PART ONE

Basic Concepts

CHAPTER

The Central Concepts of Economics

1

The Age of Chivalry is gone; that of sophisters, economists, and calculators has succeeded.

Edmund Burke

A. WHY STUDY ECONOMICS?

As you open this textbook, you may be wondering, Why should I study economics? Let us count the ways.

Many study economics to help them get a good job.

Some people feel they should understand more deeply what lies behind reports on inflation and unemployment.

Or people want to understand what kinds of policies might slow global warming or what it means to say an iPod is "made in China."

For Whom the Bell Tolls

All these reasons, and many more, make good sense. Still, as we have come to realize, there is one overriding reason to learn the basic lessons of economics: All your life—from cradle to grave and beyond—you will run up against the brutal truths of economics.

As a voter, you will make decisions on issues that cannot be understood until you have mastered the rudiments of this subject. Without studying economics, you cannot be fully informed about international trade, tax policy, or the causes of recessions and high unemployment.

Choosing your life's occupation is the most important economic decision you will make. Your future depends not only on your own abilities but also on how national and regional economic forces affect your wages. Also, your knowledge of economics can help you make wise decisions about how to buy a home, pay for your children's education, and set aside a nest egg for retirement. Of course, studying economics will not make you a genius. But without economics the dice of life are loaded against you.

There is no need to belabor the point. We hope you will find that, in addition to being useful, economics is even a fascinating field. Generations of students, often to their surprise, have discovered how stimulating it is to look beneath the surface and understand the fundamental laws of economics.

SCARCITY AND EFFICIENCY: THE TWIN THEMES OF ECONOMICS

Definitions of Economics

Let us begin with a definition of economics. Over the last half-century, the study of economics has expanded to include a vast range of topics. Here are

some of the major subjects that are covered in this book:[1]

- Economics explores the behavior of the financial markets, including interest rates, exchange rates, and stock prices.
- The subject examines the reasons why some people or countries have high incomes while others are poor; it goes on to analyze ways that poverty can be reduced without harming the economy.
- It studies business cycles—the fluctuations in credit, unemployment, and inflation—along with policies to moderate them.
- Economics studies international trade and finance and the impacts of globalization, and it particularly examines the thorny issues involved in opening up borders to free trade.
- It asks how government policies can be used to pursue important goals such as rapid economic growth, efficient use of resources, full employment, price stability, and a fair distribution of income.

This is a long list, but we could extend it many times. However, if we boil down all these definitions, we find one common theme:

Economics is the study of how societies use scarce resources to produce valuable goods and services and distribute them among different individuals.

Scarcity and Efficiency

If we think about the definitions, we find two key ideas that run through all of economics: that goods are scarce and that society must use its resources efficiently. *Indeed, the concerns of economics will not go away because of the fact of scarcity and the desire for efficiency.*

Consider a world without scarcity. If infinite quantities of every good could be produced or if human desires were fully satisfied, what would be the consequences? People would not worry about stretching out their limited incomes because they could have everything they wanted; businesses would not need to fret over the cost of labor or health care; governments would not need to struggle over taxes or spending or pollution because nobody would care. Moreover, since all of us could have as much as we pleased, no one would be concerned about the distribution of incomes among different people or classes.

In such an Eden of affluence, all goods would be free, like sand in the desert or seawater at the beach. All prices would be zero, and markets would be unnecessary. Indeed, economics would no longer be a useful subject.

But no society has reached a utopia of limitless possibilities. Ours is a world of **scarcity,** full of **economic goods.** A situation of scarcity is one in which goods are limited relative to desires. An objective observer would have to agree that, even after two centuries of rapid economic growth, production in the United States is simply not high enough to meet everyone's desires. If you add up all the wants, you quickly find that there are simply not enough goods and services to satisfy even a small fraction of everyone's consumption desires. Our national output would have to be many times larger before the average American could live at the level of the average doctor or major-league baseball player. Moreover, outside the United States, particularly in Africa, hundreds of millions of people suffer from hunger and material deprivation.

Given unlimited wants, it is important that an economy make the best use of its limited resources. That brings us to the critical notion of efficiency. **Efficiency** denotes the most effective use of a society's resources in satisfying people's wants and needs. By contrast, consider an economy with unchecked monopolies or unhealthy pollution or government corruption. Such an economy may produce less than would be possible without these factors, or it may produce a distorted bundle of goods that leaves consumers worse off than they otherwise could be—either situation is an inefficient allocation of resources.

Economic efficiency requires that an economy produce the highest combination of quantity and quality of goods and services given its technology and scarce resources. An economy is producing efficiently when no individual's economic welfare can be improved unless someone else is made worse off.

The essence of economics is to acknowledge the reality of scarcity and then figure out how to organize

[1] This list contains several specialized terms that you will need to understand. If you are not familiar with a particular word or phrase, you should consult the Glossary at the back of this book. The Glossary contains most of the major technical economic terms used in this book. All terms printed in boldface are defined in the Glossary.

society in a way which produces the most efficient use of resources. That is where economics makes its unique contribution.

Microeconomics and Macroeconomics

Economics is today divided into two major subfields, microeconomics and macroeconomics. Adam Smith is usually considered the founder of **microeconomics,** the branch of economics which today is concerned with the behavior of individual entities such as markets, firms, and households. In *The Wealth of Nations* (1776), Smith considered how individual prices are set, studied the determination of prices of land, labor, and capital, and inquired into the strengths and weaknesses of the market mechanism. Most important, he identified the remarkable efficiency properties of markets and explained how the self-interest of individuals working through the competitive market can produce a societal economic benefit. Microeconomics today has moved beyond the early concerns to include the study of monopoly, the role of international trade, finance, and many other vital subjects.

The other major branch of our subject is **macroeconomics,** which is concerned with the overall performance of the economy. Macroeconomics did not even exist in its modern form until 1936, when John Maynard Keynes published his revolutionary *General Theory of Employment, Interest and Money.* At the time, England and the United States were still stuck in the Great Depression of the 1930s, with over one-quarter of the American labor force unemployed. In his new theory Keynes developed an analysis of what causes business cycles, with alternating spells of high unemployment and high inflation. Today, macroeconomics examines a wide variety of areas, such as how total investment and consumption are determined, how central banks manage money and interest rates, what causes international financial crises, and why some nations grow rapidly while others stagnate. Although macroeconomics has progressed far since his first insights, the issues addressed by Keynes still define the study of macroeconomics today.

THE LOGIC OF ECONOMICS

Economic life is an enormously complicated hive of activity, with people buying, selling, bargaining, investing, and persuading. The ultimate purpose of economic science and of this text is to understand this complex undertaking. How do economists go about their task?

Economists use the *scientific approach* to understand economic life. This involves observing economic affairs and drawing upon statistics and the historical record. For complex phenomena like the impacts of budget deficits or the causes of inflation, historical research has provided a rich mine of insights.

Often, economics relies upon analyses and theories. Theoretical approaches allow economists to make broad generalizations, such as those concerning the advantages of international trade and specialization or the disadvantages of tariffs and quotas.

In addition, economists have developed a specialized technique known as *econometrics,* which applies the tools of statistics to economic problems. Using econometrics, economists can sift through mountains of data to extract simple relationships.

Budding economists must also be alert to common fallacies in economic reasoning. Because economic relationships are often complex, involving many different variables, it is easy to become confused about the exact reason behind events or the impact of policies on the economy. The following are some of the common fallacies encountered in economic reasoning:

- *The **post hoc fallacy.*** The first fallacy involves the inference of causality. *The post hoc fallacy occurs when we assume that, because one event occurred before another event, the first event caused the second event.*[2] An example of this syndrome occurred in the Great Depression of the 1930s in the United States. Some people had observed that periods of business expansion were preceded or accompanied by rising prices. From this, they concluded that the appropriate remedy for depression was to raise wages and prices. This idea led to a host of legislation and regulations to prop up wages and prices in an inefficient manner. Did these measures promote economic recovery? Almost surely not. Indeed, they probably slowed recovery, which did not occur until total spending began to rise as the government increased military spending in preparation for World War II.

[2] "Post hoc" is shorthand for *post hoc, ergo propter hoc.* Translated from the Latin, the full expression means "after this, therefore necessarily because of this."

- *Failure to hold other things constant.* A second pitfall is failure to hold other things constant when thinking about an issue. For example, we might want to know whether raising tax rates will raise or lower tax revenues. Some people have put forth the seductive argument that we can eat our fiscal cake and have it too. They argue that cutting tax rates will at the same time raise government revenues and lower the budget deficit. They point to the Kennedy-Johnson tax cuts of 1964, which lowered tax rates sharply and were followed by an increase in government revenues in 1965. Hence, they argue, lower tax rates produce higher revenues.

  Why is this reasoning fallacious? The argument assumes that other things were constant—in particular, it overlooked the growth in the overall economy from 1964 to 1965. Because people's incomes grew during that period, total tax revenues grew even though tax rates were lower. Careful econometric studies indicate that total tax revenues would have been *even higher* in 1965 if tax rates had been held at the same level as in 1964. Hence, this analysis fails to hold other things constant in making the calculations.

