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AN ECONOMICS PRIMER FOR COASTAL ZONE MANAGEMENT: BASIC CONCEPTS AND METHODS FROM MICROECONOMICS, PUBLIC FINANCE, AND ENVIRONMENTAL AND RESOURCE ECONOMICS

by

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January 1986

TECHNICAL REPORT 86-1

This report was prepared with funds from the J. N. Pew Jr. Charitable Trust, the Woods Hole Oceanographic Institution's Marine Policy and Ocean Management Center, and the Department of Commerce, NOAA, National Sea Grant College Program, under Grant No. NA84AA-D-00033.

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ABSTRACT

While the economic impacts of resource use pervade discussions of coastal zone management, most discourses tend to be ill-defined and incomplete, and to lack a solid basis in economic theory. This primer was written to eliminate this confusion for those non-economists who seek insight into economic thought and into how economic analysis can contribute to coastal zone management. The first half of the report introduces readers to basic concepts and analytical methods in microeconomics, public finance, and environmental and resource economics. The foundation for monetary valuations becomes apparent as the concepts are explained. The realization that neither markets nor prices are required for economic valuations is an important result of the explication. Consequently, one can assess losses associated with pollution, reduced access, and so on in units that are commensurable with market-oriented development.

The second half of the primer inculcates these basic concepts and methods through (1) critiques of several stereotypical, pseudoeconomic arguments, (2) a case study of the benefits of protecting water quality for recreation, and (3) a benefit-cost analysis of a hypothetical acquisition program that is intended to protect groundwater quality, to protect opportunities for aquatic recreation, and to reduce the growth in traffic.

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PREFACE

If a reporter stopped you on the street and asked you to define economics and economic value, what would you say? Your responses would probably involve household and business finances and characteristics of the national economy such as prices, markets, inflation, interest rates, unemployment, deficits, recession, and gross national product. And most responses would be correct in a general way. However, if the reporter pressed you for precise definitions, we would soon find some fundamental disagreements between economists and non-economists. Among other things we would probably have different definitions of costs and profits, of the relationship between price and value, and of whether markets are necessary for economic value to exist.

One purpose of this primer is to introduce non-economists to some basic economic concepts and to some methods for the analysis of economic issues, in particular as those concepts and methods apply to coastal zone management. You will soon learn that it is easy to "think economically." That is, many economic concepts are quite logical--even common sensible--and easy to grasp. Other concepts will require more explication but they, too, will become evident. It will be helpful if you approach the primer with an open mind and consider the time spent an effort to learn a new language that happens to use English words.

I was motivated to write this primer by the enormous confusion that surrounds arguments on the use of natural resources in the coastal zone. "Economic" arguments invoked by those who are pro- or anti-development can fall into several traps. These arguments may often be misused (perhaps inadvertently), may mix statements of alleged economic benefits and costs with personal beliefs on what <u>should</u> be done, or may omit important components of economic value that are not captured in the marketplace. The fundamental goal of the primer is to teach the reader enough about economics to ask clear, thoughtful questions of those who either promise benefits or warn of costs associated with conflicting uses of resources in the coastal zone. Thus, I hope to help ferret out the confusion, the misconceptions, the misuse, and the personal biases inherent in commonplace arguments, and to provide an objective understanding of economic benefits and costs.

The word objective is emphasized. A proper economic analysis is concerned only with the efficient allocation of resources. That is, the analysis is concerned only with the accurate estimation of benefits and costs, and whether the net benefits of one use exceed those of another use. Thus, economic analysis is impartial and cannot answer questions on what is fair and unfair, or on what is right or wrong. Concerns about a fair distribution of income or the rights of individuals are goals that society has in addition to that of an efficient use of its natural resources. However, economists are uniquely qualified to speak out on the economic consequences of actions and to identify who gains, who loses, and by how much.

Lest you are shying away from reading further, let me remind you that the primer is a selective introduction to economics that focuses on issues in the coastal zone. The only analytical talents that one needs are a familiarity with algebra and an ability to follow simple graphs. The primer is not an economics textbook nor a handbook that details quantitative, analytical methods in cookbook fashion. Although I do not shy away from advanced concepts that are relevant to the discourse, I will present these in nontechnical ways.

The chapters are arranged as follows. Chapter 1 sets the stage by identifying the myriad conflicts that seem to center on the development of the coastal zone. Although I sometimes refer specifically to coastal Massachusetts and Rhode Island, the problems are generic to most coastal areas around the world. Chapter 2 lays much of the groundwork for later chapters by defining several basic economic concepts. Commonly used methods for the analysis of economic impacts are introduced in Chapter 3. The methods include market approaches, several techniques from environmental economics that impute values to environmental goods and services for which there are no specific markets, and, finally, a few methods, including benefit-cost analysis, that organize a large amount of economic data in the evaluation of alternative policy strategies.

In Chapter 4 we "think economically" about several stereotypical, pseudoeconomic arguments. This chapter and the following two chapters are intended to exercise what you have learned in Chapters 2 and 3. Chapter 5 summarizes a study on the economic benefits of protecting water quality in coastal ponds and lagoons for recreation. A hypothetical benefit-cost analysis of development on Cape Cod, Massachusetts (Chapter 6) considers the net economic effects of residential development versus spillovers manifest in traffic, reduced water quality, town finances, the quality and availability of outdoor recreation, and the preservation of environmental resources for future generations and for wildlife. Concluding remarks are offered in Chapter 7.

As indicated above, this primer is written for non-economists. I hope that I have succeeded in presenting the concepts and methods clearly. I also hope that you find the primer to be useful. Comments are certainly invited.

I wish to acknowledge the editorial skills and insightful comments and advice provided by Judy Fenwick, Elaine Edwards, and Donna Edwards. I also want to thank Ethel LeFave and Jane Zentz for typing and making corrections to the manuscript.

CHAPTER ONE

Introduction: Conflicts Between Private and Public Interests in the Coastal Zone

The coastal zone supports considerable human activity. Households and entrepreneurs find employment, income, and profit in resource-based industries related to construction, tourism, minerals, and marine commerce. In addition, households derive considerable satisfaction from the aesthetic pleasures and leisure opportunities available only along the coast. These households in turn support many sectors of the economy that provide goods and services to satisfy their everyday needs and wants. All indications are that these market and environmental benefits will continue to draw people to the coast and at an increasing rate. By one estimate, fully 75% of the population of the United States will live within 150 miles of the coastline by the year 2000--an increase from 50% in 1970.

At one time the coastal zone could support all interests simultaneously. Times have changed, however. Ecosystems and socioeconomic systems in many coastal areas can no longer assimilate all the impacts of human use. Many private and personal interests are now in conflict with public interests. That is, the activities in private markets, in which people decide on an individual basis where they want to work and live, what business they want to start, and what they want to buy, can have unintended spillover or external effects on others. For example, the development of the shoreline, which provides income, profit, and recreation for labor, entrepreneurs, and households, steadily reduces the recreational opportunities for the general public who find it increasingly difficult to gain access to the shore for recreation. As another example, the residential development of vacant land can lead to health hazards when sewage leachate enters the groundwater.

The list of conflicts goes on and on. They will continue to exist and are guaranteed to intensify unless steps are taken now to plan for traditional economic growth and an expanding population. This is no easy matter, though. First, many individuals have conflicts within themselves. To use the above examples, many people in the construction industry certainly enjoy fishing and swimming in the ocean (as do their children), and prefer drinking groundwater to drinking bottled water. Second, it is difficult to know the general public's preferences when private markets for outdoor recreation, water quality, preservation, and so on do not exist. Furthermore, we cannot expect a few private citizens to be altruistic and wealthy enough to provide the general public with environmental amenities and opportunities for outdoor recreation. Thus, it becomes the responsibility of government and law to represent the public's interest and to address the external effects of private actions.

One ingredient of an overall analysis of resource use conflicts is a comprehensive evaluation of the economic consequences of alternative uses of the coastal zone. The basic question that economists seek to answer is whether society can increase the benefits that it receives from its current allocation of resources. As explained below, many of the benefits are not captured in markets but nevertheless fall within the purview of economics. A complete economic analysis of efficiency then becomes information that planners and policy-makers can use along with the analyses provided by policy analysts from other disciplines.

1.1 Cape Cod and the Islands

Resource conflicts between private and public interests on Cape Cod, Martha's Vineyard, and Nantucket represent in microcosm many of the problems evident throughout the world's coastal zone. Here these conflicts center on the development of vacant land and the concomitant growth in population. Each of us living within the coastal zone contributes to one or more problems ("We have met the enemy and they are us").

According to the Association for the Preservation of Cape Cod, the number of houses on Cape Cod in the past twenty years has more than doubled: from 46,840 units in 1960 to about 100,000 units in 1980 (APCC 1985). By the year 2000, half of the remaining vacant buildable land is expected to be developed with 44,000 additional units. In addition, previous summer dwellings are being rapidly converted into year-round residences. Condominiums, motels, hotels, and conference centers are being built to accommodate the expected growth in residential and tourism demands. All in all, year-round and summer population sizes are expected to increase by the year 2000 from about 167,000 and 247,000 in 1985 to about 216,000 and 281,000, respectively.

Further development stems from increased population. Vacant land is developed into supermarkets, shopping malls, gas stations, restaurants and marinas to satisfy the demands of the growing population. In addition, towns must also increase the provision of municipal services, including police and fire protection, public education, elderly services, road maintenance and repair, water supply, and garbage and sewage disposal. Furthermore, towns are often compelled to provide additional types of services when the size and composition of their population change.

Growing populations also reduce environmental quality and the "traditional way of life." Local newspapers invariably contain articles on at least one of the following spillovers: contamination of groundwater with sewage and other hazardous wastes, reduced access to ponds and the ocean, increased traffic, congested beaches and fishing areas, freshwater and saltwater ponds polluted with sewage, beach shellfish bed closures. Each of these problems results in losses in the well-being of residents and tourists alike.

1.2 Overview

Economic analysis is capable of addressing all of these effects--nonmarket effects as well as market effects. That is, economic analysis can provide information that compares the economic benefits of development with the economic costs of development, including spillovers. This might be hard to understand at first since the precise meaning of benefits and costs to economists differs in fundamental ways from common usage in the English language. Hence, one purpose of this primer is to introduce the reader to important economic concepts, including those that have been developed in the subdisciplines of resource and environmental economics. This is done in Chapter 2. Chapter 3 introduces the reader to further concepts and to several methods that are important for the analysis of economic benefits and costs. The fundamental goal of the primer--to prepare the reader to think economically--is exercised in Chapter 4. Here the concepts in the previous chapters are used to critique several stereotypical, pseudoeconomic arguments which are often heard or read. The next two chapters illustrate the use of several economic methods in the analysis of protecting water quality for recreation (Chapter 5), and in a hypothetical benefit-cost analysis of development on Cape Cod, Massachusetts (Chapter 6). Chapter 7 contains concluding remarks. References to literature cited in the primer and several other bibliographic references that can take the interested reader beyond this introduction are cited at the end of the primer.

CHAPTER TWO

Some Basic Concepts in Economics

Most economic concepts are easy to understand when they are presented clearly. Indeed, "thinking economically" is a logical process that often appeals to common sense. In this chapter I try to define those basic concepts which are relevant to assessing the efficient allocation of coastal resources. The only analytical talents that one needs are a familiarity with algebra and an ability to follow simple graphs. At the same time I hope to erase certain vague notions of economic value and other outright misconceptions.

2.1 What is Economic Value?

To answer the question of what is economic value and to explain why economic value can be measured in terms of money, regardless of whether markets exist, will take some time. In the process you will learn several economic concepts which have precise meanings. But first, let's lay some necessary groundwork that we will return to throughout the book.

Economics is a behavioral science. While physiologists study the behavior of cells, population ecologists the behavior of animals, chemists the behavior of molecules, and physicists the behavior of atoms, economists study the behavior of people as they allocate their available income and time among all possible goods, services and activities that yield personal satisfaction. Although the study of economics initially focused on observed behavior in markets, markets are not logical requirements for economic behavior. For the time being, though, I shall concentrate on familiar market-related concepts.

Basic to the understanding of economic behavior and economic value are the propositions that individuals seek to maximize their personal pleasure, or, satisfaction, and that entrepreneurs seek to maximize profit. Already we begin to see that economic value is related to satisfaction and to profit.

It is also important to understand a second proposition: that individuals are indifferent between different combinations of goods and services (hereafter, commodities) which provide the same level of satisfaction. In this context, _indifference_ does not imply that the person could care less about a particular bundle of commodities. The indifference is _between_ bundles. Similarly, entrepreneurs are believed to be indifferent between combinations of commodities that they sell or employ which yield the same level of profit.

2.1.1 Willingness to pay, economic demand and consumer's surplus: The amount of money that a person is willing to pay for a commodity depends, in part, on the amount of satisfaction that he/she will derive from its consumption or use. Economists refer to levels of satisfaction as levels of _utility_. And although satisfaction or utility _per se_ could only be measured directly with great difficulty, it is possible to observe the way people spend their income and thereby infer estimates of economic value.

As an example, consider your consumption of cups of coffee during a day. Admittedly, economists have a tedious habit of conjuring up simplistic examples to explain their points. Nevertheless, we do not want to tackle complex examples at this time. I ask you to indulge me for now. (If you do not drink coffee, consider tea, or ice cream cones during a week in the summer.)

We begin by asking, what is the absolute most that you would be willing to pay for your first cup of coffee in the morning? Let's say $1.25. In addition, let's say that $1.25 is taken from you and you drink the first cup. Next we ask, what is the most that you would be willing to pay for your second cup during the same day? Most likely, the first cup satisfied a significant part of your personal desire for coffee for the day; therefore, the most that you would be willing to pay is probably less than $1.25. Let's say it's $1.00. Again, $1.00 is taken from you and you drink the second cup. The process continues for a third cup and so on to, say, six cups with the subsequent levels of satisfaction corresponding to a willingness to pay $0.75, $0.50, $0.25 and nothing. You are satiated after five cups; the sixth cup would yield no satisfaction. Economists are so confident that additional utility decreases as consumption increases that we call it a law (actually a statistical law)--the law of diminishing marginal utility.

The concept marginal is extremely important in economics. It simply refers to one additional unit at a time. In this case, marginal utility refers to the sequential levels of satisfaction derived from drinking cups of coffee--one by one. The fact that the utility you get from each cup of coffee decreases as you consume more is manifest in a decreasing willingness to pay for subsequent cups. This is illustrated in Figure 2.1a using a bar graph. (All figures and tables are found in the appendices at the end of the primer's text.) Figure 2.1b illustrates the same information except that the plot is smoothed out. The line in this figure is called a demand curve. Thus, a demand curve delineates one's marginal willingness to pay.

Next we might ask what is the total satisfaction, or, value of six cups of coffee to you? This is approximated by your total, maximum willingness to pay, or in this case, \$1.25 + \$1.00 + \$0.75 + \$0.50 + \$0.25 + \$0.00 = \$3.75. Graphically, it is the sum of the rectangles in Figure 2.1a, or, equivalently, the area under the demand curve in Figure 2.1b

While I have discussed what you might be willing to pay for cups of coffee, I have been careful not to say what the price is for a cup. If a cup of coffee actually costs \$0.50, how many cups would you buy in a day? In our example above, the first three cups each provide more than the equivalent of \$0.50 of utility. However, you are just willing to pay \$0.50 for the fourth cup; hence, your <u>quantity demanded</u> is four.

Notice that the total level of satisfaction from consuming four cups is approximated by \$3.50 (\$1.25 + \$1.00 + \$0.75 + \$0.50). Yet, you are only paying \$2.00 for the four cups (\$0.50 x 4). The remaining \$1.50 worth of satisfaction is a bonus, or, surplus. In general, the amount of satisfaction that a person receives from a good or service which he or she does not have to pay for is called <u>consumers' surplus</u>. Graphically, it is the area behind a demand curve but above price (Figure 2.2a).

Other people will have different demand curves for coffee. For example, the demand curve depicted in Figure 2.2b shows that this person is just willing to pay \$0.50 for one cup of coffee during the day. Therefore, this person derives no consumer's surplus from cups of coffee when the price is \$0.50. Figure 2.2c depicts the pattern for someone who is not even willing to buy one cup at \$0.50. The price would have to be \$0.25 for him/her to participate in the market. Finally, Figure 2.2d depicts the purchasing pattern of someone who buys six cups at \$0.50.

We can use the information on <u>individual demand curves</u> to develop an <u>aggregate demand curve</u>. If price is \$1.75 per cup, the total <u>quantity</u>

demanded by the four people is one cup of coffee (Figure 2.3). At $1.50, the quantity demanded is two cups. And so on until at $0.25 the quantity demanded by the four people is 15 cups of coffee. Since price is actually $0.50 in this example, the total quantity demanded is 11 cups. This corresponds to $12.12 in total satisfaction or benefits (approximated by the total area under the demand curve between 0 and 11 cups), $5.50 in total expenditures ($0.50 x 11), and $6.62 in consumers' surplus ($12.12 - $5.50 = $6.62). (You might notice that the estimate of consumers' surplus and, therefore, total benefits is greater than what you would compute using bar graphs. This is an artifact of drawing a smooth curve to represent demand. This does not create a problem in practice, though, since as the number of consumers in a market increases the differences in the two estimates converge.) The same process could be followed to develop a market demand curve for everyone who buys cups of coffee.

There are several reasons why individuals have different demand curves. First, people might have different personal tastes and preferences. Thus, the indivdual in Figure 2.2d might like coffee a lot more than anyone else (i.e., get more personal utility from coffee).

Second, peoples' choices of what and how much to buy are constrained in part by their income. Thus, even if the person depicted in Figure 2.2c has the same tastes and preferences as the person in Figure 2.2a, he/she might not be able to afford to buy a cup of coffee. Hence, price relative to income is an important determinant of demand. For most commodities, the higher your income the greater your willingness to pay.

Finally, the prices of substitutes (possibly tea) and complements (i.e., a commodity that goes well with a cup of coffee, possibly a donut) could differ across consumers. Thus, even if preferences and incomes are identical, the demand curve depicted in Figure 2.2b could be lower than in Figure 2.2a because the price of a substitute to this person is relatively less, or the price of a complement is relatively high. That is, the price of a commodity relative to the prices of substitutes and complements is an important consideration for consumer demand. In general, if the price of a substitute decreases (increases), your willingness to pay for a commodity will likewise decrease (increase); if the price of a complement decreases (increases), your willingness to pay for a commodity will likely increase (decrease). The point is that factors other than the price of a commodity affect peoples' willingness to pay, and, therefore, estimates of consumers' surplus.

Consumers' surplus is the most crucial concept in the measurement of economic benefits. As we have just seen, it is a component of satisfaction that consumers do not pay for. It is a very real--not imaginary--concept. For example, if a coffee shop was able to get the person in Figure 2.2a to meet his/her maximum willingness to pay for the first four cups of coffee (this is called price discrimination), the customer would certainly lose an amount of satisfaction equivalent to $1.50. After all, the person would have $1.50 less to spend on other commodities that also yield utility.

Consider the notion of consumers' surplus from another perspective. If a supermarket runs a sale on something that you usually buy, it is like getting a bonus. The money that you save during the sale can be used to buy other things that give you utility. As a result, your total utility increases.

This perspective illustrates the importance of estimating changes in consumers' surplus in economic analysis. Suppose that coffee growers in South America have a bumper crop this year and increase exports to the U.S. substantially. This could very well result in a price reduction for a cup of coffee to, say, \$0.45. What effect would this have on consumers?

Figure 2.4, which depicts the local market's demand curve for cups of coffee, will be used to answer this question. At \$0.50, let's say that 1200 cups of coffee are bought each day. To say that the benefit of the price reduction for consumers is \$60 [i.e., 1200 x (\$0.50 - \$0.45)] would underestimate the actual gain in surplus by \$1 (\$1 is the value of the small rectangular area in Figure 2.4). That is, the price reduction would result in a gain in satisfaction which is equivalent to \$60 for the original 1200 cups of coffee plus \$1 associated with the additional 40 cups that would be consumed at the lower price.

Another way to look at this gain in surplus is that the very most that these consumers would be willing to pay for the price reduction is \$61 a week, although they do not actually have to pay it. In other words, consumers as a whole would be <u>indifferent</u> between (a) 1200 cups of coffee and the bundle of other commodities that they could buy with the rest of their daily incomes (i.e., daily incomes less 1200 x \$0.50 = \$600 spent on coffee), and (b) 1240 cups of coffee and the bundle of other commodities that they could buy with their daily incomes less the \$558 (i.e., 1240 x \$0.45) spent on coffee, <u>and</u> less the \$61 increase in surplus. If we consider a person with the demand curve in Figure 2.5 and a \$100 daily income, the indifference is between (a) 4 cups of coffee and commodities bought with \$100 - (4 x \$0.50) = \$98, and (b) 5 cups of coffee and commodities bought with \$100 - (5 x \$0.45) - [(\$0.50 - \$0.45)4 + (1/2)x(\$0.50 - \$0.45)x(5-4)] = \$97.52 where the last term in parentheses is the gain in surplus on the 4 original cups plus the surplus on the fifth cup. You might want to review this example.

You have been exposed to a lot of new information. Let's summarize the salient points. First, economic value can be expressed in terms of money simply because you and I allocate our budgets over the large number of commodities which yield varying degrees of satisfaction. Second, price is related to value simply because certain people are willing to pay it. However, price represents value for the marginal (i.e., last) unit purchased. Third, if someone claims that the value of something is price times quantity demanded, you will know that this underestimates total value by the amount of consumers' surplus. Thus, consumers' surplus is the net value, or net benefit that consumers receive, and is equal to the difference between total willingness to pay and actual payment, or cost to consumers. Finally, changes in consumers' surplus represent changes in net benefits. Economists call the analysis of changes in surpluses welfare analysis since the changes in individuals' well-being are being assessed.

2.1.2 Marginal cost and economic profit: We switch now to concepts related to the production and sale of commodities. Using the coffee shop as an example of a firm, what would economists consider to be the costs in the sale of cups of coffee? Certainly, the owner of the coffee shop has to pay for the coffee that is sold, for hired help, for electricity, possibly a mortgage, and so on. Economists call these factors of production, or inputs. They can be classified as fixed factors, the use of which does not change in the short run by definition regardless of the number of cups of coffee sold (e.g., the mortgage), and variable factors which can vary at any time depending on how good business is (e.g., coffee beans, labor). (In the long run all factors of production are variable by definition).

The firm's accountant might stop here to determine total costs. However, economists insist on factoring in the costs associated with the entrepreneur's time and investment as well. After all, the owner of the coffee shop could be earning an income, for example, by selling the coffee shop and investing in a restaurant. However, this opportunity for making income is foregone by choosing to own the coffee shop. The cost of one's highest paying alternative is called an opportunity cost in economics. (More on this below.)

Now we can define economic profit as economists see it. Economic profit is total revenue minus total economic costs, including the opportunity cost of the owner. Let's assume that the cost to produce each cup of coffee during a day is constant regardless of the number of cups sold (for the sake of simplicity assume also that fixed costs are zero). In other words, the marginal cost of producing each cup of coffee is constant, and, therefore, equal to average cost. Thus, if the marginal cost is $0.30 per cup but the firm receives $0.50 per cup, there is an economic profit of $0.20 per cup. If the entrepreneur sells 400 cups per day the total economic profit is $80. As for consumers' surplus, economic profit is an economic benefit.

We should consider the marginal cost relationship in more detail. Typically, the marginal cost of producing additional units of a commodity is expected to increase as the number of units produced increases. This is a technical matter but can be explained using our coffee example if the productivity of labor decreases as output increases. By productivity I mean the number of cups of coffee that one worker can serve in one day. For example, as more labor is hired to serve coffee, one would expect the employees to eventually begin to get into each other's way. For this reason, an additional worker cannot serve as many cups as the worker who was hired before him/her. Furthermore, the new worker also reduces the number of cups that all other workers can serve. Thus, to double the number of cups of coffee produced the owner would have to more than double the number of workers. The result is that the marginal cost for additional cups of coffee increases as output increases. This is illustrated with a bar graph in Figure 2.6a. The total cost of producing the cups of coffee is determined by adding the value of the bars (you also need to include fixed costs if they are non-zero). As we did for demand, we can smooth out the bar graph with a line to approximate the marginal cost curve (Figure 2.6b), with the area below the line representing total economic cost.

In a competitive industry (defined below) where there are many coffee shops selling coffee at the same price, a single coffee shop will sell, or, supply cups of coffee until the cost of providing an additional cup--marginal cost--is just equal to the price received. In this case marginal revenue is constant; the owner gets the same revenue for each cup of coffee sold which in this case is price. The owner makes a profit on each cup until the point where marginal revenue equals marginal cost and, therefore, marginal profit is zero. That is, an entrepreneur in a competitive market maximizes profit by producing output until the additional revenue from the sale of the last unit equals the additional cost of producing it. Since the competitive firm's marginal cost curve delineates the quantity supplied at each price, it is also the firm's supply curve.

These concepts are illustrated in Figure 2.7a. Total economic profit is the sum of marginal profits on each cup of coffee. Graphically, it is the area above the marginal cost curve but below price. And as we did for individual demand curves, we can add individual supply curves to get an aggregate supply curve as in Figure 2.7b.

It is of interest exactly who receives the profit. Strictly speaking, the owner of the fixed assets (the building, or, land), who I have assumed to be the manager, keeps the profit. If the manager is actually renting the shop, the owner could conceivably increase the rent until he/she captures all the profit. (Actually, economists prefer to call economic profit either rent or quasi-rent depending on market conditions. We will keep it simple and continue to use the word profit, though.) Recall that we are talking about economic profit. At this point the lessee would be indifferent between working at the coffee shop or working at his/her next best alternative since either job would provide the same income.

Finally, we can consider the effect of a reduction in the price of a cup of coffee on the profits of the owner of the coffee shop (assume again that the manager and owner are the same person). However, we must also consider the effect of a reduction in the input price of coffee beans on profits. A reduction in the price of beans which is equivalent to $0.05 per cup lowers the marginal cost curve as illustrated in Figure 2.8. The net effect in this example is actually no change in economic profits since the loss in profits due to a reduction in the price of cups of coffee (area ABCD) is exactly offset by an increase in profit due to the lower price of inputs (area DEFG). Note that if someone estimated the change in profit by either multiplying the change in input costs by the original number of cups of coffee sold (gain of $0.05 x 400 = $20), or by multiplying the change in the price of a cup of coffee by the original number of cups (loss of $0.05 x 400 = $20), they would over- and underestimate, respectively, the impacts on profits. In actuality, the coffee shop's profits would probably increase somewhat since only part of the reduction in costs would be passed on to consumers.

