

*TRANSPORTATION RESEARCH RECORD 786*

# Parking

*TRANSPORTATION RESEARCH BOARD*

*COMMISSION ON SOCIOTECHNICAL SYSTEMS  
NATIONAL RESEARCH COUNCIL*

*NATIONAL ACADEMY OF SCIENCES  
WASHINGTON, D.C. 1980*

**Transportation Research Record 786**

Price \$4.20

Edited for TRB by Mary McLaughlin

mode

1 highway transportation

subject area

54 operations and traffic control

**Library of Congress Cataloging in Publication Data**

National Research Council. Transportation Research Board.

Parking.

(Transportation research record; 786)

Reports presented at the 59th annual meeting of the Transportation Research Board.

1. Automobile parking—Addresses, essays, lectures. I. National Research Council (U.S.). Transportation Research Board. II. Series.

TE7.H5 no. 786 [TL175] 380.5's [388.4'74] 81-9573

ISBN 0-309-03200-8 ISSN 0361-1981 AACR2

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# Overview of Implemented Parking Management Tactics

JOHN F. DiRENZO, BART CIMA, EDWARD BARBER, AND WAYNE BERMAN

The operating characteristics of parking management tactics that are being used by a variety of jurisdictions throughout the United States are identified and reviewed. The assessment is based on an extensive literature review, followed by telephone interviews and on-site investigations. Six categories of parking management tactics are identified: (a) on-street supply, (b) off-street supply in activity centers, (c) pricing, (d) enforcement and adjudication, (e) fringe and corridor parking, and (f) marketing tactics. These tactics are generally part of the overall transportation system management plan to meet local transportation, economic, and environmental goals. The tactics reviewed include policies that offer incentives for multi-occupant-automobile travel and short-term parking for shoppers. Disincentives such as parking tax surcharges are also evaluated. The first four categories of tactics are discussed in detail.

A number of reports and articles have been published on the general topic of transportation system management (TSM) and related tactics. However, relatively little information is available on the types and effectiveness of parking management tactics that have been and are being implemented by local governments in many parts of the nation. In response to this need for information, the Federal Highway Administration (FHWA) is funding a comprehensive study of parking management (1). This paper, which uses information and analyses from that study, has the following specific objectives: (a) to identify the types of parking management tactics in use in selected jurisdictions and (b) to discuss the operational characteristics and impacts of such parking management tactics. The jurisdictions discussed here are considered to have parking management tactics and programs that are among the most comprehensive, ambitious, and (in some instances) innovative ones currently in use.

The information and data used to describe implemented parking management tactics were compiled from three sources:

1. An extensive review of available literature on parking management was performed to describe the tactics and jurisdictions of interest. A particularly valuable source of information was a national survey of parking management activities conducted in 1977 by the Virginia Highway and Transportation Research Council (2).

2. Many telephone interviews were conducted to verify available information and to obtain additional information on parking management tactics implemented by local governments. The jurisdictions contacted were asked to provide reports, ordinances, and related materials describing their parking management tactics.

3. Jurisdictions that have particularly comprehensive and innovative tactics were the subject of on-site investigations. A total of 13 communities were visited to obtain first-hand information on their parking management activities.

## PARKING MANAGEMENT

Although the term parking management is widely used in transportation planning and traffic engineering, a generally accepted definition of the term has not been developed. To many planners, engineers, elected officials, and others, parking management tactics appear to be viewed primarily as disincentives or restrictive actions intended to (a) discourage automobile travel, particularly travel by single-occupant automobiles; (b) control or reduce the

supply of parking; or (c) increase parking rates. This perception may be related to the parking management controls that gained widespread attention in the early 1970s through the promulgation of transportation control plans by the U.S. Environmental Protection Agency (EPA) for urban areas that did not meet air quality standards. This "restrictive" perception of parking management is only one aspect of such tactics and, in fact, is not consistent with the application of parking management tactics by many jurisdictions.

Simply stated, parking management tactics are actions taken to alter the supply, operation, and/or parking demand of a jurisdiction's parking system to further the attainment of local transportation, economic, environmental, and other objectives. A parking management program is an integrated set of parking management tactics designed to further the attainment of local objectives. For example, a parking management program could include a marketing program, strict enforcement of on-street parking regulations, construction of fringe parking facilities, and a residential parking-permit program.

It is important to note that a jurisdiction's parking management program may not be documented in a single, fully integrated planning study or policy statement. Nevertheless, for the purposes of this research, such combinations of tactics are considered parking management programs.

A key element of the above definition is the link between a parking tactic and the objectives of a jurisdiction. In some communities, parking management tactics and programs have been implemented to reduce or constrain automobile traffic and alleviate its negative impacts. In other communities, the tactics and programs are intended to encourage nonwork travel (e.g., travel by shoppers and tourists) to central business districts (CBDs) as a means of promoting economic growth. Some jurisdictions have used such tactics and programs to promote more efficient use of their existing parking facilities. Generally, many of these factors are of concern to local governments in planning, implementing, and operating a parking management program.

The above definition of parking management tactics is consistent with the broader concept of TSM, which includes both incentives and disincentives to encourage the efficient use of the existing transportation system and applicable local and regional objectives.

## TYPES OF PARKING MANAGEMENT TACTICS

In order to focus the analysis, six categories of parking management tactics were identified:

1. On-street parking supply,
2. Off-street parking supply in activity centers,
3. Fringe and corridor parking,
4. Pricing,
5. Enforcement and adjudication, and
6. Marketing.

Specific tactics within these categories are described later in this paper.

## STATE OF THE ART IN PARKING MANAGEMENT

### Overview of Parking Management Tactics and Programs

This analysis examined parking management tactics

and programs in 20 communities: Alexandria and Arlington, Virginia; Baltimore and Montgomery County, Maryland; Boston and Cambridge, Massachusetts; Eugene and Portland, Oregon; Chicago, Illinois; Hartford, Connecticut; Honolulu, Hawaii; Madison and Milwaukee, Wisconsin; Seattle, Washington; St. Paul, Minnesota; Los Angeles, Palo Alto, and San Francisco, California; Washington, D.C.; and Vancouver, British Columbia.

Figure 1 identifies the parking management tactics used or under serious consideration by each of the 20 jurisdictions and details the various types of tactics that fall under the six broad categories of parking management tactics previously cited. The jurisdictions that have the most ambitious parking management programs are Baltimore; Boston; Montgomery County, Maryland; Portland; San Francisco; Seattle; and Washington, D.C. Each of these jurisdictions has implemented multiple tactics that generally cover each of the six categories of tactics cited.

#### On-Street Parking Supply

Our survey revealed that residential parking-permit programs (RPPPs) were the most widespread form of innovative on-street parking tactics. Some communities have operated RPPPs for more than five years, and it appears that many more areas will be giving serious consideration to the prohibition of nonresident parking. Another on-street tactic that is receiving attention is the policy of reserved parking spaces for carpools. Both of these tactics are described below.

#### Residential Parking-Permit Programs

##### *Description*

RPPPs were first initiated in the early 1970s and have become an increasingly popular method of preventing long-term parking by commuters in residential neighborhoods that are close to employment centers. The initiation of these programs was marked by numerous lawsuits that alleged unconstitutional discrimination between residents and nonresidents of such neighborhood areas. In 1977, however, the U.S. Supreme Court upheld the constitutionality of RPPPs, and it appears that many communities will be using this tactic in the near future (in addition to existing programs).

RPPPs are typically implemented to control the excess parking demand created by persons who live outside a neighborhood but park their vehicles there in order to shop, work, or attend school nearby. Major parking generators that have led to the use of RPPPs include employment centers, universities, hospitals, retail trade centers, and transit terminals.

##### *Planning and Implementation*

Planning responsibilities for an RPPP are usually vested in the city planning agency or traffic engineering department, depending on which agency is historically responsible for local parking management. In several communities, the planning function was transferred from the planning department to the traffic department after the overall program design was established and an ordinance providing for the creation of additional RPPP districts was passed. Although some communities have enacted ordinances that allow the city government to implement RPPPs at their administrative discretion (or based on criteria specified in the ordinance), other cities, such as Washington, D.C., and San Francisco, require

the mayor and/or the city council to approve each petition for an RPPP in a particular neighborhood.

With the exception of the citywide RPPP in Cambridge, Massachusetts, RPPPs have been implemented in specific neighborhoods or subareas within cities because of the local nature of the parking problems that RPPPs are designed to address.