  Remember to hold other things constant when you are analyzing the impact of a variable on the economic system.
- *The **fallacy of composition.*** Sometimes we assume that what holds true for part of a system also holds true for the whole. In economics, however, we often find that the whole is different from the sum of the parts. *When you assume that what is true for the part is also true for the whole, you are committing the fallacy of composition.*

  Here are some true statements that might surprise you if you ignored the fallacy of composition: (1) If one farmer has a bumper crop, she has a higher income; if all farmers produce a record crop, farm incomes will fall. (2) If one person receives a great deal more money, that person will be better off; if everyone receives a great deal more money, the society is likely to be worse off. (3) If a high tariff is put on a product such as shoes or steel, the producers in that industry are likely to profit; if high tariffs are put on all products, the economic welfare of the nation is likely to be worse off.

  These examples contain no tricks or magic. Rather, they are the results of systems of interacting individuals. Often the behavior of the aggregate looks very different from the behavior of individual people.

We mention these fallacies only briefly in this introduction. Later, as we introduce the tools of economics, we will provide examples of how inattention to the logic of economics can lead to false and sometimes costly errors. When you reach the end of this book, you can look back to see why each of these paradoxical examples is true.

Positive Economics versus Normative Economics

When considering economic issues, we must carefully distinguish questions of fact from questions of fairness. Positive economics describes the facts of an economy, while normative economics involves value judgments.

Positive economics deals with questions such as: Why do doctors earn more than janitors? Did the North American Free Trade Agreement (NAFTA) raise or lower the incomes of most Americans? Do higher interest rates slow the economy and lower inflation? Although these may be difficult questions to answer, they can all be resolved by reference to analysis and empirical evidence. That puts them in the realm of positive economics.

Normative economics involves ethical precepts and norms of fairness. Should unemployment be raised to ensure that price inflation does not become too rapid? Should the United States negotiate further agreements to lower tariffs on imports? Has the distribution of income in the United States become too unequal? There are no right or wrong answers to these questions because they involve ethics and values rather than facts. While economic analysis can *inform* these debates by examining the likely consequences of alternative policies, the answers can be resolved only by discussions and debates over society's fundamental values.

COOL HEADS AT THE SERVICE OF WARM HEARTS

Economics has, over the last century, grown from a tiny acorn into a mighty oak. Under its spreading branches we find explanations of the gains from international trade, advice on how to reduce

unemployment and inflation, formulas for investing your retirement funds, and proposals to auction limited carbon dioxide emissions permits to help slow global warming. Throughout the world, economists are laboring to collect data and improve our understanding of economic trends.

You might well ask, What is the purpose of this army of economists measuring, analyzing, and calculating? *The ultimate goal of economic science is to improve the living conditions of people in their everyday lives.* Increasing the gross domestic product is not just a numbers game. Higher incomes mean good food, warm houses, and hot water. They mean safe drinking water and inoculations against the perennial plagues of humanity.

Higher incomes produce more than food and shelter. Rich countries have the resources to build schools so that young people can learn to read and develop the skills necessary to use modern machinery and computers. As incomes rise further, nations can afford scientific research to determine agricultural techniques appropriate for a country's climate and soils or to develop vaccines against local diseases. With the resources freed up by economic growth, people have free time for artistic pursuits, such as poetry and music, and the population has the leisure time to read, to listen, and to perform. Although there is no single pattern of economic development, and cultures differ around the world, freedom from hunger, disease, and the elements is a universal human goal.

But centuries of human history also show that warm hearts alone will not feed the hungry or heal the sick. A free and efficient market will not necessarily produce a distribution of income that is socially acceptable. Determining the best route to economic progress or an equitable distribution of society's output requires cool heads that objectively weigh the costs and benefits of different approaches, trying as hard as humanly possible to keep the analysis free from the taint of wishful thinking. Sometimes, economic progress will require shutting down an outmoded factory. Sometimes, as when centrally planned countries adopted market principles, things get worse before they get better. Choices are particularly difficult in the field of health care, where limited resources literally involve life and death.

You may have heard the saying, "From each according to his ability, to each according to his need." Governments have learned that no society can long operate solely on this utopian principle. To maintain a healthy economy, governments must preserve incentives for people to work and to save.

Societies can support the unemployed for a while, but when unemployment insurance pays too much for too long, people may come to depend upon the government and stop looking for work. If they begin to believe that the government owes them a living, this may dull the cutting edge of enterprise. Just because government programs pursue lofty goals cannot exempt them from careful scrutiny and efficient management.

Society must strive to combine the discipline of the marketplace with the compassion of social programs. By using cool heads to inform warm hearts, economic science can do its part in finding the appropriate balance for an efficient, prosperous, and just society.

B. THE THREE PROBLEMS OF ECONOMIC ORGANIZATION

Every human society—whether it is an advanced industrial nation, a centrally planned economy, or an isolated tribal nation—must confront and resolve three fundamental economic problems. Every society must have a way of determining *what* commodities are produced, *how* these goods are made, and *for whom* they are produced.

Indeed, these three fundamental questions of economic organization—***what, how,* and *for whom***—are as crucial today as they were at the dawn of human civilization. Let's look more closely at them:

- *What* commodities are produced and in what quantities? A society must determine how much of each of the many possible goods and services it will make and when they will be produced. Will we produce pizzas or shirts today? A few high-quality shirts or many cheap shirts? Will we use scarce resources to produce many consumption goods (like pizzas)? Or will we produce fewer consumption goods and more investment goods (like pizza-making machines), which will boost production and consumption tomorrow?
- *How* are goods produced? A society must determine who will do the production, with what resources, and what production techniques they will use. Who farms and who teaches? Is electricity

generated from oil, from coal, or from the sun? Will factories be run by people or robots?

- *For whom* are goods produced? Who gets to eat the fruit of economic activity? Is the distribution of income and wealth fair and equitable? How is the national product divided among different households? Are many people poor and a few rich? Do high incomes go to teachers or athletes or autoworkers or venture capitalists? Will society provide minimal consumption to the poor, or must people work if they are to eat?

MARKET, COMMAND, AND MIXED ECONOMIES

What are the different ways that a society can answer the questions of *what, how,* and *for whom?* Different societies are organized through *alternative economic systems,* and economics studies the various mechanisms that a society can use to allocate its scarce resources.

We generally distinguish two fundamentally different ways of organizing an economy. At one extreme, government makes most economic decisions, with those on top of the hierarchy giving economic commands to those further down the ladder. At the other extreme, decisions are made in markets, where individuals or enterprises voluntarily agree to exchange goods and services, usually through payments of money. Let's briefly examine each of these two forms of economic organization.

In the United States, and increasingly around the world, most economic questions are settled by the market mechanism. Hence their economic systems are called market economies. A **market economy** is one in which individuals and private firms make the major decisions about production and consumption. A system of prices, of markets, of profits and losses, of incentives and rewards determines *what, how,* and *for whom.* Firms produce the commodities that yield the highest profits (the *what*) by the techniques of production that are least costly (the *how*). Consumption is determined by individuals' decisions about how to spend the wages and property incomes generated by their labor and property ownership (the *for whom*). The extreme case of a market economy, in which the government keeps its hands off economic decisions, is called a **laissez-faire** economy.

By contrast, a **command economy** is one in which the government makes all important decisions about production and distribution. In a command economy, such as the one which operated in the Soviet Union during most of the twentieth century, the government owns most of the means of production (land and capital); it also owns and directs the operations of enterprises in most industries; it is the employer of most workers and tells them how to do their jobs; and it decides how the output of the society is to be divided among different goods and services. In short, in a command economy, the government answers the major economic questions through its ownership of resources and its power to enforce decisions.

No contemporary society falls completely into either of these polar categories. Rather, all societies are **mixed economies,** with elements of market and command.

Economic life is organized either through hierarchical command or decentralized voluntary markets. Today most decisions in the United States and other high-income economies are made in the marketplace. But the government plays an important role in overseeing the functioning of the market; governments pass laws that regulate economic life, produce educational and police services, and control pollution. Most societies today operate mixed economies.

C. SOCIETY'S TECHNOLOGICAL POSSIBILITIES

Every gun that is made, every warship launched, every rocket fired signifies, in the final sense, a theft from those who hunger and are not fed.

President Dwight D. Eisenhower

Each economy has a stock of limited resources—labor, technical knowledge, factories and tools, land, energy. In deciding *what* and *how* things should be produced, the economy is in reality deciding how to allocate its resources among the thousands of different possible commodities and services. How much land will go into growing wheat? Or into housing the population? How many factories will produce computers? How many will make pizzas? How many children will grow up to play professional sports or to be professional economists or to program computers?

Faced with the undeniable fact that goods are scarce relative to wants, an economy must decide

how to cope with limited resources. It must choose among different potential bundles of goods (the *what*), select from different techniques of production (the *how*), and decide in the end who will consume the goods (the *for whom*).

INPUTS AND OUTPUTS

To answer these three questions, every society must make choices about the economy's inputs and outputs. **Inputs** are commodities or services that are used to produce goods and services. An economy uses its existing technology to combine inputs to produce outputs. **Outputs** are the various useful goods or services that result from the production process and are either consumed or employed in further production. Consider the "production" of pizza. We say that the eggs, flour, heat, pizza oven, and chef's skilled labor are the inputs. The tasty pizza is the output. In education, the inputs are the time of the faculty and students, the laboratories and classrooms, the textbooks, and so on, while the outputs are informed, productive, and well-paid citizens.

Another term for inputs is **factors of production.** These can be classified into three broad categories: land, labor, and capital.

