CHAPTER **4** Money and Inflation

Questions for Review

1. Money has three functions: it is a store of value, a unit of account, and a medium of exchange. As a store of value, money provides a way to transfer purchasing power from the present to the future. As a unit of account, money provides the terms in which prices are quoted and debts are recorded. As a medium of exchange, money is what we use to buy goods and services.

2. Fiat money is established as money by the government but has no intrinsic value. For example, a U.S. dollar bill is fiat money. Commodity money is money that is based on a commodity with some intrinsic value. Gold, when used as money, is an example of commodity money.

3. In many countries, a central bank controls the money supply. In the United States, the central bank is the Federal Reserve—often called the Fed. The control of the money supply is called *monetary policy*.

   The primary way that the Fed controls the money supply is through open-market operations, which involve the purchase or sale of government bonds. To increase the money supply, the Fed uses dollars to buy government bonds from the public, putting more dollars into the hands of the public. To decrease the money supply, the Fed sells some of its government bonds, taking dollars out of the hands of the public.

4. The quantity equation is an identity that expresses the link between the number of transactions that people make and how much money they hold. We write it as

$$\text{Money} \times \text{Velocity} = \text{Price} \times \text{Transactions}$$

$$M \times V = P \times T.$$

The right-hand side of the quantity equation tells us about the total number of transactions that occur during a given period of time, say, a year. T represents the total number of transactions. P represents the price of a typical transaction. Hence, the product $P \times T$ represents the number of dollars exchanged in a year.

   The left-hand side of the quantity equation tells us about the money used to make these transactions. M represents the quantity of money in the economy. V represents the transactions velocity of money—the rate at which money circulates in the economy.

   Because the number of transactions is difficult to measure, economists usually use a slightly different version of the quantity equation, in which the total output of the economy Y replaces the number of transactions T:

$$\text{Money} \times \text{Velocity} = \text{Price} \times \text{Output}$$

$$M \times V = P \times Y.$$

P now represents the price of one unit of output, so that $P \times Y$ is the dollar value of output—nominal GDP. V represents the income velocity of money—the number of times a dollar bill becomes a part of someone's income.

5. If we assume that velocity in the quantity equation is constant, then we can view the quantity equation as a theory of nominal GDP. The quantity equation with fixed velocity states that

$$MV = PY.$$

If velocity V is constant, then a change in the quantity of money (M) causes a proportionate change in nominal GDP (PY). If we assume further that output is fixed by the factors of production and the production technology, then we can conclude that the quantity of money determines the price level. This is called the *quantity theory of money*.

6. The holders of money pay the inflation tax. As prices rise, the real value of the money that people hold falls—that is, a given amount of money buys fewer goods and services since prices are higher.

7. The Fisher equation expresses the relationship between nominal and real interest rates. It says that the nominal interest rate i equals the real interest rate r plus the inflation rate π:

$$i = r + \pi.$$

This tells us that the nominal interest rate can change either because the real interest rate changes or the inflation rate changes. The real interest rate is assumed to be unaffected by inflation; as discussed in Chapter 3, it adjusts to equilibrate saving and investment. There is thus a one-to-one relationship between the inflation rate and the nominal interest rate: if inflation increases by 1 percent, then the nominal interest rate also increases by 1 percent. This one-to-one relationship is called the **Fisher effect**.

If inflation increases from 6 to 8 percent, then the Fisher effect implies that the nominal interest rate increases by 2 percentage points, while the real interest rate remains constant.

8. The costs of expected inflation include the following:
    a. **Shoeleather costs.** Higher inflation means higher nominal interest rates, which mean that people want to hold lower real money balances. If people hold lower money balances, they must make more frequent trips to the bank to withdraw money. This is inconvenient (and it causes shoes to wear out more quickly).
    b. **Menu costs.** Higher inflation induces firms to change their posted prices more often. This may be costly if they must reprint their menus and catalogs.
    c. **Greater variability in relative prices**. If firms change their prices infrequently, then inflation causes greater variability in relative prices. Since free-market economies rely on relative prices to allocate resources efficiently, inflation leads to microeconomic inefficiencies.
    d. **Altered tax liabilities.** Many provisions of the tax code do not take into account the effect of inflation. Hence, inflation can alter individuals' and firms' tax liabilities, often in ways that lawmakers did not intend.
    e. **The inconvenience of a changing price level.** It is inconvenient to live in a world with a changing price level. Money is the yardstick with which we measure economic transactions. Money is a less useful measure when its value is always changing.