Almost all of the ordinances that cities have adopted for creating residential parking-permit zones require occupancy counts before an area can be designated for permit parking. These ordinances typically contain usage criteria that must be met by a neighborhood or a district if it is to be eligible for an RPPP. The criteria generally require that a traffic survey conducted during peak parking periods reveal 75 percent overall use of available parking space and at least 15 percent nonresident use (these criteria vary by locale and range from 50 to 80 percent for overall occupancy and from 10 to 50 percent for nonresident occupancy).

Restrictions on nonresident parking range from complete prohibition to limited parking privileges. Some communities, such as Alexandria, Virginia, and Boston, permit nonresidents to park for 2 or 3 h during the time the RPPP is in effect. Communities that allow nonresident parking for limited periods are frequently trying to preserve short-term parking opportunities for shoppers and business clients while preventing long-term nonresident parking. A limitation of this approach is the increased level of enforcement required to monitor the duration of nonresident parking. If nonresident parking is allowed for as long as 3 or 4 h, commuters may try to circumvent the policy by moving their cars from one location to another within the zone during the day.

##### *Costs*

Start-up costs for RPPPs depend on the scale of the program and the administrative procedures adopted to implement it. The city of San Francisco allocated \$65 000 in its last budget to cover the costs of one full-time staff engineer, one part-time supervising engineer, and two technicians assigned to the RPPP. Material costs were about \$65/sign (installed) plus printing costs for designation materials and permits. San Francisco has three relatively large RPPP districts in operation and plans to implement 15-20 additional districts in the next few years. Alexandria, Virginia, on the other hand, implemented a much smaller RPPP (about 55 block faces in two districts) for about \$13 000. These start-up costs included signing, registration materials, and permits and a part-time administrative assistant to distribute the permits. Implementation of a 70-block-face RPPP in Montgomery County, Maryland, cost approximately \$4000 for personnel and \$2955 for sign fabrication and installation.

In Washington, D.C., the District of Columbia Department of Transportation (DOT) estimated annual costs for a typical 100-block RPPP zone as follows:

<u>Item</u>	<u>Cost (\$)</u>
Signs, labor, and materials (annualized)	5 000
Administration, computer support, and overhead	5 000
Clerical staff to issue permits and maintain records	3 000
Printing of permits and purchase of supplies	2 000
Total	15 000

The city DOT projects permit sales for the area to be 3000 permits at \$5 each for total revenues of

Figure 1. Parking management tactics in use by or proposed for 20 selected jurisdictions.

Parking Management Tactics	Jurisdiction																			
	Alexandria, Va.	Arlington, Va.	Baltimore	Boston	Cambridge, Ma.	Chicago	Eugene, Ore.	Hartford, Conn.	Honolulu	Los Angeles	Madison	Milwaukee	Montgomery County, Md.	Palo Alto, Calif.	Portland, Ore.	St. Paul, Minn.	San Francisco	Seattle	Vancouver, B.C.	Washington, D.C.
<b>On-Street Supply</b>																				
Residential Parking Permit Program (RPPP)	●	●	●	●	●	●						●	●	○			●	●	●	●
Carpool/Vanpool Preferential Parking															●			●		
Institutional TSM Plans																	●	●		
<b>Off-Street Supply in Activity Centers</b>																				
<b>Expand or Restrict Supply in CBD and Activity Centers</b>																				
<b>Zoning Requirements</b>																				
— Maximum and No Minimum Parking Requirements										○				●	●	●	●	●		
— Joint Use										○				●	●	●	●	●		
<b>Constrain Normal Growth in Supply</b>																				
— Maximum Ceiling (i.e., Freeze) on CBD Supply				●						○				●	●	●	●	●		
— Reduced Minimum Parking Requirements Through HOV and Transit Incentives		●				●				○				●	●	●	●	●		
— Restrict Principal Use Parking Facilities						●								●	●	●	●	●		
<b>Construct New Municipally-Owned Parking</b>																				
— CBD				●										●	●	●	●	●		
— Neighborhood Shopping Districts				●										●	●	●	●	●		
Carpool/Vanpool Preferential Parking	●		●	●				●		○		●				●	●	●	●	
<b>Fringe and Corridor Parking</b>																				
<b>Fringe Lots</b>																				
Park and Ride Lots			●					●							○	●	●	●		
Carpool/Vanpool Lots			●					●								●	●	●	●	
<b>Pricing</b>																				
<b>Increase Parking Rates</b>																				
<b>Differential Pricing Programs</b>																				
— Rates Favor Short-Term Parker									●		○		●			●	●	●	●	
— Geographical Rate Differentials									●				●			●	●	●	●	
— Carpools/Vanpools													●			●	●	●	●	
Free Downtown Parking							●									●	●	●	●	
Parking Tax																	●	●	●	●
Surcharge on Parkers Arriving During "Prime Time" (i.e., 6:30 - 9:30 am)											○						●	●	●	●
<b>Enforcement and Adjudication</b>																				
● Aggressive Ticketing				●	●		●					●				●	●	●	●	●
● Booting				●	●														●	●
● Towing				●	●														●	●
● Administrative Adjudication																			●	●
● HOV Enforcement			●															●	●	●
<b>Marketing</b>																				
<b>Monthly Parking Convenience Stickers</b>																				
Advertising (Media Ads, Brochures, Maps)							●		●				●			●	●	●	●	●

○ Increase Rates For City Employees

Key:  
 ● - Implemented  
 ○ - Planned

\$15 000. These estimates do not include the costs or revenues associated with program enforcement.

#### *Impacts*

Without exception, communities that have implemented RPPPs feel that the parking problems they hoped to correct were substantially or completely resolved. Usage studies conducted before and after the implementation of RPPPs in Washington, D.C., and San Francisco suggest the magnitude of the impacts generated by RPPPs.

The San Francisco Division of Traffic Engineering conducted a parking survey of RPPP area A in the fall of 1976. The survey discovered that, with 4191 legal on-street parking spaces, there were 4320 vehicles parked at 1:00 p.m., an occupancy rate of 102 percent. Fifty-two percent of all parking was composed of commuter vehicles. In October 1978, after the RPPP was implemented, another survey was conducted in which an overall occupancy of 94 percent was recorded and 35 percent of the parked vehicles lacked resident stickers (2-h nonresident parking is permitted in area A). A postcard survey of residents of area A conducted at the same time indicated that 74 percent of the respondents favored the continuance of the program (based on a 29 percent return).

The District of Columbia DOT conducted before-and-after surveys for the two permit areas of Friendship Heights and Georgetown. In Friendship Heights, parking-space occupancy fell from 96 to 42 percent. Because of the large number of illegal parkers, occupancy in Georgetown decreased from 109 to 91 percent. Both of these studies were based on the number of legal spaces in the area.

#### Preferential Parking for Carpools

##### *Description*

Portland, Oregon, and Seattle have implemented on-street parking programs for carpoolers. Basically, these programs allow participants to park downtown all day at specific metered locations, for relatively small monthly fees, by displaying permits that they have purchased. The objective of the program is to increase high-occupancy-vehicle (HOV) travel.

The two programs differ in several respects. In Portland, carpoolers purchase \$15 monthly permits that allow them to park at any of the 2615 specified meters. Other parkers may also use these spaces, but carpoolers are exempted from the 6-h parking limit and do not have to pay the meters. Essentially, the Portland permit is a "license to hunt" for a space. The incentives are monetary savings and relief from the 6-h parking limit. The city of Portland issues a maximum of 500 permits/month.

The Seattle program reserves 164 specified spaces for carpoolers between 7:00 and 9:00 a.m., after which time the spaces become available to the general public. Spaces are not assigned to individual carpools but, since the program has issued only 193 permits, carpoolers can reasonably expect to find a space in the morning. The monthly fee is \$5, and the carpool does not pay the meter.

Carpools are defined in both programs as groups of three or more people. One transferable permit is issued for each valid carpool application. Both Seattle and Portland carefully check and verify the information provided on applications. Workplace and location of residence are scrutinized as a further check. The permits are renewed either monthly or quarterly, and random checks are made to ensure that

the carpool information furnished is still valid.

Portland's expenditures between September 1977 and February 1978 for the 288 carpool permits sold were \$7564. Total costs for program promotion and application processing and verification were \$4827, and total materials costs were \$2736.

#### *Impacts*

Average vehicle occupancy for participants in the Portland program is 3.3 persons, and in Seattle the average is 3.18 persons. A survey of participants in the Portland carpool program produced the following results:

1. Of the 58 percent of the respondents who were new carpoolers, half were former bus riders and half formerly drove with fewer than three riders;
2. Forty percent were already in three-person carpools; and
3. Cost saving was the primary reason for becoming involved in the program.

These results indicate that about two-thirds of the people subscribing to the Portland program were already carpooling or previously used transit.

