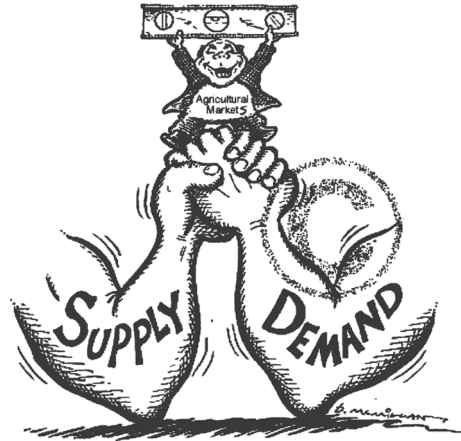




What Is Agricultural Economics?

Chapter Outline

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Agricultural economics is an applied social science that deals with how producers, consumers, and societies use scarce resources in the production, marketing, and consumption of food and fiber products. In agricultural markets, the forces of supply and demand are at work. Credit: Brad McMillan/Cartoon Stock.

Agriculture certainly is among the most prominent sectors of any economy. Psalm 104 illustrates this point: “Bless the lord, O my soul, thou dost cause the grass to grow for the cattle, and plants for man to cultivate, that he may bring forth food from the Earth.” Unequivocally, from biblical times agriculture has been a discipline worthy of study. We specifically are interested in the economic relationships inherent in the agricultural sector.



The roots of agricultural economics perhaps can be traced back to ancient Egypt, arguably to the first agricultural economist, Joseph. Joseph interpreted the dreams of the Pharaoh of Egypt and correctly predicted seven years of feast and seven years of famine.

What is agricultural economics? If you were to say “Agricultural economics is the application of economic principles to agriculture,” you would be technically correct—but in a narrow context. This definition does not recognize the economic, social, and environmental issues addressed by the agricultural economics profession. To perceive agricultural economics as being limited only to the economics of farming and ranching operations would be incorrect. These operations account for only 2% to 4% of the nation’s output. Actually, the scope of agricultural economics goes well beyond the farm gate to encompass a broader range of food- and fiber-related activities. When viewed from this broader perspective, the agricultural sector accounts for approximately 12% to 15% of the nation’s output.

Before we define agricultural economics further, let us first examine the scope of economics and the role that agricultural economists play in today’s economy. This examination will allow us to propose a more definitive answer to the question raised by the chapter title. A more in-depth assessment of the nation’s food and fiber industry is presented in Chapter 2.

SCOPE OF ECONOMICS

Two frequently used clichés describe the economic problem: “You can’t have your cake and eat it too” and “There’s no such thing as a free lunch.” Because we—individually or collectively—cannot have everything we desire, we must make choices. Consumers, for example, must make expenditure decisions with a budget in mind. Their objective is to maximize the satisfaction they derive from allocating their time between work and leisure, and from allocating their available income to consumption and saving, given current prices and interest rates. Producers must make production, marketing, and investment decisions with a budget in mind. Their objective is to maximize the profit of the firm, given its current resources and current relative prices. After considering the costs and benefits involved, society also must make choices on how to allocate its scarce resources among different government programs most efficiently.

Scarce Resources

The term *scarcity* refers to the finite quantity of resources that are available to meet society’s needs. Because nature does not freely provide enough of these resources, only a limited quantity is available. **Scarce resources** can be broken down into the following categories: (1) natural and biological resources; (2) human resources; and (3) manufactured resources.

Scarce resources can be divided into natural and biological resources, human resources, and manufactured resources.

Natural and Biological Resources Land and mineral deposits are examples of scarce **natural resources**. The quality of these natural resources in the United States differs greatly from region to region. Some lands are incapable of growing anything in their natural state, and other lands are extremely fertile. Still other areas are rich in coal deposits or oil and natural gas reserves. In recent years, our society also has become aware of the increasing scarcity of fresh water, especially in the West. Whereas energy-related natural resources have represented critical scarce resources in recent decades,



water could become *the* critical scarce natural resource in the near future. In addition to natural resources, scarce resources also include **biological resources** such as livestock, wildlife, and different genetic varieties of crops.

Human Resources Human resources are services provided by laborers and management to the production of goods and services that also are considered scarce. Laborers, for example, provide services that, combined with scarce nonhuman resources, produce economic goods.¹ Workers in the automotive industry provide the labor input to produce cars and trucks. Farm laborers provide the labor input to produce crops and livestock. Labor is considered scarce even when the country's labor force is not fully employed. Laborers supply services in response to the going wage rate. Agribusinesses may not be able to hire all the labor services they desire at the wage they wish to pay.

Management, another form of human resource, provides entrepreneurial services, which may entail the formation of a new firm, the renovation or expansion of an existing firm, the taking of financial risks, and the supervision of the use of the firm's existing resources so that its objectives can be met. Without entrepreneurship, large-scale agribusinesses would cease operating efficiently.

