Chapter 2

Tools of Analysis for International Trade Models

Topics to Be Covered

Some Methodological Preliminaries
The Basic Model: Assumptions
The Basic Model: Solutions
Measuring National Welfare
National Supply and Demand

Key Words

Positive analysis
Normative analysis
General equilibrium
Money illusion
Relative price
Nominal price
Production possibility frontier (PPF)
Opportunity (or social) cost
Indifference curve
Community indifference curve (CIC)
Autarky
National supply
National demand

One of the messages of the preceding chapter is that the international economy is extremely complex. All countries of the world take part. Some trade extensively, others very little. Each country is different in terms of its endowment of productive resources and level of economic development. Most countries have many trading partners. Thousands of different types of goods are exchanged. How can all of this activity be understood and explained?

In this chapter and the chapters that follow we seek to answer that question. In particular, in this chapter we begin to build an economic model of a nation that engages in international trade. Once the model, or theory, is constructed, it will be used to answer a number of important questions. For instance, *why does international trade occur?* What are the benefits that are gained, and what are the costs that are incurred? It would seem obvious that there are gains from trade, or else people would

not participate. It seems equally obvious that not everyone within a country gains equally from trade, or else trade would not be the contentious issue it is today.

There are a number of questions related to the characteristics of countries engaged in international trade that we would like our theory to answer. For instance, *What goods will a country import, and what will it export?* This is one of the oldest questions in the theory of international economic relations. And, as we shall see, there are a number of alternative answers. In addition, *What will be the volume of trade?* Is trade likely to be large or small relative to the overall size of the economy? And *What will be the prices at which trade occurs?* One measure of international prices is known as the terms of trade. This measure is defined as the price of a country's exports divided by the price of its imports. As we shall see, changes in a country's terms of trade are closely related to gains from international trade for that country.

Finally, we would like our theory to be able to explain *the effect of trade on payments to various factors of production*. That is, how does international trade affect the level of wages paid to labor or rents paid to owners of capital goods? This is perhaps the most important question we can ask regarding international trade; and yet, at first glance, it would seem that trade has little effect on wages or rents. As groups such as the United Steelworkers of America are quick to remind us, however, trade can have a profound effect. For instance, competition from foreign steel producers has helped lead to large-scale reductions in domestic steel employment and to wage concessions from the union to the domestic industry. And, of course, it is situations such as this that produce opposition to free international trade and call for protection from foreign competition. Hence, we would also like our theory to be able to explain how government can regulate the volume of international trade and what the effects of such regulation might be.

We proceed in our development of the theory of international trade as follows: In this chapter we concentrate on the basic elements of economic model building. Our attention will be focused on the economy of a country that lives in isolation from the rest of the world. We study such an economy to understand how prices and outputs are determined in the absence of international trade, so that we can compare these prices and outputs with those that prevail once trade is allowed. In the next two chapters we introduce this country to a world of international trade under differing assumptions about the production characteristics of the country. Beginning with Chapter 6 we show how to incorporate government-imposed restraints on trade into the model and how to analyze the effects of these restraints.

SOME METHODOLOGICAL PRELIMINARIES

An economy is a collection of agents (including individuals and firms) that interact with each other in the exchange of goods and services. In international economics, economies are separated from each other by national boundaries, and countries are treated as economic agents as well. International economics is interested in explaining the interaction of countries in the exchange of goods and services.

Economists often build economic models to help them understand the pattern of economic behavior. An *economic model* is a theoretical description of this behavior. An economic model can take a variety of forms. It can be a purely verbal statement about economic behavior. Verbal models are the most important of all, because it is through these that economists can pass along their understanding of economic phenomena to the general public. Because the audience is the general public, verbal models are usually very simple. But to be truly useful, a model must be capable of application to a variety of circumstances. Thus, the challenge of building a good verbal model is to ensure that underlying the model is a formal structure that is consistent in its internal logic. And since mathematics is the formal language of logic, we often find that economists use this tool in formulating their theories.

Mathematical expressions of economic theories can take two forms. They can be geometric, which is the case with most of the models found in this book. The advantages of a geometric

model are that it is a formal mathematical statement, it is relatively simple for most people to understand, and it can be readily manipulated to analyze many different phenomena. A disadvantage of a geometric model is that it is necessarily limited to no more than three dimensions. This restricts the number of variables that can be studied or manipulated at any one time.

Models can also be algebraic. An algebraic model is useful first because it is not hampered by dimensionality limitations. Second, it can be used in conjunction with a computer to conduct a statistical evaluation of economic data or to simulate economic behavior.

Despite differences in their degree of formality, all economic theories have certain common characteristics. Models are abstractions from reality; that is, they employ assumptions about the environment to be studied or the behavior of the agents that allow the economist to make the most precise predictions the theory allows. Theories are necessarily simpler than the real world; not surprisingly, therefore, they are not always correct in their explanation of or predictions about behavior. The late Nobel Prize–winning economist, Milton Friedman, argued that a test of the validity of a theory is not to question the plausibility of the assumptions employed but rather to compare the predictions of the theory with experience.* Theories can be rejected if their predictions are frequently contradicted, or if they are correct less often than the predictions of alternative theories. This is a methodology that is common to all sciences. However, it is particularly difficult to apply in economics—because economists can rarely carry out controlled experiments.

Consider the following example: From introductory microeconomics we know that (under the usual assumptions about demand and supply) the effect of the imposition of a tax on a product is to raise its price. Suppose a 50 cents per gallon tax on gasoline is imposed by the government and shortly thereafter the price of gasoline falls. Is economic theory wrong? According to a naive interpretation of the criterion for judging economic theories discussed earlier, the answer would seem to be yes. However, it is simple to show that if, at the same time the tax is imposed, the demand for gasoline is falling (due to a recession or to a nationwide green initiative to reduce the carbon footprint of the country), gasoline prices could fall. Ideally, then, we would like our theory to be a complete enough picture of the world so that we can distinguish among the effects of various and possibly conflicting forces at work on the economy. Once these forces have been identified, the theory is stated in terms of the effect one variable has on the economy, holding all other variables constant. Going back to our example, the correct way to express our theory is that, all else constant, a tax on cigarettes will lead to an increase in their price.

As we shall see in the coming chapters, real-world phenomena do not always square well with the predictions made by our theories regarding international trade. In some cases, this lack of agreement will cause us to search for factors we have not properly taken into account. In other cases, it will cause us to develop new theories.

A second common feature of all theories in economics is that they can be used to conduct both **positive** and **normative analysis**. Positive analysis refers to the attempt to answer descriptive questions: What is the effect of a tax on cigarettes on the amount of cigarettes produced or consumed? In normative analysis, the effort is to answer questions that are more prescriptive in nature: Should the government impose a tax on cigarettes? The answers to the first type of question are usually noncontroversial, especially among economists. Any two economists working with the same model should reach the same conclusions (although different models may give very different answers). Answers to normative questions depend much more on value judgments and could differ strongly from one economist to the next. In this book we try to point out where and when our own value judgments enter into the analysis presented. We shall also try to give an evenhanded account of opposing viewpoints on the optimality of various government policies related to the international economy.

Positive analysis
Analysis that studies economic behavior without making recommendations about what is or ought to be.

Normative analysis
Economic analysis that makes value judgments regarding what is or should be.

* Milton Friedman, "The Methodology of Positive Economics," in *Essays in Positive Economics* (Chicago: University of Chicago Press, 1953), 3–43.

THE BASIC MODEL: ASSUMPTIONS

General equilibrium
Simultaneous equilibrium in all the markets of an economy.

We begin now to build a basic model of an economy that engages in international trade. The model we build is known as a **general equilibrium** model. By *general equilibrium* we mean that production, consumption, prices, and (eventually) international trade are all determined simultaneously for all goods produced and consumed in the country.

