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THE ECONOMICS OF RECREATION

A SURVEY

RAND CORPORATION

SEPTEMBER 1974

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September 1974

P-5301

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PREFACE

This report is intended primarily as a discussion of the appropriate way to measure the benefits of recreational open space. While the results of some empirical work are reported, they should be considered exploratory rather than final. The research was conducted while the author was a graduate student at the University of Chicago, and helpful comments were received from Professors George Tolley, Charles Upton, and Robert Rugg. The author would also like to thank George Cooley of the Department of Development and Planning of the City of Chicago for many helpful discussions and comments. Errors remain the author's responsibility.

Much of the work compiling the data was done by Ralph Braid, Robert Schmitz, Larry Huckins, and Ronald Krumm. James Cavallo assisted in organizing the data in analyzable form.

The research was supported by grants from the National Science Foundation and Resources for the Future, Inc., and the Canada Council.

SUMMARY

The purpose of this report is to examine the economics of the provision of recreation resources. The rapid urbanization of the United States has pushed access to open space further and further away from a large fraction of the population. Recently, tne increase in real per capita income and a growth in the awareness of the importance of the environment have resulted in popular demands for more urban open space. At the same time, the outmigration of middle-income families from large cities into their suburbs, and the resulting decline in the metropolitan tax base has placed a critical emphasis upon solving the problems associated with making the city a pleasant place to live. Adequate recreation facilities are an important determinant of the quality of urban life.

The provision of recreational open space in urban areas has typically not been left to the competitive forces of supply and demand. The reason for this lies in the belief that there are benefits enjoyed by society from the participation in recreational activities beyond the direct pleasure of the participants themselves. More specifically, these benefits can be categorized under a number of headings: (1) general social benefits, or the benefits to society at large, including the reduction in crime, vandalism, and social tension that might result from participation in outdoor recreation; (2) option demand, or the knowledge that the opportunity to participate is available even if one does not actually participate; and (3) location-specific benefits, which are the non-user advantages enjoyed by those living near a park--the pleasant view, cleaner air, and reduced residential density. A number of other reasons have also been advanced for the public provision of recreation resources, including the goal of redistributing municipal services toward the poor, but these are less convincing and have no empirical evidence to support them.

A result of the reliance on the public sector for urban space and of the failure to develop analytic techniques to base planning decisions upon, has been the haphazard and inequitable growth of parks in the metropolitan areas. Parks are distributed unevenly between cities and between areas within cities. The failure to price recreation facilities appropriately has led to overcrowding and inefficient use.

The only way in which these problems can effectively be dealt with is through the establishment of planning principles based upon a comparison of the costs and benefits of alternative plans. While the costs of open-space development are relatively straightforward to compute, there is no way to measure the value of a recreation site directly since the necessary price-quantity data are not available. Instead, indirect ways must be developed in order to be able to evaluate alternatives.

It was originally felt that no "price" could be placed upon a commodity so intangible as a visit to a park. However, as the budgetary demands of the national park service grew so did the need to justify the expenditure. Early attempts by the Department of the Interior involved calculating the impact on the regional economy of the construction of a National Park. However, this is clearly not the appropriate benefit measure for a cost-benefit analysis. During the 1950s, an alternative approach, using predicted visits and an artificial planning price, was used to estimate the value of a park. This, too, is unsatisfactory because the planning price is arbitrary.

There are three different methodological approaches currently being used by recreation analysts. The first consists of using engineering models to estimate the flow of visitors to a proposed recreation site. While this information is a necessary input into any planning decision, there is no direct way of calculating the value that the visitors place upon their visits and, therefore, no way of estimating the true value of the recreation area. Recent developments in the field have included the cost of a visit as one of the determinants of the number of visits, and, therefore, the demand function for a site can be estimated, which allows the benefit to be measured.

The second technique is based upon estimating the functional relationship between visit cost and the visit rate from populations surrounding the recreation area. The problem with this approach is that it is site-specific in that actual visit rates to an already existing park must be used, and the demand curve that is derived is the demand curve for a specific park. It is difficult to justify the application of such a demand curve to a proposed park.

Neither of these approaches measures the benefits that might accrue to non-users. While these may be quite small for a park situated well outside an urban area, a park in a city might bestow considerable benefits on nearby residents, even if they did not enter the park. The third method is an attempt to measure these as well as user benefits. It is based upon using the increment to land values in areas around a park as a measure of the value that purchasers of the land place upon such a fortunate location. The traditional land-value methodology does not measure the consumer surplus that intra-marginal consumers may earn from their residential location. An alternative model is developed that allows this surplus to be measured.

Ultimately, in any well-developed planning model, elements from all three techniques must be used if the benefits from a recreation system are to be adequately measured. A partial synthesis, to use as the basis for the construction of a planning model is described in the final chapter.

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Chapter I

INTRODUCTION

Any Innocent amusement that the human heart can invent is useful under a double point of view: first, for the pleasure itself which results from it; Second, from its tendency to weaken the dangerous inclinations which man derives from nature.

Jeremy Bentham

Hours spent working represent only a small part of the total time budget of an individual, and, over time, that fraction appears to be declining. Surprisingly, while the interaction of the demand and supply of goods and services produced during working hours has been subjected to considerable attention by economists, it has not been until recently that leisure time has been regarded as an area for economic investigation.[1] Perhaps the problem has been the abstract nature of the goods produced, but recent studies in the areas of health, education, and fertility have shown the value of the contribution that economics is able to make. Recreation is another area in which economic analysis is capable of yielding information useful to those charged with the allocation of resources.

This paper is concerned with one area of recreation important to the urban planner, the demand for open space and facilities necessary for recreation in an urban area. Urban dwellers express their need for open space in a wide variety of ways. The enthusiastic golfer may purchase a home with a yard large enough to include a practice putting green; a sun worshipper may pay extra rent in order to live in an apartment facing south with a balcony; a jogger may move to a neighborhood with a park close by; and a white-water canoeist may drive hundreds of miles to try new rivers on weekends. In each of these cases, the individuals' desire to maximize their level of satisfaction (within the constraints imposed by their level of income and the range of opportunities before them) is reflected in their purchase of services from open space, either directly in the first three cases, or indirectly, through the travel expenses incurred, in the last. Similarly, the weekend bowler

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1 The seminal work in this field is Becker (1965).

expresses his tastes and preferences by paying for games at his local lanes, as does the theatergoer when purchasing tickets.

The "demand for recreation" is, then, reflected in a large number of activities, some occurring within well-defined markets, others performed outside of markets, where no clear price is determined through the interaction of sellers and demanders. The focus of this paper will be upon recreation activities that are supplied only in part through market actions. But at the outset, it is important to realize that to a greater or lesser extent, the backyard, the Broadway play, and the Grand Canyon are substitutes for each other. It is important, too, to realize the large number of functions that open space performs within the urban environment, and that these functions are dynamic in that they change in importance as the socioeconomic characteristics of the urban area change.

In the ancient city, where population rarely rose above 25,000, open space was publicly provided and maintained for religious and political functions, and to ensure facilities for regular markets. Physical recreation was not a concern since open countryside was immediately available to the inhabitants. As cities grew in size these original functions moved indoors into more permanent and often privately supplied quarters, and open space was used for new functions. In imperial Rome, perhaps the first city to house more than one million people, and to suffer the concomitant social and environmental problems, open space took on renewed importance. Parkland was used to ventilate and drain some of the less attractive parts of the city; extensive and expensive parades and circuses, requiring considerable open space, were publicly financed in order to relieve social pressures; wide roads and vistas were constructed to lend authority to imperial and civic power (as well as making government buildings more easily defended -- a criterion that was important in a later age in Baron Haussmann's wide boulevards). The chaos following the fall of Rome led to the contraction of town size, and the need for easy fortification reduced the provision of open space to the needs of the weekly market.

The economies of large-scale production and agglomeration that accompanied the industrial revolution, and the deterioration of the environment from fossil-fuel burning, again placed a premium on urban open space. However, the new cities growing up at railroad junctions, on coal fields, or on canals were no longer ruled by an elite group of landowners, but by a broader class of capital owners who were less sensitive to the benefits that well-landscaped open spaces might bring to a city. This belief that public open space was not part of the new industrial city is well expressed in an editorial in the New York Herald in 1868, opposing the waste of good building land on a project named Central Park (quoted by Olmsted, 1870):

> It is folly to expect this country to have parks like those in old aristocratic countries. When we open a public park Sam will air himself in it. He will take his friends, whether from Church Street or elsewhere. He will knock down any better dressed man who remonstrates with him. He will talk and sing and fill his share of the bench and flirt with the nursury maids in his own coarse way. Now, we ask, what chance have William B. Astor and Edward Everett against this fellow citizen of theirs? Can they and he enjoy the same place?

Only in those cities where there was some natural feature that might be turned into a valuable tourist attraction (Chicago's lakefront, Montreal's Mont Royal) or where the land was inherited from a private source with restrictions upon its use (New York's Central Park, Vancouver's Stanley Park) were extensive efforts made to provide for open-space recreation.

The rapid urbanization at the end of the nineteenth century pushed open space further and further away from the city dweller. The development of slums leading to both a loss of part of the tax base for city government and a loss of property values by many landlords provided a stimulus for a more effective provision of recreation resources. Through zoning and compulsory purchase, cities set aside land to remain as open space. The demands for recreation land have been felt by politicians in all levels of government. Need has expanded faster than supply, leading to confrontation. Important aspects of both the race riots in Chicago in 1919 and a police student confrontation in Berkeley in 1968 centered on the use of recreation land.

Clawson (1959) estimates that demand for recreation has been growing at 10 percent per annum since World War II. This, Fischer (1961) predicts, will lead to a growth in the demand for open space from 44 million acres in 1960 to 136 million acres in 2000. The real estate boom in rural land in popular recreation areas is another symptom of the same phenomenon.[1]

As a result of past neglect and present rising incomes and urbanization, there is a crisis in outdoor recreation.[2] Research is needed into many aspects of recreation if the limited resources available are to be used to the greatest effect. The task of the researcher is not easy. As has been suggested, urban open space fulfills a wide variety of needs. A partial list[3] might include (in no particular order):

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1 See the Committee on Environmental Quality, Environmental Quality 1973, and David (1969).

2 See Clawson (1959).

3 Clawson (1969) provides an excellent discussion of many of these aspects.

- Improvement in the attractiveness of an area.

  Cities dominated by large buildings can be rendered more liveable with the inclusion of small open spaces for pedestrians. Views and similar amenities can be shared with the public if access space is included.[1]

- Environmental modification.

  Green areas can provide drainage for surrounding land, can modify the ecology of an area, can moderate temperature and air quality, and can provide visual amenities in themselves.[2]

- Open-space recreation.

  City parks provide a place for people to walk themselves or their dog, a place to exercise, or a place to relax.

- A site for recreation facilities.

  Parks may also provide the setting for certain recreation activities, whether a tennis game involving two people or an outdoor concert involving thousands.

- A total recreation experience.

  State and National Parks provide facilities where people may spend several days and escape completely from their city way of life and indulge in camping, fishing, skiing, and hiking.

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1 The problem of aesthetics has by and large escaped quantification. For a discussion of the issues involved see: Burchard (1970); Eckbo (1964); Fagin and Weinberg (1958); Lichfield (1965); Urban Land Institute (1961). Cook (1972) used survey results to attempt to place a value on different types of trees, and a number of studies have used land values as an attempt to measure the values of views. These are discussed in Chapter VI.

2 See Olmsted (1871) for a general discussion of this aspect of parks.

Planning urban recreation must be regarded as planning a system of recreation facilities. It is probably not desirable to have each park fulfill all of the recreation needs of the nearby residents. Rather, different park types should be used to provide different services. A possible recreation system for an urban area is shown in Figure I-1, and described in Table I-1. Research must be aimed at means of determining (a) the number of each park type, (b) the distribution of each park type throughout the area, and (c) the facilities provided at each location. Before such detailed analysis can occur several fundamental questions remain to be answered. Most basic of all is the problem of how a value may be placed on a recreation activity to provide the planner with a measure of the benefits that society shall receive from the investment in recreation facilities.[1]

In Chapter II below, the reasons for the public provision of recreation facilities are discussed and their implications for the measurement of the value of recreation discussed. Chapter III offers an overview of the history of the measurement of benefits, while in Chapters IV through VI three major and related methodologies--consumption prediction, demand estimation and land value augmentation--are analyzed. Chapter VII offers a tentative synthesis of methods in order for a cost-benefit study of a proposed urban park area to be made.

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1 A discussion of the systems approach to park planning is contained in Hart (1966).

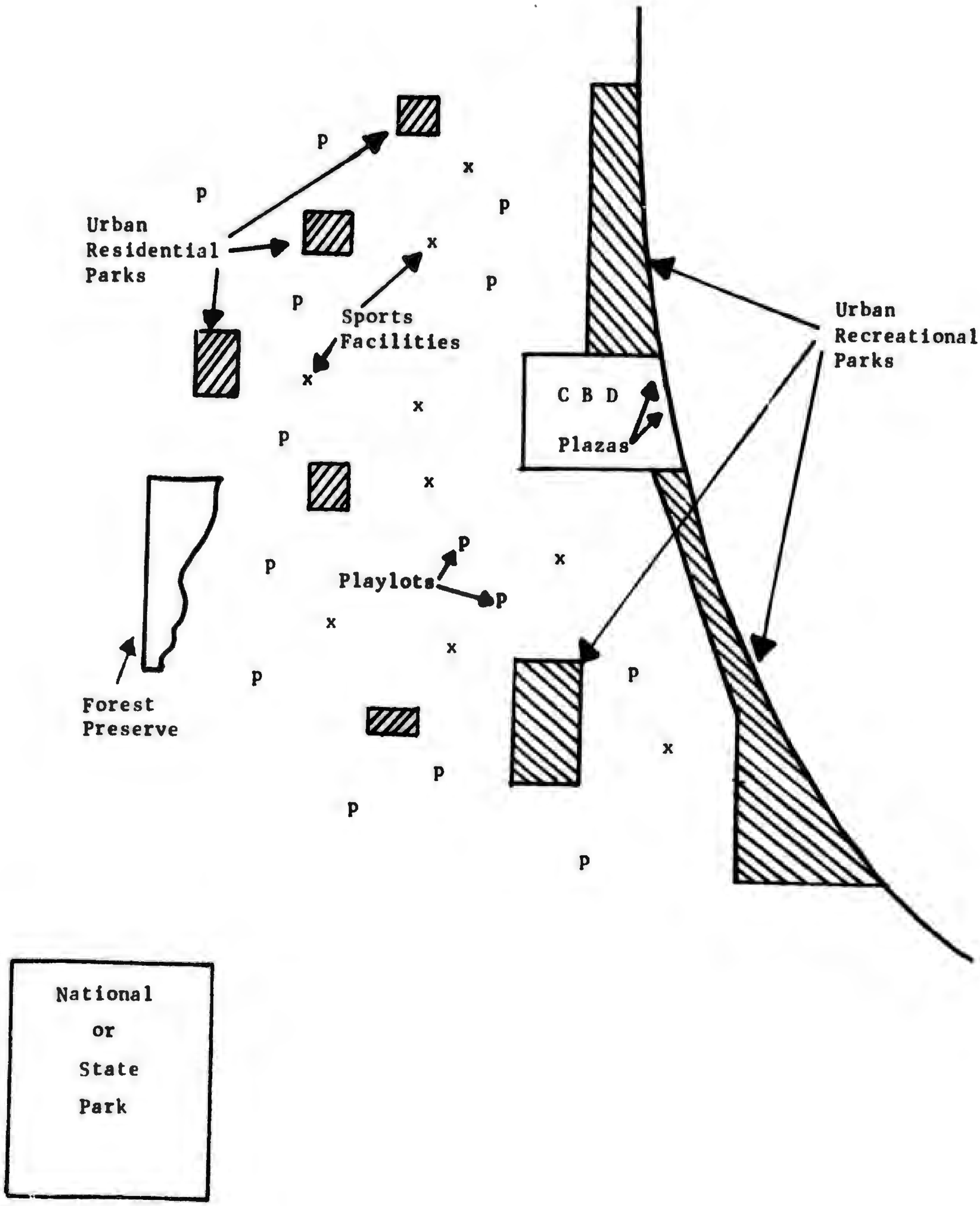

FIGURE I-1. Hierarchy of urban recreation areas.

Table I-1

TAXONOMY OF PARK TYPES[1]

Park Type	Examples in Chicago	Services Provided
(1) Plazas	Civic Plaza, first National, Riverwalk.	Space, Seating, Sculptures, Fountains, Views.
(2) Urban Recreational (20 acres+)	Lakefront, Douglas, Garfield, Humboldt, Marquette, Washington.	Bandshells, Museums, Zoos, Aquariums, Conservatory. All Sports (swimming, tennis, baseball, track, football) Playlots. Parkhouses.Parking, Varied Walks, Gardens, Picnic Areas, Water, Views, Space.
(3) Urban Residential (4-20 acres)	Indian Boundary, Palmer, Archer, Merrick, Mather, LaFollette, etc.	Space, View, Some Sports.
(4) Playlots		Recreation Equipment, Seating.
(5) Sports Facilities	Tennis Courts, Marinas, Schoolyards, etc.	Sport Specific Equipment.
(6) Unpaved Public Areas, Resident's Yards.		Space, Density Modification, Limited Recreation Equipment.
(7) Forest Preserves	Palos Heights, Schiller Woods, Salt Creek, Morton Arboretum.	Walks, Space, Picnic Facilities.
(8) National and State Parks	Indiana Dunes, Starved Rock.	Space, Walks, Sports, Overnight Facilities, Camping, Cabins.

1 This taxonomy is only suggestive and not based upon any rigorous analysis.

CHAPTER II

PUBLIC RESPONSIBILITY FOR

URBAN RECREATION

I believe it may be justly inferred that the Park stands in competition with the grog shops and worse places, and not with the churches and Sunday Schools.

Frederick Law Olmsted
1870

The purpose of this chapter is to explore (a) the reasons why the provision of open space has most often been achieved through the use of public funds rather than through the use of the market, and (b) the implications that this has upon the measurement of the benefits of such open space.

Economists argue that private transactions between people who wish to purchase a good and producers of that good will fail to produce an optimum quantity of that good if certain conditions are not met. One such condition occurs if the commodity is not produced under constant returns to scale. Another occurs if the activity creates costs and benefits that are not limited to the purchaser and supplier, known as external costs or benefits. In the pages following, reasons offered by observers for the public provision of resources used for recreation are analyzed.

(1) Public Goods

Public goods are a special case of external benefits in which the benefit bestowed upon the nonpurchaser is identical with the commodity itself. Samuelson identified the concept and used a lighthouse as an example. If one shipping company undertakes to construct a lighthouse to avoid some hazard, then all other shipping companies will enjoy the same benefits even though they have paid nothing toward the construction costs. There are two problems with public goods that prevent an efficient quantity from being produced. First, the marginal cost of supplying an additional consumer with the commodity is zero; and second, the supplier is unable to collect any revenue from other users. The result will be the underproduction of the commodity.

Few goods are pure public goods. Techniques have been developed to deal with goods that contain an element of "publicness."[1] Cicchetti et al. (1969) argued that recreation contains elements of a public good. The case is weakest when considering a National Park, because the direct benefits accrue only to the users, and it is difficult to conceive of non-users receiving the same benefits without setting foot inside the park. For an urban park it might be argued that by providing open space for one person, it is also provided for others. However, it is only available for others because no entrance fee is charged, and it is quite conceivable that exclusionary pricing could be effected.[2] An urban park is a public good because it is publicly supplied rather than through anything innate in the type of services that it provides.

The marginal cost of supplying a park to an additional user is not zero. A park must be maintained if it is to continue to provide services, and therefore additional use does involve resource costs.

The concept of public goods adds little to the discussion of recreation, and it is more convenient to treat any public good aspects that might exist as part of the more general class of external benefits.

(2) External Benefits

Three broad types of external benefits have been associated with outdoor recreation. The first might be called "general social benefits." These might be summarized by the argument that participation in outdoor recreation makes a person a better member of society. Olmsted (1870) feared that:

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1 See Samuelson, Paul E., "Diagramatic Exposition of a Theory of Public Expenditure," Review of Economics and Statistics, Vol. XXXVII, 1955, pp. 350-356. See also Barzel (1969), Musgrave (1959), and Weisbrod (1964), and a discussion in Cicchetti et al. (1969).

2 Gramercy Park in New York is one example.

> ...every evil to which men are especially liable when living in towns is likely to be aggrevated in the future unless means are devised and adopted in advance to prevent it.

He believed that parks could draw men away from grog shops and cited the apparent decline in attendance at such places following the completion of Central Park as evidence. More recently, Seckler (1966, p. 489) has asserted that:

> Externalities flowing from outdoor recreation, it seems to us, are quite high. The 300 - 400 million dollar annual expenditure estimated by Mr. Clawson could quite easily be paid for in the diminution of crime and mental disorders alone.

The National Advisory Commission on Civil Disorders reported that inadequate recreational facilities ranked fifth (immediately after the neglect of education) among the reasons for discontent among urban blacks.[1]

The existence of such externalities is a question that must be answered empirically, but which has received very little rigorous attention. There is no a priori reason to dismiss the argument, and quantification of the benefits will hopefully result from a detailed analysis of the determinants of anti-social behavior, although no such data are currently available.

The second type of externality has been labeled "option demand," and is the value of the recreation site to the non-user who knows that the site is there if it should be needed.[2] Similar arguments might be made for the subsidization of the theater, noting the discrepancy between the number of people who claim they live in a city because of the cultural amenities

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1 Cited in Bureau of Outdoor Recreation (1968).

2 The term was coined by Weisbrod (1964), and is further discussed in Kahn (1966) and Devine (1966).

and the number who actually use them. Some evidence might be available through the level of contributions given by non-users to organizations whose purpose is the preservation of open space (the Sierra Club for example). There has, however, been no attempt to quantify this benefit with regard to recreation areas.

The third type of externality might be called "locational benefits" and comprises benefits enjoyed by non-users of a recreation site because of their residential proximity to the park. While recreation areas outside cities offer few such benefits because of the small number of people living nearby, an urban park offers several potential amenities to surrounding residents. Population density is reduced, a pleasant view is provided, birds and other natural life are attracted to the area, the air is cleaned, and land drainage is often improved. The increase in property values surrounding parks is more than the simple saving in recreation trip time would predict.[1] In one study it was found that a premium was paid by residents living within one hundred feet of the park of one thousand dollars over the price that a similar piece of property would cost 800 feet from the park.[2] Residents would have to make more than one trip every day of the year and value their travel time at three dollars an hour for this premium to be explained entirely through the reduction in the cost of recreation trips.[3]

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1 See Darling (1973), Hammer et al. (1971), Hendon (1973), Kitchen and Hendon (1967), Vaughan (1974), and Weicher and Zerbst (1973).

2 See Chapter VI below.

3 The additional 1400 feet per trip would add approximately 5 minutes to the round trip time. The value of the annual flow of savings must equal about 100 dollars, which, at twelve trips for 3 dollars, implies 400 trips.

This evidence would seem to suggest that there are external benefits of urban parks that are perceived by house purchasers. This is not a valid argument for the public provision of open space unless it can also be shown that there are no institutional arrangements that might allow the internalization of externalities. In many cases, particularly in the center of the city, this is probably true since the number of landowners involved in a transaction to provide public open space is very large; this does not imply, however, that open space must always be publicly provided or that steps should not be taken to encourage the private provision, or even ownership, of common open space.

There is a limited, and only suggestive, body of evidence to suggest that, at least in some cases, the costs associated with "internalizing" the external benefits may not be prohibitively high. A land developer constructing a subdivision of houses will be anxious to maximize the total value of the land he develops and will have considerable experience from market transactions of the value that house purchasers place on the proximity of open land. Left unconstrained, he will therefore include open land in the plans for the subdivision until the marginal value of an additional acre, reflected in the increment to all property prices in the subdivision, is equal to the cost of providing that incremental acre its value as residential rather than open land. Gramercy Park in Lower Manhattan is one example of the private provision of open land, with access limited to the purchasers of surrounding buildings. European cities provide further examples of private city parks.[1] Many estate developments in suburbs incorporate open space that is often under the control of residents through some form of condominium association. The experience of Irving and Freemont in California illustrates one of the problems that may have contributed to the failure of many towns

1 Plazas built alongside large office buildings are another example of the private provision of open space.

to provide for an adequate supply of open space.[1] Anxious to avoid what was felt to be undesirable sprawl exemplified in many suburbs of Los Angeles, these cities attempted to encourage less uniform development by offering builders the incentive of waived zoning requirements --narrower sidewalks, smaller residential lots, and the inclusion of duplexes in single family areas --if common land were included in the development plans. Many builders accepted the offer, and observers have felt that the result has been a more attractive type of residential development. The technique has become known as planned unit development (PUD). The parks are managed by the property owners which has led to another desirable result. Facilities are installed (financed through membership dues) that reflect the tastes of the residents and, therefore, lead to the optimal type of park and maximum park use. The constraint that zoning may impose on the provision of open space can be illustrated using simple economic theory. In Figure II-1 the quantity of private recreation land that a homeowner purchases is measured on the vertical axis, while the quantity of public land is measured on the horizontal axis. The price of private land is the cost per square foot of yard area, while the price of public land reflects the increase in price for each resident that a developer must charge for the provision of public land, plus the capitalized value of that resident's share of maintenance costs. Given these prices and the consumer's income and preference for open space, the budget line DD' can be constructed. In the absence of any restrictions, the consumer will spend OX' on private land and DX' on public land and attain a level of utility reflected by U', the highest possible indifference curve

1 Discussed in Congress for Recreation and Parks (1966) and Norcross (1966).

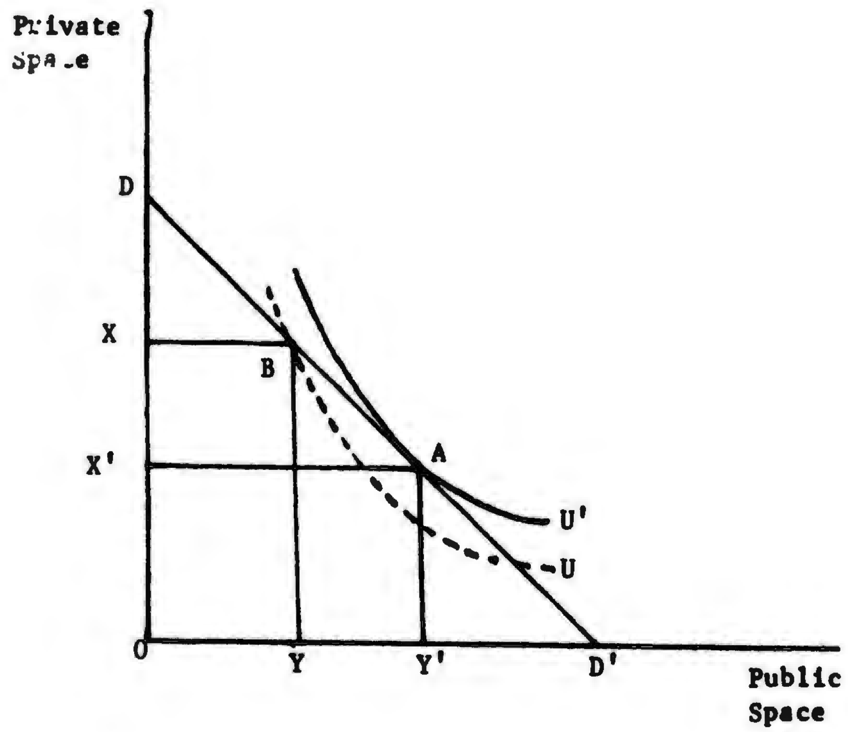

FIGURE II-1. The impact of zoning on the purchase of private and public land.

that can be attained. If zoning imposes an active constraint, as the discussion above suggests, then the result is to force the consumer to purchase more private land than he would wish. This is shown in the diagram as a movement from A to B, where OX represents the expenditure on private land that is compatible with the minimum lot size required by the zoning law. The consumer reduces his purchase of public land by YY', which results in the developer supplying less. The result will be a fall in the total value of the devloped land in the subdivision and, perhaps, also a loss of utility to consumers, since there is a deadweight loss in the efficiency of land use. This point can also be illustrated in demand and supply curves. In Figure II-2, DD' represents the unconstrained demand for public land by house purchasers (corresponding to A in Figure II-1). The result of the zoning law is to shift the demand curve downward to dd'. The supply schedule SS' is upward sloping, reflecting the fact that as more public land is provided the opportunity cost rises since the value of residential land has been augmented, and also that the maintainance cost per resident increases.

