Flexible-Price Macroeconomics

PART 3

In this part we shift our point of view and take a "snapshot" of the economy, looking at it over such a short period that its productive resources are fixed but such a long period that wages and prices are fully flexible. In this analysis, the key questions are: What are the economic forces that keep real GDP at its equilibrium value? And in an economy with flexible wages and prices what determines the division of real GDP among consumption spending, investment spending, government purchases, and net exports?

Part 3 contains three chapters. Chapter 6 assembles the building blocks. It analyzes the determinants of the components of spending that make up GDP. The answers to the questions above are the same whether prices are flexible (Part 3) or sticky (as they will be in Part 4). So our building blocks form the basis for both our long-run and our short-run stories. In Chapter 7 these building blocks are put together. Chapter 7 demonstrates how to use the flexible-price model to analyze the composition of real GDP and how a flexible-price macroeconomy reacts to disturbances and shocks. Chapter 8 turns the focus of attention from production to the price level. It performs the straightforward task of analyzing the determinants of the price level and inflation in the flexible-price model.

CHAPTER 6

Building Blocks of the Flexible-Price Model

QUESTIONS

What is a full-employment analysis?

What keeps the economy at full employment when wages and prices are flexible?

What determines the level of consumption spending?

What determines the level of investment spending?

What determines the level of net exports?

What determines the level of the real exchange rate?

In the previous two chapters we looked at long-run growth — at how the economy develops and evolves over periods as long as generations. In this chapter we look at the economy over such a short period that its productive resources are fixed but such a long period that wages and prices are fully flexible.

This chapter, Chapter 6, first answers the question: What are the economic forces that keep real GDP at its equilibrium value? In Section 6.1 we show that if wages and prices are flexible enough (as we assume they are here in Part 3), then markets clear: Quantities demanded are equal to quantities supplied. In particular, the labor market clears: Employment is equal to the labor force (save for some "frictional" unemployment), and production is equal to potential output. Should production not be equal to potential output, rising or falling real wages will quickly lower or raise firms' demands for labor and bring the economy back to equilibrium at full employment.

Then this chapter assembles the building blocks we need for nearly every remaining chapter in the book. How do consumers decide on consumption spending — how much to spend on themselves and their households? How do businesses decide on the level of investment spending? How are net exports determined? The answers to these questions are the same whether prices are flexible (Part 3) or sticky (as they will be in Part 4 of this book). So our building blocks form the basis for both our long-run and short-run stories.

A word is needed about the *flexible price assumption* made in this part. Part 3 answers the first question above in the case where wages and prices are flexible, in which the market system works well, in which markets clear — every buyer finds a willing seller and every seller finds a willing buyer. This means, most important, that labor supply equals demand: No firms wanting to hire workers are left unsatisfied, and no workers willing to work are left permanently unemployed. (In Part 4 we analyze the case in which prices are sticky, the market system does not work perfectly, real GDP is not always equal to potential output, and unemployment can rise high enough to become a critical economic problem.)

6.1 POTENTIAL OUTPUT AND REAL WAGES

In the *flexible-price* model of the macroeconomy, two sets of factors determine the levels of potential output and of real wages: the production function and the balance of supply and demand in the labor market. Once we have determined **potential output** — the economy's full-employment productive potential — we then know what its actual level of output is, for in the flexible-price model potential output and actual output are the same. Why are they the same? We'll see shortly that it is the flexibility of prices and wages that guarantees that potential output and the actual level of output are equal.

potential output
The level at which national product would be if all resources were fully employed.

The Production Function

Chapter 4 introduced the **production function**, the rule that tells us how much the economy can produce given its available productive resources. In the Cobb-Douglas form of the production function, as we learned, potential output Y^* is determined by the size of the labor force L, the economy's capital stock K, the efficiency of labor E, and a parameter α that tells us how fast returns to investment

production function
The relationship between the total amount of output produced in an economy and the quantities of labor and capital and the levels of technology and organization used to produce it.

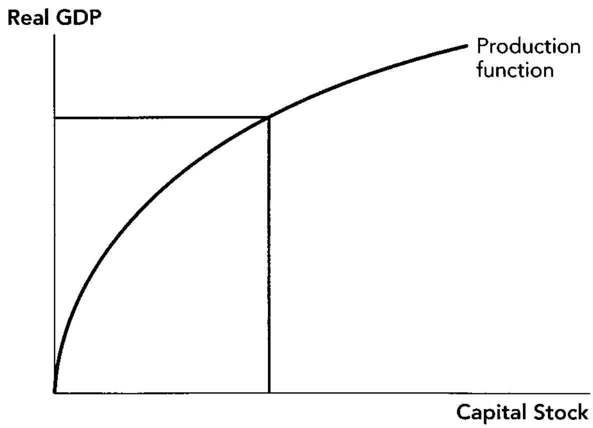


FIGURE 6.1
The Production Function
Holding the labor force and the efficiency of labor constant, real GDP increases as the capital stock increases. Because each successive addition to the capital stock produces a smaller increase in output, the production function is curved. The smaller the level of α, the greater the curvature and the more rapidly the returns to investment diminish.

diminish. The production function tells us that potential output is[1]

$$Y^* = K^{\alpha}(LE)^{1-\alpha}$$

The graph in Figure 6.1 shows us, once again, just one slice of this production function — the relationship between the capital stock K and potential output Y^*, holding the supply of labor L and the efficiency of labor E fixed. In Chapters 4 and 5, we were looking at changes over time. In this chapter we are looking at the economy at one instant, not over time.

The assumption that wages and prices are flexible was commonly made by the classical economists, who wrote before World War II. Thus this assumption is also called the **classical assumption.** The classical assumption guarantees that markets work — that prices adjust rapidly to eliminate gaps between the quantities demanded and the quantities supplied. No businesses find their inventories of unsold goods piling up, and there is full employment: Everyone who wants a job (at the market-clearing level of wages) can get a job. Every business that wants to hire a worker (at the market-clearing level of wages) can hire a worker. Thus actual output is equal to potential output: There is no gap between the economy's productive potential and the level of output the economy produces.

classical assumption
The assumption that wages and prices are flexible.

This classical assumption that we make in this part of the book — in Chapters 6, 7, and 8 — means that Part 3 is devoted to full-employment flexible-price macroeconomics. However, the flexible-price assumption is not always a good one. Experience has shown that a market economy does not always have flexible prices. Sometimes prices and wages turn out to be sticky, or sluggish, or stuck. Thus the economy does not always work well, and does not always provide full employment.

In Part 4 we will drop the classical flexible-price full-employment assumption. From Part 4 on, we will instead make the "Keynesian" assumption that wages

[1] In Chapter 4, the production function we worked with was usually expressed as $Y/L = (K/L)^{\alpha} E^{1-\alpha}$. Multiplying both sides of that equation by L and rearranging terms gives us the equation in the text. We did not distinguish between actual output Y and potential output Y^* in Chapter 4 but need to do so here.

TABLE 6.1
Classical Flexible-Price versus Keynesian Sticky-Price Analyses

Issue	Classical	Keynesian
Wages and prices	Fully flexible	Can be "sticky" or fixed
Expectations	Consistent with full employment	Volatile — can take a number of forms
Labor market	Always in equilibrium with full employment	Can be out of equilibrium, causing involuntary unemployment
Effect of shocks to aggregate demand	Change in the composition but not the level of GDP	Change in the composition and the level of GDP

and prices are sticky and that markets do not work perfectly. This leads to a number of important differences in the analysis, some of which are briefly noted in Table 6.1.

If the classical flexible-price assumption is not always a good one to make, why make it at all? First, it can be a very good assumption if conditions are right. It is a good assumption if wages and prices are relatively flexible, and if we are looking at processes that take enough time for prices in all of the economy's markets to adjust in order to balance supply and demand. Second, starting with the classical assumption makes this course easier. It simplifies the analysis of several issues and facilitates an understanding of how the macroeconomy works in the long run. One habit of economists is to start with the simpler cases, and only after they are well understood, to look at more complicated ones.

Moreover, the way an economy functions under the flexible-price assumption provides a useful baseline against which to assess economic performance. If we want to assess the costs to society of sticky prices and periods of high unemployment, we need a benchmark against which to make comparisons, and the behavior of the economy in the flexible-price model provides such a benchmark.

Nevertheless, we must remember that Part 3 presents only one model of the economy. The Keynesian sticky-price model behaves very differently in a number of ways. So Part 3 does not tell the full story.

The Labor Market

When markets work well, what keeps the economy at full employment and actual production equal to potential output? One way to look at this issue is that the answer lies in the adjustment of prices and supply and demand in the labor market. When the supply of and demand for labor balance, real GDP will equal potential output.

labor market
The market in which workers are hired by firms.

Labor Demand

Economists try to suppress every detail and difference that does not matter for the overall result in order to simplify the analysis and focus it on the important factors — the ones that really count. Because differences between businesses will not matter, let's think about an economy with K typical — identical — representative firms, each of which owns 1 unit of the economy's capital stock.

Each of these firms hires a number of workers — let's call the number of workers each firm hires L_{firm}. Each firm in the economy pays each worker the same nominal wage W. Each firm sells Y_{firm} units of its product at a per-unit price P. The typical firm does not control either the wages it must pay or the prices it receives; those are determined by the market, and each firm takes the wages and prices it is offered. And each firm tries to make as much profit as it can.

Thus we have a very simple and standard model of a typical firm. The firm's *profits* are simply its revenues minus its costs, and its only costs are the wages it pays to workers:

$$
\begin{aligned}
\text{Profits} &= \text{Revenues} - \text{Costs} \\
&= P \times (Y_{\text{firm}}) - W \times (L_{\text{firm}})
\end{aligned}
$$

To figure out how many workers to hire in order to maximize its profits, the firm must:

1. Hire workers in order to boost output.
2. Stop hiring workers when the extra revenue from selling the output produced by the last worker hired just equals the value of the last worker's wage.

The value of the output produced by the last worker hired is the product's price times what economists call the **marginal product of labor** (MPL). What is the marginal product of labor? The marginal product of labor is the difference for some time period between what the firm can produce with its current labor force L_{firm} and what it would produce if it hired one more worker, as Figure 6.2 shows for the benefit of those of you who like graphs rather than sentences with subclauses.

marginal product of labor (MPL)
The increase in potential output from a 1-unit increase in the quantity of labor employed by the firm.

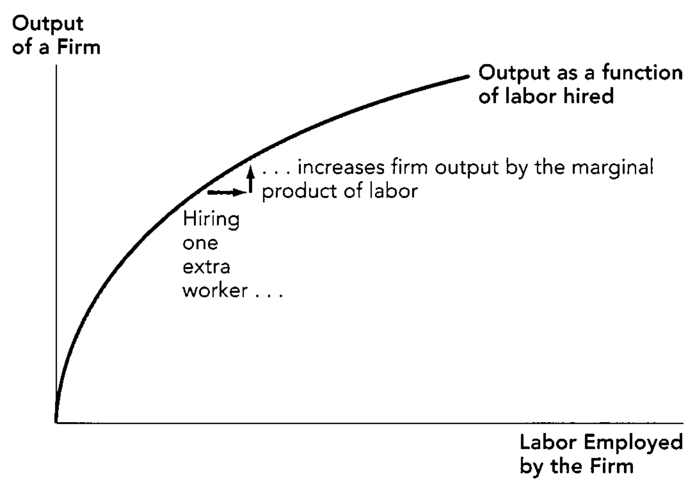


FIGURE 6.2
The Firm's Output as a Function of the Firm's Employment
Holding the capital stock of the typical firm constant, each extra worker the firm employs produces smaller and smaller increases in total output. As the level of employment increases, this marginal product of labor (MPL) decreases.

Since a typical firm owns 1 unit of capital, its output is what can be produced using that single unit of capital and the firm's workers, according to the production function

$$Y_{\text{firm}} = F(\text{Capital, Labor}) = F(1, L_{\text{firm}})$$

And so the marginal product of labor (MPL) is

$$\text{MPL}_{\text{firm}} = F(1, L_{\text{firm}} + 1) - F(1, L_{\text{firm}})$$

The MPL for the representative firm with a Cobb-Douglas production function, where $K = 1$, is just the derivative with regard to labor L of the production function:

$$MPL = \frac{K^{\alpha}(1-\alpha)E^{1-\alpha}}{(L_{\text{firm}})^{\alpha}} = \frac{(1-\alpha)E^{1-\alpha}}{(L_{\text{firm}})^{\alpha}}$$

There is nothing deep in this math. Indeed, the Cobb-Douglas function was tweaked so that it would yield such simple forms for quantities like the MPL. That is why economists use it so often.

Now that we know the MPL, determining how many workers this representative firm will hire is straightforward. It will keep hiring workers as long as doing so remains profitable. As Figure 6.3 shows, the firm hires workers up to the point where the product of the price it sells its goods for and the marginal product of labor has fallen so that it equals the wage

$$P \times (\text{MPL}) - W = 0$$

For the Cobb-Douglas production function, this profit-maximizing level of labor demand for the firm is

$$L_{\text{firm}} = \left[\frac{(1-\alpha)E^{1-\alpha}}{\frac{W}{P}}\right]^{(1/\alpha)}$$

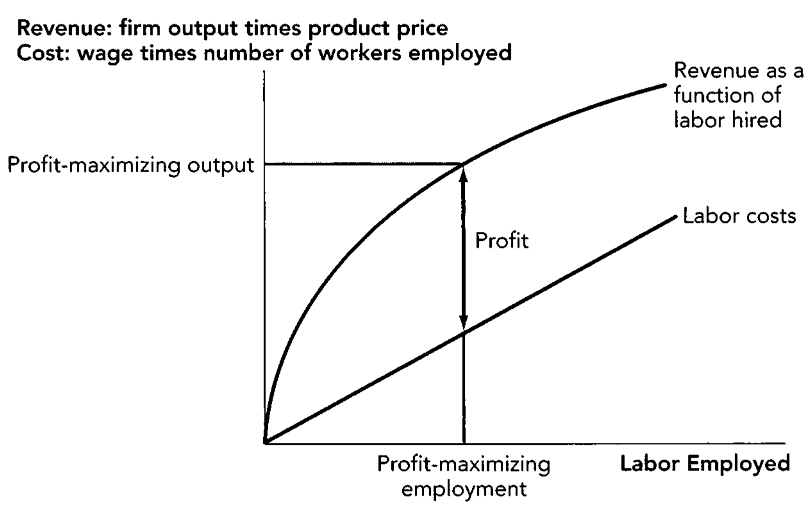


FIGURE 6.3
The Typical Firm's Hiring Policy
The typical firm chooses to hire the number of workers that make marginal revenue product — the MPL times the product price P — equal to the wage W. At that point the revenue and cost curves are parallel, and profit is maximized.

An example is provided in Box 6.1. And since there are K firms in the economy — one for each unit of capital — this gives us an economywide demand for labor by firms L^d equal to

$$L^d = K\left[\frac{(1-\alpha)E^{1-\alpha}}{\frac{W}{P}}\right]^{1/\alpha}$$

BOX 6.1

FIRM LABOR DEMAND: AN EXAMPLE

Suppose that we have a specific Cobb-Douglas production function — suppose that for the firm the value of labor efficiency E equals 1, the parameter α equals 1/2, and so the production function is

$$Y_{\text{firm}} = K_{\text{firm}}^{1/2}(L_{\text{firm}} \cdot 1)^{1/2} = (\sqrt{K_{\text{firm}}})(\sqrt{L_{\text{firm}}})$$

The annual output of the firm is equal to the square root of the firm's capital stock times the square root of the firm's labor force. This — since the typical firm has only 1 unit of capital — immediately simplifies to

$$Y_{\text{firm}} = \sqrt{L_{\text{firm}}}$$

Suppose further that the wage the firm pays each of its workers is \$25,000 a year, that output is measured in millions of gallons, and that each gallon of output sells for \$1. (Let's not ask gallons of what.)

Now let's think about how many workers the firm should hire. Raising employment from 0 to 1 increases production from 0 to 1 million-gallon-unit per year and raises the firm's total sales by \$1,000,000. Since the first worker has to be paid only \$25,000, this looks like a very good deal. Raising employment from 100 to 101 would increase output from 10 million-gallon-units to 10.050 units (that's the square root of 101). That amounts to an extra \$50,000 in annual revenue at an extra wage cost of \$25,000. This still looks like a very good deal.

How about raising employment from 400 to 401? That raises output from 20 million-gallon-units to 20.02498 million-gallon-units. That's an extra \$24,980 in extra revenue, but at an extra wage cost of \$25,000. The 401st worker lowers profits. So at 400 workers it is time to stop.

Should the firm have stopped earlier? Suppose that you cut employment from 400 to 399. You save \$25,000 a year in reduced wage costs. But you also cut your output from 20 million-gallon-units to 19.97498 units: 20 − 19.97498 = 0.02502. So you lose \$25,020 in revenue. The 400th worker earns his or her keep, and the firm should not cut employment below 400.

Labor Market Equilibrium

Economywide labor demand is only half of the labor market. To understand what is going on in the labor market we also need to know what is going on with the **labor supply**. The answer is simple: The labor supply is the number of workers who want to work. The labor market will be in equilibrium when firms' total demand for workers is equal to the economy's labor force L.

labor supply
The number of workers who want to work.

Can the labor market be out of equilibrium if wages and prices are flexible? No. Think about what happens when wages and prices are flexible if labor supply is not equal to demand. Suppose there are more workers who want to work than the number of workers that firms want to hire at current wages and prices. Some of the workers will find themselves unemployed. Then some of the unemployed will underbid the employed workers, offering to take their jobs and work for less. The workers who are employed will respond by offering to accept lower wages to keep their jobs.

real wage

The wage paid to the average worker divided by the price level.

The wage W will decline relative to the price level P, and the **real wage** W/P will fall. Unless the firm changes its labor demand, the marginal product of the last worker hired will now exceed the real wage. To maximize profit, the firm should change its labor demand until the MPL falls to the point where it equals the new lower real wage. But the firm knows that the marginal product of the last worker hired will fall as it hires more workers, something we economists call *diminishing returns*. So as this real wage falls, firms wishing to profit maximize will hire more workers.

Suppose, on the other hand, that firms want to hire more workers than there are people in the labor force. Some firms will try to bid workers away from other firms by offering higher wages. The real wage W/P will rise. As the real wage rises, other employers will reduce the quantity of labor they demand. Thus, as Figure 6.4 shows, in **labor market equilibrium**, labor demand L^d will equal the labor force L:

labor market equilibrium

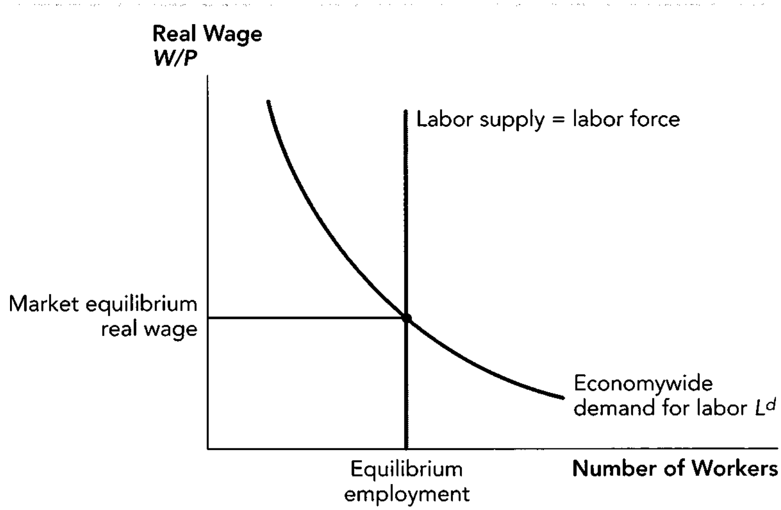
When, save for those in the process of changing jobs, the economy is at full employment.

$$L = L^d = K\left[\frac{(1-\alpha)E^{1-\alpha}}{\frac{W}{P}}\right]^{1/\alpha}$$

We can rearrange this equation and solve for the real wage W/P to see that labor demand is equal to the labor force when the real wage W/P is

$$\frac{W}{P} = \left[(1-\alpha)E^{1-\alpha}\right]\left(\frac{K}{L}\right)^{\alpha} = (1-\alpha)\left(\frac{Y}{L}\right)$$

FIGURE 6.4
Equilibrium in the Labor Market
The equilibrium level of employment is equal to the labor force. At the equilibrium level of the real wage, there is neither excess demand for nor excess supply of labor.



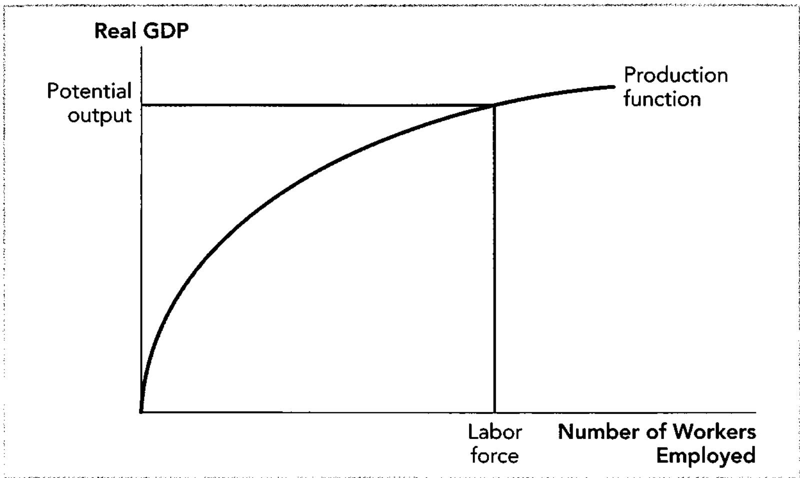


FIGURE 6.5
In a Full-Employment Economy, Real GDP Equals Potential Output
When the economy is at full employment, the level of employment is equal to the labor force and real GDP is equal to potential output.

because we already know from Chapter 4 that $(E^{1-\alpha})(K/L)^{\alpha}$ is equal to output per worker Y/L. As long as wages and prices are flexible enough for this adjustment process to work and for the real wage to converge to this, its equilibrium level, the economy will be at and will remain at full employment.[2]

The conclusion is clear: If markets work well — if wages and prices are flexible and adjust to balance supply and demand, and if markets are competitive so that firms take wages and prices as given rather than controlling them — then we can expect the labor market to be at full employment, and the actual level of production in the economy Y to be equal to the economy's potential output Y^*, as Figure 6.5 shows.

As long as we are looking at a short enough interval of time that the labor force, the capital stock, and the efficiency of labor do not change, in the flexible-price model the answer to a great many questions is simple and straightforward. If somebody asks you what is the effect on real GDP of a change in government spending or an increase in interest rates overseas or of a stock market boom or pretty much anything else, the answer will always be the same: Real GDP doesn't change, because the economy's output is equal to its productive potential. In the flexible-price model the questions that have more complicated answers are those that relate to the *division* of real GDP among its various main components: consumption, investment, government spending, and net exports.

[2]Note that this full-employment economy is not necessarily the best or even a good economy. The real incomes of people who don't own chunks of the capital stock are their real wages: $W/P = (1 - \alpha)(Y/L)$. If α is large, their real incomes will be small, and social welfare may be low.

RECAP POTENTIAL OUTPUT AND REAL WAGES

A flexible-price economy is a full-employment economy: Wages are flexible enough to keep supply and demand in balance in the labor market. Because there are enough jobs for all the workers who want to work at the prevailing market-clearing wage, real GDP in a flexible-price economy is always equal to potential output and unemployment is not a problem. This classical model of the macroeconomy is the polar opposite of the Keynesian model, where prices and wages are sticky, markets do not always clear with supply and demand in balance, high unemployment is possible, and there are gaps between real GDP and potential output.

6.2 DOMESTIC SPENDING

In Chapters 2 and 3 we saw, through the national income identity, that total spending for goods and services is divided into four components:

- Consumption spending C
- Investment spending I
- Government purchases G
- Net exports NX

Every dollar spent on final goods and services, whether spent by households on their own consumption (C), spent by businesses in maintaining or expanding their capital stock (I), purchased by the government (G), or purchased by foreigners (GX), flows to firms as revenue — except for that part of the spending flows C, I, and G that is spent buying imported goods IM. So total receipts by business firms — canceling out payments one firm makes to another — are equal to the four components of spending $C + I + G + GX - IM$, which we find more convenient to write as $C + I + G + NX$. Every dollar that firms receive is counted as somebody's income, whether paid out to workers or retained to become the property of the firm's owners or shareholders. So national income is equal to $C + I + G + NX$.

And the circular flow principle tells us that total spending and national income are essentially the same thing as real GDP, for the value of income is the same as the value of what is sold and produced. Thus

$$C + I + G + NX = Y = \text{real GDP}$$

In this section of Chapter 6 we look at the determinants of the three domestic components of spending: C, I, and G. International trade and net exports will be deferred for the moment until the next section.

Note that the rest of this chapter offers no big payoff, no single lesson to be learned at the end. The big lesson comes at the end of Chapter 7. The rest of this chapter simply sets out the factors that determine the components of spending; it does not show how all the pieces fit together.

Consumption Spending

The spending and saving decisions that determine the magnitude of the flow of consumption spending are made by households, so this subsection lays out how households make their big decisions. The decisions we focus on are those that determine how households divide their income up among taxes, saving, and consumption spending.

Household Decisions

The circular flow principle tells us that the wages of workers plus the profits of property owners (rent, interest, dividends, and retained earnings) add up to national income, which is — because at this level of analysis we are uninterested in picky accounting distinctions — essentially the same as real GDP. So for simplicity let's use Y for both income and total output.

Households pay some of their income to the government in net taxes — *taxes less transfer payments* from the government — which we write as T. To keep the analysis simple, throughout this book we will assume that net taxes are equal to the constant average tax rate t multiplied by national income Y:

$$T = tY$$

In the real world taxes are not proportional to income. Our tax system is somewhat progressive, which means that richer taxpayers on average pay more of their income in taxes than do the relatively poor. Once again, however, the complications introduced by the fact that our tax system is not proportional to income are not central to the analysis, so we follow economists' standard practice of simplifying wherever possible.

The amount left after households pay their net taxes is their disposable income, written Y^D:

disposable income
What is left of income after taxes have been paid and transfer payments received.

$$Y^D = Y - T = (1 - t)Y$$

Households also save some of their income to boost their wealth and future spending. We represent private household saving by S^H — S for "saving" and H for "household." (Note that household saving includes the retained earnings of corporations: The NIPA treats undistributed corporate earnings that are retained by the corporation as if they were distributed to the shareholding households and then immediately reinvested back into the corporation.) As Figure 6.6 shows, households spend the rest of their income — everything that is not saved or paid to the

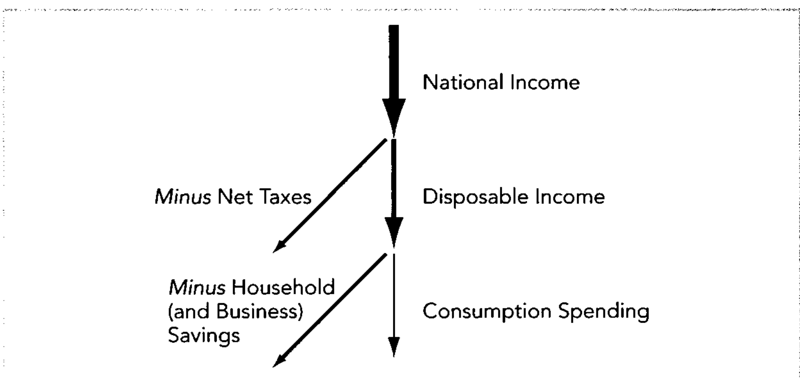


FIGURE 6.6
From National Income to Consumption Spending
To get disposable income, subtract taxes from and add transfers to national income. To get consumption spending, subtract household saving (including the retained earnings of businesses) from disposable income.

government in net taxes — buying consumption goods:

$$C = Y^D - S^H = Y - T - S^H$$

In the United States today, consumption spending — purchases by households for their own use, from pine nuts and flour to washing machines and automobiles, from Big Macs and haircuts to rent and financial consulting — accounts for roughly two-thirds of GDP.

We will break consumption spending down into a baseline level of consumption (which we define as a parameter C_0) and a fraction (which we define as a parameter C_y) of disposable income Y^D, or a fraction $C_y(1 - t)$ of total income Y:

$$C = C_0 + C_y Y^D = C_0 + C_y(1 - t)Y$$

marginal propensity to consume (MPC)

The increase in consumption spending resulting from a one-dollar increase in disposable income.