There are many advantages to a general equilibrium model. The principal benefit is that such a model allows us to keep track of what is happening to all sectors of an economy as it engages in trade. A chief drawback of general equilibrium models is that if we were truly interested in exploring simultaneous changes in the production and the consumption and the prices of *all* goods that could potentially be produced or consumed in any economy, we would quickly find that our model is too large and complicated to be studied effectively. Thus, we are forced to make some simplifying assumptions. We begin by making seven.

Assumption 1

All economic agents, in particular firms and consumers, exhibit rational behavior.

Economic agents are goal oriented. Firms make production decisions in an attempt to maximize profits. Consumers maximize utility (satisfaction) through their consumption decisions. This is a fundamental tenet in economics. If this assumption does not hold, then economic behavior would be random and hence inexplicable.

Assumption 2

There are only two countries in the world, America (denoted by the letter A) and Britain (denoted by the letter B). There are also only two goods in the world, soybeans (denoted by the letter S) and textiles (denoted by the letter T). Each good is identical in its characteristics in the two countries, and some of each is always consumed in each country.

Both parts of this assumption are made for geometric convenience. As it turns out, general equilibrium models can be expressed algebraically, wherein both the number of countries and the number of goods can exceed two by any arbitrary amount. All the conclusions of this chapter carry through in these more general models. However, in some cases the results in chapters to come do not carry through when the number of goods or countries is greater than two. We shall try to indicate where this is true.

Assumption 3

There is *no* **money illusion**.

Money illusion
A situation in which individuals make decisions based on changes in some prices without taking into account changes in others.

That is, we assume that when firms make their production decisions and when consumers make their consumption choices, they take into account the behavior of all prices rather than only a few. Thus, they are not fooled into changing their behavior when nothing "real" in the economy has changed. To make the implications of this assumption more clear, consider the following example.

Suppose a farmer is trying to decide which crop to plant in a given year. He has two choices (say, corn and wheat), each of which he can grow in equal amounts with equal effort.* Suppose that, initially, each product sells for the same price. Under these circumstances, the farmer is indifferent to planting either of these commodities and decides, perhaps by flipping a coin, to grow wheat. Now, just before planting, the farmer learns that the price of corn has doubled. Should he

* For those of you who are familiar with farming, we realize this is a rather contrived and implausible example, but bear with us.

plant corn? The answer is, Not necessarily. First, he should examine what has happened to the price of wheat. He should plant corn instead of wheat if the price of corn has risen by more than the price of wheat. If wheat prices have also doubled, then he is no better off by switching to corn production. If wheat prices have more than doubled, he is worse off by switching to corn. The farmer who looks only at changes in one price without considering changes in others suffers from money illusion.

Consider another example. Suppose that from one year to the next an individual is given a 10 percent increase in his or her salary. An individual with money illusion would think that simply because his or her income had increased in nominal (money) terms, his or her buying power (real income) had also increased. Clearly, this is not necessarily so, because the prices of the goods this person buys could have risen by more than 10 percent.

How can we represent the assumption that firms and individuals do not suffer from money illusion when they operate in the economy? The answer is to require that all economic decisions (i.e., decisions to produce or to consume) are based on **relative** rather than **nominal prices**. Nominal prices refer to money prices, such as the dollar price of soybeans, denoted as P_S, or the dollar price of textiles, P_T. A relative price refers to a price ratio, say P_S/P_T. To understand how relative prices work, consider the following important rule:

Relative price
A ratio of two product prices.

Nominal price
A price expressed in terms of money.

$$\text{If } P_S/P_T = k \text{ (then 1 unit of } S = k \text{ units of } T \text{ (in value)}$$

or

$$1 \text{ unit of } T = 1/k \text{ units of } S \text{ (in value)}$$

For example, suppose that 1 bushel of soybeans costs \$10, and 1 yard of textiles costs \$5. The relative price of soybeans in terms of textiles, P_S/P_T, would be 2. That is, 1 bushel of soybeans could be sold in the market to yield enough cash to purchase 2 yards of textiles. Note further that this would still be true if both prices doubled or changed by any other proportionate factor. Relative prices when one price in the ratio changes by more than the other; in the models presented in the next few chapters movements in relative prices influence economic agents. For an example of how a relative price change affects both consumer and producer behavior see Global Insights 2.1.

We can also illustrate the notion of relative prices graphically. Consider Figure 2.1. On the vertical axis we measure textiles in physical units. On the horizontal axis we measure units of good S, soybeans. Suppose that P_S/P_T equals 2. Suppose further that a farmer produces 10 units of soybeans and sells them all in the market. What is the maximum amount of textiles that could be purchased with the proceeds from this sale? Since soybeans are twice as expensive as textiles,

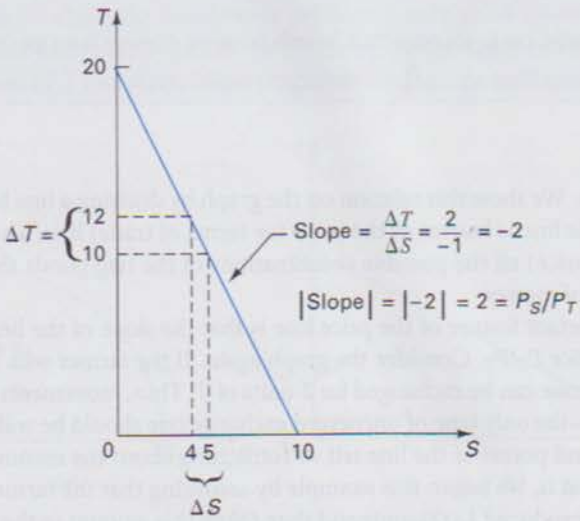

FIGURE 2.1 Example of a Price Line

Global Insights 2.1

World Response to Higher Relative Price of Oil

Throughout 2007 and into 2008 oil prices rose dramatically around the world, and so did the price of gasoline. In many parts of the United States, a gallon of gasoline rose from about $2 per gallon to over $4. This rise in the price of gasoline can be viewed as a relative price change since prices of virtually all other goods did not rise nearly as much over this period. This change in an important relative price had an enormous effect on behavior in the United States and around the world.* In 2008, monthly U.S. consumption of crude oil and petroleum products averaged about 4 percent less than in comparable months the year before. In May 2008, Americans drove 9.7 billion fewer miles than they had a year earlier, a decline of 3.7 percent. Other specific examples of how U.S. consumers responded to the relative price change include the following.

Americans switched automobile purchases away from large cars and pickups to smaller, more fuel-efficient cars, motor scooters, and bicycles. Dealerships quickly sold out of hybrid cars such as the Toyota Prius and placed would-be purchasers on long waiting lists. Ford announced that it would drastically change the mix of cars it produces in its North American assembly plants, away from trucks, SUVs, and other gas guzzlers toward smaller, more fuel-efficient models similar to the ones it produces in Europe and other parts of the world where gasoline prices have been high for decades. Bicycle repair shops reported large increases in business. In record numbers, students enrolled in online college courses rather than drive to attend campus classes. Amtrak train ridership soared and so did other forms of mass-transit ridership. Homeowners around the country increased their purchases of more energy-efficient home appliances.

Around the world, producers also took measures to reduce their use of gasoline and other petroleum products. Domestic and foreign airline companies switched their purchases of airplanes to the most fuel-efficient models on the market. Farmers in the Indian state of Rajasthan switched to camels rather than tractors to pull their plows. In a similar move, farmers in parts of Tennessee switched from tractors to mules. Farmers in Iowa shifted to air drying harvested corn rather than using propane heaters.