Manufactured Resources The third category of scarce resources is **manufactured resources** or, more simply, **capital**. Manufactured resources are machines, equipment, and structures. A product that has not been used up in the year it was made also is considered a manufactured resource. For example, inventories of corn raised but not fed to livestock or sold to agribusinesses represent a manufactured resource.

Scarcity is a relative concept. Nations with high per capita incomes and wealth face the problem of scarcity like nations with low per capita incomes and wealth. The difference lies in the degree to which resource scarcity exists and the forms that it takes.

Scarcity refers to the fixed quantity of resources that are available to meet societal needs.

Making Choices

Resource scarcity forces consumers and producers to make choices. These choices have a time dimension. The choices consumers make today will have an effect on how they will live in the future. The choices businesses make today will have an effect on the future profitability of their firms. Your decision to go to college rather than get a job today was probably based in part on your desire to increase your future earning power or eventual wealth, knowing what your earning potential would be if you did not attend college.

The choices one makes also have an associated **opportunity cost**. The opportunity cost of going to college now is the income you are currently foregoing by not getting a job now. The opportunity cost of a consumer taking \$1,000 out of his or her savings account to buy a cell phone or other assorted technological devices is the interest income this money would have earned if left in the bank. An agribusiness firm considering the purchase of a new computer system also must consider the income it could receive by using this money for another purpose. The bottom line expressed in economic terms is whether the economic benefits exceed the costs, including foregone income. Simply put,

Opportunity cost refers to the implicit cost associated with the next best alternative in a set of choices available to decision makers.

¹ Goods and services produced from scarce resources also are scarce and are referred to as economic goods. Economic goods are in contrast to free goods, in which the quantity desired is available at a price of zero. Air has long been a free good, but pollution (a negative good), which makes the air unfit to breathe, is changing this notion in some areas.



opportunity cost is a concept associated with economic decisions. It refers to the implicit cost associated with the next best alternative.

To illustrate the concept of opportunity cost, consider the following hypothetical example. Suppose that RJR Nabisco has three alternatives for manufacturing snack foods:

Alternative 1: manufacture cookies alone and obtain a profit of \$30 million.

Alternative 2: manufacture chips alone and obtain a profit of \$25 million.

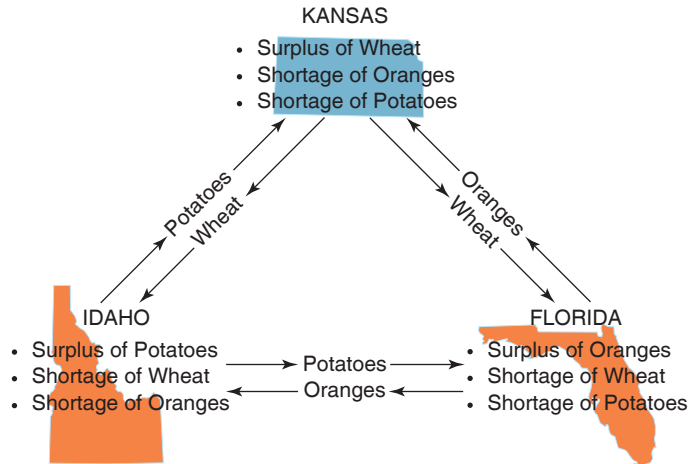
Alternative 3: manufacture both cookies and chips and obtain a profit of \$35 million.

Because Alternative 3 offers the highest profit to RJR Nabisco, it is rational economically for the firm to adopt this choice and consequently manufacture both cookies and chips. However, in doing so, the firm foregoes Alternatives 1 and 2. The implicit cost associated with the next best alternative is to forgo a profit of \$30 million. Thus, \$30 million is the opportunity cost in this example.

Sometimes the choices we make are constrained not only by resource scarcity but also by noneconomic considerations. These forces may be political, psychological, sociological, legal, or moral. For example, some states have blue laws that prohibit the sale of specific commodities on Sundays. A variety of regulations exist at the federal and state levels that govern the production of food and fiber products, including environmental and food safety concerns. For example, specific chemicals are banned from use in producing and processing food products because of their potential health hazard. The Big Green movement in California in 1990 sought to ban the use of all agricultural chemicals that were shown to pose health hazards to laboratory animals. As another example, over the period February 2007 to August 2007, a nationwide recall of Peter Pan peanut butter took place due to its association with salmonella contamination. This product was not available in grocery stores for a period of 27 weeks.

Most resources are best suited for a particular use. For example, the instructor of this course is better qualified to teach this course than to perform open-heart surgery. By focusing the use of our resources on a specific task, we are engaging in **specialization**. With a given set of human and nonhuman resources, specialization of effort generally results in a higher total output. Individuals should do what they do comparatively better than others, given their endowment of resources. Some individuals might specialize in fields such as professional athletics, medicine, or law. Others might specialize in agricultural economics. States and nations may find it to their advantage to specialize in the production of coffee, rice, or computers and import other commodities for which their endowment of natural, human, and manufactured resources is ill-suited. As illustrated in Figure 1-1, Kansas has a surplus of wheat production but a shortage of orange production, while Florida has a surplus of orange production and a shortage of wheat production. Both states have a shortage of potato production, while Idaho has plenty to spare. Specialization in production provides the basis for trade among producers and consumers.