- *Land*—or, more generally, natural resources—represents the gift of nature to our societies. It consists of the land used for farming or for underpinning houses, factories, and roads; the energy resources that fuel our cars and heat our homes; and the nonenergy resources like copper and iron ore and sand. In today's congested world, we must broaden the scope of natural resources to include our environmental resources, such as clean air and drinkable water.
- *Labor* consists of the human time spent in production—working in automobile factories, writing software, teaching school, or baking pizzas. Thousands of occupations and tasks, at all skill levels, are performed by labor. It is at once the most familiar and the most crucial input for an advanced industrial economy.
- *Capital* resources form the durable goods of an economy, produced in order to produce yet other goods. Capital goods include machines, roads, computers, software, trucks, steel mills, automobiles, washing machines, and buildings. As we will see later, the accumulation of specialized capital goods is essential to the task of economic development.

Restating the three economic problems in these terms, society must decide (1) *what* outputs to produce, and in what quantity; (2) *how,* or with what inputs and techniques, to produce the desired outputs; and (3) *for whom* the outputs should be produced and distributed.

THE PRODUCTION-POSSIBILITY FRONTIER

We learn early in life that we can't have everything. "You can have chocolate or vanilla ice cream. No, not both," we might hear. Similarly, the consumption opportunities of countries are limited by the resources and the technologies available to them.

The need to choose among limited opportunities is dramatized during wartime. In debating whether the United States should invade Iraq in 2003, people wanted to know how much the war would cost. The administration said it would cost only $50 billion, while some economists said it might cost as much as $2000 billion. These are not just mountains of dollar bills. These numbers represent resources diverted from other purchases. As the numbers began to climb, people naturally asked, Why are we policing Baghdad rather than New York, or repairing the electrical system in the Middle East rather than in the U.S. Midwest? People understand, as did former general and president Eisenhower, that when output is devoted to military tasks, there is less available for civilian consumption and investment.

Let us dramatize this choice by considering an economy which produces only two economic goods, guns and butter. The guns, of course, represent military spending, and the butter stands for civilian spending. Suppose that our economy decides to throw all its energy into producing the civilian good, butter. There is a maximum amount of butter that can be produced per year. The maximal amount of butter depends on the quantity and quality of the economy's resources and the productive efficiency with which they are used. Suppose 5 million pounds of butter is the maximum amount that can be produced with the existing technology and resources.

At the other extreme, imagine that all resources are instead devoted to the production of guns. Again, because of resource limitations, the economy can produce only a limited quantity of guns. For this example, assume that the economy can produce 15,000 guns of a certain kind if no butter is produced.

Alternative Production Possibilities

Possibilities	Butter (millions of pounds)	Guns (thousands)
A	0	15
B	1	14
C	2	12
D	3	9
E	4	5
F	5	0

TABLE 1-1. Limitation of Scarce Resources Implies the Guns-Butter Tradeoff

Scarce inputs and technology imply that the production of guns and butter is limited. As we go from A to B . . . to F, we are transferring labor, machines, and land from the gun industry to butter and can thereby increase butter production.

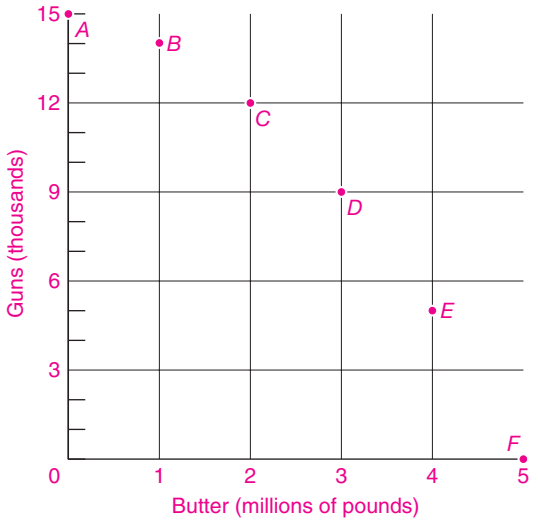

FIGURE 1-1. The Production Possibilities in a Graph

This figure displays the alternative combinations of production pairs from Table 1-1.

These are two extreme possibilities. In between are many others. If we are willing to give up some butter, we can have some guns. If we are willing to give up still more butter, we can have still more guns.

A schedule of possibilities is given in Table 1-1. Combination F shows the extreme, where all butter and no guns are produced, while A depicts the opposite extreme, where all resources go into guns. In between—at E, D, C, and B—increasing amounts of butter are given up in return for more guns.

How, you might well ask, can a nation turn butter into guns? Butter is transformed into guns not physically but by the alchemy of diverting the economy's resources from one use to the other.

We can represent our economy's production possibilities more vividly in the diagram shown in Figure 1-1. This diagram measures butter along the horizontal axis and guns along the vertical one. (If you are unsure about the different kinds of graphs or about how to turn a table into a graph, consult the appendix to this chapter.) We plot point *F* in Figure 1-1 from the data in Table 1-1 by counting over 5 butter units to the right on the horizontal axis and going up 0 gun units on the vertical axis; similarly, *E* is obtained by going 4 butter units to the right and going up 5 gun units; and finally, we get *A* by going over 0 butter units and up 15 gun units.

If we fill in all intermediate positions with new green-colored points representing all the different combinations of guns and butter, we have the continuous green curve shown as the *production-possibility frontier,* or *PPF*, in Figure 1-2.

The **production-possibility frontier** (or ***PPF***) shows the maximum quantity of goods that can be efficiently produced by an economy, given its technological knowledge and the quantity of available inputs.

Applying the PPF *to Society's Choices*

The *PPF* is the menu of choices that an economy has to choose from. Figure 1-2 shows a choice between guns and butter, but this concept can be applied to a broad range of economic choices. Thus the more resources the government uses to spend on public highways, the less will be left to produce private goods like houses; the more we choose to consume of food, the less we can consume of clothing; the more an economy consumes today, the less can be its production of capital goods to turn out more consumption goods in the future.

The graphs in Figures 1-3 to 1-5 present some important applications of *PPF*s. Figure 1-3 shows the effect of economic growth on a country's production possibilities. An increase in inputs, or improved technological knowledge, enables a country to produce more of all goods and services, thus shifting

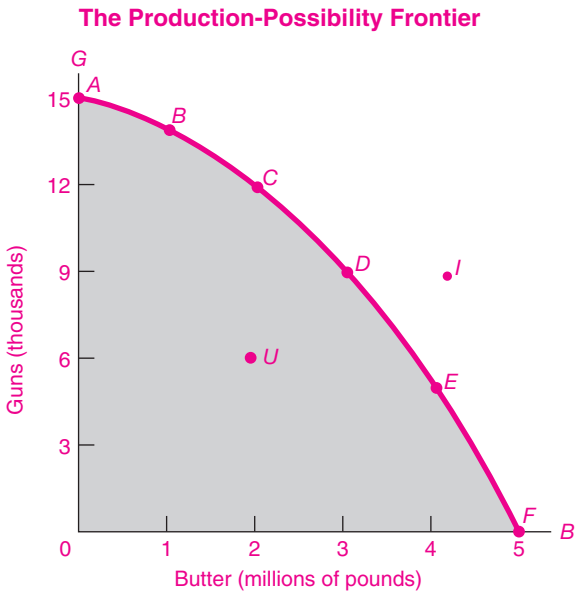

FIGURE 1-2. A Smooth Curve Connects the Plotted Points of the Numerical Production Possibilities

This frontier shows the schedule along which society can choose to substitute guns for butter. It assumes a given state of technology and a given quantity of inputs. Points outside the frontier (such as point *I*) are infeasible or unattainable. Any point inside the curve, such as *U,* indicates that the economy has not attained productive efficiency, as is the case, for instance, when unemployment is high during severe business cycles.

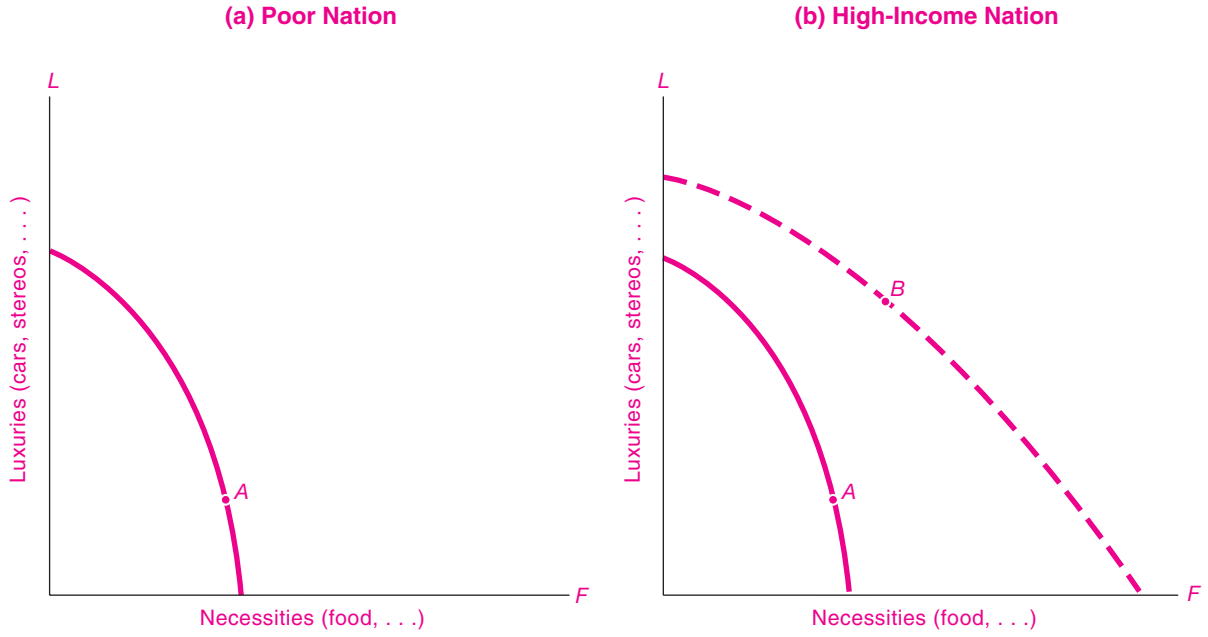

FIGURE 1-3. Economic Growth Shifts the *PPF* Outward

(**a**) Before development, the nation is poor. It must devote almost all its resources to food and enjoys few comforts. (**b**) Growth of inputs and technological change shift out the *PPF.* With economic growth, a nation moves from *A* to *B,* expanding its food consumption little compared with its increased consumption of luxuries. It can increase its consumption of both goods if it desires.

