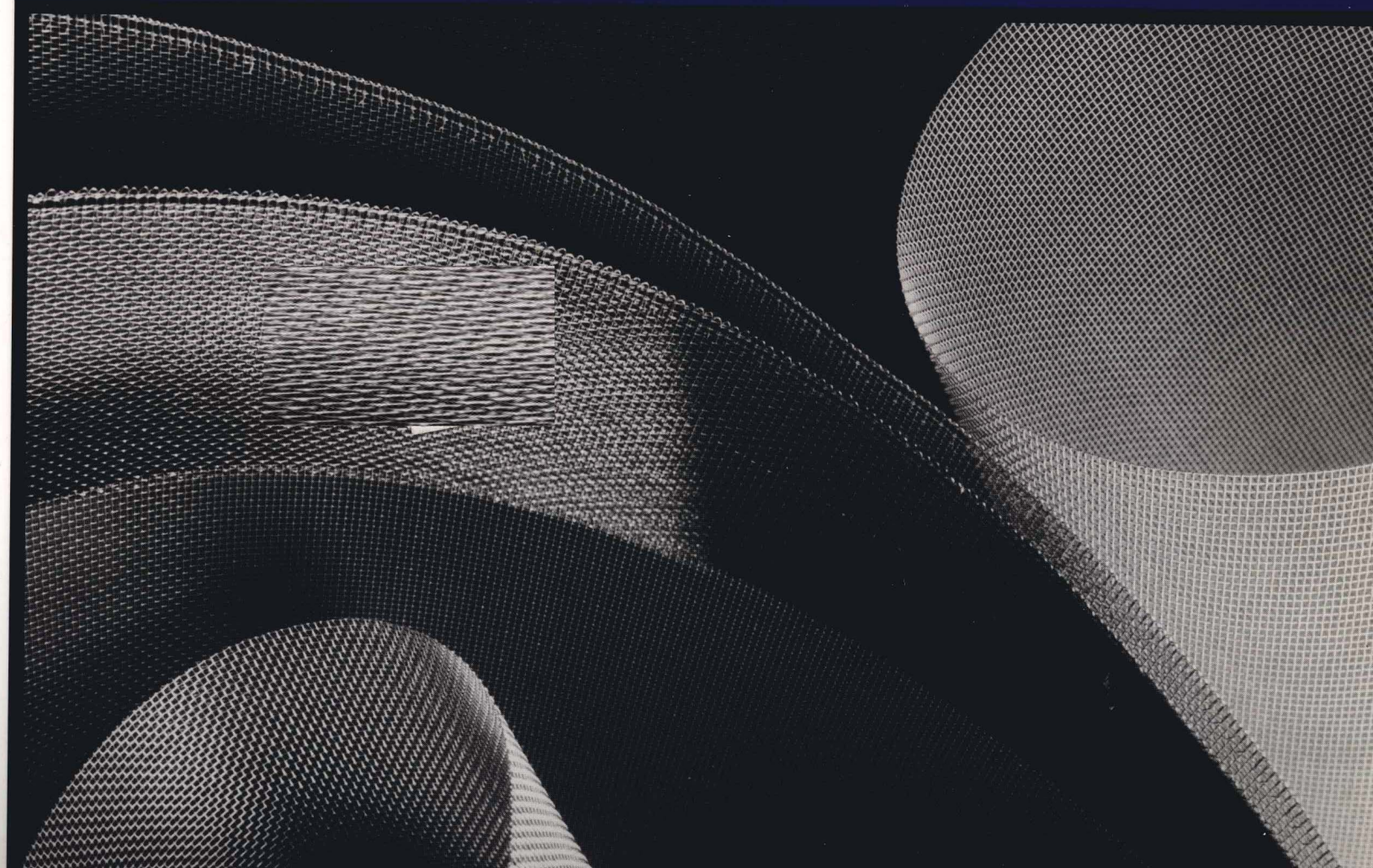
Robert S. Pindyck · Daniel L. Rubinfeld

Study Guide

Valerie Y. Suslow • Jonathan Hamilton

THIRD EDITION

MICROECONOMICS



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Microeconomics

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PREFACE

This Study Guide accompanies the third edition of *Microeconomics* by Robert Pindyck and Daniel Rubinfeld and, when used in conjunction with the textbook, can be a useful learning tool to help reinforce the basic concepts presented in the text. This Study Guide also presents numerous problems and provides detailed answers to help you gain practice in working through economics problems. You should not use this Study Guide as a substitute for the text, which provides complete coverage of the material.

