chapter 11

Inflation: Fiscal and Monetary Aspects

Continuing with our simple framework of fixed output, purchasing power parity, and free capital mobility, we now turn for the first time to the study of inflation. Although this simplified framework lacks realism, it helps us focus on important particular monetary and fiscal aspects of inflation. Later in the book we shall consider many more realistic complications, as they come up in the discussion.[1]

Inflation is defined as the percentage change in the price level. Therefore, we should take pains to identify the price level properly from the start. In the model we have developed so far, the price level P applies to the single output in the economy. Later on, when we start to deal with differentiated goods produced at home and abroad, the price level will be an average of the prices of domestic and foreign goods. In practice, inflation is normally measured by the change in the consumer price index (CPI), the average price of the basket of goods and services consumed by a representative household.

We need to distinguish early on between *once-and-for-all* price increases and *persistent* price rises. The former result from particular shocks, such as one-time increases in world oil prices, while the latter usually result from some chronic economic problem, such as a large and persistent budget deficit. It is also useful to distinguish inflations by their severity. In some countries, such as West Germany and Switzerland, inflation has been below 10 percent per year for decades. In others, price rises have exceeded 20 percent per year for long periods of time. In a third group of countries, including Argentina, Brazil, and Peru, inflation has exceeded 100 percent per year for most of the 1980s.

[1] In later chapters, we discuss the implications of a breakdown in purchasing power parity. We also analyze the effects of different forms of wage-setting behavior on the dynamics of inflation. In fact, one of the most interesting aspects of inflation, the so-called Phillips curve, is importantly affected by the nature of wage bargaining. These and other issues are the main focus of Chapters 15 and 16.

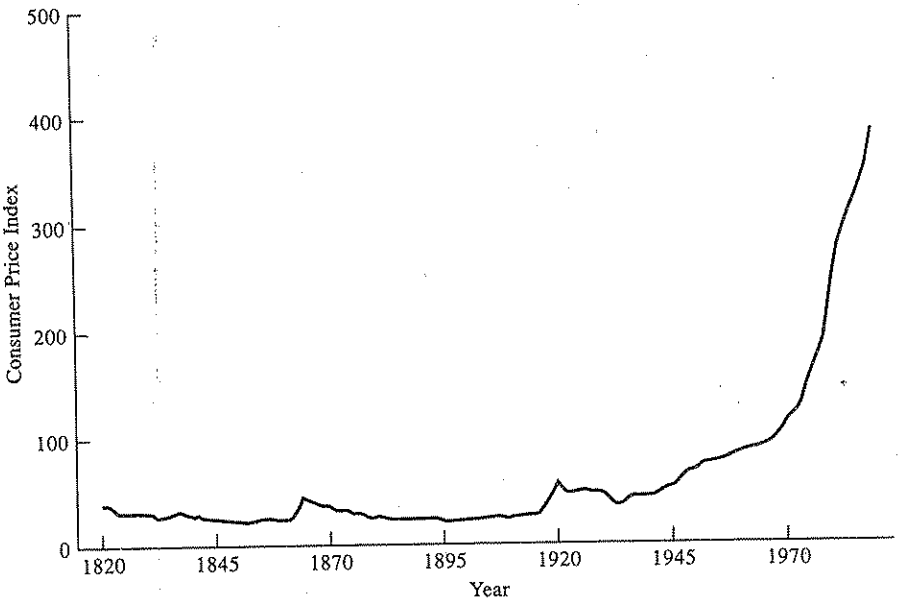


Figure 11-1
Evolution of the Price Level in the United States, 1820–1990 (CPI, 1967=100)

(Data from 1820–1970: U.S. Historical Statistics; *data from 1970–1990:* Economic Report of the President, 1991.)

In some extreme episodes, inflation has reached an excess of 50 percent per month (an annual rate of about 13,000 percent per year), in which case the high inflation is termed a *hyperinflation*.[2] Hyperinflations are very rare, and also fascinating—except perhaps for the residents of the afflicted country! Recent hyperinflations include those in Bolivia during 1984–1985 and those in Peru, Argentina, Brazil, Nicaragua, Poland, and Yugoslavia during 1989. (The problem of ending very high inflations is treated in Chapter 23.)

Throughout history, the United States has generally had a low rate of inflation. The highest sustained inflation during the post–World War II period came in the late 1970s, when inflation reached about 10 percent per year. Inflation was brought down in the early 1980s, partly through a sharp rise in unemployment, and partly through a fall in the international price of oil. Figure 11-1 shows the long-term path of the *price level* in the United States. Note that during the long period from 1820 to 1933, the United States was on the gold standard, with the result that money supply growth and therefore inflation were linked to variations in the amount of gold available. Prices rose relatively rapidly after new gold discoveries in 1849 and 1896, but they declined during long stretches between these discoveries, such as the

[2] Philip Cagan introduced the formal criterion for hyperinflation as a case of inflation in excess of 50 percent per month. Cagan's great contribution to the subject is "The Monetary Dynamics of Hyperinflation," in Milton Friedman, ed., *Studies in the Quantity Theory of Money* (Chicago and London: University of Chicago Press, 1956).

TABLE 11-1

INFLATION IN SELECTED AREAS, 1981–1990

Area	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Industrial countries*	8.8	7.4	5.2	4.4	3.7	3.4	3.0	3.3	4.0	4.1
Asia developing countries†	10.7	6.4	6.6	6.1	6.0	8.7	9.5	14.4	11.7	7.9
Western hemisphere developing countries†	59.7	67.1	108.7	133.5	145.1	87.8	130.9	286.4	533.1	768.0

** Average of percentage changes in GNP deflators for individual countries weighted by the average U.S. dollar value of their respective GNPs over the preceding three years.*
† Percentage changes of geometric averages of indices of consumer prices for individual countries weighted by the average U.S. dollar value of their respective GNPs over the preceding three years.
Source: *International Monetary Fund,* World Economic Outlook, *May 1991.*

period between 1873 and 1896. This pattern of rising and falling prices kept inflation low during an entire century: indeed, the price level in 1913 was below the price level in 1820! After World War II, the progressive delinking of the currency from gold gave the Fed more freedom to increase the money supply. This allowed more room for inflation, and the price level has risen in every year since 1945.

Table 11-1 presents the inflation rates of different regions of the world for the period 1981–1990. The remarkably high levels of inflation in the developing countries of the Western hemisphere, mainly Latin America, during the 1980s is particularly striking. Probably no other region in economic history, with the possible exception of Central Europe in the 1920s, has experienced such high rates of inflation for such a prolonged period of time. In the Latin American countries, this high inflation can be traced to large and persistent budget deficits which are monetized by the central bank—that is, they are paid for by printing money. The heavy foreign debt burden of the Latin governments has played a fundamental role in the process, both by enlarging the budget deficits and by limiting the government's ability to finance these deficits by borrowing rather than by monetization. The process of money financing of budget deficits is a subject of much interest in this chapter.

11-1 GOVERNMENT DEFICITS AND INFLATION

Suppose that the public sector spends more than it takes in. We saw in Chapter 9 that it can pay for the deficit in three ways: it can borrow from the public, it can run down foreign-exchange reserves, or it can print money. A government that has borrowed a lot in the past has already accumulated a heavy debt, and it will have difficulties borrowing further, either domestically or from abroad, because of doubts about its capacity to service its debts. Typically, such a government has also exhausted its stock of foreign-exchange reserves after a prolonged period of large budget deficits. For these reasons, a government with chronically large budget deficits is likely

to find itself eventually compelled to pay for those deficits by printing money.

Now, one can ask why the government continues to run a deficit in the face of very high inflation. In principle, it can avoid a deficit through a combination of spending cuts and tax increases. The problem is that these kinds of policies are hard to implement, and they often require mustering a majority in the legislature that may be very difficult to assemble. Powerful organized forces—lobbying groups, trade unions, political parties in a coalition government—find it possible to exercise a veto over measures that hit the particular groups they represent. Nouriel Roubini and Jeffrey Sachs have shown that coalition governments have a harder time closing budget deficits than do governments in which a majority party rules by itself.[3]

Budget Deficits Under Fixed Exchange Rates

Let us now consider an economy with an ongoing budget deficit. In this case, we assume that it is operating under fixed exchange rates. Further, let us say that the government does not have access to direct borrowing from the public, either at home or abroad, and that it has exhausted its foreign-exchange reserves. Thus, its only option is to borrow from the central bank.

To put this in a formal framework, we start from the consolidated government budget constraint. We already analyzed this in Chapter 9, more specifically in equation (9.12), which we rewrite as

$$(D^g_{\$} - D^g_{\$-1}) + (Mh - Mh_{-1}) - E(B^*_c - B^*_{c-1}) = P(G + I^g - T) + iD^g_{\$-1} - E(i^*B^*_{c-1})$$

where a "*," as usual, denotes a foreign variable (B^*_c is the stock of net foreign assets held by the central bank).

The right side of the equation is the fiscal deficit: the excess of government spending (current spending, investment, and interest payments on domestic debt) over government income (taxes plus interest receipts on foreign-exchange reserves). The left side of the equation shows the sources of deficit finance. Now, if the government cannot borrow from the public, then $(D^g_{\$} - D^g_{\$-1}) = 0$. For the sake of simplicity, let us say that high-powered money (Mh) is equal to the money supply (M). Finally, let us define DEF as equal to the nominal budget deficit, deflated by the price level: $DEF = (G + I^g - T) + (iD^g_{\$-1} - Ei^*B^*_{c-1})/P$.