The fraction C_y is more commonly known as the **marginal propensity to consume (MPC)**. It tells us the change in consumption spending when disposable income changes by one dollar:

$$C_y = \frac{\Delta C}{\Delta Y^D}$$

Thus we assume that consumption spending C is a simple linear function of real GDP Y: If we plot consumption on the vertical axis and real GDP on the horizontal axis of a graph, the **consumption function** will be a straight line.

consumption function

The relationship between baseline consumption C_0, the marginal propensity to consume C_y, and disposable income Y^D.

Notice that in writing this particular consumption function, we again follow the economists' principle (or vice) of ruthless simplification. In our more complicated world, consumption spending does not depend on disposable income alone. As Figure 6.7 shows, other factors affecting consumption include changes in the real interest rate, household total stock market and real estate wealth, the demographic structure of the population, income distribution, consumers' relative optimism,

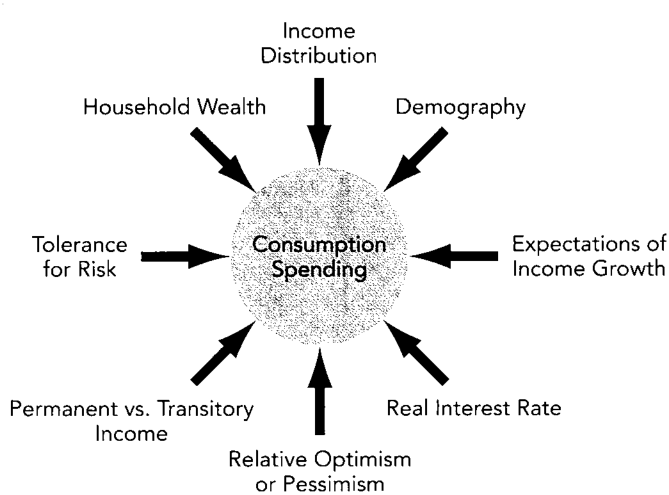


FIGURE 6.7
Other Determinants of Consumption Spending
Other factors besides taxes and saving affect consumption spending. Each of these factors can change baseline consumption C_0.

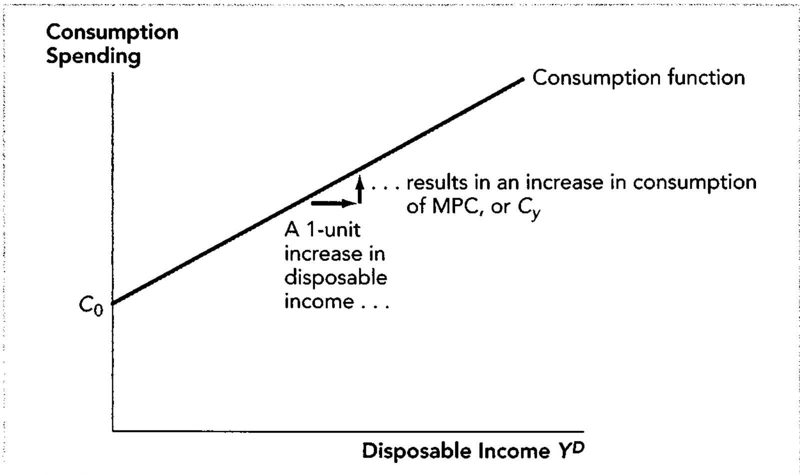


FIGURE 6.8
The Consumption Function
Consumption spending depends on the level of disposable income and two parameters: C_y (the marginal propensity to consume, or MPC) and C_0 (the baseline level of consumption). If we know both these parameters and the value of disposable income Y^D, we can plot the level of consumption spending at each possible level of disposable income.

expected future income growth, tolerance for risk, and whether consumers see changes in disposable income as *transitory* or *permanent*. (If consumers expect an income increase to be transitory, they will save most of it and spend only a little; if they expect an income increase to be permanent, they will spend most of it.) But here and throughout the book we will sweep these complications under the rug. We will think only about baseline consumption C_0, the marginal propensity to consume C_y, and disposable income Y^D as the determinants of consumption spending and allow all these other factors in by saying that they change baseline consumption C_0.

The Marginal Propensity to Consume

The marginal propensity to consume (MPC), the parameter C_y in the consumption function, is the amount by which consumption spending rises in response to a $1 increase in disposable income (see Figure 6.8). We are sure that C_y is greater than zero: If disposable incomes rise, households will use some of their extra income to boost their consumption spending. We are also sure that C_y is less than 1: As disposable incomes rise, households will increase their saving as well; they will not spend all their extra disposable income on consumption goods.

The value of the marginal propensity to consume also depends on how long people expect the change in disposable income to last. As discussed in Appendix 6a, if people expect the change in disposable income to be permanent, then the MPC is likely to be relatively large. If they expect the change in disposable income to be transitory — and think their disposable income next year will revert back to its normal pattern — the MPC is likely to be relatively small.

Baseline Consumption

Although sometimes we say the baseline level of consumption, the parameter C_0, is the amount households would spend on consumption goods if they had no income at all, that's somewhat misleading. Such a definition invites you to (incorrectly!) think of the consumption function as some sort of individual consumption function for an individual household. But it's not. The consumption function tells us, for the economy as a whole, how consumption varies with changes in real GDP and total national income.

The baseline level of consumption spending, the parameter C_0, tells us where the aggregate consumption function hits the vertical axis. If wealth increases, the consumption function shifts up; C_0, the baseline level of consumption, increases. But would this economy truly consume C_0 if the entire economy produced not one single good or service and its real GDP was zero? No one knows. And because knowing requires observing a completely devastated economy, we hope no one ever will!

With these two parameters, C_0 and C_y, we can calculate what the total level of consumption spending will be for each possible level of disposable income Y^D (see Box 6.2).

6.2

CALCULATING CONSUMPTION FROM INCOME: AN EXAMPLE

If we know the parameters C_0 (the baseline level of consumption), C_y (the marginal propensity to consume, or MPC), and t (the tax rate), we can calculate the level of consumption spending C for any level of total national income Y using the equation

$$C = C_0 + C_y Y^D = C_0 + C_y(1 - t)Y$$

Suppose the tax rate t is 25 percent, the total national income Y is \$10 trillion, the baseline level of consumption C_0 is \$2 trillion, and the marginal propensity to consume C_y is 0.6. We first calculate disposable income — how much households have left after paying their taxes. Disposable income is equal to $(1 - t)Y$, which for these parameter values and this level of national income is

$$Y^D = (1 - 0.25)(\$10 \text{ trillion}) = \$7.5 \text{ trillion}$$

We can then calculate consumption:

$$\begin{aligned} C &= C_0 + C_y(\$7.5 \text{ trillion}) \\ &= \$2 \text{ trillion} + 0.6(\$7.5 \text{ trillion}) \\ &= \$6.5 \text{ trillion} \end{aligned}$$

What will happen if disposable income rises from \$7.5 trillion to \$8 trillion? Consumption spending will rise from \$6.5 trillion to \$6.8 trillion — a change in consumption spending equal to the marginal propensity to consume, 0.6, times the change in disposable income, \$0.5 trillion.

Investment Spending

In the United States today investment spending averages only about 15 percent of GDP. But investment spending is the most volatile and variable component of GDP. When economists use the term "investment," they mean something different from what most people mean by the word. Most people use it to mean activity such as buying a stock or bond, a *certificate of deposit*, or *commodity futures*. But such purchases do not directly increase the economy's capital stock or have any place in the national income and product accounts.

When economists use the term "investment" or "investment spending," they are talking about transactions that replace depreciated machinery and equipment, or add to the capital stock and increase potential output. Such transactions include the purchase and installation of new business machinery and equipment, the construction and purchase of new buildings or residential structures (or the repair of old ones), and a change in business inventories. Box 6.3 highlights two different ways economists break down total investment spending.

6.3

KINDS OF INVESTMENT: SOME DETAILS

Economists categorize investment in two different ways. The first distinction they draw is between gross investment and net investment. Gross investment is the total sum of spending on machines, construction (houses, factories, office buildings, privately owned roads, dams, and bridges), and additions to inventories.

Some of gross investment adds to the capital stock of machines, goods in process, buildings, and other structures. The rest of gross investment replaces worn-out and obsolete pieces of capital. The amount of gross investment spending that increases the capital stock is called net investment. The amount of investment spending that replaces obsolete and worn-out capital is called depreciation or capital consumption.

Economists also categorize investment according to use, as follows:

1. *Residential construction*
2. Nonresidential construction
3. Equipment investment
4. *Inventory investment*

To some degree, these four subcategories of investment have different determinants and different consequences. But in order to simplify and construct a useful model, we ignore those differences.

Fluctuations in economywide investment spending have two sources. First is the interest rate: The higher the **real interest rate**, the lower is investment spending. A higher real interest rate makes investment projects more expensive for firms to undertake, so they undertake fewer of them. Second is business managers' and investors' confidence — what John Maynard Keynes called their "*animal spirits*." The higher their confidence, the higher is investment spending. Optimistic managers and investors are more willing than pessimistic ones to bet their careers and fortunes on the belief that an expansion of productive capacity or some other investment will pay off.

real interest rate
The nominal interest rate minus the inflation rate.

Why Firms Invest

Interest Rates A business invests because its managers believe that the investment project will be profitable. One way managers decide if a project is profitable is by comparing the appropriately discounted return on the investment with the investment's cost. Their rule: Undertake the investment project only if the return is at least as great as the investment's cost. The higher the interest rate, the lower is the appropriately discounted return on the investment project. And so the higher the interest rate, the smaller is the number of potential investment projects that will be profitable. Thus a higher interest rate leads to lower investment spending.

present value

The value in today's dollars of a sum of money to be received in the future.

Why does the discounted return fall when interest rates rise? The answer uses the economists' concept of **present value** — the amount of wealth that you would have to set aside today and put into financial assets earning the real interest rate to generate some particular amount of purchasing power in the future. If the real interest rate is 5 percent per year, to have \$130 million of inflation-adjusted purchasing power in five years you would have to take \$101.85 million today, put it aside, and let it compound in the bond market: $\$101.85 \times (1.05)^5 = \$130$ million. Thus the present value of \$130 million in five years at an interest rate of 5 percent is \$101.85 million.

To calculate the present value \$PV of a sum of inflation-adjusted purchasing power \$SUM to be received n years in the future at an interest rate of r percent per year, you *discount* the future sum back to the present at the rate r using the formula

$$\$PV = \frac{\$SUM}{(1 + r)^n}$$

because \$PV in the bond market at an interest rate of r for n years will compound to \$SUM. (If whether or not the \$SUM will actually be paid in the future is subject to more than the usual amount of risk found in the bond market, the present value will be lower: You can either risk-adjust the \$SUM to a lower value or risk-adjust the discount rate r by adding a risk premium σ^s and discounting at $r + \sigma^s$.)

At a real interest rate of 6 percent, the present value of \$130 million received in five years is \$130 million/$(1.06)^5 = \$97.14$ million. When we used an interest rate of 6 percent rather than 5 percent, the present value of \$130 million received in five years fell from \$101.85 million to \$97.14 million. What's true in our example is true in general: The higher the real interest rate, the lower the discounted value — the present value — of an investment project that will generate revenue in the future.

With present value, the decisions of business managers become easier. One investment project will be a better use of resources than another only if the first has a higher present value than the second.

Most investment projects don't yield returns in the shape of a single, lump-sum payment n years into the future. Most yield a stream of profits each year for a prolonged period. Thus more useful than the formula for the present value of a \$SUM n years in the future is the \$STREAM formula for the present value of a stream of payments each year from now into the indefinite future:

$$\$PV = \frac{\$STREAM}{r}$$

Think of how much a flow of real purchasing power of \$1 million per year each year into the indefinite future is worth. If you wanted to receive such an annual flow, how much would you have to put into the bond market today? \$1/r million invested in the bond market yields an annual flow of real purchasing power of \$1 million per year. Thus an investment project that you expect to yield a cash flow of \$STREAM in real purchasing power per year each year has a present value of \$STREAM/r.

You can see from these financial formulas how important the real interest rate is for determining whether investments are worthwhile or not. If an investment project promises a long-running stream of returns — as in the example above — a small change in the real interest rate can have an enormous impact on present value.

How many investment projects will a higher interest rate discourage? How much lower will investment be if the interest rate is higher? The answer is captured by a parameter we call "investment's response to a change in the interest rate," or I_r. The greater is I_r, the greater is the change in investment spending in response to a change in the real interest rate.

The interest rate most relevant to determining investment is the long-term, real, risky interest rate. The relevant interest rate is *long-term* because investment projects affect the business's profits and costs for a long time to come. The relevant interest rate is *real* — that is, inflation-adjusted — because an investment project gives the business that undertakes it a real, physical asset, not a financial claim denominated in dollars. The relevant interest rate is *risky* because investment projects are risky. In calculating whether investment projects are worthwhile, be sure to compare apples to apples. Discount the long-term, real, risky profits anticipated from undertaking an investment project by the long-term, real, risky interest rate.

Animal Spirits A number of factors other than changes in interest rates can affect investment spending; we capture all these other factors in what Keynes called "animal spirits." When businesspeople's optimism soars, their expected return from an investment project soars too. More projects become profitable at every interest rate. Investment spending rises.

When businesspeople's perception of risk increases — when their certainty about the future return on an investment project becomes, well, less certain — then they tend to become more cautious in committing large quantities of money to a long-term investment project. At every interest rate, investment spending falls.

The Investment Function

To model the inverse relationship between the level of investment spending and the long-term, real, risky interest rate, set investment spending I equal to the baseline level of investment (the value of the parameter I_0) minus the real interest rate r times the slope of the **investment function**, parameter I_r (see Figure 6.9):

$$I = I_0 - I_r r$$

investment function

The relationship between the real interest rate r and investment spending.

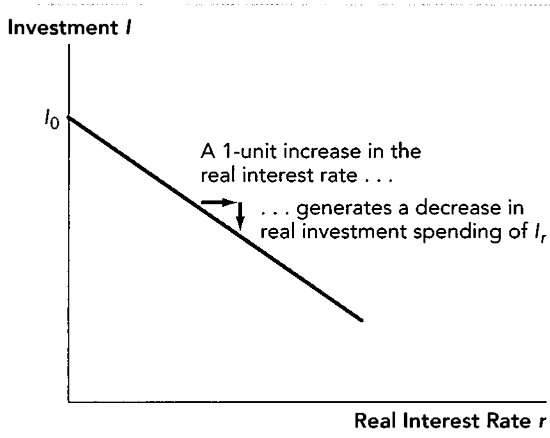


FIGURE 6.9
The Investment Function

Investment spending increases as the real interest rate decreases. How much investment spending changes is measured by I_r. Changes in baseline investment spending shift the investment function.

6.4

HOW INVESTMENT RESPONDS TO A CHANGE IN INTEREST RATES: AN EXAMPLE

From the parameters I_0 (the baseline level of investment) and I_r (the responsiveness of investment to a change in real interest rates) we can calculate the level of investment spending for each possible value of the real interest rate r.

For example, suppose that I_0 is \$2 trillion and that I_r is \$10,000 billion. Then we can use the equation

$$I = I_0 - I_r r$$

to calculate that if the real interest rate is 5 percent ($r = 0.05$), then the level of investment spending is \$1.5 trillion:

$$I = \$2 \text{ trillion} - (\$10{,}000 \text{ billion} \cdot 0.05) = \$1.5 \text{ trillion}$$

If the real interest rate is 10 percent ($r = 0.10$), the level of investment spending is \$1 trillion:

$$I = \$2 \text{ trillion} - (\$10{,}000 \text{ billion} \cdot 0.10) = \$1 \text{ trillion}$$

And if the real interest rate is 0 percent, the level of investment spending is \$2 trillion:

$$I = \$2 \text{ trillion} - (\$10{,}000 \text{ billion} \cdot 0) = \$2 \text{ trillion}$$

Box 6.4 shows how to use this investment function equation to calculate the level of investment spending at a particular interest rate. Box 6.5 presents an alternative way of thinking about the investment function — one that focuses on the stock market, not on interest rates.

6.5

THE STOCK MARKET: SOME DETAILS

An alternative way of looking at investment — one that would complicate our models too much for us to use here — sees the level of investment spending as a function of the level of the stock market. Think about what determines stock market values. Most investors in the stock market face a choice between holding stocks — shares of ownership of a corporation that also give you ownership of that corporation's profits or earnings — or holding bonds: pieces of paper that represent loans that pay interest. If you hold your wealth in bonds, you earn the real interest rate r. If you buy shares of stock, your return is equal to your share of the profits of the companies whose stock you own.

When expected future profits are high, investors find stocks more attractive than bonds and thus bid up stock prices. When the real interest rate falls, investors also find stocks more attractive than bonds and bid up stock prices. In either case, the stock market will rise. However, when expected future profits are high, businesses invest more. When the real interest rate falls, businesses find investment projects cheaper and also invest more. The same things that determine the value of the stock market also determine the level of investment spending. The stock market and investment move together: What raises or lowers one raises or lowers the other.

The only significant difference is that causes of fluctuations in investment affect the stock market first and investment spending second. The stock market is thus a very useful leading indicator of investment spending. Keep a close watch on the stock market if you want to forecast the level of investment spending.

Notice the regular pattern used for parameters so far: C_0, C_y, I_0, I_r. This regular pattern is an attempt to make the names of parameters used in algebraic equations clearer and easier to remember. In general, the capital letter in the name of each parameter tells you what variable is on the left-hand side of the equation in which the parameter appears. A C means that the parameter is part of an equation determining the level of consumption spending C; an I means it is part of an equation determining the level of investment spending I; and so forth. The subscript tells you the variable by which the parameter is multiplied in that equation. For example, I_r is the amount by which investment spending I changes in response to a change in the real interest rate r.

Like the consumption function, the investment function is an enormous simplification of real-world investment patterns. In the real world, firms' investment decisions depend not only on the real interest rate but also on how much money the firms have available. Total profits are also an important determinant of investment. In the real world, some components of investment — construction, for example — are very sensitive to changes in the real interest rate. Other components of investment — for example, inventory investment by small firms with little access to outside sources of funding — are not. Box 6.6 discusses two tools government policy makers sometimes have at their disposal to change the level of investment.

6.6

HOW TO BOOST INVESTMENT: A POLICY ISSUE

As we saw in Chapters 4 and 5, a high level of saving and investment is one of the keys to a prosperous economy. The higher the share of GDP devoted to investment spending, the higher is the equilibrium capital-output ratio and the richer is the economy.

Governments seeking to boost investment have two major tools at their disposal. First, they can induce the central bank to lower real interest rates. If real interest rates are lowered, more investment projects will be undertaken and investment spending will rise. Second, governments can try to raise the baseline level of investment by encouraging private decision makers. They can exhort and reassure them — although the tactic sometimes backfires, as in President Herbert Hoover's repeated declaration during the Great Depression that "prosperity is just around the corner." More important, policy makers can try to reduce or eliminate sources of risk. Instilling confidence that the economy will be stable and risks will be managed is perhaps the best way to boost investment by encouraging optimism.

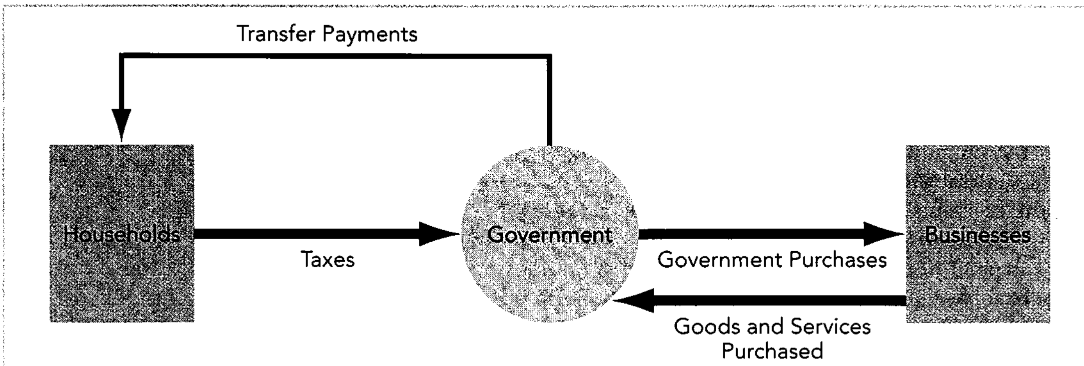
Government Purchases

The federal government buys the labor of government employees — judges, air traffic controllers, customs inspectors, FBI agents, National Oceanic and Atmospheric Administration researchers, and others — as well as military hardware, sections of the interstate highway system, and other goods and services. All these expenditures plus those of state and local governments make up the **government purchases** component of GDP. Such government purchases of goods and services add up to about 20 percent of GDP.

government purchases
Government spending on goods or services (including the wages of government employees).

Note that government *spending* is larger than government *purchases*. In addition to buying goods and services (including the work time of its employees), the

FIGURE 6.10
Government Purchases, Transfer Payments, and Taxes



government also spends by transferring money to citizens through Social Security and other programs, disability benefits, food stamps, and other **transfer payments**. Because transfer payments do not themselves represent demand for final goods and services, they do not show up directly as a portion of GDP in government purchases G. Rather, transfer payments show up in the NIPA as negative taxes. The variable T represents **net taxes**, taxes less transfer payments. It is the net amount by which the government's tax and transfer system reduces disposable income. (See Figure 6.10.)

transfer payments

Spending by the government that is not a purchase of goods or services but instead simply a transfer of income from taxpayers to program recipients.

net taxes

The difference between taxes collected by the government and transfer payments received by households and businesses.

As noted previously, in this book we assume net taxes T, taxes less transfers, are equal to the average tax rate t times income Y:

$$T = tY$$

We do not inquire into what determines either government purchases G or the average tax rate t. We leave that for the political scientists. We will look at what happens when government spending G or the tax rate t changes.

RECAP DOMESTIC SPENDING

Consumption spending C depends on four factors: the baseline level of consumption C_0, the marginal propensity to consume (MPC) C_y, the tax rate t, and the level of real GDP (or national income) Y:

$$C = C_0 + C_y(1 - t)Y$$

Investment spending I depends on three things: the baseline level of investment I_0, the interest sensitivity of investment I_r, and the real interest rate r:

$$I = I_0 - I_r r$$

We leave the determinants of government purchases G to the political scientists.

6.3 INTERNATIONAL TRADE

The final component of GDP is net **exports** — the difference between gross exports and imports. **Gross exports** are made up of goods and services that are produced in the home country and then sold abroad. GDP is a measure of production, and since gross exports are part of production, they need to be counted in GDP. But first **imports** need to be subtracted from GDP. Not all the goods and services that make up consumption, investment, and government purchases are produced domestically. Consumption, for instance, includes spending on Chinese toys, Irish computers, Brazilian coffee, and Scottish tweeds as well as on domestically made goods. Investment includes spending on British airplanes and Italian machinery. Federal, state, and local government purchases include German buses and Japanese subway cars. So adding up C, I, and G overestimates domestic demand for U.S.-made products. By adding net rather than gross exports to $C + I + G$, economists (1) take account of goods made domestically that are sold to foreigners and don't show up in $C + I + G$ and (2) correct $C + I + G$ for the amount of foreign-made goods it counts.

net exports
The difference between exports and imports.

gross exports
Total goods and services produced at home and sold to purchasers in foreign countries.

imports
Goods and services produced in other countries and purchased by residents of our country.

Gross Exports

The volume of gross exports from the United States depends on two variables. The first is the real GDP of our trading partners — call it Y^f, for "foreign GDP." The second is the real exchange rate — call it ε. The higher the value of the real exchange rate — the more expensive the foreign currency — the cheaper are U.S.-made goods to foreigners, and the more of them they buy, as Figure 6.11 shows.

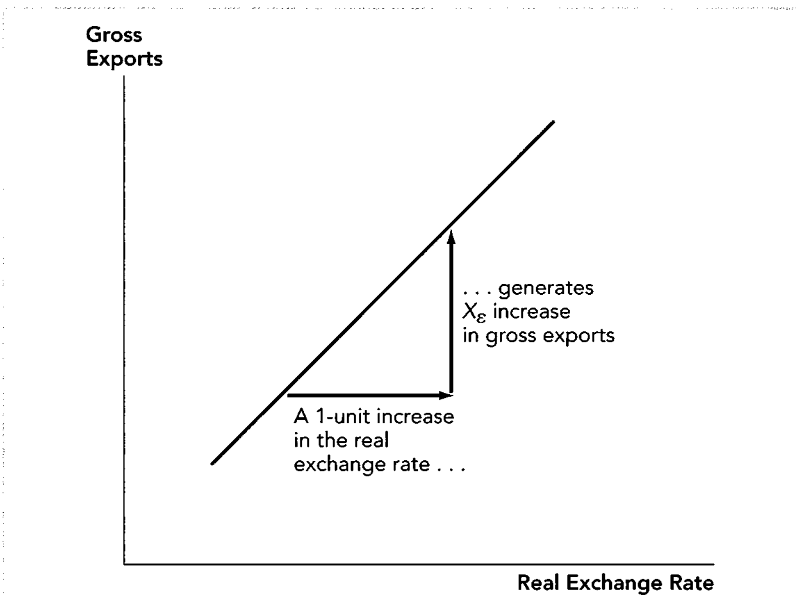


FIGURE 6.11
Gross Exports and the Real Exchange Rate
Gross exports of goods and services to the rest of the world increase as the real exchange rate increases. How much gross exports change is measured by X_ε.

Thus the function for gross exports GX is

$$GX = X_f Y^f + X_\varepsilon \varepsilon$$

Here, just as in the investment and consumption equations, X_ε and X_f are parameters that help determine gross exports. X_f is the increase in exports generated by an increase in foreign GDP. It measures the change in our exports as foreign GDP changes. X_ε measures the increase in exports produced by a rise in the real exchange rate ε.

In the real world, the relationship between the real exchange rate and exports is not as simple as shown in Figure 6.11. Many determinants of gross exports are suppressed in order to keep the model simple. Moreover, the process entails substantial lags. A change in the real exchange rate has little or no effect on gross exports this year but will have effects on gross exports one, two, and three years into the future, as Box 6.7 explains. But as we move forward we again follow the economist's pattern of simplifying whenever doing so doesn't alter our essential story, and simply assume gross exports GX respond to changes in foreign income Y^f and the real exchange rate ε.

Imports and Net Exports

The value of demand for imports — for products produced abroad — depends on domestic real GDP: The higher the real GDP, the more money consumers and businesses and government agencies spend on imported goods and services. The higher, that is, the *value* of imports IM.

The quantity of imports demanded depends as well on the real exchange rate ε. The higher the real exchange rate — the higher the purchasing power of foreign currency — the more expensive are foreign-made goods and the fewer of them do domestic consumers and investors buy. However, we are interested not in the *quantity* but in the *value* of imports. When the quantity of imports falls as the real exchange rate rises, the real dollar value of imports is about the same. So the value of imports IM is largely independent of the real exchange rate.

Therefore, we simplify and model gross imports IM as a constant share — a share that is the propensity to import IM_y — of real GDP Y:

$$IM = IM_y Y$$

Net exports NX are the difference between gross exports and imports. Thus they depend on the real exchange rate ε; on real GDP abroad Y^f; and on real GDP here at home Y:

$$NX = GX - IM = (X_f Y^f + X_\varepsilon \varepsilon) - (IM_y Y)$$

The Exchange Rate

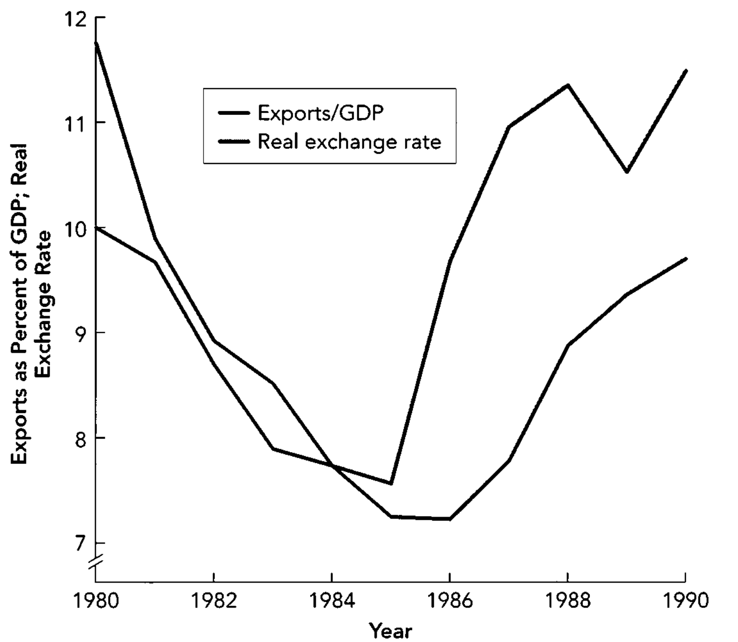
We have seen that the real exchange rate is an important determinant of net exports. And in Chapter 2 we had the *definition* of the real exchange rate: $\varepsilon = e \cdot P^f/P$, the real exchange rate is the product of the nominal exchange rate and the price ratio between the foreign and domestic economies. But what *determines* the nominal and real exchange rates? What is the behavioral story?