CONTENTS OF THE STUDY GUIDE

- Important Concepts
- Chapter Highlights
- Concept Review and Exercises
- Multiple Choice Questions
- Problem Sets

Each chapter of the Study Guide corresponds to a chapter in the textbook. At the beginning of each Study Guide chapter is a checklist of the important concepts covered in the corresponding chapter of the textbook. This list is followed by the "Chapter Highlights," which present a summary of the chapter containing quick definitions of the important concepts that will be reviewed. The core of each Study Guide chapter is the section entitled "Concept Review and Exercises," which presents short summaries of each key concept and exercises you can use to test your understanding as you read through the summaries. The concept reviews are organized to follow the text, section by section. Again, note that these section summaries are too condensed to use as a replacement for the material in the text.

The concept review is followed by a set of multiple choice questions that you can use to test your knowledge of the basic definitions and concepts. A "Problem Set" with more challenging short-answer questions to solve follows the multiple choice questions. The answers to the Exercises, Multiple Choice Questions, and Problem Set are given at the end of each chapter.

Notation Used in the Study Guide:

1. Some sections are marked with an asterisk to correspond with similarly marked sections in the text denoting that they are either more difficult or optional. Certain questions in the Study Guide are also marked with an asterisk, to denote that they require calculus or correspond to an optional section.

2. The figures in the answer section at the end of each Study Guide chapter are marked with the letter "A" (e.g., Figure 4A.5), in order to distinguish these figures from those in the concept review section. It will be clear in the context of the discussion which graph is relevant.

SOME HINTS ON APPROACHING ECONOMICS PROBLEMS

Most economics problems can be approached in three different ways: intuitively, graphically, and mathematically. The intuitive approach works well for simple problems. As you progress through this economics course, your economic intuition will develop. For the more complex problems, however, you might find that you will miss some of the finer points (i.e., the right answer!) if you rely on intuition rather than putting pencil to paper. This said, it is worth emphasizing that even if the intuitive approach can't always provide you with the exact answer, you should never ignore your economic intuition. There may be times when the algebra or the graphs become confusing. Or, you may make a simple algebraic error and find that the answer you get "just doesn't make economic sense." In those cases, let your intuition guide you to the correct answer or at least the correct approach to the problem, even if you can't work the problem through to the end.

For both simple and complex problems you can always turn to graphs to capture the essence of the problem. The benefit to learning how to use graphs is that they focus your attention on only the necessary elements of the problem. If you don't conceptualize problems well using equations, try drawing the graph first, and it will lead you to focus on the right equations. Using graphs also forces you to prove to yourself that you understand the material. Don't take your instructor's word for it when he or she draws several curves and says that something must therefore be true. Redraw the graph and convince yourself that it is true. Finally, graphs are useful because they can provide a qualitative answer to a problem when the math fails you.

Some students don't see things easily in a graphical representation and prefer working with algebra or calculus. If math is your strength, approach the problem mathematically first, then draw the corresponding graph.

Everyone who takes an economics course will have at least some trouble learning how to apply the concepts learned in class and in the text to "word problems." It is true that learning how to approach economics problems takes practice. Economics problems do tend to follow a logical progression, but at first it can be hard to tell which concept needs to be applied, given the situation described in the problem. You will find the task much easier if you concentrate first on learning the basic definitions. This will help you to feel secure about the building blocks in each chapter and you can then attack the problems with confidence.