Another problem occurs through the partial supply of open land by public bodies. If a public park is provided nearby, then the demand for additional land within the subdivision will fall (since a cheap substitute has become available), and the quantity of space provided within the subdivision will fall. The uncertainty of the public provision of land and the cost of bilateral bargaining between the local authority and the developer may conspire against the optimum provision of open space.[1]

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1 No detailed information is available on the cost of either changing a zoning ordinance or encouraging the public provision of land by a land developer. Figures stated in recent indictments and convictions of Chicago aldermen indicate that the cost could be considerable. The State of Illinois requires that 5 percent of developed land be left as open space; this may not be optimal however.

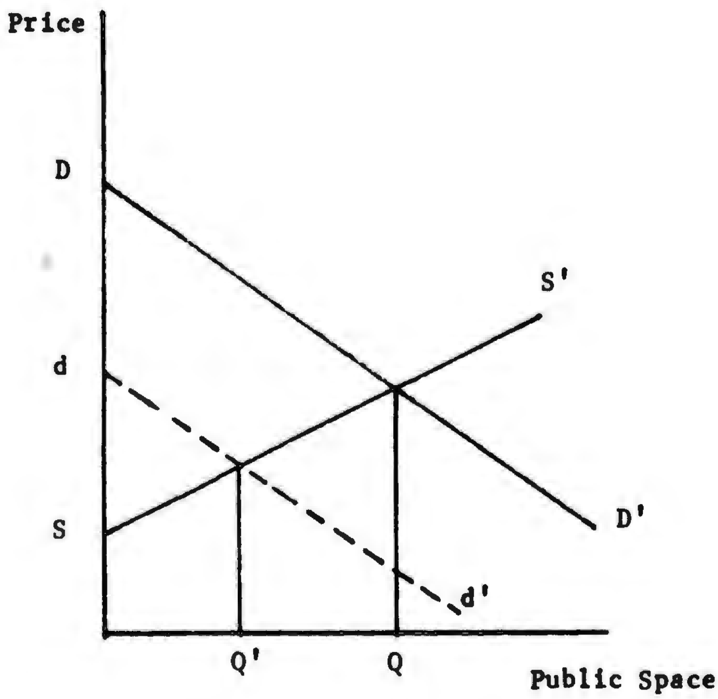

FIGURE II-2. The demand and supply for public open space. A fall in the demand curve reduces the supply of public space in a subdivision from Q to Q'.

A third potential barrier is the way in which property rights over the common land are assigned. The less control that the individual has over the open space in the subdivision, the lower will be the value that he places upon it. Areas where the rights of condominium associations are not clearly defined will discourage the private development of common land.

A similar problem arises with the provision of even more localized open spaces -- sidewalk planting strips and front yards -- which have some aspect of common property associated with them in as much as they are shared visually with the whole block. The scars of urban decay that mar the appearance of many inner city neighborhoods --with the rise in crime and deterioration in the property tax base -- have long defied attempts at reversal by local governments. A principal problem has been the lack of legal status of the residents of the block to enforce building codes and to draw up their own bylaws. This has impeded the "internalizing" of declining-neighborhood externalities. Recent experiences in New York and on Chicago's West Side have suggested that with a minimum of cooperation from City Hall quite dramatic improvements in the appearance of a block can be both effected and maintained.[1] Well organized

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1 While it is not usually considered as part of the concern for urban recreation, the provision of localized open space, even at this modest level, is rightly to be included in a discussion of urban open space. The results indicate that the appearance of a block may have a very significant impact on the value of property within that block. The number of residents on a block also seems to be an important determinant of the block's ability to be organized to maintain its appearance. There is probably also an interaction between the quality of the street and the use of neighborhood parks since attractive streets would lower the "costs" associated with a trip to the park by making the journey more pleasant.

block clubs sometimes contribute directly to the provision of recreation facilities by converting vacant lots into playlots.[1]

This discussion raises an issue that is central to the whole issue of urban open-space provision --the problem of residential density. Density might loosely be defined as "the sense of overcrowding" that lowers the level of welfare of a resident of a dense neighborhood and is an external cost of the provision of additional residents in a neighborhood. One of the oft-quoted reasons for zoning ordinances is an attempt to avoid these costs.

> Control of residential density is fundamental to any effective town planning while the layout of a residential area has, perhaps, the strongest and most direct influence on the happiness and well being of the people of any planning tool.[2]

Yet density, as a condition to be avoided, remains a most elusive disamenity to define. There are several factors which one would expect, a priori, to have some influence on a resident's perception of the density of his neighborhood.

- The number of residents per acre of land.
- The amount of public or common land available in the neighborhood.
- The topography of the area. An undulating terrain may provide a greater sense of openness than flat land.
- The degree of homogeneity of the neighborhood. It is possible that a wide variety in the type and size of the buildings may reduce the sense of density even if the number of persons per acre is unaffected.

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1 For an informal report on neighborhood associations, see The Christian Science Monitor, Feb 11 - 14, 1974, and The New York Times, May 23, 1974.

2 Lewis Keeble, quoted in Sussna, Stephen A. (1973, p. 1).

- The size of the residential plot.
- The provision of recreation facilities in adjacent neighborhoods.
- The attractiveness and neatness of a neighborhood.

It is not impossible to believe that the inhabitants of Daly City, California may feel the pressure of density more than residents of some parts of Manhattan, even though the simple measure of density, persons per acre, would indicate the reverse.

It is not clear that zoning is either the only or the best way to tackle the problem of residential density and the supply of open space. In fact, by homogenizing a neighborhood and deterring the private supply of open space, zoning may be contributing to the problem that it was designed to cure.

To summarize, there is evidence to suggest that external benefits may be present and that they may constitute a rational argument for the public provision of open space. This is especially powerful in areas of the city in which land ownership is so diffuse that no private contractual arrangements can be cheaply brought about. However, there are indications to suggest that some of the barriers to the private organization of recreation facilities should be examined in order to understand more fully how this potential source might be efficiently used in residential development and redevelopment.

(3) Income Redistribution

In response to initial attempts to place a monetary value on recreation, several critics argued that a main objective of the public provision of recreation facilities was to redistribute income toward the poor,[1]

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1 This point was made by Hines (1958) in his reply to Trice and Wood, and was reechoed by Seckler (1966), who asserted that recreation demand curves

and that proper market demand curves reflected only ability to pay rather than the true marginal utility of the recreation experience. There is an additional institutional argument that in view of the political problems associated with income transfers,it is more politically feasible to make transfer payments in kind rather than in money.[1] Very little has been done to determine the extent to which income transfers in the desired direction are effected. In the case of National Parks, the income of visitors is often above the national average which might imply that there is an income transfer in the reverse direction.[2]

For urban parks,the position is less easy to determine. There is little empirical evidence on which to base any conclusions,but certain observations are possible. Land values near most urban parks are higher than land less fortunately situated. It is possible that income may be inversely related to the distance to the nearest park. If,as is suggested in Chapter VI below, there is consumer surplus enjoyed by those capable of purchasing park services, then, again, it is possible that urban parks also represent a subsidy paid from those unable to afford to live near a park to those who are able to afford it. This is an important empirical question that has yet to be answered satisfactorily.

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should be corrected to allow for the unequal distribution of income. There is not the space in this paper to enter into the debate that has been stimulated by Harberger (1971).

1 See Marshall (1966).

2 There are a large number of studies that introduce income as a determinant of the number of recreation days spent in National Recreation Areas. These are discussed more fully in Chapters IV and V below, but see Brown et al.(1964), Burch (1967), Cicchetti et al (1968), Craig (1972), Hauser (1962), Hendee et al. (1968), Lindsay and Ogle (1972), Mueller et al.(1962), and Tatham and Dornoff (1971).

(4) Merit Goods

Musgrave (1959) introduced the concept of merit goods, goods which should be subsidized because, left to their own desires and devices, consumers will not necessarily consume enough of them. The basic rationale is that the welfare of non-consumers is increased by the knowledge of another individual's consumption of the good.[1] This provides an explanation for voluntary income redistribution through charities, and perhaps even tax exemption on church land. The case of demerit goods is stronger than the case for merit goods --alcohol, cigarettes, and blue movies seem to affect the welfare of non-users and the health of users in the same direction.

The concept is difficult to discuss since it involves subjective judgment and is extremely difficult to quantify.[2]

(5) Learning by Doing

Davidson et al. (1966) and Cicchetti (1969) argue that underinvestment in recreation facilities will occur because there is an element of learning by doing in recreation behavior.

> The thought behind this concept is that if facilities are available, users in t_1 would learn to develop a demand for a recreation activity which would result in an increase in their demand in t_2 as opposite to the case where facilities are not available. Moreover, this increased demand may spill over to their families' and associates' demand through social interaction.[3]

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1 Cicchetti et al. (1969) discuss this concept with respect to recreation.

2 Not impossible though. Information on the willingness of one group to subsidize the activities of another group through charity contributions would be one way of measuring this external benefit.

3 Cicchetti et al.(1969, p. 29).

This is not a substantial argument for the public provision of recreation facilities, unless it can be shown that private entrepreneurs consistently underestimate future demand. This is unlikely, since many of those activities with the strongest learning-by-doing component (skiing, sailing, etc.) are those with the highest fraction of facilities supplied by the private sector.

(6) Irreplaceable Natural Resources

It has been argued that intervention is necessary to secure irreplaceable natural resources for future generations.[1] Because of public ignorance, it may be possible for land developers to convert a particularly unique area into housing or a commercial development, a process which cannot be reversed. This raises questions which are too broad to enter into in any detail in this paper concerning the effectiveness of the market system in protecting the interests of future generations. It is difficult to deny that it would be possible for a particular resource area to be purchased for the wrong purpose because its value as a recreation area was not fully understood.

(7) Countering Distortions in other Markets

One of the external benefits that must be attributed to a project is the increase in the level of an activity in which distortions are restricting output below optimum, and the reduction in the level of activities producing

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1 See, for example, Krutilla and Cicchetti (1972).

at above their optimum level.[1] Since recreation areas are supplied at below their marginal cost, one of the results is congestion which is discussed below. Congestion implies that facilities are used to the extent that the value of the marginal visit is less than the marginal cost. If a recreation project will be a substitute for already existing, congested recreation areas, then one of the benefits that it will bring is a reduction in the level of congestion in these substitute areas. Additional benefits may accrue if the project reduces congestion on roads leading to other recreation areas. The way in which these benefits should be counted is illustrated in Figure II-3. The original demand function for the alternative recreation areas (or service road) is represented by DD' with SS' representing the private cost of using the facility and SC' the social cost, which is above the private cost since the congestion is caused by the addition of one marginal user is suffered by all users. The waste is shown by the area abc, with actual output Q while the optimal output is at Q'. The new project reduces demand to dd' which results in external benefits of ebcf (shown shaded).

Other areas in which open spaces might capture similar types of benefits include the reduction of noise through the muffling effect of trees and shrubs and the air pollution reduction, especially low particulate matter.[2]

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1 A survey conducted for the 1973 Outdoor Recreation Survey (discussed in Appendix A of the report) found that 79 percent of all tennis games and 80 percent of all golf games were played over weekends.

2 For attempts to quantify some of these benefits, see U.S. Department of Agriculture, "Trees and Shrubs for Noise Abatement," Washington, D.C., 1971.

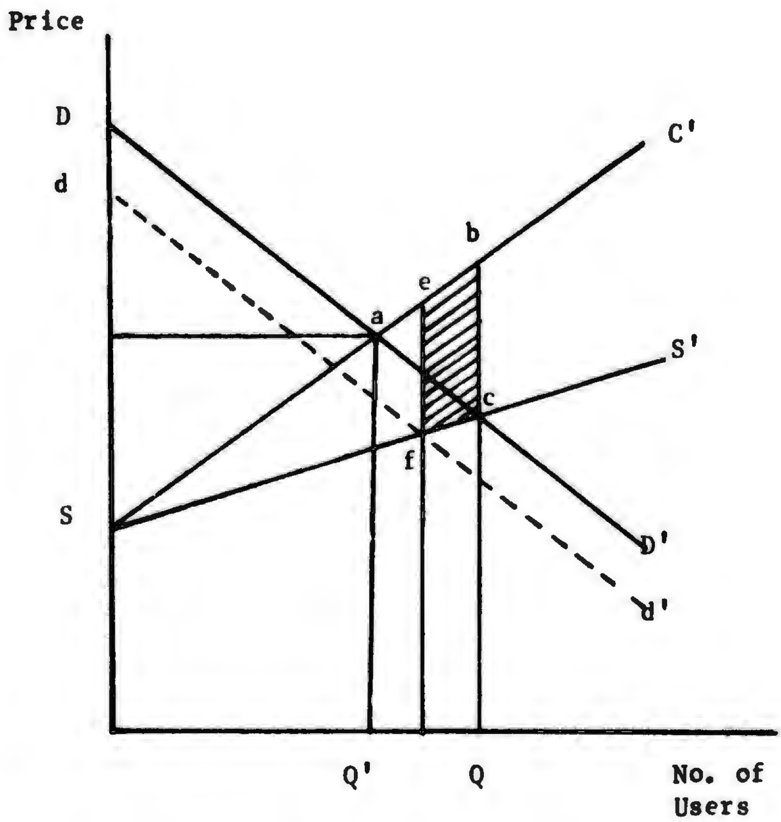

FIGURE II-3. The external benefits of congestion reduction.

(8) Indivisibilities and Unique Resources

Where a recreation area is based upon certain unique natural phenomena - the Grand Canyon, the Petrified Forest, Crater Lake, etc. - private ownership of the resource will lead to an excessive, monopolistic price being charged for admission to the area. This can be seen with reference to Figure II-4. DD' represents the demand curve for the resource, and SS' represents the marginal costs of additional visitors (i.e., the costs of providing parking space, adequate pathways, restrooms, etc.). DM is the marginal revenue curve derived from the demand curve. The owner of the unique resource will charge P' as the entrance fee allowing OQ' visitors, while the optimum quantity to admit is OQ" at price P". The welfare loss of allowing the resource to fall into the hands of the monopolist is shown by the shaded triangle. Each of the additional visitors would value access to the site at more than above the resource cost of allowing them in.

For large recreation parks, the cost of additional visitors may be a falling function of the number of visitors, at sites where congestion is not a severe enough problem to offset this . This may be due to a phenomenon known as indivisibilities.[1] This is due to the fact that the amount of additional investment in the facility necessary to permit extra visitors to attend declines as the number of visitors increases.

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1 Discussed by Krutilla (1966). For the basic work see: Bowen, H.R., Toward Social Economy, (1948); Musgrave (1959); Margolis, J., "Secondary Benefits, External Economies and the Justification of Public Investment," Review of Economics and Statistics, Vol. 39, 1957, pp. 347; and Chipman, John S., "External Economies of Scale," Quarterly Journal of Economics, Vol. 84, No. 3, 1970, pp. 347-385.

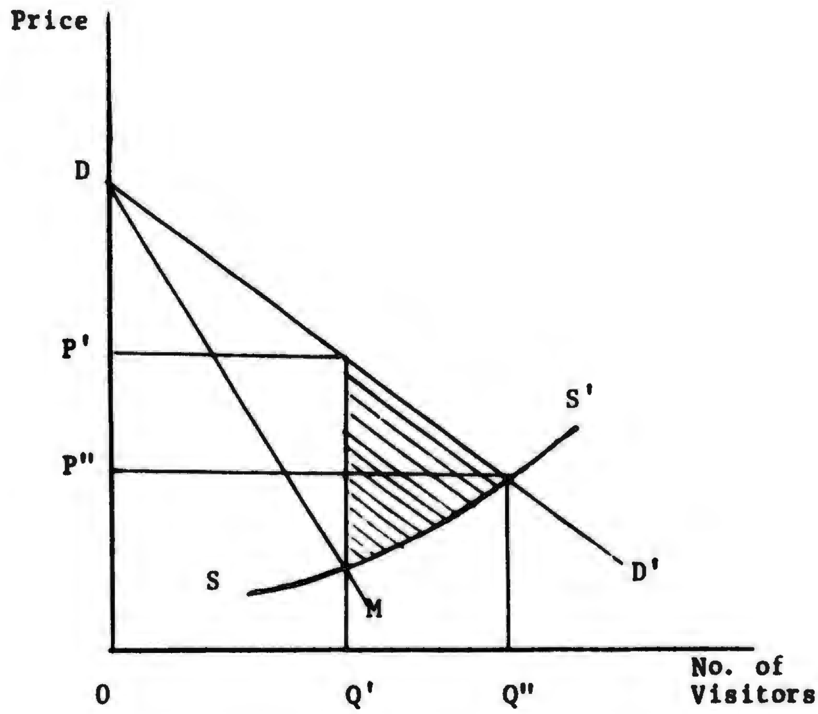

FIGURE II-4. Monopoly and the overpricing of unique recreation sites.

In this case, marginal cost pricing will be impossible to the private supplier since this will not cover all expenses. In Figure II-5, DD' again represents the demand curve for the facility, and CS' represents the marginal costs, while CC' represents the average costs. Under private ownership, OQ' visitors will be admitted at price P'. The optimum number of visitors is OQ" at admission price P". This will entail an operating subsidy equal to PabP".

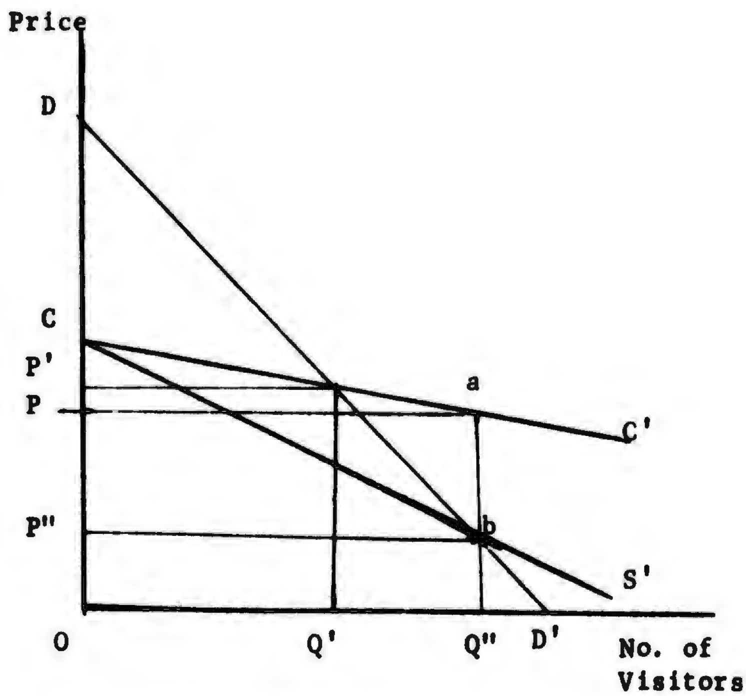

FIGURE II-5. Economies of scale and the optimum number of visitors.

(9) The Results of the Public Supply of Open Space

As a result of the public provision of open space for recreation purposes, the determination of the quantity and quality to supply has been removed for the most part from the market process and must be determined by land-use planners. Any analysis aimed at assisting in this decision process must develop indirect methods of evaluating the benefits of open space in order to be able to place a dollar value on outdoor recreation, since direct measures of value through prices are not available.

Because of the political nature of the decisions involved, parkland has been provided unevenly throughout most cities and between cities. One advantage of the development of an efficient technique of evaluation would be to partially depoliticize such decisions.

Another result of the public provision of recreation resources and the failure to price them at marginal user cost is that many of the resources are over-used, in that they are often congested. If resources were privately owned, then the admission cost would be raised to that point where it equalled the cost of providing the facility to an additional user plus the impact of that additional user. In Figure II-3 this would involve charging an admission price of OP to the facility, which would restrict output to the economically efficient point OQ'. Where there are a large number of resources, then there will be different levels of crowding at different prices.

> Producers will provide separate facilities with crowding dependent upon the visit price, and consumers will choose the particular resource whose combination of price and crowding enables them to best satisfy their preferences. The profit equalization condition ... implies an inverse relationship between crowding (measured by the number of visits) and the price charged. The consumer can, therefore, choose less crowded

facilities, but at the expense of an increased visit price.[1] Overcrowding can best be overcome through the use of some form of peak-load pricing, a technique developed to provide for the efficient use of electrical generating capacity. Several studies have shown that calculation of the peak-load price for recreation sites and facilities -- the price charged during the most crowded times--can be computed relatively easily.[2] Appendix B describes the methodology.

(10) Summary

Examination of the reasons why open space has been publicly provided has illustrated the type of benefits that analysis of open spaces must attempt to quantify. Apart from the benefits to the users themselves, other benefits may accrue to society including general social benefits, the feeling that it is good to have the resource there should it be needed, the enjoyment from knowing others are enjoying the resource, the attractive vistas and improved environment, the reduction in population density, and the reduction in the congestion of other facilities. While many of these benefits are elusive, some quantification may be possible, and research aimed at estimating their values should be undertaken. Wantrup has argued forcibly that every effort should be made to place values on all forms of benefits, and opposed the use of the term intangibles to describe them, preferring instead the term extra-market benefits (1957). The market alone does not seem to be an adequate supplier of recreation facilities.

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1 Anderson and Bonsor (1974, p. 52-3)

2 The problem of congestion is discussed in: Bechter (1971); Brown (1971): Cicchetti et al.(1968); Goldin (1971); Haverman (1973); Knetsch (1963); and O'Riordan (1973).

Through public choice, responsibility for the provision of open-air recreation facilities has been placed in the hands of federal, state, and local governments. This is not to deny that the private sector cannot make significant contributions to the provision of open space nor that it should not be encouraged to do so.[1] Neither is it to deny that economic tools developed to explain and analyze market behavior cannot be used to provide considerable insight into the way in which publicly provided goods should be supplied.

> There are many important tasks that the market does exceedingly well; there are many important tasks the market does not do well at all; there are many important tasks where it is not clear whether the market is superior to another kind of organization. The first category is of interest to the economist as he studies the market for an understanding of its functioning. The second is a challenge in terms of designing market alternatives. The third represents the area of controversy which represents the real opportunity to the economist as he strives to provide information that will be of value in decision making on social problems.[2]

In the following chapters, the use of market techniques as a way of measuring user and non-user, market and extra market benefits of recreation facilities will be analyzed.

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1 Tax laws have provided one indirect incentive for the gifting of private estates and land for use as public recreation land. Morton Arboretum is a large example of the private provision of open space. The Open Space Action Committee has published a tract on the use of tax laws to set up public land (Stewardship, 1965). See also Durham (1966) and Bevins (1966).

2 Castle and Stoevener (1970, p.544).

Chapter III

PLACING A VALUE ON RECREATIONAL FACILITIES

The typical medieval town had at its foundation and through most of its existence a far higher standard for the mass of population than any later form of town.

Lewis Mumford, 1961.

In 1870, as the unprecedented and highly controversial landscaping of Central Park neared completion, its architect and, at times, its only supporter, Frederick Law Olmsted argued in an address to the American Social Science Association that the provision of recreational open space should be the subject of cost-benefit analysis (Olmsted, 1870). It was, he felt, the only way in which the provision of an adequate supply of parkland could be secured against the machinations of city governments and land developers. He even suggested that the distance travelled by visitors to his park was one indication of the value they placed upon it, and that the change in adjacent land values could also enter the calculus. In spite of his requests and warnings, and the very real success of his projects, economists largely ignored the problem, to such an extent that similar appeals for professional involvement were still being made in the1960s.[1]

The problems that confront anyone attempting to measure the value of open space are considerable, and it is probably fair to say that it is only recently that the dramatic reduction in the costs of data collection and analysis has made such estimations feasible.

In Chapter II it was argued that the public provision of recreation sites and facilities has meant that there are no market prices from which the marginal value of recreation might be calculated. Further, the existence of spillover effects which might not enter market transactions adds new complications to the definition of value. The result has been that the provision of facilities

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1 See, for example, the American Society of Planning Officials(1965),Hewes(1960), Loomer (1961), U. S. Bureau of Outdoor Recreation (1968), Vaughn (1964).

has arisen from the interaction of particular pressure groups and different levels of government. This has led to a dramatic disparity in the per capita availability of public recreation, not only between cities, but also between areas within a city, as is illustrated by Table III-1.[1]

The task of the economist must be to develop techniques that enable the planner to determine the efficient use of land for residential purposes. The decision is by no means a small one. Setting aside one city block in a middle-income residential area (less than four acres) involves land that may be worth more than $500,000 for residential purposes. Without some efficient criterion for effective decision making, the potential for waste is obviously large.

In Chapter II, two broad classes of benefits were identified. Benefits accruing to the actual user of the facility, "the amount that they would be willing to pay for the use of the area," and the spillover benefits enjoyed by non-users. Although there has always been an attempt to argue, if loosely, within the framework of cost-benefit analysis as to the value of creating recreation areas, the type of approach has not always rested upon a consideration of the basic economic issues, but has been influenced, instead, by the type of data available and the goals of government policy.