These changes show why economists stress the role of changes in relative prices as a motivator of human behavior. By the end of 2008 the relative price of gasoline had fallen dramatically, although it still remains above its pre-spike level, and consumption continues to be lower than it was in 2007. The lower rate of consumption is due in part to the higher rates of unemployment across the country as well as the fuel-saving measures adopted by American consumers. Whether or not energy-saving behavior continues clearly depends on what happens to the relative price of energy, as well as the overall state of the economy in future years.

* These and other examples can be found in "U.S. Retools Economy, Curbing Thirst for Oil," *Wall Street Journal*, August 12, 2008.

the answer is 20 units. We show this relation on the graph by drawing a line between 20 units of T and 10 units of S. This line is known as the price (or terms of trade) line. The price line shows us (for a given relative price) all the possible combinations of the two goods that can be purchased with a fixed amount of money.

The most important feature of the price line is that the slope of the line (in absolute value) tells us the relative price P_S/P_T. Consider the graph again. If the farmer sells 1 unit of S, we know that the resulting revenue can be exchanged for 2 units of T. Thus, movements along the line reflect trades of equal value—the only type of uncoerced exchange one should be willing to make.

Note that the end points of the line tell us something about the income level of the person making the trade. That is, we began this example by assuming that the farmer produced 10 units of S. Suppose he had produced 1,000 units and then taken this amount to the market to sell. What would be the maximum amount of T he could purchase? The answer is, of course, 2,000 units.

Hence, the end points of the price line would be 1,000 on the S axis and 2,000 on the T axis, and the slope of the line connecting these points would again be 2 (in absolute value)—the relative price of S. Thus, for any given level of S (or T) the price line tells us at what rate that good could be exchanged in the market for the other.

Finally, suppose that P_S/P_T rises from 2 to 3. What will be the effect on the price line? It will get steeper. What does this imply? It means that the same amount of S now trades for 3 units of textiles rather than 2 units. That is, T has become relatively cheaper, or, equivalently, S has become relatively more expensive. Hence, graphically, price lines that are steep denote the fact that S is relatively expensive compared with T, while price lines that are flat denote the opposite.

ASSUMPTION 4

In each country, factor endowments are fixed and the set of technologies available to each country is constant.

If these conditions hold, then we can illustrate the supply conditions of a country by a **production possibility frontier (PPF)**. A production possibility frontier tells us the maximum amount of output of one type of good, say T, that can be produced in a country, given the technology of that country, that country's factors of production (e.g., land, labor, capital), and the level of output of the other good, S. Figure 2.2 illustrates two possible shapes for a country's PPF. In part (a) of the figure, we provide the diagram familiar from most textbooks. Given the country's resources, production can occur anywhere along or inside the curve DE. If the output point of the country is on the frontier, say, at point G, then resources are fully employed and production is said to be efficient. This is because it is not possible to increase the output of one good without lowering the output of the other. If production occurs in the interior of the PPF, say, at point I, then there is inefficiency in production, because the output of one or both goods can be increased without increasing the resource base of the country. And it is assumed that production cannot occur at a point outside the frontier (e.g., point H), because this would require resources or technology not available to the country.

Production possibility frontier (PPF)

A diagram that shows the maximum amount of one type of good that can be produced in an economy, given the production of the other.

Recall that when resources are being efficiently utilized, it is not possible to increase the production of any one good without decreasing the production of the other. We define the **opportunity (or social) cost** of producing one more unit of S (T) as the amount of T (S) that must be sacrificed to use resources to produce S (T) rather than T (S). Now, note that the PPF in Figure 2.2a has a bowed (concave to the origin) shape. This shape signifies the assumption that production of the two goods in the country is subject to *increasing opportunity costs*. That is, beginning from point E (where the economy is producing only good T), as the economy moves toward producing more and more S (i.e., as the economy moves down its PPF), the cost in terms of foregone production of T increases. More simply, as Figure 2.2a indicates, for each additional

Opportunity (or social) cost

The amount of production of one type of good that must be sacrificed to produce one more unit of the other.

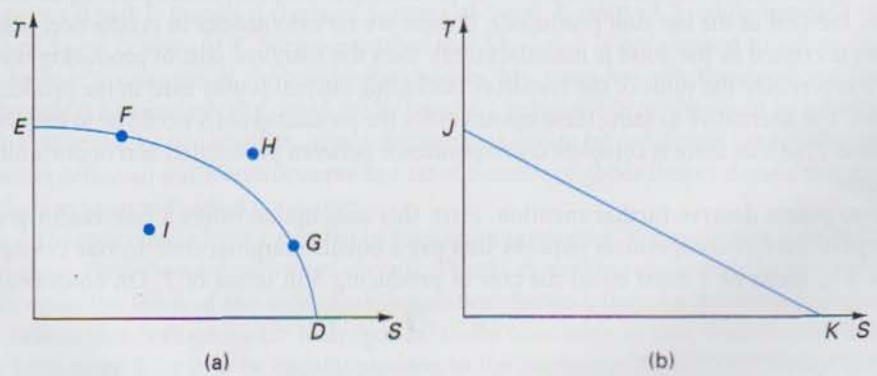

FIGURE 2.2 Examples of Production Possibility Frontiers: (a) Increasing Opportunity Costs; (b) Constant Opportunity Costs

unit of S produced in the economy, the amount of T produced falls by an increasing amount. Mathematically, we can define the cost of producing an additional unit of S as minus the slope of the PPF at the initial production point, that is, $-\Delta T/\Delta S$.*

What could cause opportunity costs to increase? One possibility is that the two industries, S and T, use factors of production in different combinations in the production process. For instance, textiles might require large amounts of labor to produce, while soybeans might need only small amounts; likewise, soybeans might require vast tracts of land, while textile production could be concentrated in a very small area. Now consider point E in the diagram. At that point all of the country's resources are concentrated in the T industry. To move away from that point, the T industry must release factors to industry S. Given that T needs large amounts of labor but only a little land, while S requires just the opposite, an efficient reallocation of resources would prompt T as it contracts to release initially to S more land than labor. As a result, the output of T would fall by only a small amount, while the production of S would rise by a large amount. However, this process cannot go on indefinitely. If the output of S is to continue to expand, eventually more and more labor relative to land will be released from T. As this begins to happen, the output of T will fall by larger and larger amounts.

Part (b) of Figure 2.2 illustrates an alternative assumption—namely, *constant opportunity costs*. In this case, as the production of S expands, the output of T falls, but at a constant rate. A condition that would produce this situation would be one in which factors of production are used in fixed proportions identical with each other in both industries. For example, suppose that both industries always employ 100 workers per acre of land. Then, as one industry contracts, it will always release factors at this rate, and output will fall by a fixed amount. Meanwhile, the expanding industry will want to absorb resources at this rate, and its output will rise by a fixed amount.

In the models that follow, we have occasion to assume that the economy is subject to either constant or increasing opportunity costs. While both situations are possible in the real world, most economists agree that the assumption of increasing opportunity costs offers a better approximation of reality. On the other hand, the assumption of constant opportunity costs is sometimes very useful, because it is somewhat easier to work with and it leads to powerful predictions about the effect of international trade on various characteristics of the economy.

Assumption 5

Perfect competition prevails in both industries in both countries. In addition, there are no externalities in production.

Recall that the opportunity cost (i.e., social cost) of producing one more unit of good S is the amount of output of good T foregone in the process. Assumption 5 guarantees that market prices reflect the true social (opportunity) costs of production. From basic principles of microeconomics we know that a competitive firm maximizes its profits by producing at the point where price equals marginal cost (i.e., the cost of the last unit produced). If there are no externalities in production (e.g., if no pollution is created as the good is manufactured), then the marginal cost of producing one more unit of S is precisely the value of the resources (including normal profit) used in the production of this good. The alternative to using these resources for the production of S would be to employ them to produce T, so that there is complete correspondence between production and opportunity costs in this case.

