Figure 5.6 shows the household's reduction in spending as a leftward shift in the aggregate demand curve in panel A. Before the reduction in the stock of money, the aggregate demand curve is AD_1 and the equilibrium price of commodities is P^{E1}. After the fall in the stock of money, the aggregate demand curve is AD_2 and the equilibrium price is P^{E2}. To restore equality between the quantity of commodities demanded and the quantity of commodities supplied, the price level must fall by the same proportion as the stock of money, since the demand for money is proportional to GDP. Once the price level has fallen, the household is content to hold the lower quantity of nominal balances. A drop in the nominal supply of money does not affect the real wage, the quantity of employment, or the quantity of commodities supplied because they are each determined by technology, endowments, and preferences. Real variables are not altered by a drop in the money supply, but nominal variables fall in proportion. This proposition is called the neutrality of money.

Using the Classical Theory to Understand Data

In Chapter 4, we evaluated the predictions of the classical model for the theory of business cycles. Now we turn our attention to the predictions of the classical theory of the price level. How well does the theory enable us to understand the problem of inflation? Box 5.2 presents a numerical example of how to determine the price level.

The Classical Explanation of Inflation

Classical theory determines the price level as the point of intersection of the aggregate demand curve with a vertical aggregate supply curve. Because inflation is the percentage rate of change of the price level from one year to the next, this theory also explains inflation. An important component of classical theory is the assumption that output is determined by equilibrium in the labor market. This assumption allows us to draw a vertical aggregate supply curve on panel A of Figure 5.6.

Table 5.2 describes the dependence of the price level on the propensity to hold money, the aggregate supply of commodities, and the quantity of money supplied. The first equation in this table takes the aggregate demand curve, Equation 5.4, and replaces the quantity of commodities demanded by Y^E, the equilibrium quantity of commodities supplied. The equation, expressed in this way, is called the **quantity equation of money**. Table 5.2 lists the factors that, according to the quantity equation, possibly cause increases in the price level: the propensity to hold money, the equilibrium quantity of commodities supplied, or the supply of money.

The first factor that could be responsible for changes in the price level is k. Because classical theory assumes k is constant, this explanation can be ruled out. The second factor that could cause changes in the price level is the level of aggregate supply. But in order for changes in aggregate supply to be responsible for inflation, output would have to fall continuously over time. This would be equivalent to a continuous leftward shift of the aggregate supply curve. In fact, most countries' economies have been growing over time, which tends to cause the price level to fall. The only remaining possible explanation of inflation

BOX 5.2

A CLOSER LOOK
A Mathematical Example of Aggregate Demand and Supply

In this box, we use the example from Box 4.5 to show how the price level is determined. In that example, the production function of a typical firm was given by

5.1.1 $$Y^S = L^D - (1/2)(L^D)^2,$$

and the labor demand curve was given by the formula

5.1.2 $$1 - L^D = (w/P)$$

where (w/P) is the real wage. The labor supply curve was given by

5.1.3 $$(w/P) = L^S,$$

and in equilibrium we established that

5.1.4 $$(w/P)^E = 1/2, \quad L^E = 1/2, \quad \text{and } Y^E = 3/8.$$

Notice that neither P nor w is determined individually; it is only their ratio that is set in the labor market.

To complete the classical model, suppose that the propensity to hold money, k, is equal to 2, and the stock of money, M^S, equals 100. The classical aggregate demand curve is given by the equation

5.1.5 $$P = \frac{M^S}{k\,Y^E}$$

Plugging in the numbers for M^S, k, and Y^E, the equilibrium price level in this economy can be found to be

5.1.6 $$P = \frac{100}{2 \times (3/8)} = 133.33$$

Finally, since

5.1.7 $$(w/P)^E = 1/2,$$

the equilibrium money wage in this economy is given by

5.1.8 $$w^E = P^E \times (1/2) = 133.33 \times 1/2 = 66.66.$$

is an increase in the stock of money, which would cause the aggregate demand curve to keep shifting rightward over time.