During the 1930s, with a great deal of federal money being spent on make-work schemes that often involved the building of recreation areas in depressed areas, the issue was less the cost effectiveness of the

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1 For a detailed list of outdoor facilities by state, see ORRRC Study Report No. 1. For a comparison of certain major urban areas see ORRRC Study Report No. 21. For a comparison by state, see Bureau of Outdoor Recreation (1972).

Table III-1

Distribution of Parks Between
Cities and Chicago Suburbs

ACRES OF PARKLAND PER 1,000 PEOPLE IN MAJOR AMERICAN CITIES AND CHICAGO SUBURBS

CITY	ACRES PER 1,000	PER CAPITA EXPENDITURES
PEORIA	50.0	17.78
DAYTON	12.7	12.73
NASHVILLE	12.0	5.95
OAKLAND	6.3	16.73
NEW YORK	4.8	6.92
ST LOUIS	4.5	8.44
LOS ANGELES	4.2	8.72
CHICAGO	2.0	13.79
NAPERVILLE	17.6	20.40
PALATINE	12.1	22.50
NORTHBROOK	6.9	20.20
MT PROSPECT	6.0	16.00
EVANSTON	33.4	21.20
PARK RIDGE	2.5	22.50
HARVEY	2.4	8.30
OAK LAWN	2.4	7.80
OAK PARK	1.5	21.50

Source. National Recreation and Park Association, reprinted in the Chicago Sun Times, June 23, 1974.

park itself, but its value in generating business in the region. Initial studies simply measured the gross volume of business that might be attributable to the park.[1] This was attractive because the data were relatively easy to collect, and the resulting numbers were generally large.[2] However, it was not a meaningful number, since it neither represented the value of the park nor the local rate of return on the federal investment. One obvious refinement was to consider, instead, the additional net volume of business --the gross figure minus the costs of production.[3] While these measures may provide the government with some indication of the effectiveness of federal expenditures in generating local income, they do not provide the recreation planner with information concerning the value of the recreation site per se, and, therefore, cannot provide the basis for making a cost-benefit evaluation.

Concerning the recreation aspect of these government projects, there was a strong belief that an evaluation of recreation could not be made within an economic framework.[4] Most observers seemed to imply that the values of recreation land were self- evident and that detailed attempts at quantification were somehow unnecessary. This belief achieved some degree of formalization in a paper by the National Park Service (1950), that was repeated before Congress (1962), according to which, if the methodology is analyzed, the benefits from recreation investment are always equal to twice the costs

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1 See Clawson (1959b, p.5, footnote 5) for a partial list of such studies, and also Mohony (1960), the National Park Service (1957), and Van Doren (1959).

2 Clawson, op. cit., p.6.

3 See Clawson (1959b, p.8) for a list, and also Dana (1957), and Swanson (1960).

4 Essentially the conclusion reached by Prewitt (1949).

of making the investment.[1]

In 1952 there was a change of administration which "resulted in there being exhibited in Washington a marked preference for having more of the nation's economic functions carried out in the private sector." (1966, p. 61). This, Krutilla has argued, "induced economists to some extent to address more specifically than before, the justification for public intervention". One important aspect of this would be to attempt to measure the value of such investments.

Several initial attempts to quantify benefits proved arbitrary. In the absence of clearly defined market prices, the U.S. Forest Service used planning prices which, it was hoped, would "measure the amount that users would be willing to pay if such payments were required to avail themselves of the project recreation resources."[2]

Questionnaires which allowed users to place a dollar value on their recreation experiences have also been used.[3] Unfortunately, the amount of freedom that questions of this type, unattached to any monetary obligation, allow respondents often leads to quite unreliable answers.

An alternative approach was to use the price charged for comparable

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1 U. S. Congress, Supplement No. 1, (1962). For a more detailed discussion see Cicchetti et al.(1968), and Smith and Kavanagh (1969).

2 Quoted in Smith and Kavanagh, p. 319.

3 For example, see Davis (1964), and Knetsch and Davis (1966). Darling (1973) used questionnaires as well as land values in his examination of urban water parks.

recreation facilities by private clubs or other commercial sectors.[1] However, for many recreation sites and activities there are no comparable private alternatives. The private club will offer a qualitatively different type of recreation service. A tennis game at a private club involves less queue time and usually a number of auxiliary benefits (showers, etc.) not found in a public park.

The first real contribution toward identifying the value of a recreation resource to the user was made by Hotelling in a letter to the director of the National Park Service.[2] He suggested that park users' willingness to pay could be gauged from the distance they travelled to enjoy the recreation opportunity. His suggestion remained largely undeveloped until path-breaking work by Trice and Wood (1958) and Clawson (1959b). A large number of informative studies based on this methodology have been undertaken. A discussion of these studies, together with some of the problems that still remain, forms the basis for Chapter V below.

The travel-time approach is basically site-specific, in that it estimates the value of a certain recreation site, in a certain geographic area with a certain economic base. Policy makers often need to know the demand for a proposed rather than an actual site. Clawson suggested that this could be done through comparison with the actual demand for a similar site in a similar setting that already

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1 Mohony (1960) and Brown use the value of commercially caught fish to place a value on recreational fishing (1964). Crutchfield (1962) discusses the problems associated with using private river rents to value public river access.

2 Reported in Prewitt (1949).

exists. However, in view of the potentially large number of variables that might affect the demand for a recreation area, this could be no more than a very rough method. In an attempt to overcome this problem,an alternative approach for the prediction of park visits (rather than the demand schedule)[1] based upon the socio-economic characteristics of the base population, and even more important, the availability of alternative recreation sites has been developed. While this does not directly place a value on the area, it does provide a useful planning tool. This "systems" approach is discussed in Chapter IV.

The third approach is derived directly from cost-benefit analysis of development projects in underdeveloped countries and from attempts to evaluate flood control projects undertaken by the Corps of Engineers. It consists of using th increase in the value of land as a measure of the benefits resulting from the creation of a recreation site. This is not applicable to sites located outside urban areas, since the increase in land values near the site does not necessarily reflect the value to recreationists who have travelled a great distance. It has yielded promising results in the evaluation of urban parks, where it is conceptually capable of reflecting the spillover benefits enjoyed by non-users discussed in Chapter II, which an analysis of users alone is unable to do. This technique is discussed in Chapter VI below.

None of these techniques have been applied to the system of urban recreation facilities, with the result that open-space standards have been adopted based upon intuition rather than cost effectiveness. The extent of

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1 Although not all proponents of the sytems approach have distinguished between "demand "and the "quantity demanded". See Chapter IV below.

the task is large, but not prohibitive. With the collection of adequate data and the application of methods discussed below, guidelines for urban planners can be established to provide a more efficient means for determining the allocation of open space within the urban framework.[1]

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1 For a list of the various "standards" for the provision of open space and recreation facilities, see U. S. Bureau of Outdoor Recreation, Outdoor Recreation Space Standards (1967), which includes an extensive bibliography. For examples of specific standards adopted by urban areas, see : Baltimore Regional Planning Council (1959 and 1960) ; Butler (1958); California Committee on Planning for Recreation (1956); Chicago Park District (1952); Dallas Department of City Planning (1959); Illinois Department of Business and Economic Development (1966 and 1969) ; Kansas Joint Council on Recreation (1966); Kentucky Department of Finance (1966); National Recreation and Park Association (1965); Sacremento County Planning Association (1960) ; Urban Renewal Administration (1965).

Chapter IV

PREDICTING FACILITY USE

A large body of recreation research has been concerned with investigating the socioeconomic determinants of visits to recreation sites or activities. Cicchetti (1972, p.90) divides this work into "three broad areas, namely: site-specific recreation area models, site-specific user models, and population-specific models."

The first area, the analysis of the use and value of a particular recreation site, will be discussed in the following chapters. There are two separate techniques, the use of the distance that visitors travel to estimate the value that they place on the recreation opportunity (Chapter V), and the use of land values around a recreation site to estimate the site's value (Chapter VI). The other two areas of research are concerned with the socioeconomic properties of the visitors themselves. This information is useful for two purposes. It can be used to predict the number of visits that will be made to any given recreation site, and it can provide some useful insights into the the decisions processes of recreationists. This latter point may be very important. In Chapter II the possibility of external benefits to society from recreation visits was raised. Visitors may exhibit more socially desireable behavior patterns (a lower tendency toward crime for example), which would imply that investment in promotir recreation activity may be an efficient use of resources. The fact that many large cities spend considerable sums of money on programs for low income children is some indication of the belief in this principle. The more that is understood concerning the reasons why some population groups participate and others do not, the better suited to this task could the programs become.

Before discussing the models and some of their results, it is important to clarify exactly what such analyses can and cannot be used to determine. Many reports and articles have discussed the actual or predicted number of visits as the "demand" for recreation.[1] The term demand is used interchangeably with the "quantity demanded", which is both inaccurate and confusing. In the field of economics, the term demand is used to describe the functional relationship between the price that is charged for a commodity and the quantity of that commodity that is purchased in any specific market. In Figure IV-1, the line DD' shows this relationship for a hypothetical commodity, and is called the "demand curve". The price of the good is measured on the vertical axis, while the quantity that a given group of consumers are prepared to purchase is measured along the horizontal axis. The typical negative slope to the function implies that if the price of the good is lowered, then the quantity that consumers are prepared to purchase will increase, all other things remaining unchanged. This last qualification is important because the position of the demand curve depends upon the magnitude of a large number of other factors.

For convenience, the factors that affect the position of the demand curve can be divided into three categories; the income of the consumers and potential consumers; the price of substitute and complementary commodities; and the tastes of the consumers. Any change in either of these categories will shift the DD' curve. For example, if the income of the community increases, then its members may purchase more of the commodity at any given price. This is reflected in Figure IV-1 in a movement of the DD' curve to dd'. Several studies have shown that most forms of recreation exhibit an increase in the quantity demanded at each price in response to an increase in income. An understanding of the magnitude of this shift is therefore important in planning

1 A partial list of those studies that misuse the concept of demand includes Evans and Van Doren (1960), Mueller, Guerin and Wood (1962), and NRPA (1963). An excellent discussion of the problems of identifying recreation demand functions is contained in Kalter and Gosse (1970).

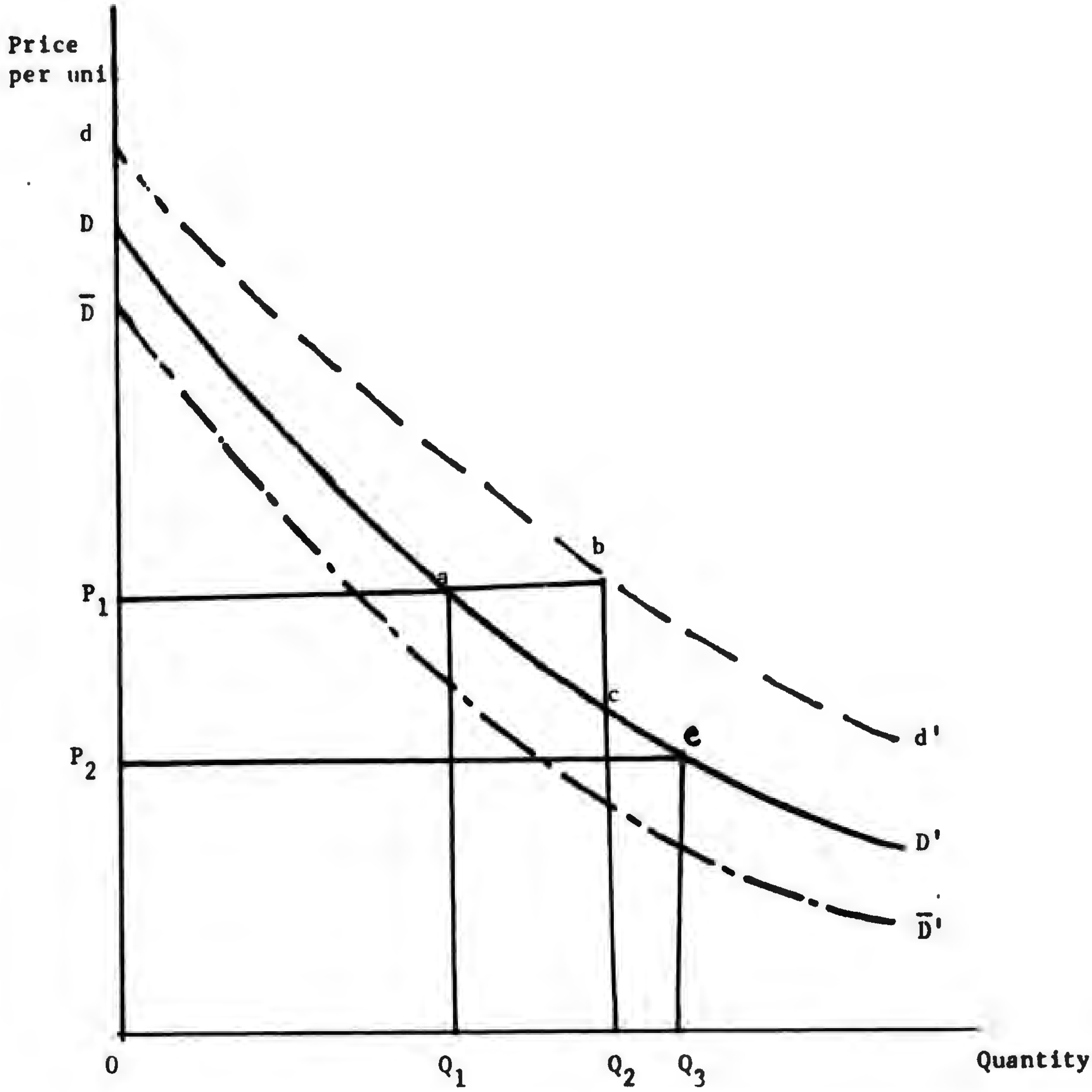

FIGURE IV - 1. The demand curve for a commodity for the provision of adequate recreation facilities.

To illustrate the importance of a change in the price of " substitute" or "complementary" goods, assume that the demand curve shows the number of visits that will be made to a particular park at different admission costs. Then suppose that a nearby park, that had been charging $3 for admission, lowers its price to only one dollar. There will now be fewer visits made to the original park, since some of those original visitors will be taking advantage of the lower price at the rival park. The demand for visits at the original park will fall from DD' to $\bar{D}\,\bar{D}$".

Alternatively, suppose the state institutes a special, low cost, bus service to the park. The price of a complementary good (transportation) has fallen, which will result in the demand for visits to the park increasing (DD" to dd').

A change in tastes will also lead to a shift in the demand curve. The rapid increase in the popularity of tennis during the past two years may not be possible to explain in terms of rising income alone. Education may increase the population's awareness of the benefits of active outdoor recreation which will lead to an increase in the use of facilities. Taste changes are particularly difficult to predict, but analysis of the relationship between such taste-determining factors as education, degree of urbanization, race, and age, and the frequency of visits, may yield useful information concerning the direction and magnitude of demand shifts resulting from taste changes.

What is the importance of identifying the demand curve for a recreation facility? The demand curve yields unique information concerning the value of a recreation site. Assume that the park facing the demand function DD' has sufficient capacity to handle Q_1 visitors in any one time period and that it ensures that no extra visitors enter by charging P_1 admission fee. The value of the resource is equal to the area under the demand curve between 0 and

Q_1, or DaQ_1O.[1] The reasoning behind this assertion is that the height of the demand curve measures the value of the marginal visit--i.e., it was not until the price was lowered to that particular level that the visitor was prepared to spend his or her money on a visit to the park; any slight increase in the price would deter the marginal visitor and the money would be spent elsewhere.

Estimates of the demand curve, therefore, enable the analyst to place a dollar value on the recreation site. It is also possible to use the functional relationship between the number of visits and the price to evaluate the benefits that expansion of capacity would create. If capacity at the park is increased from Q_1 to Q_3, allowing the admission price to be reduced to P_2, then the value of the additional space is aeQ_3Q_1.

Unfortunately, the information needed to estimate the demand function is rarely available. Most recreation sites have no admission charge, and those that do have an admission charge have not changed it sufficiently to provide enough variation to estimate a demand curve.

Models that allow a prediction of facility use, the quantity demanded, do not estimate the demand for recreation, and, therefore, do not provide a way of directly estimating the value of a recreation site or the value of any recreation investment. Instead, they show the relationship between a change in facility use and a change in one of the determinants of the position of the demand curve, perhaps income, providing the price of the recreation opportunity remains constant. For example, the models might be used to predict that, for an estimated growth in income the number of visits made to a particular site will increase from Q_1 to Q_2.

In Part(1) below, the site specific user models are briefly reviewed, and in Part(2) population specific models are discussed.

(1) Site-Specific User Models

Models of this form are based upon surveys made at particular recreation sites -- a National Park, a forest preserve, or a lake. The socioeconomic characteristics of the visitors are correlated and sometimes compared with the general characteristics of the population at large.[1] Such work may provide the manager of a site with some feel for the type of people that visit his facility, and, therefore, an intuitive indication of the additional equipment that might be needed. However, there is no capacity for accurate prediction of the number of visitors and no ability to assess the value of the site.

If information on the distance that the visitors have travelled is also collected, then the survey results can be used to estimate the demand curve for the facility (see the following chapter). Some useful insight into the tastes of the visitors can also be obtained (see King (1968), and Burch and Wenger (1967)), by asking them to evaluate certain aspects of the recreation experience. But, the approach has little to offer for the larger question of determining the optimum level of investment in the site (some of the practical applications of a user survey are discussed below in Chapter VII).

(2) Population-Specific User Models

A more fruitful approach is to survey a sample of a population area, since this includes information both on the users of recreation sites in the area and on the non-users of the recreation sites. With this information, the socioeconomic characteristics of the respondents can be related to their participation

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1 Studies based upon this type of model include: Davis (1967); Burch and Wenger (1967); Fisher and Krutilla (1972); Hendee, Cotton, Marlow and Brockman (1968); King (1968); Krutilla and Cicchetti (1972); Lucas (1964): and Stankey (1964).

rate in selected activities, which allows the identification of some of the determinants of the position of the demand curve for a recreation site. This provides useful additional information to the actual demand estimation described in the following chapter.

Data collected under the stimulus of the Outdoor Recreation Resources Review Commission reports that were published in 1962 provided the basis for a large number of reports (discussed in Cicchetti, (1972)). The first analysis was a preliminary report by Proctor (published as an Appendix to ORRRC report No. 19). He estimated the correlation between certain socioeconomic factors and four factors which represented weighted participation rates in groups of outdoor activities. Using another survey, Mueller and Guerin constructed a participation scale which was used as the dependent variable in a series of regressions in which various socioeconomic variables were used as the independent variables, including income, occupation, education, vacation time, location, sex, age, and race. Only 30 percent of the variation of the dependent variables were explained in most of the regressions.

A problem that immediately presents itself in analyses of this sort is the form of the dependent variable. Because of the large number of non-participators, the linear regression model will often be inappropriate.[1] To overcome this, it is possible to use a two-stage technique. The first stage consists in clustering the observations into groups and calculating the cell mean of the particupation rate (from a 0, 1 dummy, having the value 1 if the household participated in the recreation activity). This probability is transformed to reflect a normal distribution and then becomes the dependent variable in a standard linear regression with the socioeconomic variables of the group as the independent variables.[2] In the second stage, the number of days spent at

1 See Goldberger, A. S., (1964)

2 The technique is discussed (but not used) by Cicchetti et al.(1968) and used by Tadros and Kalter (1971).

the recreation activity by participators is regressed against the socioeconomic variables. The model estimates first the probabilty that a household of a certain type will participate in a given activity and, second, the number of days that it will spend. This provides the planner with an accurate way of predicting, for any given population, what changes will occur in participation rates following a change in the socioeconomic characterisitics of the base population. The modeldoes not allow an accurate prediction of the participation rate at a new facility since supply conditions are not explicitly included.[1]

The second problem that arises is the high degree of multicollinearity between the independent variables. Both income and education, separately, are probably influential in recreation decisions. However, they tend to be highly correlated, and, therefore, estimating their separate effect through regression analysis is difficult. One technique that has been used to overcome this problem is to cluster the observations by income and estimate separate regressions within each cluster (Tadros and Kalter (1971) and Tatham and Dornoff (1971)). Failure to account for this problem probably explains the conflicting results concerning the relative importance of race, education, and income in several studies.[2]

Perhaps the most important problem with these types of models has been the omission of any information concerning the cost of recreation trips. If the cost of reaching a recreation lake is different for low-and middle-income households, then different participation rates in the two groups would be

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1 A partial list of studies attempting to explain participation rates includes Cesario et al.(1969); Cicchetti (1969) and (1972); Cicchetti et al.(1969); Davidson et al.(1964); Evans and Van Doren (1960); Gillespie and Brewer (1968); Hauser (1962); Lindsay and Ogle (1972); Arthur D. Little (1962); Mueller et al.(1962); NRPA (1963); Pankey and Johnston (1969); Proctor (1962); Seneca et al.(1968).

2 For a brief discussion, see Cicchetti (1972) and Cheung (1969).

expected even if there were no difference in the position of the respective demand curve Referring back to Figure IV-1, if two communities of equal size both have demand curves represented by the line DD', but the low-income group faces a higher travel cost, equal to P_1, while the travel cost of the middle-income group is only P_2, then the middle-income community will make Q_2 recreation trips, while the low-income groups will only make Q_1 visits. This consideration might explain the discrepancy between the findings of several studies in which income was an important determinant [1] and the study of Lindsay and Ogle (1972), in which income was not found important. The latter study, in Weber County, Utah, was in an area where recreation facilities were readily available close to an urban area for all income groups.

Cicchetti et al.(1969) and Seneca et al.(1968) argue that where no direct measure of accessibility of recreation opportunities is included, then what is estimated is a reduced form parameter which

> ...can be thought of as an economic multiplier depicting the total change in the dependent variable, e.g., recreation days, that result when the independent variable is changed, e.g., acres of recreation water.[2]

While this correctly describes the nature of the model, it does not remove the problem. The difficulty is essentially that there is no way to separate the effects of a change in the supply curve and a change in the demand curve. Kalter and Gosse(1970) summarize (p.44):

> Models which ignore the identification problem, whatever its source, do not provide adequate information on effective demand and willingness to pay. Public resource allocation cannot, therefore, be aided by either economic efficiency or equity criteria.

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1 For example, see Mueller and Guerin (1962), Hauser (1962), Burch and Wenger (1967), U. S. Forest Service (1969).

2 Cicchetti et al.(1969), p. 64.

A number of attempts have been made to overcome the shortcomings of the simple model. Ullman and Volk (1962) found that distance was significant in explaining the participation at particular recreation sites. However, when particular sites, rather than activities, are used, another problem arises. One of the determinants of how many times a given household will visit a particular site will be the number of alternative sites and their relative distances. The number of "intervening opportunities" will obviously be important.[1] A number of quite elaborate participation models using information on the distance to alternative sites have been constructed.[2]

Often the distance to the alternative site is negative (i.e. park visitors drive past other sites on their way to a park), which makes the simple intervening opportunities model difficult to apply. This may be due to the superior facilities at the further site or the higher density of visitors at the nearer site (Appendix E discusses the latter case). Grubb and Goodwin (1966) attempted to include qualitative measures of a site's attractiveness to explain this by using the size of the reservoir as one of the determinants of the number of visitors. Van Doren (1967 constructed an index of the attractiveness of recreation areas in Michigan for the same purpose, and Cicchetti et al. (1969) used a weighted list of the facilities at recreation sites (1969). The number of visitors at a particular site, therefore, depends on the characteristics of the population it serves and upon the attractiveness of the site itself, which is a function of its distance, the facilities that it offers, and the number of alternative sites nearby. The principle is very

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1 The principle of intervening opportunities was first formulated by Stouffer (1940) and later in (1960). For other statements of it and developments see Clark and Roeske(1969), Isard (1960), Olsson (1965), and Thompson (1967).

2 For example, see Ellis and Van Doren (1966).

similar to the laws of gravity, and models including these variables have been referred to as gravity models.[1] Predictions based upon this approach have tended to overestimate the number of visits from short distances and underestimate the number of visits from long distances [Wolfe (1972) and Wilkinson (1973)]. This has been overcome by including an inertia term which is analogous to a fixed cost associated with making a recreation trip that is independent of the distance travelled.

As an alternative to the gravity model, a number of researchers have developed predictive models based upon a systems analog.[2] Recreation trips are seen as an electric current flowing through a system of recreation sites, and being distributed through those sites depending upon the strength of the resistance (traffic congestion and site capacity).

Complex models provide a useful insight into the way in which a system of recreation facilities will be used, and also are useful in assessing the need for transportation facilities. However, prediction of the number of visitors does not provide the basis for estimating the value of an additional recreation site nor the benefits that would follow from expansion in the capacity of an existing site. This requires an understanding of the demand curve for recreation activities in an area, and information concerning the cost of travel so that predictions of the price at which recreation activities are available can be made. The work of Burt and Brewer (1971) in converting the basic gravity model into a means of estimating demand function is discussed in Chapters V and VII below.

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1 An excellent description of the gravity model is contained in Carrothers (1956), and a brief description, and comparison with the systems analog model provided in Wilkinson (1973).

2 See Barton and Schechter (1973) and Ellis (1966).

Chapter V

THE ESTIMATION OF THE DEMAND FOR RECREATION

All the business of life
is to endeavour to find
out what you don't know
by what you do.

Duke of Wellington, 1855

In the previous chapter, methods of estimating the number of trips that are made to a recreation site were discussed. Such estimates do not place a value on a recreation area. The implication is that such values can be calculated through the use of planning prices placed upon estimated visits. Planning prices are, however, highly subjective, and the cost effectiveness of a site, measured in this way, is very sensitive to the level of planning prices selected. Some method of using the actual value that the site users placed upon the visit would be preferable. Questionnaires may be unreliable because of the freedom that they allow a respondent. When determining his actions, the respondent must obey the constraints placed upon his activities by his income and prices of goods and services, but he faces no such constraints when filling out a survey. What is required is an estimation of the demand schedule for the recreation site--the relationship between the cost of admission to the site and the number of visits. Since prices are only nominal or more often zero for many outdoor recreation sites, there is no direct way of obtaining this information.[1]

Following the suggestion of Hotelling[2] that differences in distance travelled to a facility represented different costs of access, Trice and Wood (1958) published a study that formalized this idea. They grouped visitors into zones from which travel costs to a facility were similar (see Fig. V-1). They then calculated the cost per visitor day for each visitor within each zone, using information on distance travelled, average travel costs per mile, time spent in the area, and the number in each party. To compute the

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1 Wantrup (1952) suggested that experimental pricing policies be tried in certain recreation areas in order that this information would become available.