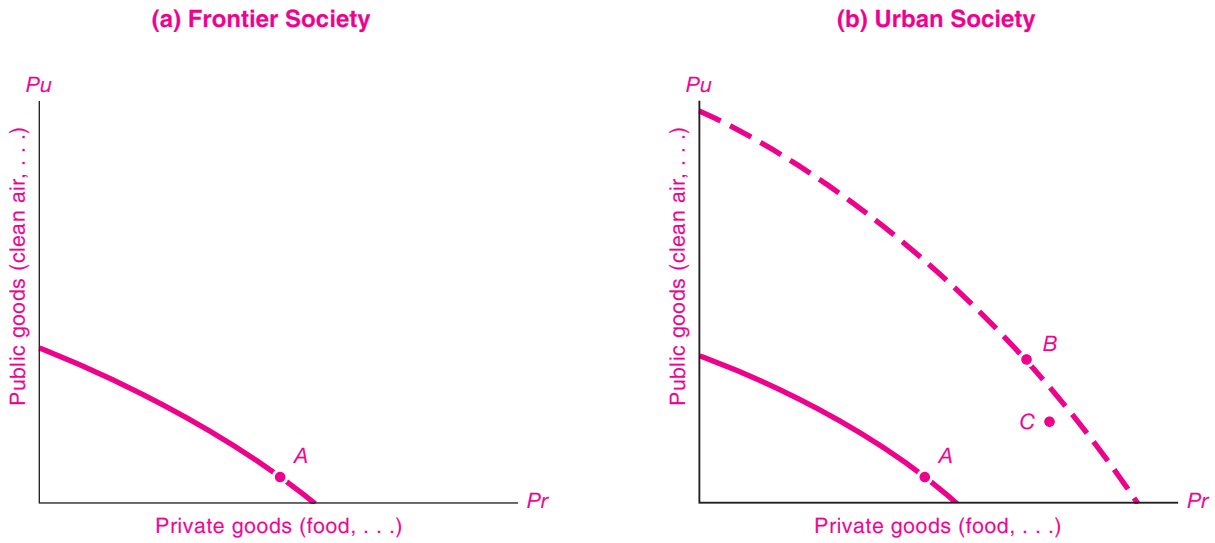

FIGURE 1-4. Economies Must Choose between Public Goods and Private Goods

(a) A poor frontier society lives from hand to mouth, with little left over for public goods like clean air or public health. **(b)** A modern urbanized economy is more prosperous and chooses to spend more of its higher income on public goods and government services (roads, environmental protection, and education).

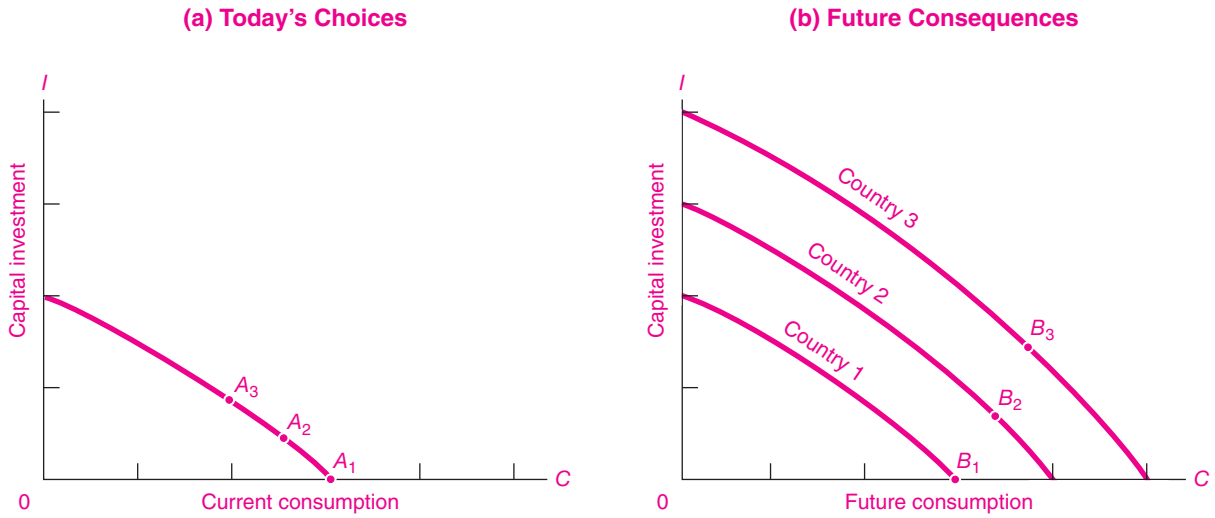

FIGURE 1-5. Investment for Future Consumption Requires Sacrificing Current Consumption

A nation can produce either current-consumption goods (pizzas and concerts) or investment goods (pizza ovens and concert halls). **(a)** Three countries start out even. They have the same *PPF,* shown in the panel on the left, but they have different investment rates. Country 1 does not invest for the future and remains at A_1 (merely replacing machines). Country 2 abstains modestly from consumption and invests at A_2. Country 3 sacrifices a great deal of current consumption and invests heavily. **(b)** In the following years, countries that invest more heavily forge ahead. Thus thrifty Country 3 has shifted its *PPF* far out, while Country 1's *PPF* has not moved at all. Countries that invest heavily can have *both* higher investment and consumption in the future.

out the *PPF*. The figure also illustrates that poor countries must devote most of their resources to food production while rich countries can afford more luxuries as productive potential increases.

Figure 1-4 depicts the choice between private goods (bought at a price) and public goods (paid for by taxes). Poor countries can afford little of public goods like public health and primary education. But with economic growth, public goods as well as environmental quality take a larger share of output.

Figure 1-5 portrays an economy's choice between (*a*) current-consumption goods and (*b*) investment in capital goods (machines, factories, etc.). By sacrificing current consumption and producing more capital goods, a nation's economy can grow more rapidly, making possible more of *both* goods (consumption and investment) in the future.

Be Not Time's Fool

The great American poet Carl Sandburg wrote, "Time is the coin of your life. It is the only coin you have, and only you can determine how it will be spent. Be careful lest you let other people spend it for you." This emphasizes that one of the most important decisions that people confront is how to use their time.

We can illustrate this choice using the production-possibility frontier. For example, as a student, you might have 10 hours to study for upcoming tests in both economics and history. If you study only history, you will get a high grade there and do poorly in economics, and vice versa. Treating the grades on the two tests as the "output" of your studying, sketch out the *PPF* for grades, given your limited time resources. Alternatively, if the two student commodities are "grades" and "fun," how would you draw this *PPF*? Where are you on this frontier? Where are your lazy friends?

Recently, the United States collected data on how Americans use their time. Keep a diary of your time use for two or three days. Then go to *www.bls.gov/tus/home.htm* and compare how you spend your time with the results for other people.

Opportunity Costs

When Robert Frost wrote of the road not taken, he pointed to one of the deepest concepts of economics, *opportunity cost*. Because our resources are limited, we must decide how to allocate our incomes or time. When you decide whether to study economics, buy a car, or go to college, you will give something up—there will be a forgone opportunity. The next-best good that is forgone represents the opportunity cost of a decision.

The concept of opportunity cost can be illustrated using the *PPF*. Examine the frontier in Figure 1-2, which shows the tradeoff between guns and butter. Suppose the country decides to increase its gun purchases from 9000 guns at *D* to 12,000 units at *C*. What is the opportunity cost of this decision? You might calculate the cost in dollar terms. But in economics we always need to "pierce the veil" of money to examine the *real* impacts of alternative decisions. On the most fundamental level, the opportunity cost of moving from *D* to *C* is the butter that must be given up to produce the extra guns. In this example, the opportunity cost of the 3000 extra guns is 1 million pounds of butter forgone.

Or consider the real-world example of the cost of opening a gold mine near Yellowstone National Park. The developer argues that the mine will have but a small cost because Yellowstone's revenues will hardly be affected. But an economist would answer that the dollar receipts are too narrow a measure of cost. We should ask whether the unique and precious qualities of Yellowstone might be degraded if a gold mine were to operate, with the accompanying noise, water and air pollution, and decline in amenity values for visitors. While the dollar cost might be small, the opportunity cost in lost wilderness values might be large indeed.

In a world of scarcity, choosing one thing means giving up something else. The **opportunity cost** of a decision is the value of the good or service forgone.