Equation 5.7 depicts the quantity equation in the form of proportional changes.[2] Assuming that k is constant, the classical theory predicts that the rate of inflation, $\Delta P/P$,

2. Mathematical Note: The notation ΔX, where X is any economic variable, means the change in X from one year to the next. The notation $\Delta X/X$ means the change in X divided by the level of X; that is, $\Delta X/X$ is the proportional change in the variable X. The exact relation between growth rates and levels is:

$$\text{if } m = \frac{M}{P} \text{ then } \frac{\Delta m}{m} \cong \frac{\Delta M}{M} - \frac{\Delta P}{P}$$

where $\cong$ means "is approximately equal to." As the period gets very small (i.e., as Δ tends toward zero) the approximation becomes exact. This is true for instantaneous growth rates.

TABLE 5.2

The Factors That Determine the Price Level

The Quantity Equation of Money: $P = \frac{M^S}{kY^E}$		
k	Propensity to hold money	This is assumed to be constant by the classical theory.
Y^E	Aggregate supply	This grows at a rate determined by preferences, technology, and endowments.
M^S	The money supply	This grows at a rate determined by the government.

should be equal to the rate of money growth, $\Delta M^S/M^S$, minus the rate of growth of output, $\Delta Y^S/Y^S$.

$$5.7 \qquad \frac{\Delta P}{P} = \frac{\Delta M^S}{M^S} - \frac{\Delta Y^S}{Y^S}$$

Rate of Inflation | **Rate of money supply growth** | **Rate of output growth**

Before the middle of the twentieth century, money was backed by precious metals, usually gold or silver. During this period, no government could issue money unless it had enough gold or silver in the treasury to meet the public's demands to convert their paper currencies back into gold. In the sixteenth century, with the discovery of gold in the New World, European economists recognized that there was a connection between increases in the stock of money and increases in prices. These early empirical observations gave an impetus to the development of the quantity theory of money.