#### Off-Street Parking Supply in Activity Centers

##### *Description*

Table 1 summarizes the off-street parking management tactics used by the communities studied and identifies the responsible agency, area of application, operating characteristics, degree of compliance, and the impacts of the tactics. The following discussion reviews the planning, implementation, operation, and impacts of these off-street parking management tactics.

The cities of Portland, San Francisco, and Seattle are using development controls to restrict the growth of CBD parking supply. They have combined a "no-minimum" parking requirement with a low maximum parking limit to discourage increased parking construction. At 1 space/1000 ft<sup>2</sup>, the limits in Portland and Seattle are comparable with those in most areas (Table 1). The San Francisco limit of 7 percent of the gross floor area translates to approximately 75 parking spaces for the average downtown high-rise development, according to local officials. The application of these zoning regulations occurs in the development review process. In Seattle, state environmental protection laws require the filing of an environmental impact statement (EIS) for new CBD developments. This step may increase development time and cost but gives the community more opportunity for comment.

The three examples of joint use of parking facilities in Table 1 are really a mixture of zoning and administrative actions. The proposed Los Angeles and existing Portland and Palo Alto codes allow developers to jointly use a parking facility to meet zoning requirements. In Los Angeles and Palo Alto, joint use is allowed only if the demand patterns do not conflict (e.g., daytime and nighttime use). Portland allows the pooling of spaces in one structure. Portland recently reached an agreement with a developer to increase the number of short-term spaces in an adjacent city garage to help meet the projected parking-supply requirements of the development. Finally, Montgomery County leases excess capacity in a public garage to a local college. If existing county-owned facilities are underused, joint use allows the county to increase facility use without increasing parking supply.

The two examples of maximum-supply ceilings given

in Table 1 are significantly different. Boston has frozen the total number of commercial spaces, and the ceiling does not affect free employee or customer spaces. The Portland ceiling places a limit on the total number of parking spaces in the CBD, including on-street, off-street, municipal, and private spaces. Further, the Portland CBD is divided

into sectors for the allocation of spaces. The Boston program is part of the air quality improvement plan, and parking space permits are issued by the Boston Air Pollution Control Commission. Although the ceiling in Portland is also partly an air quality measure, the program is enforced by the Portland Planning Commission as part

Table 1. Characteristics of various parking management tactics for off-street parking supply.

Tactic	Jurisdiction	Agency	Area	Operating Characteristics	Enforcement	Impact	
Expand or restrict parking supply in CBD and activity centers	Maximum and no minimum parking requirements	Portland, OR	Planning Commission	CBD	Maximum allowed parking for retail or office development = 1 space/1000 ft <sup>2</sup>	Development review process	In conjunction with other tactics has resulted in 1 space/1350 ft <sup>2</sup> for new developments
		San Francisco	City Planning Commission	CBD	Parking limited to 7 percent of gross floor area	Development review process	Moderate growth in private off-street parking versus high growth in downtown office and retail space
		Seattle	Department of Buildings	CBD	Depending on zone and use, range in maximum allowed parking = 1 space/1000 ft <sup>2</sup> to 1 space/2000 ft <sup>2</sup>	EIS review	Parking supply increasing in areas farther from retail core and decreasing closer in
Joint use	Los Angeles	Planning Commission	Entire city	Would allow developments within 1500 ft to share parking if demand patterns do not conflict	Land covenant; performance bond	Proposed action	
	Montgomery County, MD	Division of Parking	Suburban CBDs	Spaces rented by local college for use by students	Parking patrol checks for valid stickers	Impacts of student parking reduced	
	Portland, OR	Planning Commission	CBD	City has agreed to increase number of short-term spaces in city garage if developer reduces number of off-street spaces provided; code allows developers to share parking	Development review process	Development under construction	
Constrain normal growth in supply	Palo Alto	Department of Planning and Community Environment	Entire city	Reductions of up to 20 percent allowed for developers without conflicting demand patterns	Development review process	—	
Maximum ceiling (i.e., freeze) on CBD supply	Boston	Air Pollution Control Commission	CBD	Limit on total number of allowable commercial spaces; freeze does not apply to free employee and customer parking	Development review process	Development not hindered	
	Portland, OR	Planning Commission	CBD	Limit on total number of allowable parking spaces by sector	Development review process	Ceiling not reached; parking in desired sectors encouraged; development not hindered	
Reduced minimum parking requirements through HOV and transit incentives	Arlington, VA	Zoning Administration	Entire county	Developers located near rail rapid transit station may provide approximately 70 percent of required parking	Development review process	Should reduce commuter parking impacts	
	Chicago	Zoning Administration	CBD	Required parking reduced if developer meets certain conditions concerning transit stations	Development review process	1000 fewer spaces in CBD since 1975; 110-story building (Sears Tower) constructed with 150 spaces	
	Los Angeles	Planning Commission	Entire city	Parking requirements would be reduced if developer provides HOV and transit incentives; developer would be allowed to substitute on-site spaces for off-site park-and-ride spaces; developer would be able to reduce required parking by 1.5 spaces for each space reserved for HOVs	Land covenant; development review process; developer would contribute money for park-and-ride facility development and transit shuttle services	Proposed actions	
	Palo Alto	Department of Planning and Community Environment	Entire city	Up to 20 percent reduction in required parking allowed if transit and HOV incentives are used	Development review process; legal agreements	Agreement by several new developments to institute HOV incentives	
	Chicago	Zoning Administration	CBD	Construction of principal-use parking facilities prohibited	Development review process	1000 fewer parking spaces since 1975; increase in number of long-term parkers	
Restrict principal-use parking facilities	San Francisco	Planning Commission	CBD	Conditional use review of new principal-use parking facilities required	Development review process	—	
	Seattle	Department of Buildings	CBD	New parking lots prohibited; new parking structures prohibited in most of CBD	Development review process	No new principal-use facilities built since 1976; economics a major factor	



Table 1 continued.

Tactic	Jurisdiction	Agency	Area	Operating Characteristics	Enforcement	Impact
Construct new municipally owned parking facilities CBD	Baltimore	City	CBD	New facilities for tourists and shoppers in Capital Improvement Plan	NA	Facilities planned and under construction
	Montgomery County, MD	Division of Parking	Suburban CBDs	New parking structures constructed to meet long- and short-term demand	NA	Employers and shoppers encouraged to work and shop in suburban CBDs
	Portland, OR	Downtown Development Commission	Retail core of CBD	Recently completed 492-space garage, 752-space garage under construction; designed for short-term use only; \$0.60/h merchant stamp program	NA	Merchants pleased by increased supply of short-term parking
Neighborhood shopping districts	Los Angeles	City DOT	Various neighborhoods	More than 7000 spaces in more than 100 facilities provided	NA	Attractiveness of shopping districts increased
	San Francisco	Parking Authority	Various neighborhoods	Program begun to increase number of available short-term spaces	NA	Merchants supportive; less impact on surrounding neighborhoods
Preferential parking for carpools and van-pools	Alexandria, VA	City	CBD	Spaces reserved for ≥3-person city employee carpools; city vehicles available to carpools	Applications cross checked	15 pools in program
	Los Angeles	City	At city facilities	Free reserved spaces for city employees proposed	—	Proposed action
	Montgomery County, MD	Division of Parking	Suburban CBDs	55 spaces reserved for ≥3-person carpools at \$16/month versus normal fee of \$24/month	Vehicles must arrive with >3 occupants	48 pools in program

of the development review process.

Both Arlington, Virginia, and Chicago allow developers to reduce the amount of required parking if certain transit-related conditions are met. For example, developments located near Metrorail stations in Arlington have lower parking requirements than comparable developments located elsewhere in the county.

The proposed Los Angeles and existing Palo Alto zoning codes provide for reduced parking in exchange for developer-funded HOV and transit service incentives. The Los Angeles plan would allow substitution of on-site spaces for the development of off-site park-and-ride facilities and reductions in on-site spaces for dedicated HOV spaces and various mixtures of transit and HOV incentives. Palo Alto zoning codes allow developers to reduce total parking requirements by creating transit and HOV incentives. How to ensure the continued operation of HOV incentives and transit services offered by a developer is of concern to officials in Los Angeles. They have indicated that land covenants may be the most effective way of ensuring the long-term continuation of incentives at several new projects.

Chicago, San Francisco, and Seattle have implemented restrictions on the development of "principal-use" parking facilities. Both Chicago and Seattle have prohibited the development of principal-use parking facilities in all or most of their CBDs. In San Francisco, proposed new principal-use parking facilities must undergo a conditional use review.