In summary, economic profit is a measure of benefits received by owners of factors of production--the owner of the coffee shop, the partners in a restaurant business, a large corporation of stockholders. It differs significantly from the commonplace use of the word profit because the value of earnings foregone by doing one thing instead of another is a real cost--an opportunity cost. We will take up the economists' notion of cost again shortly.

2.1.3 Markets: I must say a few words about markets in order to show how prices emerge from economic behavior, and to set the stage for the discussion of externalities and public goods. A market for a commodity consists of a group of potential buyers and sellers. Under competitive conditions the actions of all buyers and sellers determine the market price. Thus market prices emerge from economic behavior. If sellers set the price too high, they will not sell their entire inventory. If the price is set too low, they will run out of their product too soon. At equilibrium, the product's price is such that consumers are just willing to pay the price for all units available and suppliers are just willing to sell the same amount at that price. This is illustrated in Figure 2.9. The market demand and supply curves for coffee intersect at a price equal to P^*. This price just clears the market. Thus, in a purely competitive situation market forces--demand and supply--determine price. Individually, though, each buyer and seller takes prices as given.

The concept of a competitive market holds a special place in economists' hearts. In essence, pure competition implies (among other things) that (1) there are numerous firms and consumers who individually have no effect on prices, and (2) that all costs and benefits are captured in markets. Under these conditions social benefits (i.e., consumers' surplus plus producers' profits) are maximized. This is shown in Figure 2.9. Here P^* corresponds to the point where the marginal benefits to society (i.e., all consumers) are just equal to the marginal opportunity costs to society (i.e., the marginal opportunity costs of factors used in the production of cups of coffee). Consumers' surplus in this market, summed across all buyers, is area ABC. Similarly, economic profit for all producers is area BCD. If the price of a cup of coffee is set higher or lower (and this is not due to changes in the price of inputs or of substitutes or complements for coffee), total social benefits would be reduced.

The economic impacts (i.e., changes in surplus) of a price reduction on the entire market for cups of coffee due to a price adjustment in the input market for coffee beans can now be illustrated with market demand and supply curves. The market demand in Figure 2.10 is the same as in Figure 2.4; the market supply is identical to that depicted in Figure 2.7b. As discussed above for this example, the net effect on producers' profits is zero. However, the price reduction to consumers results in a gain in consumers' surplus equal to area BCFD. Thus, the net effect on the market is area BCFD, or, equivalently in this example, area AFH minus area ACG = area GCFH.

We will return to the analysis of changes in economic benefits in Chapter 3. Before leaving this topic, though, I want to plant another seed. Some of you might be wondering about the significance of the change in costs to produce cups of coffee. Recall that the marginal cost curve delineates the total cost of using and employing <u>all</u> variable factors of production--coffee beans, labor, electricity, and management in our example. Looked at from another perspective it is the income earned by the owners of the productive inputs which are used to produce the cups of coffee. In our example, coffee growers are getting a lower price for their coffee beans. Labor is also a variable input, however. It might seem a bit unusual to express it this way, but you and I are owners of our labor and we sell our labor in labor markets to those who want to buy it at the wage rate for which we are willing to sell it. The way that changes in income are treated in economic analyses is an important theoretical and practical matter which will be considered at the end of Chapter 3. The important point for now is that the impacts of price changes in one market can have effects in other markets.

It is of considerable interest that many individuals acting in their self-interest could actually maximize the social benefits of all goods and services. Thus, an entire economy operating under competitive conditions would allocate its inputs as queued by prices to the most efficient markets. By efficiency I refer to an optimal allocation of inputs in the production of commodities which yield maximum net economic benefits for society.

Of course the world is not set up this way. Not all markets are perfectly competitive. And as we shall see in Section 2.4 of this chapter, there are important cases when markets fail to exist.

2.2 Personal Discounting

Often individuals and firms are faced with making decisions that will affect consumption and earnings over time. How do economists treat such decisions? Again, the answer lies in indifference.

We will start with a traditional example: you would propose that it is better to receive $100 today than a year from today (or any time in the future for that matter) because among other things you could put the money in a bank today and after one year have more than \$100. If the interest that you earn is 10% (compounded annually), you would have \$110 at the end of a year.

Let's look at this from a different perspective and ask what amount of money would make you indifferent between receiving that amount in one year versus \$100 today. If your answer is \$110, you are indifferent between the satisfaction that \$100 could buy you today and that \$110 could buy you in one year. This is equivalent to saying that you <u>discount</u> future consumption by 10%. Hence, the <u>present value</u> of \$110 worth of commodities in one year is \$100 today.

This relationship between present and future values is expressed algebraically by the equation:

$$PV_{t=0} = A_t/(1 + d)^t,$$

where $PV_{t=0}$ is present value of consumption in the current year, A_t is the future value in year t, and d is your personal discount rate. This equation can also be transformed algebraically to show the relationship between the discount rate and present and future values:

$$d = (A_t/PV_{t=0})^{1/t} - 1.$$

In our example of indifference between \$100 today and \$110 in one year, t=1, $PV_{t=0}$=\$100, and $A_{t=1}$=\$110. Hence,

$$d = (\$110/\$100)^1 - 1 = 0.10, \text{ or, } 10\%.$$

In general, the present value of a flow of future income is equal to

$$A_0/(1+d)^0 + A_1/(1+d)^1 + A_2/(1+d)^2 + \ldots + A_T/(1+d)^T, \text{ or,}$$

$$\sum_{t=0}^{t=T} A_t/(1+d)^t$$

where T is the last time period, and $\sum$ is a symbol representing the summation over time. Thus, you can express any future benefit, opportunity cost, or difference between benefits and costs in terms of its present value to you. How convenient.

Notice that the future value in the above example (i.e., $110) is expressed in real terms. That is, I did not adjust the future value for inflation. In contrast, nominal values would include increases due to inflation over the time period(s) being considered. Therefore, if you are looking at a time series of data for the price of a commodity such as the prices of automobiles between 1965 and 1985, you would want to adjust them for inflation to make them comparable. Remember, prices relative to each other and to income are important. In a discounting problem the adjustment can be made with a nominal discount rate which includes the rate of inflation. Otherwise, if you are projecting values of benefits and costs into the future from the present, it is best to use real values.

Discounting is an important concept for economic analysis because it organizes complex information in a logical and theoretically sound way, and in a form which facilitates the comparison of alternatives for decision-making.

For example, Table 2.1 (found in Appendix II) summarizes the costs over time of buying a canoe plus accessories today for $800 versus renting one for $30 per day over the next 16 years. Let's say that you expect to go canoeing twice a year; therefore, the real (vis-à-vis nominal) rental cost is $60 per year. Assume also that if you bought the canoe you would expect to keep it for 16 years at which time you could salvage it for $120. Also, your maintenance costs for repairing the canoe and replacing equipment are expected to be $30 every 4 years beginning in the fifth year. To keep it simple, assume that you derive the same satisfaction from canoeing whether you rent or own; therefore, the benefits cancel out across alternatives and we are only interested in minimizing costs. So, is it rational to buy or to continue renting?

Using a 10% rate of personal discount, the present value of the costs of purchasing and maintaining the canoe and equipment is $844.06 (Table 2.1). However, the present value of the <u>salvage value</u> of the canoe ($28.73) must be deducted from this, leaving $815.33. This is considerably more than the present value of the costs of renting ($471.29); hence, it would be rational to continue renting. It is very important to notice that this conclusion is the opposite that would be reached if the person unwisely neglected to discount and simply added the future values: $960 for renting versus $770 for buying.

You might wonder, however, what the price of a new canoe would have to be in order for it to be worthwhile for you to buy. If the canoe and equipment were on sale for $456 and your personal discount rate was 10%, you would be just indifferent between renting and buying.

Before leaving this section, notice the effect of the discount rate on future values. Discounting quickly reduces future values to smaller and smaller present values as time extends into the future. Even at 2% discounting, the present value of $100 received in 50 years is only $37.15 (Table 2.2); in 100 years it is $13.80. The higher the discount rate the faster the reduction in present value.

2.3 Economic Costs are Opportunity Costs

Most people think of costs in terms of financial outlays, or what they must spend to buy or rent something. Economists have a different perspective on the matter, though. As indicated above when discussing economic profit, economists consider costs to be the value of what is given up by doing one thing instead of something else--the value of foregone opportunities, hence, opportunity costs. Thus, there is a cost associated with everything that you do or do not do. This is why economists insist that nothing is free.

Opportunity costs are closely related to the scarcity of resources. By scarce I mean that there is not enough of a resource to satisfy all demands on it; hence, it must be allocated to different uses. Market prices often mediate the allocation process.

For the vast majority of us, income and time are scarce resources which we allocate between work and leisure and among commodities. For example, if you decide to go to a movie rather than out for pizza, the opportunity cost of that decision is the consumer's surplus foregone by not eating pizza (presumably, this opportunity cost is less than the consumer's surplus that you expect from the movie; otherwise, you would make the opposite decision). As another example, a decision not to work, say, ten hours a week at a part-time job suggests that the ten hours of leisure time are valued more than what could be bought with the extra income earned from working. Nevertheless, the income foregone represents an opportunity cost of not working. As a final example (and at the risk of giving you an excuse to stop reading this primer), the time that you are now spending with this primer has an opportunity cost equal to the value of what you would be doing otherwise.

This thought process can be extended to firms as well. We already discussed the opportunity costs of an entrepreneur's investment in relation to the coffee shop example. Owners of fixed factors of production will ask what income do they forego (including profit) by not selling their assets and investing them elsewhere.

Opportunity costs can be considered from society's point of view as well (as opposed to an individual's). The issue becomes what does society as a whole lose when scarce resources--labor, capital, land, the natural environment--are used to produce one thing rather than another. Cups of coffee rather than deli sandwiches. Movie theatres rather than restaurants. Residential housing rather than outdoor recreation.

Actually, it is about time for us to consider the opportunity costs of private development in the coastal zone. In other words, what is the economic value of the land in its natural state? Keep this question in mind when reading the following section.

2.4 Introductory Economics of Nonmarkets and Nonuse

So far I have concentrated on concepts which have traditionally been associated with markets--consumption, demand and supply curves, prices, consumers' surplus, economic profit. Indeed, markets are necessary for the existence of prices and economic profits. However, you will recognize that markets emerge from the desire of individuals to maximize satisfaction and profit. That is, economic demand and supply are necessary for the existence of markets, but not vice versa. Nevertheless, the existence of demand and supply does not always guarantee the existence of markets. To complicate matters further, economic demands do not even require consumption or use. To understand these points we now turn to a discussion of goods and services (and sometimes bads and disservices) which are not bought and sold in markets but are associated nonetheless with gains or losses in economic benefits (i.e., gains or losses in economic surplus).

2.4.1 Public goods and externalities: There are several reasons why markets may not exist. First, although there might be people willing to supply a product, there might not be an economic demand (Figure 2.11a). Even when supply and demand curves exist, there is no guarantee of a market. Thus, demand may be so small or production costs so high that producers cannot cover their opportunity costs (Figure 2.11b).

Two additional reasons for the absence of markets concern market failures. In both cases there is a demand for a good or service but no producer is willing or able to supply it.

First, consider what economists call public goods. With public goods, a prospective producer cannot prevent people from enjoying a commodity for which they have not paid. Consequently, producers may be unable to collect payments. Except for cases of altruism, the lack of remuneration undermines any incentive to maximize profits. Thus, no firm(s) would be willing to supply national defense, clean air, or clean water on their own initiative since they could not sell the service to some people without nonpayers reaping the same benefits. In these cases, it is necessary for governments to intervene on behalf of the public to provide goods and services.

Another market failure concerns <u>spillovers</u>, or, <u>externalities</u>. In this case the actions of individuals in private markets result in unintended effects which are not taken into consideration in the market. For example, the waste or residuals from producing electricity pollute the atmosphere. The effects of polluted air on nearby tree farms, on the health of nearby residents, on automobiles and other private property, on forests and lakes that are harmed by acid rain are all externalities. The social opportunity costs of externalities are not included voluntarily in the private costs of the firms that pollute the atmosphere. Voluntary private markets for externalities do not generally exist, again due to a lack of well defined property rights, but also due to the difficulty and high costs of organizing large groups of individuals without the ability to define, monitor, and enforce property rights. Thus, who owns the air: the general public (who, incidentally, benefits from the use of electricity) or the utility companies? Furthermore, and as for public goods, clean air, clean water, etc. benefit everyone simultaneously. And, unlike in traditional markets, if I pay for reducing pollution, neither I nor the firms could easily exclude nonpayers from the same benefits. Thus, many people who actually have a demand for clean air may not participate in a market voluntarily. Again, we often need government intervention to internalize externalities.

Actually, we have been discussing a particular type of externality called <u>technical externality</u>. Technical externalities directly affect either (a) the productivity of inputs, and, therefore, the marginal costs to producers, or (b) the utility of individuals. An example of the first case is when sulfur emissions from an electric company burning coal reduces the growth rate of agricultural crops. Concerning the latter case, the total emissions from the power plant also reduce visibility around, say, the Grand Canyon, thereby reducing the satisfaction that tourists derive from visits to the National Park.

Another type of externality is called a pecuniary externality. In this case the activities of individuals in one market cause prices to change in other markets. Whether these have efficiency implications depends on employment conditions in the other markets. We will return to this possibility at the end of Chapter 3.

I have concentrated on the negative aspects of externalities resulting from the production process because they characterize many of the conflicts in the coastal zone. In these cases the marginal social costs of production exceed the marginal private costs of production in markets by the increment of external costs due to reductions in the productivities of other firms or reductions in personal utilities (Figure 2.12). However, it should be recognized that there can be cases when firms produce external benefits for which they are not compensated. In addition, the activities of individuals other than firms can create negative and positive externalities. For example, people who choose not to sell their land to developers actually provide external benefits to the general public. In effect, they reduce the negative impacts of population growth on water quality, traffic, recreation and so on. It is arguable, however, whether they are fully compensated for these public services even when they receive preferential tax status. I leave it to readers to expand their knowledge of these cases.

2.4.2 Economic value revisited: It might seem trivial to note that market prices do not exist for public goods (bads) and externalities since this is so by definition. But does this mean that panoramic views, public access to beaches, clean air and water, have no economic value? Certainly not. The question is meant to underscore the commonly held misconception that markets and prices are necessary conditions for economic value. However, is it legitimate to consider the value of reduced externalities and of public goods in monetary terms? To answer this question we return to the foundations of economic thought.

Recall the introduction to this chapter. Economic value requires only that a person determine value on the basis of satisfying personal wants, that a person intends to make rational choices in maximizing personal wants (utility or profit), and that the person's preferences for commodities to be bought or sold are characterized by indifference. If I may use the phrase environmental resources in general to refer to environmental quality and amenities, the satisfaction derived from swimming in the ocean, drinking clean groundwater, driving on uncrowded streets, observing wildlife in nature, preserving wildlife, protecting the environment for potential use by future generations, etc., indifference implies tradeoffs between levels of environmental resources and levels of income (actually, what one can buy with his/her disposable income) that yield the same level of utility. For example, someone may be indifferent between the pairs of situations depicted in Figure 2.13. In other words, he/she is indifferent between (a) canoeing once a year and the commodities that can be bought with a disposable income of $25,250, and (b) canoeing 10 times a year and a disposable income of $22,000 for other commodities. He/she is also indifferent between these situations and not going canoeing at all, but having $28,000 to spend on other commodities.

The curve illustrated in Figure 2.13 is an indifference curve. That is, these combinations of canoeing trips and "other commodities" provide equal levels of satisfaction, or, utility; this person cares not which combination of situations he/she gets. Of course the pair that one actually gets depends on a number of things that we discussed above, particularly personal income, the travel costs of canoeing trips at this site, the travel costs of traveling to substitute sites, and the prices of complements (perhaps the price of a six-pack or fishing equipment).

I used this example specifically to illustrate that neither physical consumption nor markets are necessary for economic value to be well defined. For our purposes we can divide environmental resource values in economics into three types: consumptive use values, nonconsumptive use values, and nonuse values. Consumptive use value involves the physical use of the environment. Fishing and hunting are good examples. When the use value concerns uncertain future use, economists refer to option value as the extra amount (an insurance premium if you will) that a person is willing to pay to eliminate the risk of an opportunity not being available if he/she decides to partake of it in the future. Thus, even if you are uncertain about whether you will ever go canoeing at a particular site, you might have an option value for protecting its water quality. This is in addition to the expected value of future use. (Here, expected value refers to the utility that you would get from future use times the probability that you will actually use the resource.) This is distinguished from present value since even expected values would have to be discounted to a present value in an economic analysis of future benefits. Option price is then defined as the sum of the expected value of future consumption plus option value.

Nonconsumptive use value requires being at the site but no physical use. There are many possible examples including canoeing, swimming, viewing wildlife, and photographing landscapes. In a sense, the experience itself, as opposed to the physical object, is being consumed. Option value and option price are also relevant for future, nonconsumptive uses.

Finally, nonuse values, or what economists call existence values, concern one's willingness to pay to preserve wildlife (preservation value) and the environment for future generations (bequest value). Admittedly (and this is a personal opinion not necessarily shared by most economists), it is difficult to consider existence values entirely in terms of economics, *a priori*. Nevertheless, the concepts are well defined for those people who base their maximum willingness to pay solely on the satisfaction that they personally receive from preserving wildlife and making bequests, and whose preference structures for income and these goals are mapped by indifference curves.

2.4.3 Shadow prices and shadow values: Accepting if you will that economic values for environmental resources are well defined for many people, how does one go about measuring economic value when markets are nonexistent? In order to answer this question--which we will do in the next chapter--one must understand the concepts, shadow price and shadow value.

Recall the useful role that prices play when markets exist. Those prices reflect the value of the marginal unit. That is, they reflect the satisfaction of the last unit manifest in peoples' willingness to pay. And if you had information on the quantities exchanged at different prices you could begin to identify demand and supply curves, and, therefore, to estimate consumers' surplus and producers' profit.

When market prices do not exist, however, you must engage in some detective work to uncover other proxies for willingness to pay. Such proxies are referred to as shadow prices and shadow values. They may be for public goods such as access to ocean beaches, as environmental amenities that are sold jointly with other goods such as when you buy a house with a water view, or as corrections to reflect externalities as part of total social costs. Sometimes it is feasible to discern shadow prices for small (i.e., marginal) changes in environmental resources. At other times, however, it is not feasible to subdivide the environment into small units that would correspond to marginal willingness to pay. For example, it makes no sense to think of one-one thousandth of a view. As a further example, it is conceptually difficult to think of making small improvements in water quality when we are really trying to value the opportunity to go shellfishing or not. In these cases we try to assess directly the entire economic value of the resource--its shadow value.

CHAPTER THREE

Some Analytical Methods in Economics

In this chapter we outline several methods that economists use to quantify and to compare economic values. Although benefit-cost analysis is treated in some detail, most methods are discussed briefly, leaving the interested reader to pursue more complete and advanced discussions.

For our purpose, economic methods can be divided into descriptive methods which quantify demand and supply curves and associated economic benefits, and comparative methods which analyze policies by assessing changes in surplus. The comparative methods require information derived from descriptive studies.

3.1 Descriptive Methods

Descriptive methods can be divided further into those used traditionally to estimate market relationships and those used to estimate shadow prices and shadow values. The latter approaches are either experimental or market-related in the sense that some market data are used.

3.1.1 Market methods: A subfield of economics which uses statistical methods to quantify demand and supply relationships is called econometrics. Data on prices, quantities sold, income, prices of substitutes, prices of inputs, etc. over time (time series data) or across regional markets (cross-sectional data) can be used to identify demand and supply curves. For example, the data and corresponding graph in Figure 3.1 for pairs of visitations per year and entry fees to a campground can be expressed by the equation

$$\text{Price} = \$14 - (\$2 \times \text{Visits}),$$

or, after transforming the equation algebraically,

$$\text{Visits} = 7 - (0.5 \times \text{Price}).$$

If the entry fee is \$10 this person would go camping twice a year (7 - 0.5 x \$10 = 2). The consumer's surplus associated with this price is the area of the triangle above \$10 and behind the demand curve:

$$1/2 \times [2 \text{ visits} \times (\$14 - \$10)] = \$4.$$

Figure 3.2 illustrates a more realistic picture of the same individual's demand for camping which takes into consideration the effects of income and of the price of a possible substitute such as staying at a country inn. In this case the demand curve implied by these data is

$$\text{Price}_{camp} = \$12 - (2\text{xVisits}) + (0.00005\text{xIncome}) + (0.025\text{xPrice}_{inn}), \text{ or,}$$

$$\text{Visits} = 6 + (0.000025\text{xIncome}) + (0.0125\text{xPrice}_{inn}) - (0.5\text{xPrice}_{camp}).$$

To see how this equation can be used to predict the number of visits let income=\$20,000, price_{inn}=\$40, and price_{camp}=\$10. In this case the individual would visit the campsite twice a year if the camping fee is \$10 (6 + (0.000025x20,000) + (0.0125x40) - (0.5x10) = 2).

In either case, econometrics is used to estimate statistically the numerical coefficients on each determinant of demand and the intercept, and thereby quantify the effects of prices, income, etc. on the quantity demanded. For example, every $2 decrease (increase) in the fee for camping will increase (decrease) the number of visits demanded in a year by 1 (0.5 visits x $2), everything else held constant. Therefore, if $\text{price}_{\text{camp}}$ decreased from $10 to $2 per visit, visits would increase by four. Similarly, every $10,000 change in income would change the number of visits by one-half (on average).

Suffice it to say that a similar approach is taken to estimate supply curves and production functions, another important technical relationship in economics. Production functions are equations that show the relationship between quantities of a product produced and the quantities of inputs (capital, labor, land) used to produce them, given a type of technology. While supply curves (like demand curves) are behavioral relationships showing how people behave when price and other factors change, production functions express physical relationships. Nevertheless, a firm's production function is an important determinant of the supply relationship (recall the discussion of how labor productivity affected costs). Two additional functions which take advantage of this relationship are called damage functions and cost functions. Damage functions quantify the physical relationship between externalities and productivity, and value the change of productivity at the market price of the output. Cost functions internalize prices. The cost function approach is preferred since it can be used to derive supply curves directly. See Freeman (1979) for a further discussion.

It is tempting to go on about various estimation techniques, potential statistical problems, the choice of model <u>specification</u> (i.e., what variables to include) and of <u>functional form</u> (e.g., linear in the variables, as above, or logarithmic), and alternatives to econometrics, but I shall refrain. If you have a basic understanding of the above examples, you understand the essence of an important set of analytical methods.

<u>3.1.2 Market-related methods</u>: Often there is no market or an insufficient amount of market data to allow the direct estimation of demand and supply equations for environmental resources. However, there are cases when peoples' preferences are revealed indirectly in related markets. Many of the public goods (bads) and externalities that concern residents in coastal zones can be studied using one of three market-related techniques.

The first technique takes advantage of situations when the demand curve for a market good or service is affected by a nonmarketed environmental resource. For example, the demand for fishing bait may be a function of water quality as it affects fish populations. Thus, an improvement in water quality would cause the demand for bait to increase from D^0 to D^+, while a reduction in water quality would cause demand to decrease from D^0 to D^+ (Figure 3.3). Data on exactly how the price and quantity of bait changes as water quality changes could be used to estimate the demand for water quality. You can probably think of other examples such as the demand for a private beach or golf course as a function of the number of users.

Another market-related technique takes advantage of situations when someone actually buys a combination of commodities in a single package. Consider your decisions when buying an automobile. You probably evaluate the importance of style, age, color, a stereo, air conditioning, and so on. In fact, when buying a new car you can select from a range of options. The same is often true when you are looking to rent or to buy a house. In addition to the property's location relative to work, its square footage, the number of bathrooms, and other physical and neighborhood characteristics, many people also determine the price that they are willing to pay based on the environmental resources that the property's location provides. These include distance to a beach, whether there is a water view from the property, the amount of water frontage, the amount of privacy, and so on. The hedonic property value technique is designed to identify the contributions of environmental resources to the total economic value of property (Figure 3.4). The technique can be used to estimate the implicit or shadow prices of environmental resources capitalized in property values and their demands. It has been used to study the demand for air quality, water quality, noise reduction, visual amenities, and proximity to recreational sites. It can also be used to predict changes in property values when the levels of property attributes change.

A third market-related method, the travel cost technique, has been used extensively to study the demand for outdoor recreation. It uses information on travel expenses, number of visits to a particular site, and other economic data on income, tastes, and prices of substitutes. Travel expenses are taken as shadow prices for the visit; the farther you live from the site the greater the travel cost and, therefore, shadow price (Figure 3.5). There are many potential applications of this technique to assess recreational values within the coastal zone, as well as opportunities to assess the impacts of externalities. For example, the technique could be used to estimate the demand for ocean beaches and the effect of substitutes, traffic, and degree of crowding on demand (Figure 3.6).

It should be mentioned that the value of time is an important consideration in travel cost studies. That is, time spent traveling and at a particular recreational site is associated with an opportunity cost since you "cannot do two things at once." Thus, the monetary equivalent of time cost must be added to other out-of-pocket expenditures such as on gasoline. Important inroads are currently being made into the assessment of these costs.

Each of the above market-related approaches has relative strengths and weaknesses which must be weighed when deciding the appropriate method for a particular job. It is also very important to try and include the influence of substitutes, congestion, and income on demand since they will influence estimates of consumers' surplus. See Kneese (1985), Freeman (1979), or Randall (1981) for more details on these methods.

3.1.3 Nonmarket methods: Sometimes there is insufficient market and market-related data to use the above techniques. For example, the travel cost technique is undermined when distances to the recreational site, and, therefore, travel costs are negligible. In other cases, people may not be able to perceive certain externalities and public goods, let alone changes in their levels. This is often true for the case of water quality which is hard to distinguish with the naked eye. In these situations, valuations will not be implicit in property markets. In addition, many effects are not expected until the future, and, therefore, are not reflected in current behavior. Finally, certain classes of economic value, such as the nonuse values, are not revealed by definition in behavior. In these situations economists usually use various forms of contingent choice methods, particularly the contingent valuation method.