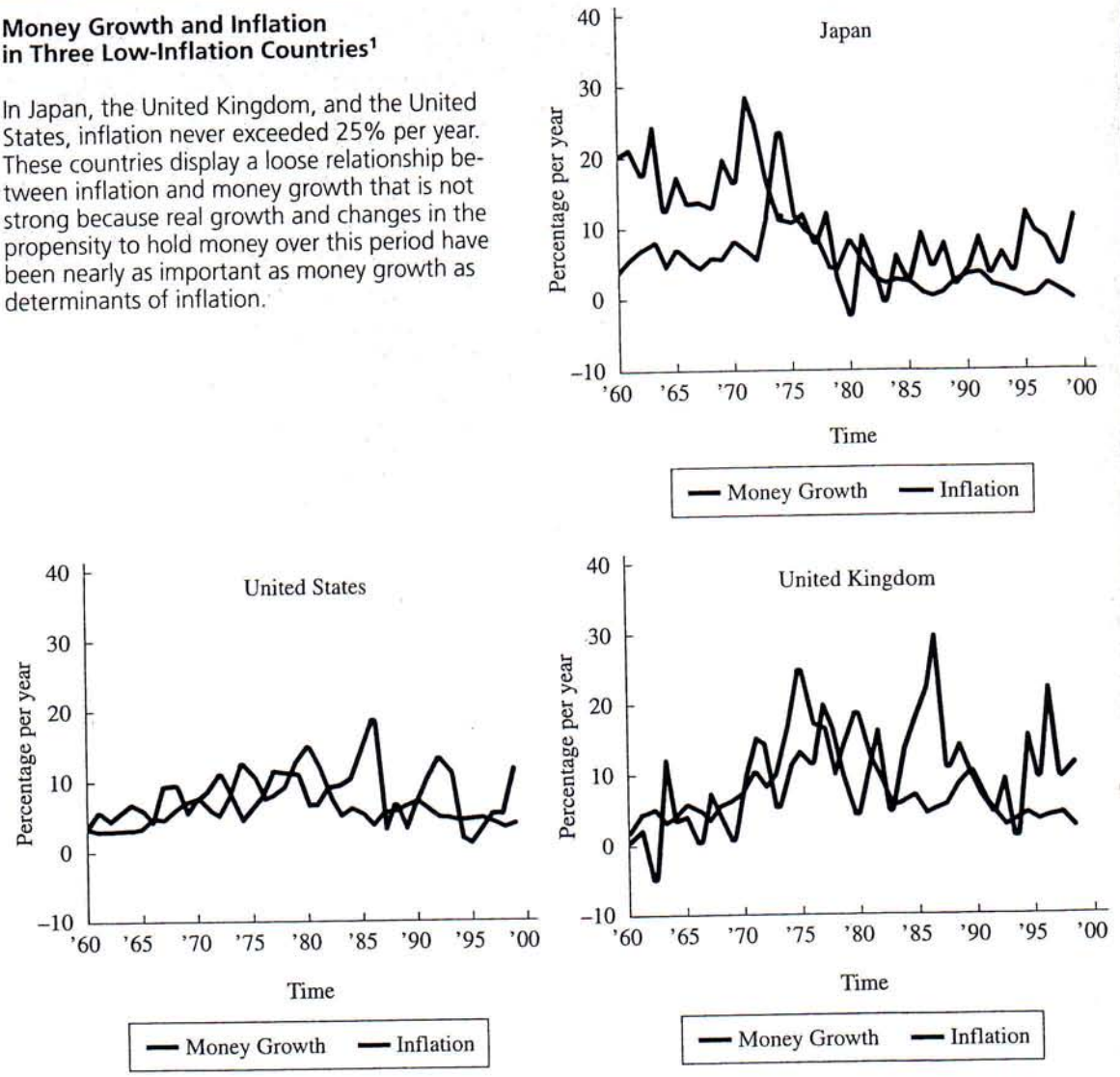
Since the 1930s, the world monetary system has been uncoupled from precious metals; nothing backs the currency in any country other than the promises of national central banks. In some countries, such as the United States, the United Kingdom, and Japan, the nation's central bank has maintained a relatively tight control over the supply of money, and these countries have experienced relatively low inflations. In other countries, such as Israel, Argentina, and Brazil, the central bank has printed money to finance government expenditure programs instead of raising government revenues by taxation. These countries have experienced very rapid inflations. The different experiences of three low-inflation countries and three high-inflation countries are illustrated in Figures 5.7 and 5.8.

Figure 5.7 plots money growth and inflation for the period from 1960 through 1999 for Japan, the United Kingdom, and the United States. None of these countries experienced

FIGURE 5.7

Money Growth and Inflation in Three Low-Inflation Countries[1]

In Japan, the United Kingdom, and the United States, inflation never exceeded 25% per year. These countries display a loose relationship between inflation and money growth that is not strong because real growth and changes in the propensity to hold money over this period have been nearly as important as money growth as determinants of inflation.



[1] Data are from *International Financial Statistics*, published by the International Monetary Fund, Washington, DC. All figures are percentages per year.

inflation exceeding 25% over this period. The figure illustrates that even in low-inflation countries, there is a connection between money growth and inflation. This connection is not particularly strong, because real GDP growth and changes in the propensity to hold money have been almost as important as the rate of money creation in determining the rate of inflation.

FIGURE 5.8

Money Growth and Inflation in Three High-Inflation Countries

Inflation in Brazil, Argentina, and Israel is several orders of magnitude higher than in the United States. The scale of the graph of Israeli inflation runs from −100% to +400% per year. The scale of the other two graphs runs from −100% to +4,500% per year. In countries with very rapid money growth, changes in the propensity to hold money and changes in real GDP are negligible as determinants of inflation relative to the rate of growth of the money supply. In these countries there is a very close connection between money growth and inflation.