Municipalities such as Baltimore, Montgomery County, and Portland are building new parking facilities in CBD locations, whereas Los Angeles and San Francisco are expanding parking supply in neighborhood shopping districts. In Baltimore, Portland, Los Angeles, and San Francisco, the parking facilities are intended primarily for short-term parking. Montgomery County is planning and constructing facilities for both short- and long-term parking. In the new municipal parking facilities in Portland,

the first level is dedicated to commercial and retail use.

Alexandria and Montgomery County are examples of communities that are reserving parking spaces in municipal parking facilities for carpools of three or more persons. However, it should be noted that the number of spaces involved in each jurisdiction is relatively small. Los Angeles has proposed to provide free reserved spaces in city parking facilities for city employees in carpools.

#### Impacts

The most comprehensive applications of parking management tactics involving off-street zoning and parking-supply constraints have occurred in Chicago, Portland, San Francisco, and Seattle. In all four of these cases, the growth of parking supply has been restricted. Supply in Chicago and Seattle has decreased by approximately 1000 spaces over the last several years.

Improvements in transit service in Portland and Seattle have resulted in increased ridership. Average daily transit ridership in Portland increased from 145 000 in 1975 to 180 000 in 1978. Air quality in Portland and Seattle has also improved. In all four cities, development of new commercial spaces has continued despite these restrictions. On the negative side, Chicago has experienced an increase in long-term parking, which implies a decrease in available short-term spaces. The Chicago CBD's share of regional retail sales has also declined from 66 to 58 percent during this time period. The lack of convenient, short-term parking spaces may have contributed somewhat to the decline. Merchants in downtown Seattle have also expressed this concern.

#### Pricing Tactics

##### Description

The review of pricing tactics for parking management indicated that the implemented tactics could be

categorized as follows: (a) general increases in parking rates, (b) preferential parking rates for short-term parkers, (c) preferential parking rates for carpools and vanpools, (d) parking taxes, and (e) other selected tactics, such as merchant parking validation programs and the elimination of monthly parking contracts. Montgomery County, Portland, and San Francisco have implemented multiple pricing tactics to reinforce and complement their other parking management and TSM tactics.

Preferential parking rates for HOVs are significantly less than the typical monthly parking rate for long-term parking. In Montgomery County, the monthly carpool sticker costs only \$16 whereas the standard parking sticker costs \$24. In Seattle, the \$5 monthly cost for an HOV on-street parking permit is dramatically below the comparable long-term monthly meter rate of approximately \$39. The same situation is found in Portland. In an effort to promote vanpools, the California Department of Transportation (Caltrans) instituted \$10 monthly parking rates (the standard monthly rate was \$60) for vanpools that used designated public parking facilities located under freeways adjacent to the San Francisco CBD.

Eugene, Oregon, and St. Paul each offer free downtown short-term parking in municipal parking facilities. The Eugene program involves 3000 spaces and is funded by a complex set of taxes on downtown businesses and professional people. Employees who work in the parking district are prohibited from parking there between 9:00 a.m. and 6:00 p.m. each weekday unless they have a monthly sticker. A limited number of monthly parking stickers are available to employees for \$16/month. Only employees who have valid stickers are exempt from the parking ban.

St. Paul recently developed a plan for the CBD that includes reduced parking rates for short-term parkers and increased rates for long-term parkers. The city is planning fringe parking facilities in conjunction with its proposed downtown people-mover system.

Considerable discussion in the TSM literature has been devoted to the potential benefits of employers not subsidizing employee parking. Increased parking rates are expected to promote transit ridership and the formation of carpools and vanpools and to reduce congestion, air pollution emissions, and energy consumption. Clearly, this is a sensitive labor-relations issue to both management and employees. Management provides such incentives as a way to attract employees and, in some cases, as a fringe benefit explicitly or implicitly built into labor agreements. Employees who have enjoyed free or low-cost parking are frequently strong opponents of proposals to eliminate this fringe benefit.

Two important examples of large employers who have substantially increased parking rates for their employees are the federal governments of Canada and the United States. In Canada, the rates were increased from "no monthly charge" to 70 percent of the applicable commercial rate (approximately \$20-\$24/month). In the United States, the federal government recently implemented a program that requires its employees to pay commercial parking rates in federal facilities. The city of Los Angeles is also considering raising parking rates for city employees.

#### *Impacts*

Parking taxes in San Francisco and Washington, D.C., have generated substantial revenues: \$5.4 million and \$8.0 million, respectively, in FY1978. Preferential HOV pricing tactics have generally been

successful in attracting carpools. The rate of use of the HOV spaces has generally exceeded 75 percent in Montgomery County and Seattle. A survey in Portland determined that 61 percent of the carpools using the on-street carpool spaces were formed as a result of the program.

In Honolulu, the doubling of municipal parking rates to discourage long-term parking resulted in a 6 percent increase in the total number of cars using municipal spaces, a doubling of available parking spaces during the lunch hour, and a 36 percent increase in monthly parking revenues.

In Montgomery County, the higher parking rates resulted in an increase in turnover in short-term parking spaces, from 3.39 to 3.78 vehicles/space. Data are not available on the impacts of higher rates on long-term parking demand and facility use. In the county's Silver Spring Parking Lot District, parking rates were not increased in selected underused off-street facilities in order to attract parkers from other, heavily used areas of the district, but the desired redistribution of parkers did not occur. County officials believe the price differentials may not have been large enough to compensate parkers for the less convenient parking locations.

Increasing parking rates for federal employees in the city of Ottawa had several important travel impacts, including (a) a 23 percent reduction in the number of employees driving to work; (b) an increase in average automobile occupancy, from 1.33 to 1.41 persons/vehicle; and (c) a 16 percent increase in transit ridership among Canadian federal employees.

#### *Enforcement and Adjudication*

In the past few years, several cities have initiated aggressive policies regarding the enforcement of parking regulations in order to increase their general revenues and to improve traffic circulation and the use of on-street parking. In particular, Boston and Washington, D.C., have increased the level of ticketing and have developed procedures to apprehend scofflaws who have not paid outstanding citations. Some cities have dealt with parking enforcement problems by transferring enforcement responsibilities from their police departments to their traffic departments. Unlike regular police, civilian parking patrol officers regard parking violations as their first priority, and they are less expensive to employ than uniformed police officers.

#### *Aggressive Ticketing*

The policy of aggressive ticketing, or strict enforcement of traffic regulations, has been adopted recently by several communities that have a history of lax enforcement and serious problems with illegal parking. Boston, for example, currently employs about 50 parking control aides (PCAs), civilians in the Boston Traffic and Parking Department who were hired largely to augment the police department in enforcing parking laws. The PCAs write about 80 percent of all parking citations (each writes about 100 tickets/day), and the city budgets \$1.24 million/year for them (including supervision and vehicles). In 1976, 1.4 million tickets were issued in Boston.

Washington, D.C., has also chosen to improve its parking enforcement capabilities through the use of civilian PCAs. After a two-week training course, Washington, D.C., PCAs are assigned to foot patrols or vehicles to monitor parking meters, hourly restrictions, and parking regulations. The PCAs are also responsible for identifying vehicles in

tow-away zones and notifying the towing dispatcher. The city DOT estimates that the PCAs will write an additional 1 million tickets/year in excess of the 1.5 million citations/year currently issued, for an approximate daily average of 75 tickets/PCA. For FY1979, the city DOT estimated related expenses for these activities to be \$1.03 million and anticipated gross revenues from fines of \$6.4 million, for a net of \$5.37 million. Studies of parking turnover in the CBD were conducted before and after the enforcement program was initiated. The results showed that the number of legal hours parked at metered spaces increased from 13 to 56 percent and the number of illegal hours decreased from 84 to 31 percent. Turnover increased from 1.2 to 2.9 vehicles/h. In a comparison between the three-month period of November 1977 to January 1978 and the same period in 1978-1979, meter revenues had increased 39 percent.

Another city that has instituted strict enforcement policies is Portland, Oregon. The city employs 24 civilian PCAs in its Bureau of Traffic Engineering. Sixteen PCAs are assigned to the CBD, which is covered at least four times each day. The city budgets \$0.4 million for the enforcement patrol and collects about \$1 million/year in fines. Enforcement of parking-meter regulations and other parking regulations has a high priority in the Portland Bureau of Traffic Engineering because the meter revenues are used to finance the bureau's operations.

#### *Towing*

Many communities have towing operations to remove illegally parked cars that seriously affect traffic circulation or prevent access of emergency vehicles. Boston originally towed the vehicles of scofflaws who had five or more outstanding citations, but capacity constraints in the impoundment lots and the introduction of "Denver boots" led the city to adopt booting as a more cost-effective way to deal with the problem. Boston continues to tow vehicles that are parked in areas such as loading zones and at fire hydrants. But this is an unprofitable activity for the city, since state legislation limits the maximum towing fine to \$12.50 and the estimated cost to the city of towing an automobile is \$39.