Choices in the allocation of resources made by society (a collection of individuals) might be quite different from the choices made by individual members of society. For example, all nations normally allocate some resources to military uses. Society as a whole must decide how best to allocate its resources between the production of civilian goods and services and the production of military goods, popularly referred to as the choice of “guns versus butter.”

**Figure 1-1**

Specialization and resource allocation.

DEFINITION OF ECONOMICS

With the foregoing concepts of resource scarcity and choice in mind, we may now define the nature and scope of the field of economics as follows:

Economics is a social science that deals with how consumers, producers, and societies choose among the alternative uses of scarce resources in the process of producing, exchanging, and consuming goods and services.

Microeconomics versus Macroeconomics

As with most disciplines, the field of economics can be divided into several branches. **Microeconomics** and **macroeconomics** are two major branches of economics. Microeconomics focuses on the economic actions of individuals or specific groups of individuals. For example, microeconomists are concerned with the economic behavior of consumers who demand goods and services and producers who supply goods and services, and the determination of the prices of those goods and services. Macroeconomics focuses on broad aggregates, such as the growth of the nation's gross domestic product (GDP), the gaps between the economy's potential GDP and its current GDP, and trade-offs between unemployment and inflation. For example, macroeconomists are concerned with identifying the monetary and fiscal policies that would reduce inflation, promote growth of the nation's economy, improve the nation's trade balance (exports minus imports), and reduce the national debt. Macroeconomics explicitly accounts for the interrelationships between the nation's labor, product, and money markets and the economic decisions of foreign governments and individuals.

Despite the differences between microeconomics and macroeconomics, there is no conflict between these two branches. After all, the economy in the aggregate is certainly affected by the events taking place in individual markets.

A word of caution: we must be careful when generalizing the aggregate or macroeconomic consequences of an individual or a microeconomic event. If not, we run the risk of committing a **fallacy of composition**, meaning that which is true in an individual situation is not necessarily true in the aggregate. For example, suppose Walt Wheatman adopts a new technology that doubles his wheat production. If the thousands of other wheat farmers in the United States and other wheat

Microeconomics is a branch of economics that focuses on the actions or behavior of individual agents or groups of agents.

Macroeconomics is another branch that centers attention on broad aggregates of the economy.



producers worldwide do not follow suit, Walt's income will rise sharply. It would be wrong for Walt or others to conclude, however, that all wheat farmers would achieve income gains if they also adopted this new technology. If other wheat producers did respond, supply would expand substantially, and wheat prices would fall dramatically.

Positive versus Normative Economics

Positive economics deals with what-is and what-would-happen-if questions.

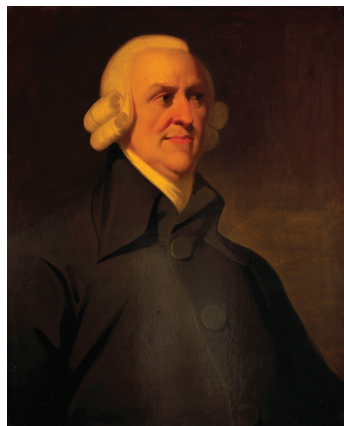
Normative economics focuses on what-should-be or what-ought-to-be questions.

The study of economics also can be divided between **positive economics** and **normative economics**. Positive economics focuses on what-is and what-would-happen-if questions and policy issues. No value judgments or prescriptions are made. Instead, the economic behavior of producers and consumers is explained or predicted. For example, policymakers may be interested in knowing how consumers and producers would respond to a tax cut or alternatively to a tax hike. Or, policymakers may be interested in to what degree the problem of obesity may be mitigated if a notable tax is placed on sugar-sweetened beverages.

Normative economics focuses on determining “what should be” or “what ought to be.” For example, policymakers might inquire as to which of several alternative policies *should be* adopted to maximize the economic welfare of producers and consumers. At the micro level, an automobile manufacturing plant might be interested in knowing the number of vehicles it *should be* producing to maximize profit.²

Alternative Economic Systems

An *economic system* can be defined as the institutional means by which resources are used to satisfy human desires; the term *institutional* refers to the laws, habits, ethics, and customs of the nation's citizens. **Capitalism** is a free market economic system in which individuals own resources and have the right to employ their time and resources however they choose, with minimal legal constraints from government. Prices signal the value of resources and economic goods. Under capitalism, as claimed by the Scottish economist and moral philosopher Adam Smith in his book *An Inquiry into the Nature and Causes of the Wealth of Nations* published



Adam Smith, the pioneer of capitalism.

² For a more in-depth discussion of positive and normative economics, see Friedman (1974).