2 In Prewitt, Op. Cit.

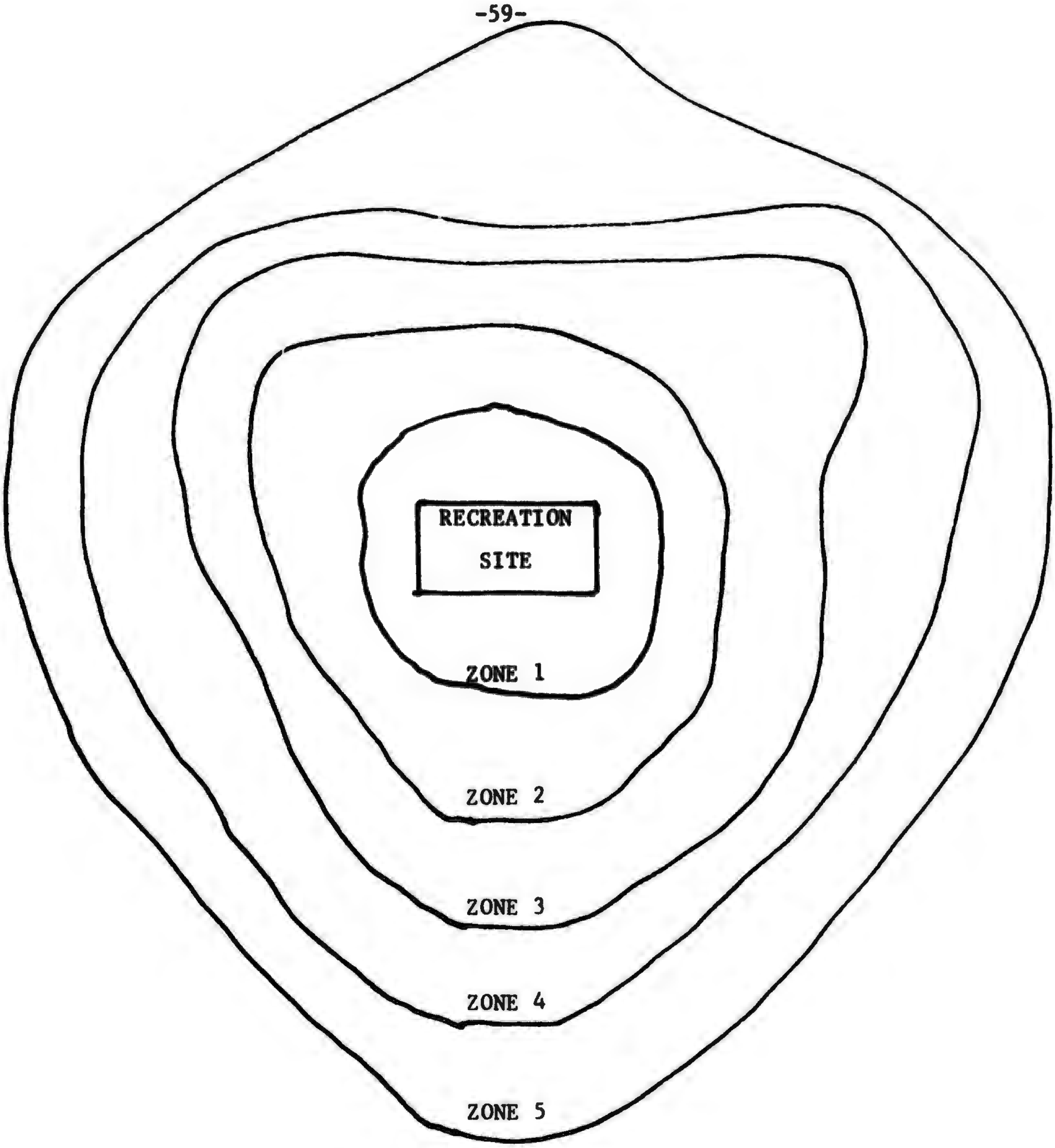

FIGURE V-1. Travel zones surrounding a recreation facility value of the facility, they assumed that the most expensive 10 percent of the visits from any one zone (in terms of travel costs per visitor-day) were marginal in that the visitors earned no benefit over the costs incurred. All other visitors from that zone earned a benefit equal to the difference between what they spent on travel and the costs of the marginal visitor. By summing over all visitors within each zone and between zones, a total "benefit" for the site was calculated. However, they were not calculating the demand curve. It is not necessarily true that the difference in travel costs reflects the surplus value of the visit. In fact, the approach leads to an undervaluation of the consumer surplus. For example, if the range in travel costs in zone 2 is between ten and twenty dollars, the most "surplus" that a visitor might earn would be ten dollars. There may be other visitors from further zones who pay fifty dollars for each visit. Unless those who live near the park, place a much lower valuation on visits, then some of those in zone 2 must earn at least forty dollars in "surplus."

The refinements necessary to allow the derivation of the demand schedule for the facility from the information on travel costs were provided one year later by Clawson (1959b). He computed the visit rate (per 100,000 of the population in each zone) from each travel zone. This he defined as the demand schedule for the entire recreation experience. Then, by assuming that not only were people homogeneous with respect to tastes for recreation and income within each zone (as Trice and Wood had done) but also were homogeneous between zones, he used the functional relationship between visit rate and travel costs to estimate the number of visits that would be undertaken at different admission prices. The technique may be summarized as assuming that an admission charge raising the visit cost from zone 1 to the pre-admission charge cost from zone 2 would lower the visit rate in zone 1 to the pre-admission charge rate from zone 2. In this way, the visit rate in each of the zones for a range of

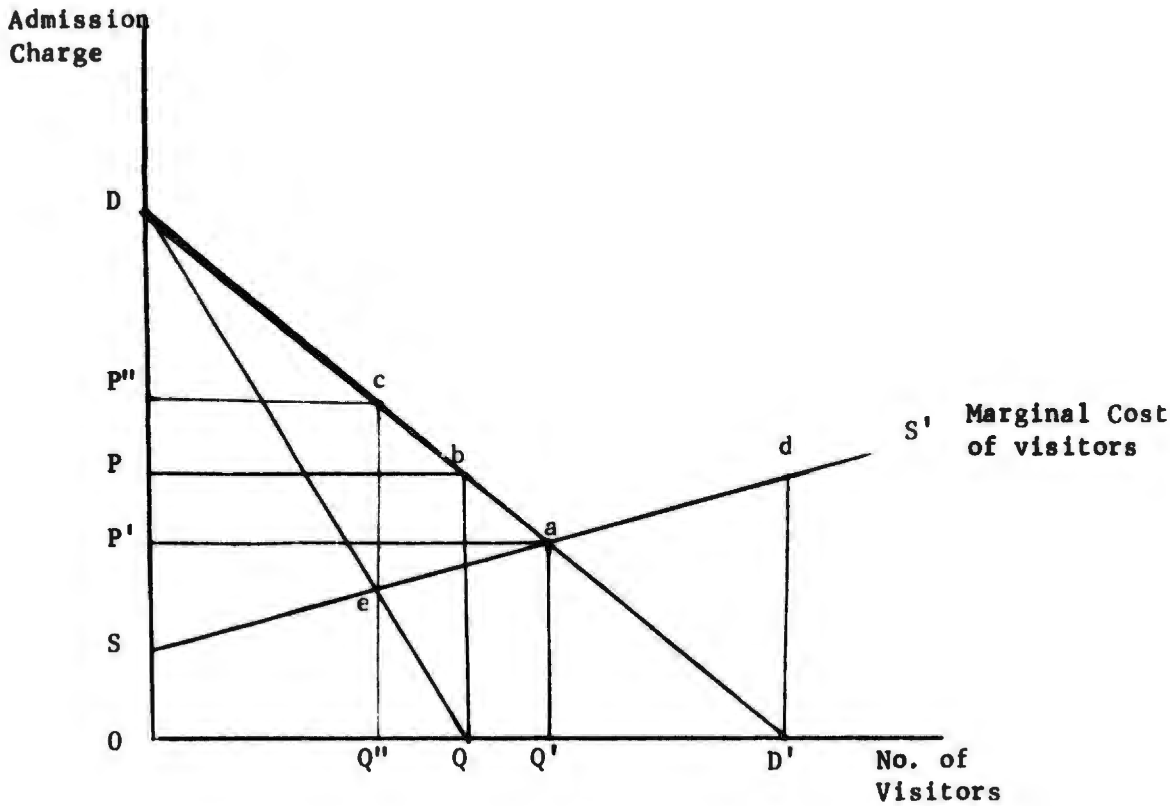

FIGURE V-2. The demand for a recreation site and the measurement of total benefits.

charges is calculated; and, by multiplying by the base populations, the total number of visits at each admission price is estimated. This gives the demand function relating visits, V, to admission price, P, which is represented by the curve DD' in Figure V-2.

There was, initially, some debate over the way in which the demand curve should be used to derive the value of the recreation site. Clawson(1959b) argued that the maximum revenue that a non-discriminating monopolist could raise represented the benefits to the consumers. This would be obtained by charging a price that reduced the number of visitors to that point where the marginal revenue of the last visitor (derived from the marginal revenue schedule DQ in Figure V-2) was equal to zero. This would imply price OP, giving the benefits as PbQO. This position was also taken by Stevens (1967) and Castle and Brown (1964).[1] Knetsch (1964) believed that the entire area under the derived demand schedule measured the benefits attributable to the park, DD'O. Seckler (1966) argued that there is a resource cost associated with visits to a recreation area (SS' represents the marginal costs of providing facilities for additional visits) and that the benefits must be measured net of these costs.[2]

Recent restatements of the basic postulates of welfare economics have stated that the benefits and costs associated with an activity can be measured directly from the demand and cost curves -- the height of the demand curve measuring the value of an extra unit of the commodity to the consumer, and the marginal cost curve measuring the cost to society of providing an extra unit.[3] Following this, the net benefit associated with the provision of a recreation facility would be DaS

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1 However, in his preface to the third printing, in 1970, Clawson admitted that, if he were to rewrite the article, he "...would apply more carefully the concept of consumer surplus."

2 For a clear statement see Harberger (1971). Seckler(1966) wanted the demand function adjusted by the decline in marginal utility of income, but Harberger opposes this.

3 See Figure V-4 below for an analysis of Seckler's objection

if the resource were priced at marginal cost (OP'), with P'aS earned as producer surplus (the difference between the cost of running the park for a year and the revenue collected), and P'aD enjoyed as pure consumer surplus.[1] In a static society, this measure of benefit, divided by the rate of time discount, can be compared with the present capitalized value of the costs of setting up the recreation area. If the resource is not priced at marginal cost, but instead is open with free admission, then the annual net benefits are reduced to DaS -- adD'. This is because, for each of the additional visitors attracted by the absence of admission charges, the cost of providing for the visit exceeds the value of the visit ; aD'Q' represents the total value of the extra visits, while adD'Q' is their resource cost.

This method of measuring benefit can be illustrated with reference to indifference curve analysis. In Figure V-3, income is measured on the vertical axis and recreation days spent at a given site on the horizontal axis.[2] U' and U" are two indifference curves in the consumer's indifference map, with U" representing a higher level of welfare than U'. The consumer has income OY, and faces fixed costs YT_x before he can start consuming recreation days, whose costs per day are represented by the slope of the budget frontier T_xR_x. The consumer maximizes his level of welfare by spending OQ_x days at the recreation site, spending T_xV_x in so doing in daily expenses, and YT_x in fixed costs (including travel expenses, etc.). The area under a consumer's demand curve, measured by the Clawson method, is equal to the amount that could be added to the consumer's fixed costs, so as to leave him indifferent between spending recreation days at the site

1 This is only true if DD' is the <u>true</u> demand curve--see discussion and Figure V-4 below.

2 This exposition is based upon the work of Pearse (1968).

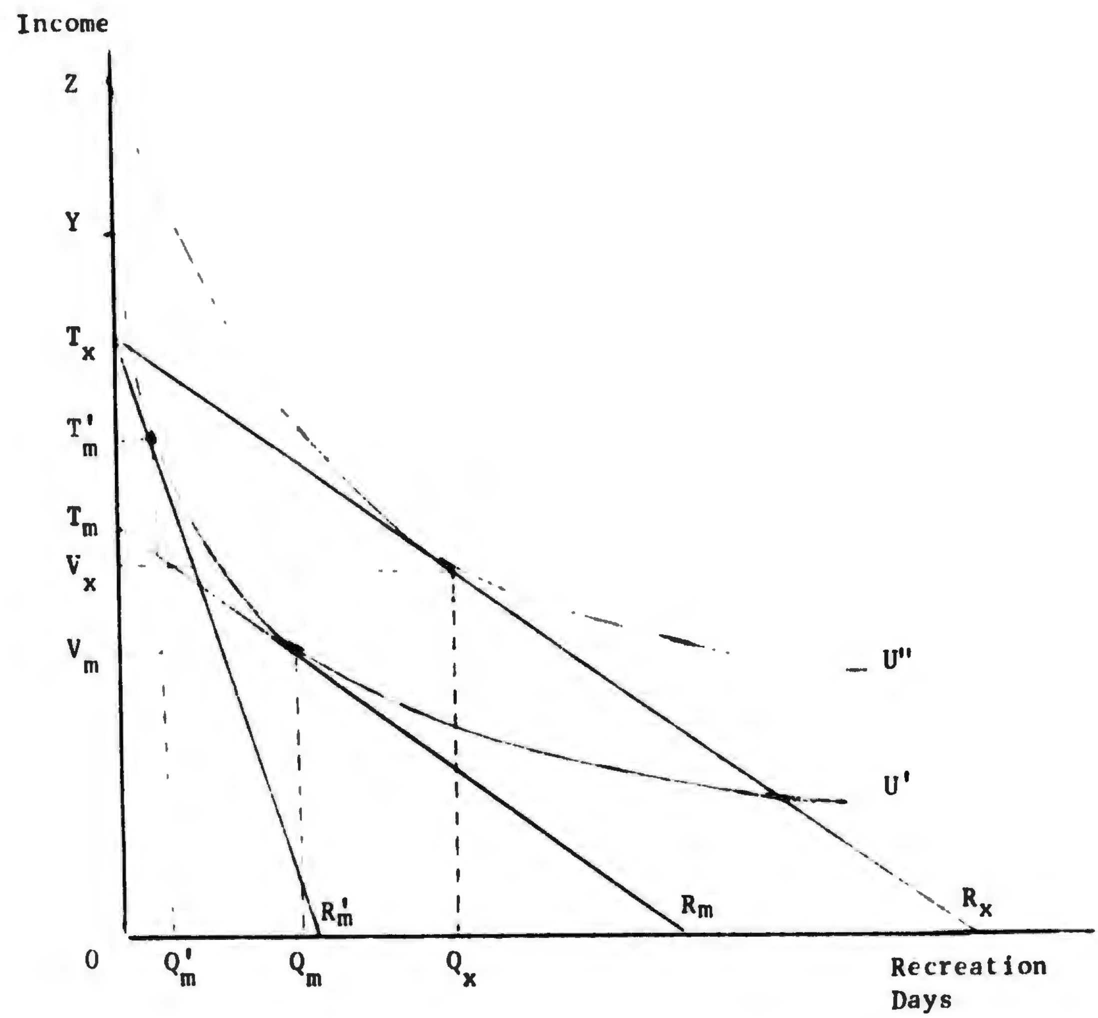

FIGURE V-3. Consumer surplus and recreation visit pricing[1].

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1 (Based on Pearse, 1968)

and not spending any, and is the distance T_mT_x in Figure V-3. This is the same as the "equivalent surplus" identified by Hicks. YZ measures the amount that it would take to bribe the consumer to abstain from recreation activity (Crutchfield suggested using this bribe as a measure of the equivalent surplus (1962)). The slope of the line $T_xR'_m$ represents the maximum price per day that the consumer can be charged to leave him indifferent between spending some or none of his days at the recreation site. It is important to notice that the Clawson approach implies that the addition to visit cost be in the form of a component of fixed cost rather than a component of variable cost. Any increase in variable cost will not only reduce the number of visits but also affect the duration of each visit, and since Clawson estimated costs as costs per visit, he was implicitly excluding this form of substitution. The price on the vertical axis must be interpreted as a price per visit rather than a straightforward admission charge.

This, then, is the simple model, and it has been the basis of a large number of studies.[1] It has remained subject to several criticisms which are discussed below.

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1 Following is a partial list of studies that have been undertaken using this methodology, although in some of the cases a slight modification may have been incorporated by the investigators Boyet and Tolley (1966); Common (1973); Dauite (1966); Knetsch (1964); Lerner (1962); Mansfield (1971); Merewitz (1968); Scott (1965); Smith (1970 and 1971); Smith and Kavanagh (1969); Spargo (1964); Stevens (1966): and Wood (1961).

(1) The Estimation of Travel Costs

The estimation of the demand curve derived from travel expenses is obviously highly sensitive to the way in which travel costs are computed. There are several components to travel costs. First, the direct travel costs, including plane, train, bus, or auto expenses (gasoline, oil, depreciation, and tolls). Second, the incidental expenses-- hotel, motel, and meal costs. The latter should properly enter as the difference between the costs of these goods and services on the road and their costs if produced in the consumer's own home. Since most analyses have entered these costs "gross" rather than "net" this has led to a considerable overstatement of their value. As if to counterbalance this excessive estimate, most studies have omitted the cost of time used in driving to the final destination, a criticism raised by Scott (1965).

The inclusion of travel time is both important and difficult, since estimating the cost of time attributable to the final destination is very elusive. What is theoretically required is an estimate of the value of the leisure time involved in the trip minus the utility gained during the journey (including subsidiary visits made, the pleasure of driving, etc.). Burton and Fuller (1968, p. 40) report on studies made in both America and Europe that indicate that a significant amount of driving is undertaken for pleasure alone. Norton (1970), on the other hand, reports the result of a survey of visitors to Snowdonia, in Wales, which found incidental benefits during the trip to be relatively unimportant. Mansfield (1971) attempted to overcome the cost-measurement problem by using perceived travel costs based upon the survey of visitors to a recreation site, arguing that:

> One is measuring "utility" in consumers' surplus calculations and therefore, should be valueing costs at what motorists think they are paying and not what they actually pay.

Smith (1970) used the central tendency of survey responses about travel costs as the measure in his study. As Common (1973) points out, this implies that the consumer is able to violate his budget constraint. He attempts to circumvent the problem by calculating the cost of time endogeneously while estimating the demand function. He does this, basically, by choosing the value of the cost of time that best predicts the number of visits from all classes when the demand function is estimated. His results indicate that the motorist gets positive net utility from the trip itself. If this is true for all recreation-directed trips, then the overstatement of the costs by adding full motel and meal costs becomes very important, and the elasticities of the demand curves for unique National Parks derived by Clawson are greatly overestimated. The basic argument is that since the trip itself is an important part of the recreation experience, motorists would be deterred by high admission costs. Much more research in this area is necessary before confidence can be placed in the shape of the demand functions estimated this way.

(2) Homogeneity of Visits

Visits to a recreation site are not distributed uniformly throughout the year. The type of recreation services that an area is able to provide is a function both of the time of year (which affects the opportunity cost of time as well as the climate and the range of facilities open to the visitor), but also upon the number of other visitors using the site. The marginal social cost curve is not constant throughout the year because of different levels of congestion, and, therefore, using annual visits and marginal costs is unlikely to give a satisfactory measure of the annual net benefits necessary for an accurate cost-benefit analysis.

This problem can be overcome by estimating a number of demand curves during the year; one for the busiest 10 percent of the visit days; another for the next 10 percent, and another for the remainder (obviously some understanding of the nature of congestion costs, and at what level they become significant, is important in disaggregating the market in this fashion). A diagramatic explanation of the importance of the separation of these two markets (basically, peak and off-peak) is shown in Figure V-4. DaDa' represents the total demand curve for visits during nine months of off-peak visits when there is no congestions problem estimated through the Clawson technique. DbDb' represents the true demand curve during the peak season when congestion is a problem. The curve gPC measures the private cost of congestion and, therefore, with no admission charge, there will be OQ visits. Since congestion is not included in the Clawson technique, OQ will be calculated as the number of visits at zero user charge. The total number of visits estimated through this approach at zero user charge will be ODa' + OQ', or PDas", adding the DaDa' curve to the DbDb' curve horizontally but at the wrong level. The estimated Clawson demand schedule is therefore Dbc'Dab" with PP' as the horizontal axis. Therefore, the Clawson technique leads to an under-estimation of the quantity demanded at each admission price. However, it can be shown that the area under the Clawson curve exactly equals the total value of the benefits bestowed by the recreation area upon users, net of congestion costs. Following the basic postulates of welfare economics,[1] total net benefits are equal to DaDa'O + DbfQ'O - geQ', where the last term is the social cost of congestion. The area under the Clawson demand curve is equal to DaDa'O +DbfP.

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1 See Harberger (1971).

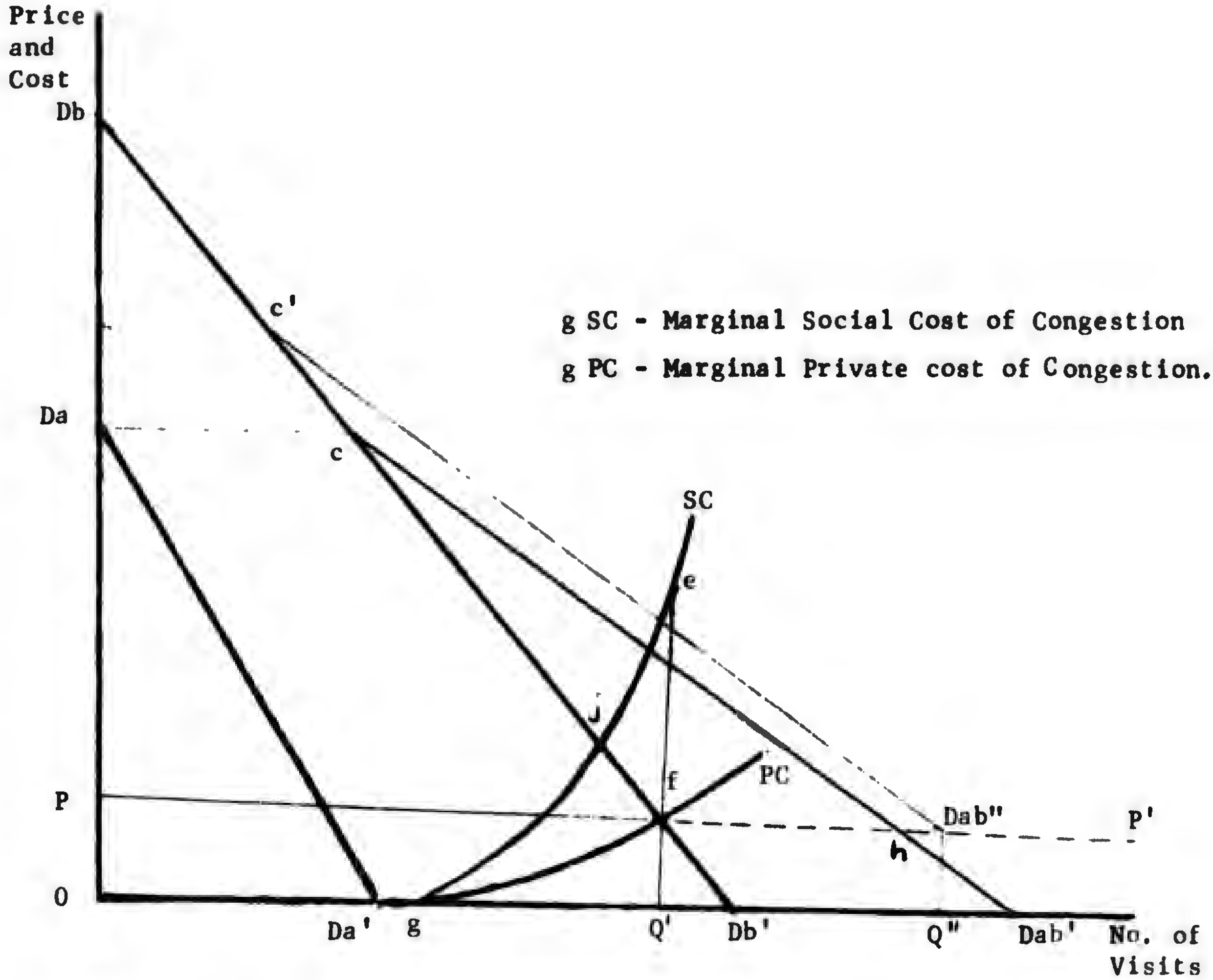

FIGURE V-4. Congestion and demand curve estimation.

However, since PfQ'0 is equal to geQ' (the sum of the private congestion costs is equal to the total social congestion costs), then the two areas are equal. The Clawson estimating technique provides an estimate of the demand schedule net of congestion costs, and therefore the objections raised by Seckler are not applicable. However, this does show that to be able to estimate the true demand curve, it is necessary to "disaggregate" into separate seasons.

Not only do visits differ according to the season, but also between visitors. Some may visit a park for only a few hours, while others may stay overnight (if there are facilities). By estimating an aggregate demand function, the same value is attached to a visit regardless of its duration. Estimating separate demand functions for different types of visits would obviously overcome this problem. Pankey and Johnston (1969) found that by separating visits to National Parks in California into day visits and overnight visits, the reliability of their model was increased. Failure to separate will lead to an overvaluation of the recreation area, since visitors from nearby are assumed to value a short day visit by as much as visitors from a greater distance value their overnight stay.

(3) Choice of Functional Form

Several studies have used the logarithmic transformation of the variables in estimating the demand function from travel costs. This has the disadvantage in that price tends to infinity as quantity tends to zero, which leads to an infinite consumer surplus. In order to avoid this, the rather arbitrary process of adding one to the quantity is chosen.[1] Common suggests that

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1 For example, Clawson (1959b); Mansfield (1971); Smith (1971); and Smith and Kavanagh (1969).

the surplus might be calculated up to that point where the partial derivative of the number of visits with respect to a change in the cost is very small, thereby ignoring a rectangle of benefits, which would be similar for all recreation sites examined; or, if the absolute level of benefit were important, then the logarithmic form should not be used, no matter how well it fits the data.

(4) Homogeneity of Base Populations

In order to be able to use the different visit rates from each zone to predict the way in which the visit rate from any one zone would change as the price of each visit was changed, it is necessary for Clawson to assume the populations in each zone are identical in their preferences for recreation. As Lessinger (1958) pointed out in his criticism of Trice and Wood, people who locate farther away from a recreation site may have less of a taste for that form of recreation than those who locate near the site. Therefore, their visit rate should not be used to project how the group located near to the park would respond to higher costs.

A fundamental problem of the Clawson method from the point of view of recreation planning is that it measures the unique demand curve for a single recreation site offering a particular range of recreational services and set in a particular socio-economic matrix. Clawson recognized this but argued that the value of a proposed project could be estimated by examining the estimates of demand functions for similar, already-existing, sites serving comparable socio-economic areas.