Under these conditions, equation (9.12) becomes

$$(M - M_{-1}) - E(B^*_c - B^*_{c-1}) = P(DEF) \qquad \textbf{(11.1)}$$

With fixed exchange rates, the stock of money is determined solely by money demand, as we saw in the previous chapter. Recall that in such an exchange regime the equilibrium quantity of money is determined from equation (10.9) as

$$M = \frac{EP^*Q}{V(i^*)}$$

more generally $M = \phi Mh$ where ϕ is money multiplier.

[3] See their article "Government Spending and Budget Deficits in the Industrial Economies," *Economic Policy*, Spring 1989.

Similarly,

$$M_{-1} = \frac{E_{-1}P^*_{-1}Q_{-1}}{V(i^*_{-1})}$$

But if the exchange rate is fixed, then $E = E_{-1}$; with full employment (and no growth), $Q = Q_{-1}$; and since world variables are given and constant in our analysis, $P^* = P^*_{-1}$ and $i^* = i^*_{-1}$. With all these assumptions, M will simply equal M_{-1}. Using this result in (11.1), we get

$$-E(B^*_c - B^*_{c-1}) = P(DEF) \qquad \textbf{(11.2)}$$

This statement tells us something quite fundamental: if money demand is constant, and if the government can borrow only abroad or from the central bank, then, in effect, all borrowing is from abroad, even if the government actually *tries* to borrow from the central bank! Any attempt to borrow from the central bank simply leads to an increase of high-powered money that, in turn, causes a loss of reserves and a subsequent reversal of the money supply increase. Thus, a finance minister who decides to cover a deficit by borrowing from the central bank will indirectly be financing the deficit out of international reserve losses.

This outcome has important implications for real-world events. Governments, especially in the developing world, often find themselves with few available sources of financing. When they are virtually unable to borrow from domestic residents, and when their international creditworthiness is severely impaired abroad, their only option to finance a deficit is to borrow from the central bank. But as we have seen, according to our benchmark result, direct borrowing from the central bank, under fixed exchange rates and perfect capital mobility, leads indirectly to losses in foreign reserves. It is as if the budget deficit were being paid for directly by running down foreign reserves.

Take, for example, the case of Chile in 1970–1973, shown in Figure 11-2a. During this period, the public-sector deficit swelled from slightly over 6 percent of GDP to about 30 percent of GDP, mostly financed by monetary emission of the central bank. Not surprisingly the level of international reserves dropped from 41 percent of annual imports to a mere 9 percent of imports. Thus, the average level of reserves in 1973 covered about one month of imports, which is extremely low by any prudent standard. In effect, a large part of the fiscal deficit was financed by spending international reserves. A similar picture of Peru emerges for the period 1985–1988, as shown in Figure 11-2b.

What does all this tell us about inflation? As long as foreign reserves continue to be available, the country can avoid inflation. The exchange rate remains fixed at its pegged level, and the external price level is given. With purchasing power parity, domestic prices also remain stable. If the fiscal deficits persist, however, the government eventually runs out of reserves. At that point, when domestic residents attempt to exchange their home money for foreign currency, the government cannot continue to intervene in the market. The central bank has no option but to allow the exchange rate to depreciate, either as the result of devaluation of the local currency or because it allows the domestic money to start floating. The collapse of a pegged exchange-rate system when the central bank runs out of reserves is called a *balance-of-payments crisis*.

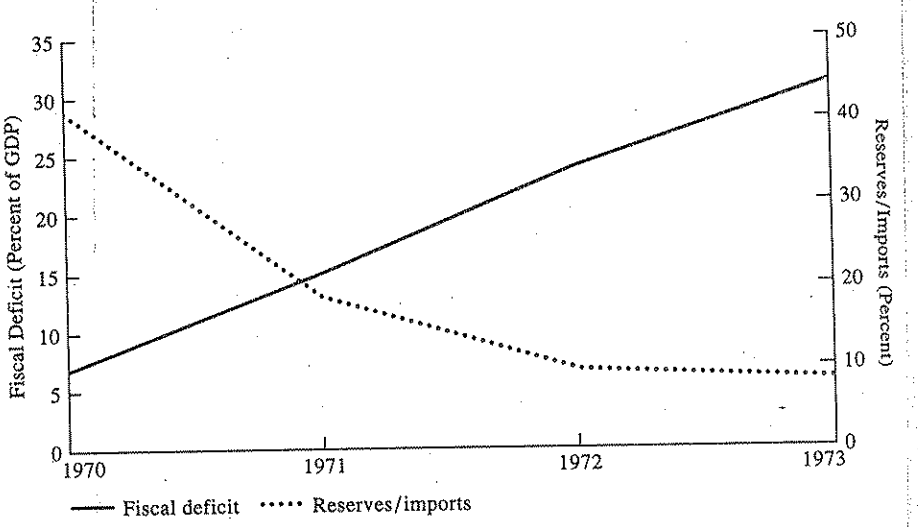
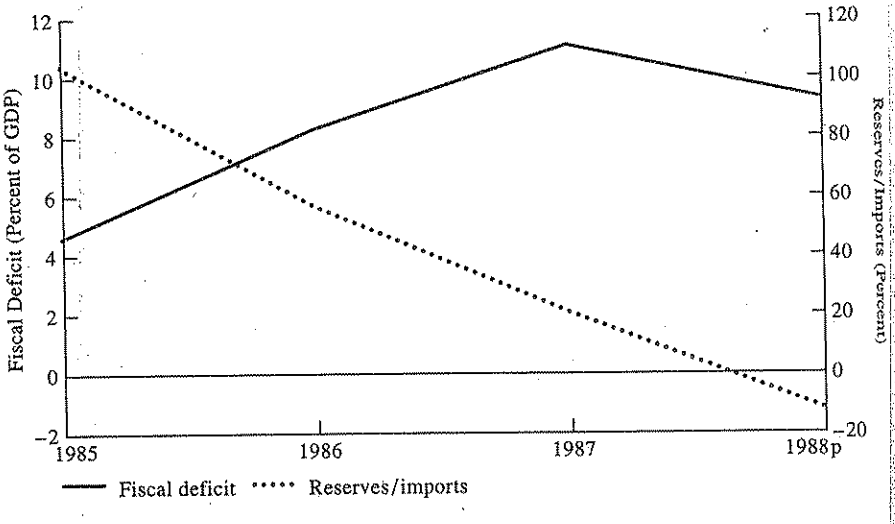


Figure 11-2a
Public Sector Deficits and International Reserves in Chile, 1970–1973

(From F. Larrain, "Public Sector Behavior in a Highly Indebted Country: The Contrasting Chilean Experience," in F. Larrain and M. Selowsky, eds., The Public Sector and the Latin American Crisis, *San Francisco: ICS Press, 1991.)*

Figure 11-2b
Public Sector Deficits and International Reserves in Peru, 1985–1988

(From C. Paredes, "The Behavior of the Public Sector of Peru—A Macroeconomic Approach—and Central Bank of Peru," in F. Larrain and M. Selowsky, eds., The Public Sector and the Latin American Crisis, *San Francisco: ICS Press, 1991.)*



p = Preliminary.

The breakdown of a fixed exchange-rate regime is often accompanied by great political drama and a sense of crisis. In one of several studies of this issue, Richard Cooper analyzed 24 devaluations in developing countries over the years between 1953 and 1966.[4] In about 30 percent of the cases, Cooper found, the government in power fell within a year of the devaluation. Of course, this does not say that the government fell *because* of the devaluation. But it is interesting that only 14 percent of governments that did not devalue their currencies fell within a year. For finance ministers, the evidence is even stronger: 60 percent of those who presided over a devaluation lost their job in the following year, as compared to only 18 percent in the group that did not move their exchange rates. Thus, we can sympathize with the reluctance of finance ministers to devalue.

Budget Deficits Under Floating Exchange Rates

Let us continue with the hapless finance minister who presides over continuing fiscal deficits after the central bank has run out of reserves. This time, however, the exchange-rate system changes from fixed to floating. Under these circumstances, the government cannot borrow and it no longer has foreign-exchange reserves, so the only way to finance the deficit is through money creation. With $B_c^* - B_{c-1}^* = 0$, equation (11.1) becomes

$$\frac{(M - M_{-1})}{P} = DEF \tag{11.3}$$

The real value of the deficit is now equal to the real value of the change in the money supply.

This change in the money supply is going to cause inflation. By manipulating equation (11.3) we can draw a link between the budget deficit and the inflation rate. We first rewrite equation (11.3) as

$$DEF = \left[\frac{(M - M_{-1})}{M}\right]\left(\frac{M}{P}\right) \tag{11.3'}$$

Next, from equation (10.9), we borrow the fact that $M = (PQ/V)$. If we assume that DEF is constant period to period and that Q also does not change, these assumptions, in turn, guarantee that velocity (V) is also constant. Thus, $M_{-1} = (P_{-1}Q/V)$. Replacing M and M_{-1} in the first term of the right side of equation (11.3'), and canceling the common terms, we obtain

$$DEF = \left[\frac{(P - P_{-1})}{P}\right]\left(\frac{M}{P}\right) \tag{11.4}$$

By multiplying the right-hand side by P_{-1}/P_{-1}, we can write

$$DEF = \left[\frac{(P - P_{-1})}{P_{-1}}\right]\left(\frac{P_{-1}}{P}\right)\left(\frac{M}{P}\right) \tag{11.4'}$$

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[4] This important study by Richard Cooper is "Currency Devaluation in Developing Countries," *Essays in International Finance*, No. 86 (Princeton, N.J.: Princeton University Press, June 1971).