In essence, the contingent valuation method is an advanced survey method which is designed to collect economic data directly from individuals. A hypothetical, yet realistic, market for an environmental resource is described to respondents. Valuations of large changes in the levels of the environmental resources are requested in terms of willingness-to-pay. Hence, the method goes directly for shadow values. The valuations are contingent on the conditions described in the hypothetical market--hence, contingent valuation. There are several potential sources of problems awaiting the researcher, but none that cannnot be handled.

The contingent valuation method is often used to assess the economic value associated with large changes in the levels of water quality, visibility, wildlife encounters, noise, and other environmental resources (as opposed to marginal changes). It is also a necessary approach for the assessment of existence values, and is very useful for assessing the value of potential future events before they occur. As above, see Kneese (1985), Freeman (1979), or Randall (1981) for more details.

3.2 Comparative Methods

This section concerns a few methods that economists use to organize economic information on the economic benefits and costs of public policies. Benefit-cost analysis and cost-effectiveness analysis are concerned with economic efficiency. The former compares alternatives on the basis of net economic benefits. Thus, a project may fail or pass the benefit-cost analysis criterion depending on whether efficiency in the allocation of resources is expected to be reduced or promoted. Benefit-cost analysis can also be used to help determine the efficient size of a public project or program.

Cost-effectiveness analysis differs in that a project's goal or size is taken as given. For example, society might decide that groundwater must be potable. The economists' task in using cost-effectiveness analysis is then to determine which alternative from a list of plausible alternatives can achieve the goal at the least cost to society. Using the groundwater example, is it cost effective to regulate land uses that affect groundwater, to install slurry walls, to build tertiary treatment plants, to treat water at the well, to use the assimilative capacity of wetlands, to use spray irrigation, to require households to install denitrification systems, or to buy bottled water?

The third method considered here--economic impact analysis--is actually a detailed accounting of the economic benefits and costs of policies. This approach provides policy-makers with information on which groups of people are likely to receive benefits and to incur costs. While economists cannot pass judgment on what society should or should not do, information from an economic impact assessment allows decision-makers to consider the redistribution of income and wealth which is expected to result from a project. As we shall see, transfers of economic surplus from one group to another have no implications for the result of efficiency analyses; however, they are very important considerations for policy-makers who must consider equity as well as efficiency.

This stand on equity might sound callous. In fact, many individuals criticize the use of benefit-cost analysis because it does not consider the implications of the distributions of benefits and costs, whether they be across individuals in the current population, across generations, or involve effects on wildlife and natural ecosystems. However, much of the criticism is actually misplaced. Economists do not pretend to judge equity, or what is right or wrong. But the omission of such judgments from economic analyses should not be construed to suggest that economists do not recognize their potential importance. This can be understood if we make distinctions between positive and normative analyses. Positive analysis is concerned only with the facts. What is the demand for public beaches? What is the change in consumers' surplus if more public beaches are opened? What is the associated opportunity cost of protecting beaches for the public? Contrast this with normative analyses which attempt to prescribe what should be done based on certain ethical principles of fairness and rights. Thus, "we should acquire more beaches in Massachusetts for public use" and "we should protect the potability of groundwater" are normative statements.

Economists concentrate on positive analyses. As a profession, we can speak authoritatively on the implications of resource allocation for efficiency, but can no more say what should be done than the next person. I quickly add that no scientist--be he/she an ecologist, chemist, physicist, or political scientist--can preach what should be done based on their studies of environmental and social systems. These are largely matters of personal opinion.

I do not mean to suggest that economic analyses do not have ethical implications. You might have noticed that willingness-to-pay is constrained by one's ability to pay--in other words, income. There is an alternative concept called willingness-to-accept-compensation which is not bounded by income, and might be more appropriate in certain situations. Although theoretical inquiries suggest that the two concepts should be similar, empirical studies of environmental quality indicate that the latter tends to greatly exceed willingness-to-pay. While willingness-to-pay tends to promote the current distribution of income, willingness-to-accept-compensation might tend to promote changes. A detailed discussion of the relationship between these concepts and utility is beyond this primer. See Just, Hueth and Schmitz (1982) for details.

In this continued discussion on economic methods of analysis, I shall refer almost exclusively to benefit-cost analysis since the concepts and practices are the same for cost-effectiveness analysis (after all, benefits and opportunity costs are often symmetric concepts. In fact, losses in benefits can be called damages.) Comments on economic impact assessments will be made throughout.

3.3 Benefit-Cost Analysis

Benefit-cost analysis is a systematic method of identifying and organizing economic benefits and costs that are expected to result from a proposed public policy or program, including the implicit policy alternative of doing nothing (i.e., the status quo). As indicated above, much confusion surrounds benefit-cost analysis in practice versus benefit-cost analysis in principle. There is no doubt that benefit-cost analysis has been misused and abused. In many cases it is easy for someone to come up with the answer that they want by "fudging" with discount rates and by selectively omitting certain opportunity costs, particularly those associated with externalities. However, this is a problem with certain practitioners and not an inherent flaw of the method. I ask you to reconsider the merits of benefit-cost analysis based on its proper usage. This request is consonant with one goal of this primer--to inform you as to how to expose those who would mislead you with technically sounding, yet bogus information.

Benefit-cost analysis is based on what economists call the potential Pareto criterion. Early in the nineteenth century, Italian economist Vilfredo Pareto argued that a public policy that would change the allocation of productive resources is beneficial if no one is hurt by the policy and at least one person gains from it. In the real world, however, this result is rare. As an alternative, economists Sir John Hicks and Nicholas Kaldor argued for the relevance of potential compensation in public finance--a reallocation of resources increases efficiency when the economic benefits exceed the opportunity costs regardless of who incurs the benefits and costs. In these cases, winners could potentially compensate losers--hence, the potential Pareto criterion.

Notice that I did not claim that winners should compensate losers. This may or may not be true depending on the circumstances, society's beliefs about what is just or fair, and the law. Again, goals concerning equity and fairness are extraeconomic goals. Thus, benefit-cost analysis does not provide automatic decisions; nor does it supplant the political decision-making process.

3.3.1 Additional concepts in benefit-cost analysis: As an example to get you through this discussion, consider an ambitious benefit-cost analysis of the development of a coastal region such as Cape Cod under current zoning. Consider the baseline situation to be the present and expected future trends in development under current zoning [residents of Cape Cod might already be familiar with the recent Growth Report published by the Association for the Preservation of Cape Cod (1985)]. As far as economists are concerned, the general question becomes "What are the net economic benefits of managing the development of the coastal zone?" In order to answer this question, the net economic benefits of expected development must be compared with the net economic benefits of alternative uses of land and water.

You can imagine the arguments, pro and con. The construction industry and local businesses might argue that development will generate considerable income and employment in the region. Furthermore, part of the income will be respent, thereby having a multiplier effect on the regional economy. In addition, the "improvement" of the vacant land will increase the tax base of the towns, and, therefore, increase tax revenue.

On the other hand, many residents might argue that population growth burdens the town's finances, causing tax rates to be increased. Also, the sewage from additional households will pollute groundwater and nearby ponds. Traffic will worsen considerably. Beaches will become overcrowded. Public access to open space will be reduced significantly. Critical wildlife habitat will be lost. The environmental services that wetlands provide to communities will be chipped away. Sound familiar? It does if you already live on Cape Cod, Long Island, or within nearly any other coastal zone.

The remainder of this chapter will highlight concepts and practices related to these issues. In Chapter 6 I will present a numerical example to demonstrate the use of benefit-cost analysis for the hypothetical development of Cape Cod.

3.3.2 Social discounting: The previous discussion of discounting concerned private, or personal, discount rates, based on goals of utility or profit maximization. Many economists argue, however, that private rates are higher than those for discounting social benefits and costs. Unfortunately, this literature is very complex and cannot be covered here. Suffice it to say that many economists argue for real social discount rates between 2% and 6%.

Benefit-cost analysis also uses the present value criterion to organize economic benefits and costs that occur across groups and across time. For example, the information in Table 3.1 for the economic effects of three alternative policies for protecting shoreline would be difficult to interpret in their present form even though the time period is quite short. However, we can discount all future economic benefits and costs to their present value using the social discount rate. The net present value (NPV) is then defined as the difference between the present value of economic benefits and the present value of economic costs. Mathematically, this is equivalent to the following operation:

$$NPV = \frac{(B_0 - C_0)}{(1 + d)^0} + \frac{(B_1 - C_1)}{(1 + d)^1} + \frac{(B_2 - C_2)}{(1 + d)^2} + \frac{(B_3 - C_3)}{(1 + d)^3}$$

$$NPV = \sum_{t=0}^{t=3} (B_t - C_t)/(1 + d)^t$$

where t is the year in which the benefits (B) and costs (C) occur, d is the social discount rate, and $\sum$ is a summation sign indicating the addition across years. The net present values in this example using a 4% rate of social discounting (i.e., d = 0.04) are $7.6 for alternative I, $17.7 for alternative II, and $21.4 for alternative III. Based on this analysis, alternative III is the most efficient alternative for shoreline protection since its net present value is the greatest.

In general,

$$NPV = \sum_{t=0}^{t=T} (B_t - C_t)/(1 + d)^t$$

where T is the last year to be considered. Few projects include analyses beyond 50 years since present values decrease rapidly with time (recall Table 2.2). Therefore, the timing of benefits and costs are crucial to the determination of net present values.

3.3.3 Sunk costs, transfer payments and double counting: It is very easy to include irrelevant costs and to count benefits and costs more than once even when you try to be careful. Of course this practice must be avoided; otherwise, the net present value of a project's alternative (or its present value of costs in cost-effectiveness analysis) would be biased, leading one to erroneous conclusions.

There are certain "costs" which economists do not consider to be social opportunity costs at all. A social opportunity cost is assigned to a project at the time it is incurred and only if it involves the use of productive resources. Thus, costs which might be related to an overall policy but which were incurred in the past are considered sunk costs. Since they occurred in the past and have nothing to do with present or future costs (except perhaps indirectly if they lower the available budget or otherwise limit the policy alternatives that you can choose from), they should be ignored.

Depreciation costs are also irrelevant to economists. They are simply accounting devices for tax purposes.

On the other hand, transfer payments may involve actual economic benefits and costs. Nevertheless, they have no influence on the economic evaluation of a project's alternatives based on efficiency alone. As the term implies, a project alternative might involve the transfer of income and benefits from one group to another but with no change in net benefits--a zero sum result. Taxes and subsidies usually fall into this category. For example, the excise tax that state and federal governments charge on gasoline, cigarettes and alcoholic beverages is a transfer of surplus from consumers of these products to the government. (To be precise, there is actually an associated "deadweight" loss, although it is probably small for these markets. We will consider this loss later in Chapter 4.) No economist need be reminded, however, that transfers do involve winners and losers, and although it makes no difference on efficiency grounds (recall the potential Pareto criterion), it might make a difference on political or ethical grounds. Again, an economic impact assessment provides information to help decision-makers which goes beyond the needs of benefit-cost analysis and cost-effectiveness analysis.

Double counting refers to situations when economic benefits or costs are counted more than once. It would be double counting if a policy that reduces costs is counted once on the cost side by lowering costs and again as an increase on the benefit side in the same calculation. Probably more common is to count benefits or costs once as a flow that occurs over time, and then, albeit inadvertently, as a stock. An example will clarify the point. Suppose that the State of Massachusetts is considering the expansion of Routes 6 and 28 to reduce the time it takes to get to and through Cape Cod. As part of the benefits calculation the state includes the value of time saved over the next 50 years for motorists due to reduced travel times. It would be double counting, however, also to include increased property values on the Cape (a stock) resulting directly from the improved roads.

The treatment of transfer payments can also result in double counting. The possibility depends largely on what you consider to be the boundary of the analysis. (Boundaries will be discussed below as part of external and internal effects.) For example, Massachusett's Self-Help Program has provided towns such as Edgartown with monies to acquire open space for outdoor recreation. While the recipients undoubtedly consider the amount to be a benefit, from the state's point of view the disbursement is a transfer of tax dollars from residents throughout Massachusetts to Edgartown.

3.3.4 Direct and indirect effects and related concepts: First consider the difference between direct, or primary, and indirect, or secondary, effects. Direct effects concern the intended output of a project. Using our example, construction companies add to the supply of housing--housing is the output. Meanwhile, the demand for housing continues to grow rapidly. The direct net benefits are the present value of total willingness-to-pay by households for the houses, minus the present value of the opportunity costs of the resources used to develop the Cape--labor, materials, construction equipment and the earnings that owner(s) of the construction companies forego by not building or investing their capital elsewhere. As we saw in Chapter 2, this is equivalent to consumers' surplus plus economic profit.

Any other expected effects induced by, or stemming from, the proposed subdivision are indirect effects. The question is whether indirect effects represent real additions to or deletions from the value of society's output. In other words, do the indirect effects represent gains or losses in consumers' surplus and producers' economic profits or just transfers of benefits from one group to another?

Consider the earnings of resources used in construction, particularly of labor but also of businesses that sell building materials. Unless the development employs labor and resources that otherwise would be unemployed, the net benefits of their use induced by construction is zero. Why? Because the resources would still be employed elsewhere in the production of other commodities valued by society--once again we encounter opportunity costs.

The same conclusion holds for claims of respending induced by and stemming from the construction. Some argue that those employed by the construction industry and others selling materials and services (e.g., real estate agencies, insurance companies) to the industry will respend part of their earnings in other markets--restaurants, grocery stores, clothing stores, etc. Again, the earnings induced by construction represent net economic gains only if the resources used in the production of these inputs would have been otherwise unemployed. In most cases the effects drop off rapidly after the first round of spending.

This is important to understand since much of the alleged benefits of a project are in terms of respending. Multipliers of between 3 and 5 are misused. Although the earnings of factors employed by a project may be spent and respent 3 to 5 times as the income moves through the regional economy, it is necessary to subtract the opportunity costs at each step to determine the net effects. Suffice it to say that the multiplier effect will usually be considerably less than one.

One must be careful when treating the opportunity costs of labor in benefit-cost analysis and cost-effectiveness analysis. Even if there is considerable unemployment, it is necessary to determine whether the project(s) will actually hire the unemployed. Furthermore, it is necessary to consider whether present unemployment levels will persist throughout the length of the project.

The same can be said of other earnings stemming from the project. Businesses might be built to service the new residents--new restaurants, new grocery stores, new clothing stores, new real estate agencies, etc. Again, one must inquire about the opportunity costs of these ventures.

Externalities are also a form of indirect effects. One form concerns municipal finances. Clearly, the increased market value of the developed land will raise the tax base of towns, generating additional tax revenue. However, it is not clear that this represents a net benefit. Obviously towns are required to provide certain services to new property owners. These might include police and fire protection, road maintenance, trash disposal, and public education. Furthermore, as towns grow new types of services may be required such as investments into elderly services and welfare programs. The additional costs of providing these services tend to exceed the additional tax revenues generated by development. For example, the capital expenses of new schools and new police cars are quite high; hence, everyone's tax rate increases.

Of course the opportunity costs of these expenditures must be reduced by the surplus received by the new residents when determining net costs. Furthermore, from a pure efficiency standpoint it doesn't matter who bears the costs. Thus, the <u>increased</u> taxes paid by current residents is essentially a transfer to the new residents--a pecuniary externality. Nevertheless, it might matter very much to those paying the higher taxes. Again, economic impact assessments provide additional useful information to decision-makers even though transfers are superfluous to efficiency analysis.

Other pecuniary externalities are worth mentioning. For example, the "discovery" of Cape Cod by wealthy Bostonians and then others from New York, Connecticut, and, indeed, the world has no doubt increased the market demand for existing housing (certainly good substitutes for new houses) dramatically during the past decade (Figure 3.7), causing prices to increase sharply. In addition, the increased property values of existing houses stress the ability of low and middle income families and those on fixed incomes to pay their property taxes. Finally, the high prices for property on the Cape make it increasingly difficult for young people to purchase their first house. The problems in rental markets seem less severe, but the high price of rental property does stress the ability of some to pay. Although these matters are beyond an efficiency analysis, economic impact assessments can be used to quantify the effects.

Many of the externalities of development are technical externalities which affect utility and production directly through changes in environmental resources. In many cases they cause real losses in personal utility and productivity, and, therefore, must be included in a benefit-cost analysis. Until recently most of these effects were considered to be incommensurables--that is, beyond measurement. However, many economists (particularly resource and environmental economists) now devote their careers to the assessement of these values as well as to the development of market-related and nonmarket methods such as those introduced earlier.

An example of a technical externality that affects utility directly is the opportunity cost of reductions in groundwater quality. Losses in satisfaction due to diminished recreational opportunities are also indirect costs of development. This may be due to reduced water quality in ponds, reduced access to recreation sites, or increased congestion at remaining sites. Additional time spent in traffic will also lower most peoples' utilities, and possibly the profits of some businesses since potential customers might be reluctant to cross or merge onto crowded streets. Finally, traffic can reduce the productivity of firms when transportation time for businesses increases.

3.3.5 The "art" of benefit-cost analysis: Despite the rigorous framework, considerable judgment usually enters into applied benefit-cost analysis. However, economists can strengthen the analysis and make it more useful to decision-makers by providing a range of likely estimates of net present values, and by consulting with experts who can provide professional advice on technical matters which influence the estimation of benefits and costs. For example, hydrogeologists can advise economists on the timing and probability of a groundwater plume impinging on a public well. This is important since future costs are discounted to a present value.

The different types of judgments essentially follow the steps in a benefit-cost analysis. First, the analyst must decide on the boundary of the analysis. That is, which benefits and costs will be internal to the project and which will be external, or excluded. Often this is determined by the governmental unit or person who pays for the study. For example, a town, state, or nation. There is no reason to believe, however, that those groups affected by a policy fall within convenient geopolitical boundaries. It is the economists' job to point out which categories of social costs and benefits are being excluded, and, possibly, which internal benefits and costs are actually transfers.

The second step of benefit-cost analysis involves identifying relevant alternative policies and the specific system of accounts. The unit that commissions the study will probably determine the specific alternatives. However, the analyst will probably decide on the specific categories of economic benefits and costs, perhaps constrained by what is considered to be internal to the study. Decisions on admissible indirect effects and the incidence of tranfers and double counting are not always obvious.

The next step is to collect data on the components. This is always easier said than done since market prices do not always reflect opportunity costs or utility at the margin. Furthermore, many benefits and costs are not captured by markets. The economists' professional judgment always comes into play here.

Related to this step, time and budget constraints on the analysis often require economists to use approximations, concentrating only on the expected changes in the flows of income with a project <u>versus</u> without a project. Among other things, one often makes the tacit assumptions that: (1) markets are in competitive equilibrium; therefore, prices reflect social values of commodities and inputs at the margin; (2) changes in prices and/or quantities are so small relative to the entire market that they can essentially be valued at the margin; and (3) the marginal utility of a dollar is constant regardless of income levels and is equal across individuals. Clearly, these assumptions will most likely be violated in many cases. For example, the many nonmarket effects discussed above would not be included in such an assessment. When important environmental externalities are expected nevertheless, the decision-maker might judge whether the net present value of a project causing these effects would be outweighed by the unaccounted for damages. This approach is a poor substitute for actual quantification.

Next, the economist needs to predict future events in order to determine the magnitudes of benefits and costs through time--all without the aid of a crystal ball. Ideally we want to know what conditions would exist as a result of a policy alternative and compare these to conditions that would exist without the project. How will peoples' tastes and preferences change? How will population size change? What will the distribution of income be through time? What will the unemployment rates be? Inflation rates? Market structures? And so on. Clearly one's confidence in the assignment of benefits and costs will lessen with distance into the future. In practice, analysts sometimes resort to describing conditions before and after a project. Thus, present conditions are extended into the future to represent costs and benefits without the project, and expected changes in present conditions due to the project are projected into the future to represent with-project benefits and costs.

The final steps involve <u>sensitivity analyses</u> of the data to see how estimates of net present values change when the social discount rate changes and when relatively large benefit and/or cost components vary. As indicated above, economists do not know <u>the</u> social discount rate. Therefore, it is important to demonstrate the sensitivity of results to changes in the discount rate. Furthermore, estimates of benefits and costs will be imperfect, and, therefore associated with some degree of error or uncertainty. Again, it is the economists' job to provide a sensitivity analysis for how estimates of net present values change as estimates of economic benefits and costs change. It would be a mistake, however, to conclude that discount rates and benefit and cost estimates are determined arbitrarily. As indicated above, the social discount rate is thought to be between 2% and 6%. The use of rates beyond this range might be inappropriate for the analysis of public investments. Also, a qualified economist will have a good idea of the probable ranges of values for benefits and costs.

CHAPTER FOUR

Thinking Economically

It is time to leave the classroom and enter the real world. It is time to "think economically" about resource conflicts in the coastal zone.

The following parables are intended to inculcate the concepts that you have just learned, and to reveal some ways in which economics can be used to analyze a variety of resource use conflicts in the coastal zone. This is accomplished by evaluating ten stereotypical, pseudoeconomic arguments that you might hear or read. Unfortunately, it is beyond the scope of this primer to expound on these issues. However, I may not be able to resist the opportunity to slip in a few more concepts in order to increase your knowledge of economics. To help you through this chapter, you will find an index at the end of the primer which will facilitate locating the page number where the economic concepts were first described.

1. A large construction company wants to build a 200-unit condominium complex in Boomtown. The application for a building permit is for land that is adjacent to a quarter-mile of ocean beach, near a salt pond used for recreation, and within the recharge area of a public well. At a town meeting the company's president explained that the project will employ 25 skilled workers from Boomtown during the three-year construction phase and 15 people thereafter to manage and run the complex. He emphasized that the construction phase of the project will pour $2.4 million into the local economy over the next three years, including wages for the 25 workers. Furthermore, he claimed that the money will be respent a number of times locally on building materials, food, housing, and sundry other businesses. Using a multiplier of 3.5, the income that the construction phase of the project is expected to generate is $8.4 million. What a deal!

Alarms should be going off in your head. Indirect effects. Opportunity costs. Discounting. Large construction companies tend to argue from the input side, or, according to the project's expenditure on factors of production (particularly labor) including multiplier effects. I am not suggesting that this is inadmissible--just woefully incomplete.

First, this argument does not even consider the net direct benefits of the condominium project. Certainly the owners of the construction company expect to cover their opportunity costs (i.e., the net income from investing their capital in construction elsewhere), and presumably make an economic profit. And what about the expected value of consumers' surplus for those who will buy the condominiums? Both omissions clearly ignore the net direct benefits of the project.

On the other hand, the concentration on expenditures induced by the project in markets for labor, building materials, and housing most certainly overestimates the <u>net</u> indirect benefits induced by the project. The opportunity costs of inputs used in the production of the condominiums as well as in local markets where employees respend their income must be deducted to determine net indirect benefits. In one extreme case when all inputs would be employed with or without the project, the indirect benefits would be near zero. This is likely to be the case when skilled labor is employed. If the net multiplier for this example is 10%, the net indirect benefits would be at most $2.4 million x 0.10, or, $240,000. However, even this figure would be an overestimate because we did not discount the net benefits in the second and third years to their net present value. If the net indirect benefits are spread evenly over the three years, the net present value is $228,800 using a 5% social discounting rate. (Note that for simplicity, I treated the net benefits for each year as if they were received on the first day of the year. Hence, the years are 0, 1 and 2 instead of 1, 2 and 3. In reality, the benefits would be spread evenly across the three years on almost a daily basis. Although a different formula would be used, the principle is the same.)

Finally, there is no accounting of the technical externalities which the development might ultimately create. Thus, would Boomtown have to raise their tax rate in order to augment the provision of municipal services? Would traffic be increased significantly? Would groundwater within the recharge area remain potable? Would the shellfish beds in the nearby pond be closed? Would the general public lose access to the stretch of beach adjacent to the planned units? I think you get the point.

> 2. An entrepreneur wants a permit to dredge a 100-slip marina in Yacht Cove. The owner of the only marina now in the cove argues, however, that this will hurt her business. Without being specific, her accountant estimates losses of over $100,000 a year. In addition, two employees might be laid off. In fact, the owner might go out of business.

Owners of businesses who expect to be hurt by new competition tend to argue from the output side. That is, they announce the amount of revenue (not economic profit) that they expect to lose. There is no doubt that new firms selling the same product or services as existing firms could affect the latters' profitability. The economist cannot say, however, if this is fair or unfair. But the economist can estimate the relevant economic impacts of new entry.

In this case, the $100,000 probably represents expected losses in revenues from the rental of slips and the sale of supplies to the clientele. If this is the case, it does not represent a net annual loss to the marina owner. From this we must deduct the opportunity costs of inputs that she uses to provide services to customers, and the opportunity cost of her land (that is, the costs expected to be affected by entry). For example, vacant slips might have value as a fishing pier or a boat launch. Even if the slips affected by entry would be idle at first, one must try to determine when the slips might be filled in the future as the demand for slips increases with an increasing population.

Next consider the opportunity costs for the two people who might be laid off. Would they find a job elsewhere? How about the proposed marina? If they do find other employment, there would be little if any net indirect effect on them.

The possibility that the owner might go out of business raises several interesting points. It is important to consider the difference between accounting profit and economic profit. The accountant's figures might show that the owner's take home pay is $60,000 a year. But what part of that represents the owner's opportunity cost for her time and perhaps the marina itself if she owns the land and capital? If she goes out of business, it might suggest that she could still earn $60,000 a year by working elsewhere, by renting her marina to someone else, and/or by selling it to another business. Of course, if she is making an economic profit, that would be considered a social loss. There is also the possibility that the owner derives personal utility directly from time spent working at the marina. The loss of this satisfaction should be considered. Finally, one should consider the owner's transaction costs if indeed she goes out of business including closing fees, lawyer fees, and possible moving costs.

Finally, consider the possibility that the owner does not go out of business and that the loss in revenue is due solely to a lower price, or, rental fee for slips. Also, for the sake of argument, let's say that the existing and proposed firms are essentially identical and that the expected lower rental fee is just enough to cover the firms' variable and fixed costs, including the respective owners' opportunity costs. Thus, without the second marina the existing firm is making an economic profit which it will lose with the second firm's entry. However, the lower price also means that the current customers will receive a gain in consumers' surplus. Furthermore, the new marina and lower price will allow more people to dock their boats, resulting in an additional increase in consumers' surplus. Thus, the loss in the existing firm's profit is simply a transfer from the producer to consumers--a pecuniary externality. In addition, though, there is still a net gain in economic surplus composed of an increase in consumers' surplus which is in excess of the loss in economic profit. Ah, the joys of perfect competition. These are direct effects since they occur in the market which would be directly affected by entry.