Two points deserve further mention. First, this assumption offers a convenient graphical counterpart. Perfect competition requires that price equals marginal cost. In our example, the price of S in terms of T must equal the cost of producing S in terms of T. Or, equivalently, the

* Because the slope of the PPF is negative, we include a minus sign in the definition of opportunity cost so that cost is measured in terms of positive numbers. Alternatively, we can define the cost as the absolute value of the slope of the PPF at the initial production point.

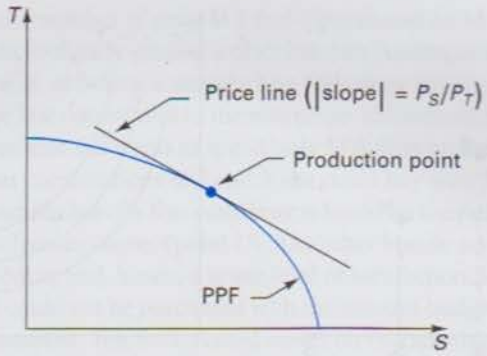

FIGURE 2.3 Relationship Between Price Line and Production Point

absolute value of the slope of the PPF at the production point, $|\Delta T/\Delta S|$, must equal the relative market price ratio P_S/P_T. This is illustrated graphically in Figure 2.3.

Second, the assumption of perfect competition extends to factor markets as well. This means that labor unions and the like, which in the real world could lead to factor payments higher than those observed in competitive factor markets, are assumed not to exist.

Assumption 6

Factors of production are *perfectly mobile* between the two industries within each country.

The implication of this assumption is that factors of production will move between the industries in response to any potential differences in factor payments. This guarantees, then, that factors (e.g., labor) earn the same factor payments (i.e., wages) in both industries within a country.

Assumptions 4 through 6 describe the supply side of the economy we shall study. The next assumption, Assumption 7, has to do with demand. However, before we spell out the last assumption, it is necessary to digress for a moment to review the theory of individual consumer choice.

Whenever an individual goes to a market, he or she is faced with a number of choices. What determines the final choices of the consumer? Economists believe that how much of each type of item a consumer buys depends upon the prices to be paid for each of the many items being considered, the total amount to be spent, and established preferences (or tastes) for these items. In particular, based on prices, budget, and preferences, it is assumed that the consumer will choose the bundle of goods that yields the highest possible level of satisfaction (or utility).

How can this process of utility maximization for the individual consumer be illustrated? Consider a simplified example. Suppose that Ms. Jones is offered the choice between two different bundles of goods, each containing some S and some T. These bundles are illustrated in Figure 2.4a by the points 0 and 1. Bundle 0 contains S_0 units of S and T_0 units of T, while bundle 1 contains S_1 units of S and T_1 units of T. Suppose further that Ms. Jones is not allowed to sell or give away any of the goods contained in the bundle she chooses. Ms. Jones has only three options. She could prefer bundle 0 to bundle 1; she could prefer bundle 1 to bundle 0; or she could be equally happy to receive either of the two bundles, in which case she is said to be indifferent (or equally satisfied). Economists define an **indifference curve** as a set of bundles of goods that each yield the same level of satisfaction to an individual consumer.

Indifference curve
A diagram that expresses the consumption preferences of an individual consumer.

Indifference curves have a number of important properties. We use Figure 2.4b to illustrate some of these. First, they are individual specific. That is, everything about their location and shape depends upon the tastes of the individual in question. Second, they are downward sloping. This simply reflects that both goods are truly "goods" to the consumer, so that if one bundle has less T, it must have more S for it to be equally pleasing to the consumer. Third, indifference curves are convex to the origin. This reflects the common belief that people like variety, so that the more they have of one type of good, the less they want still more of it. Note, however, that some people may

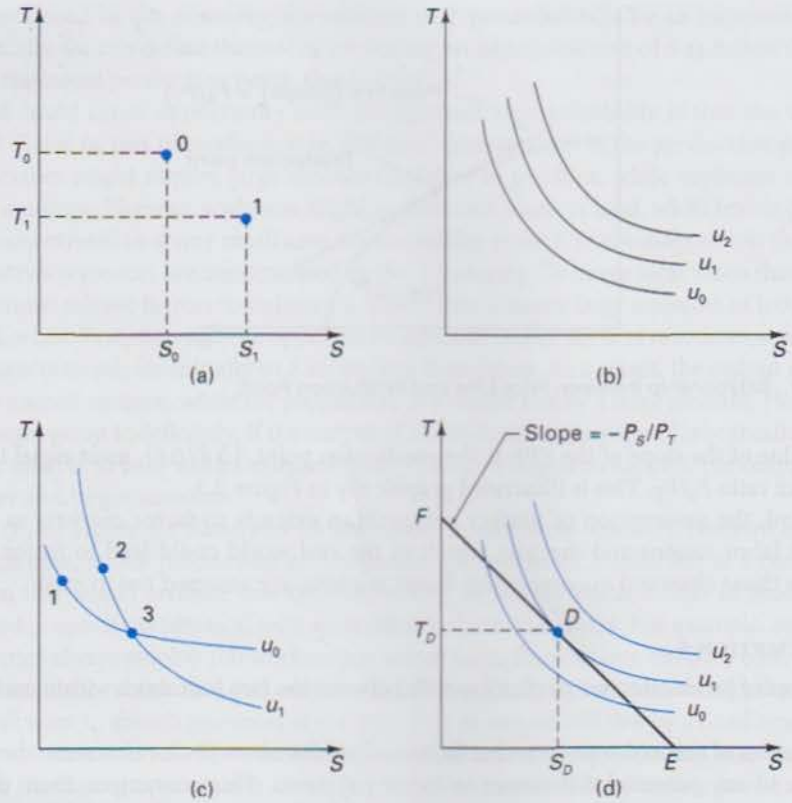

FIGURE 2.4 Indifference Curves and Individual Utility Maximization

have a particular preference for bundles with large amounts of one type of good, say T, relative to the other. In this case, their indifference curves would have the shape depicted in Figure 2.4b but would lie closer to the T axis.

Fourth, since—hypothetically at least—consumers should be able to describe their feelings regarding any conceivable consumption bundles, there are infinitely many indifference curves, each lying above the other. We have illustrated three such curves in the diagram. It is important to note that higher indifference curves reflect higher levels of satisfaction. Finally, indifference curves cannot intersect. This guarantees that preference rankings are always consistent.

To understand the importance of this last property, suppose that, as drawn in Figure 2.4c, two indifference curves did intersect. Bundles 1 through 3 lie on these two indifference curves. For the individual represented in this diagram, 2 (which contains more of both goods) is on a higher curve than 1, and thus he or she prefers 2 to 1. Since 3 is on the same curve as 2, this individual should also prefer 3 to 1. But in the diagram, 3 is also on the same indifference curve as 1, indicating that these two bundles provide equal satisfaction. Here is the logical contradiction. If a person's tastes are consistent, he or she cannot prefer 3 to 1 *and* be indifferent to the choice between 3 and 1.