THE J-CURVE: SOME DETAILS

Trade links across countries take time to create, time to modify, and time to destroy. So while an increase of the U.S. real exchange rate causes an increase in foreign purchases of U.S. goods, a year or more will pass before we see the change in the volume of trade. In the short run, a rise in the real exchange rate — an increase in the purchasing power of foreign currency — may generate a fall, not a rise, in exports. Economists call this the *J curve*, because the plot of exports over time after a rise in the exchange rate looks a little like a "J." The real exchange rate began to rise very steeply in 1986, but as Figure 6.12 shows, real exports in 1986 were flat. It was not until 1987 and 1988 that the increased competitiveness of U.S. exporters led to an export boom.

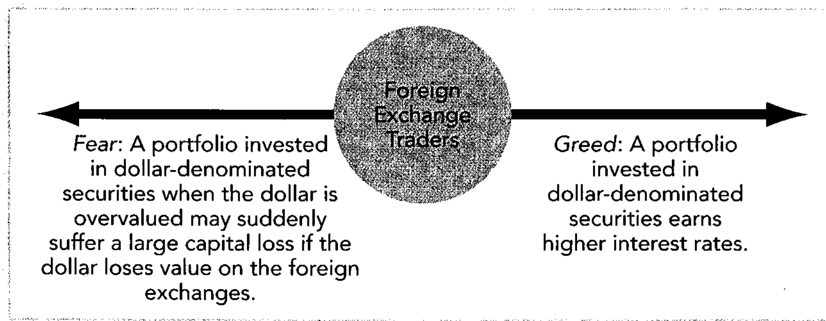
FIGURE 6.12

The J Curve in the 1980s During the 1980s the U.S. real exchange rate, the purchasing power of foreign currency, fell from 20 percent above its 1973 level to 25 percent below its 1973 level and then reversed itself. As the real exchange rate fell, U.S.-made goods became more expensive to foreigners, and exports fell. As the real exchange rate rose in the late 1980s, U.S.-made goods became cheaper to foreign purchasers, and exports ultimately rose but changes in export volumes lagged behind changes in the real exchange rate by a year or more.



Source: The 2004 edition of *The Economic Report of the President* (Washington, DC: Government Printing Office).

FIGURE 6.13
Greed and Fear in Foreign Exchange Markets



Consider foreign exchange speculators whose job is to trade currencies and make money. They spend their days glued to computer terminals, watching the prices of bonds denominated in different currencies flash across the screen. They buy and sell bonds and stocks of different countries and governments denominated in different currencies — dollars, euros, pounds, yen, pesos, ringgit, and more than 100 others. Their lives are ruled by greed and fear, as sketched out in Figure 6.13:

- *Greed:* Suppose a trader sees higher interest rates paid on the dollar-denominated bonds of U.S. companies than on the euro-denominated bonds of German companies. In this case, there is money to be made by selling ("going short on") German companies' bonds, buying ("going long on") U.S. companies' bonds, and pocketing the extra interest.
- *Fear:* Suppose that the trader is long on dollar-denominated bonds (owns many of them) and short on euro-denominated bonds (owns few of them) and the U.S. exchange rate then rises. At a higher real exchange rate, each dollar will be worth fewer euros; whatever profits were expected from the interest rate spread are wiped out by the loss caused by the exchange rate movement. So if today's value of the exchange rate is below long-run historical trends, the fear that exchange rates will soon rise to their normal relationships and impose large foreign exchange losses will be immense. Traders will shy away from dollar-denominated bonds if they fear an imminent depreciation of the dollar.

The greater the difference in interest rates in favor of dollar-denominated securities, the higher is the greed factor. Foreign exchange traders demand more dollar-denominated assets and demand fewer assets denominated in other currencies. They thus need less foreign currency and so they decrease their demand for foreign currency. By the laws of supply and demand, this lowers the price of foreign currency which is the nominal exchange rate e, which makes the real exchange rate ε drop also. So when the gap between domestic and foreign real interest rates increases, the greed factor leads to a lower real exchange rate.

But at this lower real exchange rate, fear is heightened. Foreign exchange traders worry that a future exchange rate movement might wipe out their gains. So not all traders rush to fill their portfolios with dollar-denominated assets, despite the more favorable domestic interest rates. The enormously liquid, enormously high-volume, enormously volatile foreign exchange markets settle at the point where greed and fear balance. Thus we say the real exchange rate ε is equal to the average foreign exchange trader's opinion ε_0 of what the exchange rate should be if there were no interest rate differentials, minus a parameter ε_r times the interest rate differential between domestic real interest rates r and foreign real interest rates r^f:

$$\varepsilon = \varepsilon_0 - \varepsilon_r(r - r^f)$$

The longer that interest rate differentials are expected to continue, and the more slowly that real exchange rates are expected to revert to trend, the higher ε_r will be and the larger will be the effect of a given interest rate differential on the exchange rate.

Remember: The exchange rate is the value of foreign currency. If foreign currency becomes more valuable, the exchange rate rises; if domestic currency becomes more valuable, the exchange rate falls. Often you will hear people talk of an appreciation or revaluation of the dollar or of a depreciation or devaluation of the dollar. An *appreciation* or *revaluation* of the dollar is a fall in the value of the exchange rate. A *depreciation* or *devaluation* of the dollar is a rise in the value of the exchange rate.

Our equations for net exports

$$NX = GX - IM = (X_f Y^f + X_\varepsilon \varepsilon) - (IM_y Y)$$

and for the exchange rate

$$\varepsilon = \varepsilon_0 - \varepsilon_r(r - r^f)$$

are the last of the building blocks of the flexible-price model.

RECAP INTERNATIONAL TRADE

Gross exports depend positively on foreign real GDP and on the real exchange rate. Imports depend positively on domestic real GDP. The difference between gross exports and imports is net exports, which is the fourth and last component of aggregate demand.

In turn, the exchange rate depends on a number of factors, the most important of which is the difference between domestic and foreign real interest rates. The higher the domestic real interest rate or the lower foreign real interest rates, the lower are the nominal and real exchange rates. The most important of the other factors that affect the real exchange rate is foreign currency speculators' confidence.

6.4 CONCLUSION

This chapter has focused only on the building blocks of the analysis. Putting the blocks together and determining the division of real GDP between its four components are tasks reserved for the next chapter. Moreover, recall that this chapter has presented only a snapshot view of the flexible-price economy. It has not discussed the impact of changes in policy and in the economic environment on economic growth. That was done in Chapters 4 and 5 (refer to them to analyze how changes in investment spending ultimately affect productivity). This chapter has ignored the nominal financial side of the economy — money, prices, and inflation — entirely. That topic will be covered in Chapter 8.

Last, but not least, the flexible-price analysis of this part, Part 3, is itself not a complete analysis of even the real side of the economy. It needs to be supplemented by the analysis of what happens in the short run when prices are sticky. That analysis is carried out in Part 4.

Chapter Summary

1. This chapter has begun the analysis of a flexible-price, full-employment economy in a period short enough that potential output is fixed, but long enough for flexible wages and prices to bring supply and demand into balance and thus markets into equilibrium.
2. When the economy is at full employment, the level of real GDP is equal to potential output, which is the level of output generated by the production function of Chapter 4 from the current stocks of labor and capital and the current efficiency of labor.
3. When wages and prices are flexible, the working of the labor market keeps the economy at full employment. If labor demand is less than the size of the labor force, falling wages raise employment; if labor demand is greater than the size of the labor force, rising wages lower employment.
4. The level of consumption spending is determined by many things, but the most important of them are four: real GDP (or national income) Y, the average tax rate t, the baseline level of consumption C_0, and households' marginal propensity to consume C_y. National income and the tax rate together determine disposable income Y^D:

$$Y^D = (1 - t)Y$$

Disposable income, the baseline level of consumption, and the MPC together determine the level of consumption according to the consumption function:

$$C = C_0 + C_y Y^D$$

or

$$C = C_0 + C_y(1 - t)Y$$

5. The level of investment spending is primarily determined by two factors: business managers' degree of optimism, which powerfully affects the baseline level of investment spending I_0, and the real interest rate r, for the higher is the real interest rate the lower is investment spending. The simple investment function is

$$I = I_0 - I_r r$$

6. The real exchange rate is determined largely by foreign exchange traders' reactions to the differential between domestic and foreign real interest rates.
7. Net exports are determined by the level of the real exchange rate, the level of real GDP abroad (which affects the level of exports), and the level of real GDP (which determines the level of imports).

Key Terms

Analytical Exercises

1. In the full-employment model, what determines the level of real GDP?
2. In the economy as a whole, what makes labor demand equal to the labor force?
3. What happens if the parameter C_0 in the consumption function rises?
4. What happens to net exports if foreign exchange speculators become more optimistic about the long-run real value of the domestic currency?
5. What happens to net exports if interest rates abroad rise?

Policy Exercises

1. Suppose an economy with the standard Cobb-Douglas production function

$$Y^* = K^{\alpha}(LE)^{1-\alpha}$$

has a diminishing-returns-to-investment parameter α equal to $1/3$, a value of the labor force L equal to 100 million workers, a value of the capital stock K equal to \$40 trillion, and an efficiency of the labor force E equal to \$50,000. What is the value of potential output Y^*? What is the value of potential output per worker Y^*/L? What is the market-clearing real wage (in dollars per year) at which the economy is at full employment, with neither unemployed workers nor excess demand for labor?

2. In an economy at full employment with an unchanging diminishing-returns-to-investment parameter α and output per worker growing at 3 percent per year, at what rate must the real wage be growing in order to maintain full employment?

3. What would you expect happened to real investment in the United States in 1996–2001 given that the real value of the stock market doubled during that time?

4. During the 1990s foreign exchange speculators became much more confident in the long-run value of the dollar. What would you suspect happened to net exports over that period?

5. Consumers whose stock market wealth multiplied over the 1990s pulled money out of the stock market to enhance their standard of living. What kind of shift in which parameter of the consumption function could be used to model this phenomenon?

A Closer Look at Consumption

APPENDIX 6a

6a.1 PERMANENT AND TRANSITORY INCOME

One of the most important factors omitted from our consumption function is the distinction between permanent and transitory income. Your *permanent income* is the average level that you expect your level of income to be in the future. Your *transitory income* is the difference between your income now and your permanent income. *Milton Friedman* was the very first to point out that not this year's income but permanent income is likely to be the main determinant of consumption.

The Budget Constraint

Think of a consumer trying to decide how much to spend in two periods only — now and the future. Suppose that he or she can save (or borrow) in the present for the future at a real interest rate r. And suppose that the "now" and the "future" are not necessarily the same length of time: The future period is some parameter θ times the length of the present period. In the present the typical consumer decides how much to spend and how much to save. Income Y_{now}, consumption C_{now}, and saving S are linked by

$$S = Y_{\text{now}} - C_{\text{now}}$$

In the future, the consumer adds his or her future income to savings — which have in the meantime grown because they have earned real interest at rate r — and spends the total (you can't take it with you, after all!):

$$\theta(C_{\text{future}}) = \theta(Y_{\text{future}}) + (1 + r)S$$

Combining these two equations produces what economists call the *present value* form of the *consumer's budget constraint:*

$$C_{\text{now}} + \frac{\theta C_{\text{future}}}{(1 + r)} = Y_{\text{now}} + \frac{\theta Y_{\text{future}}}{(1 + r)}$$

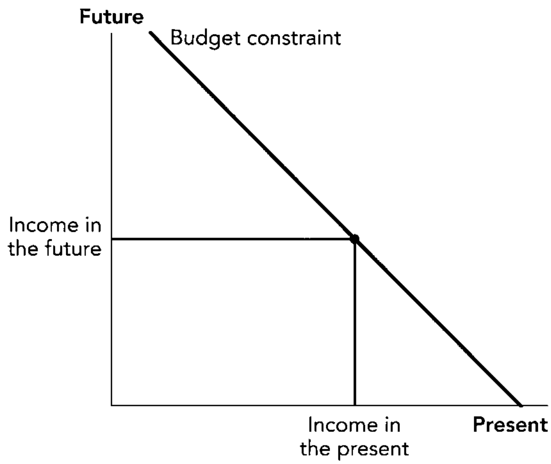


FIGURE 6a.1
The Budget Constraint
You can read off income in the present and the future from the diagram showing the consumer's income in both periods. By borrowing and lending, the consumer is free to choose levels of consumption in the present and the future corresponding to any point along the budget-constraint line. The slope of the budget line corresponds to the real interest rate. The higher the real interest rate, the steeper is the line — the more you can boost consumption in the future by cutting back and saving today.

Total consumption spending now and in the future must equal total income in the two periods. Future income and consumption count a little bit less — are "discounted" by the real interest rate — in order to turn them into "present values" before adding them to current consumption. Because savings earn interest, you must put aside only $1/(1 + r)$ dollars today in order to be able to spend 1 dollar on consumption in the future. Hence 1 dollar of consumption — or income — in the future has a "present value" of only $1/(1 + r)$ dollars today.

We can show this budget constraint on a diagram that plots the present on the horizontal axis and the future on the vertical axis (see Figure 6a.1). By borrowing or saving the consumer can redistribute consumption across time.

The Marginal Utility of Consumption

A representative consumer modeled by an economist will try to arrange his or her consumption now and in the future to maximize his or her utility. And any representative consumer in a model built by an economist will have a very simple utility function to maximize, such as

$$U = C_{\text{now}}^{\gamma} \times C_{\text{future}}^{(1-\gamma)}$$

where γ — the Greek letter "gamma" — is the parameter of the utility function. It governs how much the consumer values consumption now as opposed to consumption in the future.

If the marginal utility of per unit of time consumption (MUC) today is more than $(1 + r)/\theta$ times the MUC in the future, the consumer can increase his or her total utility a bit by cutting consumption in the future by an average of $(1 + r)/\theta$ dollars, reducing saving now by 1 dollar and increasing consumption now by 1 dollar. If the marginal utility of consumption today is less than $(1 + r)/\theta$ times the MUC in the future, the consumer can increase his or her total utility a bit by boosting consumption in the future by $(1 + r)/\theta$ dollars, increasing saving now by 1 dollar and cutting consumption now by 1 dollar. Thus if the consumer is behaving like a proper agent in an economist's model, it must be that

$$\frac{MUC_{now}}{MUC_{future}} = \frac{1 + r}{\theta}$$

What is the marginal utility of consumption now? Just as with the marginal product of labor, it is the change in utility produced by adding 1 more unit of consumption now:

$$MUC_{now} = [(C_{now} + 1)^{\gamma}](C_{future}^{1-\gamma}) - (C_{now}^{\gamma})(C_{future}^{1-\gamma})$$

which can be simplified to

$$MUC_{now} = [(C_{now} + 1)^{\gamma} - C_{now}^{\gamma}](C_{future}^{1-\gamma})$$

We can evaluate the marginal utility of consumption now by taking the derivative with regard to C_{now} of the utility function. It is

$$MUC_{now} = [\gamma(C_{now})^{\gamma-1}](C_{future}^{1-\gamma})$$

Similarly, the marginal utility of consumption in the future is

$$MUC_{future} = C_{now}^{\gamma}[(1 - \gamma)C_{future}^{1-\gamma}]$$

Thus if the consumer is behaving as expected,

$$\frac{1 + r}{\theta} = \frac{[\gamma(C_{now})^{\gamma-1}]C_{future}^{1-\gamma}}{C_{now}^{\gamma}[(1 - \gamma)C_{future}^{1-\gamma}]} = \frac{\gamma C_{future}}{(1 - \gamma)C_{now}}$$

or

$$C_{future} = \left[\frac{(1 + r)(1 - \gamma)}{\theta\gamma}\right]C_{now}$$

This equation tells us that the consumer spends a fraction γ of the present value of his or her total income on current consumption:

$$C_{now} = \gamma\left(Y_{now} + \frac{\theta Y_{future}}{1 + r}\right)$$

He or she spends the rest on future consumption. Once again, there is nothing especially "deep" in this simple result. Economists use this particular utility function often because it produces simple results.

Note that using this equation, a \$1 increase in transitory income — in Y_{now} but not in Y_{future} — would lead to a γ dollar increase in consumption today. But a \$1 increase in permanent income — in both Y_{now} and Y_{future} — would generate an increase in consumption in the present of

$$\Delta C_{now} = \gamma\left(1 + \frac{\theta}{1 + r}\right)$$

Thus the marginal propensity to consume is much larger if a change in income is permanent than if it is transitory. When an increase is transitory, consumers tend to smooth out their consumption over time by saving the bulk of the windfall, as shown in Figures 6a.2 and 6a.3. If consumers do not believe a change in income will be permanent, they will not adjust their spending now by very much.

For example, in the late 1960s President Lyndon Johnson proposed and Congress passed the Vietnam War income surtax. The surtax, a 10 percent increase in federal taxes, was imposed in an attempt to reduce consumption spending and so reduce

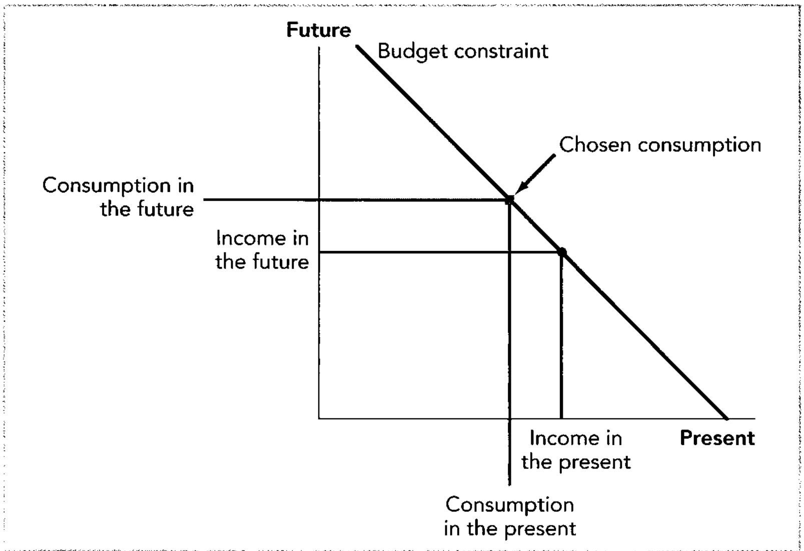


FIGURE 6a.2
Consumption Smoothing
Consumers try to smooth consumption over time. If their income is unusually high in the present, they will spend little of the excess and save most of it.

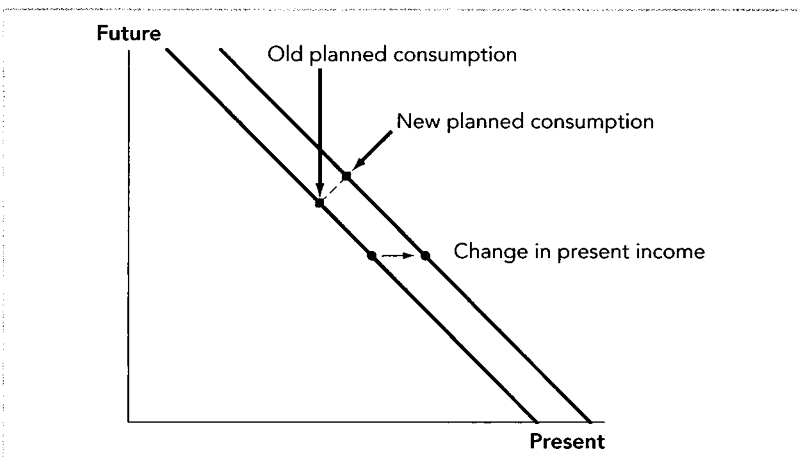
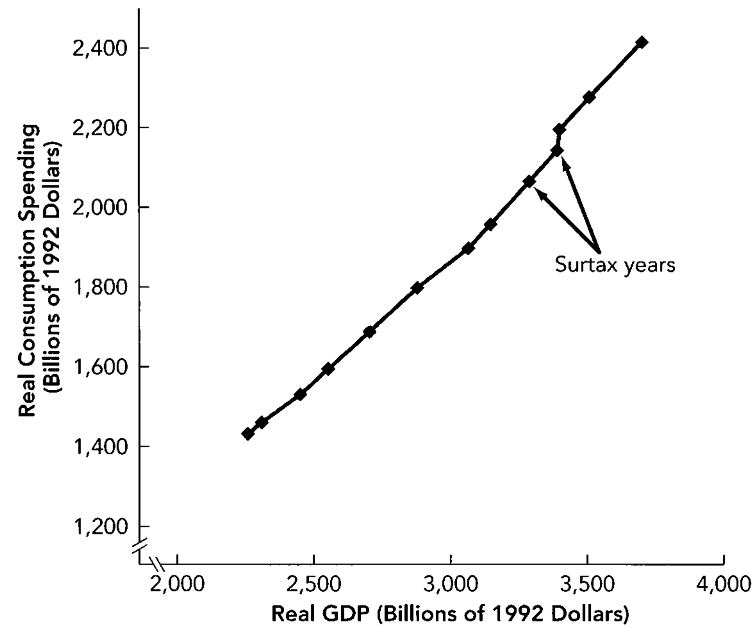


FIGURE 6a.3
The Effect of an Increase in Transitory Income
A change in transitory income — a change in income in the present but not the future — leads to a change in consumption in the present that is only a small fraction of the change in today's income.

FIGURE 6a.4
Effects of the Vietnam War Surtax on Consumption
The Vietnam War surtax had next to no effect on consumption because it was broadly seen as a *transitory* change in tax policy.



Source: The 1999 edition of *Economic Report of the President* (Washington, DC: Government Printing Office).

inflationary pressures during the Vietnam War. But President Johnson sold the surtax to Congress (and to the public) by promising that it would be a short-term, temporary measure with no permanent effects. He was convincing. Because everyone believed that the tax increase was short-term and temporary, it had no effect on consumers' beliefs about their permanent income. Everyone saw it as a change in transitory income only. And so it had next to no effect on consumption spending, as you can see in Figure 6a.4.

6a.2 CONSUMPTION AND THE REAL INTEREST RATE

An increase in the real interest rate makes saving more profitable: It means a higher rate of return earned on wealth saved and invested. Consumer saving is equal to after-tax income minus consumption. Does this mean that consumption spending is powerfully affected by the real interest rate and that an increase in the real interest rate decreases consumption spending? Probably not. An increase in the real interest rate does increase the rate of return on savings, and this induces a consumer to *substitute* saving for consumption in the present. But return to the expression for consumption spending now — C_{now} — derived earlier in this appendix:

$$C_{\text{now}} = \gamma\left(Y_{\text{now}} + \frac{\theta Y_{\text{future}}}{1 + r}\right)$$

If current income is large relative to future income — as it is if we are thinking of people saving for their retirement — then a change in the real interest rate r has no effect on current consumption spending. Thus it has no effect on current saving — the difference between current income and current consumption.

Why not? Because an increase in saving doesn't just make it more attractive to substitute saving for consumption today. An increase in the real interest rate also increases consumers' total lifetime wealth: Their permanent income is boosted because they earn higher returns on the money that they do save. This higher *permanent income* increases consumption in the present — and so reduces current saving. Which effect dominates? Is the income effect stronger, or is the substitution effect stronger? For consumers with low future incomes, the two effects almost cancel out. For consumers with high future incomes, they do indeed save more. But consumers with high future incomes had little reason to save to begin with, so even a large proportional increase in their saving has little effect on total economywide saving.

As a result, most economists think that these two effects roughly balance each other. They believe that changes in real interest rates have a small negative effect on consumption spending and a small positive effect on saving. But the effect of the real interest rate on consumption spending is not large enough to be worth the extra complication it would add to our models here.

CHAPTER 7

Equilibrium in the Flexible-Price Model

QUESTIONS

In the flexible-price model, what keeps aggregate demand and the level of production equal to potential output?

In the flexible-price model, what makes the supply of funds — saving — equal to the demand for funds — investment — in financial markets?

When saving or investment demand changes, what happens in the flexible-price model to the real interest rate, and why?

As government policies, the international economic environment, or other features of policy or the economic environment change, what happens in the flexible-price model to consumption, investment, government, and net export spending?

7.1 FULL-EMPLOYMENT EQUILIBRIUM

Chapter 6 set out the determinants of the components of total spending. But knowing what determines consumption spending C, investment spending I, and net exports NX is not enough for understanding the macroeconomy. The macroeconomy is a system. The determinants of net exports are affected indirectly by the level of investment spending. Investment spending cannot be analyzed without knowing what has happened to consumption spending. But consumption spending depends on income, which in turn depends on the levels of net exports and investment spending.

We need a way of analyzing the macroeconomy as an interdependent system, rather than as a collection of parts we stack next to each other. What are the forces in the economy that make aggregate demand equal output? This question has two answers. One answer is correct when we assume prices are fully flexible. A second — different — answer is correct when we assume prices are sticky. Starting in Chapter 9, we will look at the sticky-price model of the macroeconomy. In this chapter, we assume prices are fully flexible.

When prices are fully flexible, the amount of output the economy produces Y is always equal to its potential output Y^*. So what guarantees that in a flexible-price economy, this full-employment level of output will also be an equilibrium level of output, where output equals aggregate demand? The real interest rate r ensures equilibrium in a flexible-price macroeconomy. We saw in Chapter 6 that the real interest rate determines investment spending. Also, the real interest rate determines the real exchange rate ε, and this real exchange rate determines net exports. What you will learn in this chapter is that changes in the real interest rate are what make the demand for output equal to the available output — which in this flexible-price economy is the potential output Y^*. We will call this the *flow-of-output approach* to understanding macroeconomic equilibrium in a flexible-price economy.

The Flow-of-Funds Approach

What you will also learn is that an equivalent approach is to start with the supply of funds — saving — and the demand for funds — investment: the flow-of-funds approach to understanding macroeconomic equilibrium in a flexible-price economy. The *flow-of-funds* through **financial markets** is key to understanding why the real interest rate brings the macroeconomy to equilibrium.

financial markets

The stock market, the bond market, the short-term borrowing market, plus firms' borrowings from banks.

What is the real interest rate that plays this role? The real interest rate is simultaneously the price the lender charges and the price of borrowing money. Money flows through financial markets. Savers try to find a productive, profitable, and interest-earning place to put their savings. Businesses try to find cheap financing for the investment projects they hope will be profitable.

Why do people lend money? Because they have no immediate spending use for it, and receiving some interest is better than having it sit under the mattress. Why do businesses borrow money? They borrow money because they hope to make a profit by using the funds they borrow to invest in new plant and equipment in order to expand their operations.

Thus the saving of households and others flows into financial markets, and the borrowing of businesses seeking to finance investment flows out of financial markets. This flow of funds through financial markets is a key set of economic transactions. The real interest rate is the price charged and received in this market for *loanable funds*. When the interest rate is at its long-run equilibrium level, the supply of loanable funds equals the demand for loanable funds. Financial markets are in balance.

Assumption of Price Flexibility

The key assumption that separates how we analyze equilibrium in this chapter from our analysis that begins in Chapter 9 is the assumption of price flexibility. In this chapter, we assume prices are fully flexible. (See Box 7.1 for an example of what it means for prices to be fully flexible.) We must confess: This assumption is not a realistic description of the short run. We use it because assuming prices are flexible is very helpful for analyzing the economy in the long run.

IF PRICES WERE TRULY FLEXIBLE . . . : SOME DETAILS 7.1

What does it mean for prices to be flexible? The authors work in Berkeley, where sometimes it seems every student in a morning class arrives with a paper coffee cup in hand. The lines at one of the most popular cafés, Caffé Strada, typically go out the door just before the 10:00 a.m. classes begin. Everyone in line *needs* to have their cappuccino, latte, or espresso if they're going to make it through class. This is especially the case on our foggy, chilly mornings in late spring.