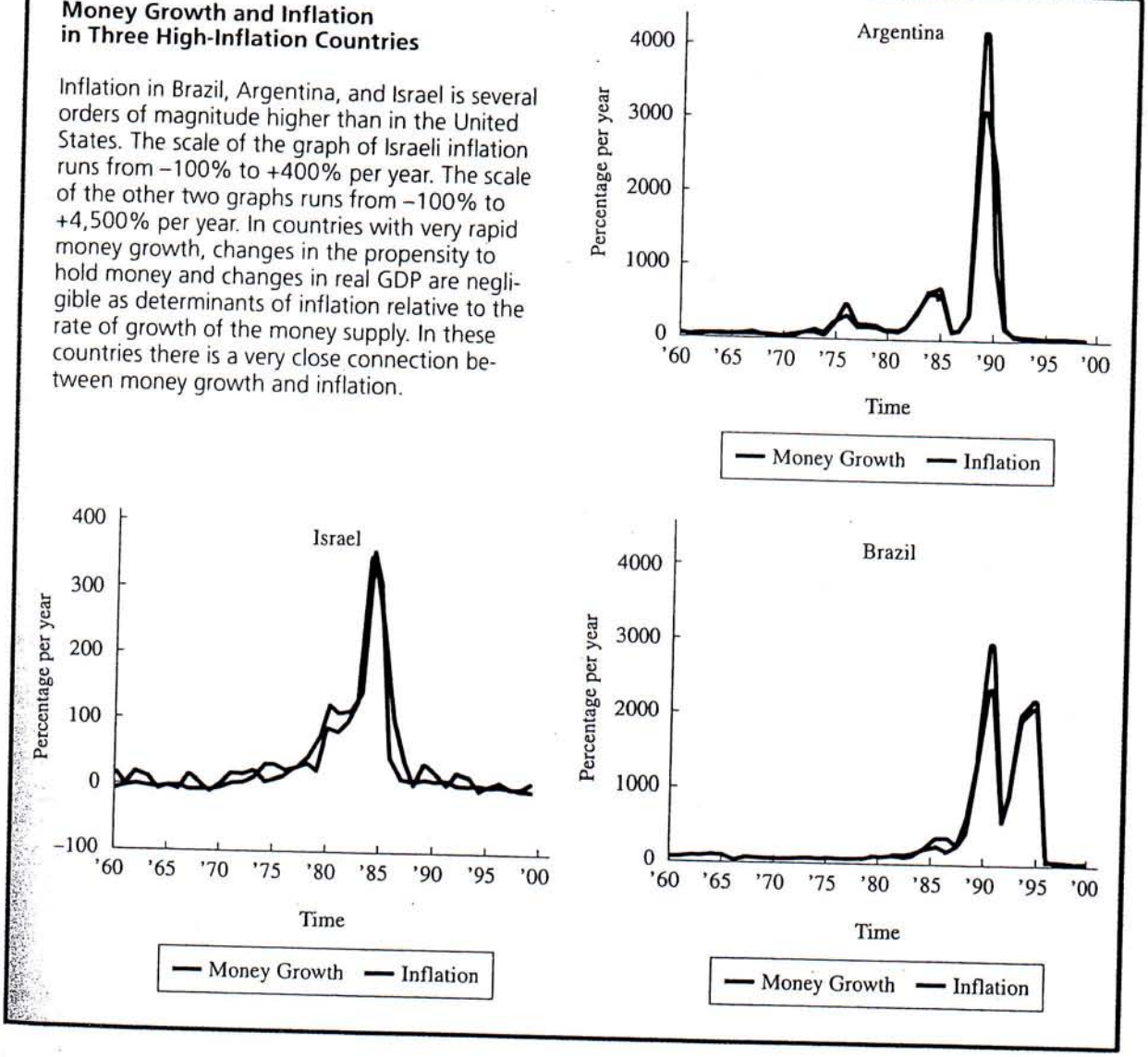


Figure 5.8 plots money growth and inflation in Argentina, Israel, and Brazil over the same period. Here, the scale of the vertical axis runs from −100% to +400% per year in the case of Israel and −100% per year to +4,500% per year in the cases of Argentina and Brazil. These countries have experienced very high inflation. Notice that in the high-inflation countries, there is a very close connection between the rate of money creation and the rate of inflation. The connection between money growth and inflation is strong in countries with very high inflation because movements in the propensity to hold money and

movements in real GDP growth are very small relative to huge movements in the stock of money. Control of the money supply by the central bank is essential if a country is to avoid the very high inflations like those of Brazil and Argentina in 1990. These periods of very high inflation are extremely disruptive to the average household.