Thomas Piketty, the French economist who proposes redistribution of wealth through global taxation.

in 1776, individuals' efforts to maximize their own gains in a free market benefit society. One of the most important concepts of *The Wealth of Nations* is Smith's idea of the *invisible hand*. In his investigation as to why some countries are poor and stay poor, while other nations grow and prosper, Smith found that increases in productivity of individuals that come from their individual talents, the division of labor unhindered by government restrictions, and voluntary transactions in a free market result in rising prosperity. The "invisible hand of the market" is a metaphor conceived by Adam Smith to describe the self-regulating behavior of the marketplace.

Capitalism differs sharply from **socialism** or **communism**. Under socialism or communism, resources are generally collectively owned and the government decides how human and nonhuman resources are to be utilized across the various sectors of the economy. Prices largely are set by the government and administered to consumers and farmers. Winston Churchill noted that "socialism is a philosophy of failure, the creed of ignorance, and the gospel of envy; its inherent virtue is the equal sharing of misery" (www.brainyquote.com). *Capital in the 21st Century*, written in 2013 by the French economist Thomas Piketty, argues that inequality in wealth leads to stagnant or declining economic growth. To address this issue, Piketty proposes redistribution of wealth through a global tax.

A measurement of the equality or inequality in the distribution of wealth for any nation can be made by calculating the Gini coefficient, proposed in 1912 by the Italian statistician and sociologist Corrado Gini. A Gini coefficient close to 0 reflects complete equality in the distribution of wealth, while a Gini coefficient close to 1 reflects complete inequality. To provide perspective concerning this metric, since 2007, the Gini coefficient for the United States has risen from 0.463 to 0.477, a change of roughly 3%.

The United States has what is commonly referred to as a **mixed economic system**; that is, markets are not entirely free to determine price in some markets but are free in others. The government's intervention in the agricultural arena, for example, is well known. Loan guarantees to crop producers and guarantees to savings and loan depositors are forms of government intervention in the private sector. The government also controls numerous aspects of transportation, communications, education, and finance. Food assistance programs such as the Supplemental Nutritional Assistance Program (SNAP) and the Women, Infants, and Children (WIC) Program also are indicative of a mixed economic system.



DEFINITION OF AGRICULTURAL ECONOMICS

Because agricultural economics involves the application of economics to agriculture, we may define this field of study as follows:

Agricultural economics is an applied social science that deals with how producers, consumers, and societies use scarce and natural resources in the production, processing, marketing, and consumption of food and fiber products.

WHAT DOES AN AGRICULTURAL ECONOMIST DO?

The application of economics to agriculture in a complex market economy such as that of the United States has a long and rich history. We can summarize this activity by discussing the activities of agricultural economists at the microeconomic level and at the macroeconomic level.

Role at Microeconomic Level

Agricultural economists at the micro level are concerned with issues related to resource use in the production, processing, distribution, and consumption of products in the **food and fiber system**. Production economists examine resource demand by businesses and their supply response. Market economists focus on the flow of food and fiber through market channels to their final destination and the determination of prices at each stage. Financial economists are concerned with issues related to the financing of businesses and the supply of capital to these firms. Resource economists focus on the use and preservation of the nation's natural resources. Other economists are interested in the formation of government programs for specific commodities that will support the incomes of farmers and provide food and fiber products to low-income consumers.

Role at Macroeconomic Level

Agricultural economists involved at the macro level are interested in how agriculture and agribusinesses affect domestic and world economies and how the events taking place in other sectors affect these firms and vice versa. For example, agricultural economists employed by the Federal Reserve System must evaluate how changes in monetary policy affect the prices of various food commodities. Macroeconomists with a research interest may use computer-based models to analyze the direct and indirect effects that specific monetary or fiscal policy proposals would have on the farm business sector. Macroeconomists employed by multinational food companies examine foreign trade relationships for food and fiber products. Others address issues in the area of international development.

Marginal Analysis

Economists frequently are concerned with what happens at the margin. A microeconomist may focus on how the addition of another input by a business, or the purchase of another product by a consumer, will change the economic well-being of the business and the consumer. A macroeconomist, on the other hand, may focus on how a change in the tax rate on personal income may change the nation's output, interest rates, inflation, and the federal budget deficit. The key word in this example is *change*, or, more specifically, how a change in price, quantity, and so on will affect other prices and quantities in the economy, and how this situation might change the economic well-being of consumers, businesses, and the economy as a whole. Many of the chapters to follow include a discussion of marginal analysis so as to better understand economic decisions made at the firm, household, or economy level.



Sonny Perdue, the current U.S. secretary of agriculture.



Zippy Duvall, the current president of the American Farm Bureau Federation.

Key agencies that agricultural economists deal with include the Economic Research Service (www.ers.usda.gov), the U.S. Department of Agriculture, and the American Farm Bureau Federation (AFBF) (www.fb.org), the voice of agriculture. The current U.S. secretary of agriculture is Sonny Perdue, and the current president of the AFBF is Zippy Duvall, a farmer from Georgia.

WHAT LIES AHEAD?

