this criterion, then workers may be able to respond to a local recession by moving across the border to get jobs, so the need for a local monetary expansion or devaluation is less extreme. Of course the neighboring region may be in

[14]David Romer, "Openness and Inflation: Theory and Evidence," *Quarterly Journal of Economics,* 108, no. 4 (1993): 869–903.
[15]You were asked to figure out the relative stabilizing properties of fixed versus floating exchange rates in Problem 2 in Chapter 18.

recession too. To the extent that shocks to the two economies are correlated, however, monetary independence is not needed in any case: The two can share a monetary expansion in tandem. There is no need for a flexible exchange rate between them to accommodate differences.

In the case of a very small region or other economic unit, the argument is clear. Consider an American state (or a Canadian province, British county, etc.). In the limiting case think of a city or square block. Such an economic unit is clearly too small to have its own currency. Its residents would have to consult the day's exchange rate postings and go to the bank to convert currency every time they wanted to buy something in the next city or the next block. A unit this small should adopt the currency of a neighboring region with which it is highly integrated, thus forming a larger currency area. In other words, the smaller unit does not constitute an *optimum currency area*.

An optimum currency area can be defined as a region for which it is optimal to have its own currency and its own monetary policy: *A region that is neither so small and open that it would be better off pegging its currency to a neighbor, nor so large that it would be better off splitting into subregions with different currencies*.[16]

Geographical regions within a country go beyond pegging their exchange rates to each other and literally use the same currency. The dollar bills issued by the Dallas Federal Reserve Bank are perfect substitutes for the dollar bills issued by the Boston Fed. Occasionally, sovereign nations also use other nations' currencies. Panama, for example, allows the U.S. dollar to circulate as legal tender. Lesotho, Nambia, and Swaziland allow the South African rand to circulate similarly. There are also currency unions in Western and Central Africa and in the eastern Caribbean. The European Economic and Monetary Union is by far the most important example. But these cases are exceptions. Most countries want to retain their own currencies—either for reasons of political pride or to get the economic seignorage that comes with the right to print money—even if they choose to fix the exchange rate.

The Case of German Monetary Union

Some economists consider the German monetary union of 1990, in which the *länder* of the former East Germany were joined to those of the former West Germany, to be an example of how *not* to go about forming a monetary union. It is not that the reunited Germany does not meet the criterion for an optimum currency area. As a result of the close cultural links within what used to be a single country, the extent of trade and labor mobility has rapidly returned to a high level—high enough to justify the adoption of a common currency. Especially important in the decision to undertake monetary union, as in other currency areas, was a political willingness for the more fortunate Western *länder* to help out the less fortunate Eastern ones with large fiscal transfers.

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[16]The phrase *optimum currency area* was coined by Robert Mundell, "A Theory of Optimum Currency Areas," *American Economic Review* (November 1961): 509–517. He was thinking of openness in terms of labor (the degree of labor mobility across the region's borders versus within the region), rather than in terms of openness of trade. The idea of using the proportion of the economy composed of traded goods as the criterion for whether a region is large enough to have its own currency was suggested by Ronald McKinnon, "Optimum Currency Areas," *American Economic Review,* 53 (September 1963): 717–724.

The major mistake that the German government appears to have made was to miss its one and only chance to get the exchange rate right, between östmarks and deutschemarks, before the monetary union. Productivity among workers in the East was only a fraction of productivity in the West, and it would take time before the former acquire the physical and human capital to close the gap. Wages must accurately reflect the differential in productivity if firms are to have adequate incentive to establish factories in the East and hire workers. The relatively easy way to accomplish this would have been to peg the exchange rate at a multiple, such as two östmarks per deutschemark. For political reasons the German government pegged the exchange rate at one to one in 1990. Unemployment in the East soared dramatically in the years following the union. The cost of paying the unemployment benefits created problems for even the powerhouse German economy. If wages were perfectly flexible, then it would be immaterial at what rate the two currencies had been unified, but this is clearly not the case (or wages in the East would have responded to the high unemployment rates by falling, which they did not do). The period of adjustment has been predictably prolonged.[17]

Is Europe an Optimum Currency Area?

There is little point in even trying to impose exchange rate stability if a country is not politically ready to accept the loss of sovereignty in economic policy-making. An attempt to peg the exchange rate under such circumstances would fail as soon as a future disturbance forced the government to choose politically between the fixed exchange rate policy and an alternative such as counteracting an increase in unemployment.

We saw in Section 23.3 that plans for the eventual European Monetary Union, agreed on at Maastricht in 1991, ran into difficulty in the crises of 1992 and 1993. Since then, the membership of the European Community has expanded into an even larger European Union, with the accession of Austria, Finland, and Sweden, and then with the addition of ten new members in 2005, most of them in Central Europe. Is this too large or diverse a collection of countries to constitute an optimum currency area?