If prices were fully flexible, the price of the coffee drinks would rise between the time the last student got in line and the time she reached the counter. The chill in the air increased demand. The time (morning) increased demand. In a world of fully flexible prices, the price of the product would respond by rising *immediately*. As you stood there, waiting to reach the counter, you'd see the price of your coffee drink rise. But 45 minutes later, when the sun had burned off the fog so the chill in the air was gone, and when everyone was already in class, the subsequent fall in demand would lead to falling prices. That swing in prices in immediate response to changes in demand would be an example of *fully flexible* prices.

This is, of course, an example on a micro scale. When the same story applies in industry after industry, then you have a macro story.

The long-run model we already studied was Chapter 4's model of economic growth. Remember — or review — that when the saving rate increases in the long run, the capital-labor ratio and the capital-output ratio both increase. More saving produces a higher standard of living. But in Chapter 4, we had no story about *how* an increase in saving produces a higher capital-labor ratio. What is the mechanism? Chapter 7 provides the answer to that question: the real interest rate. You will learn in this chapter that when saving increases, real interest rates decline, and so investment spending increases. And more investment in plant and equipment produces a larger capital stock, which in the very long run increases the capital-labor ratio, the capital-output ratio, and output per worker.

Note that there will be a certain tension in this chapter. Prices are flexible; the time scale of the analysis must be long enough for prices to adjust so that there is no excess demand or excess supply in any of the economy's markets. So this analysis of Chapter 7 applies to changes in the economy only if they take significantly longer than a month or a quarter. On the other hand, we are going to assume that potential output Y^* does not change, which means that the analysis of Chapter 7 applies to changes in the economy only if they take significantly less than a decade. The usefulness of the flexible-price model thus tends to get squeezed between the sticky-price fluctuations model covered in later chapters and the long-run growth model covered earlier.

But before we get too far ahead of ourselves, let's build the model.

RECAP FULL-EMPLOYMENT EQUILIBRIUM

In a flexible-price economy, real output Y always equals potential output Y^*. At equilibrium in output markets, this potential output will equal aggregate demand; this is the flow-of-output approach. We can also look at equilibrium with the flow-of-funds approach; saving equals investment in equilibrium. Changes in the real interest rate will take the economy to equilibrium.

7.2 TWO APPROACHES, ONE MODEL

The goal of this chapter is to show how the real interest rate ensures full-employment equilibrium in an economy with flexible prices. At equilibrium, two statements will be true: The supply of funds will equal the demand for funds, and aggregate demand for output will equal potential output. Both statements are true because there are two approaches to this one flexible-price model. In this section, we will show that these two approaches — the flow-of-funds approach and the flow-of-output approach — are mathematically equivalent.

Why, if the two approaches to this one model are equivalent mathematically, do we bother with two approaches? The answer is worth remembering, because this will not be the last time in your studies of economics that a second, mathematically equivalent, approach is suddenly substituted for an approach you have already figured out. There are times in economics — and this is one of them — when a mathematically equivalent approach has much better economic intuition than the original approach you already mastered. And the best economics is always the most intuitive story.

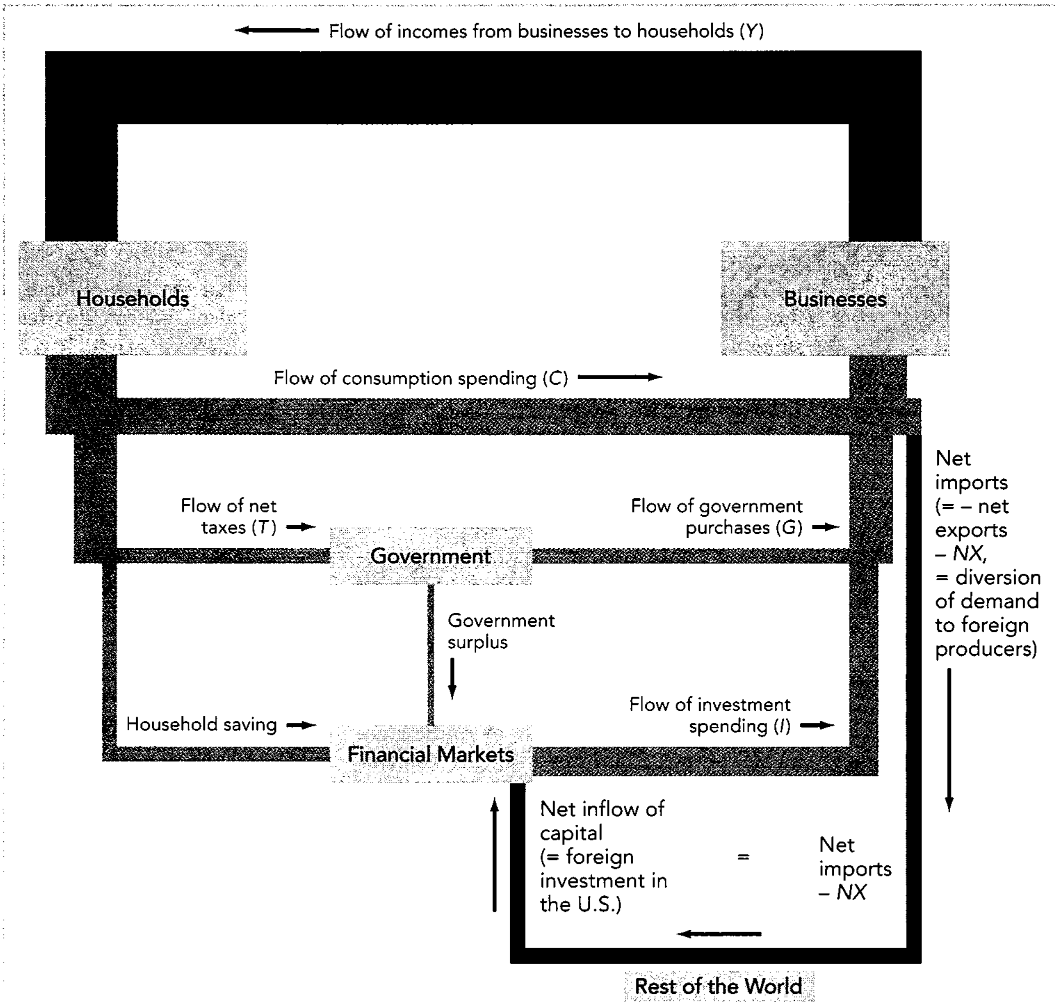
We can show that the flow-of-funds approach and the flow-of-output approach are equivalent ways of modeling the flexible-price economy in two ways. We can show the equivalence with algebra. And we can show the equivalence using the drawing introduced in Chapter 2 of the economy's circular flow. Let's start with the circular flow, depicted in Figure 7.1.

Using the Circular Flow Diagram

Goods and services — output — are produced in businesses, generating income (the blue flow) for households. Household income includes not just wage and salary income, but interest income, rent income, retained business earnings, and more. Households can do three things with this income (the green flows): consume goods and services that are produced by businesses, pay net taxes to government, or save — household saving — in financial markets. With the net tax revenues,

FIGURE 7.1

The Circular Flow Diagram This version of the circular flow is complicated by the addition of the government and financial markets to the diagram. Not all final goods and services are bought by households. Some are bought by the government, which taxes to raise resources to finance itself. Some are bought by businesses seeking to invest, which raise the needed resources by issuing stock, issuing bonds, and borrowing — all of which take place in *financial markets*. This version is also complicated by its recognizing that there is a world outside, a world that buys the products of domestic businesses and that invests through domestic financial markets.



government can buy goods and services from businesses (the pink flow) or accumulate a surplus (green flow) which it saves in financial markets. Some goods and services are imported from other countries, so not all of the spending for goods and services flows back to domestic businesses; some of it flows to the rest of the world. Imports are at least partially offset by our exports of goods and services to other countries. The difference — imports less exports — represents funds from our economy that accumulate in the rest of the world. This net inflow of financial capital from the rest of the world (red flow) is saved in financial markets.

The financial markets lend the funds saved by households, government, and the rest of the world to businesses, which use the funds to invest in plant and equipment (pink flow). **Total saving** S is the sum of household saving S^H, government saving S^G, and foreign saving by the rest of the world S^F. So through the financial markets, total saving S equals investment I. This is the *flow-of-funds* approach to equilibrium.

total saving
Household saving plus government saving (the government's surplus; government saving is negative when the government runs a deficit) plus foreign saving.

The sum of consumption spending (pink flow from households), government spending (pink flow from government), investment spending (pink flow from financial markets), less the net imports (red flow to rest of the world) flows into businesses. This is aggregate demand. Businesses produce output in response to this aggregate demand. So through the output markets, aggregate demand equals output. This is the *flow-of-output* approach to equilibrium.

And the output produced by businesses generates income for households. Off we go on another round through the circular flow.

The circular flow diagram is one way to understand that the flow-of-funds and flow-of-output approaches to the macroeconomy are equivalent. We can also demonstrate that equivalence a second way: algebra.

Using Some Algebra

We start from the familiar flow-of-output equilibrium condition, and derive the flow-of-funds equilibrium condition. Begin with the definition of aggregate demand AD:

$$AD = C + I + G + NX$$

Under the flow-of-output approach, aggregate demand AD and output Y are equal in macroeconomic equilibrium. When wages and prices are flexible, then output Y equals the economy's potential productive output Y^*. So in flow-of-output equilibrium, potential output Y^* will equal aggregate demand AD. We have

$$Y^* = C + I + G + NX$$

Now a few steps will take us to the equivalent flow-of-funds equilibrium statement. Subtract consumption C, government purchases G, and net exports NX from both sides in order to move everything except investment spending I to the left-hand side:

$$Y^* - C - G - NX = I$$

And then a little math trick will give us economically meaningful concepts: Subtract *and* add net taxes T on the left-hand side by subtracting it from income Y^* and adding it to $-G$. Add some parentheses so we can group terms by economic concepts:

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

Now let's step back and look at what this flow-of-funds equation means.

Unpacking the Flow-of-Funds Equation

The right-hand side of this equation is simply investment spending I. Under the flow-of-output approach, investment spending is simply spending by firms to build factories and structures and boost their productive capacity. But under the flow-of-funds

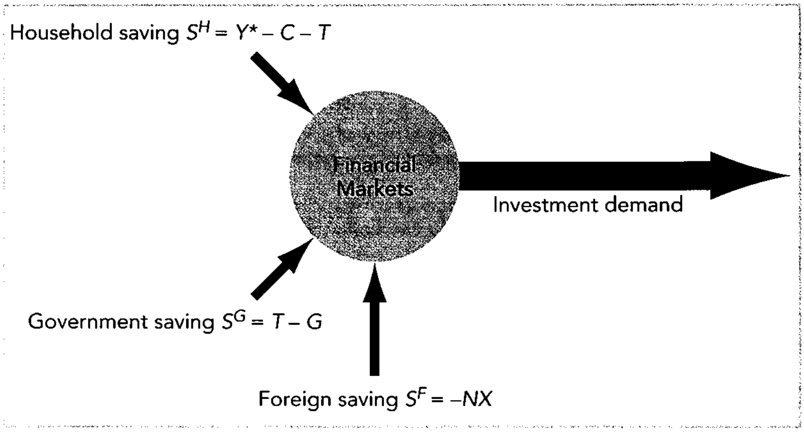


FIGURE 7.2
The Flow of Funds through Financial Markets
Household saving, government saving, and foreign saving flow into financial markets. These funds flow out of financial markets to businesses, which use the funds to finance investment demand — the purchase of new plant and equipment.

approach, we think of investment I not as the *output* that businesses buy, but as the *funds* that businesses allocate to buying these investment goods. Investment spending I is the flow of funds out of financial markets to businesses, which then use the funds to undertake investment. It is the demand for loanable funds.

The left-hand side of the equation measures the total saving flowing into financial markets from three different groups — households (which, remember, include not only the workers but also the owners of businesses), the government, and the rest of the world (see Figure 7.2).

The first term $Y^* - T - C$ is equal to **household saving** S^H. In this flexible-price model, potential output Y^* is equal to real output. Output and household income are always equal. So Y^* is just household income. Subtract net taxes T and consumption spending C from household income Y^* and what is left? What is left is household saving — the flow of funds from households into financial markets — because saving is the only thing that households do with income other than pay it to the government as taxes and spend it on consumption goods.

The second term $T - G$ is equal to **government saving** S^G. T is simply the taxes the government collects minus the transfer payments it makes to individuals. G is government purchases. So $T - G$ is the difference between the taxes that the government collects and the transfer payments and purchases the government makes. When $T - G$ is positive, the government is running a *budget surplus*. The surplus is government saving S^G. When $T - G$ is negative, the government is running a deficit (as it is today). Then S^G will be less than zero.

The last term — the opposite of net exports, $-NX$ — is **foreign saving** S^F, saving by foreigners directed into the United States. It is the **capital inflow**, the net flow of funds that the rest of the world channels into domestic financial markets. As Figure 7.3 illustrates, net exports are the difference between the dollars foreigners spend buying our exports and the dollars earned by foreigners selling us imports. If net exports are less than zero — which they typically are for America — foreigners have dollars left over after they buy all our exports they want. These internationally owned dollars flow into financial markets. They aren't spent buying our exports, and the only other useful thing the rest of the world can do with them

household saving

Equal to households' disposable incomes (which include earnings retained by corporations and then reinvested) minus their consumption spending. Household saving includes both saving done directly by households and saving done on their behalf by firms whose stock they own.

government saving

The government's budget surplus. Government saving is negative when the government runs a budget deficit.

foreign saving

The net amount of money that foreigners are committing to buying up property and assets in the home country. Equal to minus net exports.

capital inflow

Net investment by the citizens of one country in another — the "flow" of financial capital from one country to another.

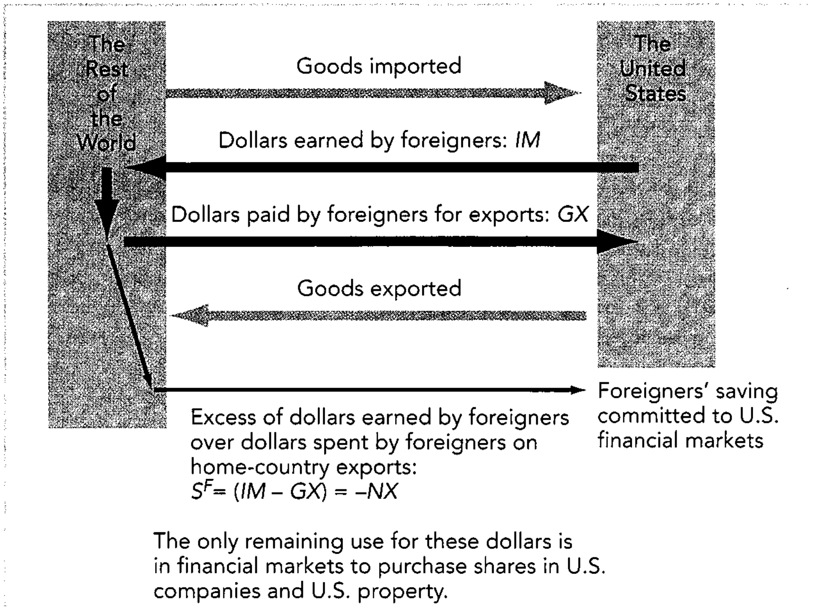


FIGURE 7.3
Imports Minus Exports Equals Foreign Saving
Dollars earned by foreigners from selling us imported goods and services return to the United States either as payments for goods and services we export or as foreign saving that flows into U.S. financial markets.

is save them. (When net exports are positive, this term has a different interpretation. It is the net amount of domestic saving that is diverted into international financial markets — the amount of saving that does not show up as loanable funds available to finance investment at home, but instead finances investment abroad.)

We have derived the flow-of-funds equilibrium equation. The three left-hand side terms of

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

are the three flows of purchasing power into the financial markets: household saving S^H, government saving S^G, and foreign saving S^F. Added together they make up total saving S, which is the supply of loanable funds. The demand for loanable funds is simply investment spending I, the right-hand side of the equation above. So the flow-of-funds equilibrium equation can also be written

$$S^H + S^G + S^F = I$$

What we have shown is that the flow-of-output equilibrium condition — output equals aggregate demand — is equivalent to the flow-of-funds equilibrium condition — saving equals investment. When one statement is true, the other must also be true. When one is false, the other must also be false. If supply equals demand in the market for loanable funds

$$S^H + S^G + S^F = I$$

then aggregate demand in the flexible-price economy is equal to full-employment output. And if output equals aggregate demand in the markets for goods and services

$$Y^* = C + I + G + NX$$

7.2

FINANCIAL TRANSACTIONS AND THE FLOW OF FUNDS: SOME DETAILS

The relationship between the funds that flow into and the funds that flow out of financial markets is indirect. When the government runs a surplus, it does not directly lend money to a business that wants to build a new factory. Instead, the government uses the surplus to buy back some of the bonds that it previously issued. The bank that owned those bonds then takes the cash it received from the government and uses it to buy some other financial asset — perhaps bonds issued by a corporation.

Similarly, households or foreigners using financial markets to save rarely buy newly issued corporate bonds. Moreover, they rarely buy shares of stock that are part of an initial public offering. On the rare occasion when they do, they are directly transferring purchasing power to a company undertaking investment. Instead, households and foreigners usually save by purchasing already-existing securities or simply depositing their wealth in a bank.

The relationship between the flows of funds into and out of financial markets is indirect, but it is very real.

then the supply and demand in the flow of funds through financial markets balances as well. (Although, as Box 7.2 points out, the relationship between the supply and demand for funds is not direct.)

RECAP TWO APPROACHES, ONE MODEL

We can approach equilibrium in two ways. One is the flow-of-output approach: In equilibrium, output equals aggregate demand. The other is the flow-of-funds approach: In equilibrium, saving equals investment. We can show that these two approaches are equivalent using the circular flow diagram. We can also show they are equivalent algebraically, by starting with one equilibrium condition, $Y = AD$, and deriving from it the other, $S = I$.

7.3 THE REAL INTEREST RATE ADJUSTS TO ENSURE EQUILIBRIUM

In a flexible-price economy, equilibrium exists when aggregate demand equals potential output. But what economic forces will make aggregate demand equal potential output? The determinants of C, I, G, and NX are things like consumers' optimism, interest rates, the sensitivity of exports to exchange rates, and so on. These determinants seem to have nothing at all to do with the determinants of Y^*. It is the form of the production function and the available resources on the supply side that determine the level of potential output Y^*. So what will make the sum of C, I, G, and NX equal potential output?

The answer is: The real interest rate r plays the key role. If government policy, the international economic environment, or domestic conditions change, then the real interest rate changes in response. In turn, the change in the real interest rate causes changes in investment spending, the exchange rate, and net exports. The real interest rate will continue to change until the economy is again at equilibrium. It is these changes in the real interest rate that ensure that in the long run a flexible-price macroeconomy reaches and stays at equilibrium where aggregate demand equals potential output.

But how could a disequilibrium between aggregate demand and output lead to a change in the real interest rate? Here is where the flow-of-funds approach comes in. Equilibrium with aggregate demand equal to potential output is equivalent to equilibrium with the supply of funds — saving — equal to the demand for funds — investment. When aggregate demand is less than potential output, saving is greater than investment. And when aggregate demand is greater than potential output, investment is greater than saving.

When the supply of funds — saving — is greater than the demand for funds — investment — what will happen? The price of funds — the real interest rate r — will fall. Some financial institutions — banks, mutual funds, venture capitalists, insurance companies, whatever — will find purchasing power piling up as more money flows into their accounts than they can find good projects to commit to. They will try to underbid their competitors. How do they underbid? They underbid by saying that they will accept a lower interest rate than the current real interest rate.

As the real interest rate falls, two things happen. The number and value of investment projects that are profitable rise. Investment spending rises, closing the gap between saving and investment (and, not coincidentally, closing the gap between aggregate demand and potential output). And net exports rise, decreasing foreign saving and further closing the gap between saving and investment (and, again not coincidentally, further closing the gap between aggregate demand and potential output). The process will stop when the interest rate has fallen just enough to make the flow of saving into the financial markets equal to investment. So that's the big bottom line: The real interest rate ensures equilibrium in the flexible-price model because both investment and saving respond to changes in the real interest rate.

Graphing the Saving-Investment Relationship

We can depict these relationships graphically. Investment spending is the demand for loanable funds. As the real interest rate r falls, investment spending I rises. The graph in Figure 7.4 should remind you of Figure 6.9, though we have switched the horizontal and vertical axes.

Total saving is the supply of loanable funds. It has three components: household saving S^H, government saving S^G (which is usually negative), and foreign saving S^F. Let's start with foreign saving. As the real interest rate r falls, foreign saving S^F falls. The intuition is a bit roundabout. As the real domestic interest rate falls, the nominal and real exchange rates rise. (If you want to review why this is so, see Section 6.3.) When the real exchange rate ε rises, gross exports GX rise. When gross exports rise, net exports NX rise, which is the same thing as saying net imports ($-NX$) fall. When net imports fall, net foreign inflow of financial capital falls. And net foreign inflow of financial capital is just a long phrase for foreign saving S^F.

The relationship is depicted in Figure 7.5. It is important to remember that foreign saving can be either negative or positive. When a country runs a *trade surplus,* foreign saving is negative. When it runs a *trade deficit,* as the United States

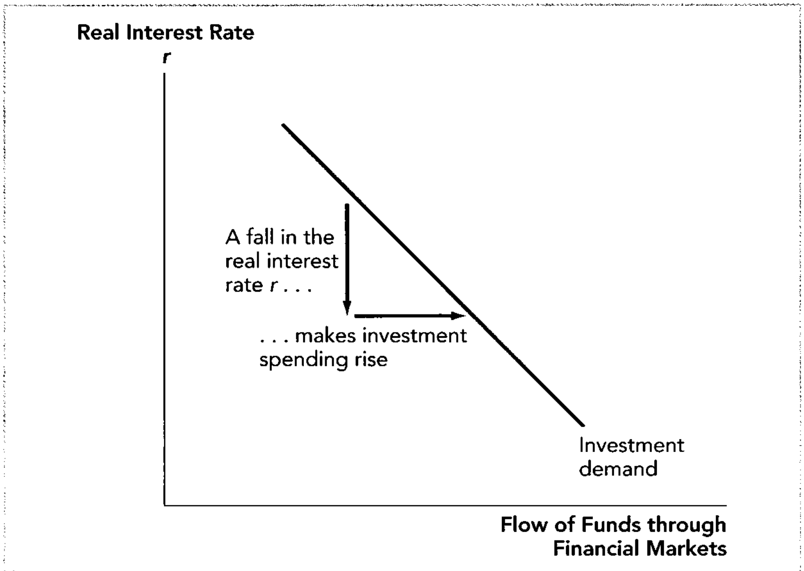


FIGURE 7.4
The Demand for Loanable Funds
The demand for loanable funds is investment demand. When the real interest rate falls, the number and value of profitable investment projects rise, increasing businesses' demand for loanable funds to finance investment.

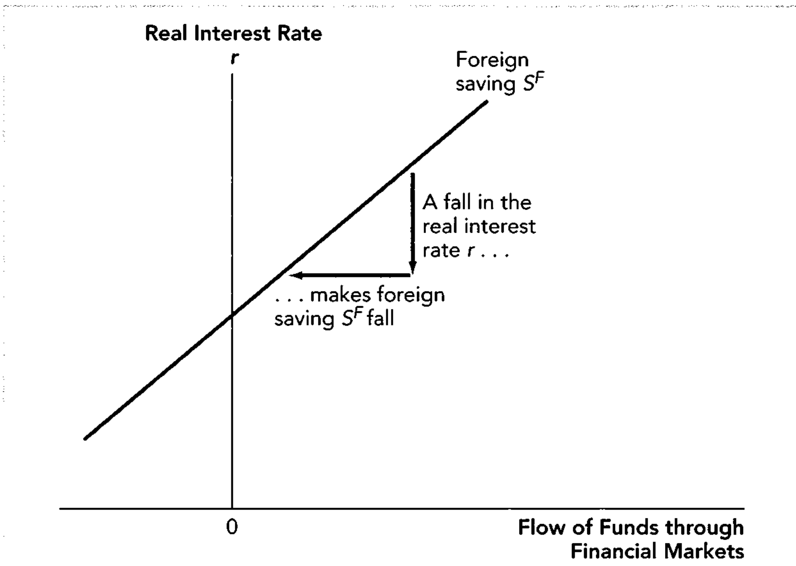


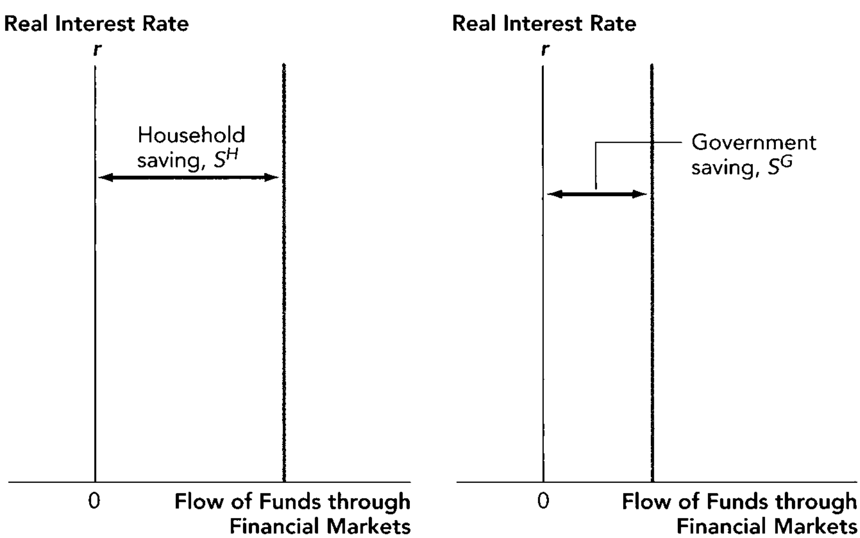
FIGURE 7.5
Foreign Saving: The Supply of Loanable Funds from Foreigners
The supply of loanable funds from foreigners is foreign saving. When the domestic real interest rate falls, foreigners will move some funds out of dollar-denominated assets and into assets denominated in other currencies, decreasing foreign saving as nominal and real exchange rates rise.

has been doing for many years, foreign saving is positive. To remind ourselves that foreign saving can be negative or positive, we draw the foreign saving curve crossing the vertical axis, as in Figure 7.5.

Household saving is another component of total saving. Household saving S^H is what's left over after net taxes T and consumption C have been subtracted from household income. Consumption spending depends on income, as do net taxes. But as we noted in Appendix 6a, real interest rates do not affect consumption. And because we are assuming that household income is always equal to potential output Y^*, which depends on the supplies of inputs and the production function, then income is not dependent on the real interest rate. And since neither the tax rate nor income depends on the real interest rate, net taxes don't change when the real interest rate changes. So household saving S^H does not change when the real interest rate changes. We show the relationship between household saving and the real interest rate as a vertical line, as in panel (*a*) of Figure 7.6.

Government saving S^G is the final component of total saving. But its value also does not depend on the value of the real interest rate. So here again, we would show

FIGURE 7.6
Household and Government Supply of Loanable Funds



(*a*) Household saving S^H does not change when the real interest rate r changes. The distance from the vertical axis to the household saving line measures the amount of funds that flow into financial markets from households. If households dissave, so that S^H is negative, the household saving line is to the left of zero.

(*b*) Government saving S^G also does not change when the real interest rate r changes. The distance from the vertical axis to the government saving line would measure the amount of funds that flow from financial markets to the government. If the government runs a deficit, so that S^G is negative, the government saving line is to the left of zero.

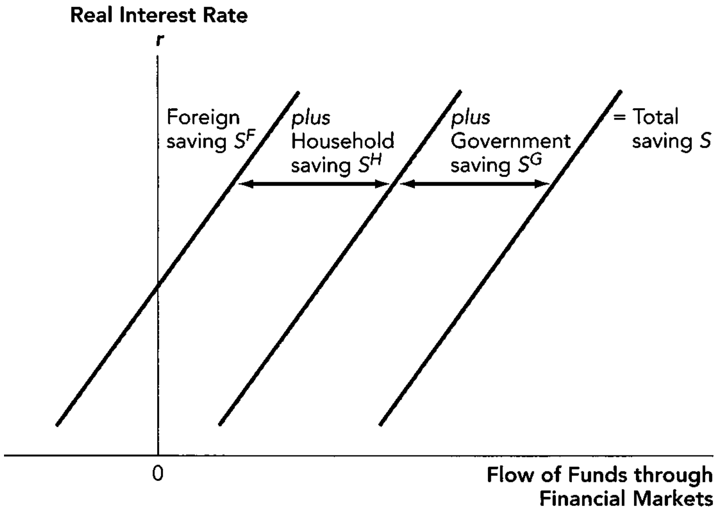


FIGURE 7.7
Total Saving: The Supply of Loanable Funds
Total saving is the sum of foreign, household, and government saving. Total saving increases as the real interest rate rises because of the relationship between the real interest rate and foreign saving.

the relationship between government saving and the real interest rate as a vertical line, as shown in panel (*b*) of Figure 7.6. If government saving was negative — if the government was running a deficit — then the government saving line would be to the left of zero.