Seignorage and the Inflation Tax

Since inflation is caused by excessive money creation, why do some governments engage in this behavior? One reason is that the government can generate revenue, called **seignorage**, by issuing money. Households and firms that hold money can choose instead to hold their wealth as interest-bearing securities by lending to corporations or to the government. If they choose to hold money, they will be able to buy fewer commodities in a year than they would otherwise. Inflation erodes the value of money.

In an economy in which there is no inflation, the value of money is worth as much at the end of the year as it is at the beginning of the year. If the government chose to increase the stock of money at the same rate as the underlying rate of real economic growth, there would be no inflation. If, instead, the government creates money at a faster rate than the rate of growth, then the purchasing power of the existing bills in the economy will be eroded. This erosion of purchasing power on the part of private agents is matched by an increase in purchasing power on the part of government. As the new money enters general circulation, it is exchanged for goods and services. In effect, the government is able to increase its purchase of real goods and services without raising income or sales taxes. Instead, it raises revenue from seignorage, also referred to as the "inflation tax."

In economies like the United States, the United Kingdom, and Japan, the government is well developed, and there are institutions in place that make it efficient and easy to raise revenue from income taxes or sales taxes. But even in Western democracies, there can be situations when the normal channels of revenue creation break down. One example was in Germany after World War I. The Allies forced Germany to pay war reparations that were so large that it was not possible to raise the revenue by standard channels. Instead, the government resorted to money creation, and the result was a hyperinflation of enormous proportions. Brazil, Argentina, and Israel have all resorted to money creation as a means of raising revenue. The results are apparent in Figure 5.8.

Assessing the Classical Explanation of Inflation

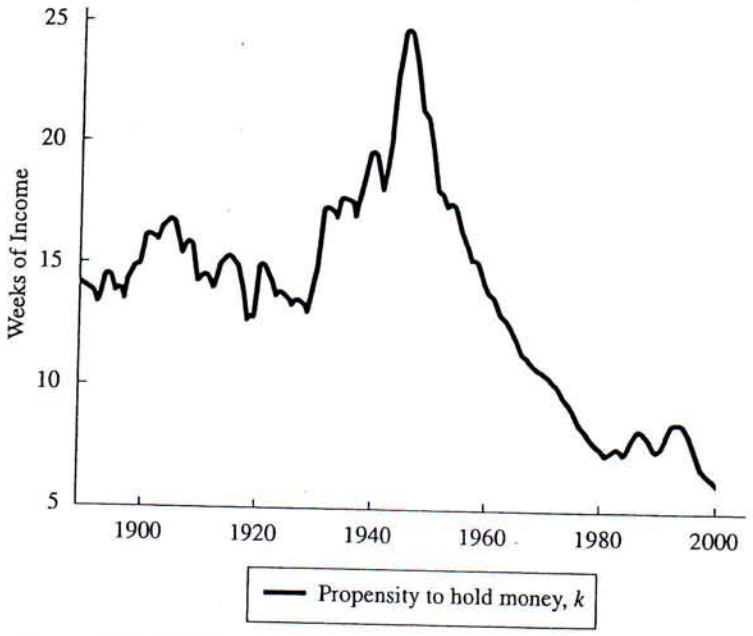
The main feature of the classical explanation of inflation is the concept of a demand function for money that is stable over time; the stability of the equation is represented by the classical assumption that the propensity to hold money, k, is a constant. There have been two principal challenges to the classical explanation. The first claims that k is not, in fact, a constant, and that inflation is just as frequently due to changes in k as to increases in the supply of money. According to this challenge, an increase in the supply of money is just one of the possible causes of inflation, and there is no reason to single out changes in the money supply over and above other causes of inflation. Figure 5.9 illustrates that k has indeed fluctuated considerably over the past century. We will return to this fact in chapter 9.