Finally, we can use the definition of inflation, $\hat{P} = (P - P_{-1})/P_{-1}$, and the fact that $P/P_{-1} = 1 + \hat{P}$, to rewrite (11.4') in the form that we want to use here:

$$DEF = \left[\frac{\hat{P}}{(1 + \hat{P})}\right]\left(\frac{M}{P}\right) \tag{11.5}$$

Expression (11.5) has very powerful implications. Under floating rates, the deficit results in inflation, and there is a definite link between the size of the deficit and the rate of inflation. Each deficit leads to a given rate of inflation. Subject to the qualifications that follow, higher deficits are accompanied by higher inflation rates.

One way to describe (11.5) is to say that the budget deficit is being financed through an *inflation tax* on real money balances. The tax rate is $\hat{P}/(1 + \hat{P})$, where $\hat{P}$ is the inflation rate. The tax base is the level of real money balances, M/P. The product of the *tax rate* and the *tax base* is the total tax revenue, which is used to finance the budget deficit.

Why do we characterize the right-hand side of equation (11.5) as an "inflation tax"? In what sense does the government receive the tax revenues from this tax? In essence, the government is paying for its expenditures by printing money. The real goods and services that the government purchases with the money that it prints each period is the measure of the "tax" revenue collected by the government as the result of this inflationary policy. The increase in the money supply each period is causing inflation. That is, the money printing is the precise way that the government collects the inflation tax.

The inflation tax is, of course, a special kind of tax; for example, its collection requires neither the approval of any law nor the administration of any tax collection agency. The tax is paid automatically as households suffer the loss in value of their money holdings each period as the price level rises. (We shall see later on how to measure the precise burden on households of the inflation tax.)

Remember the key elements in the chain of causation that links the budget deficit to inflation. The deficit leads to an increase in the nominal supply of money, as the central bank buys the treasury bonds issued by the deficit-ridden government. At given prices and interest rates, there is an excess supply of money, which, as households attempt to convert part of their excess money into foreign assets, causes the exchange rate to depreciate. With no reserves at its command, the central bank cannot intervene to stop the depreciation. And given the presence of purchasing power parity, the depreciation in the exchange rate leads to price inflation at the same rate.

Consider now a numerical example based on equation (11.5), where we express magnitudes as a proportion of GDP. (To get this, we simply divide both sides of the equation by GDP.) Suppose that a country with money balances at 30 percent of GDP is running a fiscal deficit of 5 percent of GDP. What inflation rate will be needed to finance such a deficit? The answer is 20 percent. You can verify this by performing the computations in equation (11.5). Note that with the same deficit, but real money balances of only 15 percent of GDP, the inflation rate required is 50 percent. What has happened? The base of the inflation tax has declined, meaning that collecting the same revenue collection (the 5 percent of GDP needed to finance the deficit) now requires a higher tax rate.

TABLE 11-2

DEFICIT FINANCING AND THE EXCHANGE-RATE REGIME

	Exchange Rate Regime	
Deficit Financing	**Fixed**	**Flexible**
Direct mechanism	Money creation	Money creation
Ultimate mechanism	International reserves	Inflation tax

We now have an important insight into the inflationary process. Under fixed exchange rates, the government can run a fiscal deficit without generating inflation, even when the financing is done through central bank purchases of government debt. This can happen because under fixed exchange rates, agents get rid of their excess money through purchases of foreign assets, and the deficit ends up being financed through a loss of central bank reserves. But reserves eventually dry up. At that point, the central bank can no longer defend the parity of its currency, and the exchange rate is left to depreciate. From that point on, continuing deficits are translated into a floating exchange rate, with a persistent depreciation of the domestic currency. With purchasing power parity at work, the inflation rate will equal the rate of currency depreciation. In effect, then, the financing for the deficit comes from the inflation tax. Table 11-2 summarizes the major steps in the process of financing a fiscal deficit under fixed and flexible exchange rates.

There is, then, an important link between budget deficits and the choice of an exchange-rate system. Countries with chronic and large budget deficits will find it hard to maintain a fixed exchange rate, and either they will have to go to a floating rate or at least they will frequently have to adjust the currency parity. Several countries in Latin America have had large and persistent fiscal deficits which have made it impossible for them to maintain a stable currency. But the issue is also relevant for those countries in the European Monetary System that have high fiscal deficits. For example, Italy has generally had larger budget imbalances than her EMS partners. At the same time, within the EMS the Italian lira has been pegged to the French franc, the Deutsche mark, the Dutch guilder, and so on. On several occasions, the lira has had to be devalued vis-à-vis the other currencies.

Balance-of-Payments Crises: The Transition from Fixed to Floating Rates

We can now take a closer look at the precise period of a *balance-of-payments crisis,* that is, when the central bank runs out of reserves and is forced to abandon the fixed exchange-rate parity. As before, the starting point is an underlying fiscal deficit, under fixed exchange rates, which slowly reduces the amount of reserves held by the central bank. With a finite amount of reserves, it is clear that the authorities will not be able to peg the exchange rate indefinitely. In addition, the public may well see the collapse coming and take actions which, in fact, help to trigger the sudden exhaustion of foreign-exchange reserves, as people rush *en masse* to convert their domestic currency into foreign currency just on the eve of the exchange-rate crisis.

Let us look closely at what happens to the demand for real money balances during the transition from low inflation under fixed exchange rates to high inflation under floating rates. Once the exchange-rate depreciation starts, the domestic interest rate rises. To see this, remember that perfect capital mobility requires that

$$(1 + i) = \left(\frac{E_{+1}}{E}\right)(1 + i^*)$$

Thus, as soon as the depreciation is underway (so that $E_{+1} > E$), the domestic interest rate (i) rises. Velocity, an increasing function of i, rises and this causes the demand for real money balances to decline, since $M/P = Q/V(i)$.

During the transition between the fixed rate and the floating rate, the demand for real money balances declines. Meanwhile, the public may understand the way the economy works well enough to know that the exchange rate is about to collapse. (This is a good assumption in a country like Argentina, which has suffered a collapse of a fixed exchange-rate system many times in recent years.) People will also understand that at the moment of the exchange crisis they do not want to be holding large real money balances because inflation is about to increase. They will therefore convert their excess money into foreign assets on the eve of the collapse of the exchange rate. If they wait until after the collapse, and then suddenly try to convert their domestic currency into foreign assets, the central bank will no longer be willing or even able to buy the domestic currency. In addition, the exchange rate will depreciate sharply as people flee out of domestic money, and households that still hold excess balances will suffer capital losses that they can avoid if they convert their money in time.

During this whole process, we can see an interesting pattern of reserve losses emerging over time. If the central bank starts with a large stock of foreign-exchange reserves, then reserves fall gradually, with the loss of reserves equaling the budget deficit, as described in equation (11.2). Then, just as reserve levels are getting so low that the public suspects an imminent collapse of the exchange-rate system, households suddenly move to convert massive amounts of domestic money into foreign assets because they anticipate a sharp rise in inflation.

As the public rushes in to reduce its holdings of domestic currency, the reserve loss becomes an avalanche. In fact, the stampede of households to change money into foreign assets, in what is called a *speculative attack* against the central bank's reserves depletes the bank's remaining reserves and pushes the economy off of fixed exchange rates and into floating exchange rates and high inflation. The overall process of the collapse of the fixed exchange rate is termed a *balance-of-payments crisis*. (See Box 11-1.) This process has been analyzed with great clarity by Paul Krugman of the Massachusetts Institute of Technology.[5]

The dynamics of a balance-of-payments crisis are depicted in Figure 11-3. Under fixed exchange rates, the central bank starts at time 0 with a level of reserves B_0^*. As time goes by, the fiscal deficit causes a decline in the

[5] One of the first rigorous analysis of the problem is his article "A Model of Balance-of-Payments Crises," *Journal of Money, Credit and Banking*, August 1979.

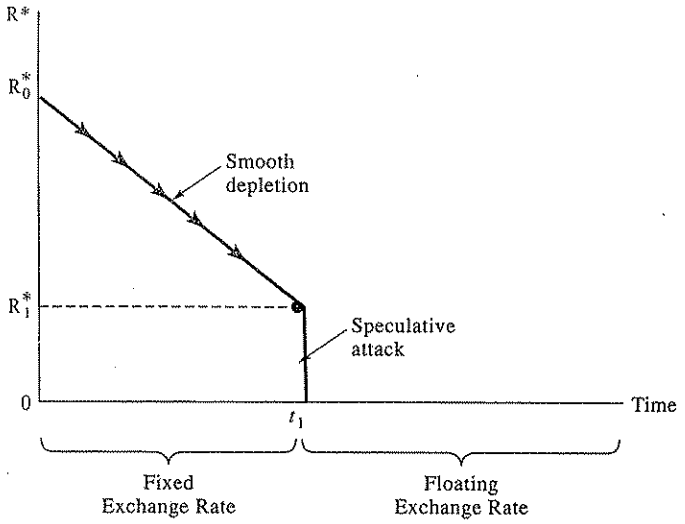
Box 11-1

A Case of Balance-of-Payments Collapse: Argentina in 1989

A clear example of a balance-of-payments collapse occurred in Argentina in the spring of 1989. The level of reserves at the central bank had been fairly stable at around $3 billion in the last quarter of 1988. By early 1989, however, the budget deficit proved uncontrollable, confidence in the economic program dwindled, and the central bank started to lose reserves. With foreign financing unavailable and domestic borrowing prohibitively expensive, the authorities initially dealt with the growing demand for foreign currency by drawing down their external assets. Thus, in the two months from December 1988 to February 1989, the central bank lost $1.1 billion of reserves, roughly one-third of its foreign-exchange holdings. The pegging of the exchange rate was held; that is, it was defended with official reserves, and it remained stable during this period.