Several suggestions have been made to improve the estimation of the demand curve by including the socio-economic variables from each zone. Knetsch (1964) suggested the inclusion of average family income of each zone, in order to separate the impact of income from that of cost. While he argued that data would not be hard to collect, he was unable to include it in his analysis. In fact, the construction of the distance zones presents considerable problems in data assembly, since the zones rarely correspond to units for which aggregate data are readily available. Boyet and Tolley (1966) use states of origin of the recreationists rather than travel zones, since aggregate income and population data were available.

Pearse (1968) developed a technique of estimating the benefits of a site witho the necessity of constructing zones and using base population information. Instead, in an approach similar to Trice and Wood except using income classes rather than travel zones, he assumed that the most expensive trip (the furthest distance travelled) undertaken by a member of an income class represented the marginal trip, and that each other member of the class earned a surplus equal to the difference between what they spent on travel and the travel costs of the marginal visitor. By summing across income class, he was able to estimate the total benefits bestowed by the recreation area. While this greatly simplified the calculations, it reduced even further the generality of the model since visit rates were not estimated and, therefore, no extrapolation to a proposed area was possible.

Stevens (1966) extended the determinants of demand to include the quality of the recreation site (measured as the amount of effort needed to catch fish). Knetsch included the availability of alternative recreation sites in a theoretical discussion in 1963, but there had been no systematic framework created to include the availability of alternative opportunities and other advances which had been made in the area of consumption prediction until Burt and Brewer in 1971.

Recreation planning requires the ability to predict the number of visits at a planned recreation facility as a function not only of the cost per visit but also of all the determining socioeconomic variables and the availability of alternative recreation sites. With this information, an accurate evaluation of the expected benefits can be made to ensure the optimal provision of facilities. This implies estimating an equation of the form

$$\Sigma_i V_i^j = f[C, Q_1, Q_2, \ldots Q_n, S_1^j, S_2^j, \ldots S_m^j, P_1^j, P_2^j, \ldots P_k^j, P^j],$$

where: V_i^j is the number of visits to the recreation site in the ith season from the jth zone; C is the admission charge to the facility; Q is a vector of the particular services and their level offered at the site; S^j is a vector of the socio-economic characteristics of the population of the jth zone; P_k^j is a vector of the prices of recreation alternatives in the jth zone; and P^j is the travel cost to the site from the jth zone.

Once this function is estimated, the value for any proposed site can be computed by assigning the appropriate values to the vectors. This formulation also indicates the type of data necessary to estimate the function. The simplest form of data would be the results of a household survey in which the number of recreation days spent at different sites together with information concerning the location and income of the household. From this, the vector of prices of alternative recreation sites can be computed and the price elasticity of demand for the proposed site estimated.

This is basically the approach of Burt and Brewer (1971). Their dependent variable was the number of visitor days spent at a particular site.[1] The net benefits from constructing an additional recreation facility was

$$NB = 1/2[P_o' BP_o] + a'P_o - 1/2[P_1'BP_1] + a'P_1$$

where P_o and P_1 are the vectors of prices at existing facilities before and after the construction; B is a vector of the gradients of the demand curves; and a is a vector of the intercept terms. With sufficient data,

1 The use of visitor days poses considerable problems (see Chapter VII below).

the demand functions for existing recreation facilities can be estimated simultaneously, from which can be derived the demand function for an additional facility.

This type of model is the most promising development as a tool for analysing the efficient allocation of resources for recreation, since it allows an accurate measure of user benefits without the problems that have been outlined above. It is discussed in more detail in Chapter VII below.

However, the benefits measured in this way do not include any of the non-user "spillover" benefits identified in Chapter II above. In the following chapter, the use of land values to measure these benefits is discussed.

Chapter VI

THE USE OF LAND VALUES

TO VALUE RECREATION SITES

... in designing a park in the environs
of a rapidly growing town, it is proper
to have in view as a secondary purpose
the general improvement of the neighborhood.

Frederick Law Olmsted 1871

(1) Introduction

Neither the attempts to predict consumption of recreation services nor the use of travel time to estimate the demand for a recreation site measure any of the external benefits discussed in Chapter II. The use of urban land values as a way of measuring the value placed by residents on the availability of a nearby recreation site is an attempt to overcome some of these shortcomings.

The underlying theory is similar to the theory of rent outlined by Riccardo one hundred and fifty years ago. He argued that land of superior fertility would earn a rent since it would yield a greater quantity of output for a similar quantity of seed and labor, and this rent would be capitalized into a higher selling price when the land changed ownership. This implies that the change in the fertility of the soil resulting from an irrigation project will be reflected in the change in the market price. Using this technique, several studies were made of irrigation projects.[1] Von Thunen showed that rent could be earned by land not only through differences in fertility but also because of locational differences; land nearer the market where produce was sold would command a higher rent than land further away, reflecting the saving in travel costs.

Conceptually, the increase in land values captures the benefits measured through the other techniques. Indeed, the use of commercial land values

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1 See Milliman (1959) and Schutjer and Hallberg (1968).

can also measure the business-value-added benefits discussed in Chapter III. Assuming that the commercial sector is competitive with no barriers to entry and that goods and services in the area can be supplied at constant costs (thus precluding any of the increased sales from being reflected in either monopoly rent or increased producer surplus), then the increase in the value of net sales will be equal to the increase in the value of commercial land.

The value of the travel time saved through living closer to a recreation site is reflected in the increased value of residential land near the recreation facility. This can be illustrated in a simple example: Suppose that everyone visits a recreation facility ten times each year and that the cost of travel (direct expenses plus the value of time) is five dollars per hour. In Figure VI-1, the recreation facility is located at 0 and the furthest distance travelled is one hour, measured along the horizontal axis. It is possible to measure the value of locating at any spot between the facility and one hour away in terms of the saved travel time. Locating next to the facility is worth one hundred dollars per year (ten trips, each having a round-trip cost of ten dollars) relative to locating one hour away, and, therefore, if the rate of time discount is 10 percent, a residential site at location 0 will be worth one thousand dollars more than a residential site one hour away. The curve DD' measures the premiums along a straight line from the recreation site. By summing all the premiums over all sites located within one hour of the facility, a total value can be calculated.

If the park also bestows certain locational externalities upon people living near it, a pleasant view and a sense of reduced density, for example,

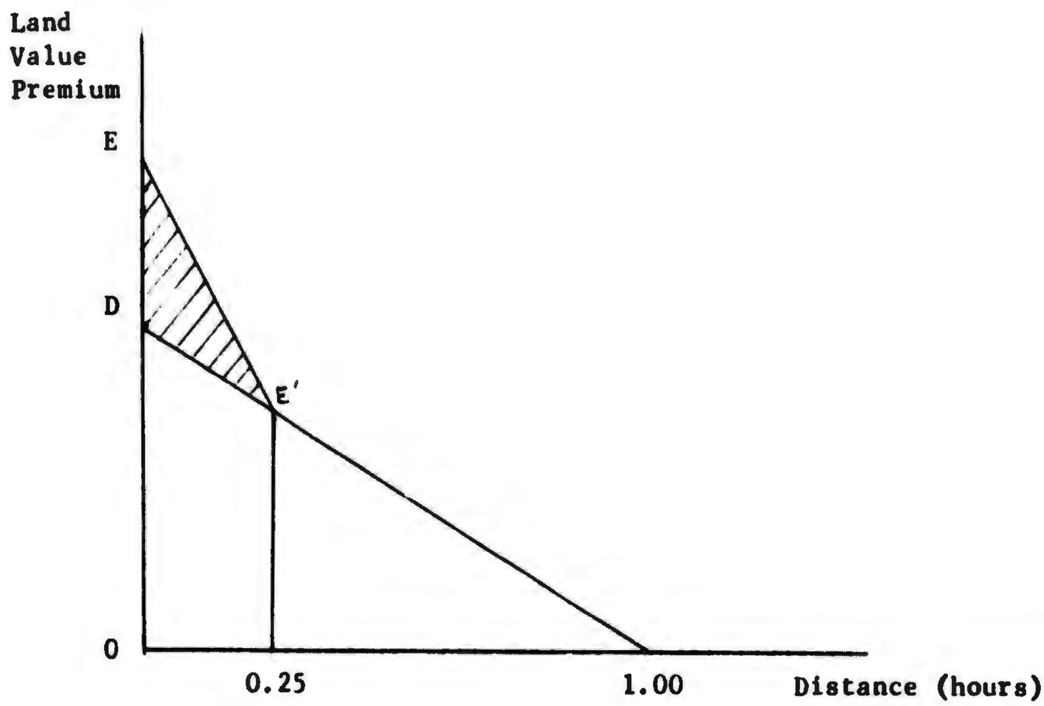

FIGURE VI-1: Land value premiums and location near a recreation facility.

then the premium paid to live within the area benefitting from these externalities will be above the level that the simple travel time calculation would predict. Assume that the value of these external benefits declines with time distance to zero at a quarter of an hour away. Then, the actual land premiums will be represented by the curve EE'D', and the land value approach will have captured the external benefits of the recreation site.

The use of this technique for National Parks is obviously limited because of the very large distances that users travel. To estimate the value of the Grand Canyon by regressing land values of the whole United States against distance from the Grand Canyon is unlikely to yield meaningful results, since there are so many determinants of the value of land other than distance from the Grand Canyon. The approach is useful for sites which have a relatively limited sphere of influence. Knetsch (1962) proposed applying it to recreation areas on the urban fringe, and there have been a number of studies embodying the basic methodology.[1] However, there has been no systematic attempt to use the technique to make cost-benefit studies of urban park systems because of the unavailability of data. The number of factors that can affect the value of a residence site is very large--the quality of the air, the quality of the neighborhood, crime, schools, the appearance of the block, the distance to the place of work, and the availability of shops, transportation, are just a few. Also, in an urban area there are very few transactions involving unimproved lots, and, therefore, property prices rather than land values must be used, which compounds the quantity of data needed.

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1 See Darling (1973), Grimes (1968), Hammer et al.(1971), Hendon (1973), Kitchen and Hendon (1967), and Weicher (1973).

None of the studies examined more than 10 parks, most examining only two or three.[1] Indeed, for some the results were not strong enough to allow more than tentative conclusions, or even to encourage more detailed research.[2] A much broader data base than that used in these studies is need to exploit the methodology to its fullest extent. Nevertheless, the use of land values as a way of measuring amenity value has proved attractive and widespread. They have been used to estimate the costs of air and noise pollution, to determine whether or not there is racial segregation, to isolate the impact of zoning, and to evaluate views.[3]

Recently, a number of objections have been raised against the use of land "premiums" around a site-specific amenity to estimate its value.[4]

The basic argument is that there is consumer surplus earned by

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1 Hammer et al. examined only one park, Darling examined three, Weicher four, Kitchen and Hendon one, and Hendon three.

2 See Hendon (1973) and Kitchen and Hendon (1967).

3 The bibliography is extensive. See respectively, Ridker, Ronald G., and John A. Henning, "Determinants of Residential Property Values with Special Reference to Air Pollution," Review of Economics and Statistics, 1967; McClure, P.T., "Indicators of the Effect of Jet Noise on the Value of Real Estate," Rand Corporation Report P-4117, 1969; Bailey, Martin J., "Effects of Race and Other Demographic Factors on the Values of Single Family Homes," Land Economics, 1966; Crecine, John P., Otto A. Davis and John E. Jackson, "Urban Property Markets: Some Empirical Results and their Implications for Municipal Zoning," Journal of Law and Economics, 1967; and Pollard, Robert, "The Value of Lake Michigan," Unpublished research, University of Chicago, 1974. This is only a partial list of a great number of studies.

4 For recent statements, see Freeman (1972 and 1973), Lind (1973), Rothenberg (1970), and Whitbread and Bird (1973).

residents located near an amenity that is not reflected in the increase in land or property values.[1] Consider a household determining where to locate relative to a park. For each few feet closer to the park that it moves, the value of the location increases (the household receives an incremental, or marginal benefit). Since property nearer the park is more expensive, the household must also pay an incremental premium (the marginal cost) to move closer to the park. The household will move closer to the park if the additional benefit exceeds the additional cost, and it will locate where the additional net benefit of moving closer is zero. This is illustrated diagrammatically in Figure VI-2. In Figure VI-2a, the PP' curve shows the price of a similar piece of property at different distances from a park situated at 0. The park has no value to a household located at more than OD_o feet away from its borders, and the property at this distance sells for OP" dollars. The difference between the height of the PP' curve and OP" measures the premium that must be paid to live at any given distance.

In Figure VI-2b, curve CD_o shows the marginal cost of moving closer to the park (from the right to the left). It is the first derivative of the PP' curve. The BD_o curve shows the marginal value placed upon an incremental move toward the park by a household. This household will choose to locate at a distance of D_1 from the park, since any further move toward the park will be valued at less than the additional cost that will be incurred. The premium at this location will be the area under the marginal cost curve between D_1 and D_o (ab in Figure VI-2a).

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1 For a full treatment of the relationship between land values and amenity benefits see Polinsky, A. Mitchell, and Steven Shavell, "Amenities and Property Values in a General Equilibrium Model of an Urban Area," Working Paper 1207-5, The Urban Institute, 1973.

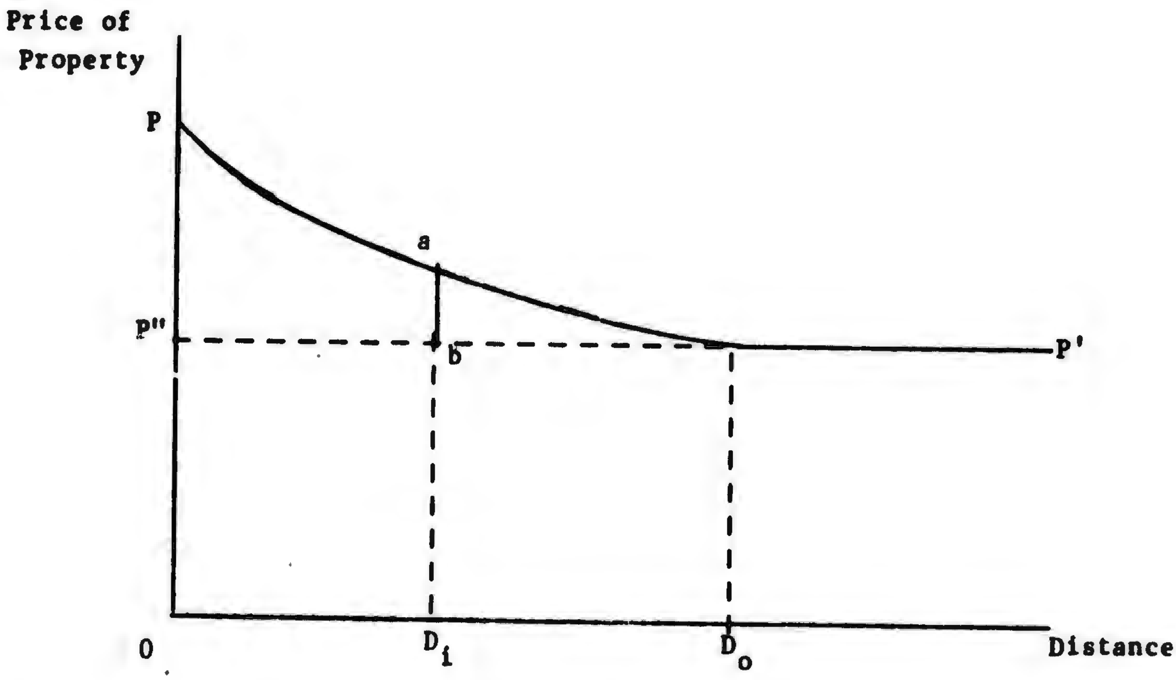

Figure VI-2a. Property values and distance to an amenity.

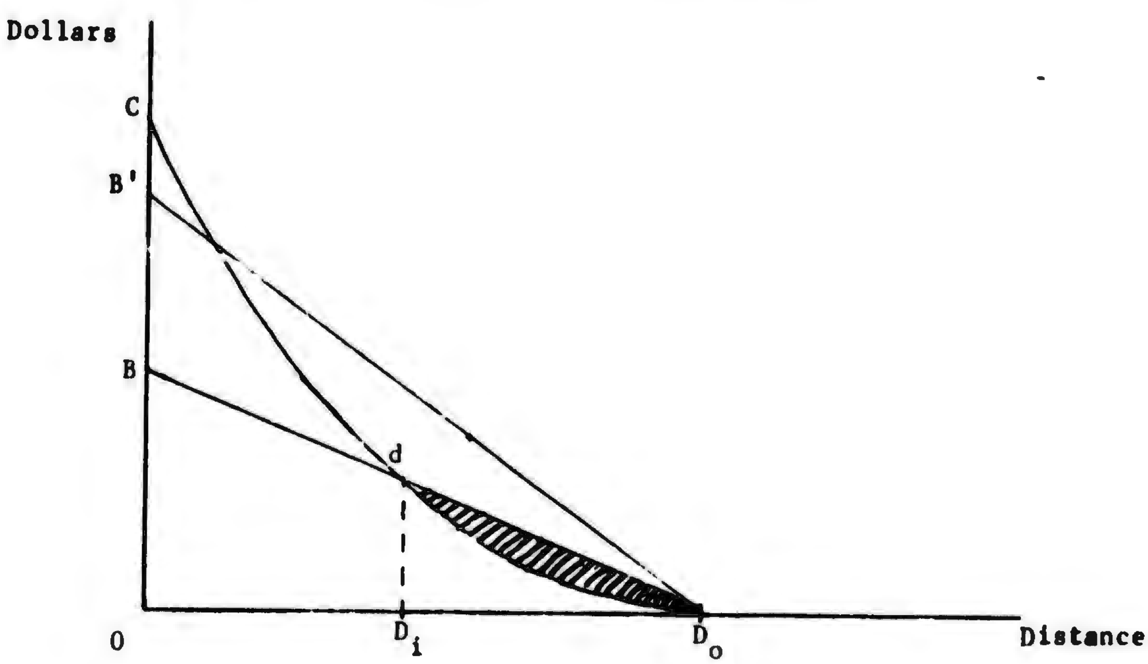

Figure VI-2b. Marginal cost and marginal benefit and consumer location.

The value of this location will be the area under the marginal benefit schedule, which is the triangle D_1dD_o. The premium therefore undervalues the value of the location by the shaded area. Any attempt to accurately measure the value of an urban park must include a measure of this "consumer surplus" that is enjoyed by those located nearby.

Only if all households are identical in their tastes, that is if they all have the same BD_o curve, will the property value premiums measure the full value of the location, since under this condition, the marginal cost curve will be coincident with the marginal benefit curve. In this case, households will be indifferent as to where they locate since they earn no consumer surplus.

If households do differ in their preference for nearness to a park, then the marginal cost curve will be determined by the interaction of the number of households with each BD_o curve (demand) and the number of residential properties available at each distance from the park (supply), and consumer surplus will be earned. The more sites that are available near a park in any given community, the lower will be the premium paid at each distance, since property values will have to be reduced to encourage those members of the community who value access relatively little to purchase the additional sites. This relationship is important because it provides a way of measuring the full value of property located near a park. In the model of household location set out in Part 2 below, it is shown that the marginal benefit of providing access to a park to one additional member of the community is equal to the average premium paid by those already living within D_o of a park in that community.

Another problem remains with the use of property values. At large distances from a park, the value of the park to residences is probably not zero, as is assumed in the following model, but is positive. Changes in observed property values are not sufficiently sensitive to measure these values however (Darling found no impact beyond 1500 feet, in the results below, no impact on property prices beyond 2000 feet from the park was discernible). This leads to an underestimation of the value of the park both because the value to those living beyond 2000 feet is omitted and because the estimation of the value to those living within 2000 feet is underestimated.

This is shown in Fig. VI-3. PP' measures the premium paid for location as a function of distance from a park located at 0. By assuming that there is no impact beyond 2000 feet, D_o, the premiums paid for locations are underestimated by OP'.

This problem can be overcome by estimating the number of visits made to the park by households as a function of distance (the methodology described by Clawson). In this way, the value of the park at each location (in terms of saved travel time) might be estimated yielding a declining premium curve

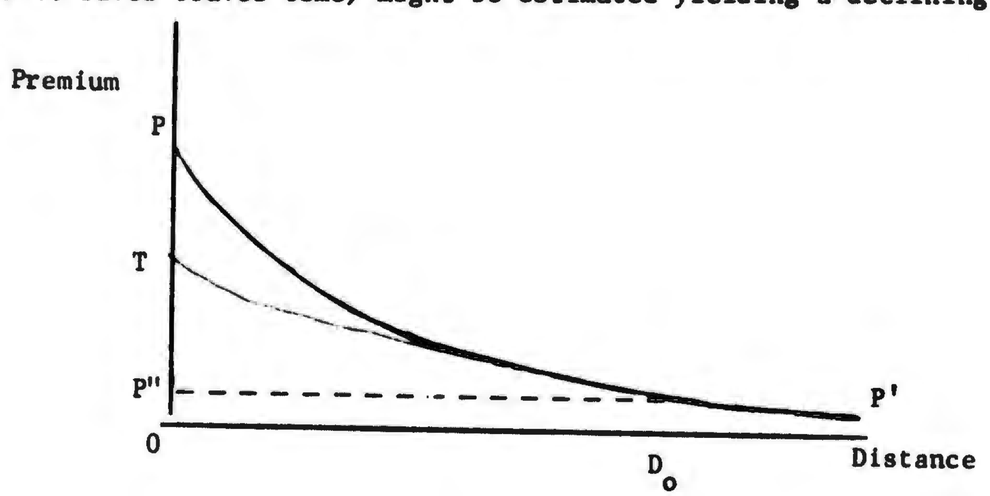

Figure VI-3. Premium and distance to park.

which is shown in Fig. VI-3 as the TP' curve. The difference between the TP' and the PP' curve is the non-user benefit at each distance. This allows an estimate of OP" to be made, and the value to all the members of the community to be estimated.[1] In order to minimize the importance of this "recreational demand" for the park in the empirical estimates below, only property surrounding small parks is considered.[2] There is some evidence that the number of visits to a small residential park by households located more than half a mile away is very low, so that the premium beyond this distance will also be low. However, no real measure of the importance of this underestimation can be made until data relating distance and the number of visits are available.

The theoretical model is described in Part 2, below. In Part 3, the model is estimated for the City of Chicago, and in Part 4, some possible applications for the City are discussed.

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1 This technique is discussed in Chapter V above.

2 A small park is defined as any park less than four city blocks in area (15 acres).

2. Household Location, Property Premiums, and Amenity Value

A. Preference Functions

Consider a community of N households located on lots of L square feet on a plain in which there are Q dimensionless parks providing benefits for those households situated within D_o feet of a park. Each household has a marginal benefit function, MB_D, as a function of distance, D, of the form,

$$(1) \qquad MB_D = U_D \left[1 - \frac{D}{D_o} \right]$$

where U_D is the marginal benefit at D = 0. In Figure VI-2b, the value of U_D for a household located at D_i is OB. The value of U_D reflects the importance of accessibility to a park in a household's preference function. This form of the function implies that the marginal benefit declines linearly with distance until it equals zero at $D = D_o$. The basic conclusion of this model is not dependent upon the assumption of linearity. The model does suggest a way of determining the appropriate functional form, which is discussed in Part 5 , below.

Preferences for accessibility to a park are assumed to be distributed evenly throughout the community, so that if all posssible values of U_D were ordered from U*, the maximum marginal benefit (at D = 0) of any household, to U', the minimum value, then a constant fraction, c, of the population would express each of the values. If m is the number of households living within D_o feet of a park, then

$$(2) \qquad N \int_{U_D = U_{D_o}}^{U_D = U^*} c \, dU_D = m \quad .$$

The total amount of land within D_o feet of a park is $Q\pi D_o^2$, and, therefore, the number of households able to live within D_o of a park, m, is given by

(3) $$m = \frac{Q\pi D_o^2}{L}$$

that is, the total land area within distance D_o of a park in the community divided by the land area per lot. The number of households located within distance D_i of a park, m_{D_i}, is

(4) $$m_{D_i} = N \int_{U_D = U_{D_i}}^{U_D = U^*} c \, dU_D = m \left[\frac{Q\pi D_i^2 / L}{Q\pi D_o^2 / L} \right] = m \frac{D_i^2}{D_o^2} .$$

Integrating,

(5) $$c[U^* - U_{D_i}] = \frac{m}{N} \frac{D_i^2}{D_o^2} .$$

Therefore, U_{D_i}, the value of U_D for a household located at distance D_i from a park, is,

(6) $$U_{D_i} = U^* - \frac{m}{Nc} \frac{D_i^2}{D_o^2} .$$

Substituting (6) into (1) the marginal benefit function of a household located at any distance D_i from a park is

(7) $$MB_{D_i} = \left[U^* - \frac{mD_i^2}{NcD_o^2} \right]\left[1 - \frac{D_i}{D_o} \right] .$$

B. Determination of Property Premium

The household locating at a distance of D_i feet from a park equates the marginal cost with the marginal benefit. Equation (7) defining the marginal benefit of a household also defines the marginal cost at D_i feet from the park. The full premium paid by that household, P_{D_i}, for their location is the integral of the marginal cost function between D_i and D_o (dD_oD_i in Figure IV-2b), or

$$(8) \qquad P_{D_i} = \int_{X=D_o}^{X=D_i} \left[U^* - \frac{mX^2}{NcD_o^2} \right]\left[1 - \frac{X}{D_o} \right] dX \quad .$$

At each distance there are $\frac{2\pi D_i Q}{L}$ residential lots, so that the total expenditure on premiums for park accessibility, $\overline{P}$, is

$$(9) \qquad \overline{P} = \frac{2\pi Q}{L} \int_{D_i=D_o}^{D_i=0} D_i \int_{X=D_o}^{X=D_i} \left[U^* - \frac{mX^2}{NcD_o^2} \right]\left[1 - \frac{X}{D_o} \right] dX \quad dD_i \quad .$$

Dividing by m to define the average premium paid , $\frac{\overline{P}}{m}$,

$$(10) \qquad \frac{\overline{P}}{m} = \frac{2}{D_o^2} \int_{D_i=D_o}^{D_i=0} \Big[U^*D_i^2 - U^*D_iD_o - \frac{U^*D_i}{2D_o}(D_i^2 - D_o^2) - \frac{D_i m}{3NcD_o^2}(D_i^3 - D_o^3)$$

$$+ \frac{D_i m}{4NcD_o^3}(D_i^4 - D_o^4)\Big] \, dD_i \quad .$$

Integrating and collecting terms,

$$(11) \qquad \frac{\overline{P}}{m} = \frac{U^*D_o}{12} - \frac{mD_o}{30\ Nc} \quad .$$

C. The Value of Parks

The value to the household of a location D_i feet from a park, B_{D_i}, is equal to the integral of the marginal benefit function between D_i and D_o (the triangle dD_oD_i in Fig. IV-2b). From equation (7),

$$(12) \qquad B_{D_i} = \left[U^* - \frac{mD_i^{\,2}}{NcD_o^{\,2}} \right] \int_{D=D_o}^{D=D_i} \left[1 - \frac{D}{D_o} \right] dD \qquad .$$

The total value of the park to those who live within D_o, $\bar{B}$, is the value of a location at distance D_i, multiplied by the number of lots at distance D_i, integrated over all distances. From (12), integrating,

$$(13) \qquad \bar{B} = \frac{2\pi Q}{L} \int_{D=D_o}^{D=0} D\left[U^* - \frac{mD^2}{NcD_o^{\,2}}\right]\left[(D - D_o) - \frac{1}{2D_o}(D^2 - D_o^{\,2})\right] dD \qquad .$$

Multiplying the right hand side by $\frac{mL}{Q\pi D_o^{\,2}} = 1$ (from (3)), integrating and collecting terms, gives

$$(14) \qquad \bar{B} = \frac{U^* D_o m}{12} - \frac{D_o m^2}{60Nc} \qquad .$$

The change in total benefits in response to a change in the number of households living within D_o of a park is the partial derivative of (14) with respect to m,

$$(15) \qquad \frac{\partial \bar{B}}{\partial m} = \frac{U^* D_o}{12} - \frac{D_o m}{30Nc} \qquad .$$

Therefore, the average premium paid for living within D_o of a park is equal to the marginal value of accessibility to one extra household (from equations (15) and (11)).