Now that we have established the important properties of indifference curves, we can use these to show the solution to Ms. Jones's problem of finding that bundle that maximizes her satisfaction. Suppose that Ms. Jones plans to spend M dollars on goods S and T. When she goes to the market she must pay P_S for each unit of S and P_T for each unit of T. If she spends all M dollars on the two goods, then her expenditure must satisfy the equation

$$P_S \times S_j + P_T \times T_j = M \tag{2.1}$$

where S_j and T_j represent the number of units of S and T purchased by Ms. Jones. Equation 2.1 is an example of something we have already studied, a price line (see Assumption 3). Consider Figure 2.4d. The graph of the price line is, as before, a straight line with slope equaling P_S/P_T in absolute value. The end points of the price line correspond to the maximum amounts of S (point E) and T (point F) this person could buy, given that she wants to spend only M dollars on the two goods. Thus, the line represents all of the various combinations of S and T she could buy with M dollars. The bundle that yields the highest level of satisfaction for this consumer is found by the point of tangency of the price line to the consumer's indifference curves (point D). Any other bundle on the price line is associated with a lower indifference curve and, hence, a lower level of satisfaction. Higher indifference curves pass through bundles that could not be purchased with the amount budgeted for these goods.

Now, reflect for a moment. You have visited stores on thousands of occasions to make purchases. Were you even aware that you have indifference curves (or that economists think that you do)? The answer is probably no. Doesn't that fact invalidate all of the previous discussion? Again, the answer is no. What is important (and what the analysis is trying to reflect) is that, given various constraints you might face, such as the amount of money you have to spend and the prices you must pay, what you choose to buy is that combination of goods that gives you the most satisfaction. Figure 2.4d simply illustrates that process.

We turn now from the analysis of a single individual and the choices he or she makes to the analysis of a group of individuals (e.g., a community or a country) and the choices it makes. To do so, we make the following assumption:

ASSUMPTION 7

Community preferences in consumption can be represented by a consistent set of community indifference curves.

That is, we assume that there is a set of **community indifference curves (CICs)** that expresses the preferences of the community over the consumption of various bundles of goods in exactly the same manner as a set of indifference curves expresses the preferences of an individual. If these curves are consistent, they possess all of the properties of individual indifference curves, which we just described.

Community indifference curve (CIC)

A diagram that expresses the preferences of all the consumers of a country.

As it turns out, Assumption 7 is very strong. It says, in effect, that various individuals can be grouped together and asked to rank their preferences over all possible consumption bundles. But in the real world, this is harder than it might at first seem. How do groups make preference decisions? One way is to have an election. The decision that is made then reflects the preferences of the majority of voters. As the following example illustrates, in such elections, if people are very different but consistent in their individual preferences, as a group they may not be consistent.

Consider a three-person economy and three bundles of goods, A, B, and C. Table 2.1 illustrates the preference rankings by each of the individuals for these bundles. Now, let there be an election to decide how the community would rank these bundles. If the group were to rate A against B, A would win two votes to one, as both Moe and Curly prefer A over B. If the group then decided between B and C, B would win because in this case Moe and Larry would prefer B to C. Hence, it would seem that if the group likes A better than B and B better than C, the group

TABLE 2.1 Illustration of Condorcet's Voting Paradox

Order of Preference	Moe	Larry	Curly
1	A	B	C
2	B	C	A
3	C	A	B

must prefer *A* to *C*. Yet, as the table clearly shows, the group would vote two to one that *C* is better. Here is the obvious problem. Even though the individuals are consistent in their preferences, the group is not.* This result should not be surprising. Anyone familiar with group activities knows how difficult it is to get a group to decide on anything.

What will it take to ensure that Assumption 7 holds? There are a variety of circumstances where group decisions can be guaranteed to be consistent. One situation is a one-person, Robinson Crusoe–type (before Friday) economy. Here, the tastes of the individual and the community are obviously identical. A second situation in which our assumption holds is in a strict one-person dictatorship, where the tastes of the dictator determine entirely the consumption choices of the populace. Finally, if every person in an economy has identical tastes and identical incomes, then the community's indifference curves would look exactly like the indifference curve of any of the (identical) members of the population. These community indifference curves would have *all* the properties of individual indifference curves. For the time being, we shall assume that this last situation holds true.†

THE BASIC MODEL: SOLUTIONS

Now that the assumptions are in place, it is straightforward to solve the model for its general equilibrium solution. In particular, we shall combine the elements of supply and demand to find production, consumption, and prices. Before doing so, however, we note that the solution we shall obtain is the **autarky** solution. Autarky means self-sufficiency. A self-sufficient country is one that abstains from international trade. Such an economy is said to be closed. Thus, the autarky solution we find is the general equilibrium solution for a closed economy.

Autarky

A situation in which a country does not take part in international trade.

Figure 2.5 illustrates this solution under the assumption of constant opportunity costs. The line *EF* is the economy's production possibility frontier. The lines CIC_0, CIC_1, and CIC_2 denote several of the economy's community indifference curves. How do the forces of supply and demand interact in this model? Recall that Assumption 1 states that all economic agents act in a rational fashion. Hence, consumers will seek to purchase that combination of goods that

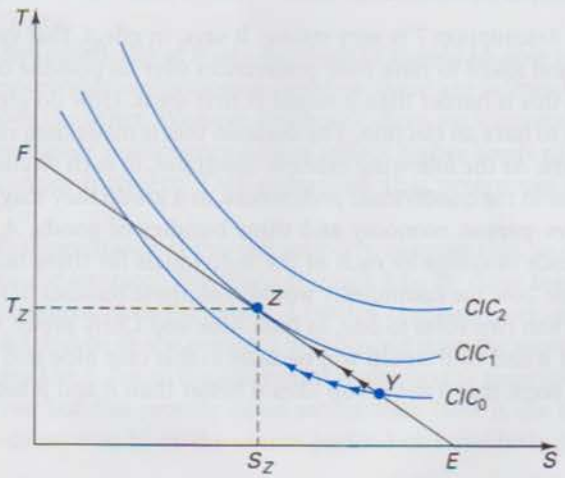

FIGURE 2.5 General Equilibrium for a Closed Economy: Constant Opportunity Costs

* This paradox was originally explained by the French mathematician Marquis de Condorcet (1743–1794). For more on the problems of constructing community indifference curves, see Kenneth J. Arrow, *Social Choice and Individual Values* (New York: John Wiley & Sons, 1951).

† For more on the interpretation and geometry of community indifference curves, see Edward Tower, "The Geometry of Community Indifference Curves," *Weltwirtschaftliches Archiv* (1979).

maximizes their satisfaction. Suppliers, through their production decisions, will attempt to meet consumers' demands. From the diagram, it is easy to see that consumers maximize their collective utility at point *Z*, the point of tangency of their community indifference curves with the economy's production possibility frontier. Thus, point *Z* is the ideal consumption point for the economy. Since this economy exists in isolation, point *Z* is also the ideal production point—that is, producers maximize their profits by producing goods in the combinations desired by society. The conclusion, then, is that, in isolation, this country will produce and consume a bundle of goods that contains S_Z units of soybeans and T_Z units of textiles.

We have now established the levels of production and consumption for both goods. What will be their relative price? From Assumption 5, we know that the price ratio is determined by the slope of the PPF at the production point. Hence, the price ratio in this case corresponds to the slope of the line segment *EF*. This is an interesting result because it says that so long as some of both goods are produced—if production occurs under the condition of constant opportunity costs—then demand plays no role in determining relative prices. The only role for demand in such a world is in picking out the precise combination of outputs of the two goods.

How does demand interact with supply to guarantee that the economy ends up at point *Z*? Consider what would happen if producers guess wrong and produce a bundle of goods other than *Z*, say, bundle *Y*. If the economy is initially at *Y*, more *S* (less *T*) is being produced than is desired by consumers. Consumers would be happy with this bundle of goods only if the relative price of *S* were to fall to a level equal to the slope of the *CIC*-intersecting point *Y*. That is, the price consumers have to pay for *S*—the market-relative price—is higher than the price they want to pay. Given this, there will be a tendency for the consumption of *S* to fall, generating a short-run excess supply of *S* in the market, which in turn will lead to a reduction in the production of *S* (i.e., there is a short-run tendency for production to move inside the PPF). As factors become unemployed in the *S* industry, they are reemployed in the *T* industry. And as the factors become reemployed and the production of *T* expands, the economy moves back to its PPF and toward point *Z*.