When the central bank was still holding about $1.6 billion of reserves in March 1989, the speculative attack occurred. When foreign reserves at the bank had declined by another $600 million in March, the authorities realized that they could not maintain the exchange rate pegged for much longer. To defend the few remaining reserves, the central bank devalued by almost 200 percent between March and April. But that was not enough. In just two months, the exchange rate went from 20 australs per dollar in March to 200 in late May, a depreciation of 900 percent! Central bank reserves dwindled to a mere $930 million in June. Uncertainty exacerbated by a presidential election prevented calm from returning to the economy, however. During a respite achieved in August 1989 (which proved to be short-lived), the exchange rate stood at 655 australs per dollar, over 40 times its level at the end of 1988.

Figure 11-3
The Collapse of a Fixed Exchange-Rate Regime



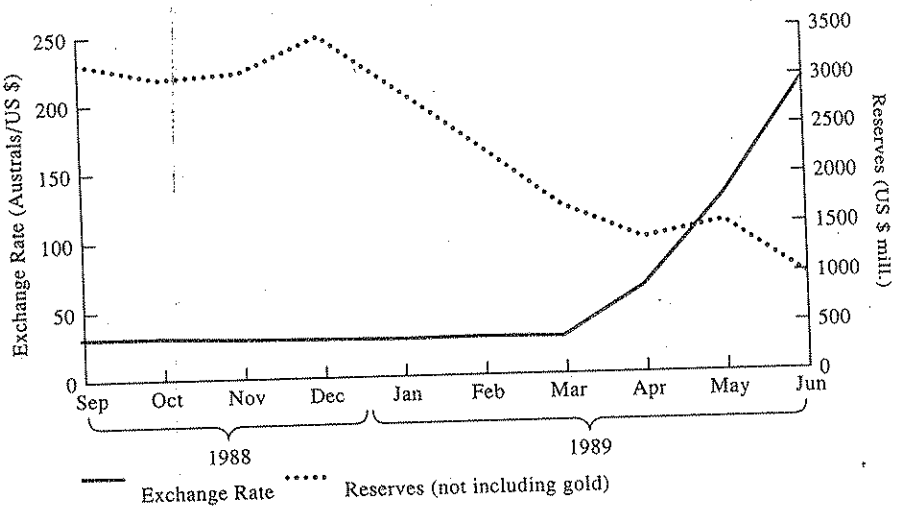


Figure 11-4
The Exchange Rate and International Reserves in Argentina, 1988–1989

(From ECLA, Economic Panorama of Latin America, 1989, *and International Monetary Fund,* International Financial Statistics, *various issues.)*

holdings of official foreign exchange. When the level of reserves reaches R_1, at time 1, a speculative attack against the currency depletes the reserves.[6] From then on, the central bank cannot any longer intervene in the foreign-exchange market, and the economy enters a regime of floating rates.

Can Domestic Borrowing Be Used To Avoid Inflation?

So far, we have looked at cases where a fiscal deficit is financed either by drawing down international reserves or by an open inflation. There are other ways to finance a deficit, of course, at least in the short run. The most important of them is the possibility of financing the deficit by borrowing from domestic residents. In this case, the treasury issues bonds which are purchased not by the central bank but by private agents. Borrowing of this sort allows the government to sustain a deficit without reserve losses or increases in the money supply.

Financing the fiscal deficit with higher domestic debt often postpones the day when the inflation tax comes into effect. The problem with domestic borrowing is that, although it provides resources today, it itself is a debt that has to be serviced tomorrow. Interest payments on government debt add to fiscal expenditures, and thereby increase the deficit over time. This may lead to higher inflation in the future, a problem that does not occur when money financing is used right from the beginning. In other words, borrowing today might postpone inflation, but at the risk of even higher inflation in the future. Now let us examine this proposition in further detail.

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[6] Reserves need not actually fall to zero. Instead, they fall to a level below which the central bank refuses to intervene in the foreign-exchange market. This level can still be positive, but the central bank feels that its "last reserves" should be kept to protect the country in case of a natural disaster, war, or some other dire eventuality, rather than used up defending the exchange rate.

Suppose a government starts with no debt and a balanced budget. Then it decides to cut taxes or increase expenditures, and it starts running a deficit. If this deficit is financed with money (under floating exchange rates), people will cover the deficit by paying an inflation tax today and the government will not accumulate obligations for the future. If instead the deficit is covered by selling domestic debt to the public, then the government will increase its liabilities. If the *primary deficit*, that is, the deficit excluding interest payments, remains unchanged as the domestic debt accumulates, the overall deficit will grow because of the rising interest burden on the debt. If the government tries to pay for that rising interest bill through still more domestic borrowing, the debt-to-GNP ratio will tend to grow over time.[7]

At some point, buyers of bonds will be unwilling to hold more public debt in their portfolios, because they doubt that the government will be able to service any additional debt. Then the government has no option but to use money financing. But by now, increases in the money supply each period will also have to cover the higher interest payments on the domestic debt. Clearly, inflation cannot be postponed forever through domestic borrowing, as Thomas Sargent and Neil Wallace have pointed out in an article suggestively entitled "Some Unpleasant Monetarist Arithmetic."[8]

Notice, however, that a future increase in inflation is not the inevitable consequence of bond-financed deficits. Debt financing may truly give the government time to implement the expenditure cuts or tax increases that will eventually close the deficit. Thus, a government may well have a rational, noninflationary reason to run a budget deficit. All we are saying is that although debt financing *by itself* does not allow a government to escape from inflation, it may buy time to carry out other strategies that will.

11-2 The Inflation Tax and Seigniorage

At this point we need to differentiate between two closely related concepts: the *inflation tax* and *seigniorage*. The former term refers to the capital losses suffered by money holders as a result of inflation. As we saw earlier, the inflation tax (IT) can be measured as

$$IT = \left[\frac{(P - P_{-1})}{P}\right]\left(\frac{M}{P}\right) \tag{11.6}$$

Seigniorage (SE), is the revenue collected by the government as a result of its monopoly power to print money. Printing money is virtually without cost,

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[7] For this to happen, the real interest rate on the government debt must be higher than the real growth rate of the economy. This condition gives rise to a Ponzi scheme in which the government's attempt to service the old debt by issuing new debt results in a debt-GNP ratio that would rise without bound. In this discussion, we assume that the condition holds in which the real interest rate is higher than the growth rate.

[8] Published in the *Federal Reserve Bank of Minneapolis Quarterly Review*, Fall 1981, this article gave rise to an interesting controversy on the subject. It was followed three years later by Michael Darby with "Some Pleasant Monetarist Arithmetic," *Federal Reserve Bank of Minneapolis Quarterly Review*, Spring 1984. Another contributor to the debate was Bennett McCallum in his "Are Bond Financed Deficits Inflationary?" *Journal of Political Economy*, February 1984.

and the bills and coins can be exchanged for goods and services. Thus, seigniorage may be measured as the purchasing power of the money put into circulation in a given period:

$$SE = \frac{(M - M_{-1})}{P} = \left[\frac{(M - M_{-1})}{M}\right]\left(\frac{M}{P}\right) \qquad (11.7)$$

Under certain conditions, in particular when households want to maintain a constant value of real money balances, the inflation tax and seigniorage are equal. Suppose that $M/P = M_{-1}/P_{-1}$. Since M_{-1}/M is then equal to P_{-1}/P, we can write $(M - M_{-1})/M$ as $(P - P_{-1})/P$. Thus, $SE = IT$ when M/P does not change over time.

Although SE and IT may on occasion be equal, however, they are not the same thing. One simple illustration should clarify the difference between the two. Suppose that inflation is zero and that the exchange rate is fixed. The inflation tax is evidently zero as well. Now suppose that a decline in world interest rates leads to a decline in domestic interest rates. The velocity of money falls, and the demand for real money balances, M/P, increases. In fact, households will then increase their money balances by selling foreign assets to the central bank in return for domestic currency. The central bank gains international reserves at the tiny cost of printing up the increased nominal money that the public wants to hold, and the government can use those foreign-exchange reserves to finance a larger budget deficit. In essence, this rise in money demand has given the government some "free" resources. This gain in purchasing power is precisely what is meant by seigniorage and measured in equation (11.7).

To what extent do governments use seigniorage as a source of revenue in the real world? All the countries shown in Table 11-3 used seigniorage, but in very different magnitudes, during the period 1975–1985. Notice that seigniorage in Germany was only 3.8 percent of government revenues; in Canada and the United States it was in the order of 6 percent. By contrast, Peru used seigniorage to collect about one-third of government revenue from other sources. But the highest proportion of seigniorage to total revenue during 1975–1985 was posted by Bolivia, where seigniorage provided significantly more resources for the public sector than all other sources of revenue. It is not surprising, then, that Bolivia experienced one of the worst hyperinflations in world history at the end of the period.

We now turn to some specific topics concerning the inflation tax and seigniorage.

The Inflation Tax and the Household Budget Constraint

Inflation has important effects on the household budget constraint. To see how this works, we start with the standard budget constraint which shows that disposable income net of consumption must equal the accumulation of money or bonds:[9]

$$P(Q - T) + iB_{-1} - PC = (B - B_{-1}) + (M - M_{-1}) \qquad (11.8)$$

[9] We ignore investment and accumulation of foreign bonds, without affecting the point of this section.