This is an important conclusion since it expresses benefits, which cannot be measured directly, in terms of premiums which can be measured.

(3) Estimating the Model

Equations (15) and (11) suggest a simple estimating equation for the model. However, since income differs between communities, and it was felt that this may affect the willingness to pay for accessibility to a park, one further assumption was made. It was assumed that U* was a function of the median income of the community, $\overline{Y}$, so,

(16) $U^* = \overline{U} + \sigma \overline{Y}$

From (11), the estimating equation was

(17) $$\frac{\overline{P}}{m} = C + \beta\overline{Y} - \alpha \frac{m}{N} + \mu$$.

where μ is a random disturbance term, and

(18a) $$C = \frac{\overline{U}D_o}{12} ,$$

(18b) $$\beta = \frac{\sigma D_o}{12} ,$$

(18c) $$\alpha = \frac{D_o}{30c} .$$

From estimates of these coefficients, the total value of the parks in a community and the value of an additional park can be calculated. For a community where $\frac{m}{N} = \frac{m_o}{N_o}$, the total value of open space, $\overline{B}$, is equal to (from (14)),

(19) $$\overline{B} = \frac{U^*D_o m_o}{12} - \frac{D_o m_o^2}{60N_o c} = N_o \int_{\frac{m}{N}=0}^{\frac{m}{N}=\frac{m_o}{N_o}} C + \beta\overline{Y} - \alpha \frac{m}{N} \, d\frac{m}{N} = (C+\beta\overline{Y})\frac{m_o}{N_o} + \frac{\alpha}{2}\left(\frac{m_o}{N_o}\right)^2 .$$

The value of an additional park, ΔB, that increases $\frac{m}{N}$ to $\frac{m_1}{N_o}$ is (from (15)),

$$\text{(20)} \qquad \Delta B = \frac{U^*D_o(m_1-m_o)}{12} - \frac{D_o(m_1-m_o)}{30N_oc} = N_o \int_{\frac{m}{N}=\frac{m_o}{N_o}}^{\frac{m}{N}=\frac{m_1}{N_o}} C + \beta\overline{Y} - \alpha\frac{m}{N}\, d\frac{m}{N} .$$

This is illustrated in Fig IV-4. DD' shows the relationship between the average premium $\overline{P}/m$, and the fraction of the population living within distance D_o, m/N. Equation (19) is the area DabO multiplied by N_o, while equation (20) is the area abcd multiplied by N_o.

In order to estimate equation (17), the average premiums in 12 Chicago communities were computed, together with the fraction living within 3 blocks and the median income per household. (Appendix A discusses the calculations.)

Estimates of the coefficients were, with the absolute value of the T-statistic in parentheses,

$\hat{C}$	=	-632.2	(0.833)
$\hat{\beta}$	=	0.1984	(3.069)
$\hat{\alpha}$	=	-1935.1	(4.912)
R^2	=	.7603 .	

These results are consistent with the hypothesis that households do differ in their preferences for location near a park, and also that there is segmentation in the residential property market to the extent that the average premium for living near a park is not equalized throughout the Chicago area. Figure VI-5 plots the values of $\frac{\overline{P}}{m}$ and $\frac{m}{N}$ for the 12 communities.

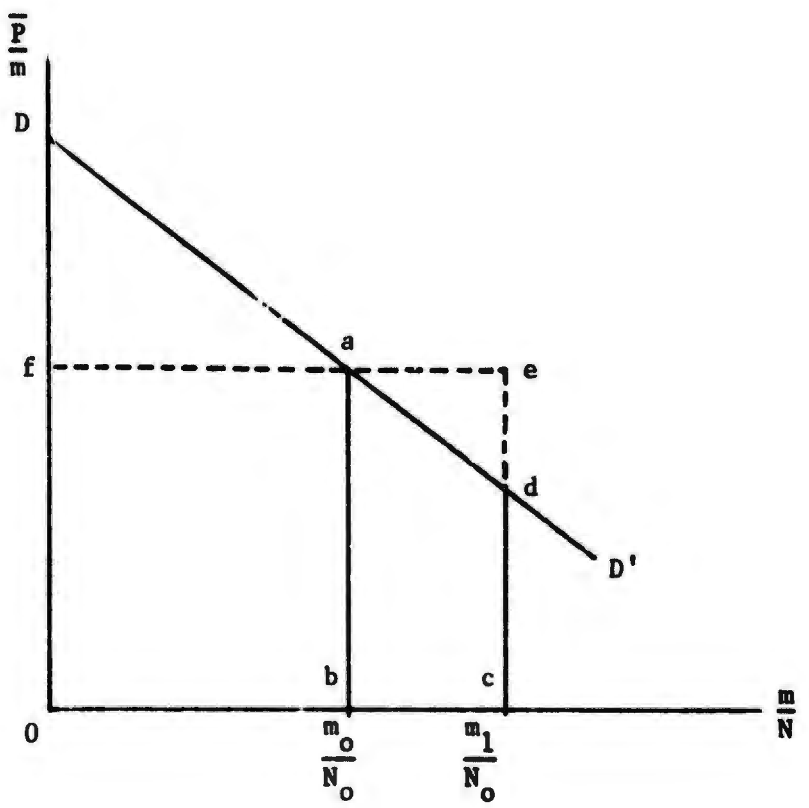

FIG. VI-4. Average premium and total value of open space.

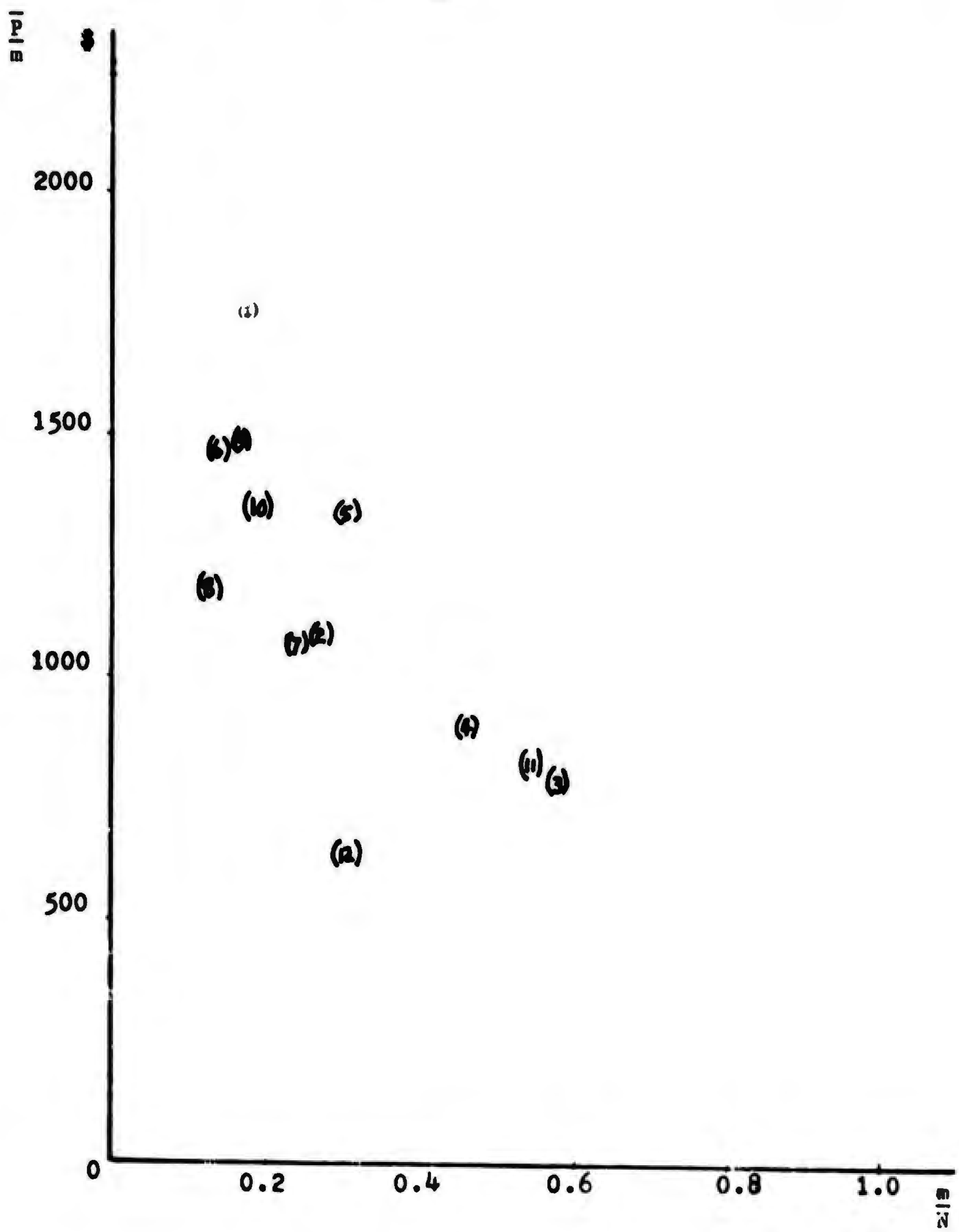

FIG. VI-5. Average premiums and fraction located near park for 12 Chicago Areas.

Equation (17) was also estimated with $[\frac{m}{N}]^2$ to test the appropriateness of the linear form. The coefficient of determination remained unchanged. The fact that the linear form seems to yield the best results is some justification for the assumption that the preferences are evenly distributed throughout the population, since it implies that $d \frac{\bar{P}}{m} / d \frac{m}{N}$ is a constant. To induce a given fraction of the population to locate near a park, the average premium must be reduced a constant amount.

Setting D_0 equal to 2000 and solving equations (18a) - (18c) and substituting the estimates of the coefficients, yields the following values for some of the parameters.

$\bar{U} = -3.7932$; $\sigma = 0.0011$; $c = 0.034$.

These figures imply that a community with an income of $3,500 or less will not be prepared to pay anything for a location next to a park. For each additional $1,000 of median income, the value of U^* rises by $1.1, and, the value placed on a location next to a park rises by $1,100 $[\frac{1}{2} .2000. U^*]$.

The value of c implies that each dollar value of U_D will correspond to the preference function of 3.4 percent of the population. In a community a median income of $12,?00, for example, 3.4 percent will value the marginal benefit at D=0 at $10, 3.4 at $9, and so on. Only 37.4 percent will place a positive value on location near a park. Only 3 of the 12 communities had such a high fraction within 3 blocks of a park, and the average premiums were very low. However, this result would seem to underestimate the fraction of the population that places a positive value on accessibility to a park. One possible explanation may be that the distribution of preferences is not evenly distributed throughout the population, but that c rises for each fall in U_D.

(4) Applications

The results of estimating the model set out in Part 2 above allow the estimation of the optimal supply of open space in an urban residential area, and the estimation of the value of an additional park. This section explores the empirical implications of the estimates made above.

Consider a community of 15,000 households, situated on land worth $200 per front foot, at a density of 69 households per block, and with a median income of $12,000. These figures are consistent with sample data collected within the City of Chicago. Assume that each park is one city block (560 x 265 feet, or about 3.5 acres) in area and that 1,500 households are able to locate near each park (i.e., 25 full blocks, which allows for non-residential zoning of some of the nearby blocks--the average number of full residential blocks near 5 single block parks in Chicago was approximately 23). The provision of each park therefore raises $\frac{m}{N}$ by 0.1. The cost of a park is the land, the cost of development, and the capitalized value of maintenance costs. There are approximately 1120 front feet per block, so that the land cost is $224,000. Development costs are estimated by the Chicago Park District at $178,000 per acre, or $623,000 per 1 block park. Maintenance costs are estimated at $22,000 per acre, per annum, or, assuming a 10 percent time discount rate, the present value of the future costs is $770,000. The cost per park is therefore $1,617,000, or $1,078 per household.

Substituting the values into (19) yields a value of 0.35 for $\frac{m}{N}$ at which the marginal cost of supplying another household with accessibility to a park equals the marginal benefit. This implies a supply of 3.5 parks or 12.25 acres, or about 0.8 acres per thousand households. (This analysis assumes that converting land from residential to recreational use has no impact on the value of land.) This conclusion cannot be used to determine the optimum supply of parkland in the entire city, since only that open space that serves as a residential amenity rather than a recreational amenity is considered. Other parkland to satisfy the recreational needs for a community is necessary, as well as the local "open-space" parkland.

By regressing front foot value on site amenities, including median income, a measure of the change of park supply costs in response to a change in the median income of the community can be obtained. The coefficien indicates that an increase in the median income of $1,000 would raise front foot values by $30, raising the marginal costs of a park by $22.4 per household. The value of parks has also increased, and the new value for $\frac{m}{N}$ is 0.44, or approximately one acre per thousand households.

Some measure of the undervaluation that results from simply using the premiums actually paid can be gained from this example. The total value of the 3.5 parks for the community with an income of $12,000, from the traditional land value approach, is 0.35(15,000).1,078 = $5,659,500. The true value of the parks, $\bar{B}$, from equation (19),

$$(21) \qquad \bar{B} = N_o \left[(C + \beta \bar{Y}) \frac{m_o}{N_o} - \frac{\alpha}{2} \frac{m_o^2}{N_o^2} \right] = \$7,410,000 \; .$$

The value of an extra park, from (20), is

$$(22) \qquad B = N_o \left((C + \beta \bar{Y}) (0\ 1) - \frac{\alpha}{2} (.08) \right) = \$1,461,900 \; .$$

If calculated from the average premium paid, the result would be $1,617,000.

In only three of the twelve communities identified is the supply of open space above the optimal computed by this method ((3),(4), and (11)), in one it is exactly optimal (12), and in the remaining areas it is below the optimal suppl

The inaccuracy resulting from using the traditional land value technique can be shown diagramatically. In Fig. VI-4, the value of the optimal quality of open space is N_o multiplied by Da $\frac{m_o}{N_o}$ 0, while the use of only measured land value premiums would only predict the value to be N_o multiplied by fa $\frac{m_o}{N_o}$0. Similarly, for estimating the value of an additional park, the land premium approach would overestimate the value by N_o multiplied by aed.

Efficient planning, however, requires the planner to be able to provide for open space in newly developing areas and also to be able to respond to changes in the need for open space in already developed areas. As with any "product", the demand for a recreation site depends upon the price at which alternative products are available. For example, if a large recreation site is created near a city, then the demand for a site within the city will decline. The estimates of the value of open space in Chicago, made above, are therefore dependent upon the cost of reaching alternative sites outside the city, as well as upon the socio-economic characteristics of the city.

The price of reaching other recreation sites is a function of both the distance that they are situated from the city, and also the cost of travelling. As a larger fraction of the population own automobiles, the average cost of travelling to a forest preserve or national park some distance from the city declines. In order to test the importance of this change over time, the ratio of land prices near parks to land prices 2500 feet from parks along 30 streets in Chicago, between 1936 and 1972, was regressed against time and distance from the city center. The following results were obtained. (Appendix C describes the full analysis.)

YEAR	-0.0038	(1.923)
DISTANCE	-0.0067	(1.453)
R^2	0.41	

The T statistic is shown in parentheses. These results indicate that the relative importance of proximity to open space has declined over time in response to the reduction in the cost of visiting an "out-of-town" recreation site. The negative coefficient on distance is to be expected, since the further from the city center that a residence is located, then the easier the access to alternative sites.

This result may explain a puzzling phenomenon in Chicago. Many of the most blighted areas of the city are concentrated around large parks. If the relative importance of the parks has declined, then the relative value of land at these locations has also fallen. The size and density of the buildings reflects the original high value of land and, therefore, land was used "scarcely" in constructing the residences. Instead of single family dwellings of modest dimension, large houses, or three and four apartment buildings were constructed. With the decline in relative land value, these structures no longer reflect the optimal use of the land. The quantity of capital embodied in each structure must be reduced. The only way that a property owner can reduce the amount of capital that his building contains is to allow it to depreciate. What has, in effect, happened, is that the rate of return that the owner earns for maintaining his building (either in terms of higher rents or a higher resale value) has fallen. The location is no longer considered quite as attractive as it initially was and will not attract buyers or tenants of such a high income. Buildings are not easily convertible to new users, and the rate of decline of a neighborhood, once started, seems to proceed with depressing rapidity.

When considering a recreation plan for a city, it is therefore important to consider the impact of the construction of new facilities upon the use and value of the old. Wherever possible, old facilities should be modified so that they do not decay as a result of losing in popularity to new facilities. For example, as new parkland outside a city becomes accessible to a larger fraction of the population, it may be necessary to modify the existing parkland in the city to include more sporting facilities, museums, and similar types of facility, in order to maintain the value of the city parkland to its surrounding residents.

(5) An Alternative Benefit Measurement Technique

The model developed in Part 2 depends upon the assumption that the distribution of households around parks is the same for all parks. However, the value of a park depends not only upon the number of households able to live within three blocks, but also upon the distribution of those households. The greater the fraction of households that are between 0 and 1 block of the park, the greater will be the value of the park. Because of land-use zoning, freeways, rivers, and other deviations from the flat, featureless plain assumption, there is a variation in the ratio of the number of households at different distances. The purpose of this section is to develop an alternative methodology for measuring the value of a park, based upon the basic assumptions of the model set out above that avoids this problem.

For expositional and computational simplicity, assume that there are three possible distances at which households can locate, within 1 block, 1-2 blocks, and 2-3 blocks. Let U_1, U_2, and U_3 be the average values of U_D for the households located at these three distances. From the assumption of linear marginal benefit functions, the average marginal benefit at each of these locations is U_1, $\frac{2}{3} U_2$, and $\frac{1}{3} U_3$ respectively. The premiums, P, paid at each distance, are therefore :

(23a) $$P_1 = U_1 + \frac{2}{3} U_2 + \frac{1}{3} U_3$$

(23b) $$P_2 = \frac{2}{3} U_2 + \frac{1}{3} U_3$$

(23c) $$P_3 = \frac{1}{3} U_3 \quad .$$

The value to a household at each location, B, is:

(24a) $$B_1 = 2U_1$$

(24b) $$B_2 = U_2$$

(24c) $B_3 = \frac{1}{3} U_3$.

Since $P_1 - P_3$ are directly observed, the full value of the park can be measured by calculating $U_1 - U_3$, solving equations (24a)-(24c), and multiplying by the number of households at each location.

If the marginal benefit functions are not linear, then the weight of the U in equations (23) and (24) will be different. The marginal benefit functions can be estimated. In further research, it is hoped to estimate the marginal benefit functions and use this approach to measure the value of parks, in order to be able to estimate the impact of different distributions of households around parks.

Chapter VII

A SYNTHESIS:

COST-BENEFIT ANALYSIS OF AN URBAN PARK

> The question of the relative value...must be settled in the case of Central Park, by a comparison of benefit with cost.
>
> Frederick Law Olmsted, 1870

Previous chapters have examined various techniques for measuring the benefits provided by a recreation area. In this chapter, the advantages of each approach are utilized to provide a framework of analysis within which planning decisions concerning the provision of recreation facilities might be made.

The basic framework is to compare the benefits of the investment (whether it is a large new public park such as the South Shore Country Club, or additional facilities in a current park, such as tennis courts or a swimming pool), with the cost incurred through making the investment. For simplicity, it is convenient to regard a large investment, such as the construction of an entire park, as a bundle of separate investments, each of which can be evaluated individually.

The first part of this chapter is concerned with ways in which the various benefits of a recreation project can be estimated, while the second part is concerned with the estimation of the costs.

(1) The Benefits of a Recreation Project

From the discussions in the previous chapters, it is apparent that there are several different types of benefits from a recreation area and that no one method of estimation is capable of measuring all of them. The following is a list of the principal benefits that arise from the creation of a recreation area:

- User benefits of all of the facilities provided. For a park, this would include the value of the open space to those walking or picnicking, and the benefits to the users of particular sporting facilities, tennis courts, swimming pools, beaches, etc.
- The value of reduced congestion in the use of other facilities. One of the results of the failure to charge the appropriate user cost for the

use of recreation sites is that they are used "excessively". One of the symptoms of this is that "non-price rationing" is used to allocate scarce resources, usually in the form of queueing for tennis courts, or overcrowding of open space. As was argued in Chapter III, any reduction in this overuse must be counted as a benefit.

- Residential amenity benefits. It was argued in Chapter VI that the provision of a park was valued by those living nearby even if it was not used. An open space is regarded as a pleasant amenity to live near.
- Non-user benefits. People walking or driving past a park, even if they do not live nearby, derive pleasure from the view. Inhabitants of a city may also derive civic pride from the existence of large recreational parks even if they never approach them in person.
- There may also be indirect benefits if users of recreation facilities reduce their participation in activities (street gang organization, crime,etc.) which impose external costs on other members of society.

In each of the sections below, methods for estimating these benefits are discussed.

(1.1) User Benefits

In order to be able to evaluate the benefits from the users of a recreation area and the facilities embodied in it, it is necessary to estimate the demand function for that activity at the geographic location of the proposed park. To do this, a number of stages of analysis must be undertaken. First, a survey of household recreation habits must be made, with the survey including information on the socio-economic properties of the household, the address, and the location at which the activities are performed.[1]

In order to estimate the demand function for any activity, it is necessary to relate the frequency of participation to the cost of participation. The cost has three components: (a) the costs that are incurred in reaching the facility; (b) the waiting time that is usually experienced; and (c) any user fees that are charged.

The basic form of the estimating equation is

$$V_i = \Sigma_j \alpha_j P_j + \Sigma_k \alpha_k E_k + \Sigma_m \alpha_m S_m + P_i + \mu \quad (25)$$

where: V_i is the number of visits made to a particular recreation facility in a specified time period; P_j is a vector of the prices at which alternative recreation opportunities are available (for example, in estimating the demand for tennis, it may be important to include the price at which substitute activities--handball, squash, swimming, etc.--are available); E_k is a vector of the socio-economic characterisitics of the household; S_m is a vector of the quality attributes of the facility (perhaps including the size, auxiliary facilities such as showers, etc), P_i is the cost of participating in the ith activity to the household (a function of the three components described in the paragraph above) , and μ is

1 This last piece of information is rarely available, but the distance to the nearest facility for the activity may serve as a first approximation.

a random disturbance item. The crucial problem is in estimating P_i. Information concerning fees is usually readily available, but the other two components must be separately estimated. Average queue time could be calculated through a survey of selected sites in the city, relating them to the properties of the base population served, and through that relationship, predicting the queue time at all locations from data on the quantity and socio-economic attributes of the population around each facility. The travel cost can be estimated endogenously in the model by determining the appropriate functional form in which distance enters (by using the R^2 as the indicator).

Where there is more than one type of visit to a particular facility (for example, all day, and short visits to a park), then separate demand curves for each type should be estimated.

Once the demand functions for all recreation activities for households are estimated, then it is possible to derive the demand function for a specific park. At any given location in the city, data on the number of households on a block and their relevant socio-economic characterisitics are available from census block data. By substituting these values into equation (25), and the appropriate values for the P_j and S_m vectors, the demand schedule for the activity in the park by the block can be placed. P_i can be estimated, and the value to the block is the shaded area under the demand schedule between 0 and Q_1 (in Fig. VII-1).

The full user value is estimated by summing over all the activities that will be practiced in the park over all the blocks that the park will service. In order for the optimum type and quantity of facilities to be supplied in the park, separate cost-benefit studies for each of the implied investments should be made. Thus, the demand for the park as an open-space area (walking, picnicking, etc.) should be estimated first, and compared with the costs, and then the demand for each "facility-specific" activity should be estimated separately (tennis, swimming, etc.) and also compared with the specific costs for the required facilities.

The estimates of the demand for the facilities for a given time period represents a flow of benefits over time (i.e., X dollars per annum). Other benefits (if estimated from land values) are calculated in terms of the capitalized present values, as are some of the components of the costs. It is important to reduce all costs and benefits to the same form, either in terms of annual flows or present values.

If the flow of user benefits is to be reduced to present values, then the projected future annual benefits must be discounted to the present by an appropriate discount rate. Projecting future demand requires an understanding of the dynamic properties of recreation demand. While some insight into the impacts of changes in socio-economic variables--income, age, race, etc.--can be gained from cross-section analysis, a time series analysis would obviously yield more meaningful results. Unfortunately, detailed and consistent data on household recreation habits over time is not available. It is to be hoped that in an effort to improve the efficiency of recreation resource allocation decisions in the future, the establishment of a regular sampling procedure would be a part of city government policy.