Efficiency

Economists devote much of their study to exploring the efficiency of different kinds of market structures, incentives, and taxes. Remember that efficiency means that the economy's resources are being used as effectively as possible to satisfy people's desires. One important aspect of overall economic efficiency is productive efficiency, which is easily pictured in terms of the *PPF*. Efficiency means that the economy is *on* the frontier rather than *inside* the production-possibility frontier.

Productive efficiency occurs when an economy cannot produce more of one good without producing less of another good; this implies that the economy is on its production-possibility frontier.

Let's see why productive efficiency requires being on the *PPF*. Start in the situation shown by point *D* in Figure 1-2. Say the market calls for another million pounds of butter. If we ignored the constraint shown by the *PPF*, we might think it possible to produce more butter without reducing gun production, say, by moving to point *I*, to the right of point *D*. But point *I* is outside the frontier, in the "infeasible" region. Starting from *D*, we cannot get more butter without giving up some guns. Hence point *D* displays productive efficiency, while point *I* is infeasible.

One further point about productive efficiency can be illustrated using the *PPF:* Being on the *PPF* means that producing more of one good inevitably requires sacrificing other goods. When we produce more guns, we are substituting guns for butter. *Substitution* is the law of life in a full-employment economy, and the production-possibility frontier depicts the menu of society's choices.

Waste from Business Cycles and Environmental Degradation. Economies suffer from inefficient use of resources for many reasons. When there are unemployed resources, the economy is not on its production-possibility frontier at all but, rather, somewhere *inside* it. In Figure 1-2, point *U* represents a point inside the *PPF;* at *U*, society is producing only 2 units of butter and 6 units of guns. Some resources are unemployed, and by putting them to work, we can increase our output of all goods; the economy can move from *U* to *D*, producing more butter and more guns, thus improving the economy's efficiency. We can have our guns and eat more butter too.

Historically, one source of inefficiency occurs during business cycles. From 1929 to 1933, in the Great Depression, the total output produced in the American economy declined by 25 percent. The economy did not suffer from an inward shift of the *PPF* because of technological forgetting. Rather, panics, bank failures, bankruptcies, and reduced spending moved the economy *inside* its *PPF*. A decade later, the military expenditures for World War II expanded demand, and output grew rapidly as the economy pushed back to the *PPF*.

Similar situations occur periodically during business-cycle recessions. The latest growth slowdown occurred in 2007–2008 when problems in housing and credit markets spread through the entire economy. The economy's underlying productivity had not suddenly declined during those years. Rather, reduced overall spending pushed the economy temporarily inside its *PPF* for that period.

A different kind of inefficiency occurs when markets are failing to reflect true scarcities, as with environmental degradation. Suppose that an unregulated business decides to dump chemicals in a river, killing fish and ruining recreational opportunities. The firm is not necessarily doing this because it has evil intent. Rather, the prices in the marketplace do not reflect true social priorities—the price on polluting in an unregulated environment is zero rather than the true opportunity cost in terms of lost fish and recreation.

Environmental degradation can also push the economy inside its *PPF*. The situation is illustrated in Figure 1-4(*b*). Because businesses do not face correct prices, the economy moves from point *B* to point *C*. Private goods are increased, but public goods (like clean air and water) are decreased. Efficient regulation of the environment could move northeast back to the dashed efficient frontier.

As we close this introductory chapter, let us return briefly to our opening theme, Why study economics? Perhaps the best answer to the question is a famous one given by Keynes in the final lines of *The General Theory of Employment, Interest and Money:*

> The ideas of economists and political philosophers, both when they are right and when they are wrong, are more powerful than is commonly understood. Indeed the world is ruled by little else. Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually the slaves of some defunct economist. Madmen in authority, who hear voices in the air, are distilling their frenzy from some academic scribbler of a few years back. I am sure that the power of vested interests is vastly exaggerated compared with the gradual encroachment of ideas. Not, indeed, immediately, but after a certain interval; for in the field of economic and political philosophy there are not many who are influenced by new theories after they are twenty-five or thirty years of age, so that the ideas which civil servants and politicians and even agitators apply to current events are not likely to be the newest. But, soon or late, it is ideas, not vested interests, which are dangerous for good or evil.

To understand how the powerful ideas of economics apply to the central issues of human societies—ultimately, this is why we study economics.

SUMMARY

A. Why Study Economics?

1. What is economics? Economics is the study of how societies choose to use scarce productive resources that have alternative uses, to produce commodities of various kinds, and to distribute them among different groups. We study economics to understand not only the world we live in but also the many potential worlds that reformers are constantly proposing to us.
2. Goods are scarce because people desire much more than the economy can produce. Economic goods are scarce, not free, and society must choose among the limited goods that can be produced with its available resources.
3. Microeconomics is concerned with the behavior of individual entities such as markets, firms, and households. Macroeconomics views the performance of the economy as a whole. Through all economics, beware of the fallacy of composition and the post hoc fallacy, and remember to keep other things constant.

B. The Three Problems of Economic Organization

4. Every society must answer three fundamental questions: *what, how,* and *for whom*? *What* kinds and quantities are produced among the wide range of all possible goods and services? *How* are resources used in producing these goods? And *for whom* are the goods produced (that is, what is the distribution of income and consumption among different individuals and classes)?
5. Societies answer these questions in different ways. The most important forms of economic organization today are *command* and *market*. The command economy is directed by centralized government control; a market economy is guided by an informal system of prices and profits in which most decisions are made by private individuals and firms. All societies have different combinations of command and market; all societies are mixed economies.

C. Society's Technological Possibilities

6. With given resources and technology, the production choices between two goods such as butter and guns can be summarized in the *production-possibility frontier* (*PPF*). The *PPF* shows how the production of one good (such as guns) is traded off against the production of another good (such as butter). In a world of scarcity, choosing one thing means giving up something else. The value of the good or service forgone is its opportunity cost.
7. Productive efficiency occurs when production of one good cannot be increased without curtailing production of another good. This is illustrated by the *PPF*. When an economy is on its *PPF*, it can produce more of one good only by producing less of another good.
8. Production-possibility frontiers illustrate many basic economic processes: how economic growth pushes out the frontier, how a nation chooses relatively less food and other necessities as it develops, how a country chooses between private goods and public goods, and how societies choose between consumption goods and capital goods that enhance future consumption.
9. Societies are sometimes inside their production-possibility frontier because of macroeconomic business cycles or microeconomic market failures. When credit conditions are tight or spending suddenly declines, a society moves inside its *PPF* in recessions; this occurs because of macroeconomic rigidities, not because of technological forgetting. A society can also be inside its *PPF* if markets fail because prices do not reflect social priorities, such as with environmental degradation from air and water pollution.

CONCEPTS FOR REVIEW

Fundamental Concepts

scarcity and efficiency
free goods vs. economic goods
macroeconomics and microeconomics
normative vs. positive economics
fallacy of composition, post hoc fallacy
"keep other things constant"

Key Problems of Economic Organization

what, how, and *for whom*
alternative economic systems:
command vs. market
laissez-faire
mixed economies

Choice among Production Possibilities

inputs and outputs
production-possibility frontier (*PPF*)
productive efficiency and inefficiency
opportunity cost

FURTHER READING AND INTERNET WEBSITES

Further Reading

Robert Heilbroner, *The Worldly Philosophers,* 7th ed. (Touchstone Books, 1999), provides a lively biography of the great economists along with their ideas and impact. The authoritative work on the history of economic analysis is Joseph Schumpeter, *History of Economic Analysis* (McGraw-Hill, New York, 1954).

Websites

One of the greatest books of all economics is Adam Smith, *The Wealth of Nations* (many publishers, 1776). Every economics student should read a few pages to get the flavor of his writing. *The Wealth of Nations* can be found at *www.bibliomania.com/NonFiction/Smith/Wealth/index.html.*

Log on to one of the Internet reference sites for economics such as *Resources for Economists on the Internet* (*www.rfe.org*). Browse through some of the sections to familiarize yourself with the site. You might want to look up your college or university, look at recent news in a newspaper or magazine, or check some economic data.

Two sites for excellent analyses of public policy issues in economics are those of the Brookings Institution (*www.brook.edu*) and of the American Enterprise Institute (*www.aei.org*). Each of these publishes books and has policy briefs online.

QUESTIONS FOR DISCUSSION

1. The great English economist Alfred Marshall (1842–1924) invented many of the tools of modern economics, but he was most concerned with the application of these tools to the problems of society. In his inaugural lecture, Marshall wrote:

   > It will be my most cherished ambition to increase the numbers who Cambridge University sends out into the world with cool heads but warm hearts, willing to give some of their best powers to grappling with the social suffering around them; resolved not to rest content till they have opened up to all the material means of a refined and noble life. [*Memorials of Alfred Marshall,* A. C. Pigou, ed. (Macmillan and Co., London, 1925), p. 174, with minor edits.]

   Explain how the cool head might provide the essential positive economic analysis to implement the normative value judgments of the warm heart. Do you agree with Marshall's view of the role of the teacher? Do you accept his challenge?
2. The late George Stigler, an eminent conservative Chicago economist, wrote as follows:

   > No thoroughly egalitarian society has ever been able to construct or maintain an efficient and progressive economic system. It has been universal experience that some system of differential rewards is necessary to stimulate workers. [*The Theory of Price,* 3d ed. (Macmillan, New York, 1966), p. 19.]