TABLE 11-3

SEIGNIORAGE IN SELECTED COUNTRIES, 1975–1985*

Country	As a % of Nonseigniorage Government Revenue	As a % of GDP
United States	6.02	1.17%
Canada	6.61	1.26
United Kingdom	5.31	1.91
Italy	28.00	6.60
France	7.19	2.73
Germany	3.85	1.08
Bolivia†	139.50	5.00
Brazil	18.36	4.13
Chile	7.48	2.39
India	14.30	1.81
Korea	10.70	1.84
Mexico	18.70	2.71
Philippines	7.79	0.99
Thailand	7.06	0.94
Turkey‡	24.40	5.09
Venezuela	10.76	3.05
Peru	29.71	4.92
Israel	24.55	2.99

* *Average for the period of annual data.*
† *Refers to the period 1977–1985.*
‡ *Does not include 1982.*
Source: *International Monetary Fund,* International Financial Statistics, *various issues, 1975–1985.*

this should use M_{-1} not M.

From equation (11.8) we can solve for consumption (C) as

$$C = (Q - T) - \frac{B}{P} + \frac{(1 + i)B_{-1}}{P} - \frac{(M - M_{-1})}{P}$$

With some minor manipulation,[10] we can express this as

$$C = \left[Q + r\left(\frac{B_{-1}}{P_{-1}}\right) - T\right] - \left[\left(\frac{B}{P}\right) - \left(\frac{B_{-1}}{P_{-1}}\right)\right] - \left[\frac{(M - M_{-1})}{P}\right] \quad (11.9)$$

[10] Before we proceed, we need to decompose the nominal interest rate into the real rate and the inflationary component. The manipulation, then, is

$$\frac{(1 + i)B_{-1}}{P} = (1 + r)\frac{[1 + (P/P_{-1}) - 1]B_{-1}}{P} = \frac{(1 + r)B_{-1}}{P_{-1}}$$

From here, equation (11.9) directly follows.

Notice that the first term on the right-hand side of equation (11.9) is the disposable income of households using the *real* rather than the nominal interest rate. The second term is the change in the real value of bonds from the previous period to the current one. The third term is the change in the nominal stock of money evaluated at current prices, $(M - M_{-1})/P$, which corresponds to the definition of seigniorage.

Remember that if $M/P = M_{-1}/P_{-1}$, then seigniorage is also equal to the inflation tax as defined in (11.6). Therefore, under the assumption that real money balances are not changing period to period, we can rewrite (11.9) as (11.9′):

$$C = \left[Q + r\left(\frac{B_{-1}}{P_{-1}}\right) - T\right] - \left[\left(\frac{B}{P}\right) - \left(\frac{B_{-1}}{P_{-1}}\right)\right] - IT \qquad \textbf{(11.9′)}$$

This leads us to a straightforward, but very important point. If people want to maintain their real stock of money in an inflationary environment, they will have to make a sacrifice and reduce their consumption by the amount IT. Each period, inflation reduces the real value of money balances. Thus, each period, households have to save merely to replenish their real money balances to desired levels. The exact amount of saving required to keep real money balances constant is equal to the inflation tax.

To put this another way, the conventional measure of household disposable income is $Q + r(B_{-1}/P_{-1}) - T$. But this overstates true disposable income because the household must devote some of its income to accumulating the nominal money balances needed just to keep the real money balances from falling. A corrected measure of disposable income that takes inflation into account would be $Q + r(B_{-1}/P_{-1}) - T - IT$.

The Laffer Curve for the Inflation Tax

In Chapter 7 we looked at the Laffer curve for taxes, which has the shape of an inverted U (see Figure 7-5). The idea there was that, starting from a low tax rate, fiscal revenues increase as the tax rate goes up, but only up to a point. There is some tax rate at which the maximum revenue collection is reached. Beyond that point, further increases in the tax rate bring about a *decline* in revenues.

The reason explained there was as follows. Tax revenues are equal to the tax rate times the tax base, where the tax base is the thing being taxed. The revenues from an income tax, for example, equals the rate of the income tax times the amount of household income. As the tax rate rises, however, households may cut back on their labor effort. Even though the tax rate goes up, the tax base goes down, and the overall revenues may fall.

The same reasoning applies to the inflation tax. There is some inflation rate that maximizes the inflation tax of the government but beyond which the government loses revenues rather than gains revenues. In other words, there is a "Laffer curve" for the inflation tax, as shown in Figure 11-5. As drawn, curve $0ML$ represents the value of the inflation tax for different rates of inflation, assuming that the economy is in equilibrium with an *unchanging rate of inflation* period to period.

When the inflation rate is zero, revenue is also zero. As inflation increases, the tax base—in this case, the demand for real money balances—goes down. There is a maximum inflation tax shown as IT_{max}, at the inflation

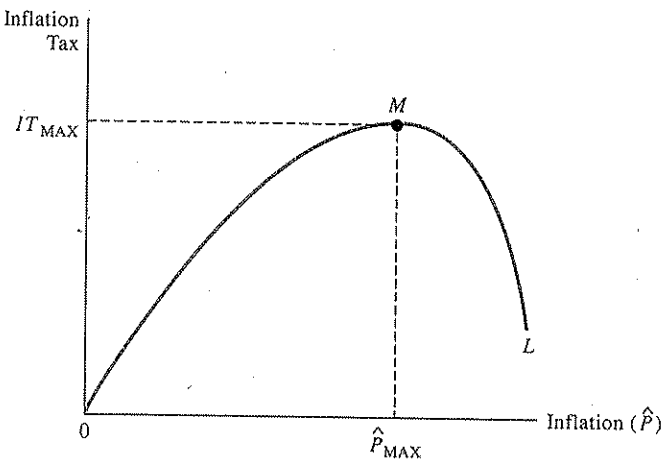

Figure 11-5
The Laffer Curve for Inflation

rate $\hat{P}_{max}$. Further increases in inflation bring about a drop in revenue, because the higher inflation is more than offset by the fall in the real money balances that are being taxed. This occurs along the segment *ML*.

This leads to an important point. Assuming a steady rate of inflation, there is a maximum deficit, equal to IT_{max}, that can be financed by printing money. It may be possible for the government to temporarily finance a deficit higher than IT_{max}, but at the cost of *accelerating* inflation rather than a steady rate of inflation.[11] If a government tries persistently to finance a deficit higher than IT_{max}, hyperinflation is the likely result. (We return to an analysis of this point in Chapter 23.)

Can a Government Earn Seigniorage under Fixed Exchange Rates?

As we have seen, under fixed exchange rates a fiscal deficit is ultimately financed out of reserves. Does this mean that such a regime makes it impossible for the government to collect seigniorage? In two important cases, the public sector can indeed collect seigniorage, while simultaneously maintaining the currency parity and its international reserves.

First is the case in which the rest of the world is also experiencing inflation. As the external price level (P^*) rises, purchasing power parity dictates that domestic prices will also increase. When this happens, the real value of money balances declines and an excess demand for money develops. This provides the central bank with an opportunity to increase the money supply just enough to offset the price increase, leaving real money balances unchanged. Notice that in this case the government collects seigniorage along with a rising price level, and does not lose any reserves.

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[11] During an accelerating inflation, it may be the case that the public is persistently underestimating the inflation that will occur each period, and is therefore holding higher money balances than it would were it to know precisely what the inflation is going to be. The government may be able to take advantage of these mistaken perceptions, at least for a while, in the sense of collecting seigniorage revenue in excess of IT_{max}.

A second possibility for seigniorage occurs when there is a growth in demand for real money balances in the economy, perhaps because of underlying GDP growth. If the central bank increases the money supply just enough to satisfy the increase in money demand, there will be no excess supply of money and no inflation (assuming, as usual, that P^* is constant). In these circumstances, the government collects seigniorage, but there is no inflation tax and no loss of reserves.

Who Gets the Seigniorage?

So far, we have assumed that the domestic country's government collects the seigniorage. But this is not always the case. In at least three interesting situations, some entity other than the domestic government receives these revenues.

If a country uses the currency of another country, it is the *issuing* country's government that gains the seigniorage. For example, both Liberia and Panama use the U.S. dollar as official currency. The absence of a local currency means that the governments of Panama and Liberia surrender the possibility of collecting seigniorage to the U.S. government. If the citizens of Liberia and Panama want to increase their money holdings, the country as a whole needs to run a balance-of-payments surplus, either borrowing the dollars or running a trade surplus to accumulate the dollars. But if the choice is to borrow, the debt in any event has to be serviced, so in either case the country has to give real goods or services in exchange for accumulating the foreign money. On the other hand, the United States gains real resources by the privilege of printing up the paper notes that the two countries will use.

This same sort of thing also happens when currency substitution exists in an economy. Currency substitution, as you saw in Chapter 8, occurs when the domestic central bank has the monopoly over creating domestic currency, but, perhaps because of a history of monetary instability, the country's residents also use a foreign currency for domestic transactions. Thus, two monies function as a medium of exchange. The seigniorage is then collected partly by the domestic government and partly by the foreign government.

There are also historical cases in which the private sector had the right to print paper money, and thereby the right to collect part or all the seigniorage. Before the creation of modern central banks, currency was often issued by private banks. Some have advocated the extreme free market position that this system of private money creation should be reimplemented.[12]

11-3 The Costs of Inflation

Inflation is widely considered a social evil. Governments usually enter office with pledges to bring it down; opposition politicians watch it closely and attack the authorities when it rears its head. The general public is highly concerned about inflation, and vigilant in tracking monthly changes in the consumer price index, the most important measure of inflation. Yet for all the preoccupation and the charged rhetoric about price increases, too little is

[12] See Friedrich Von Hayek, *Denationalization of Money* (London: Institute of Economic Affairs, 1976).

said about its real costs. It is fair to ask, then, why do people so much want to keep inflation low?[13]

Some negative effects of inflation are evident: money loses its purchasing power, and the nominal cost of goods and services increases. But if all wages and prices were adjusted upward at the same rate, would inflation still be costly? Yes it would. In contrast to the costs of unemployment, which are more evident in terms of output forgone (and which we analyze in detail in Chapters 15 and 16), many of the effects of price changes are subtle, but nonetheless important.