Our discussion of optimum currency areas indicated several economic criteria, generally falling under the rubric of the degree of economic integration. We saw that regional units are more likely to benefit, on net, from joining together to form a monetary union if (1) they trade a lot with each other, (2) there is high degree of labor mobility among them, (3) the economic shocks they face are highly correlated (so-called symmetric shocks), or (4) there exists a federal fiscal system to transfer funds to regions that suffer adverse shocks.

Each of these criteria can be quantified, but it is very difficult to know what is the critical level of integration at which the advantages of belonging to a currency area outweigh the disadvantages. The states of the United States constitute a possible standard of comparison. It seems clear that the degree of openness of the states, and the degree of economic integration among them, are sufficiently high to justify their use of

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[17]Hans-Werner Sinn, "Germany's Economic Unification: An Assessment After Ten Years," *Review of International Economics,* 10, no. 1 (2002): 113–128.

a common currency. How do the members of the European Union compare to the states in this regard? U.S. states are more open than European countries, by both the trade and labor mobility criteria. It appears that when an adverse shock hits a region of the United States such as New England or the oil states of the South, outmigration of workers is the most important mechanism whereby unemployment rates and wages are eventually reequilibrated across regions.[18] Labor mobility among European countries is much lower than in the United States. Americans are six times as likely to move between states as Europeans are to move across national boundaries within the European Union. Workers are slow to move from Italy to Ireland, even when the unemployment rate is high in the former and job vacancies are going unfilled in the latter. Thus, by the labor mobility criterion, European countries are less well-suited to a common currency than are American states.[19]

The other two criteria are also better satisfied within the United States than within Europe. Disturbances across U.S. regions have a relatively high correlation, compared to members of the European Union.[20] When disparities in income do arise in the United States, federal fiscal policy helps narrow them. Estimates suggest that when a region's per capita income falls by one dollar, the final reduction in its disposable income is only 70 cents. The difference, a 30 percent cushioning effect, consists of an automatic decrease in federal tax receipts plus an automatic increase in unemployment compensation and other transfers. Neither the fiscal transfer mechanisms that were already in place within the European Union nor those under the EMU (so-called structural funds) are as large as those in the U.S. federal fiscal system.[21]

By these optimum currency area criteria, the European Union is not as good a candidate for a monetary union as is the United States. This helps account for the deep ambivalence over the euro that remains among the population of many European countries. An interest rate that suits Ireland, when growing rapidly and in danger of overheating, may be considered intolerably high in Italy, when stagnating.

All is not lost, however. In the first place, some northern European countries probably do meet the criteria. These relatively small and open economies are linked to the German economy sufficiently closely that they are willing in essence to subordinate their monetary policies to Frankfurt: the Netherlands, Luxembourg, Austria, and Belgium.

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[18]Oliver Blanchard and Lawrence Katz, "Regional Evolutions," *Brookings Paper on Economic Activity,* 1 (1992): 1–61.

[19]Barry Eichengreen, "European Monetary Unification," *Journal of Economic Literature,* 31, no. 3 (1993); and Jorg Decressin and Antonio Fatas, "Regional Labor Market Dynamics in Europe," *European Economic Review,* 39 (1995): 1627–1655.

[20]Tamin Bayoumi and Barry Eichengreen, "Shocking Aspects of European Monetary Unification," in F. Giavazzi and F. Torres, eds., *The Transition to Economic and Monetary Union in Europe* (New York: Cambridge University Press, 1993). An analysis of which countries stood to gain or lose the most from subordinating their economies to a single European monetary policy was offered by Alberto Alesina and Vittorio Grilli, "The European Central Bank: Reshaping Monetary Policies in Europe," in M. Canzoneri, V. Grilli, and P. Masson, eds., *Establishing a Central Bank: Issues in Europe and Lessons from the US* (Cambridge, UK: Cambridge University Press, 1992), pp. 49–77.

[21]Xavier Sala-i-martin and Jeffrey Sachs, "Fiscal Federalism and Optimum Currency Areas," in Canzoneri, et al., 195–219; Tamin Bayoumi and Paul Masson, "Fiscal Flows in the United States and Canada: Lessons for Monetary Union in Europe," *European Economic Review,* 39 (1995): 253–275.