    There is an additional cost to unexpected inflation:

    f. **Arbitrary redistributions of wealth.** Unexpected inflation arbitrarily redistributes wealth among individuals. For example, if inflation is higher than expected, debtors gain and creditors lose. Also, people with fixed pensions are hurt because their dollars buy fewer goods.

9. Hyperinflation is always a reflection of monetary policy. That is, the price level cannot grow rapidly unless the supply of money also grows rapidly; and hyperinflations do not end unless the government drastically reduces money growth. This explanation, however, begs a central question: Why does the government start and then stop printing lots of money? The answer almost always lies in fiscal policy: When the government has a large budget deficit (possibly due to a recent war or some other major event) that it cannot fund by borrowing, it resorts to printing money to pay its bills. And only when this fiscal problem is alleviated—by reducing government spending and collecting more taxes—can the government hope to slow its rate of money growth.

10. *Real variables* are measured in physical units, and *nominal variables* are measured in terms of money. Real variables have been adjusted for inflation and are often measured in terms of constant dollars, while nominal variables are measured in terms of current dollars. For example, real GDP is measured in terms of constant base-year dollars, while nominal GDP is measured in current dollars. An increase in real GDP means we

have produced a larger total quantity of goods and services, valued in base-year dollars. As another example, the real interest rate measures the increase in your purchasing power, the quantity of goods and services you can buy with your dollars, while the nominal interest rate measures the increase in the amount of current dollars you possess. The interest rate you are quoted by your bank, say 3 percent, is a nominal rate. If the inflation rate is 3 percent, then the real interest rate is 5 percent, meaning your purchasing power has only increased by 5 percent and not 8 percent. The quantity of dollars you possess has increased by 8 percent but you can only afford to buy 5 percent more goods and services with these dollars.

Problems and Applications

1. Money functions as a store of value, a medium of exchange, and a unit of account.
    a.   A credit card can serve as a medium of exchange because it is accepted in exchange for goods and services. A credit card is, arguably, a (negative) store of value because you can accumulate debt with it. A credit card is not a unit of account—a car, for example, does not cost 5 VISA cards.
    b.   A Rembrandt painting is a store of value only.
    c.   A subway token, within the subway system, satisfies all three functions of money. Yet outside the subway system, it is not widely used as a unit of account or a medium of exchange, so it is not a form of money.

2. The real interest rate is the difference between the nominal interest rate and the inflation rate. The nominal interest rate is 11 percent, but we need to solve for the inflation rate. We do this with the quantity equation expressed in percentage-change form:

    % Change in M + % Change in V = % Change in P + % Change in Y.

    Rearranging this equation tells us that the inflation rate is given by:

    % Change in P = % Change in M + % Change in V – % Change in Y.

    Substituting the numbers given in the problem, we thus find:

    % Change in P = 14% + 0% – 5%

    $$= 9\%.$$

    Thus, the real interest rate is 2 percent: the nominal interest rate of 11 percent minus the inflation rate of 9 percent.

3. a.   Legislators wish to ensure that the real value of Social Security and other benefits stays constant over time. This is achieved by indexing benefits to the cost of living as measured by the consumer price index. With indexing, nominal benefits change at the same rate as prices.
    b.   Assuming the inflation rate is measured correctly (see Chapter 2 for more on this issue), senior citizens are unaffected by the lower rate of inflation. Although they get less money from the government, the goods they purchase are cheaper; their purchasing power is exactly the same as it was with the higher inflation rate.

4. The money demand function is given as

    $$\left(\frac{M}{P}\right)^d = kY.$$

    a.   To find the average inflation rate the money demand function can be expressed in terms of growth rates:

    % growth M^d – % growth P = % growth Y.

    The parameter k is a constant, so it can be ignored. The percentage change in nominal money demand M^d is the same as the growth in the money supply because nominal money demand has to equal nominal money supply. If nominal money demand grows 12 percent and real income (Y) grows 4 percent then the growth of the price level is 8 percent.

b.   From the answer to part (a), it follows that an increase in real income growth will result in a lower average inflation rate. For example, if real income grows at 6 percent and money supply growth remains at 12 percent, then inflation falls to 6 percent. In this case, a larger money supply is required to support a higher level of GDP, resulting in lower inflation.

c.   If velocity growth is positive, then all else the same inflation will be higher. From the quantity equation we know that:

% growth M + % growth V = % growth P + % growth Y.