NOTES ON LINES AND CURVES

If your basic algebra skills are rusty, you will find it difficult to work through quantitative economics problems and to manipulate the many lines and curves used to illustrate economic concepts. A good grounding in mathematics will allow you to concentrate on the economics rather than on the algebra. Your instructor can recommend a review book to you if you feel your math skills are particularly weak. If all you need is a quick refresher, the following notes may be of help.

Mathematical functions are convenient methods of stating relationships between variables in economic and business analysis. A *variable* is some quantity or attribute that can take on a set of values. The simplest relationship is one between only two variables, where the goal is to explain the behavior of one variable on the basis of values assigned to the other. For example, we might observe that sales are related to

advertising expenditure or that revenue is related to sales. Such relationships can be expressed in a specific form if there is enough information about a particular company or product. For example, we might know that

(1) $$\text{Sales} = 100 + 0.5*\text{Advertising},$$

or

(2) $$\text{Revenue} = 10*\text{Sales} - .05*\text{Sales}^2.$$

Other times we may not have the explicit form and can only write: Revenue = f (Sales), where f (•) denotes that there is a functional relationship. Most relationships used in economics are functional relationships. A *function* is denoted $y = f(x)$, and is read "y equals f of x." (Note that f (x) does not mean f times x.) A function is a rule or method for assigning a unique value of y for each x. If Q represents quantity demanded and P represents the price, we can express the relationship between quantity and price in a general functional form as $Q = f(P)$. Every value of P uniquely determines a value for Q. Here we say that Q is the dependent variable, which is determined by the independent variable P.

Finally, relationships between variables may be given graphically. Figures 1 and 2 show the relationships described by equations (1) and (2) above.

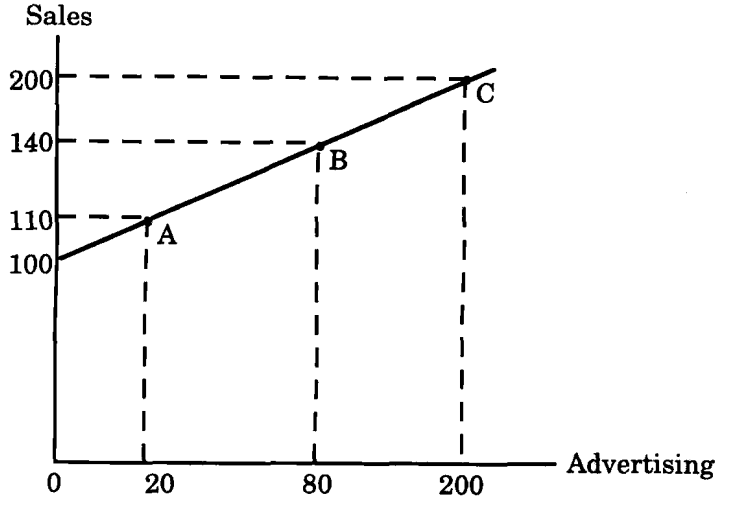

Figure 1

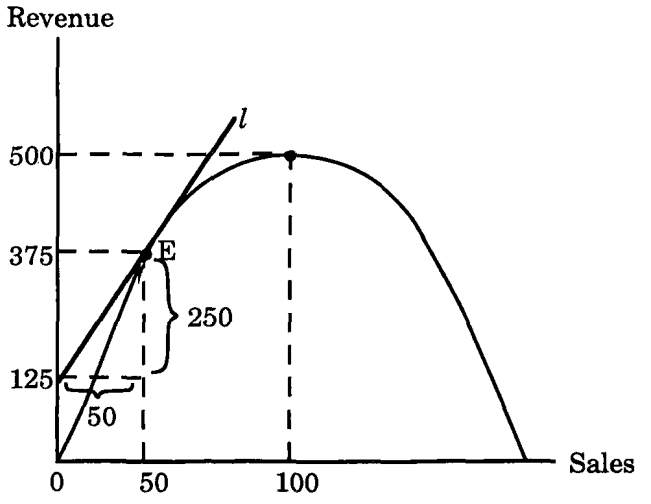

Figure 2

The rate of change in the dependent variable as the independent variable changes is the *slope* of a function. Symbolically, the slope is expressed as $\Delta y/\Delta x$, which is read "the change in y caused by a change in x." In Figure 1, as we move from point A to point B, sales increase from 110 to 140. Over the same interval, advertising increases from 20 to 80. Thus,