Chapter 2 gives an overview of the structure of the nation's food and fiber system and the important role it plays in the U.S. general economy. The remaining parts of the book can be summarized as follows:

- Part 2 focuses on understanding consumer behavior in the marketplace, particularly in explaining the demand for food and fiber products. Chapter 3 presents the theory of consumer behavior. Chapter 4 describes the conditions for consumer equilibrium and determination of market demand. Chapter 5 discusses the measurement and interpretation of demand elasticities.
- Part 3 changes the focus from the behavior of consumers to the behavior of producers of food and fiber products. Emphasis is placed on market equilibrium and market structures. Chapter 6 describes the measurement of production relationships, costs of production, and revenue. Chapter 7 describes the economics of input substitution and describes the economics of product substitution. Chapter 8 describes the determination of output and price under conditions of perfect competition. Finally, Chapter 9 describes the determination of output and price under conditions of imperfect competition.
- Part 4 examines the resource, environmental, and political setting in which producers and consumers of food and fiber products in the United States are immersed. Chapter 10 deals with resource and environmental economics. Chapter 11 focuses



on the rationale for government intervention and outlines the development and application of income and price supports in the United States, primarily from the 1930s to the present.

- Part 5 switches attention to the macroeconomy—what makes it tick and the important links between the food and fiber system and the rest of the economy. Chapter 12 discusses product markets and national output. Chapter 13 also focuses on the tools of monetary and fiscal policy. Chapter 14 centers attention on business fluctuations, addressing consequences and policy applications. Chapter 15 concerns the macroeconomics of agriculture using information gleaned from Chapters 11 to 14.
- Part 6 draws attention to international linkages and to the global economy. Chapter 16 focuses on agriculture and international trade. It examines exchange rates and agricultural trade. Chapter 17 addresses the issue of why nations trade. Chapter 18 concerns agricultural trade policy and preferential trading arrangements.

Consequently, the book addresses seven different facets: (1) agricultural economics and the food and fiber sector; (2) consumer behavior; (3) business behavior and market equilibrium in perfectly competitive and imperfectly competitive environments; (4) resource and environmental economics; (5) government intervention in the food and fiber industry; (6) the macroeconomics of agriculture; and (7) international linkages primarily concerning trade, exchange rates, and trade policy.

Importantly, we wish to develop the understanding of and the ability to apply the economic principles that agricultural economists use to understand and predict individual and aggregate economic behavior and the impact of such behavior upon the well-being of society. In short, we plan to provide you the reader a *framework to think for yourself*, at least in conjunction with issues indigenous to economics.

SUMMARY

The purpose of this chapter is to define the field of agricultural economics as a subset of the general field of economics. The major points made in this chapter are summarized as follows:

1. Scarce resources are human and nonhuman resources that exist in a finite quantity. Scarce resources can be subdivided into three groups: (1) natural and biological resources; (2) human resources; and (3) manufactured resources.
2. Resource scarcity forces both consumers and farmers to make choices.
3. Most resources are best suited to a particular use. Specialization of effort may lead to a higher total output.
4. The field of economics can be divided into microeconomics and macroeconomics. Microeconomics focuses on the actions of individuals—specifically the economic behavior of consumers and farmers. Microeconomic analysis largely deals with the notion of partial equilibrium; events outside the market in question are assumed to be constant. Macroeconomics focuses on broad aggregates, including the nation's aggregate performance as measured by gross domestic product (GDP), unemployment, and inflation. Macroeconomic analysis normally deals with the notion of general equilibrium; events in all markets are allowed to vary.
5. Positive economic analysis focuses on what-is and what-would-happen-if questions and policy issues. Normative economic analysis focuses on what-should-be or what-ought-to-be policy issues.
6. Capitalism, or free market economics, socialism, and communism represent alternative economic systems. The U.S. economy represents a mixed economic system. Some markets are free to determine price, and other market prices are regulated.
7. Agricultural economics is an applied social science that deals with how producers, consumers, and societies use scarce and natural resources in the production, processing, marketing, and consumption of food and fiber products.
8. Agricultural economists at the micro level are concerned with issues related to resource use in the production, processing, distribution, and consumption of products in the food and fiber system.



9. Agricultural economists involved at the macro level are interested in how agriculture and agribusinesses affect domestic and world economies

and how the events taking place in other sectors affect these firms and vice versa.

KEY TERMS

Agricultural economics	Human resources	Opportunity cost
Biological resources	Macroeconomics	Positive economics
Capital	Management	Scarce resources
Capitalism	Manufactured resources	Scarcity
Communism	Microeconomics	Socialism
Economics	Mixed economic system	Specialization
Fallacy of composition	Natural resources	
Food and fiber system	Normative economics	

TESTING YOUR ECONOMIC QUOTIENT

- Land, labor, and capital are examples of what three types of scarce resources?
 -
 -
 -
- An agribusiness firm may undertake three alternatives:

Alternative 1: buy cane sugar and manufacture various sugars and sweets, making a profit of \$10 million;

Alternative 2: buy wheat and produce bread, rolls, and pastries, making a profit of \$15 million; or

Alternative 3: buy corn and produce Tex-Mex foods, making a profit of \$12 million.