One way to illustrate these qualitative results is with a monopolistic firm. Monopoly simply refers to a market structure for a commodity where there is a single producer who sets market prices. Although the economists' model of monopolistic behavior still assumes profit maximization, marginal revenue is not constant as it is for a firm in a competitive industry. To see this, consider the following equation for the demand for boat slips:

$$\text{Slips} = 115 - 0.05 \times \text{Price}.$$

Quantity demanded is one when the annual rental fee is \$2280 (115 - 0.05 x \$2280 = 1); total revenue is also \$2280 in this case. At \$2260, quantity demanded is two (115 - 0.05 x \$2260 = 2) and total revenue is \$4520 (2 x \$2260 = \$4520). Marginal revenue, or the gain in total revenue by renting the second slip, is \$2240 (i.e., \$4520 - \$2280 = \$2240). At a \$2240 rental fee, quantity demanded is three, total revenue is \$6720, and marginal revenue is \$2200 (i.e., \$6720 - \$4520). The process continues. At \$1480, quantity demanded is 41 and marginal revenue is \$680.

The firm's marginal cost for providing slips is expressed directly by the following equation:

$$\text{Marginal cost} = 500 + 4 \times \text{Slips}.$$

For example, the marginal cost of making the first slip available is \$504 each year (500 + 4 x 1 = \$504). The marginal cost of providing the tenth slip is \$540 (500 + 4 x 10 = \$540). Finally, the marginal cost of providing the forty-first slip is \$664 (500 + 4 x 41).

What is so special about the provision of 41 slips? As can be seen in Table 4.1, the firm maximizes profits at this level of supply. That is, given the nature of the demand curve (i.e., what the consumers are willing to pay) the additional revenue (i.e., marginal revenue) from providing the forty-second slip (\$640) is less than the additional cost (i.e., marginal cost) of providing it (\$668). Therefore, the profit maximizer will only supply 41 slips.

These relationships are illustrated in Figure 4.1a. Consumers' surplus is area ABC (i.e., \$16,810). Economic profit is area BCDE (i.e., \$36,818) minus fixed costs. If fixed costs are \$3200, the monopolist's profits are \$33,618 and total net economic benefits are \$50,428 (the sum of consumers' surplus and the monopolist's profits).

Notice that the monopolist's marginal cost curve is <u>not</u> its supply curve. That is, the marginal cost curve does not delineate quantity supplied at each price as it does for firms in a competitive industry. At a rental price per slip of \$1480 the monopolist supplies 41 slips while a firm in a competitive industry would be willing to supply about 245 slips. [Recall that firms in a competitive industry supply commodities until their marginal cost of production equals the market price of the output. In this case, since price=marginal cost=\$1480, the quantity of slips supplied can be calculated by transforming the above equation such that slips = (price - 500)/4).]

It is important to emphasize that marginal cost (\$664) is considerably less than market price (\$1480) under monopolistic conditions for another reason. Under monopolistic and other noncompetitive market structures (see any text in microeconomics such as Mansfield's for a discussion of other market structures), the marginal cost of inputs does not reflect the social value of production simply because the market does not clear where marginal cost equals society's marginal willingness to pay. This exacerbates problems that might exist due to market failures when externalities are not captured in a firm's cost function.

Next suppose that entry of a second marina in the cove would establish a competitive market structure. In this case, the market supply is in fact the summation of the two (identical) marginal cost curves as drawn in Figure 4.1b. Each marina would take prices as given; the first marina could not maintain higher prices because its customers would simply go to the new marina. The market price is now about \$664 per slip. Demand and supply are in equilibrium at 82 slips with each marina supplying 41 slips as before. The fact that economic profit is zero for each firm (total revenue is \$27,060, total variable cost is \$24,024, and fixed cost is \$3,200) reveals that each firm is just covering its opportunity costs. And although the original firm has lost an economic profit of $33,618, the combination of a lower market price and increased output causes consumers' surplus to increase by $50,430 from $16,810 to $67,240 (area BCFG in Figure 4.1b). Since the increase in consumers' surplus exceeds the loss in the first marina owner's economic profits ($50,430 - $33,618 = $16,812), entry into this market represents a potential Pareto improvement for society as a whole.

This example was designed to drive economic profits to zero with entry of a single firm. However, if the two firms still made economic profits, one might expect more entrepreneurs to try to enter the market, driving price down further until each firm is just covering their opportunity costs. In fact, we could have used such a scenario to characterize the qualitative results discussed above. For a further discussion of adjustments in competitive markets see Mansfield (1979) or another intermediate text in microeconomics.

> 3. One possibility for raising money to acquire open space and protect against certain external effects of development is a land transfer tax. Some developers and real estate agents argue, however, that this will have a negative impact on the housing industry. Let's "think economically" about this issue.

At first cut we must agree with developers and real estate agents that this might be the case. For example, a 2% tax on the sale of vacant land and new houses would in essence raise the effective price of property to consumers. And as you now know, when price goes up, quantity demanded goes down. Let's say that at a market price of $95,000, 1000 new Cape-style houses would be sold this year (Figure 4.2a), resulting in $95 million in total revenue for construction companies. Recognize that the commission for real estate agencies is part of the construction companies' marginal costs; therefore, it is already included in the figure.

A 2% land transfer tax would lower the effective demand for Capes (Figure 4.2b). As I have the demand and supply curves drawn, the quantity demanded drops from 1000 to 900--a reduction of 100 houses. Total expenditures by consumers declines to $87.21 million (900 x $96,900). Total revenue for construction companies is now $85.5 million (900 x $95,000). The tax program receives $1.71 million [900 x ($96,900 - $95,000)] for the acquisition fund.

However, in order to estimate the annual economic impact on construction companies we need to look at the change in economic profit caused by the tax. Total variable costs from the production of 1000 houses is $92.5 million (this is the area under the industry's marginal cost curve between 0 and 1000 houses). To this we will add $1.5 million in fixed costs that the firms incur regardless of their level of construction. Therefore, economic profit in this example is $1 million ($95 million in total revenue minus $94 million in total costs). In contrast, the total variable cost of building 900 houses is $83.025 million. Since fixed costs stay the same by definition regardless of levels of output, profit is reduced to $0.975 million ($85.5 million - $83.025 million - $1.5 million) for a total loss for all firms of $25,000 in economic profit. (You might have noticed that we did not need to know fixed costs to estimate <u>changes</u> in benefits since fixed costs are constant by definition. However, if any firms go out of business their fixed costs are added as an additional loss.)

Figure 4.2b tells us more, however. Area ABD represents a loss in surplus due to the tax which is called a <u>deadweight loss</u>. It is no coincidence that the portion attributable to production is $25,000 (area BCD), or the amount of economic profit that is lost. The other portion of the deadweight loss--$95,000, or area ABC--is from consumers' surplus. The additional $1.71

million loss in consumers' surplus is the transfer to the tax program, and, therefore, not a net loss to society.

So far we have been engaged in a partial equilibrium analysis. That is, we have only considered the immediate effects of the tax in the market for houses and not any factors that might feed back and change market conditions. A consideration of possible adjustments in related markets for inputs, substitutes and complements and subsequent feedbacks is called general equilibrium analysis. Instead of going on and on about this, I simply suggest several possibilities for your consideration. First, the tax alone will likely cause the developers' demand for vacant land to decrease since their demand for land is derived from the consumers' demand for new housing. If this also results in a lower price for land, the construction companies' marginal cost curve for producing houses will decrease. Counter to this, municipalities participating in the tax program will enter the market for vacant land and thereby increase the demand for land and possibly its price. This will counter the effects of the tax by increasing the marginal cost curve in the housing market. The net effect on the marginal costs of construction companies is not clear, *a priori*. Nor is the effect on real estate agencies clear since the net effect on the price of land may be a decrease, an increase, or no change at all.

Second, the tax on new houses and/or vacant land could cause the demand for existing houses to increase. Thus, potential losses by real estate agencies in the new housing market may be recouped in the market for existing houses.

Third, market demand may actually increase if households believe that the acquisition program will protect the very environmental resources which comprise part of their demand for housing. Again, both construction companies and real estate agencies may actually benefit by the tax program in the long run.

The net effect of all these possible behavioral adjustments in the housing and related markets depends on actual shifts in demand and supply. Furthermore, the net effect on specific construction companies and real estate agencies will depend in part on whether they also own the vacant land.

Finally, consider a demand curve of a different shape--consider the concept, elasticity. (This property of demand curves can be difficult to comprehend. Don't fret if you do not grasp it the first or second time.) In Figure 4.2 the effective price increase occurred within the elastic region of the demand curve houses. By elastic we mean that the percentage change in the quantity of houses demanded,

$$(1000 - 900)/1000 = 0.10, \text{ or, } 10\%,$$

is greater than the percentage change in price,

$$(\$95{,}000 - \$96{,}900)/\$95{,}000 = -0.02, \text{ or, } -2\%.$$

Elasticity in this case is by definition

$$e = (10\%)/(-2\%) = -5.$$

In general, elasticity is defined as

$$e = (\text{percentage change in quantity demanded})/(\text{percentage change in price}).$$

A consequence of a price change within the elastic region of a demand curve is that total expenditures by consumers decreases when price increases. This is apparent in the example that we just examined where the price to consumers increased from $95,000 to $96,900 but their total expenditures decreased from $95.00 million to $87.21 million.

The effect on total consumer expenditures is the obverse, however, if the price increase occurs within an <u>inelastic</u> region of a demand curve. In Figure 4.3, the demand for housing is drawn much steeper. In this case, the percentage change in quantity demanded,

$$(1000 - 990)/1000 = 0.01, \text{ or, } 1\%,$$

is less than the percentage change in price, which is again 2%. Hence elasticity is

$$e = (1\%)/(-2\%) = -0.5.$$

Although price to the consumers increased as before, total expenditures also increased from $95.00 million to $95.93 million ($96,900 x 990). Thus, within the inelastic region of a demand curve, price and total revenue vary together.

But what does the price increase within the inelastic region of the demand curve in Figure 4.3 mean for the economic profits of construction firms? In this example, economic profits are still reduced as before, but by a much smaller amount--a combined loss of only $250 for <u>all</u> construction firms. (I wonder if this is balanced or exceeded by the benefits that builders will enjoy in their personal lives if the transfer tax program does in fact minimize external effects.) Also, there is a much smaller deadweight loss. However, consumers lose even more surplus although most is in the form of the tax.

What do you think? Is the demand for property in your coastal zone elastic or inelastic at current prices? Only an economic analysis of housing markets can answer this question.

4. Residents in the town Petiteport are upset about likely reductions in the quality of municipal services if the town's population increases as projected by a recent growth report. According to a consulting firm which studied the implications of projected growth for the town, it would cost an additional $12 million dollars in property taxes to maintain the same standard of services that current residents are now accustomed to, not to mention the likely additional costs of new services that they do not need now but will likely need with a significantly larger population. Eight million dollars of additional costs would be borne by current residents. The firm is somewhat confident that these costs would be distributed as $1.6 million in 1990, $2.4 million in 1995 and $4.0 million in 2000, for a total of $8 million. These figures include expected inflation.

The firm made two mistakes. First, the expected costs are not discounted to a present value. Second, the firm used nominal values for costs (including inflation) when it would have been much easier to use real, 1985 dollars. It's okay to use nominal dollars if you also use nominal discount rates, but why bother?

After talking to the consulting firm we find that the real costs are expected to be $0.9 million in 1990, $1.8 million in 1995, and $3.5 million in 2000. Using a 6% discount rate for the town, the present value of the costs is

$$PV = (\$0.9/(1 + 0.06)^5) + (\$1.8/(1 + 0.06)^{10}) + (\$3.5/(1 + 0.06)^{15})$$
$$= \$3.14 \text{ million.}$$

Our conversation also revealed that the firm is somewhat unsure of its estimates. In fact, the estimates are "worse case" scenarios. Actually, the firm felt that the probability of these costs coming to fruition is only 30%, although they were very confident of the timing of the costs. More likely (and with a 70% probability) the costs would be \$0.7 million in 1990, \$1.3 million in 1995, and \$2.9 million in 2000.

How do we include this information on probabilities when computing present values? One way is to determine the <u>expected value</u> of the costs. Thus, if the firm thinks that the probability of costs being \$0.9 million in 1990 is 30% (i.e., 0.3) and the probability is 0.7 that the costs will be \$0.7 million, the expected value of the costs in 1990 is

$$(\$0.9 \text{ million} \times 0.3) + (\$0.7 \text{ million} \times 0.7) = \$0.76 \text{ million.}$$

Using the same procedure, the expected value of the costs in 1995 and 2000 are \$1.45 million and \$3.08 million, respectively. Therefore, the present value of the <u>expected</u> costs is

$$PV = (\$0.76/(1 + 0.06)^5) + (\$1.45/(1 + 0.06)^{10}) + (\$3.08/(1 + 0.06)^{15})$$
$$= \$2.66 \text{ million.}$$

This simple analysis reveals how easy it is to misrepresent the expected costs of a project by not discounting.

5. Residents of Mercenaria are concerned that further development around Mercenaria Pond will force the shellfish warden to close the clam beds. They convinced the town to hire a consulting firm to estimate roughly the annual losses in recreational benefits that would result from a closure. The firm was advised by a resource economist to look at the travel cost literature to get a rough idea of the economic value of recreational shellfishing. After doing so, an employee selected an annual value of $30 per individual. The town's Department of Parks and Recreation told the firm that 1200 residents went shellfishing last year. Hence, the firm estimated the recreational value to be $36,000 per year.

This is an adequate approach as long as you recognize that you get rough estimates at best. Nevertheless, we still want to clarify a few issues. First, are the actual travel costs deducted from this figure (i.e., does this figure represent consumers' surplus or total benefits?). Probably not, but since distances to the pond are likely to be quite short for residents, and the estimate is a ballpark figure anyway, it makes little sense to be picky about this oversight.

There is, however, another potentially important consideration. The employee later ran into the economist at Mercenaria Pond. They were discussing the benefits calculation when the economist asked what study had been used to get the $30 figure. Whoops! There were no close substitutes for recreationists to choose from in the particular study selected by the consulting firm's employee. Yet, residents using Mercenaria Pond have several nearby sites at which to go shellfishing. Hence, the $30 figure could easily be an overestimate of actual benefits. As shown in Figure 4.4, all else being constant, an individual's demand for a shellfishing site which has substitutes will be more elastic at each shadow price than for a site without substitutes. Consumer's surplus will be less in this case. The economist also pointed out, though, that travel cost studies only include actual users. Therefore, those who are currently nonusers but who nevertheless have an option price for possible future use would not be represented in the employee's benefits calculation. Nor does the figure include economic existence values that residents might have. Ironically, the employee might have provided an estimate of total economic benefits, although fortuitously.

6. It is well known that wetlands, including salt marshes, assimilate human waste. In fact, wetlands provide the equivalent of tertiary treatment. This functional service provided by wetlands leads some people to argue that if an acre of saltmarsh can do the same job as a tertiary treatment plant which operates at, say, $25,000 per year, then the acre's economic value in waste assimilation is also $25,000 per year.

The reasoning here is fallacious. First, economic value is ultimately bounded by the demand for a commodity, which in this case is an environmental resource. Consequently, if residents do not demand the level of waste treatment that salt marshes can nevertheless provide, then the claim does not even begin to have a basis in economics (Figure 4.5a).

However, the derived demand for wetland acreage to perform waste assimilation may actually be growing in many coastal areas which have a groundwater pollution problem, or are facing expensive alternatives for sewage disposal in general. Conceivably, the demand for tertiary treatment may equal or exceed the capacity of an acre of wetlands to assimilate waste (Figure 4.5b). In this case, the operating costs of tertiary treatment (area under the marginal cost curve) would underestimate the economic value of waste assimilation (area under the demand curve).

7. The town of Gull Hill learned recently of the possibility of sending municipal trash to TRASHMASS for disposal. Unfortunately, the town had already bought land for a new landfill for $600,000. As a result, several people are arguing that it is better to continue with the original plans so as not to waste the $600,000.

Although the conclusion that it is "better" (presumably, the supporters of this stance mean more efficient) to continue with the plans for the landfill may turn out to be correct, the logic is incorrect. The expenditures to date on a landfill site are sunk costs; what's done is done. From an economic standpoint it would be wiser to assess the cost-effectiveness of the two alternatives starting at the present time: the present value of the future costs of sending trash to TRASHMASS versus the present value of future costs associated with continuing with the landfill project; forget about past costs.

8. An engineering firm is trying to convince the town council of Aquifer to install a slurry wall up-gradient of a public well. The wall will divert a plume of toxic waste that is encroaching upon the well and a nearby pond. The firm argues that not only will the slurry wall protect groundwater quality and the water quality of the nearby pond, but it will protect the property values of owners who receive water from the well, thereby adding immensely to the economic benefits of the slurry wall.

Although the slurry wall might protect water quality in the well and the pond and protect property values, it would be incorrect to add these benefits together. Adding the independent estimate of avoiding damages to property values to the estimates of the values of protecting potable water and of aquatic recreation would be double counting the benefits of the wall since they measure the same thing.

9. Three people are discussing--indeed, arguing--about the relative costs and benefits of land use strategies designed to protect the coastal environment. One person insists that the only thing to do is buy the remaining open space; acquisition is the only sure-fire way to protect the benefits of environmental quality.

A second person thinks that this idea is quixotic. He argues that towns cannot afford acquisition programs of the size that would be needed. Regardless, property owners would never vote to raise their taxes by the large amount needed. The best alternative, he claims, is to tax all new development at a rate that covers the external costs of new development. That's fair, isn't it? After all, it is new development that will cause the additional problems.

A third person counters that no sane politician or town council member would campaign for such a large transfer tax. What is needed, she says, is a combination of a conservation easement program and a transfer-of-development-rights (TDR) program. In this way landowners and developers could either volunteer for one program or be compensated by the other. That's democratic.

The others think that she is naive. They claim that an insufficient number of people would participate and important benefits would still be lost. Regardless, the costs of administering a large TDR program would be too high. Furthermore, there aren't enough places in the town to which to detour expected development anyway.

This is certainly a convoluted exchange. The only point that I wish to make is that a careful consideration of the alternatives would frame the discussion. It is important here to keep the with-versus-without distinction clear. In this case we have four alternatives: status quo, acquisition, transfer tax, and a combination of conservation easements and TDR'S. The benefits and costs of each alternative need to be quantified and expressed in present values. A modest attempt is made in Chapter 6 to illustrate the type of analysis which is needed.

10. An exasperated environmentalist complains that economists have an annoying habit of placing a dollar value on everything. There are some things that simply should not have a price tag, he argues. We should preserve open space for wildlife. We should bequest a clean environment to future generations. These things should be done regardless of cost.

Well, some economists might monetize "everything", but some economists recognize the possibility of intangibles. And I am not sure whether this person would be willing or able to pay all that is necessary to protect the environment for wildlife and for future generations. But he does raise a valid point concerning the purview of economic analysis.

Hopefully you have gained an understanding of why economists are able to express certain values in monetary units even when markets do not exist and use is not involved. The valuations represent personal utility and economic profit. Markets and prices are not necessary for well-defined economic values; only an interest in one's own well-being, an intent to behave rationally, and an indifference mapping of preferences such as in Figure 2.13 in Section 2.4.2 are needed as a foundation for economic value. Economists do not question peoples' preferences and valuations; economists seek to measure these completely and accurately.

It is certainly conceivable that the concerns expressed by some people for wildlife and future generations, as well as the well-being of others and the "right" to work, recognize an inherent worth of others. But this argument needs structure to prevent it from becoming semantic. As a beginning, economic value is a particular case of instrumental value whereby one assigns value to something depending on "something's" ability to provide personal utility or profit to the person who is assigning the value. Contrast this with intrinsic value which is independent of anyone's value assignment. (You should understand that some economists might disagree with me on this possibility.) Although someone might be willing to pay to protect the interests of wildlife or future generations, one cannot necessarily assume that his/her willingness to pay represents well-defined notions of economic value unless indifference represents his/her preference structures. I would caution you, however, against exaggerating the prevalence of genuinely ethical concerns which cannot be represented by tradeoffs on indifference. When in doubt ask youself whether one's motivation is truly altruistic or disguised self-interest (the word disguised is not intended tô carry any negative connotations). [The interested reader might try to learn about an alternative preference structure called lexicographical preference. See Baumol (1977).]

CHAPTER FIVE

Economic Impact Analysis of Protecting Water Quality in Coastal Ponds: A Case Study in Rhode Island

States along the coasts of the Atlantic Ocean and Gulf of Mexico are dotted with coastal lagoons and embayments (hereafter referred to as coastal ponds). Many people are flocking to the coastal pond regions because the ponds and nearby beaches offer excellent recreational opportunities including swimming, fishing, shellfishing, boating, and bird watching. Ironically, though, the people in aggregate are ruining the very environmental resources that they come to enjoy. An important set of problems centers on sewage leachate which is transported via groundwater flow into coastal ponds, thereby reducing water quality.

Rhode Island shares the pollution problems now faced by Massachusetts, New York, New Jersey, Delaware, and other states. Between 1940 and 1980, the number of houses in southern Rhode Island increased elevenfold. Also during this time, many summer cottages were converted to year-round residences. This burgeoning residential growth, almost exclusively in unsewered areas, has caused the reductions in water quality observed in parts of several ponds. Coliform standards set for safe shellfishing, and in some cases, for swimming are now exceeded during the summer. Water quality is expected to worsen since the number of houses near the ponds under current zoning regulations could triple from the 1980 figures.

5.1 Background

A study funded in part by Sea Grant in Rhode Island supported an assessment of certain economic impacts associated with the water pollution problem (Anderson and Edwards 1986). (Reduction in groundwater quality is also of concern, but was not part of this study.) The study centered on the recommendation promulgated by the State's Coastal Resources Management Council that vacant land within the coastal ponds region should be downzoned from 2-acre zoning to 5-acre zoning per buildable lot. The town of South Kingstown was selected for a case study since it was ready to consider the downzoning recommendation. Only basic results of the analysis are presented here; see Anderson and Edwards (1986) and Edwards (1984) for more details.

The 5-acre zoning recommended for South Kingstown would supersede 2-acre zoning for parcels exceeding 5 acres in areas which might impact on the town's coastal ponds. Approximately 2890 acres of land enveloping 118 privately owned parcels would be affected. The maximum number of buildable lots would decrease from 1319 to 386.

5.2 Selected Impacts

The selective economic impact analysis considered effects on three groups in the town: owners of vacant land, current and potential recreationists in the town, and the town as a whole in terms of fiscal impacts.

If a landowner has a 10-acre undeveloped parcel, the market value of the parcel would be higher under 2-acre zoning than under 5-acre zoning; "extra" land is not valued as highly as land needed for the house's foundation, the driveway, and to satisfy setback requirements. Also, it might be more difficult to sell the larger, more expensive 5-acre lots. Thus, in present value terms, the land's market value would be expected to fall under downzoning.

As water quality declines, recreational users would either continue to use the ponds, deriving less satisfaction as the quality of the site decreases or switching to less preferred substitute sites. In either case, users' recreation benefits would decrease to a greater extent under current zoning. The downzoning proposal is expected to result in less deterioration in water quality than if development occurred under current zoning.

The downzoning program would reduce the tax base of the town. However, it would also reduce the future expense of municipal services compared to expected needs under current zoning. The net effect is important since South Kingstown is required by law to have a balanced budget.

5.3 Results

5.3.1 Losses to owners of undeveloped land: The hedonic property value technique was used to predict the expected impacts on property owners. Frontage on and a view of a coastal pond or the ocean, and distance to these water bodies were significant determinants of housing and land values. For example, a typical three-bedroom house on two acres of land situated on a coastal pond one mile from an ocean beach has an estimated value of $168,400 (1980 dollars). For the sake of comparison, an identical house five miles from the nearest ocean beach and four miles from the nearest coastal pond would be valued at $76,305 in the same market.

We assumed that ten of the 118 parcels would be sold each year after the property had been divided into 5-acre lots. This rate of development is somewhat higher than the average rate over the past six years but is representative of the last year of "boom" development. The total discounted values of these vacant parcels were predicted using the estimated hedonic price model for vacant land under 2-acre and 5-acre zoning. The net present value of losses to owners of downzoned parcels was estimated to be $10.1 million at a 6% rate of social discounting (Table 5.1). However, this figure probably overestimates potential losses since (1) the reduction in the availability of building lots would actually drive up price over time, and (2) there was no account of the potential protection of property values due to the protection of water quality. An alternative development scenario, "slower development," attempting to take these factors into consideration resulted in a lower estimate of $6.4 million.

5.3.2 Recreational benefits: The contingent valuation technique was used to survey property owners on their willingness to pay in terms of option price: (1) to protect shellfishing, (2) to protect swimming and activities other than shellfishing which nevertheless require personal contact with water, and (3) to protect activities in category 2 plus fishing, bird watching, and those other activities threatened by the demise of the ponds. On average, the respondents to the survey bid $77/year to protect shellfishing, $87/year to protect swimming and other water-contact activities, and $169/year to protect swimming, fishing, bird watching, etc. Frequency of use, income, property ownership in the coastal ponds region, and uncertainty about future demand were statistically significant determinants of willingness to pay.

These results (adjusted for several sources of biases) were used to calculate total benefits of protecting water quality for residents and nonresident property owners. Since bids are on an annual basis, bids for future years were discounted to present values. Estimates of present values range from $6 million to $29 million depending on the change in water quality being valued (categories 1 plus 2 above, and categories 1 plus 3 above), and the discount rate (Table 5.1).

5.3.3 Fiscal impact on town: An analysis of the fiscal accounts for South Kingstown and other towns in Rhode Island (both larger and smaller) suggested that the downzoning program would result in a comparatively small but positive net reduction of up to $0.8 million in municipal expenses (present value) compared to the full growth scenario where land would be fully developed under current zoning regulations (Table 5.1).

5.3.4 Net present value of selected impacts: The net present values for the three impacts are also listed in Table 5.1. The estimated losses to landowners under the accelerated development scenario exceed estimates of gains to recreationists and the town overall for the changes in water quality. However, we get the opposite result for the scenario where future development proceeds at a slower rate.

A definitive statement cannot be made about the efficiency of the downzoning program. Scientific information on the exact relationship between housing development and water quality was not known. Furthermore, other direct and indirect effects of downzoning were not included (e.g., net multiplier effects in the construction related industry, recreational benefits for nonresidents, benefits of groundwater protection).