$$\frac{\Delta \text{Sales}}{\Delta \text{Adv.}} = \frac{110 - 140}{20 - 80} = \frac{-30}{-60} = +0.5$$

The rate of change from B to C is also +0.5. Thus, the slope of the line drawn in Figure 1 is constant and equal to 0.5 between any two points on the line. Other examples of linear functions are: $y = 2x$, $y = 0.5x$, $y = 2 + 4x$, or $y = 10 - 5x$. In general, any linear function can be expressed as $y = a + bx$, where a and b are fixed numbers (they are constants that are specified in the equation or given in the problem). The term a is defined as the y-intercept (where the line crosses the y-axis) and represents the value of y when x is equal to zero. In Figure 1 the y-intercept is 100. The term b is defined as the slope. In general, for <u>any</u> linear function, $y = a + bx$, the slope is equal to b and the y-intercept is equal to a. If y is set equal to zero we can find the x-intercept by solving for x. In general, the x-intercept is equal to $-a/b$.

The equation of the line in Figure 1 is written $y = 100 + .5x$ or Sales = 100 + .5Advertising. We found this equation by first finding the slope and then looking at Figure 1 to see that the y-intercept is 100. What if we knew only that points B and C were on the line, but we weren't given the equation? It turns out that you can solve for the equation of a line given two points on the line. After finding the slope, write the equation in general form as $y = a + .5x$. Now plug in <u>any</u> point on the line into your equation. Take point C in Figure 1, for example: then $200 = a + .5(200)$, or $a = 100$. Therefore (again) the equation of the line is $y = 100 + .5x$. The x-intercept of this line is found by setting $y = 0$ and solving for x: $0 = 100 + .5x$, or $x = -200$. Thus, the entire line looks like that in Figure 3.

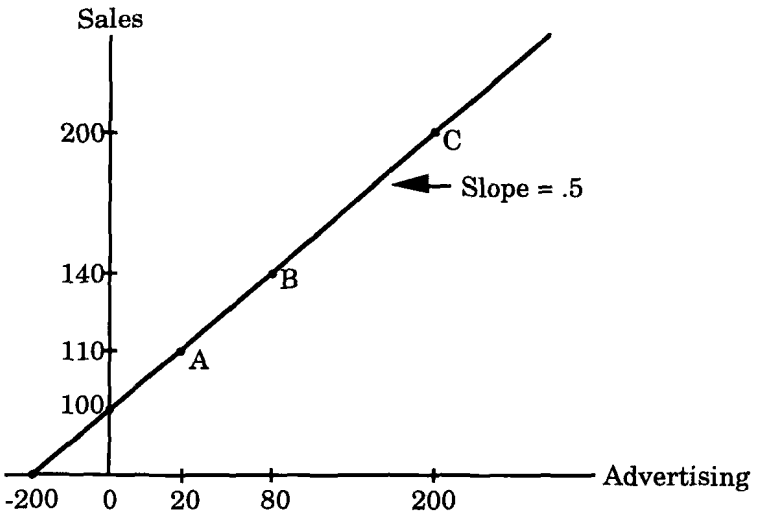

Figure 3

Let's do the same for a line with a negative slope. Suppose you know that two points on a line are $(x_0, y_0) = (2,46)$ and $(x_1, y_1) = (15,20)$. The slope of the line is $\Delta y/\Delta x = (46 - 20)/(2 - 15) = 26/-13 = -2$. So far, we have $y = a - 2x$. Now plug one point into the equation to find a: $20 = a - 2(15)$, or $a = 50$. Therefore, the equation of the line is $y = 50 - 2x$. The slope is -2, the y-intercept is 50, and the x-intercept (setting y = 0) is 25. This line is drawn in Figure 4.