Total saving is the sum of foreign, household, and government saving. Graphically, we take the foreign saving line, shift it over by the amount of household saving, and shift it over again — or in the case of a government budget deficit shift it *back* — by the amount of government saving. This gives us the relationship between total saving S and the real interest rate. We do this in Figure 7.7.

We now have the two sides of the loanable funds market. The demand for loanable funds is investment spending, depicted in Figure 7.4. The supply of loanable funds is total saving, depicted in Figure 7.7. Bring them together to see the market for loanable funds, as we have done in Figure 7.8 on page 206. When total saving S equals investment demand I, the market for loanable funds is in equilibrium.

The Adjustment to Flow-of-Funds Equilibrium

Suppose that the real interest rate is initially greater than the equilibrium real interest rate, as shown in Figure 7.9. Saving will exceed investment by the amount labeled "excess saving." Some lenders will offer to accept a lower interest rate. As interest rates fall, investment spending will increase, moving along the investment demand curve. And as interest rates fall, foreign saving will fall, moving along the total saving curve. The macroeconomy will move to the equilibrium interest rate, where saving equals investment. And, as we showed above, when saving equals investment, aggregate demand equals potential output. When prices are fully flexible, the real interest rate adjusts to ensure full employment.

FIGURE 7.8
Equilibrium in the Flow of Loanable Funds
The market for loanable funds is in equilibrium when the supply of loanable funds — total saving *S* — equals the demand for loanable funds — investment demand *I*.

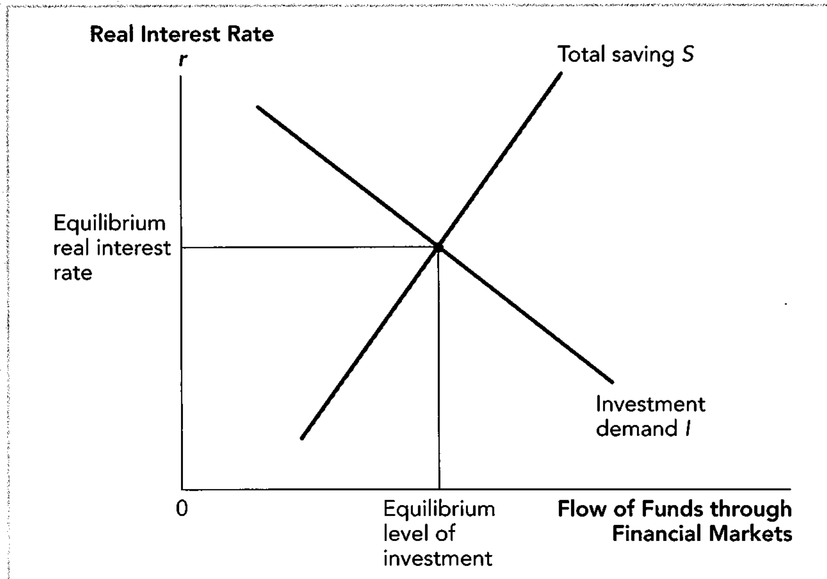
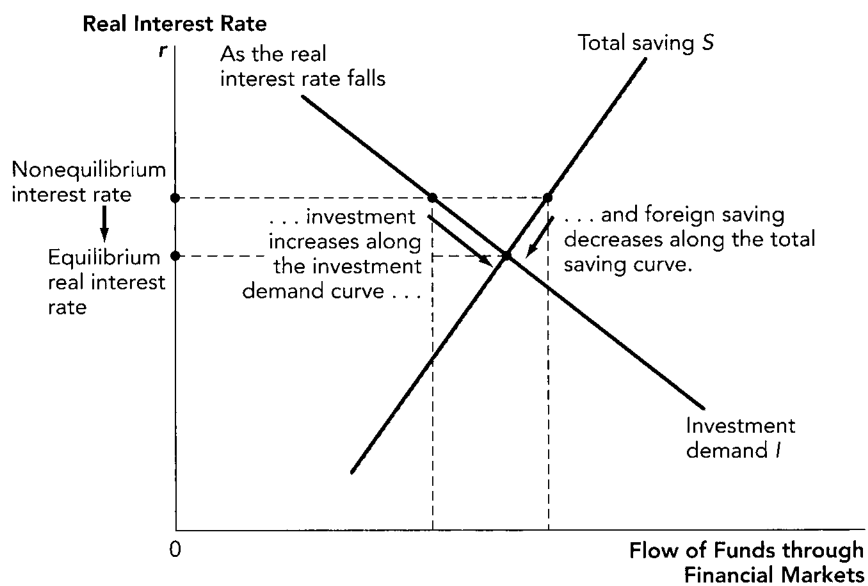


FIGURE 7.9
Excess Saving in the Market for Loanable Funds



RECAP THE REAL INTEREST RATE ADJUSTS TO ENSURE EQUILIBRIUM

In the flexible-price model, the real interest rate is the price that equilibrates the market for loanable funds — the place where saving flows into and investment financing flows out of financial markets. What happens if the flow of funds does not balance — if at the current real interest rate, the flow of saving into the financial markets exceeds the demand by corporations and others for purchasing power to finance investment? Then the price of loans — the real interest rate — will fall, until the supply of funds — saving — equals the demand for funds — investment. Conversely, if investment demand exceeds saving, the real interest rate will rise. When the real interest rate is at its equilibrium value, saving equals investment, $S = I$, and aggregate demand equals full-employment real GDP, $AD = Y^*$.

7.4 USING THE MODEL: WHAT MAKES THE REAL INTEREST RATE CHANGE?

We can use this graphical way of looking at the flow of funds to figure out what happens to the equilibrium real interest rate when there is some change in the economic environment or in economic policy. Some changes make either the saving or the investment curve shift. Other changes also affect the slope of the saving or investment curve. When one or both of the curves shift or change slope, there will be a new equilibrium real interest rate. Let's take a look.

The Effect of a Change in Saving

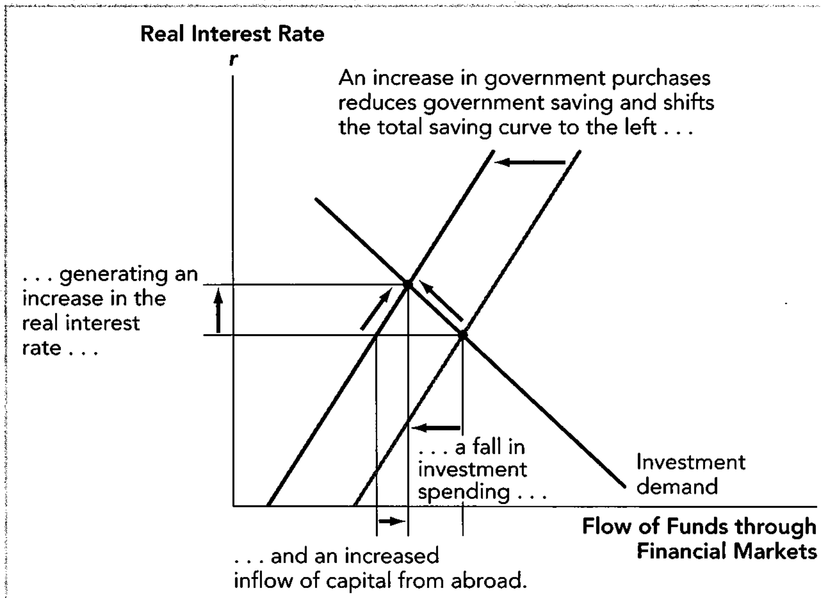
Total saving S is the sum of household, government, and foreign saving. So a decrease in any of those components of S will decrease total saving. It could be a decrease in household saving, decreasing S^H. It could be an increase in government spending, which decreases government saving S^G. It could be a decrease in our imports, which decreases foreign saving S^F. Any of these changes would be shown by a shift to the left of the total saving S curve, as shown in Figure 7.10.

As an example, let's suppose the economy is in equilibrium when policy makers decide to increase annual government purchases by the amount ΔG. More government purchases mean less government saving. Less government saving means that the supply of saving in the loanable funds market is shifted to the left: At each possible interest rate, total saving flowing into the loanable funds market is decreased.

At the original real interest rate, investment demand will now exceed total saving. This shortfall in saving will cause the real interest rate r to rise; some borrowers bid up interest rates in an attempt to obtain funding for their investment projects. But the rising interest rate squeezes other borrowers out of the market; the total quantity of funds demanded for investment falls, moving us up and to the left along the investment demand curve. The rising domestic real interest rate also lowers the real exchange rate ε and increases foreign saving flowing into domestic financial markets, moving us along the second total saving curve. The real interest rate will rise until saving again equals investment. In the end, the flow-of-funds market settles down to equilibrium at a new, higher equilibrium interest rate r with a new, lower level of investment.

When the supply of loanable funds S decreases, the real interest rate r rises, investment spending falls, and (not surprisingly) the amount of saving falls. But

FIGURE 7.10
A Decrease in Saving Increases the Real Interest Rate
When government purchases rise or taxes are cut, government saving is lowered. The drop in total saving leads to higher real interest rates, increased financing of investment by foreigners, and a fall in investment spending by businesses. Economists worry about the long-run effects of rising government deficits because of their effect on capital accumulation.



notice what has happened. The final change in investment and saving, shown along the horizontal axis, is smaller than the change in saving that threw the flow-of-funds markets out of equilibrium. How could that be? The final change in saving is smaller than the initial change in saving because foreign saving rose when the real interest rate rose. But this rise in foreign saving is relatively small so, overall, saving still falls.

A drop in household saving S^H would be analyzed the same way, as would a drop in foreign saving S^F that occurred at every interest rate. In both of these cases, the total saving curve shifts to the left, raising the real interest rate, increasing foreign saving slightly to offset part but not all of the initial drop in saving, and decreasing investment demand.

A tax cut has a slightly different effect. It is very like the effect of a government purchases increase. But because a tax cut increases disposable income and the marginal propensity to consume is less than 1, there is one difference. The difference is that a portion of the addition to household income from the tax cut shows up as household saving. So the initial shift to the left of the total saving curve is smaller than the drop in government saving by the amount of this change in household saving. Otherwise the effects are very similar: Like a government purchases increase, a tax cut leads to an increase in the interest rate, a rise in foreign saving, and a fall in investment spending.

Why do economists make such a big deal out of a decrease in government saving — whether it's due to a decrease in taxes or an increase in government purchases? Because as Figure 7.10 illustrates, in the long run, a decrease in government saving — an increase in the budget deficit — makes interest rates rise, which reduces investment spending. And remember one of the lessons of Chapter 4: Investment spending increases the capital stock, which ultimately increases

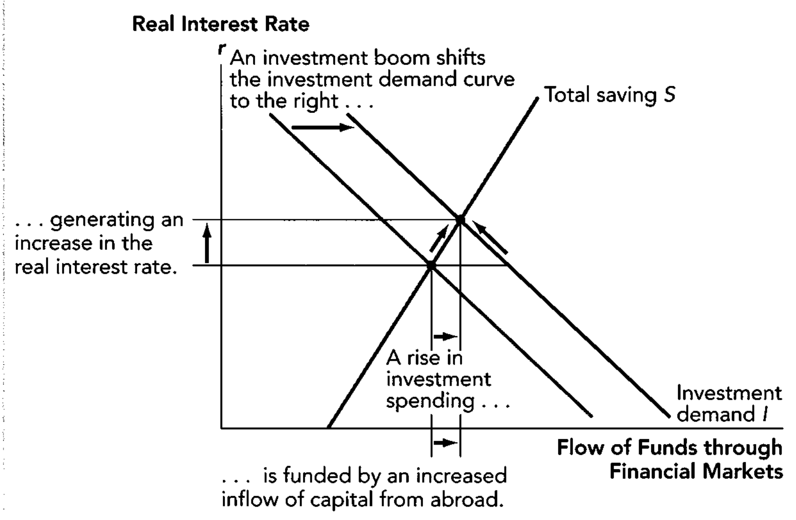


FIGURE 7.11
An Increase in Investment Also Increases the Real Interest Rate
Increased investment demand leads to higher real interest rates, which dampen business enthusiasm for new investment projects while increasing financing of investment by foreigners.

the standard of living. In the long run, increases in government borrowing "crowd out" — reduce — investment spending, which, all else equal, slows the country's rate of economic growth while the economy adjusts to a lower balanced-growth path.

The Effect of a Change in Investment Demand

We can also use the flow-of-funds graph to see the effect of an increase in investment I. Suppose that businesses suddenly become more optimistic about the future and increase the amount they wish to spend on new plant and equipment (as they did in the late 1990s). What would be the effect of such a domestic investment boom?

Investment — the demand-for-loanable-funds curve — *shifts* to the right, as Figure 7.11 shows. At the initial interest rate, investment demand now exceeds saving. Firms that wish to increase their investment spending will bid up interest rates as they compete for scarce loans. As interest rates rise, two things simultaneously happen. One, other firms will decrease their investment spending because their planned investment projects are no longer profitable at these now-higher interest rates — a *movement along* the new investment demand curve. Two, the higher real interest rate leads to a fall in the real exchange rate, to a fall in net exports, and thus to an increase in foreign saving flowing into domestic financial markets — a *movement along* the saving curve. In the end, the loanable funds market settles at a higher interest rate with an increased level of saving and investment.

Notice what happened: The higher interest rates due to the first shift in investment led to a subsequent decrease in investment that partly — but not entirely — offset the initial shift. But investment did increase. What made the increase in investment possible? The increase in foreign saving. If saving had not increased in reaction to the higher interest rates, investment could not increase. Without an increase in saving, the shift in investment demand would make interest rates rise so much that investment spending would fall right back to its initial position.

Instead, when foreign saving increases with real interest rates, both saving and investment increase in response to increased business optimism.

RECAP USING THE MODEL: WHAT MAKES THE REAL INTEREST RATE CHANGE?

We can use the graphical approach to flow-of-funds equilibrium to see that an increase in saving or a decrease in investment — shifts to the right in the saving curve or to the left in the investment demand curve — would lead to a fall in the real interest rate. And a decrease in saving or an increase in investment would make the real interest rate rise. When the supply of saving shifts, the ultimate change in saving will be smaller than the initial change in saving. When investment demand shifts, the ultimate change in investment will be smaller than the initial change in investment. In both cases, this is due to changes in the real interest rate which induce movements along the saving and investment curves that partly offset the initial shifts.

7.5 CALCULATING THE EQUILIBRIUM REAL INTEREST RATE: ALGEBRA

The flow-of-funds graphs let us figure out whether interest rates rise or fall in reaction to a change in policy or economic environment that affects investment demand or total saving. But what if we are policy makers who want to know the precise value of the real interest rate at equilibrium, and by how much the interest rate will change if we implement some policy? To figure out the value of the interest rate and *how much* it changes in reaction to a change in policy or economic environment, we need to do some algebra.

What we need are the equations for total saving S and for investment demand I. Equilibrium occurs when saving S equals investment I, so we will just set the equations equal to each other. Then we solve for the real interest rate.

This sounds straightforward — and it is. But the equations can get quite messy. Don't get discouraged. If the notation and the algebra get to be a bit much, remember that all we're doing is setting saving equal to investment and solving for r.

The Formula for the Equilibrium Real Interest Rate

Start with total saving, which is the sum of household saving S^H, government saving S^G, and foreign saving S^F:

$$S = S^H + S^G + S^F$$

Household saving is equal to total income Y minus net taxes T minus consumption spending C. But since we are in a world of flexible prices (that's our assumption in this chapter, remember), total income Y is always equal to potential output Y^*. Consumption spending depends on baseline consumption C_0, the marginal propensity to consume C_y, the tax rate t, and potential income Y^* (peek back at Section 6.2 to refresh your memory). Thus

$$S^H = Y^* - T - C = Y^* - tY^* - [C_0 + C_y(1 - t)Y^*]$$

Government saving is equal to net taxes T minus government purchases G. As in Chapter 6, let net taxes be a constant proportion of income: $T = tY$. Government saving then equals

$$S^G = T - G = tY^* - G$$

Notice that neither household saving nor government saving depends on the real interest rate. That is why we graphed household saving S^H and government saving S^G as vertical lines in Figure 7.6.

What about foreign saving S^F? Here the real interest rate plays a role. (Section 6.3 laid out the details.) Foreign saving is imports minus exports. The determinants of foreign saving are three parameters — the propensity to import IM_y, foreigners' propensity to buy exports X_f, and the sensitivity of exports to the exchange rate X_ε — and three variables — foreign incomes Y^f, domestic total income Y^*, and the exchange rate ε:

$$S^F = -NX = IM_y Y^* - X_f Y^f - X_\varepsilon \varepsilon$$

And it is the exchange rate that changes when the real interest rate r changes:

$$\varepsilon = \varepsilon_0 - \varepsilon_r(r - r^f)$$

where the real exchange rate ε depends on the baseline value of the real exchange rate ε_0, the sensitivity of the real exchange rate to changes in interest rates ε_r, the domestic real interest rate r, and the foreign real interest rate r^f.

So, because foreign saving depends on the exchange rate, and because the exchange rate depends on the interest rate, foreign saving S^F depends on the real interest rate r. When the real interest rate rises, the total saving flow increases. Why? Because an increase in the real interest rate attracts foreign capital into domestic financial markets and increases foreign saving. We can write this as

$$S^F = IM_y Y^* - X_f Y^f - X_\varepsilon \varepsilon_0 + X_\varepsilon \varepsilon_r r - X_\varepsilon \varepsilon_r r^f$$

In the fourth term of this equation we see that foreign saving depends on the real interest rate.

On the other side, demand for funds is simply investment spending. Use the investment equation from Section 6.2. When the real interest rate r rises, investment spending I falls:

$$I = I_0 - I_r r$$

The level of investment spending depends on the real interest rate.

The flow-of-funds equilibrium is where supply and demand balance — where total saving is equal to investment spending:

$$\text{At equilibrium, } S^H + S^G + S^F = I$$

So now we solve this equation for r, the equilibrium real interest rate. The details of the derivation are given in Box 7.3. In equilibrium, the real interest rate r will equal

$$r = \frac{I_0 - [Y^* - C_0 - C_y(1 - t)Y^*] + G - (IM_y Y^* - X_f Y^f - X_\varepsilon \varepsilon_0 - X_\varepsilon \varepsilon_r r^f)}{I_r + X_\varepsilon \varepsilon_r}$$

Interpreting the Equilibrium Real Interest Rate Equation

What does that equation say? First look at the numerator. When I_0 increases — when business people become more optimistic — the real interest rate will increase.

7.3

DERIVING THE EQUILIBRIUM INTEREST RATE EQUATION: DETAILS

To derive the equation for the equilibrium real interest rate, we start from either the flow-of-output or the flow-of-funds equilibrium statement:

$$Y = C + I + G + NX \qquad \text{or} \qquad S^H + S^G + S^F = I$$

Because one equilibrium statement leads to the other (see Section 7.2), many students like to start from the more familiar statement $Y = C + I + G + NX$. If you do so, you'll follow the same "plug-and-chug" steps that we use here. But here, let's use the flow-of-funds approach, so we begin with the flow-of-funds equilibrium statement $S^H + S^G + S^F = I$.

First, we need the expression for household saving:

$$S^H = Y^* - T - C$$

Substituting the equations for taxes and for consumption gives us

$$S^H = Y^* - tY^* - C_0 - C_y(1 - t)Y^*$$

Next, we need the expression for government saving, into which we substitute the equation for taxes

$$S^G = T - G = tY^* - G$$

Finally, we need the expression for foreign saving

$$S^F = -NX = IM - GX$$

First we substitute the equations for imports and for exports

$$S^F = IM_yY^* - (X_fY^f + X_\varepsilon\varepsilon)$$

and then we substitute the equation for the real exchange rate

$$S^F = IM_yY^* - X_fY^f - X_\varepsilon[\varepsilon_0 - \varepsilon_r(r - r^f)] = IM_yY^* - X_fY^f - X_\varepsilon\varepsilon_0 + X_\varepsilon\varepsilon_r r - X_\varepsilon\varepsilon_r r^f$$

Remember the equation for investment

$$I = I_0 - I_r r$$

Now "plug and chug": Set saving — the sum of household, government, and foreign saving — equal to investment:

$$[Y^* - tY^* - C_0 - C_y(1 - t)Y^*] + (tY^* - G) + (IM_yY^* - X_fY^f - X_\varepsilon\varepsilon_0 + X_\varepsilon\varepsilon_r r - X_\varepsilon\varepsilon_r r^f) = I_0 - I_r r$$

Notice that tY^* cancels out. Make that cancellation and also move every term that includes the real interest rate to the left-hand side and every other term to the right-hand side of the equation:

$$I_r r + X_\varepsilon\varepsilon_r r = I_0 - [Y^* - C_0 - C_y(1 - t)Y^*] - (-G) - (IM_yY^* - X_fY^f - X_\varepsilon\varepsilon_0 - X_\varepsilon\varepsilon_r r^f)$$

Isolate the real interest rate on the left-hand side, and we're done:

$$r = \frac{I_0 - [Y^* - C_0 - C_y(1 - t)Y^*] + G - (IM_yY^* - X_fY^f - X_\varepsilon\varepsilon_0 - X_\varepsilon\varepsilon_r r^f)}{I_r + X_\varepsilon\varepsilon_r}$$

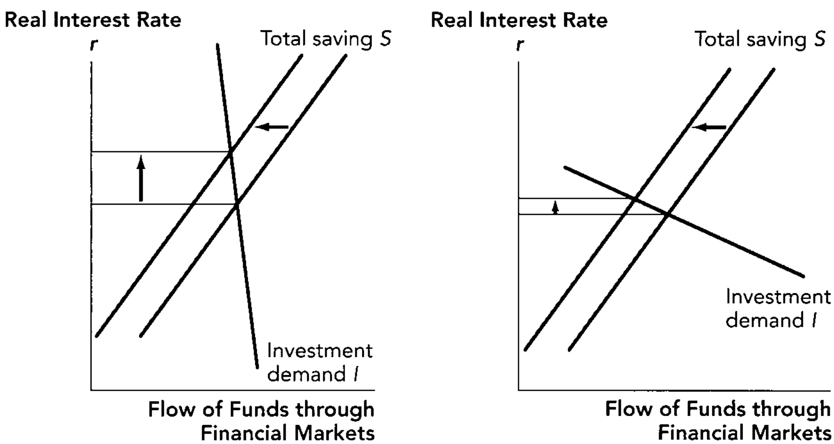
That is what we found in Figure 7.11. When G increases — when the government runs a larger deficit, decreasing its saving — the real interest rate will rise. That is what we found in Figure 7.10.

But now we can figure out by how much the real interest rate will increase. The answer comes from looking at the denominator: $I_r + X_\varepsilon \varepsilon_r$. The larger the denominator, the smaller the change in r when investors' optimism rises. Why? The first term I_r captures the change in investment due to a change in the real interest rate. The larger the sensitivity of investment to interest rates I_r, the flatter the investment demand curve; the more quickly investment spending will fall in response to a rise in interest rates (the *movement along* the now flatter investment curve). And the faster investment falls when interest rates rise, the smaller the rise in interest rates needed to restore equilibrium in the flow of funds.

The second term $X_\varepsilon \varepsilon_r$ captures the change in foreign saving due to a change in the real interest rate. The larger is foreigners' sensitivity to the exchange rate X_ε or the larger the sensitivity of the real exchange rate to changes in interest rates ε_r, the flatter is the total saving curve; the larger is the change in foreign saving when the real interest rate rises (the *movement along* the now flatter S curve). And the larger the change in foreign saving, the less interest rates will be pulled up by a rise in investment demand.

Figure 7.12 gives two examples. In panel (*a*), the sensitivity of investment to changes in the real interest rate is very low. In panel (*b*), it is very high. Notice

FIGURE 7.12
The Slope of the Investment Curve Affects the Size of Changes in the Real Interest Rate



(*a*) When investment is not very sensitive to changes in the real interest rate, I_r is small and the investment demand curve is steep. A decrease in saving makes the interest rate rise a lot.

(*b*) When investment is very sensitive to changes in the real interest rate, I_r is large and the investment demand curve is flat. A decrease in saving makes the interest rate rise only a little.

how a decrease in saving has a much larger effect on the real interest rate when I_r is small (panel *a*) than when it is large (panel *b*).

With the algebraic equations, we can calculate the equilibrium value of the real interest rate. To do so requires the value of all of those constants in the equilibrium equation above. Often, however, the information is given to us not as a list of values of parameters such as the marginal propensity to consume C_y and so on, but as equations for the four components of aggregate demand. Here again, we can calculate the equilibrium value of the real interest rate. We just remember that equilibrium occurs when saving S equals investment I, *which is the same thing as* aggregate demand AD equals output Y. Box 7.4 is an example of substituting in values of the parameters. Box 7.5 starts from the equations for aggregate demand and calculates the value of the equilibrium real interest rate.

Determining the Effect of a Change in Policy on Aggregate Demand

With the graphs of saving and investment, we were able to figure out whether the interest rate would increase or decrease. Now we can figure out the effect of a change in policy on the real interest rate and on the values of consumption, investment, government purchases, and net exports. Let's use a familiar example: an increase in government purchases G.

7.4

CALCULATING THE EQUILIBRIUM REAL INTEREST RATE FROM PARAMETER VALUES: AN EXAMPLE

Assume that the parameters of the model are:

$I_0 = 12{,}000$	Baseline investment spending is \$12,000 billion per year.
$Y^* = 21{,}000$	Potential output is \$21,000 billion per year.
$C_0 = 0$	Baseline consumption spending.
$C_y = 0.8$	The marginal propensity to consume is 80 percent.
$t = 0.375$	Tax rate is 37.5 percent of income.
$G = 2{,}000$	Government spending is \$2,000 billion per year.
$IM_y = 0.3$	Imports are 30 percent of total spending.
$X_f = 0.1$	A \$1 billion increase in foreign income increases our exports by \$0.1 billion.
$Y^f = 1{,}000$	Foreign income is \$1,000 billion per year.
$X_\varepsilon = 600$	A 1-point increase in the real exchange rate increases exports by \$600 billion.
$\varepsilon_0 = 5$	Baseline value of the real exchange rate is 5.
$\varepsilon_r = 10$	A 1-percentage-point increase in the difference between domestic and foreign interest rates ($\Delta r = +0.01$ or $\Delta r^f = -0.01$) decreases the real exchange rate by 0.1.
$r^f = 0.05$	The foreign real interest rate is 5 percent.
$I_r = 9{,}000$	A 1-percentage-point fall in the interest rate ($\Delta r = -0.01$) increases investment spending by \$90 billion a year.

To find the equilibrium real interest rate, we substitute these values into the equation for the real interest rate and then simplify.

$$r = \frac{I_0 - [Y^* - C_0 - C_y(1 - t)Y^*] + G - (IM_y Y^* - X_f Y^f - X_\varepsilon \varepsilon_0 - X_\varepsilon \varepsilon_r r^f)}{I_r + X_\varepsilon \varepsilon_r}$$

$$r = \frac{12{,}000 - [21{,}000 - 0 - 0.8(1 - 0.375)21{,}000] + 2{,}000 - [0.3(21{,}000) - 0.1(1{,}000) - 600(5) - 600(10)(0.05)]}{9{,}000 + 600(10)}$$

$$r = \frac{600}{15{,}000} = 0.04$$

When the economy is in equilibrium, the real interest rate will be 0.04, or 4 percent.