In Washington, D.C., city towing is performed by a contractor, who is required to have 25 cradle cranes available for use and must be able to tow approximately 200 cars/day between 7:00 a.m. and 7:00 p.m. The contractor is paid \$19.35/h/crane. This is a substantial saving for the city, since the Police Department estimates that each tow performed by the city costs \$29. The locations of vehicles parked in tow zones or on restricted rush-hour streets are relayed to the towing dispatcher by the PCA, and the vehicle is then marked with a bright orange sticker. The PCA continues on patrol, and the contractor tows the vehicle to an impoundment lot. To retrieve the vehicle, the motorist must pay a \$50 fine plus all outstanding tickets. From January 8, 1979, when the towing program began, through February 1979, 5096 vehicles were towed. The average vehicle towed had \$25 in outstanding fines in addition to the \$50 towing fine. The city expected to net \$4.2 million from this program in FY1979.

#### *Booting*

Booting programs designed to apprehend scofflaws have been implemented in the past few years in Washington, D.C., and Boston. If a motorist has a certain number of outstanding parking citations (five or more in Boston and four or more in Washington), the vehicle is immobilized by clamping

a boot on a front wheel. Boston estimates that there are 52 000 scofflaws on its records; in Washington, D.C., 80 000 vehicles have been issued four or more tickets that have not been paid.

Both cities use teams of spotters who patrol the streets with lists of automobiles whose owners are scofflaws. Boston uses 15 employees from the Comprehensive Employment and Training Act program and Washington sends out 10 teams/day. After a scofflaw's car has been identified, a van carrying boots is notified and an operator comes and attaches the device. Violators must then pay all outstanding fines plus the \$25 booting fine.

In Washington, D.C., gross revenues from the booting program were \$4.1 million in FY1979. Expenses are estimated at \$0.6 million; the net revenue is \$3.5 million. Boots cost \$250 each, and the average ticket value on booted cars in Washington has been \$175. In Boston, the average ticket value has declined from about \$750/automobile when the program was first implemented to about \$160 (this is attributable to the policy in Boston of going after the worst offenders first). Boston currently owns 150 boots and has an additional 100 on order. On an average day in early 1979, 140 cars were booted in Boston.

#### *Administrative Adjudication*

Along with increased enforcement efforts, several communities have investigated the idea of transferring adjudication responsibilities from city criminal courts to traffic departments. The advantage of this transfer, like that of using civilian PCAs, is that the traffic department will place a higher priority on parking enforcement. In addition, the records can be centralized in one agency. Another advantage of this concept is that it allows the traffic department to administer penalties that are consistent with its ticketing policies. According to local officials, traffic departments in Boston and in Madison, Wisconsin, have been "frustrated" in their parking enforcement efforts by the courts, which fail to impose serious fines on blatant scofflaws and parking violators. Boston has proposed the creation of a Bureau of Parking Violations but has been unsuccessful in getting the necessary enabling legislation from the Massachusetts State Legislature.

Washington, D.C., recently organized two new bureaus within the city DOT: the Bureau of Parking and Enforcement and the Bureau of Traffic Adjudication. The Bureau of Traffic Adjudication is responsible for the processing of all parking tickets and minor traffic violations (major traffic offenses are still tried in criminal court). The program of traffic adjudication was recently implemented, and data on its operation (e.g., violations processed) are not available at this time.

#### *SUMMARY*

The objective of this paper has been to identify, assess, and document the use of new and innovative parking management tactics in urban areas. The information compiled in this project and that available in the literature indicate that there is considerable interest and experience in the use of parking management tactics around the country. Many different types of parking management tactics have been implemented or are under serious consideration for implementation in the near future. Some local jurisdictions have implemented comprehensive parking management programs that include changes in onand off-street parking supply; restrictive zoning provisions on new parking construction; pricing changes



to encourage short-term, carpool, and vanpool parking; construction of fringe and park-and-ride lots; stricter enforcement; and the use of RPPPs. Communities that have implemented such comprehensive programs include Boston, Portland, San Francisco, Seattle, and Washington, D.C. Other communities around the nation have implemented selected new and innovative tactics to meet local objectives and problems.

Based on the detailed assessment of the 20 communities cited earlier in this paper, the most widely used innovative parking management tactic is the RPPP. Extensive use has also been made of park-and-ride lots; preferential parking spaces and rates for carpools and vanpools; zoning changes to reduce the growth of parking supply; supply, pricing, and marketing incentives to encourage short-term (e.g., shopper) parking; and aggressive enforcement tactics, such as ticketing, towing, and booting.

Many factors have contributed to the growing interest in parking management tactics. In some areas, including Boston, Portland, San Francisco, Seattle, and Los Angeles, EPA requirements in the early 1970s to develop parking management plans led to the development and application of new parking policies and tactics. Many communities have shown great interest in implementing actions to discourage work-trip commuting by automobile, particularly by single-occupant automobile. The joint FHWA/Urban Mass Transportation Administration TSM regulations have also encouraged local jurisdictions and regional agencies to develop coordinated TSM plans and programs to achieve transportation and related objectives.

The ruling of the U.S. Supreme Court upholding the legality of the Arlington, Virginia, RPPP has given a major impetus to the implementation of such tactics throughout the nation. Other factors that are generating interest in parking management tactics and programs include the nation's efforts to conserve energy and improve air quality in urban areas.

Local governments are primarily responsible for initiating, planning, implementing, and operating tactics of interest. The types of agencies actively involved in parking management activities include

local parking authorities, traffic engineering departments, city planning departments, zoning and planning commissions, carpool agencies, and, in selected instances, transit agencies. Although many metropolitan planning organizations are interested in parking management, most acknowledge that the power to plan and implement such tactics rests primarily with local governments. The highly localized impacts of many parking management tactics also suggest that local governments must take an active role in initiating and implementing such tactics.

Although many jurisdictions are attempting to slow the growth of downtown parking facilities, many of these same jurisdictions are endeavoring to increase the supply and attractiveness (e.g., the location and rates) of short-term parking. Such parking is considered to be highly important to maintaining and encouraging the economic development of CBDs and other older commercial areas. In some jurisdictions, such as Los Angeles, there is strong feeling within the city government and the business community that an attractive parking system must be available to promote CBD development that might otherwise occur in suburban areas.

The implementation of transit and HOV incentives in conjunction with parking management disincentives is a growing practice that helps to encourage support by community members. Some communities contacted during the project were reluctant to implement "strong" parking management tactics unless alternative transportation modes and service were improved.

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*Publication of this paper sponsored by Committee on Parking and Terminals.*

## Impact on Commuters of a Residential Parking-Permit Program in Alexandria, Virginia

MARIE L. OLSSON AND GERALD K. MILLER

The results of the first empirical assessment of the impact of residential parking zones on commuter behavior are discussed. Residential parking zones, areas where on-street parking is short-term (usually 2-3 h) for all cars except those owned by people who live in the zones, have been adopted in at least 40 communities where there is competition between residents, commuters, and others for on-street parking spaces. Some policymakers appear to believe that such measures may induce commuters who used to park in curbside spaces to change to transit or to carpool. In a survey of drivers who commuted to the central business district of Alexandria, Virginia, it was found that, after residential parking zones were adopted in that area, only 12 percent of the sample changed commuting modes from single-occupant automobiles to either transit or carpools. Most commuters continued to drive alone but changed location to either off-street parking (frequently subsidized by their employer) or streets outside the districts.

A number of urbanized communities in the United States have, over the past few years, delineated residential parking districts to grant residents of certain neighborhoods special on-street parking privileges and to restrict on-street parking by all others. This has typically been done in neighborhoods that have suffered from parking shortages or other traffic-related problems because of their proximity to major trip attractors. Within districts that have implemented such parking policies, streets where parking previously had been unregulated are usually limited to short-term parking except for residents of the area, who may purchase

permits for a nominal fee to be displayed on their cars to show that they are exempt from the time limits. The stated purposes of these districts are usually to reduce congestion, improve air quality, encourage the use of transit, expand the parking supply for residents, and maintain a residential quality of life in the neighborhoods.

Even though such plans have been adopted in at least 40 communities in the United States and many others are considering such plans, it appears that the study described here is the first empirical assessment of the impacts of these regulations.