5.4 Postmortem

In the spring of 1984, a modified 5-acre zoning ordinance was adopted by South Kingstown. Because of concerns about the legality of downzoning and of windfall losses for landowners, 5-acre zoning was only implemented where development would adversely affect the town's groundwater aquifers and not throughout the coastal ponds region. Consequently, only approximately 900 of the 2890 acres of undeveloped land in the pond region were finally downzoned. As a result, water quality in the ponds is expected to continue to deteriorate.

In retrospect, the economic analysis provided valuable input to South Kingstown's land use planning process, although noneconomic considerations of the distributive effects on landowners prevailed over efficiency goals. Nevertheless, open space preservation continues to be a critical concern in South Kingstown. A recent town council election campaign focused on this issue. The town has encouraged large holders of undeveloped land to participate in the state's use value taxation program. However, this program tends to appeal primarily to active farmers and not to owners of "nonproductive" open space. There are no easy or inexpensive solutions. If communities are committed to protecting coastal estuaries, they must confront the reality that effective policies involve large direct and indirect costs.

Acquisition programs have been recommended as the most effective and politically feasible alternatives for protecting environmental resources that yield public benefits. Although programs like downzoning might yield a potential Pareto improvement in the allocation of resources, the concentration of costs on relatively few individuals with vested interests will tend to undermine such programs. Outright acquisition, on the other hand, results in an actual Pareto improvement when residents are willing and able to pay the necessary costs to acquire large amounts of open space. In this case, landowners would receive payment for their land and the towns as a whole (including many landowners, I am sure) would protect the ponds for recreational use. The next chapter considers the allocative efficiency of a hypothetical acquisition program.

CHAPTER SIX

A Benefit-Cost Analysis of Hypothetical Development on Cape Cod, Massachusetts

This chapter exemplifies the use of benefit-cost analysis with an analysis of development on Cape Cod, Massachusetts. Although the analysis is actually an exercise using hypothetical values for economic benefits and costs, it is based nevertheless on realistic issues. "Best judgment forecasts" of population growth and housing development are taken from the Association for the Preservation of Cape Cod's Growth Report (1985) and used as a baseline for conditions without a growth management strategy.

According to the Association for the Preservation of Cape Cod, the number of houses on the Cape is expected to increase by about 31,000, or, 27%, by the year 2000 to a total of about 144,000 (Table 6.1, Scenario A), leaving about 18% of all land that is still buildable (about 45,000 acres). Year-round population is expected to increase by about 49,000, or, 30% (Table 6.1, Scenario A). In addition, seasonal population is expected to increase by 34,000 (14%) for a total peak population during the summer of 497,000 by the year 2000.

6.1 Framework

Two boundaries for external and internal benefits are evaluated: (1) all interests are internal; and (2) construction companies from outside Massachusetts are external to the analysis.

Two alternatives are compared for each boundary condition. As indicated above, the Association for the Preservation of Cape Cod projections are taken as the status quo and in essence represent one option, or, alternative that towns on the Cape might select. This is compared to an aggressive acquisition program whereby towns override Proposition 2 1/2 and buy vacant land to prevent development.

The exercise considers the following direct and indirect effects: (1) Economic profit for the construction industry; (2) multiplier effects induced by development; (3) fiscal impacts on towns; and (4) technical externalities affecting groundwater potability, traffic, outdoor recreation, and option and existence values. Other indirect effects possibly stemming from development are not considered here, the assumption being that the factors of production will be employed elsewhere at their opportunity costs.

Since this analysis is only an exercise, the projections provided by the Growth Report to the year 2000 offer a convenient, if arbitrary, cutoff period at 14 years. Typically, the time horizon should be the life of the project. Thus, the cutoff period for an acquisition program would include several generations since the effects of such a program would extend well beyond the period involving acquisition costs.

The following assumptions are made:

(1) The Association for the Preservation of Cape Cod's projections are accurate;

(2) Large construction companies build 25% of the new dwellings annually;

(3) Large construction companies (all of which are based off-Cape) make a 10% economic profit, while small companies (all of which are based on-Cape) make a 5% economic profit on new homes;

(4) 50% of the large construction companies are from out-of-state;

(5) The average price of a property with a house is $130,000 in 1985

dollars. This will grow in real (i.e, non-inflationary) terms by $15,000 per year due to increased demand and to reduced availability of buildable lots;

(6) The average price of vacant land is 30% of developed land;

(7) The net construction multiplier is 0.10;

(8) With the acquisition program, towns acquire 10% of the lots developed in the baseline case in the first year and 50% thereafter;

(9) Annual increases in travel times per household for all but recreation are 1 hour per 1000 additional households;

(10) The cost of increased travel time is $16 per hour per household;

(11) Average consumer's surplus for outdoor recreation, option value and existence values per household per year (a) decreases by $25 per household per 1000 people added to total peak population (decrease due to congestion and reduced access to recreational sites), (b) decreases by $100 when shellfishing is prohibited in most ponds, and (c) decreases an additional $120 when swimming is prohibited in most ponds and many beaches;

(12) Shellfishing and swimming are prohibited when total peak population reaches 460,000 and 480,000, respectively;

(13) The potability of wells that service 20% of the households will be lost when the number of households reaches 130,000; 30% of the households will lose their public supply of potable water when the number of households reaches 140,000;

(14) The opportunity cost per household which loses potable well water is $7 per day. This figure comprises increased costs of buying bottled water and direct losses of utility because well water is not potable.

In summary, we have delineated the boundaries of the analysis, identified the alternatives, set up a system of accounts, established the time horizon, made our assumptions explicit, and presumably conferred with experts on the likely sequence of events related to development and population growth. Next we would collect data on the benefits and costs that increase or decrease from the present for each alternative. Finally, we "crunch" the numbers to estimate net present values of the status quo and acquisition alternatives under each boundary condition.

6.2 Estimating Net Present Values

The time series of economic benefits and costs for each account is summarized in Table 6.1. Net present values of acquisition are summarized in Table 6.2 for a range of discount rates. The results of this sensitivity analysis indicates that acquisition is an efficient alternative to the status quo when the social discount rate is less than 6%.

The results illustrate how an increasing discount rate favors the influence of values early in a project. In this case, the increasing opportunity costs associated with losses in future recreational benefits, increases in travel costs, and increases in costs associated with potable water and municipal services are steadily reduced in present value terms as the discount rate increases. Consequently, the net present value of the acquisition program decreases with increasing discount rates (Table 6.2).

Several points are worth making and repeating. First, the 14-year time horizon does not adequately represent the temporal effects of an acquisition program since its effects extend well beyond the period required to buy land. Thus, the present value of reduced opportunity costs associated with recreation, travel, groundwater and municipal services are grossly underestimated. Given the assumptions in this exercise, the acquisition program would probably do very well at the higher discount rates as well.

Second, from a purely efficiency standpoint, all changes in economic benefits and costs should be included in a benefit-cost analysis. However, those who commission a study--those with specific geopolitical boundaries in mind--might insist on excluding specific effects. For example, it is conceivable that many would want to see the profits for the large construction companies that are based outside of Massachusetts excluded from the analysis. This would result in the acquisition program passing at the 6% discount rate (net present value becomes $15.5 million), but still not at the 7% and 8% discount rates (net present values become -$11.3 million and -$30.9 million, respectively). However, such exclusions represent goals other than efficiency; it is the job of economists to point out these indiscretions.

Finally, these results are tied closely to the assumptions concerning the physical relationship between development and traffic and water quality. In practice, one would quantify these relationships before predicting effects on behavior, and subsequently predicting changes in economic values. This would be done in consultation with planners and other scientists such as hydrogeologists. Many economists can help to quantify these relationships, however, with their "bag" of statistical methods. A range of probabilities for the likely values of each benefit and cost category (or at least the critical ones) can then be used to determine expected values as we did in Chapter 4.

CHAPTER SEVEN

Conclusions

The Coastal Zone Management Act of 1972 and its Amendments of 1976 admonish states to preserve, protect, develop, enhance, and where possible restore the resources of the coastal zone of the United States. This seemingly contradictory set of actions actually calls for a practical balance among competing interests. Although no particular approach is suggested by the Act, a satisfactory response to this admonition should be able to assess tradeoffs among competing interests in an objective, comprehensive, and theoretically sound manner. Economic analysis is one approach that satisfies these requirements and that has the added advantage of using commensurable measures for market and nonmarket impacts.

Market failures--particularly public goods and externalities--abound within the coastal zone. There can be little doubt that the activities of profit-maximizing firms and of utility-maximizing consumers in traditional markets often result in misallocations of the coastal zone's resources from the standpoint of efficiency. Similarly, there can be little doubt that public policy which is influenced primarily by spurious economic arguments also often results in inefficient allocations.

The realization that the earth is a "spaceship"--that the natural environment has a limited capacity to assimilate the residuals of production and consumption, and that our stocks of natural resources are truly scarce--has spurred economists as well as other scientists to consider the interactions between man and environment. The conceptual and methodological advances made in resource and environmental economics during the past 25 years now facilitates the economic valuation of natural resources where markets do not exist. Thus, if potable groundwater, access to beaches, opportunities to go fishing, uncrowded streets, and so on are valued instrumentally by coastal residents, there is now an opportunity to represent these interests on an equal footing with traditional economic growth.

Of course, the primer illustrates legitimate opportunities for economic analysis rather than solutions to the myriad conflicts of interest in the coastal zone. Indeed the primer was only intended to lay the necessary groundwork for an understanding of economics and economic valuation. To this end the interested reader might test his/her understanding of the concepts by considering once again (1) consumer's surplus and economic profit, (2) the immense importance of opportunity costs, (3) the distinction between direct and indirect effects and the implications for net multiplier effects, (4) social discounting, (5) the pivotal role of an indifference preference structure in economic valuation, and (6) why markets and prices are not necessary for economic valuation of environmental resources. These and related concepts form a solid basis for economic inquiry, and, if you wish, from which to expand your knowledge of economic analysis.

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INDEX TO KEY WORDS

APPENDIX I

Figures

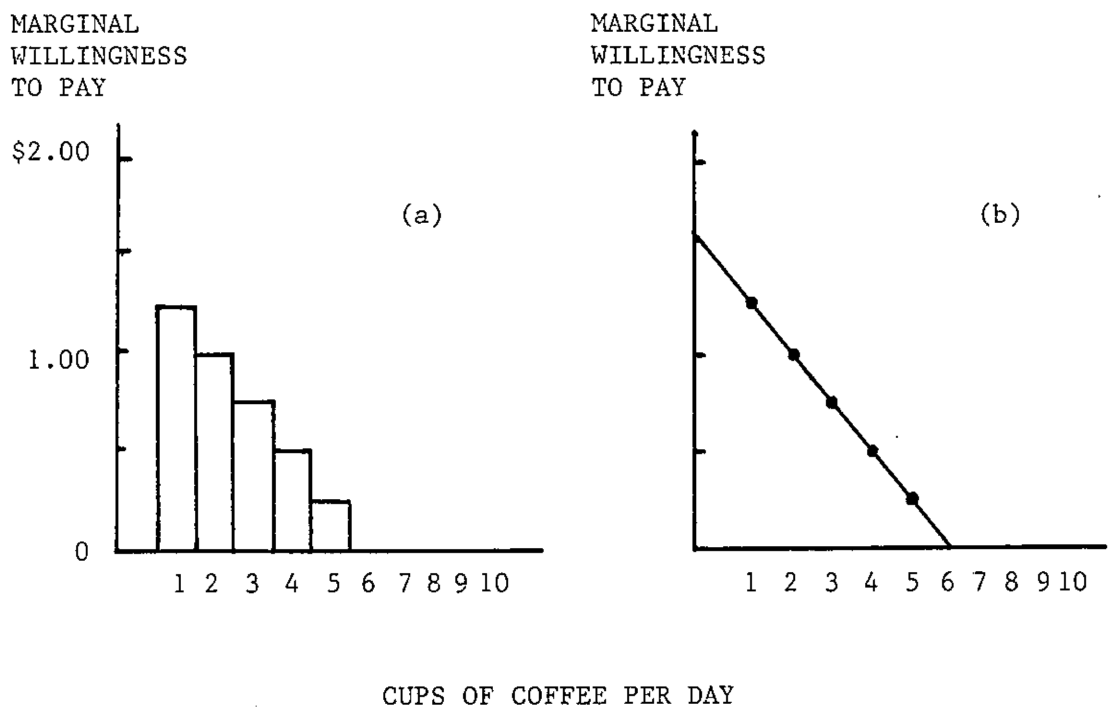


Figure 2.1 An individual's economic demand for cups of coffee.

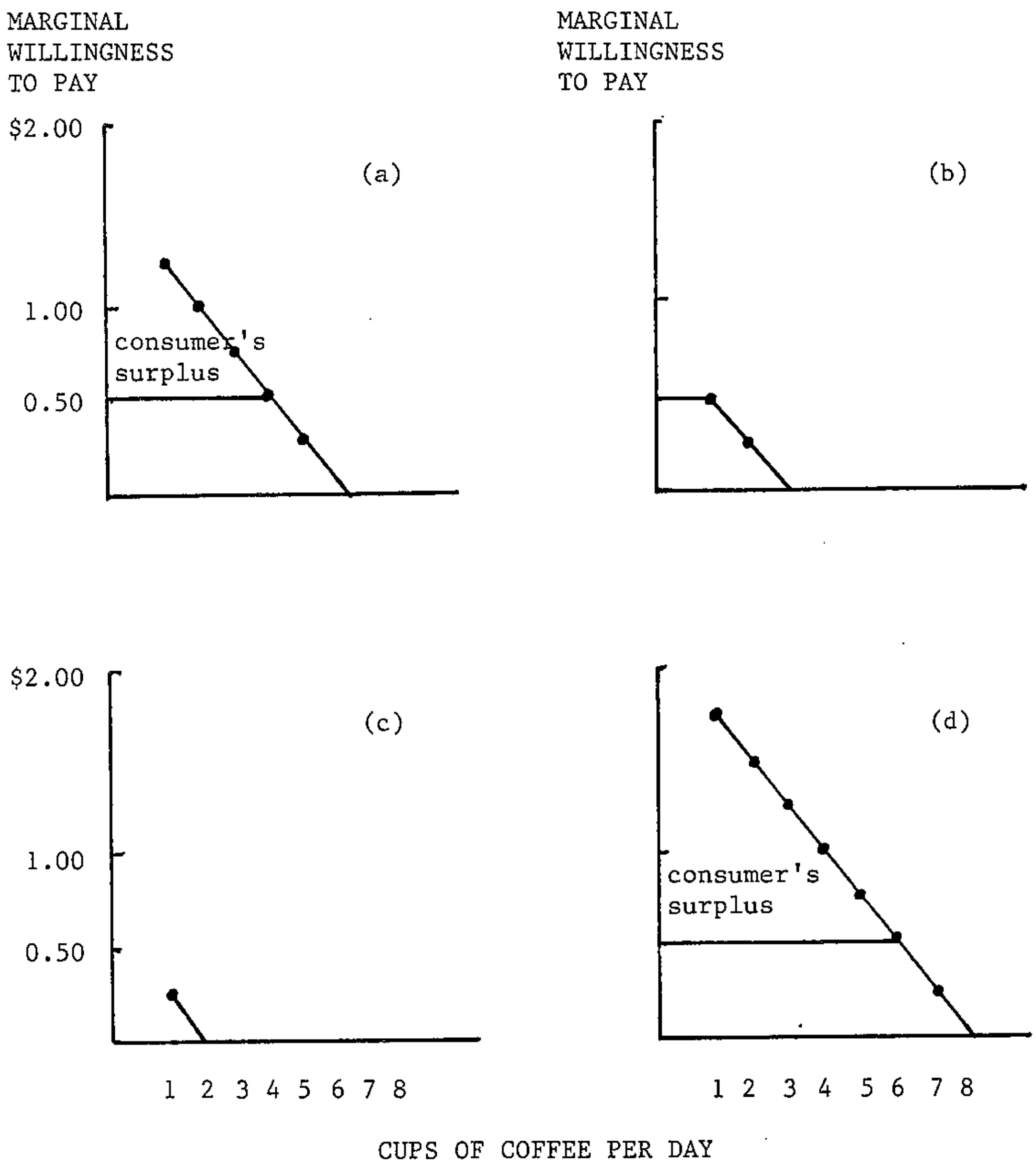


Figure 2.2 Demand curves for different individuals.

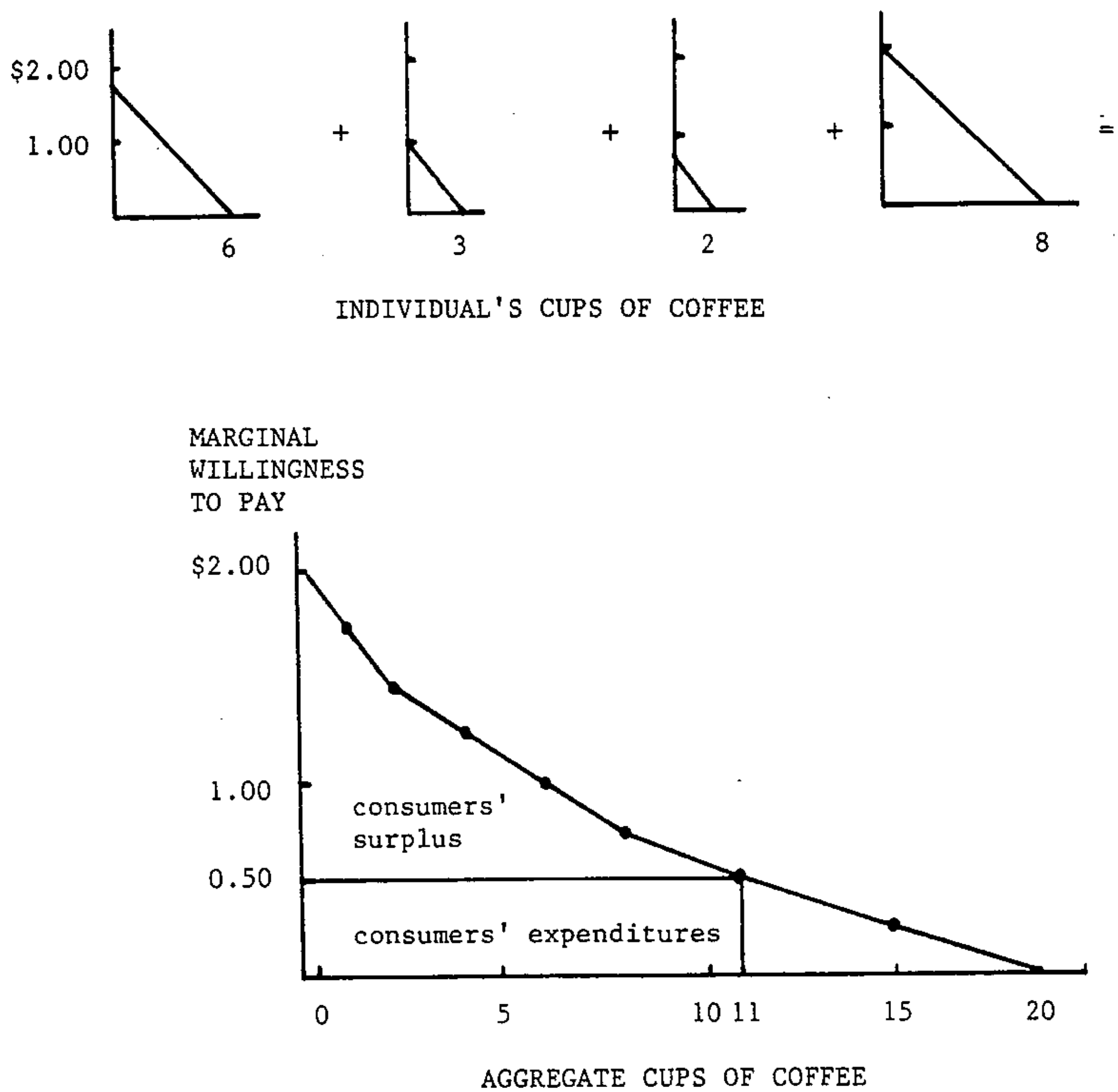


Figure 2.3 Aggregate demand for cups of coffee.

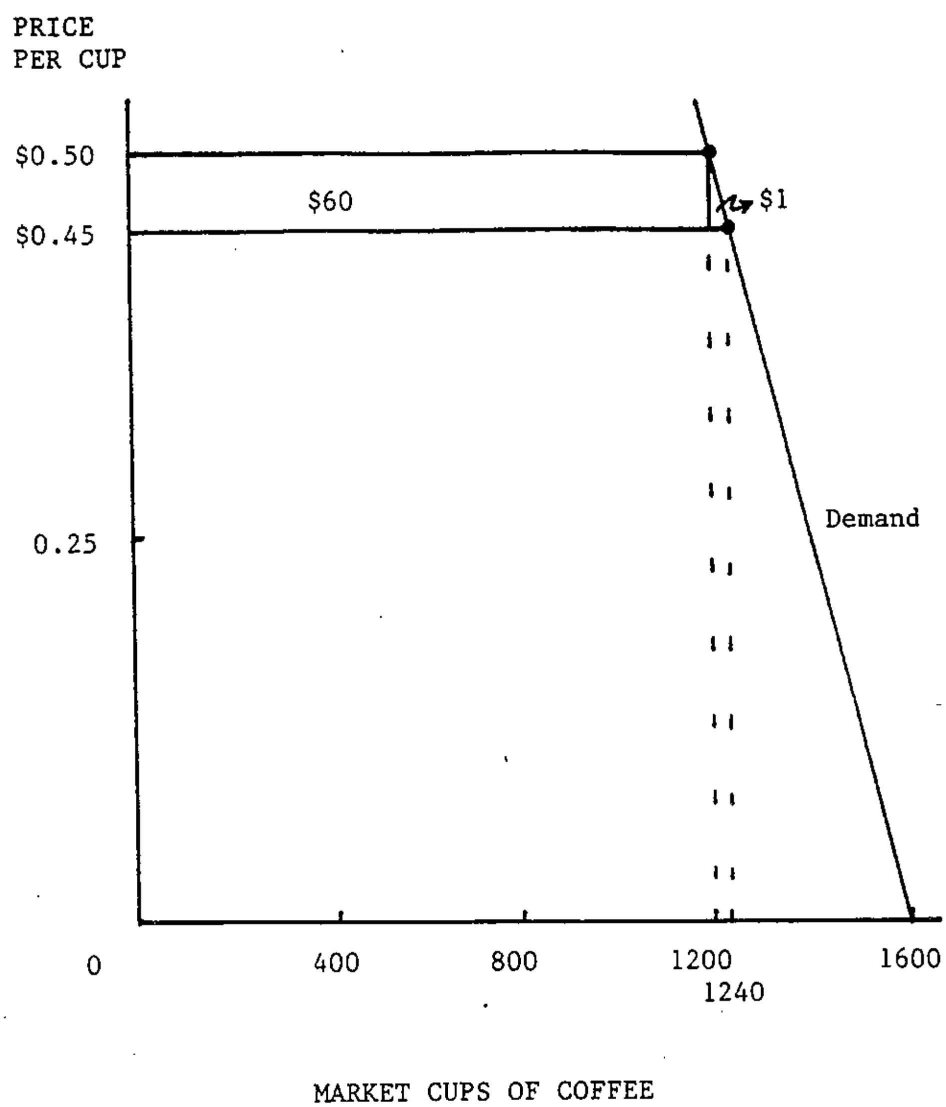


Figure 2.4 Gain in consumers' surplus due to a reduction in the price of cups of coffee.

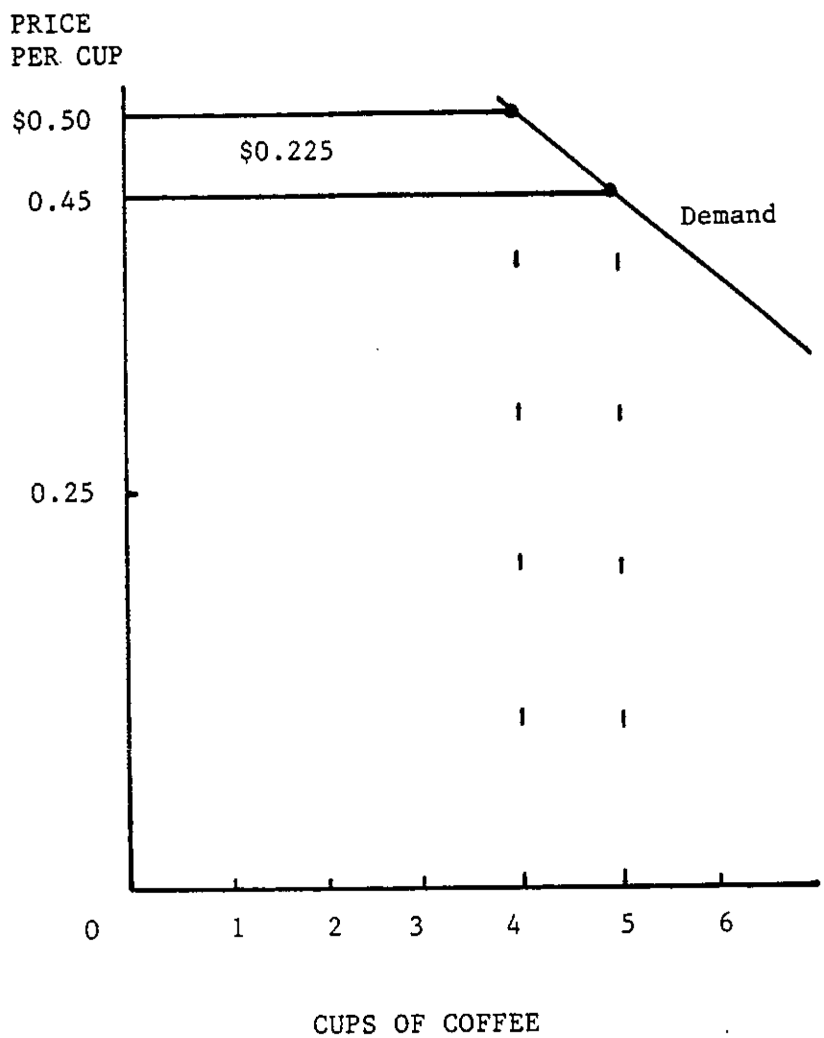


Figure 2.5 Gain in consumer's surplus due to a reduction in the price of a cup of coffee.