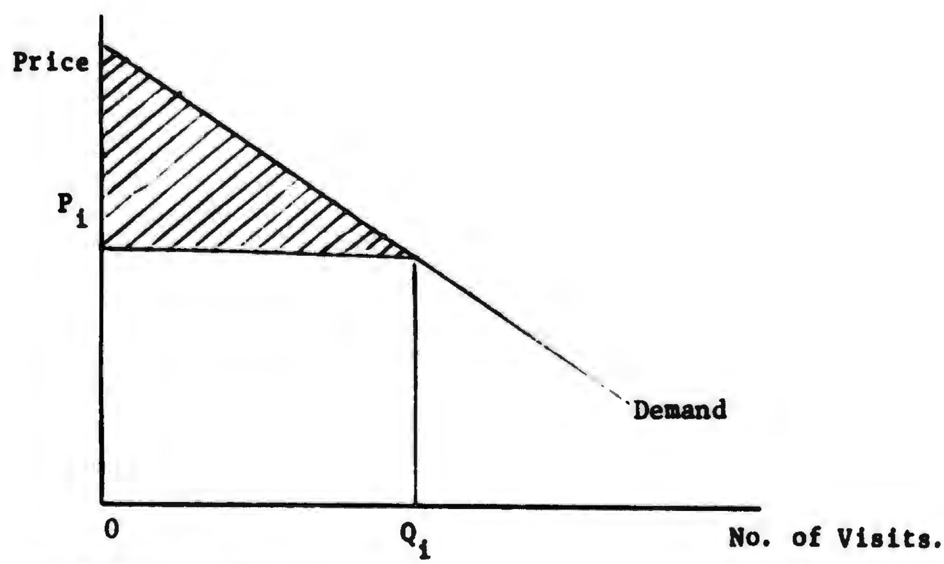

Fig. VII-1. Consumer Supplies.

To summarize, the gross user benefit of a proposed park offering n activities to k blocks (note that the number of blocks that are serviced by each activity is a function of the alternative sites that offer that specific activity and is therefore not the same for each activity) is equal to B where

(26) $$B = \sum_{i=1}^{n} \sum_{j=1}^{k} A_i^j$$

where A_i^j is the triangle under the demand curve for the ith activity on the jth block.

To the extent that individual households on the block had already been participating in the activity at uncongested locations farther away, then the entire triangle cannot be attributed as a net benefit to the new park. In this case, the net benefit is the increase in the area of the triangle. In Figure VII-2 below, the new park reduces the price of the ith activity from P_1 to P_2. The benefit is the vertically shaded area and is equal to $(P_1 - P_2).Q_2 - \frac{1}{2}\Delta Q(P_1-P_2)$. If η_i is the price elasticity of demand for the ith activity, this can be rewritten as $\bar{A}_i^j$ where $\Delta P_i = P_1 - P_2$

(27) $$\bar{A}_i^j = \Delta P_i [\, Q_2 - \frac{1}{2} \Delta P_i \frac{Q_1}{P_1} \eta_i] \quad .$$

This is substituted into (26) to calculate the net user benefits of the new park.

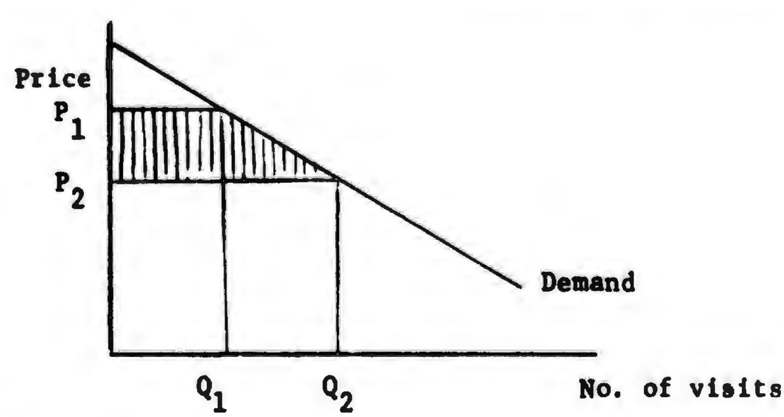

Fig. VII-2. Change in consumer surplus following a price change.

(1.2) Reduced Congestion Costs Elsewhere

Where a new facility diverts users from other facilities where there were congestion costs, then an additional benefit will be the reduced congestion costs at those other facilities. For sporting facilities such as tennis courts, a calculation of this impact can be obtained if the functional relationship between the number of visits per facility and the average waiting time is known, since the reduction in the number of users can be computed.

For activities that do not manifest congestion so clearly, then less direct means must be employed. In Appendix E, the methodology of Hastings and Tolley, using distance travelled to measure people's demand for space, is discussed. A survey aimed at estimating space demand on beaches and parks would allow the benefits of reduced density at existing parks resulting from the creation of a new park to be calculated.

(1.3) Residential Amenity Benefits

Chapter VI discussed in detail the use of land values to measure the full value of a park to those living nearby. Once the recreation value is calculated (discussed in Section (1.1) above), then the residential amenity value is the difference between the full value and the recreational value. A more detailed study using land values and information on the quality of the park would provide the basis for a deeper understanding of this aspect of park value.

(1.4) Non User Benefits

A measure of the value of driving or walking past a park can be obtained by measuring how great a detour motorists and pedestrians are prepared to make in order to enjoy the privilege. For small parks, this will probably be very slight, but for larger parks, particularly the lakefront, this might involve considerable benefits. The pedestrian detour for downtown plazas might also comprise a very large fraction of the benefits of the area. If effective planning of a downtown recreation system is to be effected, then survey information on the use of center city open-space must be collected.

(1.5) Indirect Social Benefits

Some of the potential benefits enjoyed by society at large from the participation in outdoor recreation were discussed in Chapter II. While extremely difficult to place a direct dollar value on, extensive work on the relationship between crime, illness, and other symptoms of urban stress, and the availability of recreational opportunities would provide very useful information to the urban planner. A full discussion of this topic is beyond the scope of this paper.

(2) Costs

There are three main components to the costs of a recreation area.

- The cost of the land.
- The cost of developing the site, including the cost of constructing facilities, providing the appropriate transportation capital, and landscaping.
- The present value of future maintenance expenses.

The first two components are relatively straightforward. The price of the land is its value in the most profitable use to which it may be put (commercial, manufacturing or residential). This may not correspond directly to the purchase price, but can usually be computed from land value data for the surrounding area. The cost of site development can usually be estimated directly from past experience or from quotations received from contractors.

Maintenance costs are less easy to estimate, since they depend upon three broad factors.

. The quantity and quality of the facility. Costs such as mowing and tree maintenance are usually proportional to the size of the park.

. The intensity of use. Research is needed to determine the relationship between the density and frequency of use and the amount of maintenance that is needed. This will vary according to the type of facility, and may not be a simple linear relationship. Since the amount of use depends upon the degree of maintenance, as well as vice versa, it is possible to estimate the optimum quantity of maintenance that should be undertaken at any given site.

. The type of user. Vandalism is an expensive problem for administrators of public facilities. Research aimed at understanding the relationship between the socio-economic properties of users and the tendency toward crime and vandalism is important if efficient resource allocation decisions are to be made. The effectiveness of prevention programs must also be evaluated if the appropriate measures are to be taken at the minumum cost. Again, cost-benefit criteria can be used to determine the optimum scale at which such programs are to be run.

Obviously, before an effective set of policy guidelines for investment in recreation can be formulated, a great deal of data collection and analysis must be undertaken. This paper has attempted to show the areas and the form that this research must take. It is to be hoped that cities will heed the warnings contained in the scars of urban blight and in the soaring crime statistics and commit funds and effort in this direction. Failure to do so will only contribute to a perpetuation of the problem, while a commitment may serve to open doors to practical and efficient solutions.

Appendix A

DESCRIPTION OF DATA
AND CALCULATIONS

(1) Description of Data Used in Empirical Work

The basic information concerning the building structure and its market selling price was provided by the Society of Real Estate Appraisers. The information used was for single-family dwellings sold between March 1971 and June 1972. All observations in each of the areas shown in Figure A-1 were used, except those sold through assumption of a mortgage and those with no basements. In order to determine whether there was any bias in the sample, the average selling price in each census tract (with more than 10 observations) was compared with the owner assessed property values reported in the 1970 census. The overall average was 12 percent above the census tract average which was probably due to a secular rise in property values between the time at which the census was taken and the time at which the property sale was recorded. In 65 per cent of the tracts tested, the sample average was within one standard deviation of 1.1 times the census tract average; and in 95 percent of the tracts, the average was within two standard deviations. While some bias may be present, it was not felt to be serious. The number of observations in each of the sample areas is shown in Table A-1.

Locational variables were obtained by locating each of the observations on a 1" = 1000' map. Information concerning the zoning on that part of the block where the observation was located was obtained from Olcott's "Land Values in Chicago, 1972". Census tract information was augmented with additional information compiled by tract, including the quality of the local school (SQ69), from "Selected School Characteristics," Report by the Dept. of Operations Analysis, Chicago Public Schools,

1 I am indebted to R. Schmitz and R. Braid for help in computing the locational data, to B. Bender, Argonne National Laboratories, and the Society of Real Estate Appraisers for providing me with some of the information, and to J. Cavallo for organizing the data.

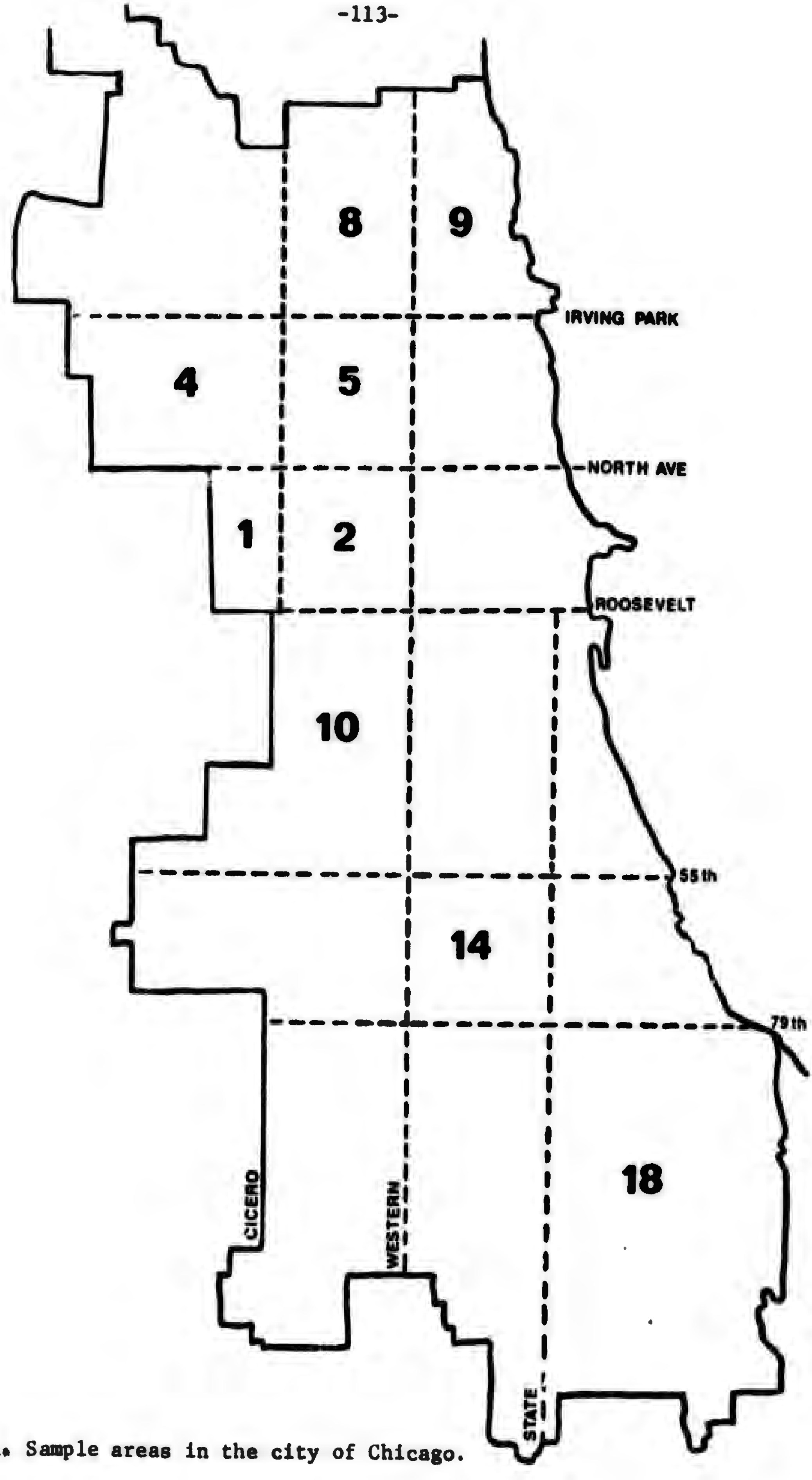

Fig. A-1. Sample areas in the city of Chicago.

and the air quality(AIR2), from the Argonne National Laboratories. Table A-3 lists the data by name.

Multicollinearity between the independent variables is a typical problem in an analysis of this sort. Table A-2 shows the simple pairwise correlation coefficients between some of the neighborhood characteristics. While some of the variables are quite severely correlated, distance to the nearest park is not, so that bias from this source in the estimates of β is not a serious problem.

TABLE A-1

Number of observations in each sample area[1]

SAMPLE AREA *	No. OF OBSERVATIONS
1	157
2	55
4	330
5	92
8	162
9	99
10	202
14	162
18	604
TOTAL	1863

1 Fig. A-1 below shows the geographic location of each area.

TABLE A-2

Correlation Coefficients between Independent Variables

CORRELATION MATRIX:

	MLPOP7 ZONI PRICE	MLPOP6 COMMK BRICK	YRSCH7 RRBK SIZ	OWNER7 DSFREE GAG	PNVAC DSPK OCE	SUB9 AVCOM ZON	DISLAK AVINC7	DENSE SCBK	AIR1 AGE	AIR2 AREA
MLPOP7	1.0000	0.9635	0.4201	0.0261	0.1582	-0.3106	-0.3496	0.0564	0.1256	0.3789
	0.0393	-0.0291	0.0717	0.0863	-0.0139	-0.3976	-0.1063	0.1097	-0.1207	-0.0350
	-0.2948	0.1956	0.0526	-0.0990	0.1793	0.2275				
MLPOP6	0.9635	1.0000	0.4255	0.0611	0.1751	-0.3085	-0.3845	0.0677	0.1728	0.4213
	0.0308	-0.0379	0.0782	0.1007	-0.0085	-0.3748	-0.0876	0.0981	-0.0951	-0.0272
	-0.2995	0.1785	0.0516	-0.0919	0.1854	0.2208				
YRSCH7	0.4201	0.4255	1.0000	0.1744	-0.2408	0.2598	-0.2690	0.2907	-0.0444	0.1365
	-0.0716	-0.0964	-0.0395	0.2008	0.0002	0.3179	0.5979	0.0575	-0.1634	0.1740
	0.2497	0.2296	0.1352	-0.0762	0.0651	0.1215				
OWNER7	0.0261	0.0611	0.1744	1.0000	-0.6093	0.0730	0.1936	0.7107	-0.3566	0.0599
	0.5196	-0.1322	-0.0506	0.3434	-0.0101	0.0188	0.5836	-0.0571	-0.2242	-0.2498
	0.2034	0.2149	0.1607	0.0021	0.1303	-0.0200				
PNVAC	0.1582	0.1751	-0.2408	-0.6093	1.0000	-0.3826	-0.1836	-0.5014	0.4282	0.0475
	-0.2046	0.1080	0.1206	-0.2609	0.0018	-0.4473	-0.6207	0.0547	0.2943	0.1624
	-0.5019	-0.2653	-0.1249	0.0070	0.0129	0.0675				
SUB9	-0.3106	-0.3085	0.2598	0.0730	-0.3826	1.0000	-0.0647	0.2318	-0.1603	-0.0259
	-0.0679	-0.0368	-0.0620	0.1492	-0.0309	0.5057	0.4620	0.0406	-0.2305	0.0447
	0.4823	0.1330	-0.0158	-0.0744	-0.0394	-0.0613				
DISLAK	-0.3496	-0.3845	-0.2690	0.1936	-0.1836	-0.0647	1.0000	0.0368	-0.5078	-0.6433
	0.2526	0.0562	-0.1654	-0.0483	0.0583	0.1819	0.0411	-0.1110	0.0796	-0.0277
	0.1374	-0.0953	0.0655	0.1037	-0.0911	-0.1237				
DENSE	0.0564	0.0677	0.2907	0.7107	-0.5014	0.2318	0.0368	1.0000	-0.3311	0.1044
	0.3281	-0.1531	0.0106	0.3220	-0.0776	0.0989	0.5475	-0.0331	-0.2763	-0.1369
	0.2954	0.2248	0.1998	0.0141	0.1171	-0.0068				
AIR1	0.1256	0.1728	-0.0444	-0.3566	0.4282	-0.1603	-0.5078	-0.3311	1.0000	0.6673
	-0.2185	0.0463	0.1710	-0.1712	-0.1043	-0.2996	-0.2625	0.0230	0.2046	0.1392
	-0.3249	-0.0956	-0.1033	-0.0472	-0.0189	0.1102				
AIR2	0.3789	0.4213	0.1365	0.0599	0.0475	-0.0259	-0.6433	0.1044	0.6673	1.0000
	-0.0056	-0.0723	0.1337	0.1064	-0.1257	-0.3750	-0.0394	0.0112	-0.0794	-0.0787
	-0.2309	0.1411	0.0241	-0.0460	0.1525	0.1546				
ZONI	0.0393	0.0308	-0.0716	0.5196	-0.2046	-0.0679	0.2526	0.3281	-0.2185	-0.0056
	1.0000	-0.0696	-0.0704	0.1090	0.0321	-0.1140	0.1580	-0.0757	-0.0197	-0.1479
	0.0460	0.0214	0.2236	0.0547	0.0495	-0.0388				
COMMK	-0.0291	-0.0379	-0.0964	-0.1322	0.1080	-0.0368	0.0562	-0.1531	0.0463	-0.0723
	-0.0696	1.0000	-0.0900	-0.1058	0.0059	-0.0200	-0.1046	-0.0955	0.0938	0.0012
	-0.0856	-0.0946	-0.0668	0.0124	-0.0475	-0.0035				
RRBK	0.0717	0.0782	-0.0395	-0.0506	0.1206	-0.0620	-0.1654	0.0106	0.1710	0.1337
	-0.0704	-0.0900	1.0000	-0.0366	-0.0136	-0.1039	-0.0716	-0.0906	-0.0847	-0.0554
	-0.1421	0.0082	-0.0463	-0.0397	0.0017	0.0089				
DSFREE	0.0863	0.1007	0.2008	0.3434	-0.2609	0.1492	-0.0483	0.3220	-0.1712	0.1064
	0.1090	-0.1058	-0.0366	1.0000	-0.0200	0.0590	0.2682	0.0096	-0.1989	-0.0857
	0.1573	0.1603	0.0565	-0.0867	0.0974	0.0140				
DSPK	-0.0139	-0.0085	0.0002	-0.0101	0.0018	-0.0309	0.0583	-0.0776	-0.1043	-0.1257
	0.0321	0.0059	-0.0136	-0.0200	1.0000	0.0537	0.0074	0.0247	0.0242	-0.0290
	-0.0265	0.0020	0.0148	0.0365	-0.0351	0.0100				
AVCOM	-0.3976	-0.3748	0.3179	0.0188	-0.4473	0.5057	0.1819	0.0989	-0.2996	-0.3750
	-0.1140	-0.0200	-0.1039	0.0590	0.0537	1.0000	0.5110	-0.0247	-0.0746	0.1631
	0.5899	0.0249	0.0733	-0.0176	-0.1821	-0.0840				
AVINC7	-0.1063	-0.0876	0.5979	0.5836	-0.6207	0.4620	0.0411	0.5475	-0.2625	-0.0394
	0.1580	-0.1046	-0.0716	0.2682	0.0074	0.5110	1.0000	-0.0392	-0.2626	0.0851
	0.5406	0.2418	0.1629	-0.0420	0.0353	0.0059				
SCBK	0.1097	0.0981	0.0575	-0.0571	0.0547	0.0406	-0.1110	-0.0331	0.0230	0.0112
	-0.0757	-0.0955	-0.0906	0.0096	0.0247	-0.0247	-0.0392	1.0000	0.0221	0.0002
	-0.0368	0.0661	-0.0539	-0.0369	0.0300	0.0387				
AGE	-0.1207	-0.0951	-0.1634	-0.2242	0.2943	-0.2305	0.0796	-0.2763	0.2046	-0.0794
	-0.0197	0.0938	-0.0847	-0.1989	0.0242	-0.0746	-0.2626	0.0221	1.0000	0.1142
	-0.3785	-0.4252	0.1253	0.2537	-0.2183	0.0215				
AREA	-0.0350	-0.0272	0.1740	-0.2498	0.1624	0.0447	-0.0277	-0.1369	0.1392	-0.0787
	-0.1479	0.0012	-0.0554	-0.0857	-0.0290	0.1631	0.0851	0.0002	0.1142	1.0000
	0.3692	-0.1091	0.2736	0.0882	-0.0232	-0.0267				
PRICE	-0.2948	-0.2995	0.2497	0.2034	-0.5019	0.4823	0.1374	0.2954	-0.3249	-0.2309
	0.0460	-0.0856	-0.1421	0.1573	-0.0265	0.5899	0.5406	-0.0368	-0.3785	0.3692
	1.0000	0.2849	0.2593	0.0986	0.0455	-0.1454				
BRICK	0.1956	0.1785	0.2296	0.2149	-0.2653	0.1330	-0.0953	0.2248	-0.0956	0.1411
	0.0214	-0.0946	0.0082	0.1603	0.0020	0.0249	0.2418	0.0661	-0.4252	-0.1091
	0.2849	1.0000	-0.0545	-0.0744	0.1645	0.0408				
SIZ	0.0526	0.0516	0.1352	0.1607	-0.1249	-0.0158	0.0655	0.1998	-0.1033	0.0241
	0.2236	-0.0668	-0.0463	0.0565	0.0148	0.0733	0.1629	-0.0539	0.1253	0.2736
	0.2593	-0.0545	1.0000	0.2238	-0.0013	-0.0002				
GAG	-0.0990	-0.0919	-0.0762	0.0021	0.0070	-0.0744	0.1037	0.0141	-0.0472	-0.0460
	0.0547	0.0124	-0.0397	-0.0867	0.0365	-0.0176	-0.0420	-0.0369	0.2537	0.0882
	0.0986	-0.0744	0.2238	1.0000	-0.0372	-0.0560				
OCE	0.1793	0.1854	0.0651	0.1303	0.0129	-0.0394	-0.0911	0.1171	-0.0189	0.1525
	0.0495	-0.0475	0.0017	0.0974	-0.0351	-0.1821	0.0353	0.0300	-0.2183	-0.0232
	0.0455	0.1645	-0.0013	-0.0372	1.0000	-0.2245				
ZON	0.2275	0.2208	0.1215	-0.0200	0.0675	-0.0613	-0.1237	-0.0068	0.1102	0.1546
	-0.0388	-0.0035	0.0089	0.0140	0.0100	-0.0840	0.0059	0.0387	0.0215	-0.0267
	-0.1454	0.0408	-0.0002	-0.0560	-0.2245	1.0000				

TABLE A-3

List of Variables

PRICE	The sales price of the residence
AGE	The age of the residence
AREA	Square feet of living area
BRICK	A dummy variable having the value 1 if the structure is of brick
ZDN	A dummy variable having the value 1 if the degree of interior modernization is below average.
OCE	A dummy variable having the value 1 if the exterior condition of the building is above average
GRG	The number of garages
BATHS	The number of full bathrooms
DSFREE	The distance to the CBD measured as twice the distance to the nearest expressway entrance (in thousands of feet) plus the distance from the expressway entrance to the CBD.
SIZ	The lot size in square feet
BLPOP7	The percent of the tract that 's black in 1970
BLPOP6	The change in percent black between 1960 and 1970
YRSCH7	The median number of years of education of those over 25 in 1970
AVINC7	The median family income in 1970
OWNER7	The percent of residences that were owner occupied in 1970
PNVAC	The percent of living units vacant in 1970
SQ69	The quality of the local school in 1969
DISLAK	The direct distance to the lake from the center of the tract in thousands of feet
DENSE	The residential density, defined as persons per thousand square feet of residential and recreational
RRBK	A dummy variable having the value 1 if the residence overlooks a railroad or freeway.

AIR2	The air quality over the tract, measured as particulate parts per million
COMBK	A dummy variable having the value 1 if there is commercial property on the block
ZON1	A dummy variable having the value 1 if the zoning is R1 or R2
DSPK	The distance to the nearest park, measured in thousands of feet if the distance is less than 2000, 2.1 otherwise

(2) Calculation of Average Premiums and Fraction of Community with Park Access For Calculations in Chapter VI

The premium that households paid for location near a park was computed from the impact of such a location on the price of single family homes in the city of Chicago. The sales price of property sold within the city between March 1971 and June 1972, together with information about the structure and its location, were obtained from a real estate research company. Following Muth (1969), it was assumed that the price of a house reflects total expenditure on a number of housing units where the quantity of units present is a function of the quantity of inputs embodied in the residence. The production function w is assumed to be multiplicative, and the estimating equation was,

$$\text{(a-1)} \qquad \text{Log(PRICE)} = C + \beta D + \sum_i \alpha_i \text{Log} A_i + \mu$$

where C is the constant term, D is the distance to the nearest park, and A_i is the quantity of the A_ith input present, and μ is a random disturbance term. The inputs included are listed in Table A-4. This equation was separately estimated for each of the communities listed in Table A-5. The number of observations ranged between 51 in Area 1, to 123 in Area 6.

In order to determine the appropriate way in which distance to the nearest park should enter the equation, distance was entered in a series of dummy variables. There was no significant impact of distances over 2000 feet. In order to avoid excessive weighting for large distances, distance was redefined so that all distances over 2000 feet were set equal to 2,100. This had no impact on the coefficient of determination. Distance was entered in logarithmic as well as linear form, and in 9 of 12 communities, the coefficient of determination fell. The 12 regression estimates gave separate estimates for β

TABLE A-4

List of Variables Used in Regression

PRICE	The sales price of the residence
AGE	The age of the residence
AREA	Square feet of living area
BRICK	A dummy variable having the value 1 if the structure is of brick
ZDN	A dummy variable having the value 1 if the degree of interior modernization is below average.
OCE	A dummy variable having the value 1 if the exterior condition of the building is above average
GRG	The number of garages
BATHS	The number of full bathrooms
COMBK	A dummy variable having the value 1 if there is commercial property on the block
SIZ	The lot size in square feet
BLPOP7	The percent of the tract that is black in 1970
YRSCH7	The median number of years of education of those over 25 in 1970
PNVAC	The percent of living units vacant in 1970
DSPK	The distance to the nearest park, measured in thousands of feet if the distance is less than 2000, 2.1 otherwise
DENSE	The residential density, defined as persons per thousand square feet of residential and recreational land.
RRBK	A dummy varaible having the value 1 if the residence overlooks a railroad or freeway.