Before we study the main problem, however, we need to distinguish between two different kinds of inflation. *Anticipated* inflation is inflation that is built into the expectations and the behavior of the public before it occurs—in other words, it is inflation for which people are more or less prepared. *Unanticipated* inflation, on the other hand, is inflation that comes as a surprise to the public, or at least comes before people have had time to adjust fully to its presence.

Anticipated Inflation

Suppose that everybody in the economy knows that inflation will be 10 percent this year, up from zero inflation last year. In such a case, everyone will incorporate this expected higher level of inflation into their plans. Both borrowers and lenders will be interested in the *real* interest rate that they will pay and receive, and nominal interest rates on loan contracts will be adjusted upward by about 10 percent.[14] House and apartment rentals will also be adjusted upward by 10 percent. Negotiated labor contracts will stipulate wage increases to reflect the higher inflation (if workers do not have money illusion). In general, all economic decisions will incorporate expected price changes.

Inflation still imposes costs, of course, even when it is totally anticipated. First, and most obviously, the inflation is a tax, and one that has not been voted by the public. The uproar that accompanies inflation may reflect nothing more than opposition to a newly imposed tax that has not been justified by legislative action. In fact, inflation may be occurring precisely because the government cannot muster the political support to raise taxes directly.

In addition to the burden of the inflation tax (which, after all, might be recouped in part or in whole from increased public services or government transfers financed by the tax), there are pure efficiency losses associated with anticipated inflation. Recall, for example, that money is the most efficient means of payment in a modern economy. An expected higher inflation rate translates into higher interest rates, and this increases the opportunity cost of holding money. Thus, as the Baumol–Tobin framework specifies,

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[13] For an analysis of the costs of inflation, see Stanley Fischer and Franco Modigliani, "Towards an Understanding of the Real Effects and Costs of Inflation," *Weltwirtschaftliches Archiv.*, 1978, pp. 810–833.

[14] The statement that the nominal interest rate increases by the same percent as inflation is an approximation. The nominal interest rate (i) that maintains the real rate (r) when inflation goes to 10 percent is given by the following equation: $(1 + r)(1 + \dot{P}) = (1 + i)$. As you have seen before, the lower the level of inflation, the more accurate the approximation.

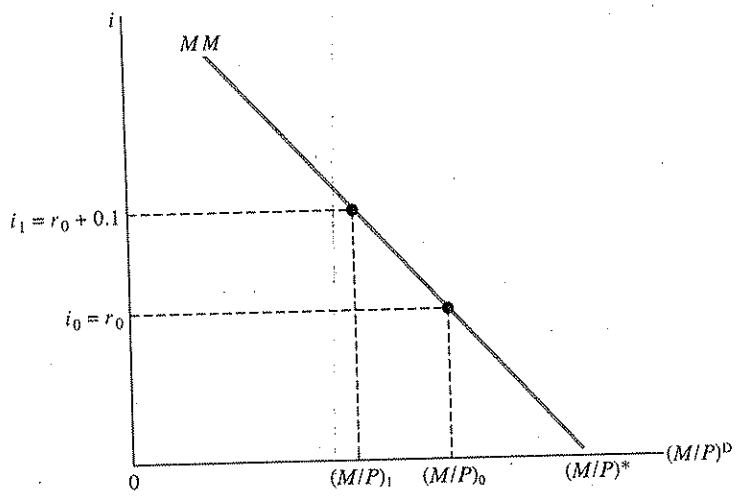

Figure 11-6
The Optimal Quantity of Money in a Partial Equilibrium Framework

people reduce their average money balances, make more trips to the bank, and they rush to make purchases to stay ahead of price hikes. Economic agents make more complicated financial transactions in order to reduce their holdings of real money balances. They may also allocate more of their wealth to consumer durables as a protection against the inflation tax. All these efforts involve real costs. The higher the inflation, the greater the costs.

In view of the fact that inflation imposes a cost on monetary transactions, economists have been led to speculate about the "optimal" rate of inflation for an economy. Is price stability, that is, zero inflation, best? The issue is considered in Box 11-2.

Another effect of anticipated inflation is what is known as *menu costs*, a general term that describes the inconvenience of having to adjust certain prices to keep them in line with inflation. The concept borrows its name from the fact that restaurants often need to write in higher prices of the dishes on their menus, and maybe print new menus, as the prices of their inputs increase. Real costs are also incurred changing over vending machines and public phones when the nominal price level changes. Owners have to spend real resources—technical personnel, transportation services, and so on—in order to alter prices. Companies that sell by mail order also have to revise, reprint, and reissue their catalogs more frequently when inflation rises.[15]

Anticipated inflation can also lead to resource misallocation through the effects of inflation on the tax system.[16] The effects of inflation on income tax brackets are one example. Suppose that marginal tax brackets are stated in nominal terms. As time goes by and nominal income rises, people are

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[15] For a survey of the menu cost literature, see Julio Rotemberg, "The New Keynesian Microfoundations," *NBER Macroeconomics Annual 1987* (Cambridge, Mass.: MIT Press for the National Bureau of Economic Research, 1987).

[16] Martin Feldstein of Harvard University has been a prominent analyst of the effect of inflation via the tax structure. See, for example, "Inflation, Income Taxes and the Rate of Interest: A Theoretical Analysis," *American Economic Review*, December 1976, and "Inflation, Tax Rules and the Stock Market," *Journal of Monetary Economics*, July 1980. See also his joint piece with Lawrence Summers, "Inflation, Tax Rules and the Long-Term Interest Rate," *Brookings Papers on Economic Activity*, No. 1, 1978.

Box 11-2
The Optimal Rate of Inflation

If anticipated inflation imposes costs, by forcing households to economize on money balance, what is the *optimal* rate of inflation? Is it zero, negative, or positive? According to Milton Friedman, the optimal inflation rate is negative, specifically, the negative value of the real interest rate.[17] If the real interest rate is 5 percent per year, Friedman recommends an annual inflation rate of −5 percent per year. He reaches that conclusion through the following reasoning.

Since money is costless to produce (the government can just print the bills), the opportunity cost of holding money should be as low as possible, to encourage the public to make use of the conveniences of money as much as possible. The demand for real money balances by the public should be maximized. The government should then aim for a nominal interest rate equal to zero, so that there is no opportunity cost to holding money. Since the nominal interest rate is equal to the real interest rate plus the inflation rate, Friedman's recipe is for the government to aim for an inflation rate which is the negative value of the real interest rate, thereby producing a nominal interest rate equal to zero.

This idea can be shown graphically, as in Figure 11-6. We can represent the demand for real money balances as the demand curve MM. It is a negative function of the nominal interest rate. The demand for money is maximized at the level $(M/P)^*$, which occurs at a zero nominal interest rate.

When the nominal interest rate is positive, the optimal quantity of money is not achieved. Notice that even with zero inflation, there is an opportunity cost of holding money, equal to the real interest rate. Increased inflation above zero only makes things worse, as people further economize on their money holdings. Suppose the real interest rate is r_0; with stable prices, households will demand $(M/P)_0$ of money. If inflation goes to 10 percent, the nominal interest rate will increase to $i_1 = r_0 + 0.1$; at that level, money demand will be $(M/P)_1$.

Friedman's conclusion has been modified by Edmond Phelps of Columbia University, who argued that while inflation was indeed distortionary, so too are taxes. Because all taxes produce some distortions, it may make sense for the government to rely on the inflation tax—at least to a small extent—in order to reduce the heavy reliance on other distortionary taxes. Generally speaking, the optimum rate of inflation has to be determined as that which minimizes the distortions from the *overall* tax system, including the inflation tax, which arise when the government must raise a given amount of fiscal revenue.[18]

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[17] See Friedman's article "The Optimum Quantity of Money," Chapter 1 in his book, *The Optimum Quantity of Money and Other Essays* (Chicago: Aldine, 1969).

[18] See Edmond Phelps, "Inflation in the Theory of Public Finance," *Swedish Journal of Economics*, January/March 1973.

pushed into higher tax brackets, increasing their marginal tax rates. A person whose pretax real income is constant thereby suffers a gradual increase in her tax liabilities, and a consequent loss of disposable income, simply because of inflation. Until the tax reform of 1986, the United States was a case in point. Tax brackets were fixed in nominal terms, and inflation inadvertently pushed individuals into higher brackets. Successive tax cuts voted by the Congress prior to 1986 undid some of the effect of the bracket creep, but such relief came unpredictably, and at irregular intervals. Since 1986, income tax brackets have been indexed to inflation.

In most countries, corporations—and sometimes individuals—are allowed to deduct interest payments as expenses from their taxable income. In the presence of inflation, nominal interest rates rise, and the tax deduction increases even while the real interest rate remains the same. In some countries, such as Chile, the tax laws have been reformed so that only the *real* interest portion of the payment can be deducted from the tax bill.