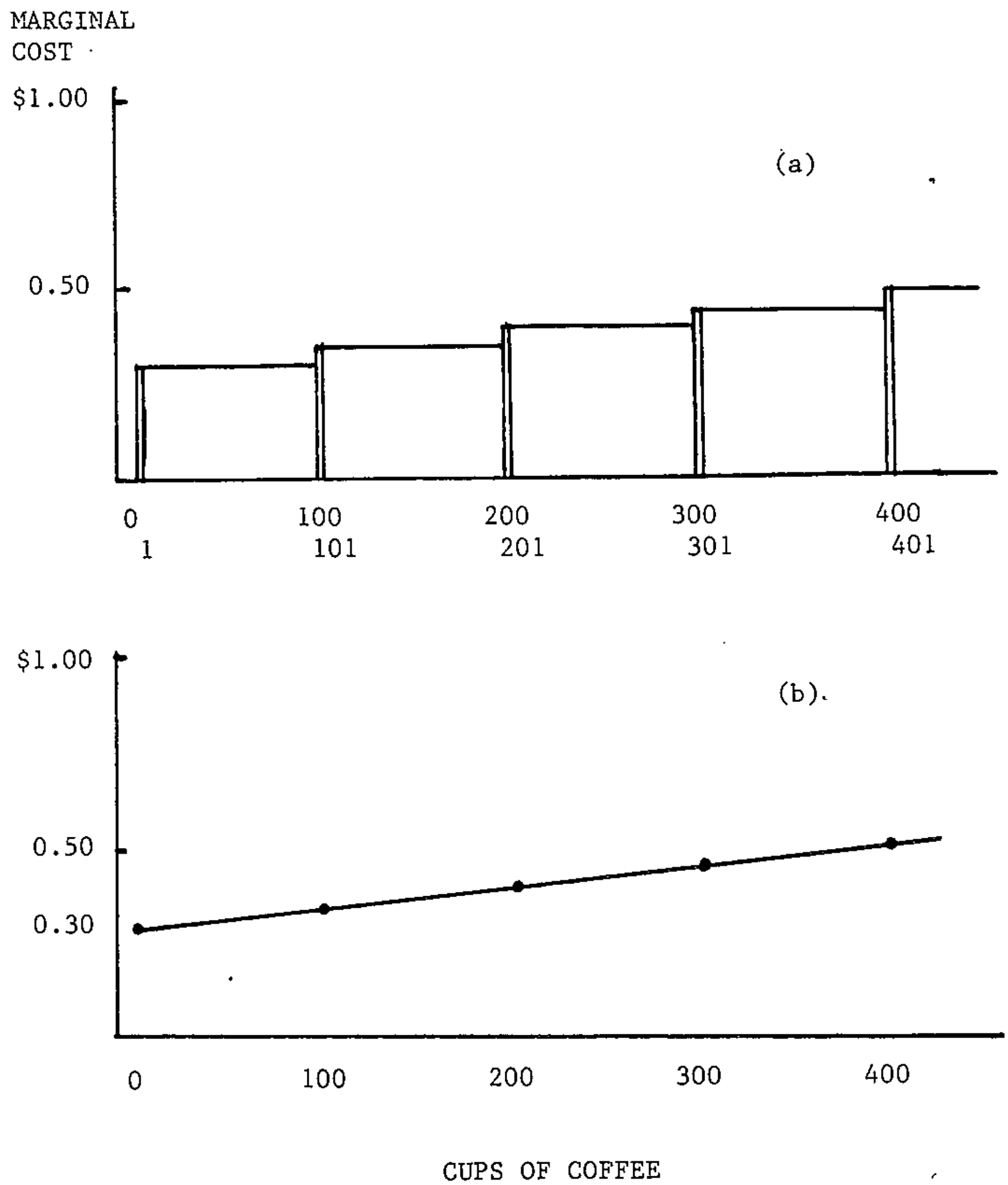
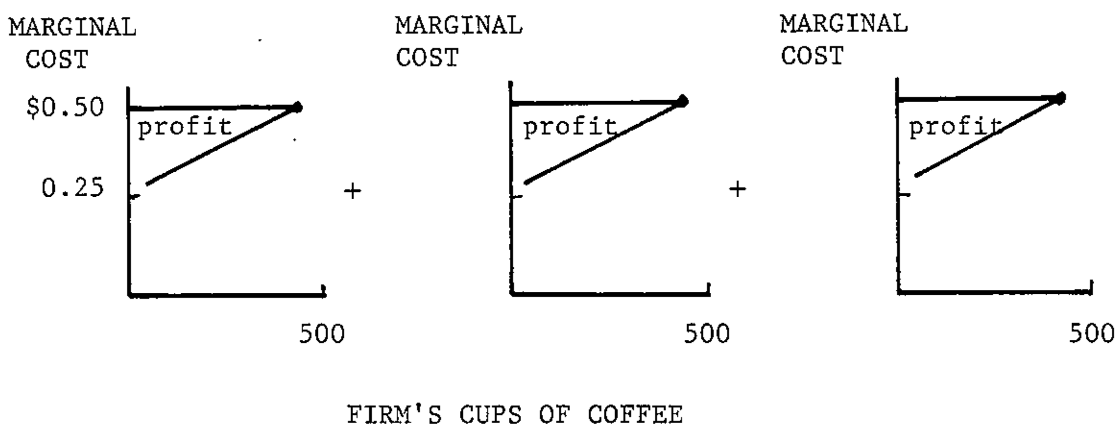


Figure 2.6 A firm's marginal costs from producing cups of coffee.

(a)



(b)

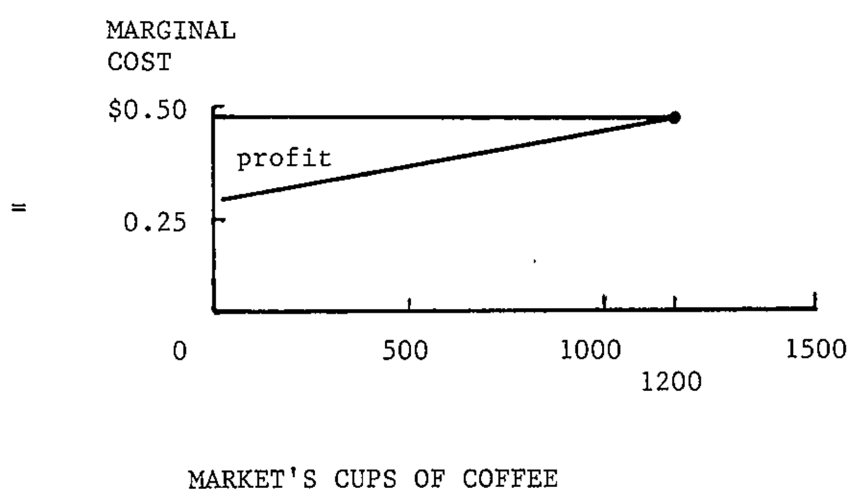
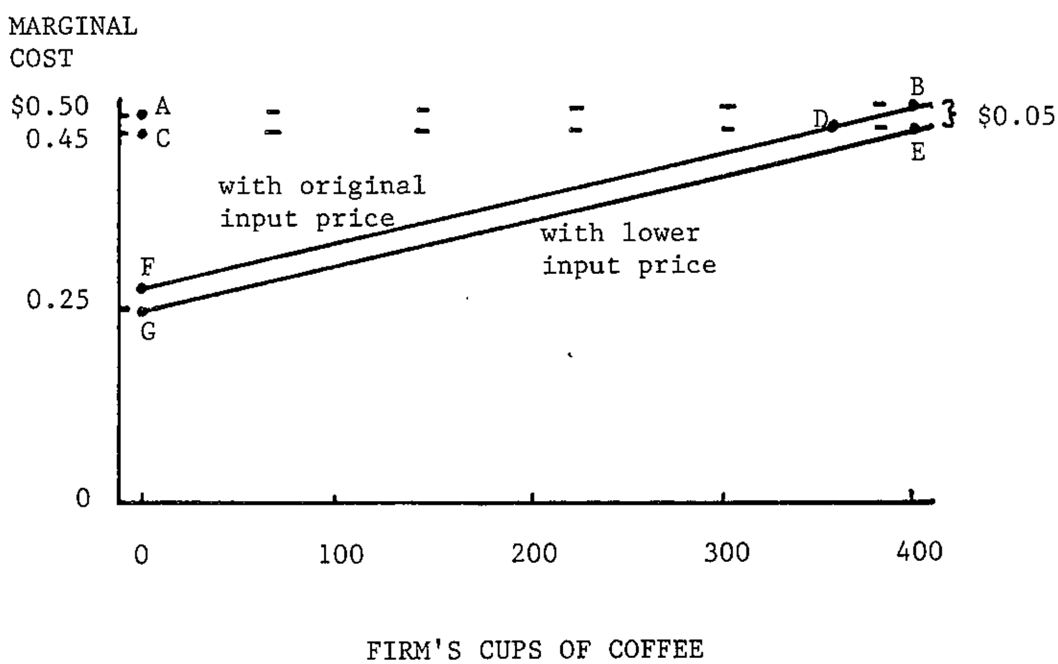


Figure 2.7 Market supply of cups of coffee.



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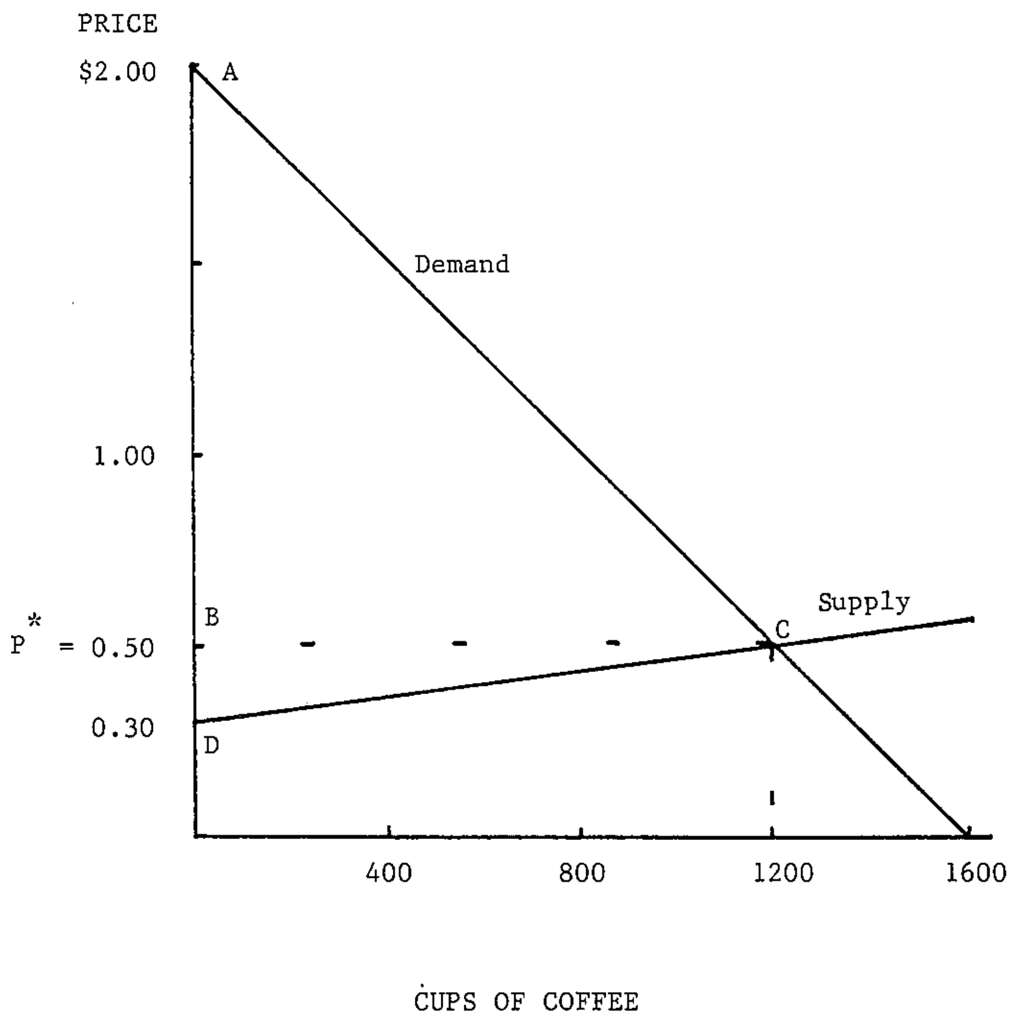

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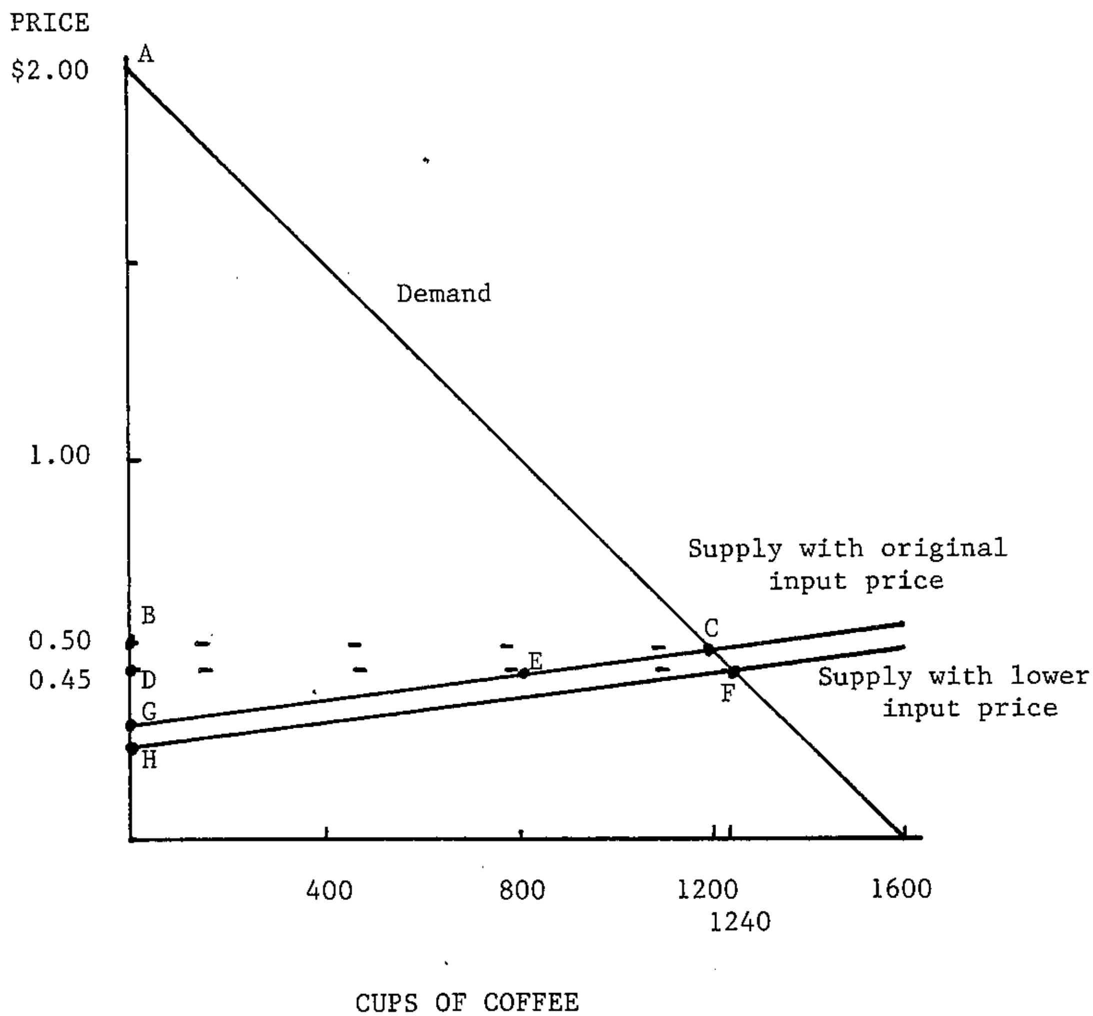

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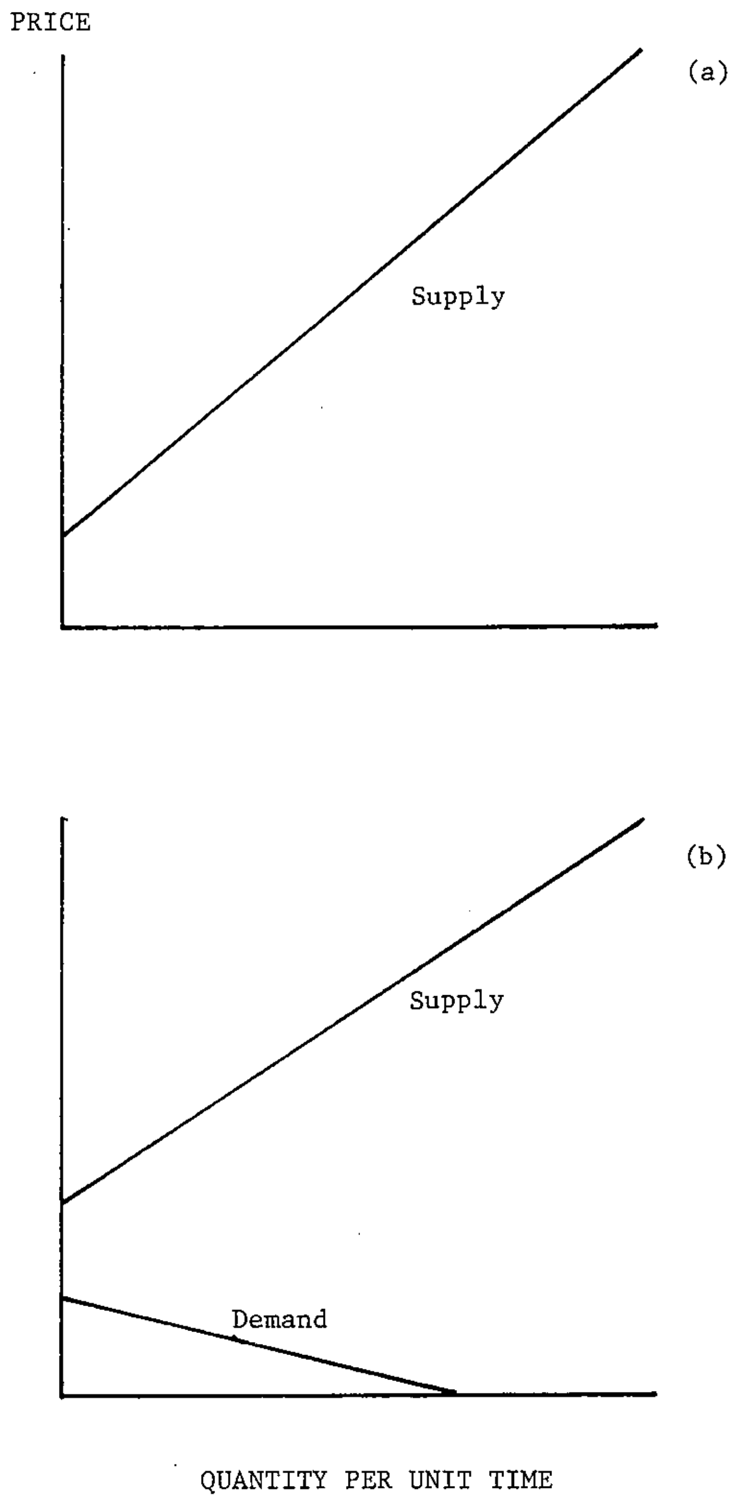

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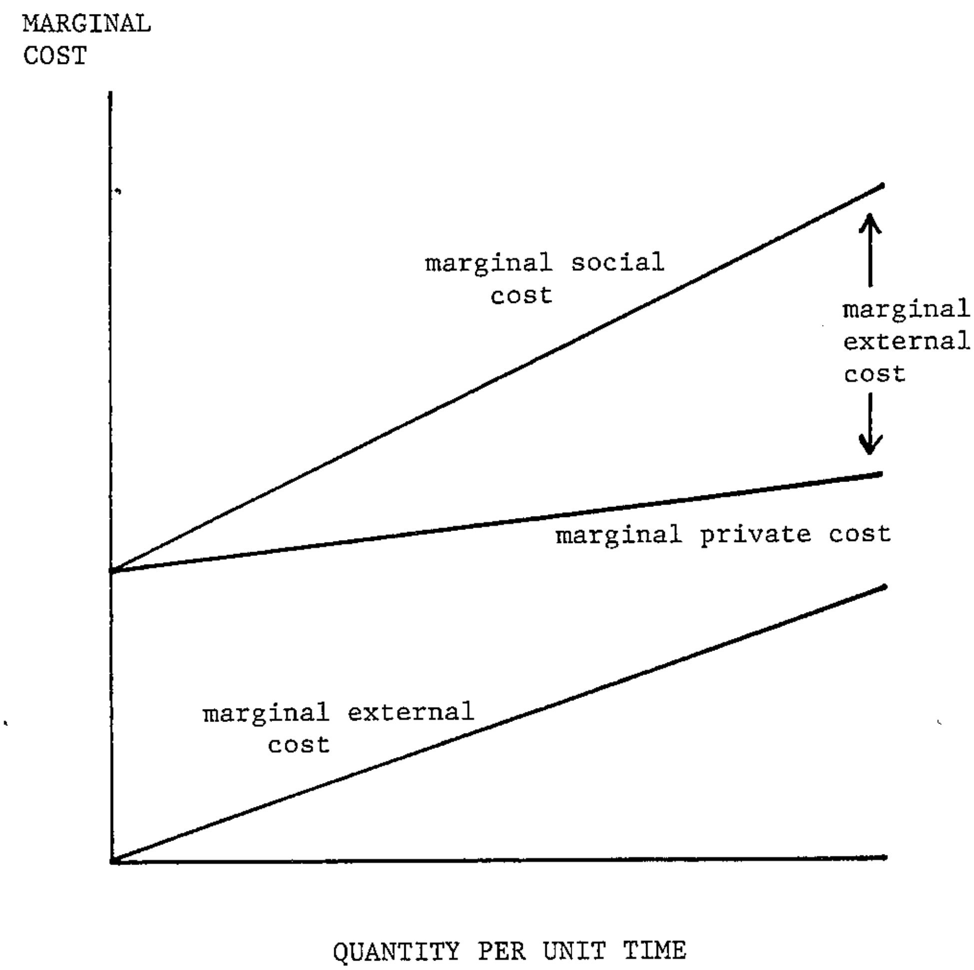