CALCULATING THE EQUILIBRIUM REAL INTEREST RATE FROM AGGREGATE DEMAND EQUATIONS: AN EXAMPLE

7.5

Suppose that we had the same economy that was described in Box 7.4, but instead of being given the values of the parameters, we were given the aggregate demand equations themselves:

$$Y^* = 21{,}000$$

$$C = 0 + 0.8(1 - 0.375)21{,}000 = 10{,}500$$

$$I = 12{,}000 - 9{,}000r$$

$$G = 2{,}000$$

$$GX = 0.1(1{,}000) + 600[5 - 10(r - 0.05)]$$

$$IM = 0.3(21{,}000)$$

First, combine the expressions for gross exports and imports to get

$$NX = -2{,}900 - 6{,}000r$$

Now how do we find the equilibrium real interest rate? We can't exactly look at the equation $C = 10{,}500$ and pick out the values of C_0, C_y, t, and Y^*. In this case, we start from the flow-of-output equilibrium statement, and then solve for the equilibrium real interest rate. In equilibrium, output Y^* equals aggregate demand AD, which is the sum of consumption C, investment I, government G, and net exports NX. Thus

$$21{,}000 = 10{,}500 + (12{,}000 - 9{,}000r) + 2{,}000 + (-2{,}900 - 6{,}000r)$$

$$-600 = -15{,}000r$$

$$0.04 = r$$

When the economy is in equilibrium, the real interest rate will be 0.04, or 4 percent.

Because the equilibrium real interest rate is

$$r = \frac{I_0 - [Y^* - C_0 - C_y(1 - t)Y^*] + G - (IM_y Y^* - X_f Y^f - X_\varepsilon \varepsilon_0 - X_\varepsilon \varepsilon_r r^f)}{I_r + X_\varepsilon \varepsilon_r}$$

a change in government spending ΔG will change the real interest rate by

$$\Delta r = \frac{\Delta G}{I_r + X_\varepsilon \varepsilon_r}$$

The size of the change in the real interest rate depends on the sensitivity of investment to changes in the real interest rate, the sensitivity of exports to a change in the real exchange rate, and the sensitivity of the real exchange rate to a change in domestic real interest rates. That is, it depends on how much investment and saving change when interest rates change.

When government spending rises, what happens to the components of aggregate demand? The change in government purchases has no effect on consumption. Because potential output does not change, national income does not change. National income, baseline consumption, the tax rate, and the marginal propensity to consume do not shift, so there is no effect on the consumption function

$$C = C_0 + C_y(1 - t)Y^*$$

Thus the change in consumption spending is zero:

$$\Delta C = 0$$

The shift in government purchases has an indirect effect on investment. Investment depends on the interest rate, and the interest rate will change as a result of the change in government purchases. So from the investment equation

$$I = I_0 - I_r r$$

we see that investment spending will change by

$$\Delta I = -I_r \Delta r$$

Substituting the expression for the change in the real interest rate gives us

$$\Delta I = -I_r\left(\frac{\Delta G}{I_r + X_\varepsilon \varepsilon_r}\right)$$

crowding out

Decreases in investment spending caused by a drop in government saving that leads to higher real interest rates.

Investment spending will fall when government spending rises. This is what we call **crowding out**: The rise in government purchases increases real interest rates, which "crowds out" private investment spending. The change in investment spending will be equal to the sensitivity of investment to the interest rate times the change in the equilibrium real interest rate.

Nothing in the international economic environment — our propensity to import, foreigners' propensity to export — changes when domestic fiscal policy changes. Nor does the level of potential output change. But the interest rate does change. Look back at our exchange rate equation

$$\varepsilon = \varepsilon_0 - \varepsilon_r(r - r^f)$$

A change Δr in the domestic real interest rate will change the exchange rate by an amount $-\varepsilon_r \Delta r$. Looking back at our export equation, a change in the exchange rate of $-\varepsilon_r \Delta r$ will in turn change exports by an amount $-X_\varepsilon \varepsilon_r \Delta r$. So net exports will shift too:

$$\Delta NX = \Delta GX - \Delta IM = -X_\varepsilon \varepsilon_r \Delta r - 0$$

Substituting the expression for the change in the real interest rate gives us

$$\Delta NX = -X_\varepsilon \varepsilon_r \left(\frac{\Delta G}{I_r + X_\varepsilon \varepsilon_r} \right)$$

Last, real GDP does not change because potential output does not change, and this is a long-run full-employment model, with real GDP always equal to potential output:

$$\Delta Y = \Delta Y^* = 0$$

The change in aggregate demand is the sum of the changes in consumption, investment, government purchases, and net exports, so substituting we get

$$\Delta AD = \Delta C + \Delta I + \Delta G + \Delta NX = 0 + \left[-I_r \left(\frac{\Delta G}{I_r + X_\varepsilon \varepsilon_r} \right) \right] + \Delta G + \left[-X_\varepsilon \varepsilon_r \left(\frac{\Delta G}{I_r + X_\varepsilon \varepsilon_r} \right) \right] = 0$$

The change in aggregate demand is 0! The increase in government spending ΔG is just offset by the decreases in investment spending and net exports. Aggregate demand does not change when government spending changes because this is a *long-run model* in which we have assumed that real GDP is always equal to its potential value Y^*. In the long run, a change in one of the components of aggregate demand leads to a reallocation of aggregate demand but doesn't change the overall value of aggregate demand.

Determining the Effect of a Change in Policy on Saving

What effect does an increase in government purchases have on total saving S? Since neither household income nor consumption changes, household saving does not change:

$$\Delta S^H = 0$$

Government purchases, however, do change. Since government saving is taxes minus government purchases, and since government purchases have gone up, the change in government saving is

$$\Delta S^G = -\Delta G$$

Foreign saving is the opposite of net exports, so foreign saving changes by

$$\Delta S^F = X_\varepsilon \varepsilon_r \left(\frac{\Delta G}{I_r + X_\varepsilon \varepsilon_r} \right)$$

Put all these pieces together and we get

$$\Delta S = \Delta S^H + \Delta S^G + \Delta S^F = 0 + (-\Delta G) + X_\varepsilon \varepsilon_r \left(\frac{\Delta G}{I_r + X_\varepsilon \varepsilon_r} \right) = -I_r \left(\frac{\Delta G}{I_r + X_\varepsilon \varepsilon_r} \right)$$

The change in total saving just equals the change in investment. This is precisely what Figure 7.10 led us to expect. The increase in government purchases reduces the flow of saving into financial markets. The interest rate rises. The higher interest rate reduces businesses' plans for investment spending but also calls forth additional saving from foreigners. And so the higher interest rate has returned the flow of funds to balance.

Note that the falls in investment and in total saving are not as large as the rise in government purchases. This is also what Figure 7.10 led us to expect. The increase in government purchases reduced the flow of domestic saving into financial markets, but the increased flow of foreign-owned capital into the market partially offset this reduction. The extra foreign saving kept the decline in investment from being as large as the rise in government purchases, as Figure 7.10 showed.

What is the point of the march through the algebra? It allows us to calculate quantitative effects: to know not just that the interest rate will go up, but by how much the interest rate will go up. An example of how to actually calculate the change in the interest rate is provided in Box 7.6.

7.6

A GOVERNMENT PURCHASES BOOM: AN EXAMPLE

Start with the same economy that was described in Boxes 7.4 and 7.5. We have

$C_y = 0.8$	The marginal propensity to consume is 80 percent.
$t = 0.375$	Tax rate is 37.5 percent of income.
$X_\varepsilon = 600$	A 1-point increase in the real exchange rate increases exports by \$600 billion.
$\varepsilon_r = 10$	A 1-percentage-point increase in the difference between domestic and foreign interest rates ($\Delta r = +0.01$ or $\Delta r^f = -0.01$) decreases the real exchange rate by 0.1.
$I_r = 9{,}000$	A 1-percentage-point fall in the interest rate ($\Delta r = -0.01$) increases investment spending by \$90 billion a year.

Initially we had an equilibrium real interest rate of 4 percent, $r = 0.04$.

Suppose that there is a sudden but sustained increase in government purchases of \$150 billion a year. This sustained boom in spending increases the equilibrium real interest rate by 1 percentage point:

$$\Delta r = \frac{\Delta G}{I_r + X_\varepsilon \varepsilon_r} = \frac{150}{9{,}000 + 600(10)} = \frac{150}{15{,}000} = 0.01 = 1\%$$

The new interest rate will be $r = 0.05$, or 5 percent. As a result, the equilibrium values of the components of aggregate demand will change by

$$\Delta C = 0$$

$$\Delta I = -I_r\left(\frac{\Delta G}{I_r + X_\varepsilon \varepsilon_r}\right) = -9{,}000\left[\frac{\$150\text{ billion}}{9{,}000 + 600(10)}\right] = -\$90\text{ billion}$$

$$\Delta G = +\$150\text{ billion}$$

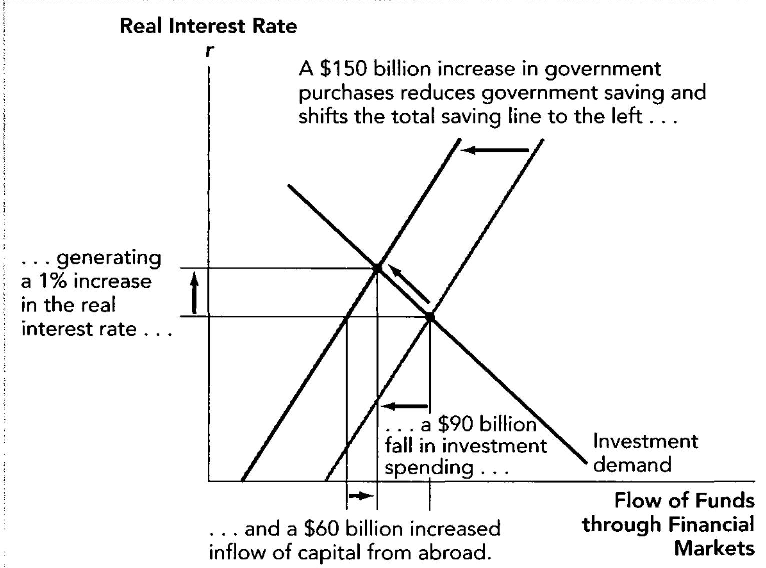
$$\Delta NX = -X_\varepsilon \varepsilon_r\left(\frac{\Delta G}{I_r + X_\varepsilon \varepsilon_r}\right) = -600(10)\left[\frac{\$150\text{ billion}}{9{,}000 + 600(10)}\right] = -\$60\text{ billion}$$

And total saving will change by

$$\Delta S = \Delta S^H + \Delta S^G + \Delta S^F = 0 + (-150 \text{ billion}) + (60 \text{ billion}) = -\$90 \text{ billion}$$

Figure 7.13 illustrates the change in the real interest rate, investment, and saving.

FIGURE 7.13
Flow of Funds: A Boost of $150 Billion to Government Purchases



We can use this same approach to analyze any change to economic policy or the economic environment. Suppose business people become optimistic and increase their investment spending. The change in autonomous investment ΔI_0 will generate an increase in the interest rate equal to $\frac{\Delta I_0}{(I_r + X_\varepsilon \varepsilon_r)}$. Suppose the foreign real interest rate r^f rises. The increase in r^f will generate an increase in the domestic real interest rate equal to $\frac{X_\varepsilon \varepsilon_r \Delta r^f}{(I_r + X_\varepsilon \varepsilon_r)}$. Suppose consumers become wealthier due to a stock market boom and so increase their baseline consumption by ΔC_0. The change in C_0 will generate an increase in the real interest rate equal to $\frac{\Delta C_0}{(I_r + X_\varepsilon \varepsilon_r)}$. Suppose the government cuts the tax rate by Δt. The tax cut will generate an increase in the real interest rate equal to $\frac{-C_y Y^* \Delta t}{(I_r + X_\varepsilon \varepsilon_r)}$.

Notice the appearance, over and over again, of the expression $I_r + X_\varepsilon \varepsilon_r$. This is the sum of two terms: I_r, the amount by which an increase in interest rates reduces investment spending; and $X_\varepsilon \varepsilon_r$, the amount by which an increase in interest rates raises the inflow of capital from abroad. The sum of these two terms is a measure of how powerful changes in the interest rate are in stabilizing the loanable funds market, of how big a gap between supply and demand is closed by each change in the interest rate. If these two terms add up to a large number, shocks to the economy will have little effect on interest rates because only a small change in interest rates will be needed to powerfully affect both demand for funds to finance investment and the supply of saving. If these two terms add up to a small number, shocks to the economy will have large effects on interest rates, because big changes in interest rates will be needed to restore equilibrium.

RECAP CALCULATING THE EQUILIBRIUM REAL INTEREST RATE

We can use the flexible-price model to calculate the equilibrium real interest rate. With equations for the components of aggregate demand and the value of potential output, we would use the flow-of-output equilibrium condition—set aggregate demand equal to output—and solve for equilibrium *r*. Or we can use the flow-of-funds equilibrium condition—set total saving equal to investment—and solve for equilibrium *r*. Either approach gives the same result. We can then use the equilibrium real interest rate and our knowledge of the economic environment to calculate the equilibrium values of the components of aggregate demand and total saving. We can also use the model to calculate how the economy's equilibrium will change in response to changes in the environment or in policy.

7.6 CONCLUSION

This chapter has analyzed a flexible-price macroeconomy in the short run—a time span in which neither labor nor capital stocks have an opportunity to change enough to materially affect the level of potential output. It has taken a snapshot of the economy in equilibrium at a point in time. It has asked how the equilibrium would be different if the economic environment or economic policy were different. It has at times implicitly talked about the dynamic evolution of the economy in the short run by describing the economy as shifting from one equilibrium to another in response to a change in policy or in the environment.

Remember that there was a tension: Prices are flexible so output always adjusts to its potential, but potential output does not change. We are caught between the long-run model of Chapter 4 and the upcoming short-run model of Chapters 9 to 12. Nevertheless, the flexible-price model presented here is powerful. It allows us to say a great deal about the way various kinds of shocks will affect the economy and the composition of total spending and output as long as full employment is maintained. And we have been able to resolve the big mystery of Chapter 4: How does a change in consumption spending or government purchases cause the standard of living to fall?

In the flexible-price model, the interest rate plays the key role in keeping the economy in balance: keeping aggregate demand equal to potential output and the economy at full employment. Changes in economic policy and the economic environment induce changes in the mix of spending. They shift the proportions of aggregate demand between consumption, investment, government purchases, and net exports. But they do not affect the *level* of aggregate demand. Things that reduce saving — whether they reduce household saving, government saving, or the capital inflow — raise interest rates and reduce investment. Changes in economic policy and in the economic environment that increase saving lower interest rates and increase investment.

Think back to Chapters 4 and 5, where long-run growth depended on the economy's saving-investment rate. Here we have seen how a great many changes in economic policy and in the economic environment affect saving and investment. There are powerful links in the long run between shifts that change equilibrium interest rates and the economy's long-run growth path. Drawing those links explicitly would be too hard and too complicated. Nevertheless, when doing analyses using this chapter's flexible-price model remember that this chapter's assumption that the level of potential output is not changed by different levels of investment spending is just a "snapshot" simplifying assumption. In the long run of Chapters 4 and 5, changes in investment have powerful effects on production and prosperity.

We have covered a lot of ground in this chapter. However, it is worth emphasizing what this chapter has not done:

- As the paragraphs above stressed, this chapter has not dealt with the impact of changes in policy and the economic environment on economic growth, which was done in Chapters 4 and 5. Refer to those chapters to analyze how changes in saving and investment ultimately affect productivity and material standards of living in the long run.
- It has ignored the nominal financial side of the economy — money, prices, and inflation — completely. That topic will be covered in Chapter 8.
- It has maintained the full-employment assumption — that notion will be relaxed in the chapters starting with Chapter 9.

Chapter Summary

1. When the economy is at full employment, real GDP is equal to potential output.
2. In a flexible-price full-employment economy, the real interest rate shifts in response to changes in policy or the economic environment to keep real GDP equal to potential output.
3. The real interest rate balances the supply of loanable funds committed to financial markets by savers — total saving — with the demand for funds to finance investments — investment demand. The circular flow principle guarantees that when the saving equals investment, aggregate demand will equal potential output.
4. An increase in saving will make the real interest rate fall. An increase in investment makes the real interest rate rise. How much the interest rate changes depends on the sensitivity of investment demand to real interest rates, the sensitivity of exports to the real exchange rate, and the sensitivity of the real exchange rate to the real domestic interest rate.
5. In a flexible-price full-employment economy, an increase in aggregate demand leads to a reallocation of output among the components of aggregate demand — consumption, investment, government, and net export spending — but not to a change in the level of aggregate demand.
6. In analyzing the effects of changes in economic policy or the economic environment on the macroeconomy, we can use the equations for flow-of-funds equilibrium.

Key Terms

financial markets (p. 194)
total saving (p. 198)
household saving (p. 199)
government saving (p. 199)
foreign saving (p. 199)
capital inflow (p. 199)
crowding out (p. 216)

Analytical Exercises

1. Suppose that in the flexible-price full-employment model, the government increases taxes and government purchases by equal amounts. The tax increase reduces consumption spending. What happens qualitatively to investment, net exports, the real exchange rate, the real interest rate, and potential output? (State the direction of change only.)
2. What happens according to the flexible-price full-employment model if the intercept C_0 of the consumption function rises? Explain qualitatively what happens to consumption, investment, net exports, the real exchange rate, the real interest rate, and potential output. (State the direction of change only.)
3. Explain qualitatively the direction in which consumption, investment, net exports, the real exchange rate, the real interest rate, and potential output move in the flexible-price full-employment model if the government cuts taxes.
4. Give three examples of changes in economic policy or in the economic environment that would shift the total saving curve on the flow-of-funds diagram to the left.
5. Give three examples of changes in the economic environment or in economic policy that would increase the equilibrium real interest rate.

Policy Exercises

1. Suppose that the relevant parameters of the economy are

$t = 0.33$	Tax rate of one-third.
$I_r = 9{,}000$	A 1-percentage-point fall in the interest rate raises investment spending by \$90 billion a year.
$C_y = 0.75$	A marginal propensity to consume of three-quarters.
$\varepsilon_r = 10$	A 1-percentage-point increase in the gap between domestic and foreign real interest rates decreases the real exchange rate by 0.10.
$X_\varepsilon = 600$	A 1-point increase in the real exchange rate leads to a \$600 billion-a-year increase in gross exports.

And suppose that irrational exuberance causes a stock market boom that leads consumers to increase their spending by \$200 billion at a constant level of disposable income. What would be the increase in interest rates in response to such an exuberance-driven consumption boom?

2. In the economy presented in question 1, suppose that total GDP is \$10 trillion and that the government does not want real interest rates to rise and investment to fall in response to the stock market–generated consumption boom. What kinds of policies can the government undertake? How successful will they be?
3. When President Bill Clinton took office, he spent essentially all his political capital on his first-year effort to raise taxes and cut spending by \$300 billion a year in an economy with an annual GDP of \$6 trillion. What, qualitatively and quantitatively, does the flexible-price full-employment model say should have been the consequences of these policies if the relevant parameters of the economy are those given in question 1?
4. When President George W. Bush took office, he cut taxes by \$300 billion and raised spending by \$200 billion a year in an economy with an annual GDP of \$9 trillion. What, qualitatively and quantitatively, does the flexible-price full-employment model say should have been the long-run consequences of these policies if the relevant parameters of the economy are those given in question 1?

5. Consider two economies. In one, the relevant parameters are

$Y^* = \$10{,}000$	In billions; potential output equals \$10 trillion.
$t = 0.33$	Tax rate is one-third.
$I_r = 9{,}000$	A 1-percentage-point fall in the interest rate raises investment spending by \$90 billion a year.
$C_y = 0.75$	The marginal propensity to consume is three-quarters.
$\varepsilon_r = 10$	A 1-percentage-point increase in the gap between domestic and foreign real interest rates decreases the real exchange rate by 0.10.
$X_\varepsilon = 600$	A 1-point increase in the real exchange rate leads to a \$600 billion-a-year increase in gross exports.

In the other, the relevant parameters are the same except

$C_y = 0.5$	The marginal propensity to consume is one-half.

Compare the effects of a \$100 billion increase in government purchases on these two economies. What effect does the drop in the marginal propensity to consume have on the size of change in the real interest rate? On the size of the change in investment demand? Are the levels of the real interest rate and investment spending the same in both economies?

6. From an economic theory point of view, one of the most interesting policies of the current Bush administration is the idea of replacing some of the Social Security system by private accounts. In terms of our model, this policy involves (*a*) a reduction in government tax revenues and (*b*) an increase in private after-tax incomes but (*c*) the government requires that the increase in after-tax income be saved. Qualitatively, how would you think that the consumption function would change as a result of this policy? What would happen in equilibrium to the interest rate? To the exchange rate? To total saving?

7. Most economists at the start of 2005 were anticipating a rise in ε_0, in foreign exchange speculators' assessments of the underlying fundamental value of foreign currency, as they began to focus on the long-run implications of America's foreign trade deficit. Qualitatively, what would you expect to happen to the economy if ε_0 were to suddenly rise?

HAPTER 8

Money, Prices, and Inflation

QUESTIONS

What do economists mean when they say "money"?

Why is money useful?

What is a "unit of account"?

What determines the demand for and supply of money?

What determines the price level and the inflation rate?

Why is inflation best avoided?

Why would a government ever generate hyperinflation — a condition in which prices rise by more than 20 percent a *month*?

8.1 MONEY

price level
The average level of prices in an economy.

inflation
An increase in the overall price level in an economy, usually measured as the annual percentage change in its consumer price index or its GDP price index.

deflation
The opposite of inflation: a decrease in the overall price level in an economy.

Economists believe strongly that price stability is a good thing. The prices of individual commodities need to rise and fall with supply and demand. But average prices — the overall **price level** — need to be stable. A stable average price level is beneficial because only then can the price system work effectively at a microeconomic level: If nobody is certain whether a rise in the price of oranges reflects a shortage of oranges relative to demand or is part of a general overall rise in prices, the price signal that the market system sends to consumers (to cut back, because oranges are now more expensive relative to other commodities) and to producers (to expand production, because oranges have become more valuable relative to other commodities) will not be understood. As British economist John Maynard Keynes put it in his 1924 *Tract on Monetary Reform,* in order to function well at a microeconomic level, "the Individualistic Capitalism of today . . . *presumes* a stable measuring-rod of value, and cannot be efficient — perhaps cannot survive — without one."

In today's world, much of the economic news reported in newspapers and on television concerns the rate of **inflation** — the rate of change of the overall price level. (Fortunately, we have not had experience with **deflation** — falling prices in general — since the Great Depression of the 1930s.) A price level that is unstable — moving either up through inflation or down through deflation — has a number of damaging consequences in addition to the damage it does to the ability of businesses, consumers, and investors to understand the microeconomic price signals that the market system sends to guide resource allocation. To quote Keynes again:

> Inflation . . . means Injustice to individuals and to classes — particularly to investors; and is therefore unfavorable to saving. . . . Deflation which causes falling prices means Impoverishment to labor and to enterprise by leading entrepreneurs to restrict production, in their endeavor to avoid loss to themselves; and is therefore disastrous to employment. . . . Inflation is unjust and Deflation is inexpedient. . . . [B]oth are evils to be shunned. . . . Those who are not in favor of drastic changes in the existing organization of society believe that [our current economic] arrangements, being in accord with human nature, have great advantages. But they cannot work properly if the money, which they assume as a stable measuring-rod, is undependable. Unemployment, the precarious life of the worker, the disappointment of expectation, the sudden loss of savings, the excessive windfalls to individuals, the speculator, the profiteer — all proceed, in large measure, from the instability of the standard of value.

To avoid inflation and deflation, especially large and unexpected inflation and deflation, is therefore one of the chief economic policy tasks of the government. Moreover, the government also has the task of avoiding even the *expectation* of inflation or deflation, for even when inflation is absent, fear that it will emerge has a powerful effect on the economy. Central banks — in the United States, the Federal Reserve — have as their principal tasks the maintenance of stable prices and the preservation of the expectation that prices will be stable.

The Federal Reserve does not always succeed. As Figure 8.1 shows, the United States experienced an episode of relatively mild inflation — prices rising at between 5 and 13 percent per year — in the 1970s. Although relatively mild, that inflation was large enough to cause significant economic and political trauma. Avoiding a repeat of the inflation of the 1970s remains a major goal of economic policy even today, three decades later.

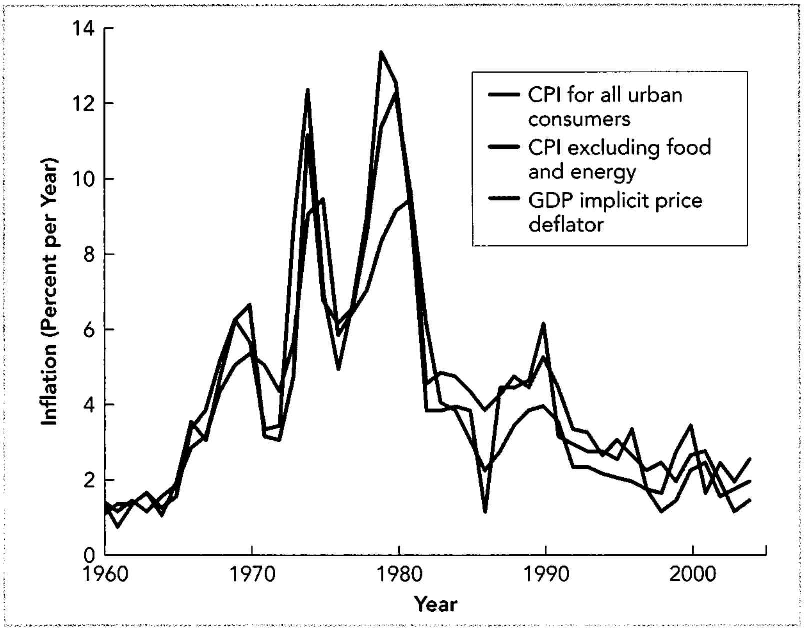


FIGURE 8.1
Post–World War II Inflation in the United States, 1960–2004
All measures of price changes show a burst of inflation in the United States in the 1970s.

Source: 2004 *Economic Report of the President*.

Many countries have experienced inflations that are not mild. In Russia in 1998 the price level rose at an annual rate of 60 percent. In Germany in 1923 prices rose at a rate of 60 percent *per week*. So-called **hyperinflations** appeared in many other countries in the twentieth century, from Argentina to Ukraine, from Hungary to China. They are extremely destructive, inflicting severe damage on the ability of money to grease the wheels of the social mechanism of exchange that is the market economy. The system of prices and market exchange breaks down, and production can fall to a small fraction of potential output.

hyperinflation
Extremely high inflation. One rule of thumb is that inflation of more than 20 percent per month is hyperinflation.

What causes inflation and deflation? How must the Federal Reserve act in order to keep prices stable? Chapters 6 and 7 did not tell us. They did not discuss the determination of the level of prices and the inflation rate. They did not have to. It was perfectly possible to figure out the real interest and exchange rates, the level of real GDP, and the division of real GDP into its components without mentioning the overall price level or the rate of inflation. And there was no feedback from production and output back to the price level.

The power to analyze real variables without referring to the price level is a special feature of the flexible-price full-employment model of the economy. Economists call it the **classical dichotomy**: Real variables (such as real GDP, real investment spending, or the real exchange rate) can be analyzed and calculated without thinking of nominal variables such as the price level. Economists also speak of it as the property whereby money is neutral or is a veil, a covering that does not affect the shape of the face underneath. Starting in Chapter 9 the classical dichotomy will not hold. Money will not be neutral; the determination of

classical dichotomy
When real variables can be analyzed and calculated without thinking about nominal variables.

the price level and its changes will be intimately tied up with fluctuations in production and employment. This is because Chapter 9 introduces prices that are sluggish, or sticky, or that are fixed. Hence they cannot adjust smoothly and instantaneously to changes in nominal variables like the money stock and the price level. But here in Part 3 prices are flexible, and the classical dichotomy holds.

This chapter explores what determines the overall level of prices and the rate of inflation (or deflation) in our flexible-price full-employment model of the macroeconomy. This topic is worth examining for three reasons. First, it provides a useful baseline analysis against which to contrast the conclusions of future chapters. Second, whenever we look over relatively long spans of time — decades, perhaps — wages and prices are effectively flexible, they have time to move in response to shocks, and the flexible-price assumption is a fruitful and useful one. Third, as we stressed above, the maintenance of price stability and of the expectation of price stability is one of the things the government needs to do if the market economy is to function well.