Demand has a more interesting role in the case of an economy with increasing opportunity costs. This is illustrated in Figure 2.6. Again, we show supply conditions via a production possibility frontier (curve *GH* in the diagram) and demand conditions by representative community indifference curves (the *CIC* curves). As before, the optimal consumption and production point is determined by the tangency of the PPF with the community indifference curves. This point is denoted by point *X*. The relative price of good *S* is found by the slope of the PPF at point *X*.

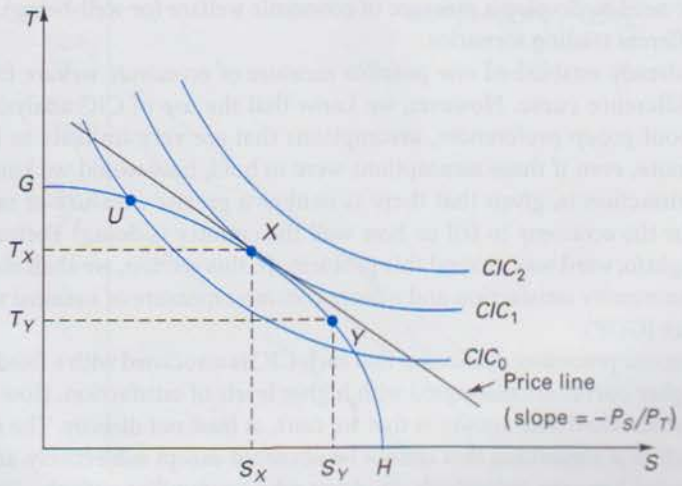

FIGURE 2.6 General Equilibrium for a Closed Economy; Increasing Opportunity Costs

If producers were to produce a bundle other than at point X, how would the economy respond? Consider what would happen at point U. There, T production exceeds (S production falls short of) the general equilibrium level. At point U, consumers are willing to pay a higher price for S (given by the slope of the CIC curve at that point) than the prevailing market price (given by the slope of the PPF at that point). Pressure from consumer demand will tend to drive the relative price of S up, encouraging S producers to expand their production levels and encouraging T producers to contract their production. The combination of these effects on national output will move the economy to point X, where the price consumers are willing to pay exactly equals the market price—the price they have to pay.

We have established the economy's consumption and production levels for the two goods and the relative price at which they are traded in the market. How long will this continue to be the solution to the model? The answer is that X will remain optimal so long as nothing changes. What could change? Production conditions could change due to a technical innovation in either or both industries. In such circumstances, the PPF would change shape, and the tangency would occur at some new and probably higher point. Without more information, it is impossible to predict the effect on relative prices.

Tastes could change. Suppose that for some reason consumers as a group increased their preference for S relative to T. Their community indifference curve map would move, rotating toward the S axis (not shown in Figure 2.6). This would imply a new optimal consumption point, such as point Y. Under such circumstances, how would production and prices behave? Clearly, at point Y the demand for good S has risen (from S_X to S_Y), while the demand for good T has fallen (from T_X to T_Y). How can producers be encouraged to change their output levels to match this change in demand? The answer lies in prices. As the demand for S rises in the economy, so too does its price. Meanwhile, falling demand for T causes its price to fall. Thus, the relative price of S, P_S/P_T, rises. This provides an incentive to producers to shift resources from textiles to soybeans.

MEASURING NATIONAL WELFARE

One of the important goals of economics is to be able, whenever possible, to illustrate the economic benefits of various types of economic activity. For instance, economists would like to be able to demonstrate whether perfect competition is preferred to monopoly under most economic situations. Recall from our preceding discussion that judgments such as these are part of the realm of normative economics. One of the normative questions we would like to answer in this text relates to the preferability of free international trade to other trading arrangements. For this purpose, we need to develop a measure of economic welfare (or well-being), which can then be applied to different trading scenarios.

We have already established one possible measure of economic welfare for a country, the community indifference curve. However, we know that the use of CIC analysis requires strict assumptions about group preferences, assumptions that are very unlikely to hold in the real world. Furthermore, even if these assumptions were to hold, how would we know what a country's level of satisfaction is, given that there is neither a precise measure of satisfaction nor a spokesperson for the economy to tell us how well the country is doing? Fortunately, there is a simple and straightforward way around this problem. In this section, we shall show the relationship between community satisfaction and a more common measure of national well-being, gross domestic product (GDP).

Recall from our preceding discussion that each CIC is associated with a fixed level of satisfaction and that higher curves are associated with higher levels of satisfaction. How can we measure these levels of satisfaction? The answer is that we can't, at least not directly. The reason for this is obvious. Satisfaction is something that cannot be observed except subjectively, and, furthermore, it can't be compared between individuals. Students who are familiar with the *Rate My Professors* Web site know that they can submit ratings of 1 to 5 on several attributes of their professors.

If Sheila gives her professor a 4 and Mary gives the same professor a 3, do we really know that Sheila liked the professor better than Mary did? The answer is no; Sheila might simply be an easier rater. What we need is some criterion that can provide us with a less ambiguous measure of satisfaction. The criterion used in the case of CICs is real GDP.

Recall from Chapter 1 that GDP is defined as the level of output of new goods and services produced by an economy during a certain period of time (usually 1 year) and valued at market prices. In our simple model, where only two goods are produced, the formula for GDP is given by Equation 2.2:

$$\text{GDP} = P_S \times S + P_T \times T \tag{2.2}$$

This equation states that at any point in time, a country's GDP is equal to the value of that country's production of soybeans and textiles (remember that in the real world, GDP measures would include the value of many other items as well as these from our model). As the formula also shows, GDP can change for at least two reasons: either production levels are altered (i.e., S or T changes) or prices change. Clearly, there are different implications from these two types of changes. In the first case, a rise in GDP means that there are more goods available for consumption. This is said to be an increase in *real* GDP. If, instead, rising GDP merely comes about because of an increase in prices, then *nominal* GDP is said to rise, but real GDP is constant.

To maintain the distinction between these two types of changes, suppose that we divide both sides of Equation 2.2 by P_T. This has the effect of changing our units of measure of GDP from money terms to real (units of T) terms. To verify this, consider Equation 2.3:

$$\text{GDP}/P_T = (P_S/P_T) \times S + T \tag{2.3}$$

From our discussion of price lines we know that P_S/P_T represents the price of S measured in terms of T, so that the first term on the right-hand side of Equation 2.3 is the value of S production measured in units of T. The second part of that side of the equation is simply the amount of T production. Thus, when these two terms are combined in this fashion, we have a measure of real GDP. And by measuring GDP in this fashion, any change in GDP reflects real (output) changes rather than nominal (price) changes.

Now consider Figure 2.7. There we graph a number of GDP lines identical with Equation 2.3. The slope of each is the same and equal in absolute value to a given relative price.