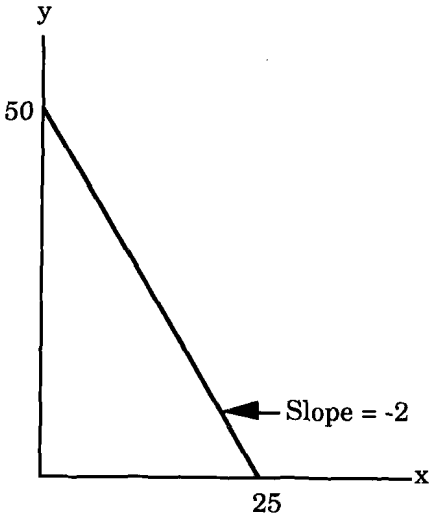

Figure 4

Examples of nonlinear functions are $y = x^{1/2}$, or $y = a + bx + cx^2$. The slope for nonlinear functions is still defined as $\Delta y/\Delta x$, but it takes on different values at different points along the curve. Focusing on the revenue function in Figure 2, we see that if sales increase from 0 to 100 units, revenue goes from \$0 to \$500, implying a slope of 5. But if we look at sales between 50 and 100, revenue increases from \$375 to \$500 and we get a

slope of 125/50 or 2.5. Thus, the slope of a curve depends on where you measure it. It is therefore useful to have a measure of the rate of change at a point (i.e., the slope for infinitesimally small changes in x and y). Graphically, this is the slope of the line tangent to the point in question. Thus, at sales of 50, the line in Figure 2 labeled l is the line tangent to the curve at point E. This tangent line has a slope of 5, as inspection of Figure 2 shows.

*For Students Who Want to Use Calculus

It is not necessary for you to know calculus in order to understand the concepts presented in the text. If you choose to, however, you can use a calculus-based approach to some of the concepts and problems, particularly if you want to calculate the rate of change at a point, which is given by the derivative of the function. Provided below is a brief review of the basic rules for taking derivatives of functions:

Function	Derivative $y' = dy/dx$	Example
y = constant	$y' = 0$	$y=10$; $y' = 0$
$y = x$	$y' = 1$	—
$y = kx$	$y' = k$	$y = 10x$; $y' = 10$
$y = kx^2$	$y' = 2kx$	$y = 3x^2$; $y' = 6x$
$y = kx^n$	$y' = knx^{n-1}$	$y = x^{31}$; $y' = 31x^{30}$
$y = f(x) + g(x)$	$y' = (df/dx) + (dg/dx)$	$y = 10x - .4x^2$; $y' = 10 - .8x$
$y = f(x)g(x)$	$y' = f(x)(dg/dx) + (df/dx)g(x)$	$y = (2x)(x^3)$; $y' = 2x(3x^2) + 2(x^3) = 8x^3$
$y = g(z(x))$	$y' = (dg/dz)(dz/dx)$	$y = 10z$, where $z = 3 - 5x$; $y' = (10)(-5) = -50$

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Our thanks go out to a number of people for their assistance with the third edition of this Study Guide. A special debt of gratitude is owed to Melinda Stuber, who worked long hours to pull the project together in its final stages. Thanks also go to Stacy Ferry, who was always patient, regardless of the number of times she was asked to fine tune a graph. Expert secretarial assistance was also provided by Marilyn Daigle, Linda Gorlitz, and Pamela Brown. Several students, including Chris Booms, Mitch Fisher, and most particularly, Todd Solomon, proofread the problems to help us find errors and point out where clarifications were needed. Finally, thanks to the editorial staff at Prentice Hall, who provided valuable input at each step of the way.