#### LIKELY IMPACTS OF RESIDENTIAL PARKING REGULATIONS

Many impacts on nonresidents and residents have been hypothesized for residential parking regulations. Commuters or others who can no longer park all day on streets in these districts may change their parking locations to off-street facilities or may park on unregulated streets just outside the districts. Those who change to parking in commercial facilities may form carpools in order to share the costs of parking. Others may switch to transit. Nonresidents may remain in the parking districts and move their cars from one space to another to conform to the time limits. If nonresidents are not given adequate transit or parking alternatives, one long-range impact may be a change of trip destination. Transit service to the area could be augmented if more commuters ride to avoid parking costs, and this could have a broad, long-term impact on travel to the area.

Residential parking districts probably have different impacts on nonresidents who normally park for short periods of time, such as shoppers, people conducting personal business, and employees whose offices are in the area but whose jobs require them to use their cars a great deal. If a permit plan is successful in opening up on-street spaces that were previously occupied by long-term parkers, short-duration trips to the area may increase. This may fulfill some urban policy objectives, such as encouraging shopping, but it may work against others, such as reducing automobile emissions and discouraging "outsiders" from parking on residential streets.

The group directly affected by residential parking districts is, of course, the residents. Since parking districts have usually been implemented where residents have had a hard time finding convenient on-street space, the new parking regulations will probably significantly increase the on-street parking supply for residents. The new districts could lead to increased automobile travel by residents and may in the long run lead to increased automobile ownership.

The degree to which residential parking districts will prompt any of these changes will vary from neighborhood to neighborhood. Impacts in any one neighborhood will depend on several factors, including existing parking supply and demand, the price of off-street parking, transit service to the area, and the stringency with which the regulations are enforced.

#### ALEXANDRIA, VIRGINIA, PARKING DISTRICTS

Although it is a close suburb of Washington, D.C., Alexandria, Virginia, has a unique and active central business district of its own, usually referred to as Old Town. Extensive restoration of colonial townhouses and construction of new townhouses, the presence of specialty shops and restaurants, the cobblestone streets and brick sidewalks, and the growing number of offices in the area have created a

pleasant urban atmosphere in a relatively tranquil setting on the Potomac River.

Both the number of employees and the number of high-income residents in the area have continued to grow since the mid-1960s. About 7000 residents live in the Old Town area, and more than 20 000 people work there. A 1974 survey of Old Town workers indicated that about 70 percent drove an automobile, 10 percent were automobile passengers, 10 percent used buses, and 9 percent walked to work. About 45-50 percent of those who drove to work parked on the street.

The city leadership has become concerned about traffic and parking problems brought about by the increased development in Old Town. On January 1, 1979, the city implemented a residential parking-permit plan for approximately 105 block faces (about 1800 parking spaces) in the area. This created two districts, located on either side of a main retail street. The city ordinance that implemented the districts states that creation of the districts would help solve the following problems: (a) hazardous traffic conditions, (b) air pollution, (c) excessive noise, (d) the accumulation of trash and refuse, and (e) the inability of residents to "gain access to their homes".

Within the parking districts, the only vehicles that can be parked for more than 3 h in the same on-street space are residents' vehicles that have permits. These regulations are in effect during weekdays, from 8:00 a.m. to 5:00 p.m. Special temporary permits are available for vehicles that belong to guests of residents and to people doing business with residents. Enforcement by the city police is considered to be effective.

The districts were implemented on a three-month trial basis, after which the city council decided to continue the program, which is popular with residents. During the trial period, however, some changes were made in the boundaries of the parking districts: The southern district was almost doubled in size in response to petitions from residents, and some blocks in the northern district were eliminated.

#### STUDY METHODOLOGY

About six weeks before the Old Town parking districts were implemented, the Urban Institute conducted a brief study of parking use that covered about half of the streets to be included in the districts. The purpose of the study was twofold: (a) to assemble a sample of long-term parkers in the area for interviews to be conducted after the permit plan was implemented and (b) to measure certain characteristics of on-street parking, such as duration and trip purpose, before the parking regulations were put into effect. The survey was conducted on November 13 and 14, 1978.

The study focused on a sample of 60 block faces (about 630 parking spaces) where long-term parking was allowed. In addition to noting all unused spaces on each block, the study team recorded license-plate numbers so that ranges of parking duration could be developed. A postage-paid mail-back questionnaire was placed on the windshield of each parked car. The questionnaire asked for information on trip purpose, arrival time, departure time, and walking distance between parking location and destination. A total of 320 completed questionnaires were returned for a response rate of 30 percent.

The second phase of the study involved the identification of a sample of commuters to be interviewed after the regulations were implemented. Telephone interviews were completed with 107 people who commute to the Old Town area by automobile. This sample was drawn from respondents to the postcard

survey who identified themselves as workers and from observing others who parked. Individuals were identified by tracing license-plate numbers back to the registered owners of the vehicles.

**CHARACTERISTICS OF ON-STREET PARKING BEFORE CREATION OF THE DISTRICTS**

The study confirmed the difficulty of finding parking spaces in the Old Town area. In the late morning and early afternoon, 93-97 percent of all parking spaces surveyed were occupied. Spaces appeared to be somewhat easier to find in the early mornings and early evenings, when occupancy rates ranged from 82 to 90 percent.

Half of the on-street parkers who responded to the mail-back survey were residents of Old Town. There were almost as many workers (42 percent) as there were residents, and relatively few (7 percent) were there for other purposes, such as shopping or personal business. However, the small proportion reporting "other" trip purposes may underrepresent the actual number, since people who were making this type of trip probably had less motivation to mail back the questionnaire.

The almost equal ratio of workers to residents did not hold throughout the day. According to the mail-back survey, by midmorning there were about twice as many workers' cars as residents' cars parked on the surveyed streets. In addition, many residents' cars were not moved at all during the day.

Study observations showed that the turnover rate in parking was also low for people in the "other" trip category. Given the high-occupancy parking rates during much of the day, the large proportion of parkers who were not residents of Old Town, and the large proportion of those who parked for longer than the 3-h limit specified in the new parking regulations, it appeared that the parking districts would have a significant impact on on-street parking in the area.

**IMPACT OF PARKING DISTRICTS ON COMMUTERS**

Two and one-half months after the Old Town parking districts were implemented, the Urban Institute conducted a telephone survey of commuters to the Old Town area in an attempt to gauge the short-term impact of the districts on commuting patterns. Telephone interviews were completed with 107 people who commuted to the Old Town area. This constituted approximately 15 percent of the estimated 750 commuters who parked on the streets within the parking districts.

The responses indicate that the parking restrictions have had a significant impact on commuters to the area. Seventy-six percent of the respondents reported that they had changed their parking location. Twelve percent of the sample reported that they had changed their travel mode (those who changed locations and joined a carpool are included in this group). Of the 13 respondents who changed from driving alone, 3 changed to bus transportation and 10 formed carpools. The new carpools average 2.4 members. Six of the new carpoolers parked off the street, two parked in the parking districts, one parked outside the area, and one was dropped off by the carpool.

The specific changes in parking patterns among respondents who formerly parked in on-street spaces are given below:

<u>New Parking Location</u>	<u>Respondents (%)</u>
Off street	29
On street	
In districts	20
Out of districts	20

<u>New Parking Location</u>	<u>Respondents (%)</u>
Metered space in districts	1
Dropped off	1
No regular parking pattern	5
Total	76

Commuters who changed parking patterns are fairly evenly split between parking on the street but moving to spaces outside of the districts, parking in off-street facilities, and parking in curbside spaces within the districts.

All of the commuters who still parked in curbside spaces within the districts said that they never stay in the same space longer than the 3 h that they are legally allowed. Apparently the districts have improved the situation for some of these commuters: Three volunteered the information that they used their cars on the job, rarely parking for more than 3 h, and that they now have a much easier time finding spaces. Two others claimed that the ease with which they now can find spaces close to their jobs more than makes up for the inconvenience of moving their cars every 3 h. However, for the most part, those who still park in the districts consider the current regulations a great inconvenience. Many of these people said that they often try to find on-street spaces outside of the districts but, in order to find one within an acceptable walking distance of their offices, they must arrive very early in the morning. Another reason given for parking within the districts was fear of one of the neighborhoods that lies just outside one district boundary. One of the more unique arrangements for parking within the districts was reported by a teacher at an elementary school, where the school custodian moves some of the teachers' cars from space to space every 3 h.

Almost all of the respondents who parked outside the districts also considered the regulations an inconvenience. Many corroborated the difficulty, reported by those parking in the restricted areas, of finding spaces outside the districts. Many said that they left home half an hour early in the mornings in order to find an out-of-district space within what they considered reasonable walking distance of their offices.

The largest group in the sample has continued to drive to work and park in curbside spaces, either within or outside the parking districts. The second largest group drives to work but has changed parking locations to off-street facilities. A large proportion (around 40 percent) of the respondents who changed to off-street facilities have made arrangements where they can park for free. The price of parking for those who do pay ranges from around \$0.70 to \$3.00/day and averages \$1.90/day. A number of employers in the Old Town area appear to have begun to provide parking subsidies of one form or another when the new regulations were implemented.