Further, consider the effects of inflation on the system of historic cost depreciation allowed by the tax code. Often, companies are permitted to subtract from their taxable income some specified amount of depreciation on their buildings and equipment. If the depreciation allowance is based on the historical costs of the investment, that is, its original costs, rather than on the replacement costs, the real value of the depreciation allowance can be substantially wiped out by inflation. This increases the tax burden on companies, and this, in turn, can act as a disincentive for productive investment. A similar problem occurs with capital gains. The tax on capital gains is calculated on the difference between the sale price and the purchase price of an asset. If the purchase price is taken at its historic value, then people will be taxed on capital gains even if the asset value has done nothing more than just keep up with inflation.

Finally, inflation also affects the real value of the tax burden when there are significant lags in tax collection. The problem is that tax obligations are accrued at a certain point, but the payment is made at a later date. In many countries, no mechanism exists to maintain the real value of the tax liability during this lag. Thus, any increase in the rate of inflation during this period reduces the tax burden. This phenomenon is known as the *Olivera–Tanzi effect,*[19] and it can lead to a vicious circle. An increase in the fiscal deficit pushes up inflation, which, in turn, reduces tax revenues; lower tax revenues, in turn, further increase the fiscal deficit, and so on. This process can be very destabilizing, and it has contributed in important ways to many of the high inflations in the developing world in the 1980s.

A dramatic illustration of the Olivera–Tanzi effect is provided by the experience of Bolivia in the first half of the 1980s, as shown in Figure 11-7. Government revenues were close to 10 percent of GDP in 1980–1981, and inflation was around 25 percent per year. In 1982, inflation soared to almost 300 percent, and revenues halved as a percentage of GDP. This downward trend continued, and the worst came in 1985, when Bolivia entered into a full-blown hyperinflation. At that time, tax revenues declined to a mere 1.3

[19] This effect takes its name from Julio Olivera and Vito Tanzi. See Olivera's "Money, Prices, and Fiscal Lags: A Note on the Dynamics of Inflation," *Quarterly Review,* Banca Nazionale del Lavoro, September 1967, pp. 258–267, and Tanzi's "Inflation, Lags in Collection and the Real Value of Tax Revenue," *International Monetary Fund Staff Papers,* March 1977.

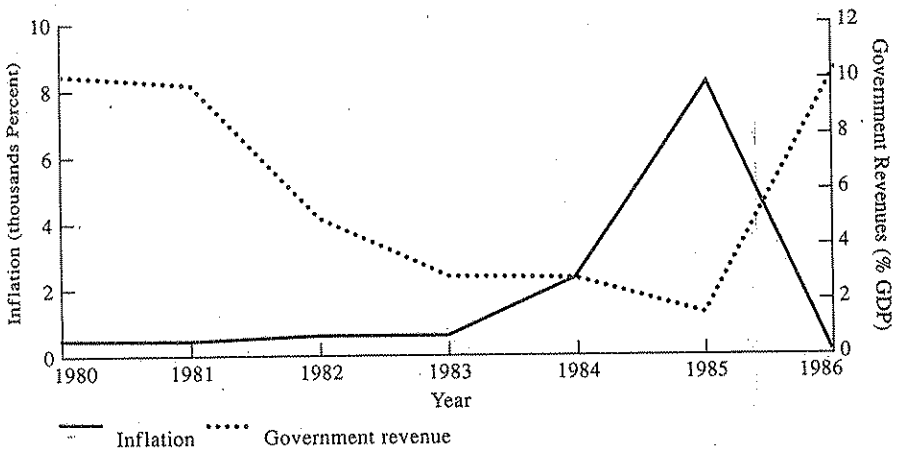

Figure 11-7
An Illustration of the Olivera-Tanzi Effect: Bolivia, 1980–1986

(Data for inflation from CEPAL, Economic Survey for Latin America, *1988; data for government revenues from J. Sachs, "The Bolivian Hyperinflation and Stabilization," National Bureau of Economic Research Working Paper No. 2073, May 1986.)*

percent of GDP, which could well have been the lowest tax burden in the world. Note, however, the sharp reversal in 1986. As a successful stabilization program was implemented, and inflation dropped to 66 percent for the year, government revenues increased to over 10 percent of GDP.[20]

Unanticipated Inflation

Countries with higher rates of inflation also tend to show more variability in inflation. When changes in inflation are frequent and marked, this instability makes it difficult to guess correctly about price level changes, even in the very near future. This problem is not confined to developing countries. Since the 1970s, most industrialized economies have experienced an increase in both the level and the variability of inflation. When variability increases, inflation tends to have a larger unanticipated component.

The main effects of unanticipated inflation are redistributional. Surprises in inflation rates lead to shifts of income and wealth between various groups in the population. To see this, let us discuss first the case of *wealth redistribution*. Consider a loan contract between a creditor and debtor that specifies a nominal interest rate of 10 percent, based on an expected real rate of interest of 5 percent and an expected inflation rate of 5 percent. Now suppose that inflation ends up being abnormally high, say, at a rate of 10 percent. Who wins and who loses?

Clearly, the debtor wins, since he was supposed to pay a real rate of 5 percent and ends up paying a zero real interest rate. Essentially, he gets the loan for free! The creditor gets back only the original real value of the loan,

[20] Of course, other things were changing in the economy as well: in 1986, the government put through an important tax reform which helped to increase revenues.

inasmuch as the interest rate is just enough to compensate for the inflation. If, in addition, the debtor can deduct interest payments for tax purposes, he receives an extra subsidy; if the creditor has to pay taxes on her nominal interest income, she loses part of the principal of the loan. Thus we can draw our first important conclusion: unexpected increases in inflation redistribute wealth from creditors to debtors, and unexpected reductions in inflation redistribute wealth the opposite way.

But this principle applies to more than loan contracts. In general, anybody holding a financial asset, the returns of which are all or in part fixed in nominal terms, will tend to suffer a loss from unanticipated price increases. Assets of this sort are called *nominal* assets, and they include money and fixed interest-rate bonds. By contrast, *real* assets have their value adjusted in line with inflation. To protect the assets held by economic agents from unexpected changes in the price level, some economies have developed indexed financial instruments. A bond that is protected in this way promises only to pay a certain *real* interest rate. In other words, people do not know in advance what nominal interest will be paid; that rate is determined only after the inflation rate of the period is known. Indexed assets are more likely to be found in countries that have experienced long inflationary histories. For example, while Brazil and Chile make widespread use of indexed assets, the United States does not.

In general, economic agents hold both nominal assets and liabilities. Thus, the full effect of unexpectedly high inflation for individual agents depends on their *net* asset positions. If one is a net creditor in nominal assets, one will lose. If, in contrast, one is a net debtor, one will become better off. The evidence for the United States indicates that the household sector is a net nominal creditor, while businesses and the government are net debtors. Thus, an unanticipated increase in inflation benefits firms and the government at the expense of households. Of course, households own the firms and pay taxes to the government, so the overall nature of the redistribution is not quite this simple.

Within the household sector there are also strong differences. Homeowners with mortgages on their homes, for example, benefit from unexpected inflation (assuming, of course, that their holdings of other nominal assets do not offset this effect). The net asset position for households also varies with age. Older people tend to hold more net nominal assets than younger people. Thus, unexpected rises in the general price level tend to redistribute wealth away from the old.[21]

Unanticipated inflation also provokes *income redistributions* among the different sectors of the population. For people locked into labor contracts, an increase in inflation that exceeds expectations means a deterioration of their real wages. This happens not only to those who have contracts without cost-of-living adjustment clauses (COLAs) but also to those with indexing clauses that operate with a lag, or that compensate for only a fraction of the inflation. In general, because wages are reset only sporadically, higher inflation leads to increased variability of a worker's wages over time. Just after a wage increase, the real wage tends to be high. Then, as

[21] This has been documented by G. Bach and J. Stephenson, "Inflation and the Distribution of Wealth," *Review of Economics and Statistics*, February 1974.

inflation continues while the wage remains unchanged, the real wage declines, until the time of the next wage hike. Even if inflation does not affect the average real wage of the worker, it certainly affects the variability of the real wage. A dramatic illustration of that variability is shown in Figure 11-8, which graphs the behavior of the real minimum wages in Peru during the high inflation period 1985–1989. The sawtooth pattern shows the extreme variations over time.

One final distributional issue concerns the inflation tax on money holdings that we have talked about earlier. Because the income elasticity of money demand is likely to be less than one, the inflation tax itself is likely to be regressive—that is, poorer people pay a higher proportion of their income as inflation tax than richer people do.

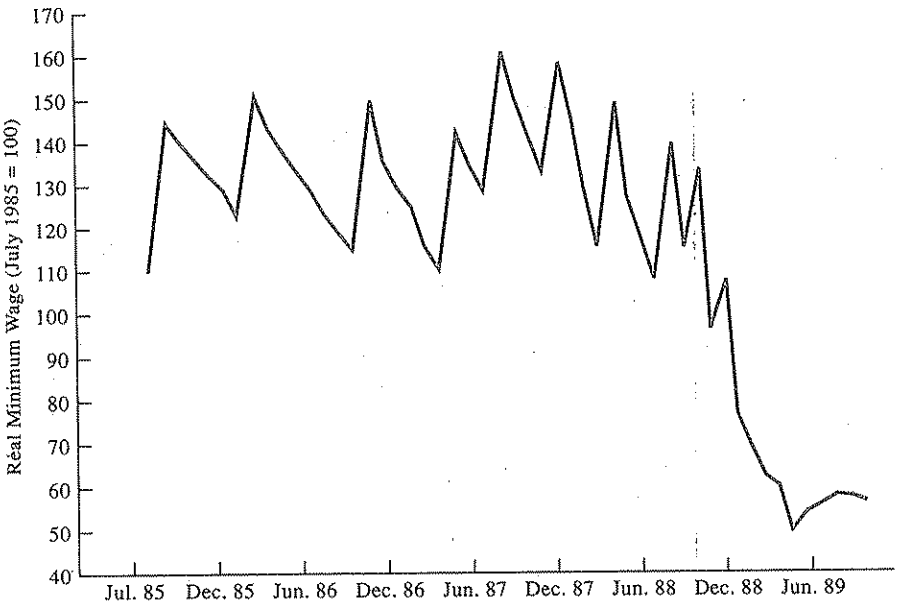

Figure 11-8
Inflation and the Real Minimum Wage in Peru, 1985–1989
(From INE, Ministerio de Trabajo, Peru.)