CONTENTS

CHAPTER 1
PRELIMINARIES

IMPORTANT CONCEPTS IN THIS CHAPTER

Positive Theories
Normative Theories
Microeconomics
Macroeconomics
Perfectly Competitive Market
Noncompetitive Market
Nominal Prices (Current Dollars)
Real Prices (Constant Dollars)

CHAPTER HIGHLIGHTS

Economics concerns itself with the allocation of scarce resources across competing wants and desires. It is a social science that seeks to answer both positive and normative questions. *Positive theories* try to describe the world: for example, why do firms in different industries exhibit different pricing behavior? how will the savings rate change in response to a change in the tax law? *Normative theories* are used to prescribe policies for both governments and businesses: should the government regulate pharmaceutical prices? should a business enter into an international joint venture? It is important to remember that normative economics must rest on a base of positive economics -- to suggest a policy solution to an economic problem, one must first understand who will be affected by the policy and what the probable effects will be. Economics does not tell us what policies should be chosen, but helps guide those who must make the decisions.

Microeconomics is the branch of economics that studies the behavior of individuals, such as consumers, workers, and firms. *Macroeconomics*, the other principal branch of economics, concentrates on the study of economic aggregates, such as the gross national product, the unemployment rate, and the money supply.

A *market* is a collection of buyers and sellers who interact with the intention of trading a good or service. The extent of a market is defined by its geographical and product boundaries. Some products are traded in local markets, while others are worldwide in scope. Similarly, some markets deal in a single product, such as raw sugar, while others cover a variety of differentiated products, such as subcompact, compact, and mid-sized cars.

A *perfectly competitive market* is one with many buyers and sellers, in which no individual buyer or seller has a significant impact on the price. In competitive markets, a single price, known as the market price, will usually prevail. A *noncompetitive market* is one in which individual firms can affect the market price. In noncompetitive markets, sellers may sometimes charge different prices. For now you need only understand that these distinctions are necessary because all markets do not look alike. Later we will study in detail how the different characteristics of a market lead to important differences in the price (or prices) charged, output, advertising, research and development, and so on.

In order to compare prices of goods and services in a given market over time it is crucial to take account of changes in the overall price level. *Nominal prices* are the "raw" or observed price data, with no adjustments for inflation. They are sometimes called "current dollar" prices. *Real prices* are prices that are adjusted according to an index of the overall level of prices. They are sometimes called "constant dollar" prices because the price index attempts to hold constant the value of a dollar over time. The most commonly used overall price index is the Consumer Price Index.

CONCEPT REVIEW AND EXERCISES

POSITIVE VERSUS NORMATIVE ANALYSIS (Section 1.2)

There is a difference between asking "what will happen?" and "what is best?". Business managers and public policy makers ask both kinds of questions. *Positive analysis* deals with explanation and prediction. What will happen to teenage unemployment if the federal government raises the minimum wage by 25 cents? *Normative analysis* deals with what ought to be. Realizing that some teenagers will be better off with a higher minimum wage while others will lose their jobs, is raising the minimum wage in the general public interest? Both types of questions have their value. It is important to realize, however, that positive analysis must come before normative. In other words, in order to weigh different policy choices or to design an optimal policy, one must know what will happen if the policy is carried out.

1. Identify the following statements as positive or normative:

a) Solar energy will be used increasingly over the next hundred years.
b) Taxes on wealthy citizens of the U.S. are too high.
c) If the U.S. government lifts the current sugar quotas, the price of sugar will fall and the corn syrup industry will suffer.
d) An increase in advertising by one major automobile company will affect the sales of the other automobile companies.
e) Mergers between two companies should always be allowed.

Normative analysis may involve a value judgment. For example, a merger might be good for the two firms involved (if costs go down) and bad for consumers (if prices go up). Normative analysis often involves weighing improvements in economic efficiency against changes in the distribution of income (equity). Microeconomics can only point out the costs and benefits of the potential action or actions, it cannot tell us what the best policy is. That is up to each person or society to decide.