Money: Liquid Wealth That Can Be Used to Buy Things

When noneconomists use the word "money," they may mean a number of things: "She has a lot of money" usually means that she is wealthy; "He makes a lot of money" usually means that he has a high income. When economists use the word "money," however, they mean something special. To economists, money is wealth that is held in a readily spendable form. **Money** is that kind of wealth that you can use immediately to buy things because others will accept it as payment. Today the economy's stock of money is made up of:

money
Wealth in the form of readily spendable purchasing power.

- Coins and *currency* that are transferred by handing the cash over to a seller (almost everyone will accept cash as payment for goods and services).
- *Checking account balances* that are transferred by electronic debit or by writing a check (which most people will accept as payment for goods and services).
- Other assets, like savings account balances, that can be turned into cash or *demand deposits* nearly instantaneously, risklessly, and costlessly.

Why do economists adopt this special definition of money? We do not know. Giving everyday words special definitions is in general a bad thing to do: It causes confusion and misunderstanding. But economists do it, and they do it not only for "money" but also for terms such as "investment" and "rational" and "utility."

Whether assets that can be quickly and cheaply turned into cash (savings account balances, money market mutual funds, liquid Treasury securities, and so on) are included in the money stock is a matter of taste and judgment. At what level of cost and inconvenience is an asset no longer "readily spendable"? There is no clear answer. Thus economists have a number of different measures of the money stock — identified by symbols like H, $M1$, $M2$, and $M3$ — each of which draws the line around a different set of assets that it counts as wealth readily enough spent to be "money."

The Usefulness of Money

In our world all you need to carry out a market transaction — whether you want to buy or sell some good or service — is either to have money yourself (if you

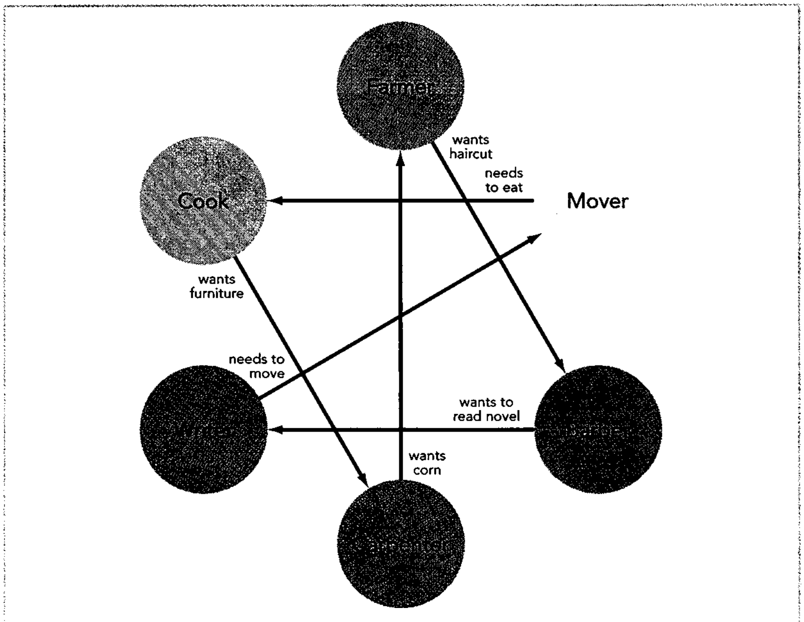


FIGURE 8.2
Coincidence of Wants
Without money, how is the carpenter to persuade the farmer to give him corn when the farmer wants a haircut but doesn't need furniture — which the cook wants? How is the mover going to persuade the cook to feed him when the cook doesn't need the moving truck — the writer does? With money, all can sell what they have for cash and have confidence that they can then turn around and use the cash to buy what they need.

want to buy) or to deal with a purchaser who has money (if you want to sell). In a barter economy, an economy without the social convention of money, market exchange would require the so-called coincidence of wants: You would have to have, physically in your possession, some particular good or service that another person wants, and that person would have to have in his or her possession some good or service that you want. As Figure 8.2 shows, finding consumption goods to satisfy the coincidence of wants would get remarkably complicated very quickly. Without money, an extraordinary amount of time and energy would be spent simply arranging the goods one needed to trade.

Units of Account

There is one other feature worth noting. The same assets that serve as the most common form of readily spendable purchasing power also serve as units of account. Dollars or euros or yen are not only what we use to settle transactions but also what we use to quote prices to one another. At some times and places the functions of money as a **medium of exchange** and as a unit of account have been separated, but today they almost invariably go together.

medium of exchange

A commodity or an asset that almost everyone will accept as payment for a transaction.

This is a potential cause of trouble. Anything that alters the real value of the domestic money in terms of its purchasing power over goods and services will also alter the real terms of existing contracts that use money as the unit of account. The effect of changes in the price level on contracts that have used the domestic money as a unit of account is a principal source of the social costs of inflation and deflation. The effect of changes in the exchange rate on contracts

unit of account

Money is a unit of account when a great many contracts are written promising to exchange a good or service for a number of units of money.

that have used foreign moneys as units of account is a principal source of the social costs of *currency crises.*

RECAP MONEY

To an economist, "money" is wealth that is held in a readily spendable form. Money is that kind of wealth that you can use immediately to buy things because others will accept it as payment. Money is useful because in its absence we would have a barter economy and market exchange would require the so-called coincidence of wants. Without money, an extraordinary amount of time and energy would be spent simply arranging the goods one needed to trade.

The same assets that serve as the most common form of readily spendable purchasing power also serve as *units of account.* Dollars or euros or yen are not only what we use to settle transactions but also what we use to quote prices to one another. This is a potential cause of trouble. The effect of changes in the price level on contracts that have used the domestic money as a unit of account is a principal source of the social costs of inflation and deflation. The effect of changes in the exchange rate on contracts that have used foreign moneys as units of account is a principal source of the social costs of currency crises.

8.2 THE QUANTITY THEORY OF MONEY

The Demand for Money

money demand

How much wealth in the form of readily spendable purchasing power — money — households and businesses wish to hold at the given levels of national income and nominal interest rates.

People have a **demand for money** just as they have a demand for any other good. They want to hold a certain amount of wealth in the form of readily spendable purchasing power because the stuff is useful. The more money in your portfolio, the easier it is to buy things. Too little money makes life pointlessly difficult. You have to waste time running to the bank for extra cash or waste energy and time liquidating pieces of your portfolio before you can carry out your normal daily transactions.

Nevertheless, you don't want to have too much of your wealth in the form of readily spendable purchasing power. Cash sitting in your pocket is not earning interest at the bank. Wealth you do not want to spend for five years could earn a higher return as a certificate of deposit or as an investment in the stock market than as cash in your checking account.

Figure 8.3 summarizes the reasons for and opportunity cost of holding money. The higher the flow of spending, the more money the households and businesses in the economy will want to hold. How much more? That depends on the transactions technology of the economy: what businesses will take credit cards, how easy it is to get checks approved, how long the float is, and so forth. In this section of the chapter, however, we ignore all other determinants of money demand and focus on the flow of spending as the principal determinant of money demand.

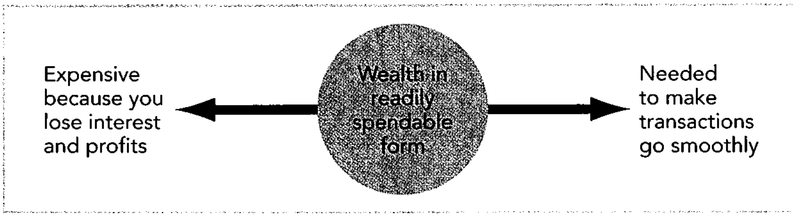


FIGURE 8.3
Reasons for and Opportunity Cost of Holding Money
As with every other economic decision, the amount of wealth households and businesses want to hold in the readily spendable form of money depends on the benefits of holding money and the opportunity cost — the lost interest and profits — of doing so.

The Quantity Equation

The theory that the only important determinant of the demand for money is the flow of spending is called the **quantity theory of money**. It is summarized in the quantity equation

$$MV = PY$$

M is the money stock. PY represents the total nominal flow of spending: Y is, by the circular flow principle, both national income and total national spending; and P is the average price in dollars for which goods sell. The parameter V — a constant, or perhaps growing slowly and predictably — is the **velocity** of money. It tells you how often a given unit of money is spent and changes hands over the course of a year. (Or, alternatively, you can think of $1/V$ as the amount of dollars' worth of money that households and businesses want to hold for each dollar of annual spending on goods and services.) The velocity of money is a measure of how fast money moves through the economy.

quantity theory of money
The theory that money demand is insensitive to changes in interest rates and that the velocity of money is nearly constant. Summarized in the equation $MV = PY$.

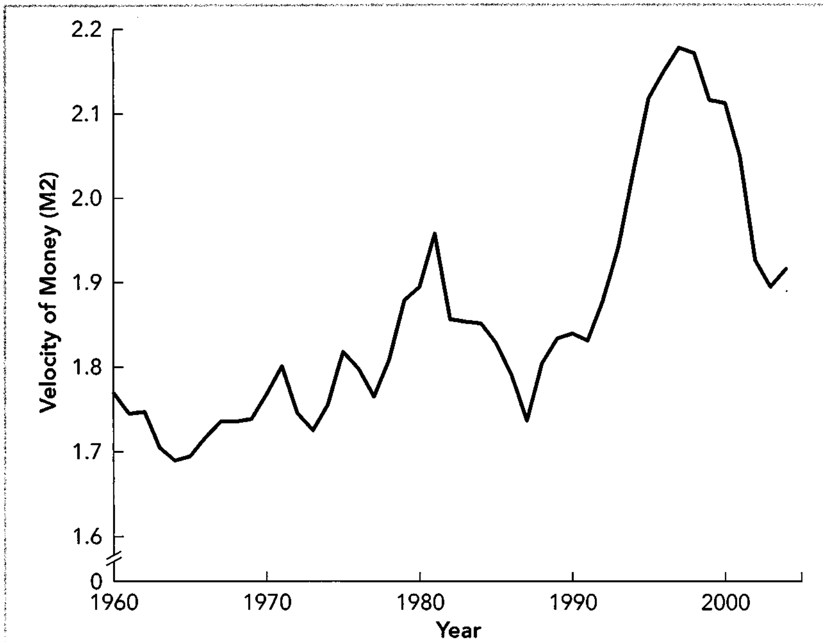
velocity
A measure of how often the average monetary asset is used as a means of payment over the course of a year, equal to nominal expenditure or income PY divided by the money stock M.

Money and Prices

The Price Level

Together, the quantity theory of money and the full-employment assumption allow us to determine the price level in the flexible-price model of the macroeconomy. Real GDP Y is equal to potential output: $Y = Y^*$. The velocity of money V is determined by the sophistication of the banking system and the social conventions that govern payment and settlement. For the "M1" concept of money — currency plus checking account deposits — the current velocity V is about 8.6: Businesses and households want to hold about \$1 of their wealth in the form of M1 for every \$8.60 of real GDP produced. Changes in financial sophistication have increased velocity over time. In the years immediately after World War II, the M1 velocity of money was only 3. For the M2 concept, velocity is considerably lower (see Figure 8.4).

FIGURE 8.4
The Velocity of Money
Between 1960 and 1980 it looked as though the velocity of money was slowly and steadily increasing as the banking system improved its efficiency and the technology available for conducting transactions. But after 1980 the velocity of money fell far short of its pre-1980 trend. Economists attribute this to lower inflation rates in the last quarter century, which diminished incentives to economize on cash and checking account balances.



Source: Authors' calculations from 2004 *Economic Report of the President.*

Thus if we know real GDP Y, the velocity of money V, and the money stock M, we can calculate that the price level is

$$P = \left(\frac{V}{Y}\right)M$$

Box 8.1 presents an example of such a quantity-theory calculation.

Should the price level be momentarily higher than the quantity equation predicts, households and businesses will notice that they have less wealth in the form of readily spendable purchasing power than they want. They will cut back on purchases for a little while to build up their *liquidity.* As they cut back on purchases, sellers will note that demand is weak and will cut their prices, so the price level will fall. Should the price level be momentarily lower than the quantity equation value, households and businesses will note that they have more wealth in the form of money than they want, so they will accelerate their purchases to reduce their money balances. Sellers will note that demand is strong and will raise their prices, so the price level will rise.

As long as prices are flexible, the economy's price level will remain at its quantity-theory equilibrium. Transitory fluctuations in the velocity of money mean that day-to-day or even year-to-year changes in the money stock are not mirrored in equivalent proportional changes in the price level. But on a decade-to-decade time scale the quantity theory of money is a very reliable guide to and predictor of large movements in prices.

8.1

CALCULATING THE PRICE LEVEL FROM THE QUANTITY EQUATION: AN EXAMPLE

It is straightforward to use the quantity theory of money

$$P = \left(\frac{V}{Y}\right)M$$

to calculate the price level. For example, in the third quarter of 1998 real GDP (in chained 1992 dollars) was equal to \$7,566 billion, the M1 measure of the money stock was equal to \$1,072 billion, and the velocity of money was equal to 7.964. Therefore,

$$P = \left(\frac{7.964}{\$7{,}566}\right)(\$1{,}072) = 1.1284$$

In the third quarter of 1998 the price level was equal to 112.84 percent of its 1992 level, which works out to an average rate of inflation of about 2.03 percent per year from 1992 to 1998.

Had velocity grown an additional 10 percent between 1992 and 1998, the price level would have grown an additional 10 percent as well if the money stock and real GDP were unchanged from their historical values. Had the money stock grown by an additional 10 percent between 1992 and 1998, the price level would have grown by an additional 10 percent as well if velocity and real GDP were unchanged from their historical values. And had real GDP grown by an additional 10 percent between 1992 and 1998, this would have reduced the 1998 price level by 10 percent relative to its historical value if velocity and the money stock were unchanged from their historical values.

From this perspective, the economic policy task of maintaining stable prices is relatively straightforward. Since

$$P = \left(\frac{V}{Y}\right)M$$

the economy will have a stable price level P if the **central bank** — in the United States, the **Federal Reserve**, or simply the Fed — allows the nominal money stock M to increase and decrease to offset fluctuations in V/Y, the ratio of the velocity of money V to the level of output Y.

But using the quantity theory in this way requires that we know the level of the money stock, and know how to change the level of the money stock. What determines the level of the money stock? And how does the Federal Reserve change the level of the money stock?

central bank

The arm of a national government that controls the money supply and the credit pattern of an economy and usually oversees and regulates the banking system as well.

Federal Reserve

The United States' central bank, consisting of a Board of Governors (seven, one of whom is chair) and 12 regional Federal Reserve banks.

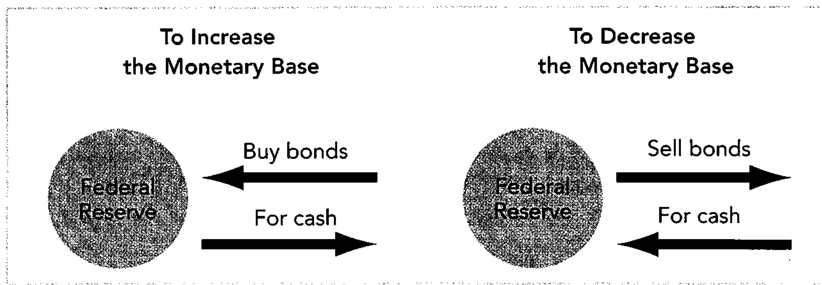
The Money Stock

The central bank directly determines what economists call the monetary base, the sum of currency in circulation and of deposits at the Federal Reserve's 12 branches. When the central bank wants to reduce the monetary base, it sells short-term government bonds and accepts as payment either currency or, as an alternative, deposits that banks already hold at the Fed's regional branches. Why do banks have funds on deposit at the regional branches of the Federal Reserve? Because of the

monetary base

The sum total of currency and of bank reserves on deposit at the Federal Reserve; also often called "high-powered money."

FIGURE 8.5
Open-Market Operations
The Federal Reserve controls the money supply through open-market operations: purchases and sales of bonds on the open market. A purchase of bonds increases the economy's money stock. A sale of bonds sucks cash out of the economy and reduces the money stock.



law: The Federal Reserve requires that national banks deposit funds in its branches so the Fed can have additional confidence that the bank is not being stripped of assets by fraud, and that the resources to pay depositors' demands to withdraw money from the bank will be met.

When the Federal Reserve sells bonds for currency, the currency it accepts as payment is then removed from circulation, no longer part of the money stock. When the Federal Reserve sells bonds and accepts as payment deposits that national banks hold at the Fed's regional branches, these deposits are then erased from its books. Thus the monetary base declines. When the Federal Reserve wants to increase the monetary base, it buys short-term government bonds, paying for them with currency, or by crediting the seller with an enlarged deposit at the Federal Reserve. These transactions are called **open-market operations**, because the Federal Reserve buys or sells bonds on the open market. (See Figure 8.5.) When and how the U.S. central bank, the Federal Reserve, undertakes open-market transactions are decided at periodic meetings of the *Federal Open Market Committee (FOMC)*, which meets eight times a year.

open-market operations

The principal way that central banks affect interest rates; the purchase (or sale) of short-term government bonds to increase (or decrease) the money supply, and push interest rates down (or up).

The Federal Reserve directly controls the monetary base. But the monetary base is not the entire **money stock**. "Money" includes many other things than just currency and reserve deposits held at the 12 regional *Federal Reserve banks:* checking account deposits, savings account deposits, small-denomination certificates of deposit, and a number of other assets that are sometimes included and sometimes excluded in various alternative measures of the money stock.

money stock

The equilibrium of money supply and money demand. The amount of money the Federal Reserve has allowed the banking system to create.

However, changes in the monetary base indirectly induce changes in these other components of the money stock as well. For example, national banks accept checking and savings account deposits. They lend out the purchasing power deposited in the bank, earn interest, and provide the depositor with a claim to wealth in readily spendable form. How much of the deposits they take in do banks then turn around and lend out? The Federal Reserve limits national banks' ability to accept deposits, and limits the proportion of the deposits they do accept that national banks can then lend out.

reserve requirements

The amount of money — usually expressed as a share of total deposits — that the central bank requires banks to maintain either as cash in their vaults or as deposits at the central bank.

The Federal Reserve requires that national banks redeposit at the local regional branch of the Federal Reserve a certain proportion of their total deposits — a proportion called the **reserve requirement**. In addition, financial institutions find it prudent to hold liquid **excess reserves** in case an unexpectedly large number of depositors seek to withdraw their money. For a financial institution, nothing is

excess reserves

Bank reserves held over and above those mandated by the central bank.

DIFFERENT DEFINITIONS OF THE MONEY STOCK: SOME DETAILS

8.2

The different definitions of the money stock all draw the line separating "money" from "not-money" in different places. Economists' definition of "money" considers any wealth held in the form of readily spendable purchasing power to be money. But ready spendability is, to some degree at least, a thing found in the eye of the beholder.

The narrowest definition of money — called "H" for "*h*igh-powered money," or sometimes "B" for "monetary *b*ase" — includes only cash and deposits at branches of the Federal Reserve. The assets that make up the monetary base are special because only they can serve as reserves to satisfy the Federal Reserve's requirement that institutions that accept deposits also maintain funds to cover any emergency spike in withdrawals.

The narrowest commonly used definition of money is M1, which consists of currency plus checking account deposits, traveler's checks, and any other deposits at institutions from which the depositor can demand his or her money back and get it instantaneously. Almost anyone will accept M1-type money as a means of payment for almost any purchase. M2 adds to M1 wealth held in the form of savings accounts, wealth held in relatively small term deposits, and money held in money market mutual funds. Some of the money included in M2 cannot be spent without paying a penalty for early withdrawal. Moreover, if the bank wants, it has the legal right to delay a withdrawal for a period of time. M2-type money is a little bit less spendable than M1-type money. The broadest definition of money, M3, includes large term deposits and institutional money market fund balances.

worse than being unable to meet depositors' demands for money. Broader measures of the money stock listed in Box 8.2 are also limited in their size by the amount of the monetary base, the regulatory reserve requirements imposed on banks and other financial institutions, and financial institutions' extremely powerful incentive never to get caught without enough cash to satisfy depositors' demands.

In this chapter (and later chapters too) we sweep these complications under the rug. We assume that the central bank can easily set the money stock at whatever level it wishes. (Although these subjects are given short shrift in this book, they are explored in great depth in money and banking textbooks by authors such as Rick Mishkin, Glenn Hubbard, and Steve Cecchetti.)

What, then, is the actual level of the money stock? This is one thing that economists argue over, because they construct different alternative measures and definitions. Table 8.1 summarizes some of these alternative definitions of the money stock.

The Rate of Inflation

The quantity equation

$$MV = PY$$

leads immediately to an equation for the **inflation** rate, which we will call π — the proportional rate of change of the price level. Recall our rule from Chapter 4 about how to calculate the proportional growth rates of products: The proportional growth rate of a product is the sum of the growth rates of the terms multiplied together. Thus

inflation rate
The annual rate of change of the overall level of prices in the economy.

$$\text{Inflation} = \text{Money growth rate} + \text{Velocity growth rate} - \text{Real GDP growth rate}$$

TABLE 8.1
Measures of the Money Stock

Concept of Money	Assets Included in Concept	Amount, 2003 (in Billions)
C	Currency	$ 664
H	Monetary base: assets that can serve as reserves for banks; equals currency plus reserve deposits at Federal Reserve banks	721
M1	Currency plus checking account deposits and traveler's checks	1,287
M2	M1 plus savings account deposits, small time deposits, and household money market funds	6,045
M3	M2 plus institutional money market funds, eurodollar accounts, large time deposits, and repurchase agreements	8,807

Source: The 2004 edition of the *Economic Report of the President* (Washington, DC: Government Printing Office).

To write this relationship in more compact form, use a lowercase m and v for the proportional growth rates of the money stock and velocity, respectively, and use a lowercase y for the growth rate of real GDP. Then

$$\pi = m + v - y$$

If the proportional growth rate of real GDP is 4 percent per year, the velocity of money V increases at a proportional rate of 2 percent per year, and the money stock M grows at 5 percent per year, then

$$\pi = 5\% + 2\% - 4\% = 3\%$$

The inflation rate is 3 percent per year.

In actual empirical fact, most changes in the rate of inflation in the medium run of years and the long run of a decade or more are due to changes in the rate of growth of the money stock. Substantial and persistent changes in y, the rate of growth of real GDP, are rare. The variable v — the rate of growth of the velocity of money — is determined by the slow pace of institutional and technological change in the banking system.[1] But m, the rate of growth of the money stock, can change quickly and substantially. Thus if you see a large and persistent change in inflation, odds are that it is due to a change in the rate of growth of the money stock. It is this fact that led Chicago economist Milton Friedman to pronounce that "inflation is always and everywhere a monetary phenomenon."

If the Federal Reserve keeps the money stock relatively stable, prices will be relatively stable and inflation will be low. If the Federal Reserve lets the money stock grow more quickly, then prices will be unstable and inflation will be relatively high. But on a year-to-year time scale, the relationship is not close: in the short run, fluctuations in y and v have a powerful role to play as well.

On a decade-to-decade scale, however, the relationship between money growth and inflation is strong. Consider what has happened in the United States in the past half century decade-by-decade, as shown in Table 8.2. The acceleration in the

[1]And also, in a complication deferred to this chapter's appendix, by the level of nominal interest rates.

TABLE 8.2
American Inflation and Money Growth by Decade, 1955–2004

Period	Average Inflation Rate (CPI)	Average Money Growth Rate (M2)
1955–1965	1.7%	4.7%
1965–1975	5.8	7.5
1975–1985	7.1	9.4
1985–1995	3.5	4.1
1995–2004	2.3	6.1

Source: 2004 *Economic Report of the President* and Macroeconomic Associates forecasts.

average rate of money growth from 4.7 percent for the period 1955–1965 to 9.4 percent for the period 1975–1985, an increase of 4.7 percentage points, is almost matched by the increase of 5.4 percentage points in the rate of inflation. The only recent decade in which money growth and inflation moved in opposite directions is the one we just finished, 1995–2004.

When one looks across countries, some of which have astonishingly high rates of money growth, the correlations between money growth and inflation are even stronger, as Figure 8.6 shows: The higher the rate of money growth, the higher the rate of inflation.

You should note that this section has greatly simplified money demand — most important, it has ignored how money demand depends on the interest rate. The appendix at the end of this chapter analyzes how changing interest rates affect money demand.

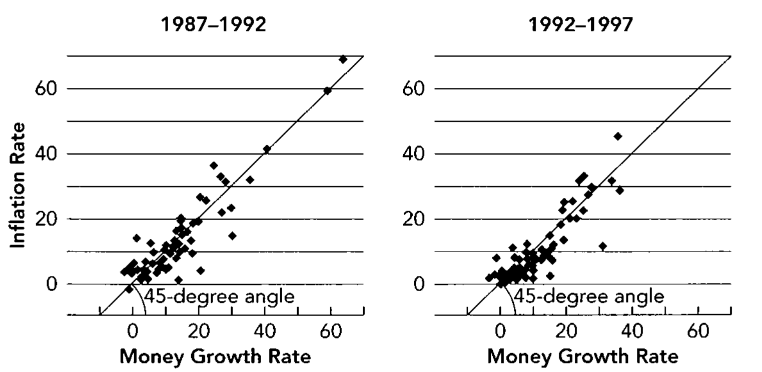


FIGURE 8.6
Money Growth and Inflation across Countries

For each country, one point shows the growth rate of money and the inflation rate for five-year periods, 1987–1992 (left) and 1992–1997 (right). Points on the 45-degree angle line have money growth rate equal to the inflation rate. Almost all countries are clustered close to that 45-degree line; the higher the money growth rate, the higher the inflation rate.

Source: Gerald P. Dwyer and R. W. Hafer, "Are Money Growth and Inflation Still Related?" *Federal Reserve Bank of Atlanta Monthly Review*, Second Quarter 1999, pp. 32–43.

Inflation and the Nominal Interest Rate

It was Yale University economist Irving Fisher who, early in the last century, pointed out that we would expect higher inflation to be accompanied by higher nominal interest rates. Households wanting to save and businesses wanting to borrow funds to use for investment bargain in financial markets over the terms of loans and debts. The market equilibrium real reward to saving and the real cost of borrowing is the real interest rate r. Changes in the rate of inflation shouldn't, in the long run, affect the terms of savers' and borrowers' bargains and the market equilibrium real interest rate, as long as they recognize the change in inflation and expect it to continue.

The interest rate we see on the evening news, however, is not the real interest rate r, but the nominal interest rate i:

$$i = r + \pi^e$$

Thus when the expected inflation rate rises, we would expect in the long run to see the nominal interest rate rise with it, point-for-point. This theoretical prediction — and rough empirical regularity — is called the **Fisher effect**.

Fisher effect

An empirical regularity whereby nominal interest rates typically rise roughly point-for-point with the expected inflation rate.

RECAP THE QUANTITY THEORY OF MONEY

People want to hold a certain amount of wealth in the form of readily spendable purchasing power because the stuff is useful. The more money in your portfolio, the easier it is to buy things. However, you don't want to have too much of your wealth in the form of readily spendable purchasing power. Cash sitting in your pocket is not earning interest at the bank. Wealth you do not want to spend for five years could earn a higher return as a certificate of deposit or as an investment in the stock market than as cash in your checking account.

The theory that the only important determinant of the demand for money is the flow of spending is the quantity theory of money, $MV = PY$, where PY represents the total nominal flow of spending. For each dollar of spending on goods and services, households want to hold $1/V$ dollars' worth of money. The parameter V, a constant, or perhaps growing slowly and predictably, is the velocity of money. The velocity of money is a measure of how "fast" money moves through the economy: how many times a year the average unit of money shows up in someone's income and is then used to buy a final good or service that counts in GDP.

8.3 THE COSTS OF INFLATION

Why should we care whether the central bank controls the money supply so that inflation is low and stable or lets the money supply expand rapidly and produce high and unpredictable inflation? One reason *not* to care about inflation is the fear that inflation makes us directly and significantly poorer. Any claim by a politician that inflation is the "cruelest tax" because its higher prices rob Americans of the benefits of their wages is not coherent. Inflation raises all nominal prices and wages in the economy. The higher nominal prices that a worker has to pay because of inflation are, on average (but only on average), offset by the higher *nominal wages* that his or her employer can pay because of inflation. Higher living standards come from better technology and more capital-intensive production processes, not from reduced inflation.

Inflation does have costs, but they are subtle. For the most part, the costs of moderate inflation appear to be relatively small, perhaps smaller than one would guess given the strength of today's political consensus that price stability is a very desirable goal.

The Costs of Moderate Expected Inflation

expected inflation rate

A hunch, formed today, of what the inflation rate will be at some time in the future. Economists usually collapse the range of different and conflicting expectations held by people into a single average number.