In addition to the distributional effects of unanticipated inflation, shocks to inflation can also cause households and enterprises to make erroneous supply and demand decisions. Suppose, for example, that a firm expects inflation to be low, but that in fact inflation throughout the economy turns out to be high. Prices rise for the output of the particular firm as well as the outputs of all other firms in the economy. When the enterprise notices that the price of its own product is rising faster than it expected, the firm might suspect that there has been a particular increase in demand for its product, rather than a rise in prices of all products in the economy. In essence, the firm confuses a general inflation for a particular increase in demand. As a result, the firm might erroneously choose to increase output in the mistaken

belief that there is a boom in demand for its particular product. If this behavior is repeated by many firms throughout the economy, there can be a mistaken shift in aggregate supply that leads to a distorted level of output in the economy.[22]

Should Countries Learn to Live with Inflation?

Economists are divided from time to time between two strategies for confronting inflation. Some say we should learn to live with it, coping with its effects by indexing the tax system, wage bargains, contracts, and so on. Others want to confront it head on, embracing whatever macroeconomic measures are necessary, even a recession perhaps (for reasons described in Chapters 15 and 23), in order to eliminate it from the system.

At first blush, improving the economy's resilience to inflation through widespread indexation might appear to be costless. If inflation does not occur, nothing is lost; if it does, its distortionary effects will be less. But as Stanley Fischer and Lawrence Summers have recently argued, reducing the costs of inflation also increases the incentives for policymakers to pursue overinflationary policies.[23] Therefore, while "inflationproofing" the economy may lower the costs of inflation for any given level of inflation, it may also raise the inflation rate that policymakers will target. Whether the economy is then better off or worse off is hard to say. Fischer and Summers cite examples in which inflationproofing leads to such a large increase in inflation that the overall losses to the economy from inflation actually rise.

In general, we can say that inflationproofing is desirable if most inflationary episodes are likely to result from shocks that are beyond the control of policymakers. In that case, the measures to index the economy will simply reduce the efficiency losses that result from the shocks. If most inflation is likely to arise from deliberate or merely careless overinflationary policies of the monetary and fiscal authorities, however, then inflationproofing might just increase the policymaker's "addiction" to a costly and hidden form of taxation.

11-4 Summary

Inflation is the percentage change in the price level, normally measured as the increase in the consumer price index. It is important to distinguish between *once-and-for-all* price increases and *persistent* price rises. It also is useful to distinguish inflations by their severity, whether an inflation is simply high or whether it is a hyperinflation. Industrialized countries have tended to show much lower levels of inflation than developing economies. The highest chronic inflations are generally found in Latin America.

Public-sector deficits can be covered in three ways: borrowing from the public, using foreign reserves, or printing money. Governments which have

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[22] Clearly, if inflation turns out to be *less* than expected, then all firms might *reduce* output, leading to a recession. The general idea that firms might confuse overall inflationary shocks with shifts in demand for their particular products was first elaborated by Robert Lucas. See his article "Some International Evidence on Output-Inflation Tradeoffs," *American Economic Review*, June 1973.

[23] See their joint article "Should Governments Learn to Live with Inflation?" *American Economic Review*, May 1989.

run persistent deficits in the past are likely to have low international reserves, and they also have difficulties borrowing further. Thus, eventually, such governments turn to monetary financing.

Under fixed exchange rates, deficits financed by printing money are ultimately financed by a loss of international reserves. As long as reserves are available, the exchange rate may remain fixed and the country can avoid inflation. If the deficit persists and reserves are depleted, however, the central bank will have no option but to devalue (or float the exchange rate). Then, inflation cannot be avoided. The collapse of a fixed exchange-rate system is known as a *balance-of-payments* crisis. The anticipation of this collapse by the public leads to a speculative attack that cleans out the foreign reserves of the central bank. Under floating exchange rates, persistent deficits cause the exchange rate to depreciate continuously, and the deficit is ultimately financed through an inflation tax on real money balances.

Domestic borrowing cannot be used to postpone inflation indefinitely. For a given *primary deficit*, that is, the deficit excluding interest payments, the overall fiscal deficit grows due to the rising interest burden of the debt. Continued debt financing makes the debt-to-GDP ratio grow over time. At some point, people will be unwilling to hold more public debt because they doubt the government's ability to service the additional debt. The government will then be forced to use money financing.

The *inflation tax* is the capital loss suffered as a result of inflation by those who hold money. *Seigniorage* is the revenue that the government collects by virtue of its monopoly power to print money; it is equal to the purchasing power of the money that it puts into circulation in a given period. Seigniorage is normally collected by the domestic country's government, but when nationals hold some of their money balances in foreign currencies, those foreign governments whose currencies are held collect part of the seigniorage. In general, the inflation tax and seigniorage are not exactly equal. They are the same when real money balances are unchanging. In an inflationary environment, agents who want to maintain their real stock of money will have to sacrifice consumption by an amount equal to the inflation tax.

Inflation has a number of costs. Price increases, even if fully anticipated, impose a tax on the public. In addition, inflation produces pure efficiency losses. Expected increases in inflation reduce average money balances held by the public. Attempts to economize on money, the most efficient means of payment, involve real costs (more frequent trips to the bank, more complicated financial transactions, and so on). *Menu costs* are another effect of *anticipated inflation*. Real resources are spent in making the adjustments required by higher prices as costs of production increase. Anticipated inflation also leads to resource misallocation through its effects on the tax system, if the tax system is not indexed. Finally, inflation also affects the real value of tax revenues when there are significant lags in tax collection.

Higher than expected inflation causes important wealth redistributions from creditors to borrowers when financial assets are not *indexed* to inflation. *Unanticipated inflation* also leads to income redistributions among the different sectors of the population. This depends, for example, on how real wages and profits respond to the price increases. The distributional consequences of the inflation tax are likely to be *regressive*. The income elasticity

of money demand is likely to be less than one, and thus poorer people tend to pay a higher proportion of their income as inflation tax than richer people do. Unanticipated inflation can also impose costs by inducing firms and households to make erroneous supply and demand decisions, for example, by making firms confuse an overall increase in prices with a specific increase in prices for the firms own product.

Key Concepts

inflation
price level
hyperinflation
balance-of-payments crisis
inflation tax
speculative attack
primary deficit
seigniorage
anticipated inflation
unanticipated inflation
income redistribution
wealth redistribution
menu costs
bracket creep
Olivera–Tanzi effect
nominal assets
real assets
indexed assets
regressive tax

Problems and Questions

1. Discuss the effects on the exchange rate (under purchasing power parity) of three different phenomena: a once-and-for-all change in the price level, inflation, and hyperinflation.

2. The government of country A is running a budget deficit of 500 million pesos per year. To finance it, the government sells treasury bills to the central bank. The exchange rate is fixed at 20 pesos per dollar. Assume that the international price level is fixed and that the central bank has a large amount of foreign reserves.

a. Calculate the yearly change in the foreign reserves of the central bank. Would you expect this process to be smooth over time? Why?

b. Describe the evolution of the price level, the exchange rate, and nominal and real monetary balances before and after the exhaustion of the foreign reserves of the central bank.

3. Explain why a government running a large budget deficit may choose to devalue the currency before the central bank runs out of foreign reserves.

4. The government of country B has a budget deficit of 2 percent of GDP. Real money demand is also growing at 2 percent of GDP per year. The government monetizes the deficit.

a. Under fixed exchange rates, describe the evolution of the foreign reserves of the central bank.

b. Under floating exchange rates, what would the rate of inflation be in country B?

5. Assume that the government of country C is running a budget deficit equal to 6 percent of GDP, financed entirely by money creation. Assume that the exchange rate is allowed to float, international inflation is 3 percent per year, and the velocity of money is fixed at 4.

a. What is the rate of inflation consistent with this deficit?

b. What is the rate of depreciation of the currency?

6. Consider a government that is running a constant and persistent budget deficit, financed by selling bonds to the central bank. There is a floating exchange-rate regime. When would you expect inflation in this country to be higher, when the velocity of money is constant or when it is a positive function of the nominal interest rate? Why?

7. Assume that inflation is greater than the rate of growth of nominal monetary balances.

a. What happens to real monetary balances?

b. Which is greater, the inflationary tax or seigniorage? Why?

8. Suppose that the government needs to raise 1/5 percent of GDP using seigniorage. The demand for money is given by $3M = PQ$, where $Q = 12$. Calculate the inflation rate that will accompany this level of seigniorage finance.

9. Some economists have argued that in order to prevent inflationary finance of budget deficits certain countries should not have a national currency. Instead, they should use the currency of a country with a long history of price stability. What are the pros and cons of this proposal?

10. Explain why companies tend to finance a higher proportion of their investment projects using loans rather than their own resources when inflation increases.

11. Do you think the costs of a sudden increase in inflation would be higher in a country that has usually had a stable price level or in one that has endured through many inflationary episodes?