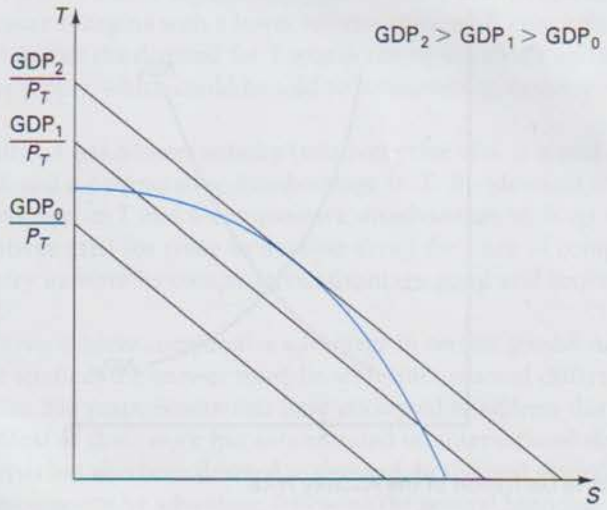

FIGURE 2.7 Determination of Real GDP Level

The height of each line is determined by the value of GDP. Higher lines represent higher GDP levels. The important point is that for a given value of P_S/P_T, production on the production possibility frontier leads to the highest possible GDP. Similarly, so long as consumers are maximizing their collective utility, increases (decreases) in real GDP may imply increases (decreases) in the community standard of living.

We use the word *may* for several reasons. First, a country's population may also be growing over time (recall that Assumption 4 rules this out in our model). Hence, even if a country's real output is growing, if population grows faster, then, on average, there are fewer goods and services available to each individual for consumption. Consequently, a better measure of standard of living is per capita real GDP. Even this measure is not perfect, however, because it implicitly assumes that all individuals are able to share in the growing standard of living. Also, as calculated in the real world, this statistic ignores quite a bit of economic activity (e.g., housework, illegal trade) and leaves unmeasured other factors that contribute to the quality of life (e.g., leisure time).

NATIONAL SUPPLY AND DEMAND

We conclude this chapter with an extension of our analysis of the general equilibrium model, national demand and supply curves for the two commodities.* These curves provide an alternative (but equivalent) way of illustrating how production, consumption, and prices are determined in an economy. Then, we use these curves to show the incentives that could induce international trade between countries.

National supply

The amount of national output of a particular good at various relative prices for that good.

We define the **national supply** curve for a product, say S, as a schedule of the amount of S produced by a nation at various relative prices of S. An example of a national supply curve appears as the curve labeled NS_S in Figure 2.8. Note that this curve has the familiar upward slope to it. This reflects the underlying assumption of increasing opportunity costs. As more and more S is produced in an economy under this assumption, greater and greater relative price increases are required to compensate producers for the rising costs that they incur. This is identical to the notion that under increasing opportunity costs, the PPF of a country gets steeper as production of a good (say S) rises.

National demand

The amount of national consumption of a particular good at various relative prices.

The **national demand** curve for a product is a schedule that tells us how much of that product a country wants to consume at various relative prices. An example appears as the curve labeled ND_S in Figure 2.8. The downward slope reflects the standard assumption about demand behavior that a higher (lower) relative price discourages (encourages) consumption of a particular good.

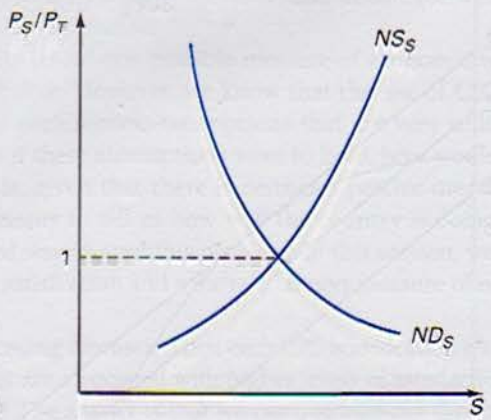

FIGURE 2.8 Alternative Derivation of the Autarky Price

* A formal derivation of these curves is provided in Appendix 2.1.

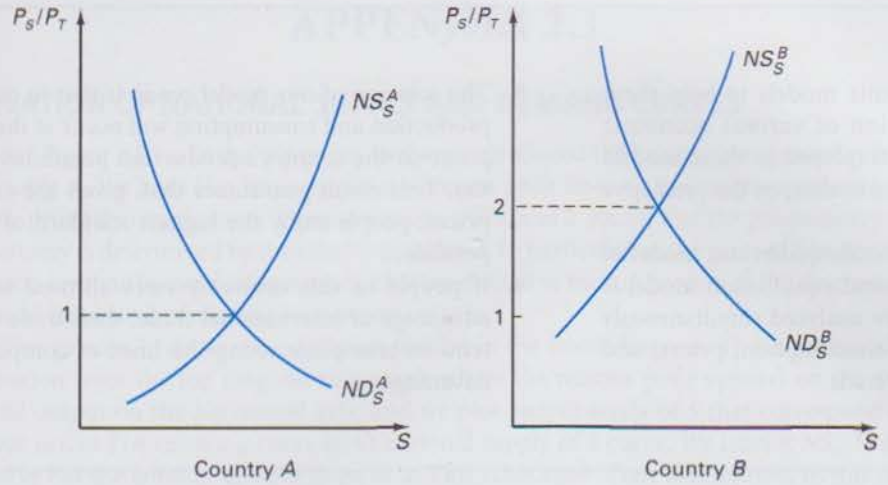

FIGURE 2.9 International Differences in Autarky Prices

The intersection of the national supply and demand curves in Figure 2.8 provides an alternative depiction of the determination of the autarky equilibrium point. Note that in this example, when the price equals 1, national demand for *S* equals national production. At a higher price, desired consumption would fall while producers would want to produce more. There would be an excess supply of *S*. At prices below 1, there would be excess demand.

Now, let's bring country *B* into the analysis. In Figure 2.9 we illustrate, without deriving, national supply and demand curves for country *B* (and for country *A*). Unless country *B* is identical in both production capacity and tastes to country *A*, its demand and supply curves will have a different position and shape from those of *A* and will be likely to intersect at a different autarky price. As we have drawn them, they intersect at a price of 2.

Suppose now that we consider what might happen if trade were allowed to occur between these two countries. Beginning at a point of autarky equilibrium prices in the two countries, consumers in country *B* would want to buy *S* from producers in country *A*, where it is cheaper. This additional demand would drive up the price of *S* in *A* (not shown in the diagram). Suppliers of *S* in *A* would expand their production, thus generating goods for export to *B*. Similarly, because *B* begins with a lower relative price of *T*, consumers in *A* would want to import *T* from *B* so that the demand for *T* would rise in *B*, driving up the relative price and leading to an excess supply, which could be sold to consumers in country *A* (not shown in the diagram).

Because country *A* has a lower autarky (relative) price of *S*, it is said to have a comparative advantage in *S* and a comparative disadvantage in *T*. By identical logic, country *B* has a comparative advantage in *T* and a comparative disadvantage in *S*. As we have seen from the diagram, incentives exist for trade to develop along the lines of comparative advantage. That is, each country exports its comparative advantage good and imports its comparative disadvantage good.

How do countries achieve comparative advantage in certain goods? According to the diagrams we have just studied, the answer must lie with international differences in demand or supply. For more than 200 years, economists have attempted to address this question in a more complete fashion. Most of their work has concentrated on international differences in supply, although some analysis has also been devoted to demand. In the next several chapters we review this effort to explain comparative advantage, following the general historical development of our modern-day understanding of this important topic.

Summary

1. Economists build economic models to help them understand the interaction of various economic forces. Assumptions are employed in these models to simplify the analysis and to sharpen the predictive power of the analysis.
2. This chapter builds a general equilibrium model of a closed economy. A general equilibrium model is one in which all goods are analyzed simultaneously in terms of production, consumption, prices, and (eventually) international trade.
3. The solution of our model predicts that in autarky, production and consumption will occur at the same point on the country's production possibility frontier. This result guarantees that, given the autarky prices, people enjoy the highest standard of living possible.
4. If people in this economy were allowed to take advantage of international trade, then trade would tend to take place along the lines of comparative advantage.