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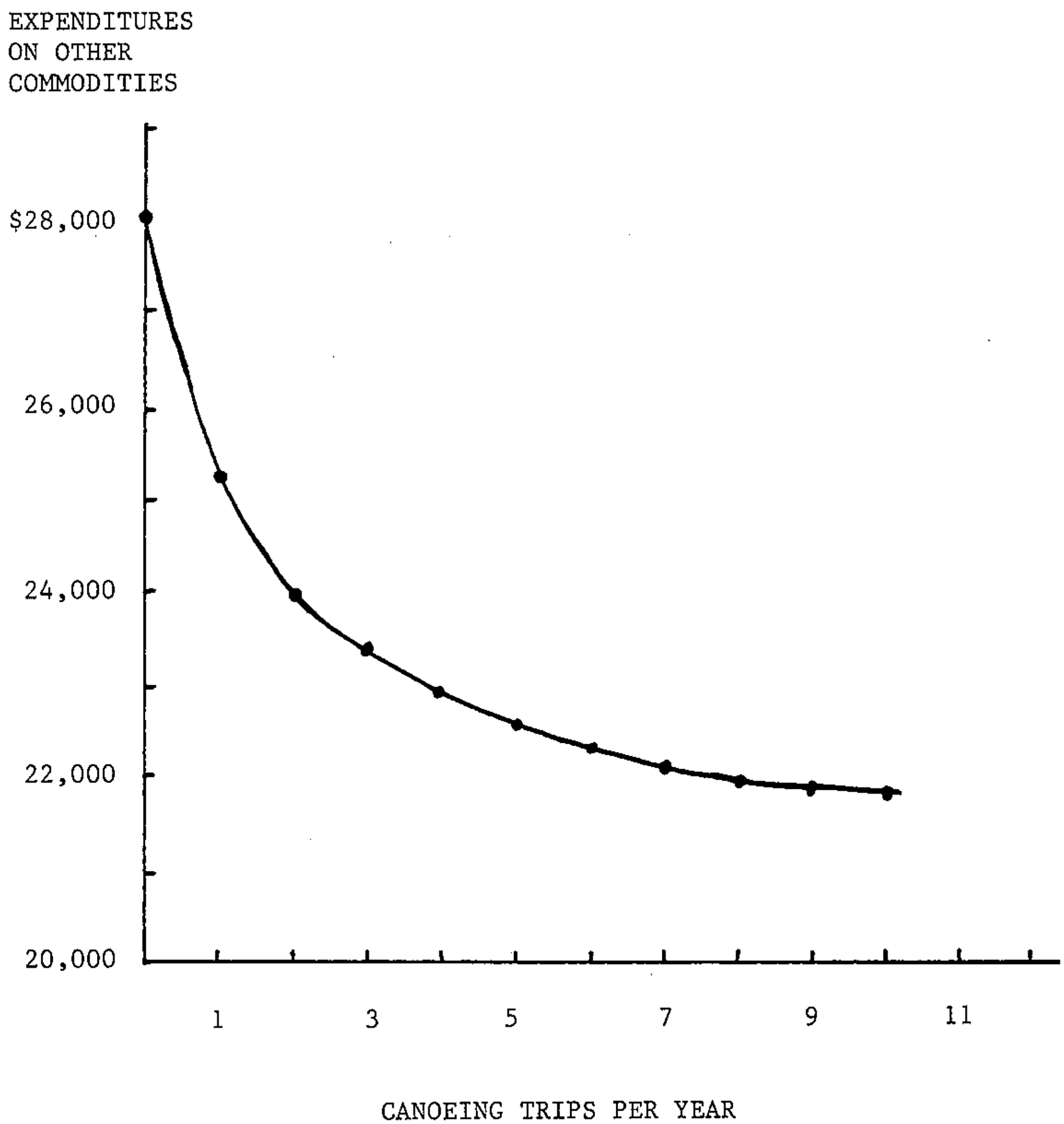
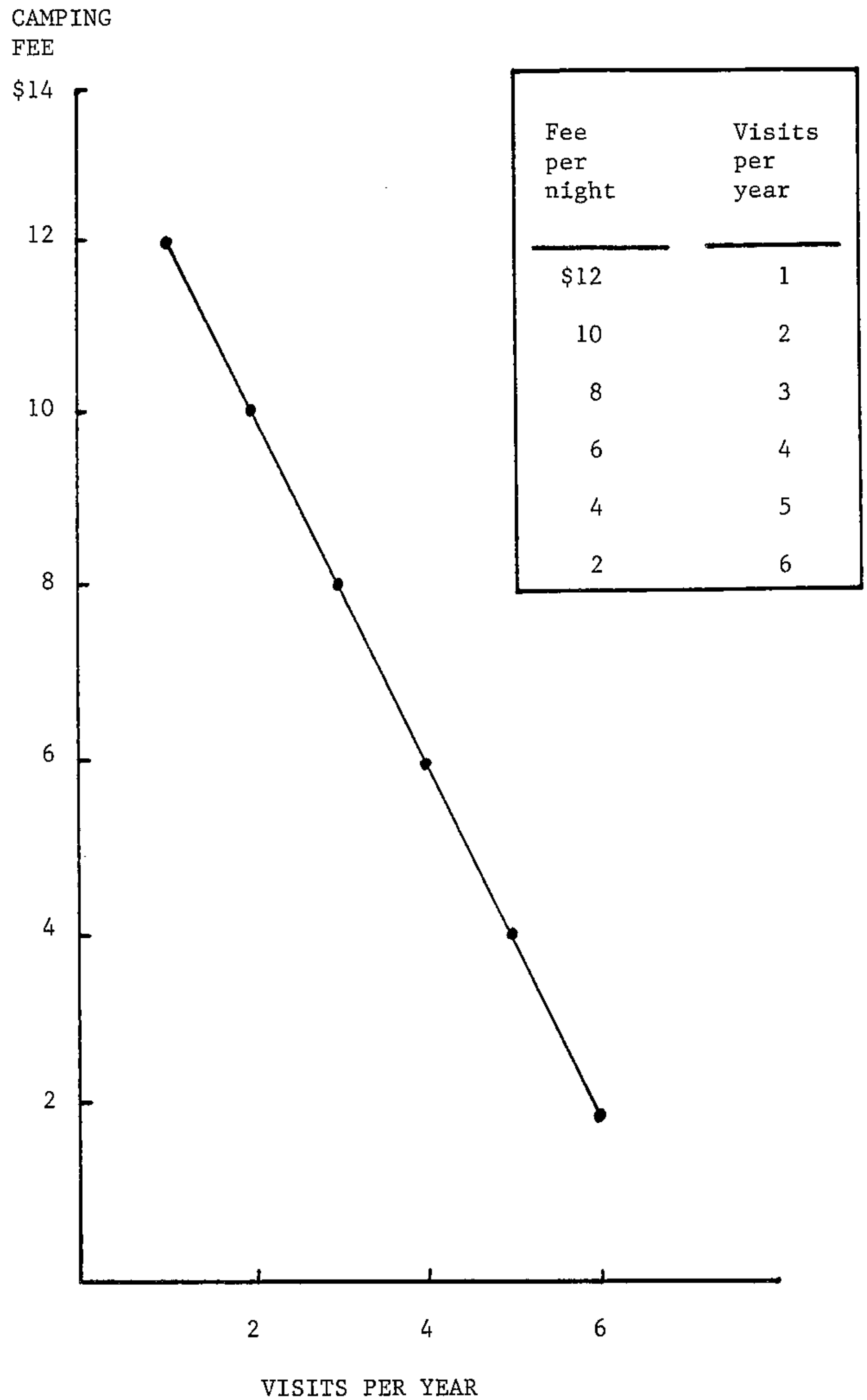
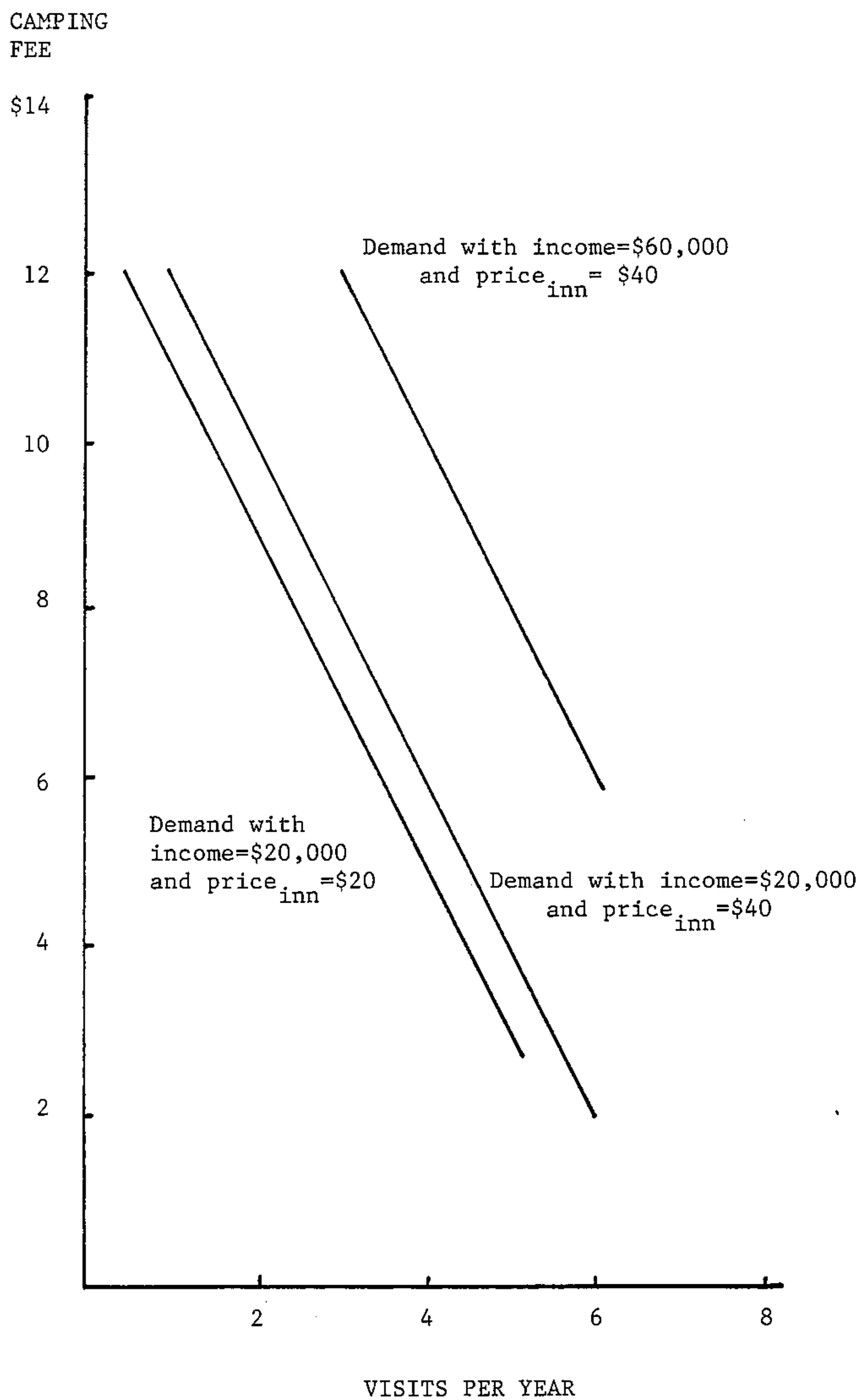


Figure 2.13 Illustration of an indifference curve.



Fee per night	Visits per year
$12	1
10	2
8	3
6	4
4	5
2	6

Figure 3.1 Graphing an individual's demand for camping.



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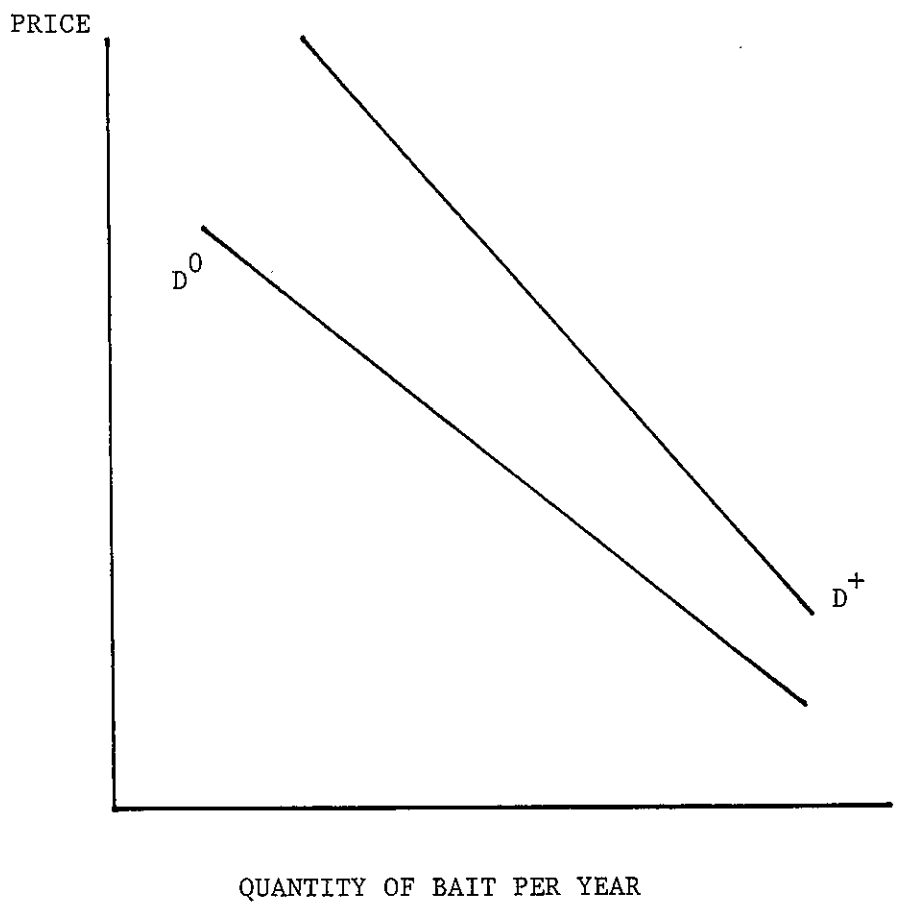

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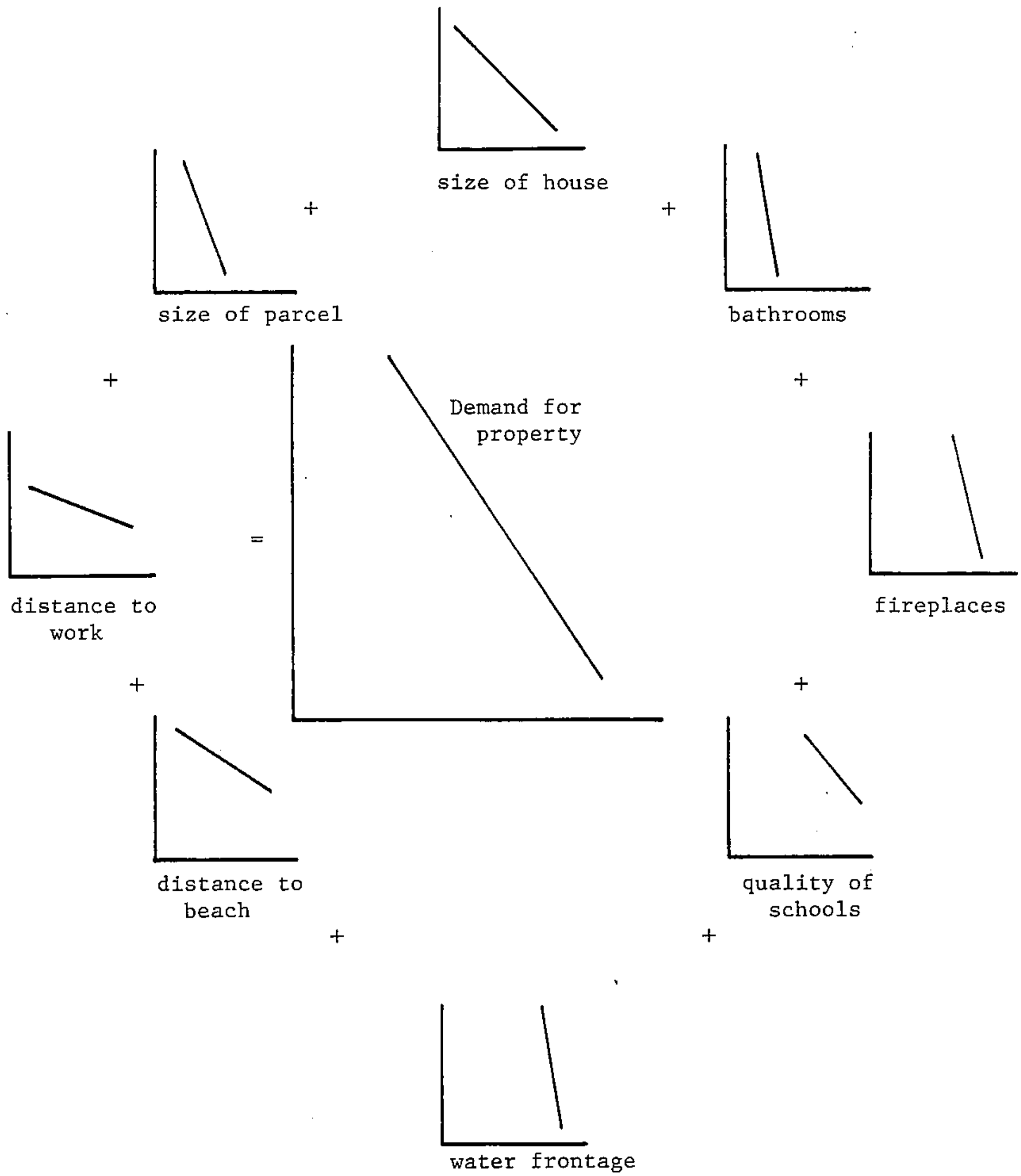

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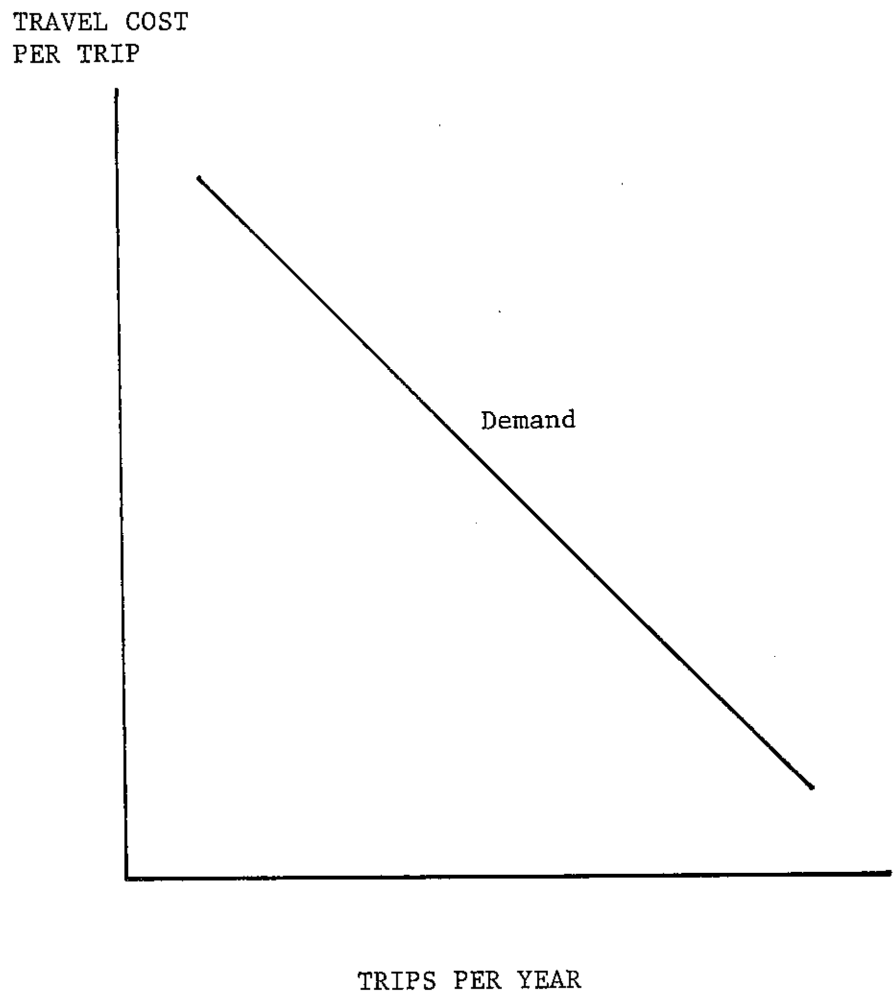

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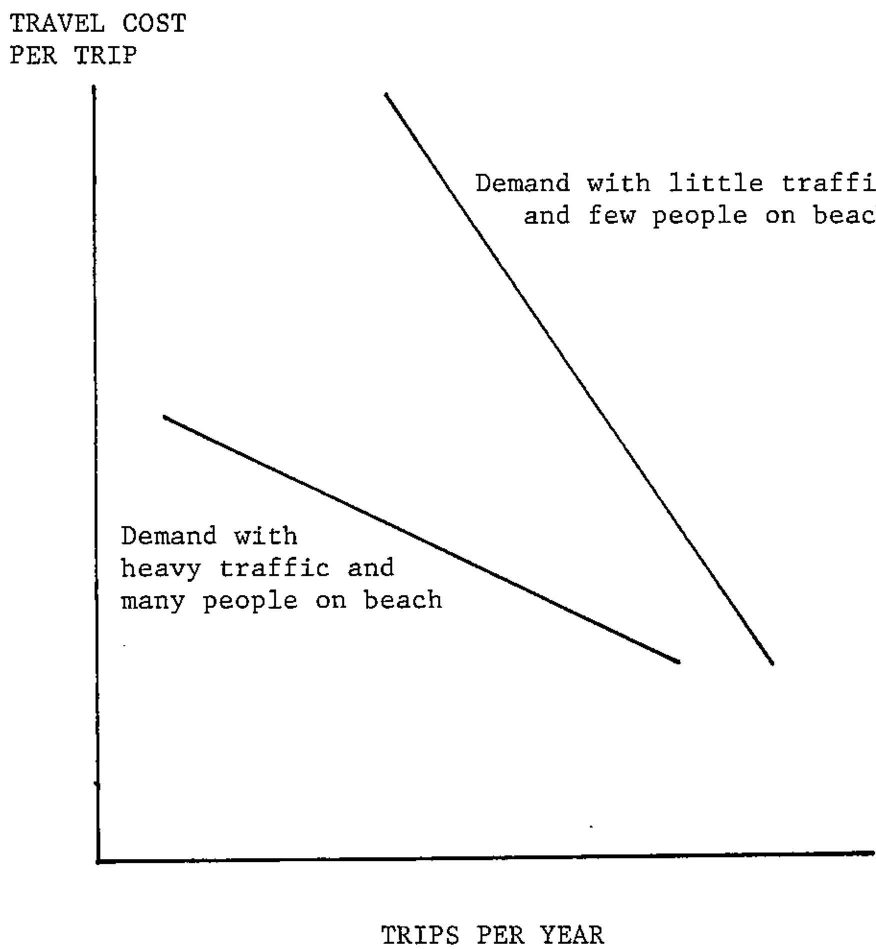

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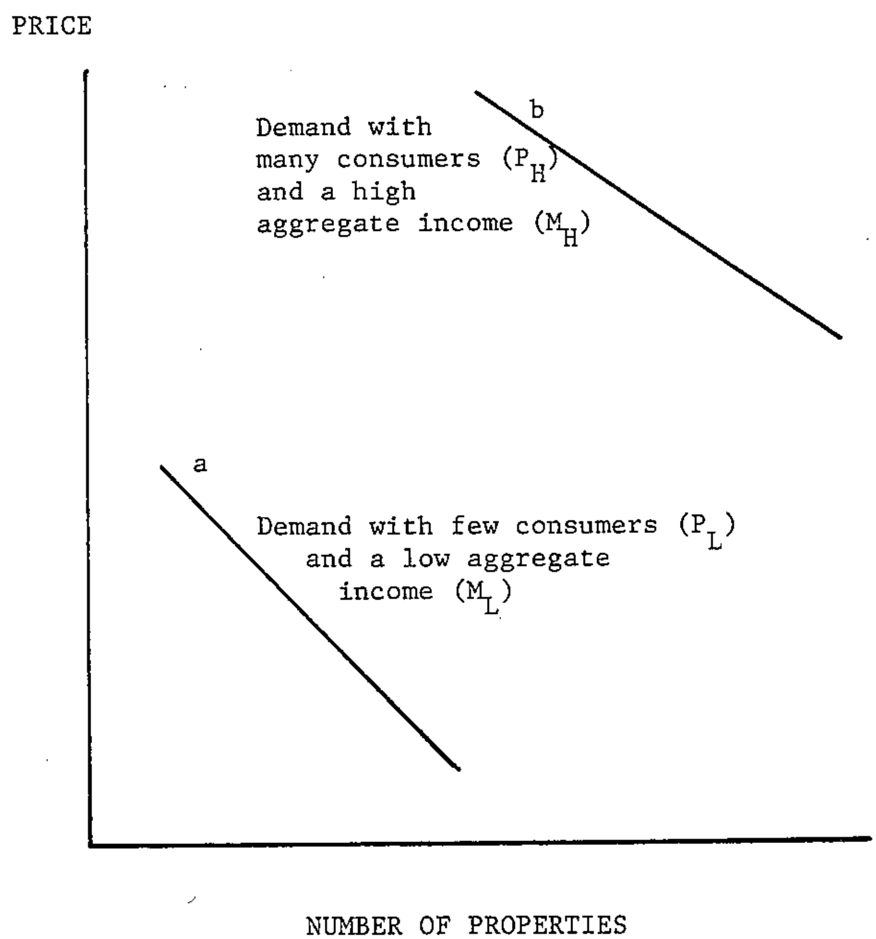

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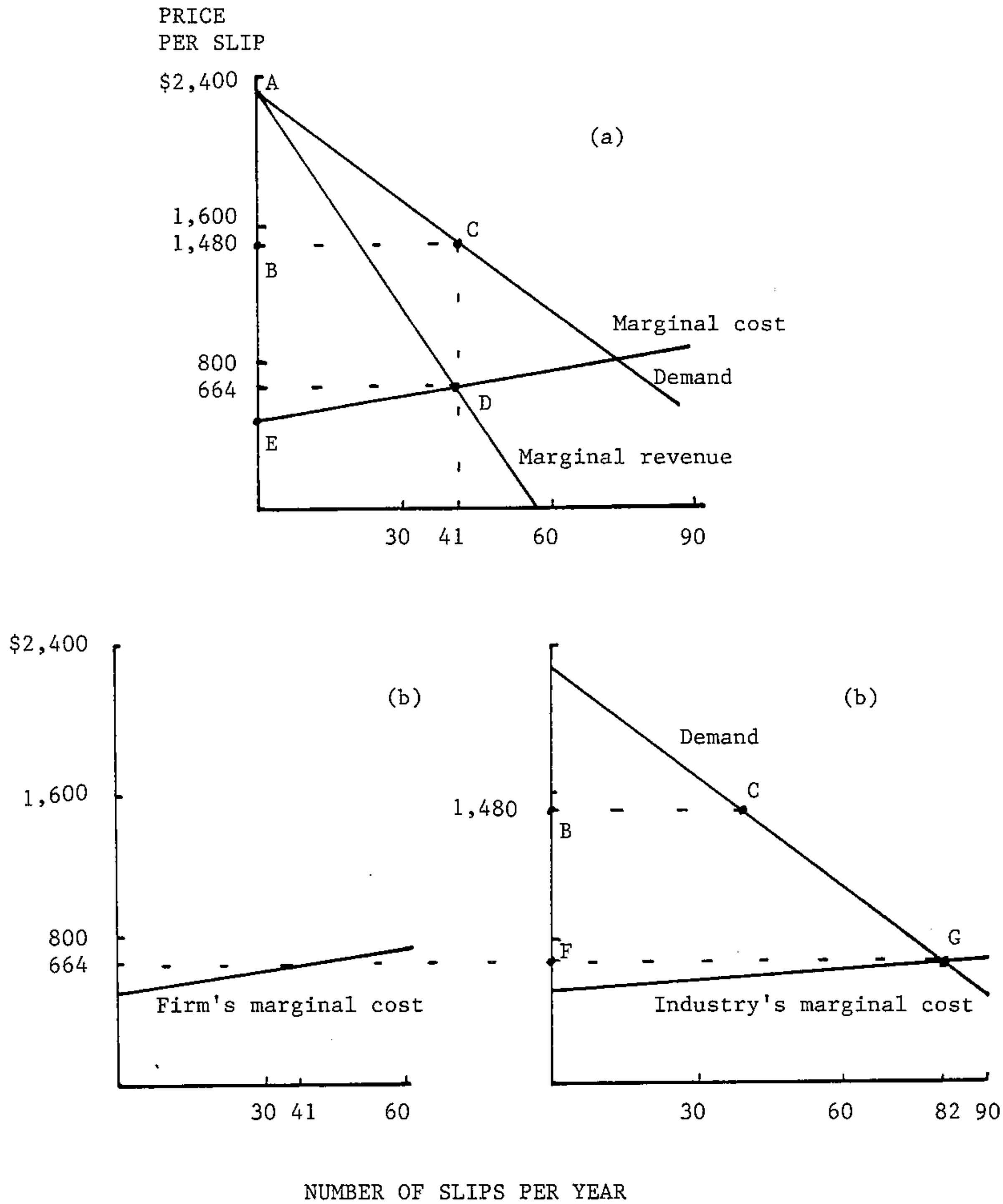