   Are these statements positive or normative economics? Discuss Stigler's view in light of Alfred Marshall's quote in question 1. Is there a conflict?
3. Define each of the following terms carefully and give examples: *PPF,* scarcity, productive efficiency, inputs, outputs.
4. Read the special section on time use (p. 13). Then do the exercise in the last paragraph. Construct a table that compares your time use with that of the average American. (For a graphical analysis, see question 5 of the appendix to this chapter.)
5. Assume that Econoland produces haircuts and shirts with inputs of labor. Econoland has 1000 hours of labor available. A haircut requires ½ hour of labor, while a shirt requires 5 hours of labor. Construct Econoland's production-possibility frontier.
6. Assume that scientific inventions have doubled the productivity of society's resources in butter production without altering the productivity of gun manufacture. Redraw society's production-possibility frontier in Figure 1-2 to illustrate the new tradeoff.
7. Some scientists believe that we are rapidly depleting our natural resources. Assume that there are only two inputs (labor and natural resources) producing two goods (concerts and gasoline) with no improvement in society's technology over time. Show what would happen to the *PPF* over time as natural resources are exhausted. How would invention and technological improvement modify your answer? On the basis of this example, explain why it is said that "economic growth is a race between depletion and invention."
8. Say that Diligent has 10 hours to study for upcoming tests in economics and history. Draw a *PPF* for grades, given Diligent's limited time resources. If Diligent

studies inefficiently by listening to loud music and chatting with friends, where will Diligent's grade "output" be relative to the *PPF*? What will happen to the grade *PPF* if Diligent increases study inputs from 10 hours to 15 hours?

9. Consider the *PPF* for clean air and automobile travel.
   a. Explain why unregulated air pollution in automobiles would push a country inside its *PPF*. Illustrate your discussion with a carefully drawn *PPF* for these two goods.
   b. Next explain how putting a price on harmful automobile emissions would increase both goods and move the country to its *PPF*. Illustrate by showing how correcting the "market failure" would change the final outcome.

Appendix 1

HOW TO READ GRAPHS

A picture is worth a thousand words.

Chinese Proverb

Before you can master economics, you must have a working knowledge of graphs. They are as indispensable to the economist as a hammer is to a carpenter. So if you are not familiar with the use of diagrams, invest some time in learning how to read them—it will be time well spent.

What is a *graph?* It is a diagram showing how two or more sets of data or variables are related to one another. Graphs are essential in economics because, among other reasons, they allow us to analyze economic concepts and examine historical trends.

You will encounter many different kinds of graphs in this book. Some graphs show how variables change over time (see, for example, the inside of the front cover); other graphs show the relationship between different variables (such as the example we will turn to in a moment). Each graph in the book will help you understand an important economic relationship or trend.

THE PRODUCTION-POSSIBILITY FRONTIER

The first graph that you encountered in this text was the production-possibility frontier. As we showed in the body of this chapter, the production-possibility frontier, or *PPF*, represents the maximum amounts of a pair of goods or services that can both be produced with an economy's given resources, assuming that all resources are fully employed.

Let's follow up an important application, that of choosing between food and machines. The essential data for the *PPF* are shown in Table 1A-1, which is very much like the example in Table 1-1. Recall that each of the possibilities gives one level of food production and one level of machine production. As the quantity of food produced increases, the production of machines falls. Thus, if the economy produced 10 units of food, it could produce a maximum of 140 machines, but when the output of food is 20 units, only 120 machines can be manufactured.

Production-Possibility Graph

The data shown in Table 1A-1 can also be presented as a graph. To construct the graph, we represent each of the table's pairs of data by a single point on a two-dimensional plane. Figure 1A-1 displays in a graph

Alternative Production Possibilities

Possibilities	Food	Machines
A	0	150
B	10	140
C	20	120
D	30	90
E	40	50
F	50	0

TABLE 1A-1. The Pairs of Possible Outputs of Food and Machines

The table shows six potential pairs of outputs that can be produced with the given resources of a country. The country can choose one of the six possible combinations.

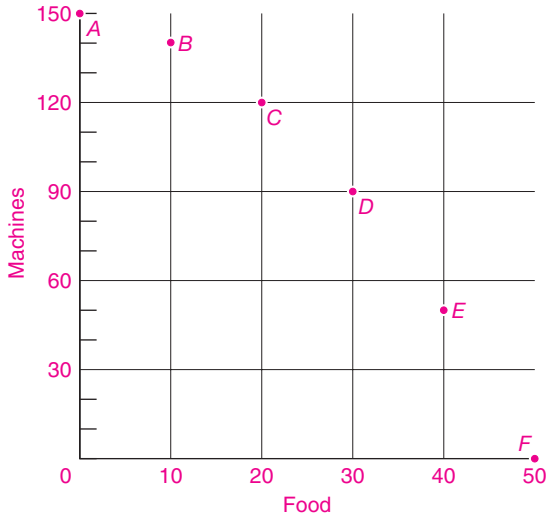

FIGURE 1A-1. Six Possible Pairs of Food-Machine Production Levels

This figure shows the data of Table 1A-1 in graphical form. The data are exactly the same, but the visual display presents the data more vividly.

the relationship between the food and machine outputs shown in Table 1A-1. Each pair of numbers is represented by a single point in the graph. Thus the row labeled "A" in Table 1A-1 is graphed as point *A* in Figure 1A-1, and similarly for points *B*, *C*, and so on.

In Figure 1A-1, the vertical line at left and the horizontal line at the bottom correspond to the two variables—food and machines. A **variable** is an item of interest that can be defined and measured and that takes on different values at different times or places. Important variables studied in economics are prices, quantities, hours of work, acres of land, dollars of income, and so forth.

The horizontal line on a graph is referred to as the *horizontal axis,* or sometimes the *X axis.* In Figure 1A-1, food output is measured on the black horizontal axis. The vertical line is known as the *vertical axis,* or *Y axis.* In Figure 1A-1, it measures the number of machines produced. Point *A* on the vertical axis stands for 150 machines. The lower left-hand corner, where the two axes meet, is called the *origin.* It signifies 0 food and 0 machines in Figure 1A-1.

The Production-Possibility Frontier

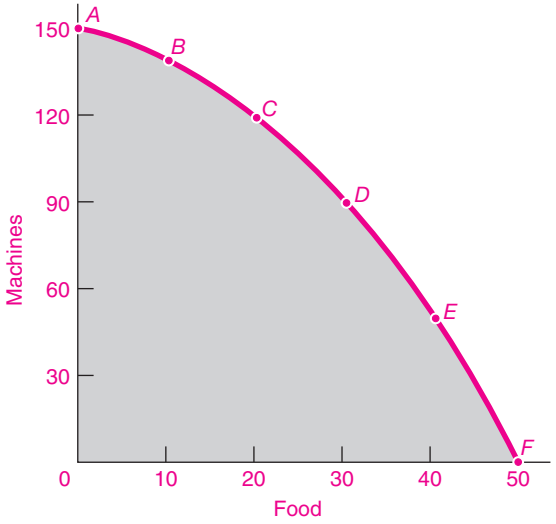

FIGURE 1A-2. A Production-Possibility Frontier

A smooth curve fills in between the plotted points, creating the production-possibility frontier.

A Smooth Curve

In most economic relationships, variables can change by small amounts as well as by the large increments shown in Figure 1A-1. We therefore generally draw economic relationships as continuous curves. Figure 1A-2 shows the *PPF* as a smooth curve in which the points from *A* to *F* have been connected.

By comparing Table 1A-1 and Figure 1A-2, we can see why graphs are so often used in economics. The smooth *PPF* reflects the menu of choice for the economy. It is a visual device for showing what types of goods are available in what quantities. Your eye can see at a glance the relationship between machine and food production.

Slopes and Lines

Figure 1A-2 depicts the relationship between maximum food and machine production. One important way to describe the relationship between two variables is by the slope of the graph line.

The **slope** of a line represents the change in one variable that occurs when another variable changes. More precisely, it is the change in the variable *Y* on the vertical axis per unit change in the variable *X* on the horizontal axis. For example, in Figure 1A-2, say that food production rose from 25 to 26 units. The slope of the curve in Figure 1A-2 tells us the precise change in machinery production that would take place. *Slope is an exact numerical measure of the relationship between the change in* Y *and the change in* X.

We can use Figure 1A-3 to show how to measure the slope of a straight line, say, the slope of the line between points *B* and *D*. Think of the movement from *B* to *D* as occurring in two stages. First comes a horizontal movement from *B* to *C* indicating a 1-unit increase in the *X* value (with no change in *Y*). Second comes a compensating vertical movement up or down, shown as *s* in Figure 1A-3. (The movement of 1 horizontal unit is purely for convenience. The formula holds for movements of any size.) The two-step movement brings us from one point to another on the straight line.

Because the *BC* movement is a 1-unit increase in *X*, the length of *CD* (shown as *s* in Figure 1A-3) indicates the change in *Y* per unit change in *X*. On a graph, this change is called the *slope* of the line *ABDE*.