WHAT IS A MARKET? (Section 1.4)

A market is a collection of buyers and sellers that interact, resulting in the possibility for exchange. In this chapter, it is only necessary for you to have a basic understanding of the difference between a competitive and a noncompetitive market. We will be spending time discussing markets in detail in later chapters of the text.

A *perfectly competitive market* is characterized by the fact that there is a "going market price" which all buyers pay and all sellers receive, and no one player in the market can individually affect that price. Each buyer and each seller is much too small a part of the overall market to have their actions affect the market price. Even if an individual seller offers to sell double the amount they usually sell, it is just a drop in the bucket compared to the total sales in the market. In a *noncompetitive market*, a single firm is large enough (relative to the size of the market) to affect the price of the product. Also, there can be more than one price in a noncompetitive market, especially if there is brand loyalty on the part of the consumers towards certain products.

Note that when we speak of a "market," that market may be local, regional, national, or global. For example, you might think that the market for contact lenses is local -- you must get them through your local optometrist. However, there are mail order companies that sell contact lenses nationwide. Knowing this might make you change your opinion of the extent of the market. In addition, the market may encompass just one good or many related goods. Is it accurate to say that there is one market for automobiles? Or, is it more realistic to talk about a market for subcompacts, a market for compacts, a market for minivans, and so on?

2. Decide whether you think the following markets are competitive or noncompetitive and why:

a) The market for wheat.
b) The market for colas.
c) The market for local residential electricity.

3. Decide whether you think the following products should be defined as a market and why:

a) McDonald's hamburgers.
b) Fast-food restaurants in Cambridge, Massachusetts.
c) All restaurants across the U.S.

REAL VERSUS NOMINAL PRICES (Section 1.5)

When comparing prices over time, they should always be adjusted for inflation (the movement in prices overall). That is, prices should be measured in *real* terms (constant dollars), rather than in *nominal* terms (current dollars). For example, suppose overall prices have gone up by five percent over the last year and you received a five percent increase in your wages. Your nominal wages have increased, but in real terms you are no better off than you were last year.

In order to calculate the real price of a good, you need a measure of the movement in overall prices. The most commonly used measure is the Consumer Price Index. Table 1.1 of the text shows that the CPI went up from 82.4 in 1980 to 107.6 in 1985. This means that consumer prices rose about 31 percent from 1980 to 1985. (The percentage increase is (107.6 - 82.4)/82.4, which is roughly .31 or 31 percent.) Therefore, since we know from Table 1.1 that the nominal price of a college education went up from $4,912 in 1980 to $8,156 in 1985, we can calculate whether a college education grew more or less expensive in real terms between 1980 and 1985. The real price of college education in 1985, in terms of 1980 dollars is:

(CPI_{1980}/CPI_{1985}) x Nominal price in 1985 = (82.4/107.6)$8,156 = $6,245.86

Therefore, the real price of a college education rose by roughly 27 percent between 1980 and 1985 (comparing $4,912, which is already in 1980 dollars, with $6,245.86).

4. The nominal price of a college education rose to $15,212 in 1993. The CPI was 107.6 in 1985, 130.2 in 1990, and 144.0 in 1993. What was the real price of a college education in *1993* in terms of *1985* dollars? *In terms of 1990 dollars?*

MULTIPLE CHOICE QUESTIONS

1. Asking whether a tax on carbon dioxide should be imposed to prevent ozone depletion is:
a) A question of positive economics.
b) A question of normative economics.
c) Not an economic question; it involves chemistry and physics.
d) a) and b).
e) *None of the above is correct.*

2. Asking whether an increase in the minimum wage will increase unemployment is:
a) A question of positive economics.
b) A question of normative economics.
c) A political question, not an economic question.
d) a) and b).
e) None of the above is correct.

3. A perfectly competitive market has:
a) Many buyers and sellers.
b) Several large buyers.
c) A meeting place for buyers and sellers.
d) a) and b).
e) a) and c).