 - Which alternative should this agribusiness firm undertake? Why?
 - The opportunity cost associated with these three choices is \$ _____ million.
- Concern has been expressed on the part of Congress and the President about what should be the optimal tax rate for those individuals who make more than \$500,000 per year. This issue corresponds to what branch of economics?
 - What branch of economics is concerned with the effects of food safety (e.g., *E. coli*) on consumer demand for beef (i.e., what-if types of questions)?
 - What branch of economics is concerned with the rate of inflation and the unemployment rate?
 - What branch of economics deals with the consumption expenditures of AGEC 105 students at Texas A&M University?
- To economists, the word *marginal* means _____.
- Circle the correct answer. The U.S. economy represents what kind of economic system?
 - Capitalistic
 - Socialistic
 - Communitic
 - Mixed
- _____ is an applied social science that deals with how producers, consumers, and societies use scarce resources in the food and fiber sector.
- Circle the correct answer. Economic reasoning that is true for one individual but not for society as a whole is referred to as
 - specialization.
 - fallacy of composition.
 - opportunity cost.
 - normative economics.
- The Belford family owns a farm near San Angelo, Texas. Three alternatives exist for how to use the farm:

Alternative 1. Grow cotton. Cotton yield would be 500 pounds per acre. The price of cotton is \$0.96 per pound and production expenses are \$285 per acre.

Alternative 2. Grow wheat. Wheat yield would be 50 bushels per acre. The price of wheat is \$7.25 per bushel and production expenses are \$210 per acre.

Alternative 3. Lease out the acres. The Belfords' neighbor, Auld McDonald, will pay \$200 per acre for leasing, but the Belfords would still have expenses of \$40 per acre.



Based on this information, answer the following:

- a. Which alternative should the Belfords undertake? Why?
 - b. Given your answer to the previous question, what is the Belfords' opportunity cost per acre?
 - c. What is the total economic cost per acre for your answer?
9. Most resources are best suited for a particular use. For example, climate and other conditions in Florida allow resources to be used in orange production in lieu of wheat or potato production. What economic concept deals with this issue?
 10. A Gini coefficient of _____ indicates perfect inequality in the distribution of wealth.
 11. What economist was a champion of capitalism and referred to the "invisible hand of the market"?
 12. What economist proposed a redistribution of wealth through a global tax?

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GRAPHICAL ANALYSIS

In many of the chapters to follow, students must understand the construction and interpretation of graphs. Given the emphasis in this book on graphical analysis, we provide a tutorial on this subject. We begin with the construction of a graph from the numbers in a table documenting the relationship between two variables.

Constructing a Graph

Two variables can be related in different ways. For example, there is a direct relationship between yields and fertilizer usage (at least over some relevant range). That is to say, the greater the amount of fertilizer applied, the higher the yield. In more general terms, the increase in one variable may be associated with an increase in another variable. Two variables can also be inversely related. As the price of gasoline increases, individuals will find ways to reduce their consumption of this product, all other factors invariant. Here, an increase in one variable is associated with a decrease in another variable. Finally, students will encounter instances later in this book in which the relationship between two variables is mixed. For example, consider the relationship between yields and rainfall. Yields will increase sharply as we move from a situation of no rainfall to some normal amount. Beyond this level of rainfall, however, yields may actually begin to decline as a result of farmers not being able to get into the fields at the proper time, low-lying areas being washed out, and so on.

Table 1-1
TWO RELATED VARIABLES: PRICE AND QUANTITY

Price per Pair (\$)	Quantity Sold during the Week	Location on Graph
9	20	A
8	30	B
7	40	C
6	50	D
5	60	E
4	70	F

To illustrate how to graph two related variables, let us assume that a local farm input supply dealer has noted a relationship between the price charged for work gloves and the number of pairs of work gloves sold during the week (see Table 1-1). The data in Table 1-1 should suggest to you that there is an inverse relationship between the price of a pair of work gloves and the number of pairs sold. As the price decreases, there is an increase in the quantity sold.

The price–quantity relationship in Table 1-1 can be viewed as coordinates on a graph. In economics, it is customary to put the dollar values (price in this instance) on the vertical, or Y, axis and quantity on the horizontal, or X, axis. Figure 1-2 shows the location of these price–quantity coordinates on a graph. Point A, for example, represents the observation that 20 pairs of gloves will be sold if the price per pair is \$9. Assume for the moment that the sales of work