A second challenge to the classical explanation of inflation recognizes that there is indeed a connection between inflation and money growth, but it asserts that classical econo-

FIGURE 5.9

The Propensity to Hold Money in the United States

The propensity to hold money has fluctuated considerably since 1890. In the early part of the century it was relatively stable. During the 1930s and 1940s it increased dramatically, reaching a peak of nearly 25 weeks of income in 1946. Since the end of World War II it has been falling.



mists have the direction of causation wrong. In other words, inflation causes money growth and not the other way around. This criticism is most often stated as a political or sociological explanation of inflation that denies the economic assumption that the rate of money growth can legitimately be considered an exogenous variable.[3] Critics of the economic explanation of inflation argue that the growth of trade unions is responsible for the spread of inflation. As unions push for higher wages, wage gains are in turn fed into price hikes. The increases in the stock of money that are often observed to accompany inflation are explained as the accommodating response of a central bank that raises the rate of money growth in order to avoid a recession. The main problem with this criticism is that there is no strong correlation between the growth of trade union power and inflation.

Perhaps the most troubling aspect of the classical theory of aggregate demand is its failure to explain the Great Depression; output fell 20% below trend and prices were strongly procyclical. In the classical model the aggregate supply curve is vertical and the aggregate demand curve is shifted only by changes in the stock of money. A leftward shift of the aggregate demand curve would lower prices, but it would not cause a drop in output because of the vertical aggregate supply curve. A leftward shift of the aggregate supply

3. Political theories of inflation based on union pressure are called *cost push* theories. Cost push theories were influential in the 1960s, although more recently they have become less popular. A good example of the cost push view can be found in P.J. Wiles: "Cost inflation and the state of economic theory," *Economic Journal*, 83, pp 377–398, 1973.

curve would lower output, but it would be expected to *raise* prices. The failure of the classical model to easily account for procyclical prices during the Great Depression led to the development of Keynesian economics, a topic that we take up in Chapter 8.

Conclusion

The quantity theory of money, the classical theory of the price level, and the classical theory of aggregate demand are different names for the same theory. The theory assumes that the use of money in exchange has costs and benefits. The cost is in resources that are tied up in cash—resources that could be used to purchase additional commodities. The benefit is in the utility yielded by the use of money to bridge the uneven timing of purchases and sales. The theory assumes that the quantity of money demanded is proportional to GDP with a constant k: the propensity to hold money.

To move from a theory of the demand and supply of money to a theory of aggregate demand, we assume that for the community as a whole, the quantity of money demanded must always equal the quantity supplied. If the price level falls, the real value of the existing stock of money will increase and individual households will experience an excess supply of cash. As they attempt to spend this excess cash, the aggregate quantity of commodities demanded will increase.

The classical theory of aggregate demand can be combined with the classical theory of aggregate supply to explain how output, employment, the real wage, the nominal wage, and the price level are determined. The classical theory implies that if the nominal quantity of money is doubled; all nominal variables will also double; but all real variables will remain unchanged. This is the neutrality of money.

The classical theory of the price level works well for countries that are experiencing very rapid inflations, such as Argentina, Israel, and Brazil. It does not work as well in low-inflation countries, such as the United States, the United Kingdom, and Japan, because the propensity to hold money is, in reality, not a constant. In high-inflation countries, movements in k are swamped by movements in the money supply; in low-inflation countries, this is not the case. The biggest problem with the classical theory is that it cannot explain why prices were procyclical during the Great Depression.

Key Terms

Classical aggregate demand curve
Classical theory of aggregate demand
Classical theory of the price level
Double coincidence of wants
Exchange services
Neoclassical synthesis
Neutrality of money
Nominal variable
Opportunity cost
Propensity to hold money
Quantity equation of money
Quantity theory of money
Real variables
Seignorage
Static barter economy
Theory of the demand for money
Velocity of circulation