4. Which of the following markets do you think is perfectly competitive?
a) The market for local phone calls.
b) The world soybean market.
c) The world oil market.
d) b) and c).
e) a), b), and c).

5. Which of the following markets do you think is noncompetitive?
a) The international television market.
b) The U.S. grain market.
c) The U.S. instant camera market.
d) All of the above.
e) None of the above.

6. The constant dollar price of a good:
   a) Is the same as its real price.
   b) Is the same as its nominal price.
   c) Adjusts for inflation in the overall price level.
   d) b) and c).
   e) a) and c).

7. If the real price of a college education has risen during a period of inflation:
   a) Its nominal price has not changed.
   b) Its nominal price has risen slower than a general index of prices.
   c) Its nominal price has risen faster than a general index of prices.
   d) Its current dollar price has not changed.
   e) None of the above is correct.

PROBLEM SET

1. State whether each of the following questions is positive or normative. If it is normative, what positive questions would have to be answered before the normative question can be answered?

   a) If a freeze wipes out 15 percent of this year's Florida orange crop, what will be the impact on orange juice prices at the supermarket?

   b) How much oil conservation (from switching to smaller cars, carpooling, etc.) will a $0.50 per gallon tax on gasoline achieve?

   c) To fund airport expansion, should the U.S. use a tax on airfares or a tax on jet fuel combined with airport landing fees?

   d) If all small businesses are required by law to provide health insurance to their employees, will the number of small businesses decline?

   e) Would higher gasoline prices (through taxes) or Federal government standards on automobile mileage be a better way to reduce gasoline consumption?

2. You have been hired to examine whether consumption of gasoline has been affected by changes in the price of gasoline over time. To complete the analysis you need to adjust nominal gasoline prices per gallon for changes in the overall price level. Use the data below to calculate the real price of gasoline for 1977 and 1989 using 1970 dollars.

Year	Gasoline Price ($/gallon, including taxes)	Consumer Price Index (1982-84 = 100)
1970	0.28	38.8
1977	0.58	60.6
1989	1.10	124.0

3. Since 1985, the barriers between markets in European countries that are members of the European Community have been lowered considerably.

   a) What is happening to the geographical extent of the market for many goods in Europe as a result?

   b) Do you expect that lowering barriers would tend to make markets more competitive or less competitive?

ANSWERS TO CHAPTER 1

EXERCISE ANSWERS

1. a) Positive.

b) Normative.

c) Positive.

d) Positive.

e) Normative.

2. a) Competitive: many small buyers and sellers.

b) Competitive (although debatable): There are two large firms, Coke and Pepsi, and a number of smaller firms. At times these firms behave very competitively.

c) Noncompetitive: there is usually just one regulated regional or state public utility which sells electricity to local residences.

3. a) Too narrow: McDonald's hamburgers compete with other McDonald's products (e.g., chicken sandwiches) and they compete with meals sold at other fast-food chains.

b) This may constitute a reasonable product market, although you might also want to include frozen dinners. Geographically, this market is too broad. Even though Cambridge is not a large city, fast-food restaurants tend to compete most intensely with other fast-food restaurants located within easy walking or driving distance.

c) Too broad, both in terms of the product and geographic definition: First, a fine four-star restaurant does not compete with fast food-restaurants. Second, restaurants compete in local markets, not in a nationwide market.

4. The real price of education in 1993 in terms of 1985 dollars is

$(CPI_{1985}/CPI_{1993})\$15{,}212 = (107.6/144.0)\$15{,}212 = \$11{,}366.74.$

The real price of education in 1993 in terms of 1990 dollars is

$(CPI_{1990}/CPI_{1993})\$15{,}212 = (130.2/144.0)\$15{,}212 = \$13{,}754.18.$

MULTIPLE CHOICE ANSWERS

1. b) The question asks whether a given policy *should* be adopted.

2. a) This is a descriptive question about the response in the labor market to an increase in the wage rate.