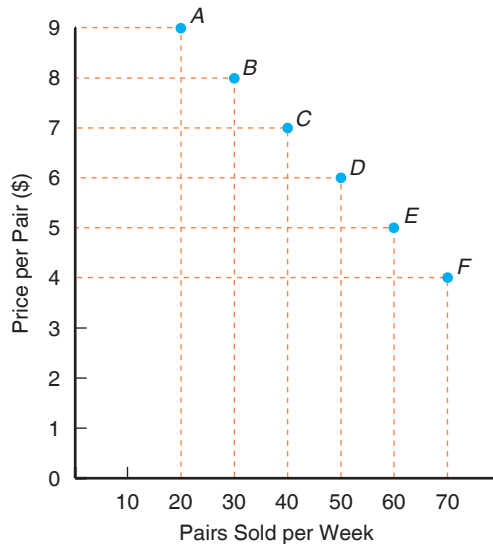


Figure 1-2

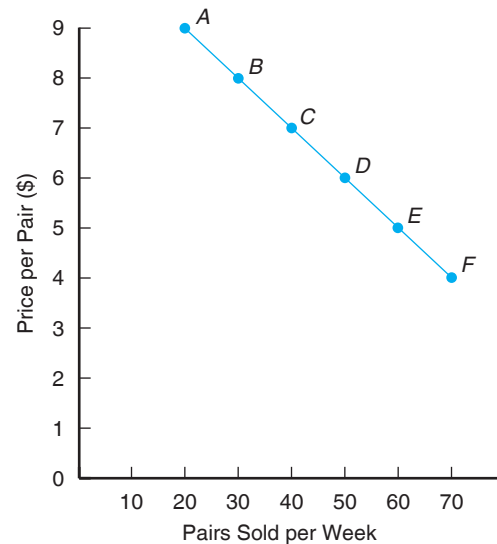
Graphing relationship between price and quantity.

gloves are perfectly divisible; that is, we can sell one-fourth or one-eighth of a work glove. This division allows us to have a quantity relationship at every possible price between the \$4 and \$9 range cited in Table 1-1 and also allows us to connect points A through F with a solid line. This line is normally referred to as a *linear curve* by economists, although this line does not curve at all. The term *nonlinear curve* refers to the situation wherein the relationship among respective variables is not linear.

Slope of a Linear Curve

An important feature of a curve to an economist is its slope, or the ratio of the change in the vertical axis to the change in the horizontal axis (rise over run). To illustrate the calculation of the slope for a linear curve, let us return to the price–quantity relationship observed for work gloves in Table 1-1. The slope of the linear curve is found by dividing the change in the values on the Y, or vertical, axis by the corresponding change in the values on the X, or horizontal, axis. As we move from point A to point B on this curve, the price per pair of work gloves falls by \$1 because we moved from \$9 a pair to \$8 a pair. The corresponding change in quantity of gloves sold per week was 10 pairs, or 30 pairs minus 20 pairs. The slope of this curve therefore would be

$$\begin{aligned} \text{slope} &= \text{Change in price} \div \text{Change in quantity} \\ &= -\$1.00 \div 10 \text{ pairs} \\ &= -\$0.10 \text{ per pair} \end{aligned}$$



Thus, the slope of this linear curve at *all* points along this curve is \$0.10. A specific property of a linear curve (which you should prove to yourself by examining other points along the curve) is that its slope is the same between any two points (i.e., its slope is constant).

Because economists often discuss basic demand and supply relationships in terms of the slopes of these curves, you must understand the difference between a positive slope, a negative slope, a zero slope, and an infinite slope. Each of these slopes is illustrated in Figure 1-3.

Positively and negatively sloped curves can take on a variety of shapes. Figure 1-4, for example, shows that a positively sloped linear curve (also called a ray) starting from the origin at a 45-degree angle has a slope of 1.0. At all points along this line, the quantity of Y is exactly equal to the quantity of X. A line with a positive slope of 0.5 will be flatter than the line having a positive slope of 1.0. Finally, lines with a slope of greater than 1.0 will be steeper than either of the first two curves.

Figure 1-4 suggests the following conclusion: the greater (smaller) a positive slope, the steeper (flatter) a linear curve will be. The opposite is true for negatively sloped linear curves.

Slope of a Nonlinear Curve

Although the slope of a linear curve is constant over the entire range of the curve, the slope of a nonlinear curve is not. A nonlinear curve, in fact, can exhibit a positive,

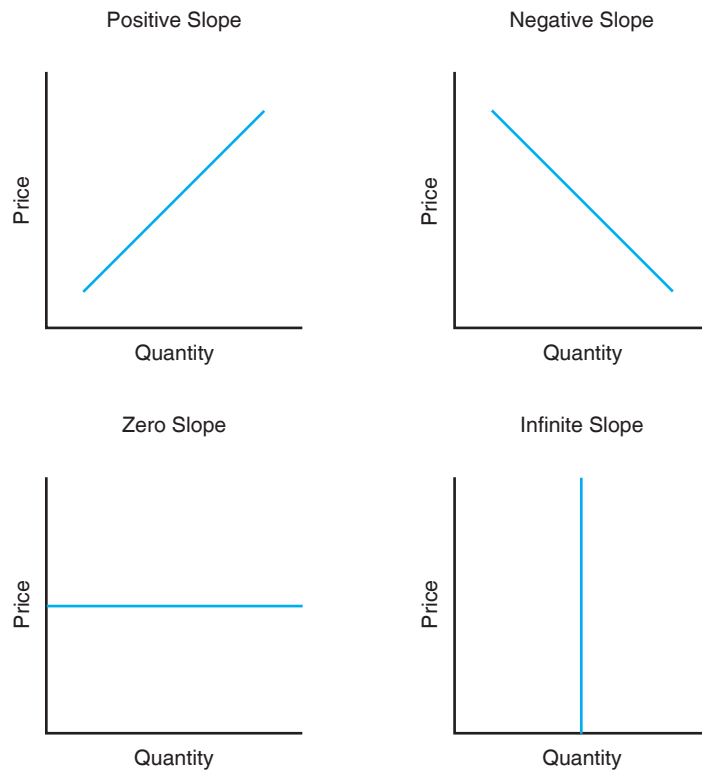


Figure 1-3
Alternative slopes of linear curves.