TABLE A-5

Regression Results

COMMUNITY AREA PARKS	TRACTS	NUMBER OF HOUSEHOLD WITHIN 1BLK	2BLKS	3BLKS	TOTAL IN AREA	FRACTION WITHIN 3BLKS	MEDIAN INCOME	MEDIAN RESIDENCE PRICE	β	TOTAL PREMIUMS PAID (000)	AVERAGE PREMIUM PAID
(1) Rogers Park	201-6	768	688	600	9917	.207	13900	28000	-0.055	3630	1765
Indian Bndry									(1.37)		
No. 273											
Chippewa											
(2) Gompers	1203	1176	1280	1200	12444	.294	12000	26000	-0.040	4141	1133
Eugene	1302 1305								(2.21)		
Forest Ave.	1402-6										
Kiwanis	1601										
(3) No.29	5601-6	390	540	960	3242	.583	11900	25000	-0.032 (1.16)	1328	703
(4) Archer	5702-3 5705	280	440	430	2376	.484	12500	22500	-0.041 (1.72)	1001	870
(5) Stony Island	4502-3	806	940	1168	8761	.333	13000	22000	-0.064	4017	1379
Avalon	4801-5								(1.54)		
(6) Kosciuszco	2104-6	404	544	760	11091	.154	10700	21000	-0.073	2557	1497
Mozart	2206-7 2209-10								(2.05)		
(7) Riis	1902-6	1264	1248	960	13420	.259	11500	24500	-0.040	3863	1113
Hanson	1908 1911-14								(1.83)		
Blackhawk											
Cragin											
(8) Merrick	2514-16	172	96	168	3802	.115	10700	18000	-0.062 (0.95)	531	1217
(9) LaFollette	2507-12	532	372	228	5795	.195	11500	21000	-0.053 (1.44)	1642	1451
(10) Chopin	1506-12	360	608	768	8335	.208	12700	23000	-0.059 (1.97)	2238	1289
(11) Rumbull	5102-3	760	720	710	3811	.575	12000	17500	-0.037	1575	719
Bensley	5105								(0.86)		
Merrill											
(12) Kilborn	1612-3	548	300	280	3520	.320	11000	21000	-0.021	581	515
Kelvyn	1909 2002								(1.61)		

in each community which are shown in Table A-4. Since the premium at 2100 thousand feet was assumed to be 0, the premium paid for accessibility at distance D_i, P_{Di}, could be calculated as

(a-2) $$P_{Di} = [\, e^{-\beta(2.1-D)} - 1\,][\, C \prod_i A_i^{\alpha_i}]$$

where the second term on the right hand side is equal to the average value of property in the area that does not enjoy accessibility to the park. In order to approximate this term, the average value of housing in the area, $\bar{P}_H$ was deflated by the average 'accessibility', that is, the average distance to the park

(a-3) $$C \prod_i A_i^{\alpha_i} = \bar{P}_H [1 - e^{\beta(2.1 - \bar{D})}]$$

In order to further simplify the calculations necessary to estimate the total expenditure on park accessibility, the integral of premiums over distance was approximated with a step function, all property within 1 block was assumed to pay the same premium (D=0.33), similarly for all property between 1 and 2 blocks, and 2 and 3 blocks. Total expenditure was calculated by estimating the premium at each distance and multiplying by the number of families at that distance.

In order to estimate the separate coefficients for the submarkets around parks, it was necessary to divide the sample areas into separate markets centered around a single park or a small group of parks. This was done by determining the census tracts served by a particular park or group of parks. In some cases, the edge of the market area was delineated by natural boundaries (the lake, railroad yards, etc.), while in other areas allocation was made simply on the basis of distance. In those areas where no distinctive market "area" could be identified, no attempt was made to isolate one. Table A-5 shows: the parks in each community area; the census tracts that constitute each area; the number of households (from census block data) at each distance; the total number of households within the community; and the median house price. This was calculated by weighting the number of houses multiplied by the median price and the number of apartments multiplied by 100 times their median rent. The estimates of β for each community are shown together with the T statistic.

Appendix B

PEAK-LOAD PRICING OF RECREATION RESOURCES

The optimum pricing of recreation resources poses a problem because they are not used at a constant rate throughout the year. During the winter, ski slopes are often densely crowded while urban parks are deserted except for the hardiest joggers and dog walkers. Neither is the use steady during the day. Tennis courts are easily accessible before 5 p.m. on the sunniest weekday, but a long wait is necessary after that hour. How should facilities be priced in order to ensure their efficient use? Utility companies have faced the same problem with the demand for electricity, since for most of the year, generating capacity stands idle, in action only when the seasonal demands of air conditioning or winter heating make it necessary.

Failure to price resources efficiently causes a loss of benefits which are borne by consumers. This might take the form of an enthusiastic tennis player waiting for a game which he or she values very highly while another player, who gets much less satisfaction out of the game but was able to get to the court before it was crowded, plays, or a camping family turned away from a campground because it is full, or a wilderness area suffering irreparable damage because too many hikers were allowed to use its trails.

The solution is to charge a low admission price when a resource (whether it is a beach or a set of baseball diamonds) is not being used to full capacity, equal to the running cost of the facility. Thus, if a single campsite costs $200 per annum to maintain, and is occupied for 200 days, the appropriate charge is $1 per day. But when the number of people who want camp sites exceeds the number of sites available, then a peak-load price must be charged, equal to the marginal cost of providing an additional campsite. This cost is equal to the interest and depreciation on the capital cost of a campsite. Therefore, if the interest plus depreciation rate is 10 percent, and the cost of a campsite is $3,000, and the peak season lasts fo

100 days, then the appropriate charge is \$3000 x 0.10 x 1/100 + 1, or \$4 per day. Peak-load pricing, apart from reducing waiting time and other peak-use problems, has the additional advantage that it provides for a clear indication when investment in extra capacity is needed. Whenever lines still form when the appropriate peak-load surcharge is made, then additional facilities should be provided.

Empirical estimates of the correct prices for many specific recreational facilities are quite straightforward and do not appear to be "unreasonable". Brown (1971) estimated that the off-peak price for a campsite in California was \$1.20, and the peak price was \$4.10 in 1967. Such prices would have led to an increase in capacity at the park studied of nearly 25 percent which would have reduced the number of turnarounds and the level of crowding considerably. A similar range of prices was considered by O'Riordan (1973) for British Columbia. By ensuring that users pay for the cost of the resources that they use, the general burden on the tax payer is reduced.

The scale of the increase in user fees that peak-load pricing would cause is quite within the range that attitudinal surveys have found campers willing to accept.[1] The discriminatory nature of the charge might give rise to a certain degree of discontent. However, there are many areas in the economy where there is discriminiation in terms of either time of purchase (reduced-rate theatre tickets before midday and differential electricity and parking rates for examples) or quantity of purchase (quantity discounts, etc.). While actual user price will rise during peak times, it is not inconceivable that

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1 See, for example, La Page, W. F.,"The Role of Fees in Campers' Decisions," U. S. Forest Service Research Paper, N. E. 118, Upper Darby, Pa., 1968.

actual user cost may decline when the benefits of reduced congestion and waiting time are included.

The problem of the appropriate measure of prices for less specific facilities such as beaches or parks is much less easily solved. There is no clear indication of the level of congestion as there is with campsites or tennis courts. In some cases, such as urban parks, demand rationing prices cannot be charged, so a measure of the correct price is irrelevant. The decision on when and by how much to extend facilities must be based upon a measure of the costs of congestion so that the benefits of congestion reduction through the expansion of facilities can be measured. Ways in which the costs of congestion might be measured are discussed in Appendix E. For those areas where prices can be charged and where the capital cost of expansion can be computed, it is still necessary to know what the capacity of the area is in order that the peak-load time period can be identified, and a clear indication of the time when additional capacity would be appropriate can be gained. This, too, requires the capability of measuring the costs associated with congestion, which is covered below in Appendix E.

Appendix C

THE VALUE OF AN URBAN PARK OVER TIME

The discussion in Chapter V suggested that the demand for a recreation site is a function not only of the attributes of the site and the socio-economic functions of the population that it serves, but also of the availability (or price) of alternative recreation areas. Over time, there are two forces that affect the demand for an urban park; first, as income and population rise, the demand schedule would have a tendency to rise, which would increase the relative value of living near a park. But as the relative price of transportation falls (due mainly to the advent of the automobile), then the relative cost of using extra-urban outdoor recreation facilities would fall which would tend to reduce the demand for a park and therefore reduce the relative premium that households are willing to pay for proximity to a park. If the second effect is larger than the first, then the importance of a park will have declined over time as a determinant of land values.

To test which effect has dominated over time empirically, land values along thirty streets which led to parks within the city of Chicago were recorded between 1912 and 1972. Land values (from Olcott's Land Values in Chicago) at one block, two blocks, three blocks, and four blocks, on residential streets, were recorded. The relative premium paid for living within one block of a park (defined as the land value at one block, divided by the land value at four blocks) was computed and regressed against the year and the distance to the CBD. Since distance to the CBD is also a crude measure of the availability of alternative recreation sites, it was expected to have a negative impact on the relative premium. The results are shown in Table C-1a. They are consistent with the hypothesis that the relative value of living near a park has declined, i.e., the reduction in the cost of reaching alternative recreation sites has, relatively, outweighed the impact of rising income. This does not imply that the absolute value of a park has declined (although in a few cases this is true), but rather that the value of the park has not increased at the same rate as the general value of land.

The reliability of the coefficient is not high however. By plotting the premium over time, it was apparent that between 1912 and 1931 there had been an increase over time, but that since 1936, the premium had declined. The regression was repeated over the two time periods, and the results are shown in Tables C-1b and C-1c.[1]

Since the availability of alternative recreation sites affects the recreation demand for a park rather than the demand for the park as a neighborhood amenity, it should be true that the greater the fraction of the premium attributable to recreation demand, the more rapidly has this premium eroded. A large park serves more recreational functions than a small one, since it contains a wider diversity of facilities. The value of saved travel time would therefore be a larger fraction of its contribution to premium than for a small park, which filled fewer needs. The regression was run separately for the 9 large parks and 14 small parks. The relative decline over time was more pronounced for the larger parks than for the smaller parks, which is consistent with this hypothesis (the results are shown in Tables C-1d and C-1e).

While these results are very tentative, they do indicate that quite significant changes in the relative value of urban recreation areas may occur over time. An understanding of the determinants of these shifts is therefore an important ingredient in urban open-space planning. When the relative value of land changes, then the quality of the neighborhood can change in response (this is discussed more fully in Appendix D below).

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1 The distance coefficient is smaller for the second period, which is consistent with the fact that the reduction in transportation costs reduced the premium associated with a central location.

TABLE C-1a

Premium on Year and Distance, 1912 - 1972

YEAR:	-0.0024	(1.494)
DISTANCE:	-0.0396	(5.286)
R^2	0.069	

TABLE C-1b. Premium on Year and Distance, 1912 - 1931.

YEAR:	0.0073	(1.065)
DISTANCE:	-0.0286	(2.187)
R^2	0.0899	

TABLE C-1c. Premium on Year and Distance, 1936 - 1972

YEAR:	-0.0038	(1.923)
DISTANCE:	-0.0067	(1.453)
R^2	0.121	

TABLE C-1d. Small Park Premium on Year and Distance, 1936 - 1972

YEAR:	-0.0021	(1.632)
DISTANCE:	-0.0054	(1.702)
R^2	0.130	

TABLE C-1e. Large Park Premiums on Year and Distance, 1936 - 1972

YEAR:	-0.0086	(2.313)
DISTANCE:	-0.0071	(1.008)
R^2	00.143	

Appendix D

PROPERTY PRICES AND CHANGES IN AMENITY LEVELS

The purpose of this appendix is to show that the use of property values to measure the impact of a change in the level of an amenity (for example, the construction of a park) may lead to a significant overestimation of the value of the amenity. Changing the level of neighborhood amenities may result in a change in the level of investment in a structure that a property owner undertakes, and unless information concerning the condition of the structure is included in the estimating equation, the coefficient for the changed amenity will include this effect as well as its impact on the value of the site.

In order to estimate the impact of a change in the level of an amenity from property values, it is convenient to assume that the owner of a bundle of housing services (composed into a single-family residence) produces services from the two composite inputs, land and structure, in a production function that exhibits a constant marginal rate of substitution, perhaps in the form (assuming that each unit of housing services has a price of one dollar),

(d-1) $$\text{PRICE} = Q = C + \alpha_1 S + \alpha_2 L$$

where: Price is the price of the bundle of services (the single family dwelling); Q is the number of units of housing services produced; and α_1 and α_2 are, respectively, the marginal products of the units of structural services, S, and land services, L; and C is some constant term. The quantity of each input is some function of the quantities of certain components. For example, the quantity of S is a function of the size of the structure, its condition, the number of bathrooms, etc. This may be written,

(d-2) $$S = f_s(A_i) \qquad i = 1,2,..n.$$

(d-2a) $$L = f_l(A_j) \qquad j = 1,2,..m.$$ [1]

A change in the quantity of L, perhaps due to a change in the level of a

1 Where S may be changed, year to year, by the landlord through investment in improvements etc, while L is determined exogeneously.

neighborhood amenity will have no impact upon the marginal product of structural services and will therefore have no impact upon a landlord's willingness to add to the quantity of services by investing in improvements in the structure. Making the assumption that f_s and f_l are both simple additive functions, estimations of the production function of housing services have been made by a linear regression of housing price upon the level of certain components (1968).

The assumptions of constant marginal product and constant rate of substitution between land and structure implicit in this approach has led several observers to use the more intuitively appealing multiplicative production function for housing services, and to estimate the function in Log-Log form which can be expressed as

(d-3) $$PRICE = C.S^{\alpha_1}.L^{\alpha_2}$$

where

(d-4) $$S = \prod_i A_i^{\alpha_i} \qquad i = 1,2,...n$$

(d-4a) $$L = \prod_j A_j^{\alpha_j} \qquad j = 1,2,...m \quad .$$

It is no longer true that a change in the quantity of L will leave the marginal product of structural services unchanged. From (d-3) the downward sloping marginal product of S schedule can be derived, in which L enters positively

(d-5) $$d(PRICE)/dS = C.(\alpha_1/S^{1-\alpha_1})L^{\alpha_2} \quad .$$

This schedule, multiplied by the price of structural services gives the marginal revenue product schedule shown in Figure D-1. The cost of such services, determined exogenously to the individual property owner, will determine the equilibrium quantity of S that will be embodied in the residence, S^o in Figure D-1. If the price of housing units, the level of neighborhood amenities embodied in L, and the price of structural services, P_s, all remain constant, then there will be no change in the quantity of structural services. This can be interpreted as saying that the condition of the building will remain unchanged, it will neither undergo extensive improvements or be allowed to deteriorate. The total value of the structure is given by the area McS^o0. If there is a reduction in the level of neighborhood amenities (for example, a deterioration in air quality), then the marginal revenue product schedule of S falls (from MN to M'N'). This will cause

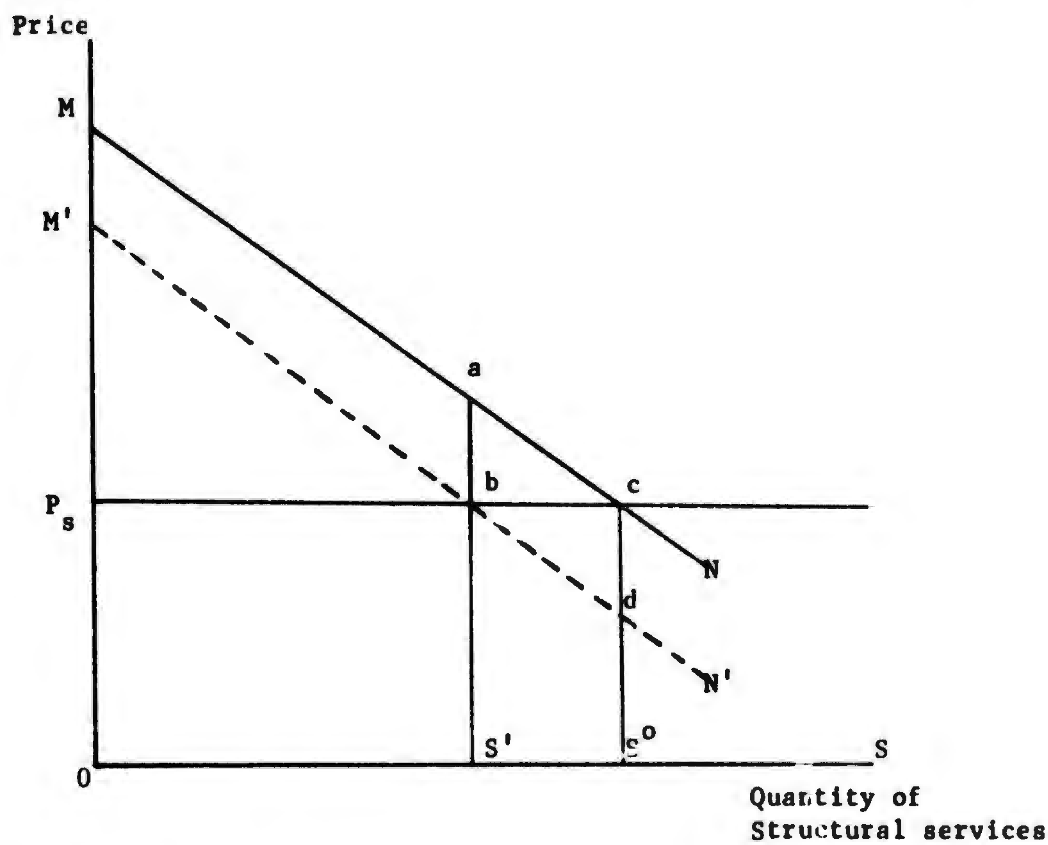

Figure D-1. The optimum level of structural services.

the landlord to reduce the stock of structural services embodied in the building (by painting it less often and performing repairs less readily) from S^o to S'. The overall value of the building will fall from McS^o0 to $M'bS'0$, or by $McS^oS'bM'$. The social cost of this fall in residence value is $McbM'$ since $cbS'S^o$ represents saved resources (time and materials for painting the building, etc). Now the problem implicit in log-log regression analysis to isolate the costs of a change in the level of an amenity becomes apparent. Two cases can be considered, and it can be shown that only one yields the correct result. First, consider the case where there is no specific information concerning the overall condition of the building. The entire fall in residence value will be attributed to the change in amenity level, which means that the coefficient for that amenity will be $McS^oS'bM'/McbM'$ too high.

If, however, the condition of the residence is included in the regression analysis, and if the functional relationship is specified correctly so that accurate measures of S can be obtained, then the MRP of S will be correctly identified, and cbS^oS' of the reduction in property value will be correctly attributed to the change in the quantity of S, leaving $McbM'$ attributed to the change in the level of the amenity.

If the production function for housing services is multiplicative, then failure to include specific data on the quality and quantity of the structure will lead to an overestimation of the impact of a change in the level of an amenity on property values. Inclusion of such information, providing that the function is correctly specified and the data correctly measured, will lead to an accurate measure of the impact of a change in the level of an amenity.

Appendix E

MEASURING THE COST OF CONGESTION

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Measuring the costs associated with crowding is important if an appropriate level of investment in recreation facilities is to be made. Ideally, crowding should only occur up to the point where the social cost of an additional user to a facility, in terms of the discomfort caused to other users, is equal to the cost of expanding the facility to provide for the additional user. Therefore, if an additional user of a beach, on 100 peak summer days, reduces the total value of the beach experience to all other users by $100, and the beach could be expanded to accommodate an additional user for only $50 per year, then the beach should be expanded until the marginal congestion damage was only $50.

For many recreation facilities, for example, campsites, the capacity of the facility can easily be computed (see Appendix B above). The capacity of more general facilities, beaches, parks, and wilderness areas, is less obvious, and therefore, the value of an addition to capacity is difficult to make. Two approaches to measurement of the costs of congestion have been developed. Fisher and Krutilla (1972) measure the costs of congestion in a wilderness area by the number of trail encounters during a hike. While the premise that damages are directly related to the number of encounters may be correct, their method leads only to an ordinal measure of congestion, not a cardinal method that might be used to measure costs in dollar terms.

A more interesting approach was developed in an unpublished paper by Hastings and Tolley (1966). Their hypothesis, tested on Long Island recreation areas, was that the demand for space by recreationists was reflected in the distance that they were willing to drive in order to reach a less crowded facility. Assuming that the adjustment of crowdedness between beaches on Long Island was "efficient" in that the marginal user was indifferent between which site he chose, and that the majority of the users were from New York City, then the additional round-trip travel costs necessary to reach a recreation area where each recreationist enjoyed an additional unit of land reflected the value of that additional unit. The demand for open space is therefore the first derivative of the functional relationship between acres per visitor and travel costs.

If the demand for visits is not infinitely elastic, then the effect of an expansion of capacity of any park will be to reduce the density in all parks, which will have a benefit of half the reduction in travel costs to attain any given level of space, multiplied by the number of visitors enjoying that level of space. Thus in Figure E-1, DD' represents the relationship between price of space and the quantity consumed for a recreationist, where the price of space is the cost of travelling the additional distance needed to enjoy the extra space. Assume for simplicity that there are n parks and that all recreationists have identical tastes for open space. Then densities will adjust so that to enjoy S_i space, the recreationist at that site will have had to expend ODa_iS_i in total travel costs. Users will then be indifferent between sites. Assume that the capacity at any given site is expanded. If the demand for visits is not infinitely elastic, then the amount of space at each site will increase, so that for the same expenditure, instead of S_i acres a visitor can now get S_i'. This additional space will be worth $a_ia_i'S_i'S_i$ (shaded in Figure E-1).

Densities will adjust so that each recreationist enjoys the same additional benefits, which implies that the farther away from the city the park is, the greater will be the reduction in density. For diagramatic simplicity, assume that the parks are so distributed so that S_i is the average quantity of space per recreationist and that the demand curve is a straight line so that $S_i' - S_i$ (=1)

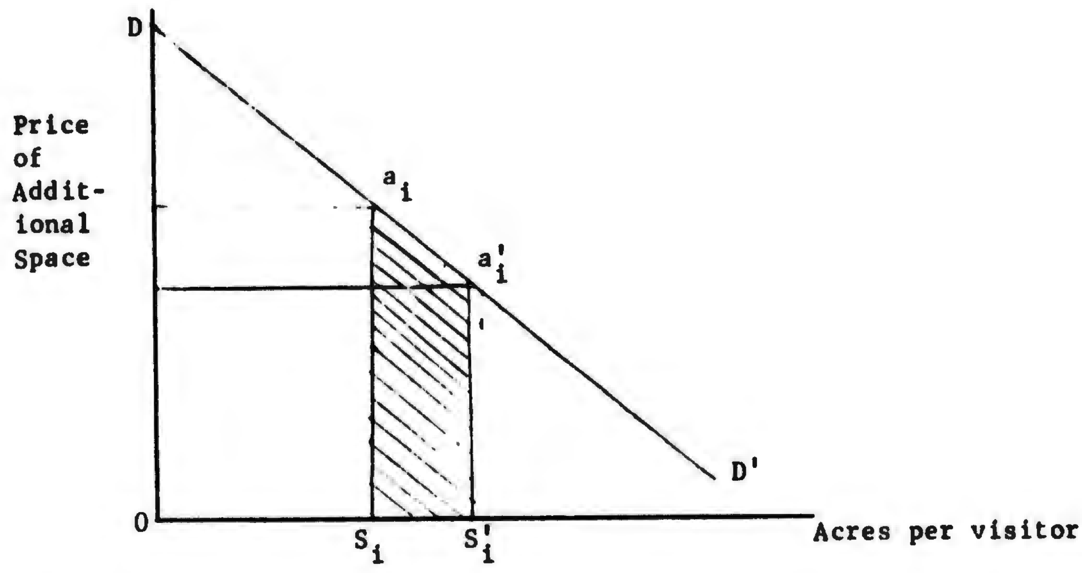

FIGURE E-1. Demand for space and the value of capacity expansion.

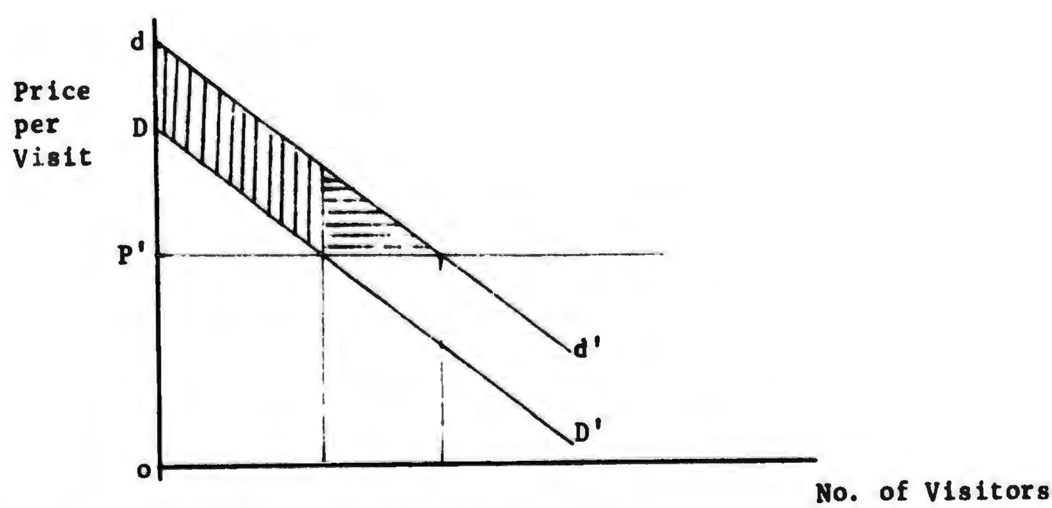

FIGURE E-2. Demand for visits and the value of capacity expansion.

is the average increase in space resulting from the expansion of capacity, and that originally there were N visitors, and that this increases to N'. The value of the extra capacity

$$\bar{B} = NP_i + \frac{1}{2}\left[N'-N\right]P_i$$

where NP_i is the value of the additional space to those who were originally visiting parks, and $\frac{1}{2}\left[N'-N\right]P_i$ is the value to those recreationists who are induced to visit following the extra capacity.

Figure B-2 shows this in a different way. DD' is the demand curve for visits to to one of the n parks. The reduction in density at the park shifts the demand curve outward to dd'. The cost of visiting the park remains unchanged at P'. The vertically shaded area reflects the value of the additional space at that site to those who were already visiting the park (P_i) while the horizontally shaded triangle represents the value of this space to new visitors.

A number of studies have found that the level of congestion affects the number of visits that are made to a recreation area. The work of Seneca, Adams, and Davidson (1968), using ORRRC data for visits to the TVA lakes identified a lag response in the number of visitors to the level of congestion. While such studies are important in identifying congestion as a problem, only in the research by Hastings and Tolley (1966) has an analytic technique for actually measuring the damages that congestion causes been set out.

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