Under the terms of Maastricht, the countries admitted to the EMU effective in 1999 were only those that met four tests. The candidate's currency must have succeeded in remaining within the EMS band for two years; its inflation rate must be close to that of the three best performing EU countries; the same must hold for its interest rates; and its budget deficit and debt should not exceed specified fractions of GDP. The signers of the agreement hoped in this way to assure convergence of macroeconomic policies. The four Maastricht tests do not coincide completely with the optimum currency area criteria. This is particularly true of the fiscal tests, which were adopted, not as optimum currency criteria, but rather because large budget deficits and debts are bad in their own right, and because they might in practice someday force the European Central Bank to bail a country out.[22] Nevertheless, European leaders judged the northern European countries named earlier as meriting admission, as well as six other countries that undertook strong efforts to reduce their budget deficits and interest rates in time to qualify: France, Italy, Spain, Portugal, Ireland, and Finland. The transition among the eleven to a common currency, the euro, went smoothly in 1999. The United Kingdom, Sweden, and Denmark opted out voluntarily, for the time being. Greece joined in 2001. Some Central European countries are planning to join soon as well.

The second point is that European countries are gradually becoming more highly integrated with each other economically and more willing to think of themselves as Europeans, so they are a bit more likely to meet the optimum currency area criteria with each decade that passes. A case in point is France. The predecessor to the EMS in the 1970s was the Snake.[23] Each time the French franc bumped up sharply against the limit in the Snake band, the French government would drop out of the agreement, rather than alter its policies. The EMS, founded in 1979, constituted a more serious attempt at stabilization of European exchange rates and was more successful in the 1980s than the Snake had been. Its first important test arose when the socialist François Mitterrand first came to power in France in 1981 and tried to expand the French economy at a time when other European countries were not expanding theirs. The consequent balance of payments deficit and downward pressure on the French franc forced Mitterrand to choose between abandoning the expansionary policies and abandoning the exchange rate constraint. Partly for the sake of the EMS and the cause of European integration, he chose the former. Thereafter the French monetary authorities were determined to maintain sufficiently anti-inflationary policies to keep the franc as strong in value as the mark.[24]

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[22]Candidates are required to get their budget deficits below 3 percent of GDP. Under the Stability and Growth Pact (SGP), the same limit is supposed to apply even after a country is admitted to EMU. In practice, however, members are able to violate this limit with impunity, at least the larger ones. Yet the SGP has proven difficult to reform. On the one hand, countries need to be able to run deficits during temporary downturns in economic demand, if for no other reason than because tax receipts slow. On the other hand, governments allowed to run cyclical deficits will claim that every downturn is temporary. One promising model is an institution that Chile uses to enforce fiscal rules: An independent panel of experts is delegated the task of deciding whether each year's output fluctuations are temporary and demand driven versus permanent and supply driven.

[23]Why "Snake"? The system established in 1971 had the world's major currencies fluctuating within certain margins of each other and the European currencies fluctuating within a narrower band. The pattern that the movement of the European exchange rates made over time looked like a "snake within a tunnel."

[24]Jeffrey Sachs and Charles Wyplosz, "The Economic Consequences of François Mitterrand," *Economic Policy,* 2 (1986): 261–313.

European integration continues to increase, partly as a result of such measures as the removal of barriers to trade and labor mobility. Even if some EU members do not satisfy the criteria for joining the optimum currency area today, perhaps they will in the future.[25]

26.6   Summary

This chapter explored the aggregate supply side of the economy in some detail. It considered a number of possible alternative supply relationships that had different implications for the ability of monetary policy to affect domestic output. In the frictionless neoclassical model, an increase in the money supply has no effect on output and employment but rather goes proportionately into prices and wages. In the modified Keynesian model, the wage is fixed. It follows that an expansion succeeds in raising output to a degree (as in the simple Keynesian model of earlier chapters) but also raises the price level to a degree. Indeed, from the viewpoint of firms, the level of output they choose to supply increases *because* the price at which they can sell their goods rises relative to the wage. In the Friedman-Phelps model, workers raise their wage demands as they adjust their price expectations upward. In the long run, the aggregate supply curve becomes vertical, as in the frictionless neoclassical model, and the money supply increase has no effect on output. In the Lucas-Sargent-Barro model, the only effect that the government can have on output is the useless one of randomly changing the money supply in unexpected directions. For practical policy-making purposes, the aggregate supply curve is vertical even in the short run. Finally, with indexed wages, monetary policy again has no effect and the aggregate supply curve is vertical even in the short run. The fixed level of output can be the wrong one, however, if real wages fail to fall in the aftermath of a fall in productivity.