**CONCLUSIONS**

If the initial impacts observed in this study are indicative of longer-term effects on commuters, then it is unclear whether the net effect on commuter automobile use is beneficial. If only 10-15 percent of automobile commuters switch to carpools or buses and 20-40 percent are forced to drive more to search for spaces or to move their cars around each day, there may not be a reduction in automobile vehicle miles of travel or pollutant emissions. More convenient parking for shoppers may increase automobile travel to the Old Town area. If residents begin to use their cars more because parking is available, this will also increase automobile travel.

The initial response in Alexandria suggests a

number of hypotheses that should be tested:

1. Residential parking restrictions alone will encourage few drivers of single-occupant automobiles to use transit or carpools,
2. Significant numbers of automobiles will be moved to off-street facilities,
3. Significant numbers of automobile drivers will continue to park in the area and move their cars from one space to another to conform to the time limits, and
4. Residents of the area will increase their use of automobiles.

#### ACKNOWLEDGMENT

We wish to thank Charles Kenyon, deputy director of transportation and environmental services for the city of Alexandria, for his assistance in this study and Franklin Spielberg of SG Associates for his help in designing and conducting the parking survey. The research was funded by the Urban Mass Transportation Administration of the U.S. Department of Transportation. The opinions expressed are ours and do not necessarily reflect the views of the Urban Institute or the U.S. Department of Transportation.

*Publication of this paper sponsored by Committee on Parking and Terminals.*

## Land Use Zoning as Transportation Regulation

DON H. PICKRELL AND DONALD C. SHOUP

Land use zoning, which is frequently relied on to improve resource allocation in the land market itself, is also used to indirectly regulate the urban transportation market. The effects of one of the means by which it does so, the requirement for a minimum amount of off-street parking space in conjunction with new commercial development, are discussed. Evidence is demonstrated that this minimum amount of parking is well above what the land market would supply in the absence of such requirements. The result is to depress the market price of parking to a level below the cost of its supply. This indirect regulation of the price of parking has several consequences, principally an increase in the number of trips made by automobile. Aside from their effects on the urban transportation market, parking requirements may also cause distortions in the urban land market. In effect, they can impose a "tax" on new development, which not only slows the redevelopment of older areas but may also alter the spatial pattern of new development in undesirable ways. Unwisely used, land market controls can thus aggravate some of the transportation, and other, problems they are intended to solve. This illustrates the potential hazard of attempts to remedy urban transportation problems indirectly—for example, by intervention in the land market rather than direct intervention in the transportation market itself.

Land use zoning, which is frequently relied on to improve resource allocation in the land market itself, is also resorted to in attempts to improve the allocative outcomes of other markets. The catalog of goals for zoning listed in the Standard State Zoning Enabling Act suggests the variety of effects sought: to promote health, safety, morals, or the general welfare; to lessen congestion on the streets; and to facilitate the adequate provision of transportation, water, sewerage, schools, parks, and other public requirements (1). Clearly, this list includes many outcomes that are determined well outside the market for urban land, the traditional province of zoning. Despite an often tenuous causal link between the explicit form of intervention in the real estate market and its intended consequences in the market where a problem is perceived, attempts to regulate non-land-market outcomes through zoning do seem to be common.

A clear illustration is the surprising variety of ways zoning is used to regulate urban transportation activity. In new residential and commercial developments, detailed specifications typically govern the width and layout of street systems as well as the design of intersections and access ways. In the downtown areas of many cities, density controls, which take the form of floor-area ratios, minimum lot sizes, and limits on the number of

dwelling units per parcel, are used in an attempt to reduce traffic congestion. Requirements for a minimum number of parking spaces in new buildings are intended to improve traffic circulation by getting cars off the street once they have arrived at their destination. All of these forms of regulation have the intent of increasing the quantity of land and other resources allocated to the provision of urban transportation services.

#### RATIONALE FOR RELIANCE ON ZONING

While land use zoning has as its legal basis the furtherance of the public welfare, it also has a long-recognized foundation in economic theory. Its potentially valuable role in mitigating the effect of negative externalities by regulating the location of offending land uses was first explicitly recognized by Bailey (2) and Davis (3).

More recently, zoning has increasingly been used to regulate the quantity of land used for various activities as well as simply to control the location of specific land uses. Like location controls, this rationing aspect of zoning has as its justification the improvement of resource allocation in a land market characterized by the presence of external diseconomies that arise from certain land uses. In fact, growing recognition of the pervasiveness of such diseconomies may have encouraged continued attempts to impose more detailed control on land use. The ease of implementing such controls has also caused them to be extended to a variety of urban problems that, while not specifically originating in the land market, often appear superficially to result from the manner in which urban land is used. Problems as diverse as slum housing, traffic congestion on city streets, and air pollution have all been the targets of local land use controls. Although confidence that zoning is a promising approach to such problems is certainly one rationale for local government's reliance on it, there are other understandable reasons why planners urge direct controls over land use to remedy what are not fundamentally land-market problems:

1. Political consensus in support of direct intervention in the various markets where problems originate is rare. For example, economists have long



**Table 1. Parking spaces required in various California cities for a 10 000 ft<sup>2</sup> office building of three floors.**

City	Parking Requirement	Total No. of Spaces Required
Placentia	8 spaces/1000 ft <sup>2</sup>	80
Duarte, Glendora, Los Alamitos, Upland	1 space/150 ft <sup>2</sup>	67
Buena Park	6 spaces/1000 ft <sup>2</sup>	60
San Jacinto	1 space/300 ft <sup>2</sup> plus 1 space/each 2 employees	53
Walnut	Minimum of 6 plus 1 space/each 175 ft <sup>2</sup> above 1000 ft <sup>2</sup>	51
Hawaiian Gardens, Paramount, Pico Rivera, Signal Hill	1 space/200 ft <sup>2</sup>	50
Costa Mesa	6 spaces/first 1000 ft <sup>2</sup> , 4 spaces/1000 ft <sup>2</sup> from 1000 to 11 000 ft <sup>2</sup> , and 3 spaces/1000 ft <sup>2</sup> above 11 000 ft <sup>2</sup>	42
Chino, Corona, Cudahy, Santa Paula, Simi Valley, Thousand Oaks	1 space/250 ft <sup>2</sup>	40
Garden Grove	4 spaces plus 1/300 ft <sup>2</sup>	37
Rolling Hills	3.5 spaces/1000 ft <sup>2</sup>	35
Fountain Valley	1 ft <sup>2</sup> of parking/1 ft <sup>2</sup> of building	31
Westminster	1 space/200 ft <sup>2</sup> of first floor plus 1 space/500 ft <sup>2</sup> of each additional floor	31
Riverside, Rialto	1 space/250 ft <sup>2</sup> of first floor plus 1 space/500 ft <sup>2</sup> of each additional floor	26
Burbank, Downey, Industry, Los Angeles (except CBD), Santa Monica	1 space/500 ft <sup>2</sup>	20
Los Angeles CBD, Long Beach, Vernon	1 space/1000 ft <sup>2</sup>	10

argued that road pricing is the most effective solution to the problem of traffic congestion in urban areas. Although limits on the density of development are certainly a less promising remedy, in the absence of a realistic prospect of implementing road pricing, the relative ease of their imposition makes density controls understandably attractive. In addition, they may provide at least partial relief from traffic problems in some neighborhoods.

2. A zoning solution entails no direct outlay of public money. This is at once an advantage and a delusion: It gives the appearance of progress in resolving the problem without public expenditure and yet disguises the true resource cost of the intervention because the costs of compliance do not appear in any public budget.

3. There is a failure to anticipate the less direct consequences even well-intentioned intervention can produce. Again, zoning measures intended to mitigate transportation-related externalities are unfortunate examples of this in their tacit assumption that the demand for travel by automobile to a site is unaffected by the street capacity that serves the location or the supply of parking there and thus by the time and cost entailed in driving to the site.

Despite the host of benevolent purposes for their use, zoning controls can go seriously awry when the real problem lies outside the land market.

This paper focuses on a particular aspect of land development controls used to regulate the urban transportation market: the requirements for minimum off-street parking contained in most local zoning

ordinances. Unfortunately, the results illustrate how a form of transportation regulation as circuitous as land use controls may actually aggravate the problem it is intended to remedy.