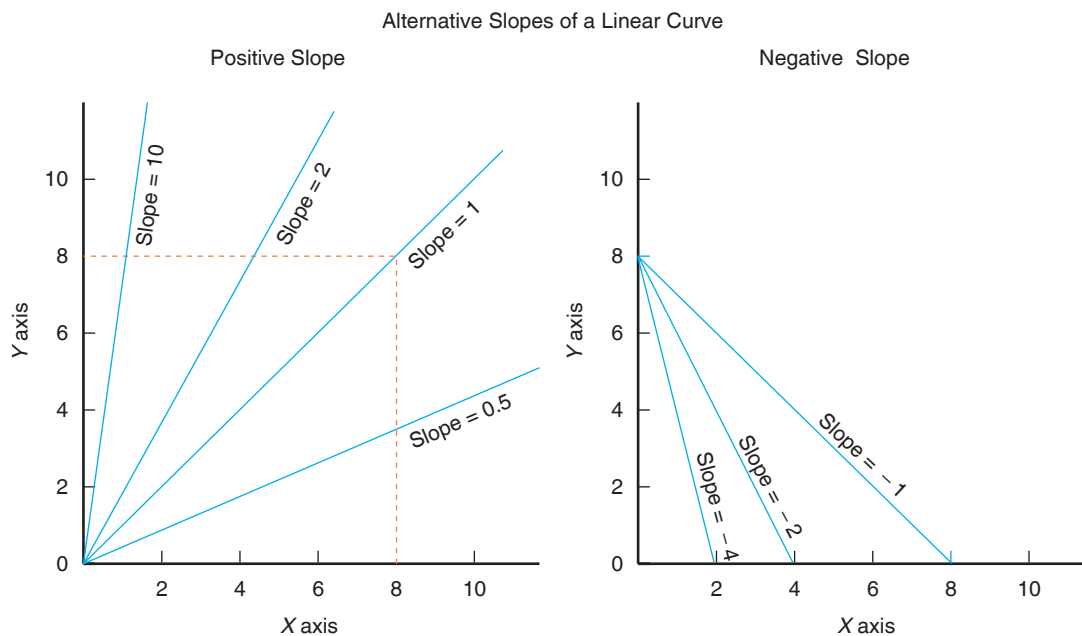


Figure 1-4
A ray from the origin (zero units of Y and zero units of X) with a 45-degree angle will have a slope of 1. Linear curves with a positive (negative) slope of less than 1 will be flatter (steeper), while linear curves with a slope greater than 1 will be steeper (flatter).

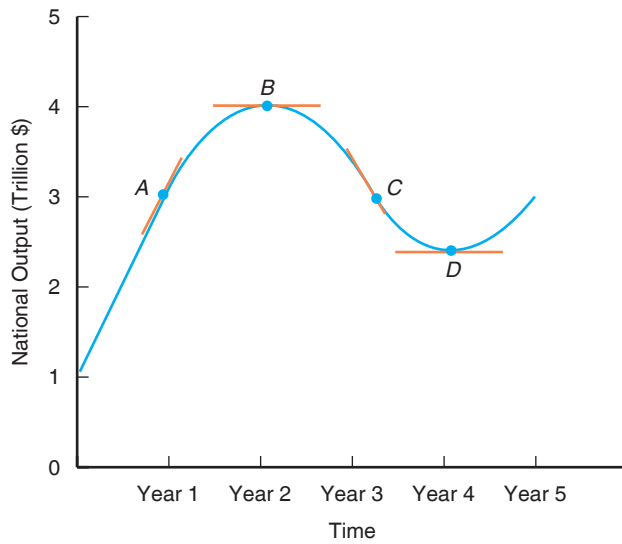


Figure 1-5
Slope of a nonlinear curve.

negative, or zero slope. Consider the nonlinear curve presented in Figure 1-5, which shows a time path for a business cycle over a period of time.

The slope at specific points along a nonlinear curve is calculated by computing the slope of a linear curve tangent to the nonlinear curve at these points. The slope at point *A* in Figure 1-5 is positive, indicating a positive growth in the economy at that point. The slope at point *B* is zero, indicating no change in the nation's output during the period. The slope of point *C* is negative, indicating a negative growth in the economy or a recession. At some point in time, the economy will bottom out (point *D*) and begin a period of positive economic growth.