A rise in the **expected inflation rate** raises the nominal interest rate, which you will recall is equal to the real interest rate plus the expected rate of inflation. If the nominal interest rate did not rise when inflation rose, borrowers would recognize that borrowing had suddenly become a very good deal: Borrow now at the same nominal interest rate, and pay back later. But because inflation will increase prices and wages, fewer goods and services will be forgone in order to make the loan payment. For this reason we expect to see nominal interest rates rise roughly point-for-point with the expected inflation rate — the *Fisher effect*, as noted earlier.

Since the nominal interest rate is the opportunity cost of holding money balances, when the rate is high, you devote more time and energy to managing your cash balances. From the viewpoint of the economy as a whole, this extra time and energy is just wasted. Nothing useful is produced, and valuable resources that could be used to add to output or be simply spent on enjoying yourself are used up.

Expected inflation wastes time and energy in other ways as well. Firms find that they must spend resources changing their prices not because of any change in their business but simply because of inflation. Households find that it is harder to figure out what is a good buy and what is a bad one as inflation pushes prices away from what they had perceived normal prices to be. The most serious costs of expected inflation surely come from the fact that our tax laws are not designed to deal well with inflation. Lots of productive activities are penalized, and lots of unproductive ones rewarded, simply because of the interaction of inflation with the tax system. The fact that debt interest is treated as a cost means that in times of high inflation, financing businesses by issuing bonds or borrowing at the bank is artificially cheap, and so businesses adopt debt-heavy capital structures that may make the economy more vulnerable to financial crises and that certainly increase the amount of resources wasted paying bankruptcy lawyers, as businesses with lots of debt tend to go bankrupt relatively easily.

And, as was stressed at the start of the chapter, inflation fuzzes up the price signals about relative scarcities, values, and opportunities that the market system sends to businesses, investors, and consumers. Stable prices make the market system work better in a microeconomic sense as a social resource-allocation calculation mechanism.

Nevertheless, when the rate of inflation is low — perhaps less than 10 percent per year, probably less than 5 percent per year, and certainly less than 2 percent per year — these costs are too small to worry about because they are counterbalanced by benefits. Suppose the central bank wants to push the real interest rate below zero in some economic crisis? It cannot do so unless there is some inflation in the economy, because nominal interest rates cannot be less than zero and the real interest rate is the difference between the nominal interest rate and the inflation rate. Moreover, many economists and psychologists have speculated that worker morale is greatly harmed if worker wages are clearly and unambiguously cut. A small amount of inflation may then grease the wheels of the labor market, allowing for wage adjustment without the damaging effect on morale of explicit wage cuts. These considerations have led the Federal Reserve's policy makers to adopt a rather odd definition of "price stability"; as far as they are concerned, an inflation rate of about 2 percent per year is price stability, and many members of today's FOMC become alarmed if the rate of inflation threatens to fall below that level.

The Costs of Moderate Unexpected Inflation

Unexpected inflation has significantly larger and more worrisome costs, for unexpected inflation redistributes wealth from creditors to debtors. Creditors receive much less purchasing power than they had anticipated if a loan falls due during a time of significant inflation. Debtors find the payments they must make much less burdensome if they borrow over a period of significant inflation. The process works in reverse as well: If inflation is less than had been expected, creditors receive a windfall and debtors go bankrupt. Most people are averse to risk. We buy insurance, after all. People who are averse to risk dislike uncertainty and unpredictability — and unexpected inflation certainly creates uncertainty and unpredictability.

Yet perhaps the economic costs of moderate unexpected inflation are relatively low. Why don't debtors and creditors want to insure themselves against inflation risk by indexing their contracts and using some alternative, more stable unit of account? In economies with high and variable inflation, we do see such indexation. The fact that we do not see it in countries with moderate and low inflation suggests that the costs of inflation to individual debtors and creditors (though perhaps not to society as a whole) must be relatively low, as long as changes in the inflation rate are low and are not too sudden.

Nevertheless, a powerful political argument holds that the costs of moderate inflation are high. Voters do not like moderate inflation. The 1970s saw government after government in the industrialized world voted out of office. Polls showed that voters interpreted the rising rates of inflation as signs that the political parties in power were incompetent at managing the economy. Since the end of the 1970s, no major political party in the industrialized world has dared run on a platform of less price stability and more inflation.

Hyperinflation and Its Costs

The costs of inflation mount to economy-destroying levels during episodes of hyperinflation, when inflation rises by more than 20 percent a month or so. Hyperinflations arise when governments attempt to obtain extra revenue by printing money but overestimate how much revenue they can raise. For some governments, printing money is an important source of revenue. Most governments tax their citizens or borrow from people who think that the government will pay them back. But if a government finds that it does not have the administrative reach to increase its explicit tax take and that no one will lend to it, it can simply print money and use the bills hot off the press to purchase goods and services.

Where do the resources — the power to buy goods and services — that the government acquires by printing money come from? A government that finances its spending by printing money is actually financing its spending by levying a tax on holdings of cash. Suppose I have $500 in cash in my pocket when the government suddenly announces it has printed up enough extra dollar bills to double the economy's cash supply. With Y and V unchanged, doubling the money supply doubles the price level. The $500 in my pocket will buy only as much after the government's money-printing spree as $250 would have bought before. The situation is as if the government levied a special one-time 50 percent tax on cash holdings.

Where did the 250 real dollars in my pocket go? The government has them: It now has 500 newly printed dollars, even if each of them is worth half a preinflation dollar in real terms. (See Figure 8.7.) Clearly, printing money can be easier than imposing a 50 percent explicit tax. To collect an explicit tax, a government needs an entire wealth-tracking, money-collecting, compliance-monitoring bureaucracy. To print money, all the government needs is a printing press, some ink, some paper, and a working connection to the electric power grid.

Almost everyone agrees that this inflation tax — also called *seigniorage* because the right to coin money was originally a right reserved to certain feudal lords, certain seigneurs — is very bad policy. One of the first principles of public finance is that taxes should be broad-based and lie relatively lightly on economic activity. The inflation tax is a heavy tax on a narrow base of economic activity, the activity of holding money. Moreover, the inflation tax is a heavy tax on one small slice of money holding: cash and deposits at the central bank.

inflation tax

The tax implicitly levied on an economy's private sector by the government's exercise of its power to print more money; also called *seigniorage*.

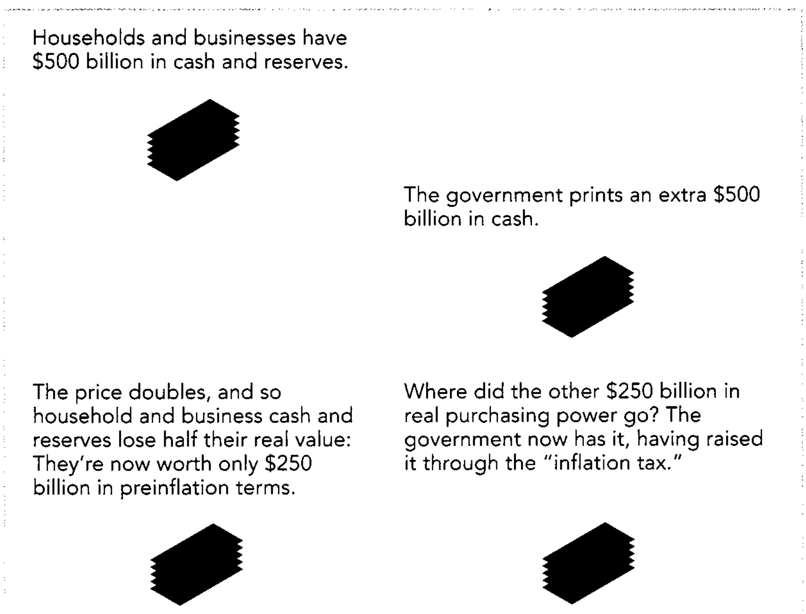


FIGURE 8.7

The Inflation Tax

The "inflation tax" is a way for the government to get command over goods and services just as much as is any other tax. Those who pay the inflation tax are those who hold assets that lose value in the event of inflation.

Other components of the money stock — your checking account, say — are not a potential source of purchasing power for the government through the inflation tax. Suppose that you deposited your money in your checking account and the bank then took that purchasing power and used it to buy an office building. If the price level doubles, you have lost half the real value of your checking account, but the gainer in real terms is not the government. The gainer in real terms is the bank, which now finds the value of the office building it owns is twice as large relative to the value of the money it owes to its depositors. Not only is an inflation tax a bad tax, but its operation disrupts the rest of the financial system as well.

For these reasons, the inflation tax is resorted to only by a government that is falling apart and lacks the administrative capacity to raise money in any other way. Even so, such a government usually finds out afterward that the costs of the inflation tax and hyperinflation outweigh the benefits. Eventually prices rise so rapidly that the monetary system breaks down. People would rather deal with each other in barter terms than use a form of cash whose value is shrinking measurably every day. GDP starts to fall as the economy begins to lose the benefits of the division of labor. In the end the government finds that its currency is next to worthless. It runs the printing presses faster and faster and yet finds that the money it prints buys less and less. At the end of the German hyperinflation of the 1920s, 1 trillion marks were needed to buy what 1 mark had bought less than 10 years before.

Writing in the immediate aftermath of World War I, early-twentieth-century British economist *John Maynard Keynes* in his *Tract on Monetary Reform* put the case against this kind of inflation more eloquently than anybody else we have ever read:

> [Soviet Russia's dictator Vladimir] Lenin is said to have declared that the best way to destroy the capitalist system was to debauch the currency. By a continuing process of inflation, governments can confiscate, secretly and unobserved, an important part of the wealth of their citizens. By this method they not only confiscate, but they confiscate arbitrarily; and, while the process impoverishes many, it actually enriches some. The sight of this arbitrary rearrangement of riches strikes not only at security, but at confidence in the equity of the existing distribution of wealth. Those to whom the system brings windfalls, beyond their desserts and even beyond their expectations or desires, become "profiteers," who are the object of the hatred of the bourgeoisie, whom the inflationism has impoverished, not less than of the proletariat.
>
> As the inflation proceeds and the real value of the currency fluctuates wildly from month to month, all permanent relations between debtors and creditors, which form the ultimate foundation of capitalism, become so utterly disordered as to be almost meaningless; and the process of wealth-getting degenerates into a gamble and a lottery.
>
> Lenin was certainly right. There is no subtler, no surer means of overturning the existing basis of society than to debauch the currency. The process engages all the hidden forces of economic law on the side of destruction, and does it in a manner which not one man in a million is able to diagnose. In the latter stages of the war all the belligerent governments practiced, from necessity or incompetence, what a Bolshevist might have done from design. Even now, when the war is over, most of them continue out of weakness the same malpractices.

RECAP THE COSTS OF INFLATION

The economic costs of expected moderate inflation are small. They are largely the costs of extra trips to the bank and of time and resources wasted in the socially unproductive activity of keeping one's money balance near its target level. The economic costs of moderate unexpected inflation are larger. It redistributes wealth unexpectedly between debtors and creditors and increases risk. Largest, however, are the political costs of moderate inflation: Voters seem to use inflation as a sign that the government's economic policy is not sound.

If you look for high economic costs of inflation, you must turn your attention to episodes of hyperinflation. In a hyperinflation a government without the ability to tax or borrow resorts to printing money to buy goods and services. The inflation rate rises to 20 percent per month or more. The price mechanism breaks down as people resort to barter. And production falls.

Chapter Summary

1. By "money" economists mean something special: wealth in the form of readily spendable purchasing power.
2. Without money it is hard to imagine how our economy could successfully function. The fact that everyone will accept money as payment for goods and services is necessary for the market economy to function.
3. Money is not only a medium of exchange, but also a unit of account — a yardstick that we use to measure values and to specify contracts.
4. Money demand is determined by (a) businesses' and households' desire to hold wealth in the form of readily spendable purchasing power in order to carry out transactions, and (b) businesses' and households' recognition that there is a cost to holding money — wealth in the form of readily spendable purchasing power pays little or no interest.
5. The velocity of money is how many transactions a given piece of money manages to facilitate in a year. The principal determinant of the velocity of money is the economy's "transactions technology": the organization of its financial system.
6. The stock of money is determined by the central bank.
7. The price level is equal to the money stock times the velocity of money divided by the level of real GDP.
8. The inflation rate is equal to the proportional growth rate of the money stock plus the proportional growth rate of velocity minus the proportional growth rate of real GDP.
9. Governments cause hyperinflations because printing money is a way of taxing the public, and a government that cannot tax any other way will be strongly tempted to resort to it.

Key Terms

price level (p. 226)
inflation (p. 226)
deflation (p. 226)
hyperinflation (p. 227)
classical dichotomy (p. 227)
money (p. 228)
medium of exchange (p. 229)
unit of account (p. 229)
money demand (p. 230)
quantity theory of money (p. 231)
velocity (p. 231)
central bank (p. 233)
Federal Reserve (p. 233)
monetary base (p. 233)
open-market operations (p. 234)
money stock (p. 234)
reserve requirements (p. 234)
excess reserves (p. 234)
inflation rate (p. 235)
Fisher effect (p. 238)
expected inflation rate (p. 239)
inflation tax (p. 241)

Analytical Exercises

1. Economists say that a government can raise real revenue — real power to buy goods and services — through the "inflation tax." Who is it that pays this tax? How is it that the government collects it?
2. Suppose that real GDP is \$10,000 billion, the velocity of money is 5, and the money stock is \$2,500 billion. What is the price level?
3. Suppose that the rate of labor-force growth is 1 percent per year, the rate of growth of the efficiency of labor is 3 percent per year, the economy is on its balanced-growth path, and the velocity of money is increasing at 1 percent per year. Suppose that the Chair of the Federal Reserve calls you into her office and asks how fast money growth should be to achieve a constant price level. What answer do you give?
4. Suppose that the rate of labor-force growth is 3 percent per year, the efficiency of labor is stable, and the economy is on its balanced-growth path. Suppose also that the rate of growth of the nominal money stock is 10 percent per year. Do you think that it is likely that the inflation rate is less than 5 percent per year? Why or why not?
5. What would the Federal Reserve have to do if it wanted to raise the monetary base today by \$10 billion? What do you think would happen to the price of short-term government bonds if the Federal Reserve did this? Why?
6. Suppose that the nominal interest rate i is 4 percent, and that the rate of inflation π is 2 percent. Suppose the rate of inflation jumps to 6 percent and remains at that new higher level indefinitely. What do you think will happen to the nominal interest rate i in the long run?

Policy Exercises

1. At the end of December 2003 the U.S. monetary base was \$720 billion. Suppose that the U.S. government decided to raise \$360 billion in real purchasing power (in the dollars of December 2003) through the inflation tax. What do you think would happen to the price level?
2. In the third quarter of 1998 nominal GDP was \$8,574 billion. The monetary base H was \$494 billion; M1 was \$1,072 billion; and M2 was \$4,210 billion. Calculate the velocities of the monetary base, M1, and M2.
3. By the third quarter of 2003 nominal GDP was \$11,107 billion. The monetary base H was \$709 billion; M1 was \$1,286 billion; M2 was \$6,144 billion; and M3 was \$8,956 billion. Calculate the velocities of the monetary base, M1, and M2.
4. Between 1990 and 2004 M1 increased from \$792 billion to \$1,287 billion, while nominal GDP increased from \$5,744 billion to a projected \$11,650 billion. What was the average annual rate of increase of the M1 money stock? Of nominal GDP? Of M1 velocity?
5. Between 1980 and 1990, and between 1990 and 2000, M1 increased from \$409 billion to \$826 billion to \$1,084 billion; M2 rose from \$1,601 billion to \$3,280 billion to \$4,932 billion; and M3 rose from \$1,992 billion to \$4,066 billion to \$7,100 billion. During these same periods nominal GDP rose from \$2,784 billion to \$5,744 billion to \$9,817 billion. Calculate the average annual rates of increase of M1, M2, M3, and nominal GDP between 1980 and 1990 and between 1990 and 2000. Calculate the average annual rates of increase of the velocity of M1, M2, and M3 between 1980 and 1990 and between 1990 and 1998. How constant do these velocity trends appear to be both across time and across different measures of the money stock?
6. Suppose that you were told that the rate of inflation was about to decline significantly over the next decade. Would you expect the velocity of money to rise unusually fast, behave normally, or fall over the course of the decade? Why?

The Interest Rate and Money Demand

.PPENDIX 8a

8a.1 A MORE SYSTEMATIC LOOK AT MONEY DEMAND

In the main body of Chapter 8, we talked of the velocity of money as a constant (or as a slowly moving steady trend). The real world is more complicated. Velocity changes over time, in not always predictable ways, and so inflation is not always proportional to money growth.

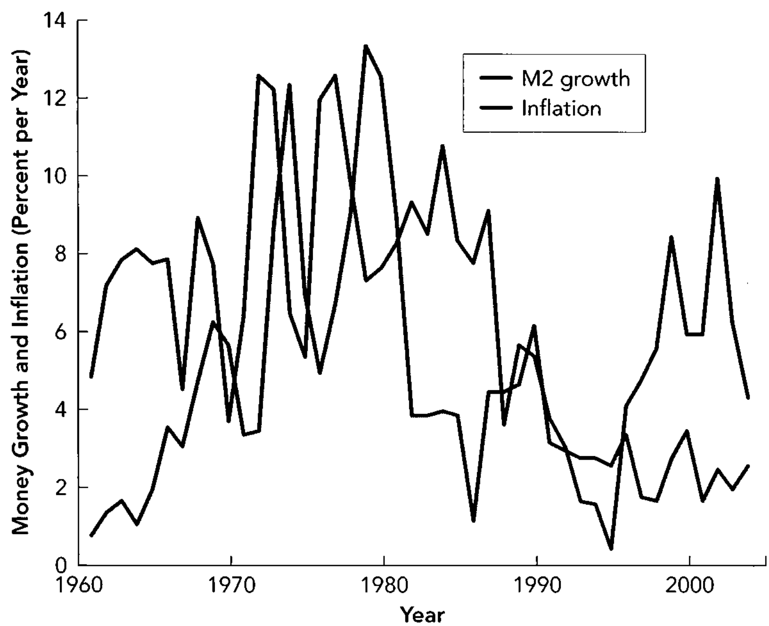
As Figure 8a.1 on page 246 shows, in the 1980s in the United States the inflation rate fell sharply, but the money growth rate stayed relatively high until nearly the end of the decade. In the late 1990s the rate of money growth accelerated, but the inflation rate did not. In both cases shifts in velocity made money growth rates, for a while, not good guides to what inflation was about to be.

One important determinant of velocity is the inflation rate itself, working through the nominal interest rate. When inflation rises, we see the nominal interest rate rise as well. And a higher nominal interest rate reduces demand for money — and so increases the velocity of money.

Why? Money demand reflects the choice households and businesses make about how much of their wealth to hold in readily spendable liquid form (money) versus in other assets. The readily spendable cash in your purse or wallet does not earn interest. Your checking account balances earn little or no interest as well. As a result, their purchasing power over real goods and services erodes at the rate of inflation. The expected real return on keeping your money in readily spendable form is $-\pi^e$, the negative of the expected inflation rate π^e.

By contrast, were you to take a dollar out of your checking account and purchase a financial asset such as a bond, its real return would be the real interest rate r. The difference between the rate of return on other assets and the rate of return on *money balances* is the opportunity cost of holding money. This opportunity cost is the sum of the real interest rate r and the expected inflation rate π^e, that is, the nominal interest rate i. The higher the opportunity cost of holding

FIGURE 8a.1
Money Growth and Inflation Are Not Always Parallel
In the 1960s and 1970s the correlation between money growth and inflation was strong and robust. In the 1980s and 1990s and 2000s this correlation broke down.



Source: The 2004 edition of *The Economic Report of the President* (Washington, DC: Government Printing Office).

money, the lower is the demand for money balances likely to be, as Figure 8a.2 shows.

Economists try to fit these insights into their model by writing down a demand-for-money function:

$$\frac{M^d}{P} = M_y Y - M_i i$$

where M^d is the nominal quantity of money that households and businesses want to hold. It is divided by the overall price level P because what households and businesses really care about is not how many pieces of paper with George Washington's face they have, but how much in the way of goods and services their money holdings can buy. M/P is called "*real money balances.*"

The parameter M_y tells how much in the way of extra real money balances people demand when total income Y goes up. Remember from Chapter 7, the circular flow principle tells us we can also think of income Y as total spending or GDP, so money demand is related to our total spending. Over long periods of time M_y tends to fall as the financial system becomes more sophisticated, the time it takes checks to clear falls, and credit card balance limits rise.

The parameter M_i tells how much households and businesses reduce the amount of wealth they want to hold in the liquid form of money when the nominal interest rate i goes up.

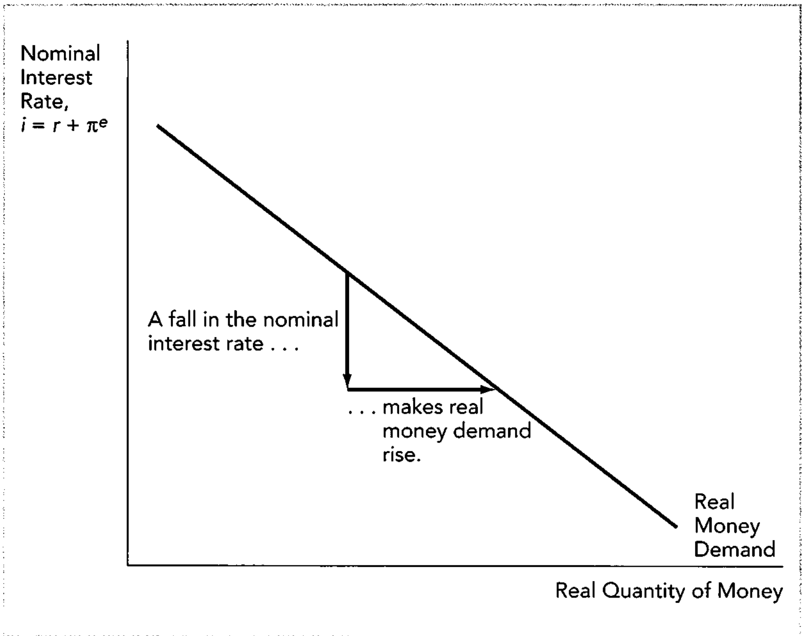


FIGURE 8a.2
The Nominal Interest Rate and Money Demand
When the nominal interest rate falls, the opportunity cost of holding wealth in readily spendable form falls, increasing the real demand for money. The amount by which real money demand rises depends on the size of the parameter M_i.

8a.2 MONEY, PRICES, AND INFLATION

Because the level of money demand depends on the current rate of inflation working through the nominal interest rate, we need to keep track of two equations to determine the behavior of money, prices, and inflation. The first equation comes directly from the money-demand function above. Simply set money demand M^d equal to the money stock M, and solve the equation for P to get

$$P = \frac{M}{M_y Y - M_i i}$$

Then recognize that the nominal interest rate i is equal to the real interest rate r plus the expected inflation rate π^e, and substitute in $r + \pi^e$ for i to get our first equation:

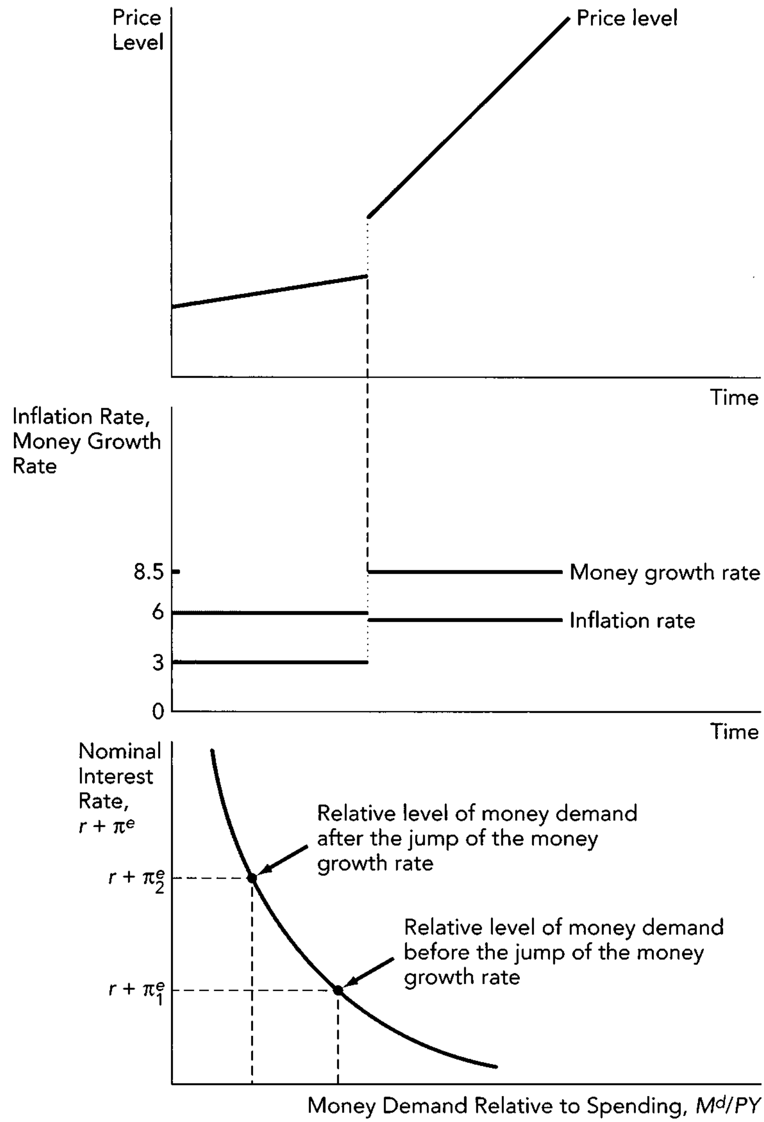
$$P = \frac{M}{M_y Y - M_i r - M_i \pi^e}$$

This tells us that a jump in the expected inflation rate π^e — in the rate at which prices are expected to increase — will cause an immediate and sudden upward jump in the price level P as well.

The second equation we pick up directly from the body of Chapter 8. If inflation is constant at some rate π, and if the proportional change in velocity is constant at some rate v, then

$$\pi = m + v - y$$

FIGURE 8a.3
Effects of an Increase in Money Growth
An increase in the rate of growth of the money stock leads to an immediate jump in the price level, a step-up of the inflation rate, and a fall in the quantity of money demanded as a fraction of nominal GDP. Prices initially increase by 3 percent per year when the money growth rate is 6 percent and the inflation rate is 3 percent. But when the money growth rate jumps to 8.5 percent, the inflation rate jumps to 5.5 percent (middle) so the price level (top) rises more rapidly. As expectations rise to the new higher inflation rate, nominal interest rates rise, decreasing money demand M^d relative to nominal spending PY (bottom) and thus increasing velocity.



Thus if the rate of growth of the money stock is 6 percent per year, the velocity trend is 1 percent per year, and real GDP growth is 4 percent per year, inflation is 3 percent per year.

Suppose that the rate of growth of the money stock suddenly increases permanently from 6 to 8.5 percent per year. When the economy settles down, the new inflation rate will be 2.5 percent per year higher, or 5.5 percent instead of 3 percent per year. But at an inflation rate of 5.5 percent per year, the opportunity cost of holding money is higher. If the real interest rate is stable at 3 percent per year, then the opportunity cost of holding money has just jumped from 6 to 8.5 percent per year.

This higher opportunity cost of holding money — the higher nominal interest rate — will tend to raise the price level suddenly and instantly. That's what our first equation for the price level tells us.

$$P = \frac{M}{M_y Y - M_i r - M_i \pi^e}$$

Now at the moment that the rate of growth of the money stock jumps, the *level* of the money stock does not jump. It is growing faster, but the faster growth has not yet had time to take effect. Our equation thus tells us that the price level will jump suddenly and discontinuously, as is shown in Figure 8a.3! By how much will the price level jump? That depends on how sensitive money demand is to changes in the nominal interest rate — on the parameter M_i. The more sensitive is money demand to the nominal interest rate, the larger will be the sudden jump in the price level.

This sensitivity of the demand for money to the interest rate creates the possibility of expectational instability in the price level and the inflation rate. If a given rate of money growth is thought to be consistent with low inflation, then money demand will be relatively high — and inflation may well be low. But if that rate of money growth is thought for some reason to be a signal of high future inflation, money demand will fall — in which case inflation will be high.