Often slope is defined as "the rise over the run." The *rise* is the vertical distance; in Figure 1A-3, the rise is the distance from *C* to *D*. The run is the horizontal distance; it is *BC* in Figure 1A-3. The rise over the run in this instance would be *CD* over *BC*. Thus

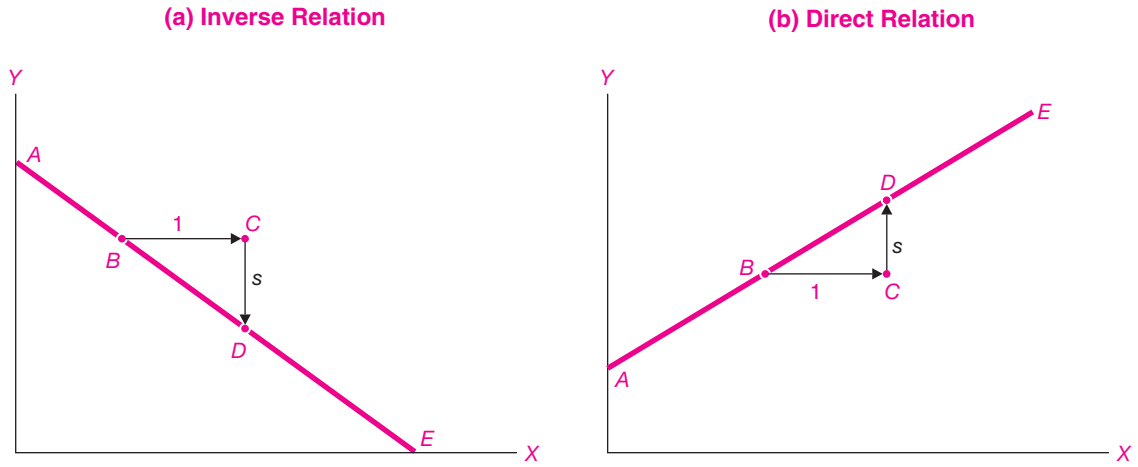

FIGURE 1A-3. Calculation of Slope for Straight Lines

It is easy to calculate slopes for straight lines as "rise over run." Thus in both **(a)** and **(b)**, the numerical value of the slope is rise/run = $CD/BC = s/1 = s$. Note that in **(a)**, CD is negative, indicating a negative slope, or an inverse relationship between X and Y.

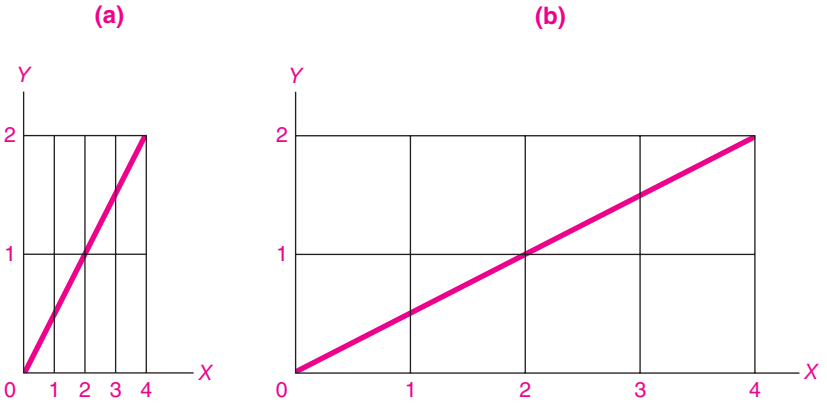

FIGURE 1A-4. Steepness Is Not the Same as Slope

Note that even though **(a)** looks steeper than **(b)**, they display the same relationship. Both have a slope of ½, but the X axis has been stretched out in **(b)**.

the slope of BD is CD/BC. (For those who have studied calculus, question 7 at the end of this appendix relates slopes to derivatives.)

The key points to understand about slopes are the following:

1. The slope can be expressed as a number. It measures the change in Y per unit change in X, or "the rise over the run."
2. If the line is straight, its slope is constant everywhere.
3. The slope of the line indicates whether the relationship between X and Y is direct or inverse. *Direct relationships* occur when variables move in the same direction (that is, they increase or decrease together); *inverse relationships* occur when the variables move in opposite directions (that is, one increases as the other decreases).

Thus a negative slope indicates the X-Y relation is inverse, as it is in Figure 1A-3(a). Why? Because an increase in X calls for a decrease in Y.

People sometimes confuse slope with the appearance of steepness. This conclusion is often but not always valid. The steepness depends on the scale of the graph. Panels (a) and (b) in Figure 1A-4 both

portray exactly the same relationship. But in (*b*), the horizontal scale has been stretched out compared with (*a*). If you calculate carefully, you will see that the slopes are exactly the same (and are equal to ½).

Slope of a Curved Line

A curved or nonlinear line is one whose slope changes. Sometimes we want to know the slope at *a given point,* such as point *B* in Figure 1A-5. We see that the slope at point *B* is positive, but it is not obvious exactly how to calculate the slope.

To find the slope of a smooth curved line at a point, we calculate the slope of the straight line that just touches, but does not cross, the curved line at the point in question. Such a straight line is called a *tangent* to the curved line. Put differently, the slope of a curved line at a point is given by the slope of the straight line that is tangent to the curve at the given point. Once we draw the tangent line, we find the slope of the tangent line with the usual right-angle measuring technique discussed earlier.

To find the slope at point *B* in Figure 1A-5, we simply construct straight line *FBJ* as a tangent to the curved line at point *B*. We then calculate the slope of the tangent as *NJ/MN*. Similarly, the tangent line *GH* gives the slope of the curved line at point *D*.

Another example of the slope of a nonlinear line is shown in Figure 1A-6. This shows a typical micro-economics curve, which is dome-shaped and has a maximum at point *C*. We can use our method of slopes as tangents to see that the slope of the curve is always positive in the region where the curve is rising and negative in the falling region. At the peak or maximum of the curve, the slope is exactly zero. A zero slope signifies that a tiny movement in the *X* variable around the maximum has no effect on the value of the *Y* variable.[1]

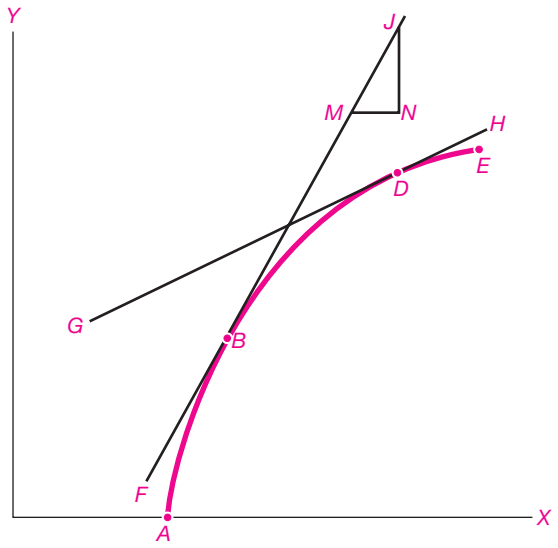

FIGURE 1A-5. Tangent as Slope of Curved Line

By constructing a tangent line, we can calculate the slope of a curved line at a given point. Thus the line *FBMJ* is tangent to smooth curve *ABDE* at point *B*. The slope at *B* is calculated as the slope of the tangent line, that is, as *NJ/MN*.

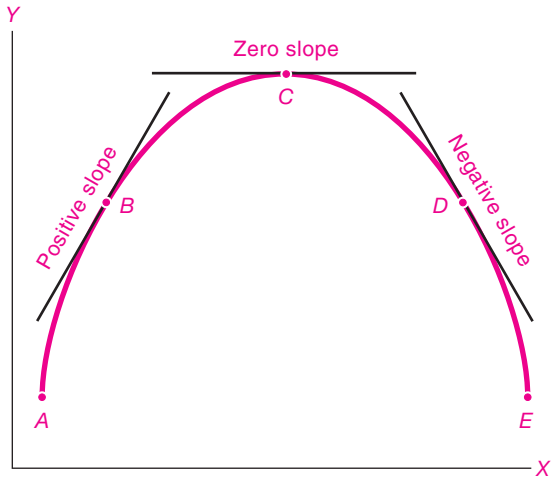

FIGURE 1A-6. Different Slopes of Nonlinear Curves

Many curves in economics first rise, then reach a maximum, then fall. In the rising region from *A* to *C* the slope is positive (see point *B*). In the falling region from *C* to *E* the slope is negative (see point *D*). At the curve's maximum, point *C*, the slope is zero. (What about a U-shaped curve? What is the slope at its minimum?)

[1] For those who enjoy algebra, the slope of a line can be remembered as follows: A straight line (or linear relationship) is written as $Y = a + bX$. For this line, the slope of the curve is *b*, which measures the change in *Y* per unit change in *X*.

A curved line or nonlinear relationship is one involving terms other than constants and the *X* term. An example of a nonlinear relationship is the quadratic equation $Y = (X - 2)^2$. You can verify that the slope of this equation is negative for $X < 2$ and positive for $X > 2$. What is its slope for $X = 2$?

For those who know calculus: A zero slope comes where the derivative of a smooth curve is equal to zero. For example, plot and use calculus to find the zero-slope point of a curve defined by the function $Y = (X - 2)^2$.

Slope as the Marginal Value

One of the most important concepts in economics is *marginal*, which always means "additional" or "extra." For example, we talk about "marginal cost," which means the extra cost that is incurred when a firm produces an extra unit of output. Similarly, in fiscal economics, we discuss the "marginal tax rate," which denotes the additional taxes that are paid when an individual earns an additional dollar of income.

We can calculate the marginal value in a relationship from the slope. Figure 1A-3 shows the marginal values for two straight lines. Look first at Figure 1A-3(*b*). Perhaps the *Y* variable is taxes and the *X* variable is income. Then the slope *s* represents the marginal tax rate. For every unit of *X*, taxes go up by *s* units. For many taxpayers, the marginal tax rate would be between 0.20 and 0.40.