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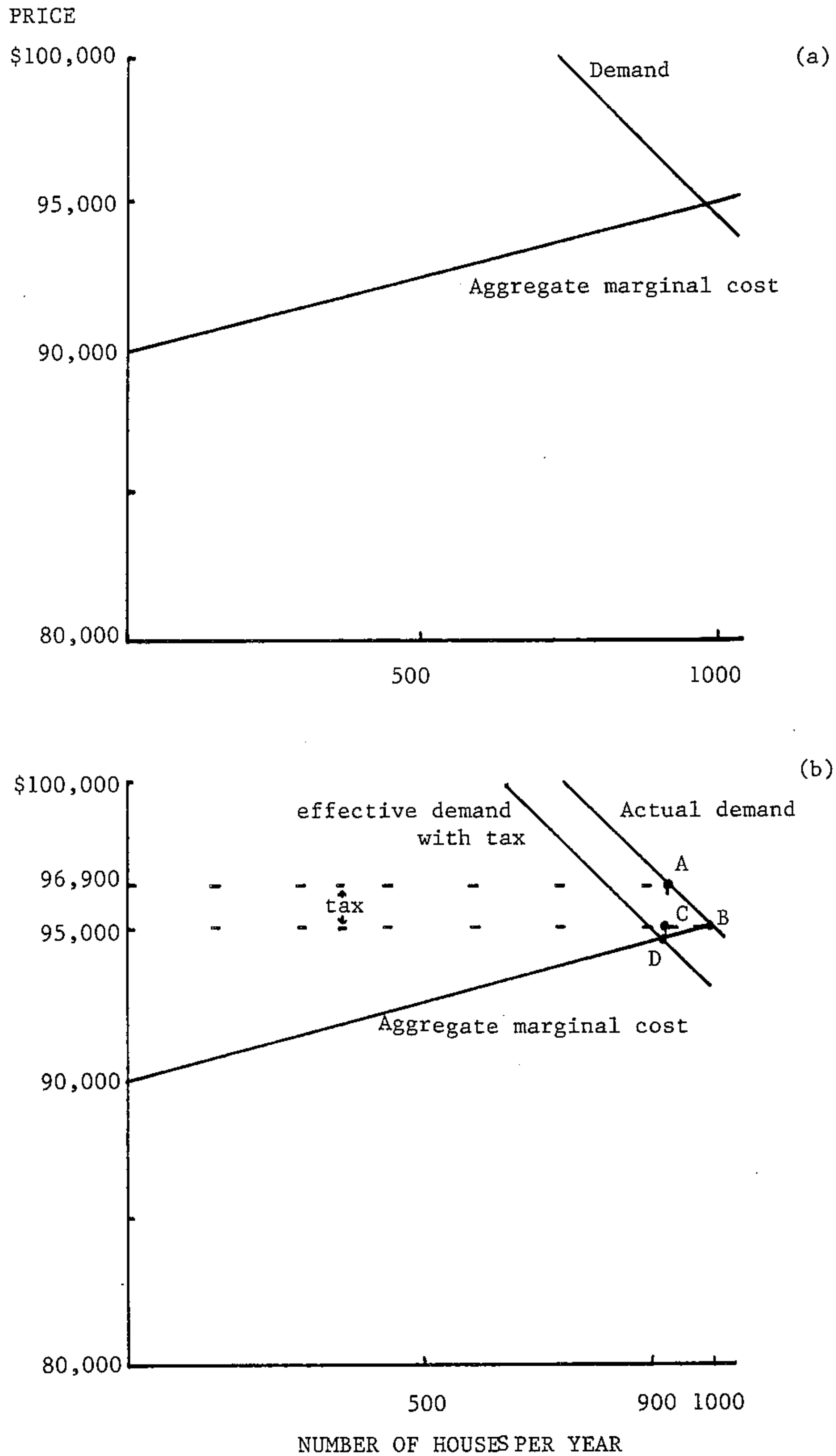

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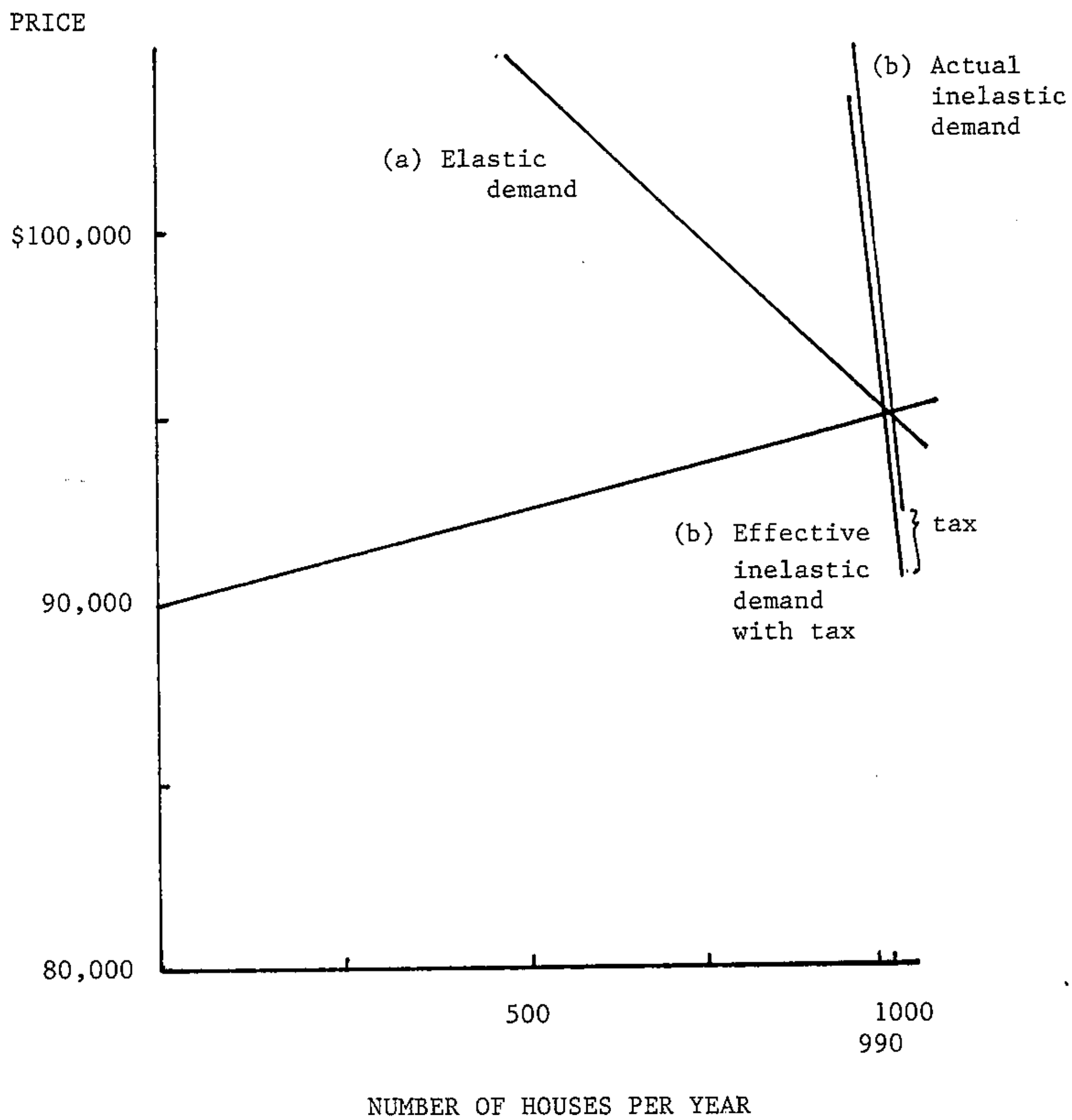

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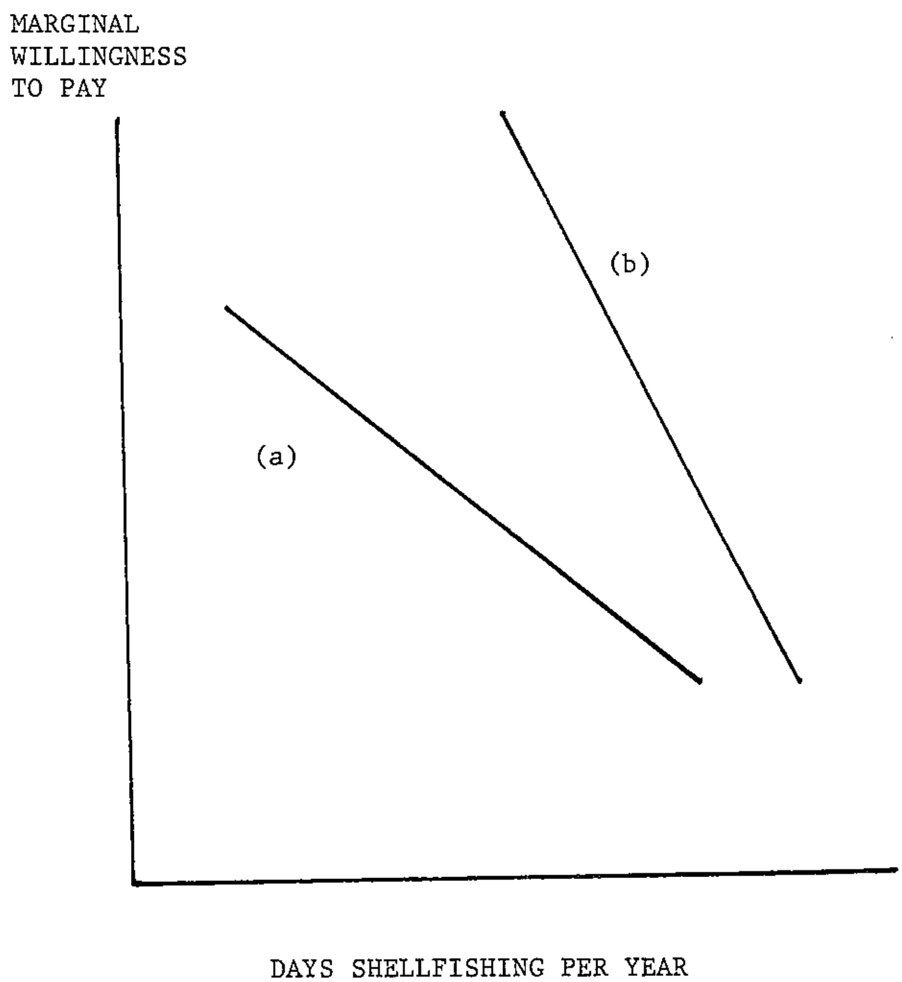

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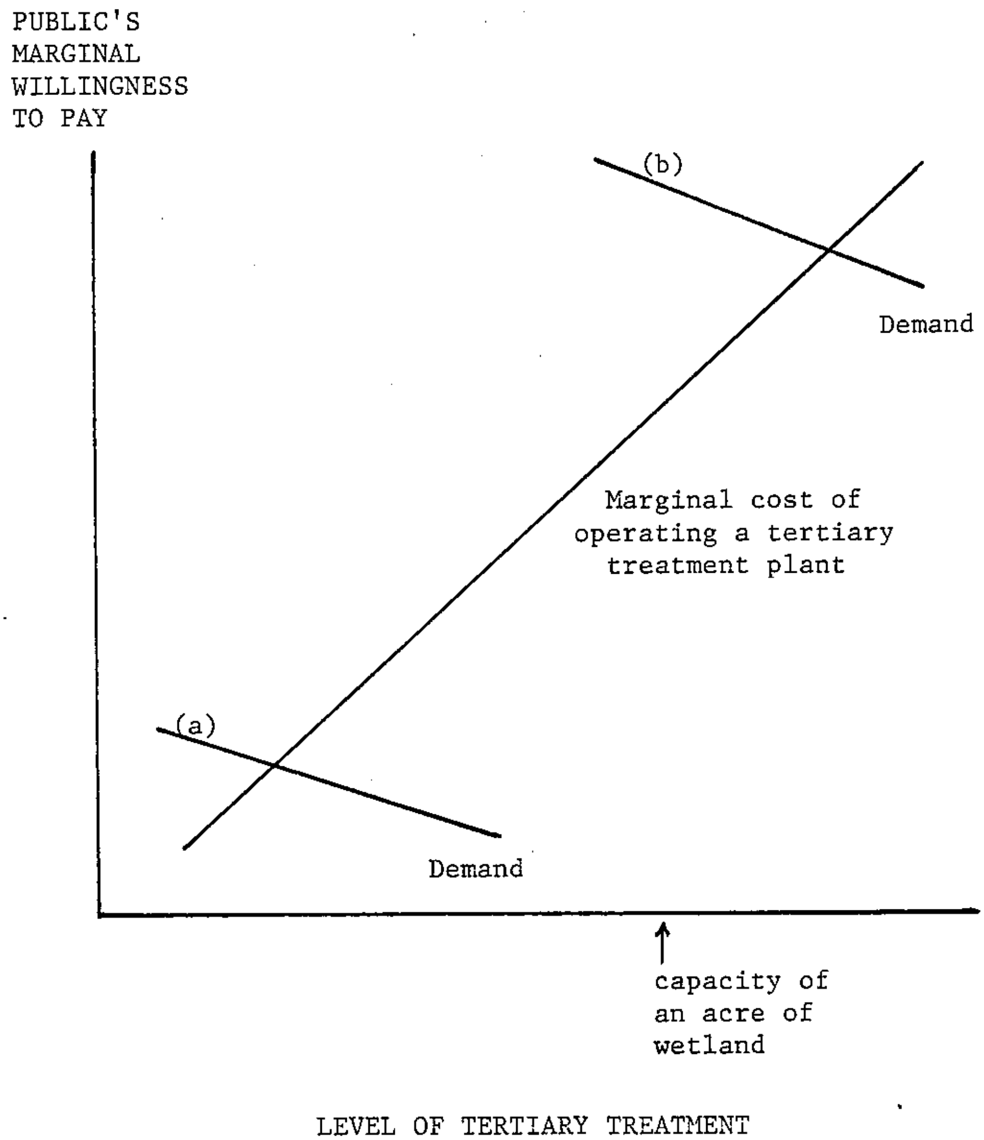

Figure 4.5 Illustration of possible demands for tertiary treatment of sewage.

APPENDIX II

Tables

Table 2.1. Cost-effectiveness Analysis of Canoeing: Is Renting or Buying the Least Costly Alternative? Present Value, $PV = A_t/(1 + 0.10)^t$.

t (year)	Alternative			
	Rent ($)		Buy ($)	
	Cost	PV	Cost	PV
0	60	60	800	800
1	60	54.55	0	0
2	60	49.59	0	0
3	60	45.08	0	0
4	60	40.98	30	20.50
5	60	37.26	0	0
6	60	33.87	0	0
7	60	30.79	0	0
8	60	27.99	30	14.00
9	60	25.44	0	0
10	60	23.13	0	0
11	60	21.03	0	0
12	60	19.12	30	9.56
13	60	17.38	0	0
14	60	15.80	0	0
15	60	14.36	-120 (salvage value)	-28.73
Present Value	$471		$815	

Table 2.2 Present Value (PV) of $100 Received at the End of "t" Years. Discount rates are percentages converted to fractions (e.g., 2% is 0.02).

t (year)	Discount Rate 0.00	0.02	0.05	0.10	0.25
0	100	100	100	100	100
5	100	90.57	78.35	62.09	32.77
10	100	82.03	61.39	38.55	32.77
25	100	60.95	29.53	9.23	0.38
50	100	37.15	8.72	0.85	0.00
100	100	13.80	0.76	0.00	0.00

Table 3.1 Net Present Values (NPV) of Three Alternative Investments for Shoreline Protection. Values are hypothetical. The social discount rate is 4%.

Alternative	Category	Time Period			
		t=0	t=1	t=2	t=3
I	Benefit, B_I	15	40	50	50
	Cost, C_I	80	40	10	10
	$B_I - C_I$	-65	0	40	40
	NPV_I	-- $ 7.6 --			
II	Benefit, B_{II}	20	40	40	40
	Cost, C_{II}	30	30	30	30
	$B_{II} - C_{II}$	-10	10	10	10
	NPV_{II}	-- $17.7 --			
III	Benefit, B_{III}	5	50	50	50
	Cost, C_{III}	60	60	5	0
	$B_{III} - C_{III}$	-55	-10	45	50
	NPV_{III}	-- $21.4 --			

Table 4.1. Marginal Revenue and Marginal Cost Account for a Profit-maximizing, Monopolistic Firm

Price	Number of slips	Total revenue (TR)	Marginal revenue (MR)	Marginal cost (MC)	Total variable cost (TVC)	Fixed cost (FC)	Profit = TR -TVC -FC	Marginal profit
$2,280	1	$ 2,280	$2,280	$504	$ 504	$3,200	-$1,424	$1,776
2,260	2	4,520	2,240	508	1,008	3,200	312	1,732
2,240	3	6,720	2,200	512	1,520	3,200	2,000	1,688
2,220	4	8,880	2,160	516	2,036	3,200	3,644	1,644
2,200	5	11,000	2,120	520	2,556	3,200	5,244	1,600
2,180	6	13,080	2,080	524	3,080	3,200	6,800	1,556
2,160	7	15,120	2,040	528	3,608	3,200	8,312	1,512
2,140	8	17,120	2,000	532	4,140	3,200	9,780	1,468
2,120	9	19,080	1,960	536	4,676	3,200	11,204	1,424
2,100	10	21,000	1,920	540	5,216	3,200	12,584	1,380
-								
-								
-								
1,500	40	60,000	720	660	23,276	3,200	33,524	60
1,480	41	60,680	680	664	23,940	3,200	33,540	16
1,460	42	61,320	640	668	24,608	3,200	33,512	- 28

Table 5.1 Net Present Value (NPV) of Selected Economic Impacts of a Proposed Downzoning Program for South Kingstown, RI. See Edwards (1984) and Anderson and Edwards (1986) for more details.

Economic Impact	Discount Rate (dollar amounts in millions)			
	0.00	0.02	0.04	0.06
Present value for each impact:				
1) Loss to landowners				
a) accelerated development	-$32.39	-$20.28	-$13.84	-$10.09
b) slower development	- 20.54	- 12.86	- 8.77	- 6.40
2) Fiscal impact on town	2.70	1.69	1.15	0.84
3) Gains to recreationists				
a) shellfishing & swimming	19.26	12.08	8.22	6.00
b) shellfishing, swimming, fishing, etc.	29.08	18.24	12.42	9.07
Net present value of the four possible combinations of the above impacts.				
4) accelerated development scenario with protection of shellfishing and swimming	- 10.43	- 6.51	- 4.47	- 3.25
5) accelerated development scenario with protection of shellfishing, swimming, fishing, etc.	- 0.61	- 0.351	- 0.27	- 0.18
6) slow development scenario with protection of shellfishing and swimming	1.38	0.91	0.60	0.44
7) slow development scenario with protection of shellfishing, swimming, fishing, etc.	12.44	7.07	4.80	3.87

Table 6.1. Demographic, Benefit, and Cost Data of Hypothetical Development on Cape Cod. See text for more details. All value are hypothetical. Monetary values are not present values.

Scenario A: Data associated with APCC's (1985) full development projections

Category	Year (time period)														
	1986 (t=0)	1987 (t=1)	1988 (t=2)	1989 (t=3)	1990 (t=4)	1991 (t=5)	1992 (t=6)	1993 (t=7)	1994 (t=8)	1995 (t=9)	1996 (t=10)	1997 (t=11)	1998 (t=12)	1999 (t=13)	2000 (t=14)
Number of houses on Cape															
Total (thousand)	115.7	118.3	121.0	123.6	126.2	128.0	129.8	131.6	133.4	135.2	136.9	138.7	140.5	142.3	144.1
Added	2620	2620	2620	2620	2620	1790	1790	1790	1790	1790	1790	1790	1790	1790	1790
Population size on Cape															
Total peak (thous)	421.5	427.2	433.8	440.4	447.0	452.0	457.0	462.0	467.0	472.0	477.0	482.0	487.0	492.0	497.0
Added	6600	6600	6600	6600	6600	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
Total expenditures on new houses ($million)	340.6	379.9	419.2	458.5	497.8	367.0	393.8	420.6	447.5	474.4	501.2	528.0	554.9	581.8	608.6
Profit in the construction industry ($million)															
Large companies:															
in Massachusetts	4.2	4.8	5.2	5.6	6.2	4.6	4.9	5.8	5.6	5.9	6.2	6.6	6.9	7.2	7.6
outside Mass.	4.2	4.8	5.2	5.6	6.2	4.6	4.9	5.8	5.6	5.9	6.2	6.6	6.9	7.2	7.6
Small companies	12.8	14.5	15.7	17.2	18.7	13.8	14.8	15.8	16.8	17.8	18.8	19.8	20.8	21.8	22.8
Net multiplier effect ($million)	34.1	38.0	41.9	45.9	49.8	36.7	39.4	42.1	44.8	47.4	50.1	52.8	55.5	58.2	60.9
Loss in consumers' surplus due to reduced recreational opportunities ($million)	7.5	15.4	23.6	32.1	41.0	60.2	66.8	73.7	80.7	87.9	95.1	119.3	127.2	135.8	143.4
Increased costs of travel ($million)	4.8	9.8	15.1	20.6	26.3	30.3	34.7	38.7	43.0	47.5	52.3	56.7	61.5	66.3	71.5
Loss in consumers' surplus due to groundwater contamination ($million)	0	0	0	0	0	0	0	79.0	80.0	81.1	82.1	83.2	126.4	128.1	129.7
Increased expenses of towns ($million) for:															
Municipal services	0	0	0	0	0	0	0	39.5	0	40.6	0	0	42.2	0	0
Aquisition of land	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 6.1 continued

Scenario B: Data associated with a hypothetical aquisition program

Category	Year (time period) 1986 (t=0)	1987 (t=1)	1988 (t=2)	1989 (t=3)	1990 (t=4)	1991 (t=5)	1992 (t=6)	1993 (t=7)	1994 (t=8)	1995 (t=9)	1996 (t=10)	1997 (t=11)	1998 (t=12)	1999 (t=13)	2000 (t=14)
Number of houses on Cape															
Total (thousand)	115.7	117.0	118.3	119.6	120.9	121.8	122.7	123.6	124.5	125.4	126.3	127.2	128.1	129.0	129.9
Added	2594	1310	1310	1310	1310	895	895	895	895	895	895	895	895	895	895
Population size on Cape															
Total (thousand)	420.5	424.8	428.1	431.4	434.7	437.2	439.7	442.2	444.7	447.2	449.7	452.2	454.7	457.2	459.7
Added	6500	3300	3300	3300	3300	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
Total expenditures on new houses (millions)	337.2	190.0	209.6	229.2	248.9	183.5	196.9	210.3	223.8	237.2	250.6	264.0	277.4	290.9	304.3
Profit in the construction industry ($million)															
Large companies:															
in Massachusetts	4.2	2.4	2.6	2.7	3.1	2.3	2.9	2.6	2.8	3.0	3.1	3.3	3.5	3.7	3.8
outside Mass.	4.2	2.4	2.6	2.7	3.1	2.3	2.9	2.6	2.8	3.0	3.1	3.3	3.5	3.7	3.8
Small companies	12.6	7.1	7.9	8.5	9.2	6.9	7.4	7.9	8.4	8.9	9.4	9.9	10.4	10.9	11.4
Net multiplier effect ($million)	33.7	19.0	21.0	22.9	24.9	18.4	19.7	21.0	22.4	23.7	25.1	26.4	27.7	29.1	30.4
Loss in consumers' surplus due to reduced recreational opportunities ($million)	7.5	11.4	15.4	19.5	23.6	26.5	29.5	32.5	35.5	38.6	41.6	57.6	60.8	64.2	67.5
Increased costs of travel ($million)	4.8	7.3	9.8	12.4	15.1	17.0	18.9	20.8	22.7	24.7	26.7	28.7	30.7	32.8	34.9
Loss in consumers' surplus due to groundwater contamination ($million)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Increased expenses of towns ($million) for:															
Municipal services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aquisition of land	2.0	57.0	62.9	68.8	74.6	55.1	59.0	63.1	67.1	71.2	75.2	79.2	83.2	87.2	91.3

Table 6.2 Net Present Value (NPV) of Acquisition Program.

(PV of acquisition program minus PV of full development)

Social discount rate (percent)	NPV (millions)
0	$275.8
1	175.8
2	126.8
3	85.6
4	50.1
5	19.2
6	- 11.2
7	- 35.5
8	- 54.5

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REPORT DOCUMENTATION PAGE	1. REPORT NO. WHOI 86-1	2.	3. Recipient's Accession No.

4. Title and Subtitle
An Economics Primer for Coastal Zone Management: Basic Concepts and Methods from Microeconomics, Public Finance, and Environmental and Resource Economics

5. Report Date
January 1986

6.

7. Author(s)
Steven F. Edwards

8. Performing Organization Rept. No.
WHOI-86-1

9. Performing Organization Name and Address
Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.
(C)
(G) NA84AA-D-00033

12. Sponsoring Organization Name and Address
J.N. Pew, Jr. Charitable Trust; NOAA, National Sea Grant College Program, Dept. of Commerce

13. Type of Report & Period Covered
Technical

14.

15. Supplementary Notes
This report should be cited as: Woods Hole Oceanog. Inst. Tech. Rept. WHOI-86-1.

16. Abstract (Limit: 200 words)

While the economic impacts of resource use pervade discussions of coastal zone management, most discourses tend to be ill-defined and incomplete, and to lack a solid basis in economic theory. This primer was written to eliminate this confusion for those non-economists who seek insight into economic thought and into how economic analysis can contribute to coastal zone management. The first half of the report introduces readers to basic concepts and analytical methods in microeconomics, public finance, and environmental and resource economics. The foundation for monetary valuations becomes apparent as the concepts are explained. The realization that neither markets nor prices are required for economic valuations is an important result of the explication. Consequently, one can assess losses associated with pollution, reduced access, and so on in units that are commensurable with market-oriented development.

The second half of the primer inculcates these basic concepts and methods through (1) critiques of several stereotypical, pseudoeconomic arguments; (2) a case study of the benefits of protecting water quality for recreation; and (3) a benefit-cost analysis of a hypothetical acquisition program that is intended to protect groundwater quality, to protect opportunities for aquatic recreation, and to reduce the growth in traffic.

17. Document Analysis a. Descriptors

b. Identifiers/Open-Ended Terms
1. economics
2. environmental economics
3. benefit-cost analysis
4. coastal zone management

c. COSATI Field/Group

18. Availability Statement:	19. Security Class (This Report)	21. No. of Pages
Approved for publication; distribution unlimited	Unclassified	128
	20. Security Class (This Page)	22. Price