Suppose that the money supply grows by 12 percent and real income grows by 4 percent. When velocity growth is zero, inflation is 8 percent. Suppose now that velocity grows 2 percent: this will cause prices to grow by 10 percent. Inflation increases because the same quantity of money is being used more often to chase the same amount of goods. In this case, the money supply should grow more slowly to compensate for the positive growth in velocity.

5. The major benefit of having a national money is seigniorage—the ability of the government to raise revenue by printing money. The major cost is the possibility of inflation, or even hyperinflation, if the government relies too heavily on seigniorage. The benefits and costs of using a foreign money are exactly the reverse: the benefit of foreign money is that inflation is no longer under domestic political control, but the cost is that the domestic government loses its ability to raise revenue through seigniorage. (There is also a subjective cost to having pictures of foreign leaders on your currency.)

    The foreign country's political stability is a key factor. The primary reason for using another nation's money is to gain stability. If the foreign country is unstable, then the home country is definitely better off using its own currency—the home economy remains more stable, and it keeps the seigniorage.

6. A paper weapon might have been effective for all the reasons that hyperinflation is bad. For example, a large increase in the money supply increases shoeleather and menu costs; it makes relative prices more variable; it alters tax liabilities in arbitrary ways; it increases variability in relative prices; it makes the unit of account less useful; and finally, it increases uncertainty and causes arbitrary redistributions of wealth. If the hyperinflation is sufficiently extreme, it can undermine the public's confidence in the economy and economic policy.

    Note that if foreign airplanes dropped the money, then the government would not receive seigniorage revenue from the resulting inflation, so this benefit usually associated with inflation is lost.

7. The money demand function is given as

$$\left(\frac{M}{P}\right)^d = L(i, Y) = \frac{Y}{5i}.$$

a.   If output Y grows at rate g, then real money balances $(M/P)^d$ must also grow at rate g, given that the nominal interest rate i is a constant.

b.   To find the velocity of money, start with the quantity equation $MV = PY$ and rewrite the equation as $V = (PY)/M = (P/M)Y$. Now, note that P/M is the inverse of the real money supply, which is equal to real money demand. Therefore, the velocity of money is $V = (5i/Y) \times Y$, or $V = 5i$.

c.   If the nominal interest rate is constant, then the velocity of money must be constant.

d.   A one-time increase in the nominal interest rate will cause a one-time increase in the velocity of money. There will be no further changes in the velocity of money.

8. One way to understand Coolidge's statement is to think of a government that is a net debtor in nominal terms to the private sector. Let B denote the government's outstanding debt measured in U.S. dollars. The debt in real terms equals B/P, where P is the price level. By increasing inflation, the government raises the price level and reduces in

real terms the value of its outstanding debt. In this sense we can say that the government repudiates the debt. This only matters, however, when inflation is unexpected. If inflation is expected, people demand a higher nominal interest rate. Repudiation still occurs (i.e., the real value of the debt still falls when the price level rises), but it is not at the expense of the holders of the debt, since they are compensated with a higher nominal interest rate.

9. Deflation is defined as a fall in the general price level, which is the same as a rise in the value of money. Under a gold standard, a rise in the value of money is a rise in the value of gold because money and gold are in a fixed ratio. Therefore, after a period of deflation, an ounce of gold buys more goods and services. This creates an incentive to look for new gold deposits and, thus, more gold is found after a period of deflation.