Exercises

1. Suppose that an economy produces three goods—raisins (R), soybeans (S), and textiles (T). What would its PPF look like under conditions of constant opportunity costs? What would it look like with increasing opportunity costs?
2. Using the following data, calculate the country's nominal and real GDP levels:

Case	P_S ($)	S	P_T ($)	T
a	5	40	2	15
b	10	40	4	15
c	4	50	8	14
d	4	50	8	16

3. Using your calculations from Exercise 2, compare changes in nominal and real GDP between cases a and b. Explain your result.
4. Suppose the economy is characterized by constant opportunity costs so that P_S/P_T equals 2. Derive the economy's national supply schedule. How does it differ from the one derived in Figure A2.1? Explain.
5. Suppose that in world markets the relative price of S is lower than country A's autarky price. Would A be a net exporter or importer of S? What would be the case for good T in country A in this situation?
6. Derive country A's national supply and demand curves for good T. Be careful how you label the axes!
7. If a country is at a point on its PPF where the slope of the PPF is flatter than the slope of the CIC touching that same point, then the standard of living would rise if outputs of the two goods would change so as to move down the PPF. True or false? Demonstrate and explain.
8. Suppose that country A produces two goods under conditions of constant opportunity costs. Given its resources, the maximum S that it can make is 700 units and the opportunity cost of making T is 2. What is the maximum amount of T that it can produce? Draw a graph and explain.
9. Suppose that a country produces two goods, X and Y, with two factors of production, K and L. The production of good X always requires more$K$ per unit than the production of good Y does. What does this imply for the shape of the country's PPF? Explain carefully.
10. Why are relative prices more important for decisions about consumption and production than nominal prices are? Provide an example to illustrate your answer.
11. Suppose that a small, tropical country produces mangoes for domestic consumption and possibly for export. The national demand and supply curves for mangoes in this country are given by the following:

$$P = 100 - 2M \quad \text{(national demand)}$$

$$P = 50 + 2M \quad \text{(national supply)}$$

where P denotes the relative price of mangoes and M denotes the quantity of mangoes (in metric tons).

a. Illustrate these relationships geometrically.
b. What is the autarky price and quantity exchanged?
c. Suppose that the world price of mangoes is 45. Will this small country export mangoes? If so, how many tons?

Please visit our Web site at www.pearsoninternationaleditions.com/husted for more exercises and readings.

APPENDIX 2.1

DERIVATION OF NATIONAL SUPPLY AND DEMAND CURVES

Consider Figure A2.1a. In the top panel, we have reproduced the production possibility frontier for country *A*. We have also imposed three different price lines on the diagram reflecting three possible prices that might exist. These prices are 1/2, 1, and 2. Recall that the production point in the economy is determined by the relative price level. In particular, as the price of *S* begins to rise, producers respond by producing more *S*. This is reflected in the top portion of the diagram by the rightward movement of the tangency points.

This process is shown in a different fashion in the lower diagram. There, we transfer the information from the top diagram to a graph where the relative price appears on the vertical axis and output on the horizontal axis, and we plot output levels of *S* that correspond to the different prices The resulting curve is *A*'s national supply of *S* curve. We label it NS_S. Note that this curve has the familiar upward slope to it. This is because of our assumption, in this case, of increasing opportunity costs. In fact, as we move down *A*'s PPF, the underlying national supply curve becomes increasingly steep. This simply reflects the fact that to encourage additional

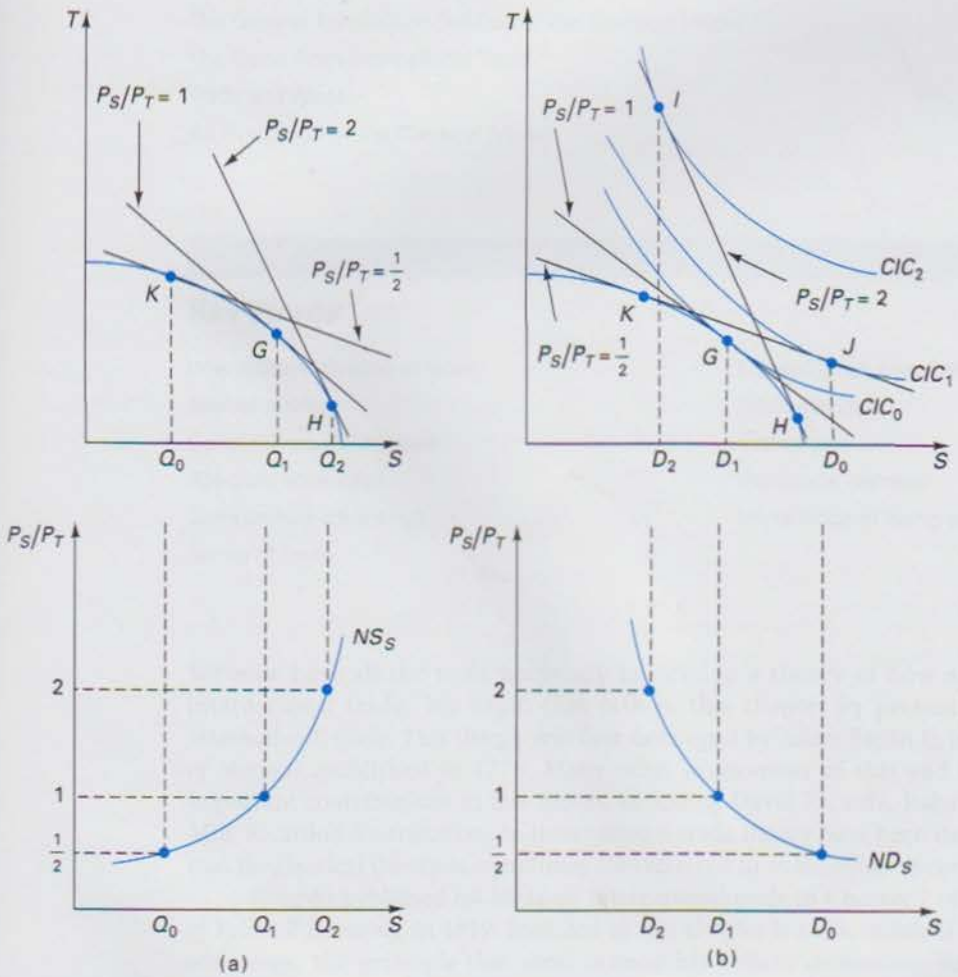

FIGURE A2.1 Derivation of National Supply and Demand Curves

production of S requires greater and greater price increases to compensate producers for the greater and greater costs they incur.

In panel (b) of the diagram we show how to derive A's demand curve for S. In the top part of the panel, we show A's production possibility frontier as well as several CICs and market prices. Recall that to maximize satisfaction, consumers would choose that bundle of goods located along the price line at the point of tangency with the highest CIC. From the diagram, we see that when P_S/P_T equals 1, the desired level of consumption is D_1 (directly below point G). Now, let the price rise to 2. Clearly, consumers will no longer want to consume D_1 units of S. Instead, and if they could, they would prefer D_2 units (directly below point I, where the new price line is just tangent to a CIC). Similarly, if the price were to fall to 1/2, A's consumers would like to expand their consumption of S to D_0 (below point J). Of course, in autarky, neither points I nor J can be reached since they lie outside of the country's PPF.

In the lower part of panel (b), information on desired consumption levels of S is recorded on a graph with P_S/P_T on the vertical axis and units of S on the horizontal. The curve that is produced is the nation's demand for S, labeled ND_S. As drawn, it has the familiar downward slope (although this does not have to be the case). Its position and slope depend, in part, on the location of the country's CIC curves. They also depend upon the location of the economy's production point.