Next examine Figure 1A-3(*a*). Here, the marginal value is negative. This might represent what happens when a particular area is overfished, where the *X* variable is number of boats and the *Y* variable is total fish catch. Because of overfishing, the marginal catch per boat is actually negative because the stock of fish is being depleted.

We can also apply this concept to curved lines. What is the marginal value at point *B* in Figure 1A-5? You can calculate that each *MN* units of *X* produce *NJ* units of *Y*. The marginal value at *B* is also the slope, which is *NJ/MN*. Note that the marginal value is declining as *X* increases because the curve is concave or dome-shaped.

Query: What is the marginal value of the relationship in Figure 1A-6 at point *C*? Make sure you can explain why the marginal value is zero.

Shifts of and Movement along Curves

An important distinction in economics is that between shifts of curves and movement along curves. We can examine this distinction in Figure 1A-7. The inner production-possibility frontier reproduces the *PPF* in Figure 1A-2. At point *D* society chooses to produce 30 units of food and 90 units of machines. If society decides to consume more food with a given *PPF*, then it can *move along* the *PPF* to point *E*. This movement along the curve represents choosing more food and fewer machines.

Suppose that the inner *PPF* represents society's production possibilities for 1990. If we return to the same country in 2000, we see that the *PPF* has *shifted* from the inner 1990 curve to the outer 2000 curve. (This shift would occur because of technological change or because of an increase in labor or capital available.) In the later year, society might choose to be at point *G*, with more food and machines than at either *D* or *E*.

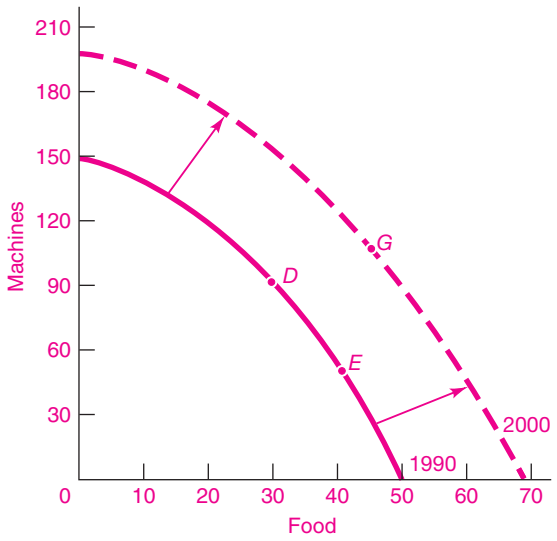

FIGURE 1A-7. Shift of Curves versus Movement along Curves

In using graphs, it is essential to distinguish *movement along* a curve (such as from high-investment *D* to low- investment *E*) from a *shift* of a curve (as from *D* in an early year to *G* in a later year).

The point of this example is that in the first case (moving from *D* to *E*) we see movement along the curve, while in the second case (from *D* to *G*) we see a shift of the curve.

Some Special Graphs

The *PPF* is one of the most important graphs of economics, one depicting the relationship between two economic variables (such as food and machines or guns and butter). You will encounter other types of graphs in the pages that follow.

Time Series Some graphs show how a particular variable has changed over time. Look, for example, at the graphs on the inside front cover of this text.

The left-hand graph shows a time series, since the American Revolution, of a significant macroeconomic variable, the ratio of the federal government debt to total gross domestic product—this ratio is the *debt-GDP ratio.* Time-series graphs have time on the horizontal axis and variables of interest (in this case, the debt-GDP ratio) on the vertical axis. This graph shows that the debt-GDP ratio has risen sharply during every major war.

Scatter Diagrams Sometimes individual data points will be plotted, as in Figure 1A-1. Often, combinations of variables for different years will be plotted. An important example of a scatter diagram from macroeconomics is the *consumption function,* shown in Figure 1A-8. This scatter diagram shows the nation's total disposable income on the horizontal axis and total consumption (spending by households on goods like food, clothing, and housing) on the vertical axis. Note that consumption is very closely linked to income, a vital clue for understanding changes in national income and output.

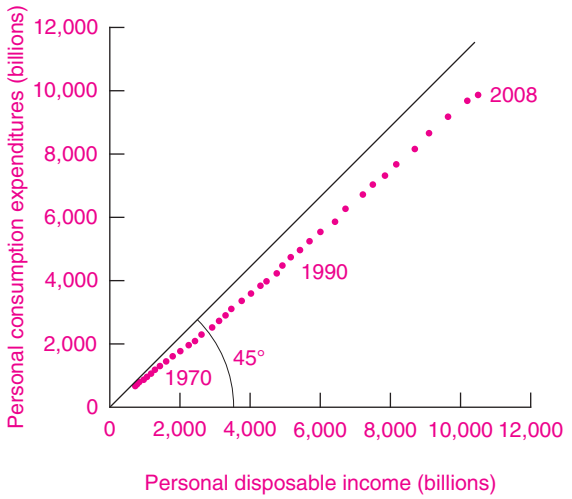

FIGURE 1A-8. Scatter Diagram of Consumption Function Shows Important Macroeconomic Law

The dots show a scatter diagram of income and consumption. Note how close the relationship is between the two. This forms the basis for the *consumption function* of macroeconomics.

Diagrams with More than One Curve Often it is useful to put two curves in the same graph, thus obtaining a "multicurve diagram." The most important example is the *supply-and-demand diagram,* shown in Chapter 3 (see page 55). Such graphs can show two different relationships simultaneously, such as how consumer purchases respond to price (demand) and how business production responds to price (supply). By graphing the two relationships together, we can determine the price and quantity that will hold in a market.

This concludes our brief excursion into graphs. Once you have mastered these basic principles, the graphs in this book, and in other areas, can be both fun and instructive.

SUMMARY TO APPENDIX

1. Graphs are an essential tool of modern economics. They provide a convenient presentation of data or of the relationships among variables.
2. The important points to understand about a graph are: What is on each of the two axes (horizontal and vertical)? What are the units on each axis? What kind of relationship is depicted in the curve or curves shown in the graph?
3. The relationship between the two variables in a curve is given by its slope. The slope is defined as "the rise over the run," or the increase in Y per unit increase in X. If it is upward- (or positively) sloping, the two variables are directly related; they move upward or downward together. If the curve has a downward (or negative) slope, the two variables are inversely related.
4. In addition, we sometimes see special types of graphs: time series, which show how a particular variable moves over time; scatter diagrams, which show observations on a pair of variables; and multicurve diagrams, which show two or more relationships in a single graph.

CONCEPTS FOR REVIEW

Elements of Graphs

horizontal, or *X*, axis
vertical, or *Y*, axis
slope as "rise over run"
slope (negative, positive, zero)
tangent as slope of curved line

Examples of Graphs

time-series graphs
scatter diagrams
multicurve graphs

QUESTIONS FOR DISCUSSION

1. Consider the following problem: After your 8 hours a day of sleep, you have 16 hours a day to divide between leisure and study. Let leisure hours be the *X* variable and study hours be the *Y* variable. Plot the straight-line relationship between all combinations of *X* and *Y* on a blank piece of graph paper. Be careful to label the axes and mark the origin.
2. In question 1, what is the slope of the line showing the relationship between study and leisure hours? Is it a straight line?
3. Let us say that you absolutely need 6 hours of leisure per day, no more, no less. On the graph, mark the point that corresponds to 6 hours of leisure. Now consider a *movement along the curve:* Assume that you decide that you need only 4 hours of leisure a day. Plot the new point.
4. Next show a *shift of the curve:* You find that you need less sleep, so you have 18 hours a day to devote to leisure and study. Draw the new (shifted) curve.
5. As suggested in the special section on time use, keep a diary of your time use by half-hour increments for 3 days; record studying, sleeping, working, leisure, and other uses. Then draw a time production-possibility curve, like Figure 1A-2, between leisure and all other activities. Locate each of your 3 days on the time *PPF.* Then put the average for all Americans on the same graph. How do you compare with the average person?
6. Go to the website of the Bureau of Economic Analysis at *www.bea.gov.* Then click on "Gross Domestic Product." On the next page, click on "Interactive NIPA data." Then click on "Frequently Requested NIPA Tables." Click on "Table 1.2 (Real Gross Domestic Product)," which is the total output of the economy. This will probably come up with the quarterly data.
   a. Construct a graph that shows the time series for real GDP for the last six quarters. Is the general trend upward or downward? (In macroeconomics, we will learn that the slope is downward in recessions.)
   b. Construct a scatter plot showing "Imports" on the vertical axis and "Gross domestic product" on the horizontal axis. Describe the relationship between the numbers. (In macroeconomics, this will be the marginal propensity to import.)
7. *For those who have studied calculus:* The slope of a smooth line or curve is its derivative. The following are the equations for two inverse demand curves (where price is a function of output). For each curve, assume that the function holds only when $P \geq 0$ and $X \geq 0$.
   a. $P = 100 - 5X$
   b. $P = 100 - 20X + 1X^2$

   For each demand curve, determine its slope when $X = 0$ and when $X = 1$. For linear demand curves such as **a**, what is the condition under which the law of downward-sloping demand holds? Is curve **b** concave (like a dome) or convex (like a cup)?
8. The marginal value of a curve is its slope, which is the same as the first derivative of a function. Calculate algebraically the marginal effect of output on price for the inverse demand curves **a** and **b** in question 7. Provide the numerical marginal values at $X = 10$ for both demand curves.