The chapter concluded by considering the formation of monetary unions and other ways that a country can commit itself to monetary discipline. A commitment to monetary discipline via a nominal anchor offers a country the advantage that, by reducing workers' expectations of monetary expansion, it reduces wages and prices. For a country too small and too open to constitute an independent optimum currency area, the gains from pegging its currency to a neighbor's (acquiring a stable anchor for monetary policy as well as reducing exchange rate uncertainty) outweigh the loss of monetary independence. For large countries, the option of a fixed exchange rate is generally less practical. Alternative nominal anchors have been proposed, although some of these—fixing the rate of growth of the money supply and fixing the price of gold—are largely obsolete because they have the major drawback that disturbances such as shifts in the demand for money or in the demand for gold can have large undesired impacts on the economy. Inflation targeting, under which the nominal anchor is the CPI itself, has become the most popular nominal rule.

[25]Jeffrey Frankel and Andrew Rose, "The Endogeneity of the Optimum Currency Area Criterion," *Economic Journal,* 104 (449) (July 1998): 1009–1025.

CHAPTER PROBLEMS

1. Equation 26.2 says that when there is an expansion of aggregate demand, the percentage increase in output equals σ times the percentage increase in P. If nominal GDP $(= PY)$ goes up by 1 percent, what fraction of this takes the form of an increase in Y? What fraction in P? If wages adjust over time, how do these fractions change?

Extra Credit

2. a. Let the production function be $Y = \phi N^\beta$, where N is the number of workers employed. What factors determine ϕ? If you know calculus, show that the marginal product of labor, dY/dN, can be expressed as

$$\beta \phi^{1/\beta} Y^{-(1-\beta)/\beta}$$

Why is the marginal product low when Y is high?

b. If firms maximize profits competitively, so that they choose the level of employment and output where the marginal product of labor is equal to the real wage, show how employment, N, can be expressed as a function of the real wage. I.e., derive an equation to describe Figure 26.2(b). Then show how output, Y, can be expressed as a function of the real wage. You have now derived Equation 26.1 from the text, $(Y/\overline{Y}) = (wP/W)^\sigma$. What must σ equal? If $\overline{Y} \equiv \phi \overline{N}^\beta$, what must w equal?

c. If an oil shock causes ϕ to fall, what must happen to W/P if full employment is to be maintained?

3. Assuming complete indexation, $\delta = 1$, it is shown in the supplement that the supply curve is given by Equation 26.S.5.

$$(Y/\overline{Y}) = (P/SP^*)^{\alpha\sigma}$$

Try to figure out whether a monetary expansion raises Y. If it does, what must happen to the real exchange rate? What would you expect to happen to the trade balance $X - M$? To the net capital inflow? To total demand for domestic goods, $C + I + G + X - M$? What do you conclude about the effect on Y?

SUGGESTIONS FOR FURTHER READING

Bernanke, Ben, Thomas Laubach, Frederic Mishkin, and Adam Posen. *Inflation Targeting: Lessons from the International Experience* (Princeton: Princeton University Press, 1999). The new conventional wisdom says that an inflation target is the best nominal anchor for monetary policy. Perhaps Bernanke, who became chairman of the Federal Reserve in 2006, will bring inflation targeting to the United States.

Calvo, Guillermo, and Carlos Vegh. "Inflation Stabilization and Nominal Anchors," *Contemporary Economic Policy,* 12 (April 1994): 35–45. The experiences of Latin American countries with stabilization plans based on exchange rate targets, versus money supply targets.

Edwards, Sebastian. "Exchange Rates as Nominal Anchors," *Weltwirtschaftliches Archiv,* 129 (1993). A review.

Eichengreen, Barry. *International Monetary Arrangements for the 21st Century* (Washington, DC: Brookings Institution, 1994). A review of exchange rate regimes in place, and alternative options for the future.

Frankel, Jeffrey. "Experience of and Lessons from Exchange Rate Regimes in Emerging Economies." In Asian Development Bank, ed., *Monetary and Financial Integration in East Asia: The Way Ahead,* vol. 2 (New York: Palgrave Macmillan Press, 2004), pp. 91–138. A survey.

Posen, Adam, ed. *The Euro at Five: Ready for a Global Role?* (Washington, DC: Institute for International Economics, 2005). How successful has the euro been so far?

Rogoff, Kenneth. "Globalization and Disinflation," *Economic Review, Federal Reserve Bank of Kansas City,* 88, no. 4 (2003): 45–78. Why has inflation come down almost everywhere in the world over the last twenty-five years? Perhaps a shift of parameters reflecting increased global competition can explain it, within the time consistency framework.

Willett, Thomas, and Fahim Al Marhubi. "Currency Policies in the Formerly Centrally Planned Economies," *The World Economy,* 17, no. 6 (November 1994): 795–817. Countries in Eastern Europe and the former Soviet Union face a choice regarding exchange rate arrangements. This is a good review of the issues in the optimum currency area framework.