10. An increase in the rate of money growth leads to an increase in the rate of inflation. Inflation, in turn, causes the nominal interest rate to rise, which means that the opportunity cost of holding money increases. As a result, real money balances fall. Since money is part of wealth, real wealth also falls. A fall in wealth reduces consumption, and, therefore, increases saving. The increase in saving leads to a rightward shift of the saving schedule, as in Figure 4–1. This leads to a lower real interest rate and an increase in the level of investment.
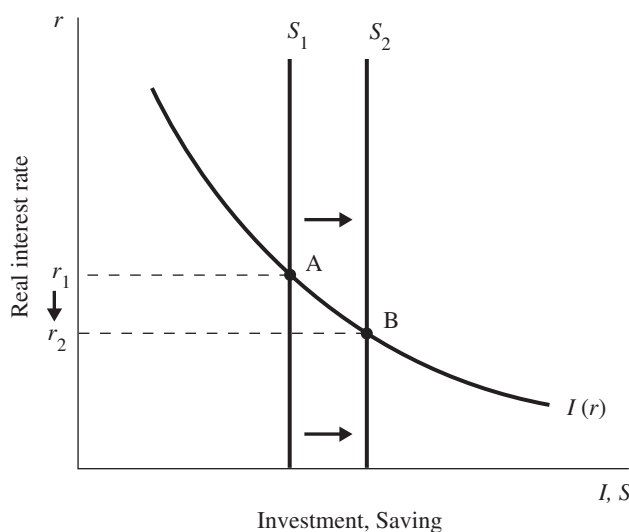

Figure 4–1

The classical dichotomy states that a change in a nominal variable such as inflation does not affect real variables. In this case, the classical dichotomy does not hold; the increase in the rate of inflation leads to a decrease in the real interest rate. The Fisher effect states that $i = r + \pi$. In this case, since the real interest rate r falls, a 1-percent increase in inflation increases the nominal interest rate i by less than 1 percent.

Most economists believe that this Mundell–Tobin effect is not important because real money balances are a small fraction of wealth. Hence, the impact on saving as illustrated in Figure 4–1 is small.

11. The *Economist* magazine has a useful Web site for tracking recent economic data (www.economist.com), although to access some data requires a paid subscription. Other useful sources are the World Bank (www.worldbank.org), the International Monetary Fund (www.imf.org), and the Central Intelligence Agency (www.cia.gov). Finding data on interest rates and inflation rates is fairly easy. Finding data on the growth of the money supply can be more challenging, plus you need to make sure you are comparing the correct monetary aggregates. For example, in 2008, inflation in Kenya was 25 percent, the interest rate was 8.5 percent, and growth of *M*3 was 13 percent. In Denmark in 2008, inflation was 3.5 percent, the interest rate was 4 percent,

and growth of $M3$ was 22 percent. Note that countries with higher rates of inflation have higher nominal interest rates. To show that countries with higher rates of money growth have higher rates of inflation is more difficult and requires gathering data on inflation and money growth across a range of years. Money growth can vary substantially from year to year within a country, and this is not always immediately reflected in the inflation rate.

As another example, in the twelve months ending in November 2001, consumer prices in Turkey rose 69 percent from a year earlier, $M1$ rose 55 percent while $M2$ rose 52 percent, and short-term interest rates were 54 percent. By contrast, in the United States in the twelve months ending in December 2001, consumer prices rose about 2 percent, $M1$ rose 8 percent, $M2$ rose 14 percent; and short-term interest rates were a little under 2 percent. These data are consistent with the theories in the chapter, in that high-inflation countries have higher rates of money growth and also higher nominal interest rates.

More Problems and Applications to Chapter 4

1. With constant money growth at rate µ, the question tells us that the Cagan model implies that $p_t = m_t + \gamma\mu$. This question draws out the implications of this equation.
   a.   One way to interpret this result is to rearrange to find:

   $$m_t - p_t = -\gamma\mu.$$

   That is, real balances depend on the money growth rate. As the growth rate of money rises, real balances fall. This makes sense in terms of the model in this chapter, since faster money growth implies faster inflation, which makes it less desirable to hold money balances.

   b.   With unchanged growth in the money supply, the increase in the level of the money supply m_t increases the price level p_t one-for-one.

   c.   With unchanged current money supply m_t, a change in the growth rate of money μ changes the price level in the same direction.

   d.   When the central bank reduces the rate of money growth μ, the price level will immediately fall. To offset this decline in the price level, the central bank can increase the current level of the money supply m_t, as we found in part (b). These answers assume that at each point in time, private agents expect the growth rate of money to remain unchanged, so that the change in policy takes them by surprise—but once it happens, it is completely credible. A practical problem is that the private sector might not find it credible that an *increase* in the current money supply signals a *decrease* in future money growth rates.

   e.   If money demand does not depend on the expected rate of inflation, then the price level changes only when the money supply itself changes. That is, changes in the growth rate of money μ do not affect the price level. In part (d), the central bank can keep the current price level p_t constant simply by keeping the current money supply m_t constant.