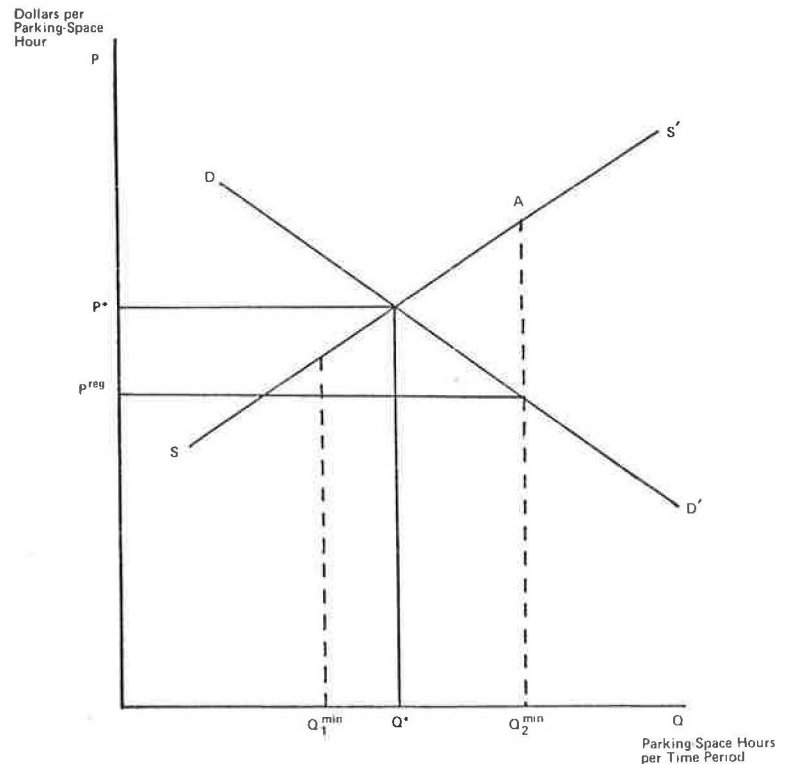
#### PARKING REQUIREMENTS IN ZONING ORDINANCES

Zoning ordinances that require the provision of off-street parking for new buildings have existed since the 1920s. Their usual intent is to alleviate traffic congestion in densely developed areas by accommodating in off-street facilities the peak number of automobiles that are drawn to a site. To accomplish this, the parking component of zoning ordinances usually states the number of required spaces per seat in a theater, per dwelling unit, or per square foot of office space. Some cities also have sliding scales for commercial development that provide one requirement for the first several thousand square feet of space and a lesser one for subsequent increments of space or one requirement for the ground floor and a lesser one for the upper floors. The minimum dimensions of the required parking spaces are also usually specified. There is a consistent rule-of-thumb quality about these requirements as well as an apparent lack of consideration of the cost of providing the spaces or the price that will be charged for their use. Apparently, the implicit assumption is that the trip generation rates on which they are based reflect a "need" to travel by automobile and that the resulting demand for parking spaces is not a function of price.

The number of parking spaces required by municipal codes varies greatly among cities. The wide variation within southern California alone is suggested in Table 1, which is taken from a special survey made in 1975 by Rex B. Link and Associates. This table gives the number of parking spaces that would be required for a hypothetical 10 000-ft<sup>2</sup> general office building of three floors in various cities in California. Because the average space required per parked car ranges from approximately 330 ft<sup>2</sup> for surface lots to 500 ft<sup>2</sup> for multilevel structures, the data in Table 1 show that almost all cities require at least 1 ft<sup>2</sup> of parking space for every square foot of building area and some require up to four times that amount. Furthermore, it is not uncommon for planning departments, as part of their negotiations with developers, to require more than the number of parking spaces required by the zoning codes as a condition for building-permit approval.

This detailed regulation of the supply of parking for new buildings implies not only that an undesirably low quantity of parking would be supplied in the absence of intervention but also that planners are capable of tailoring the parking supply to accommodate differing local circumstances. In fact, some planners recommend zoning regulations to force the supply of parking above the quantity that would be provided by the private market, whereas others recommend an upper limit on the number of parking spaces in order to force the supply below what would be provided by the private market, both with the goal of reducing traffic congestion. There is some logic to both policies, of course: Abundant off-street parking can certainly help get cars off the streets once they are at their destination, yet in the long run it may actually increase the number of vehicles traveling to activity centers. More important, insofar as the provision of more parking encourages automobile travel, it can aggravate the problems of congestion, pollution, and energy consumption that it, together with a host of other policies (many of them

Figure 1. Effect of minimum parking requirements on parking supply and market price.



promulgated by the same governmental bodies that are acting to increase the supply of parking), is intended to alleviate.

#### CONSEQUENCES OF MINIMUM PARKING REQUIREMENTS

By specifying the parking required per unit of floor space, as Table 1 illustrates, zoning mandates a minimum quantity of parking capacity for any particular density of development. Although the specification of minimum parking requirements suggests the intent of increasing the quantity of parking so that it exceeds what the market would have supplied, it is certainly possible that such requirements are based on an underestimate of what the unregulated supply would be.

Figure 1 shows this situation. The horizontal axis represents the quantity of parking-space hours (a measure of the capacity for accommodating parked vehicles), and the vertical axis represents the average price per space for 1 h. The long-run-supply curve for parking-space capacity ( $S$  to  $S'$ ) is determined by the prices of land, capital, and operating inputs at the location in question, together with the production function whereby they are combined to produce parking space. The demand-schedule curve for parking space at the site ( $D$  to  $D'$ ) is derived from the demand for automobile travel to the site, itself a function of certain characteristics of land use there and of traveler incomes and the cost of traveling there by automobile as well as by other modes. Lower parking prices increase the quantity of parking space demanded as travel is diverted from other modes and destinations or new automobile trips are induced.

In Figure 1, the dashed lines represent two possible minimum parking requirements. If local zoning requires a minimum parking capacity  $Q_1^{\min}$  in conjunction with the density to which the site is developed, the market-determined equilibrium supply and price ( $Q^*$  and  $P^*$ ) will be

unaffected. However, a minimum space requirement such as  $Q_2^{\min}$  would alter the supply function for parking capacity to the kinked configuration  $Q_2^{\min}$   $AS'$ . The result would, of course, be a binding minimum requirement that the quantity of parking-space hours  $Q_2^{\min}$  be supplied, which would in turn depress the average price they command to  $p^{\text{reg}}$ . Clearly, the divergence between this (indirectly) regulated price and the market price depends partly on how extensive an oversupply of parking is mandated by zoning codes.

Probably the strongest evidence that such requirements actually do increase the supply of parking space above its market-determined level is the fact that the marginal cost of providing additional parking in certain areas exceeds the price it commands. As Figure 1 indicates, one effect of a minimum parking requirement set above (e.g., at  $Q_2^{\min}$ ) the quantity that would be supplied in its absence ( $Q^*$ ) would be to depress the market price below the marginal cost of the zoning-mandated increase in supply.

There is clear evidence of both of these effects in the city of Los Angeles, which has the lowest parking requirement in southern California. Table 2 compares the cost of supplying additional parking in several areas of the central business district (CBD) and two outlying commercial districts with its price. It illustrates exactly how far below the cost of additional supply prices are in each of these areas: In one area of the CBD, for example, the daily price is less than half the cost of supplying additional parking space.

One effect of a zoning-mandated increase in the supply of parking may indeed be to reduce traffic congestion in the immediate area, perhaps in the entire CBD. But another consequence seems likely to be an increase in the number of automobile trips destined for the site, whether through their diversion from other destinations, a switch to automobile travel among those who formerly got to

Table 2. Parking cost and price in Los Angeles.

Location	Land Cost <sup>a</sup> (\$/ft <sup>2</sup> )	Capital Cost <sup>b</sup> (\$/space)	Daily Cost Equivalent <sup>c</sup> (\$)	Market Price <sup>d</sup> (\$)
CBD				
Arco Towers area	100	12 400	4.96	2.39
Spring Street	50	6 775	2.71	1.97
Broadway Street	40	6 150	2.46	1.57
Civic Center	30	5 525	2.21	1.34
CBD average	40	6 150	2.46	1.48
Westwood	40	7 200	2.88	~1.50
Century City	35	5 840	2.34	~1.50

<sup>a</sup>From Office of the Mayor of Los Angeles (4, p. 71).  
<sup>b</sup>From Peat, Marwick, Mitchell, and Company (5).  
<sup>c</sup>Assuming indefinite structure life, 10 percent capitalization rate, and 250 days/year.  
<sup>d</sup>From Wilbur Smith and Associates (6, Table 6) and Office of the Mayor of Los Angeles (4, p. 73).

Table 3. Estimates of price elasticity of automobile choice probability from models of work-trip mode choice.

Study	City	Elasticity of Automobile Choice Probability with Respect to	
		Parking Cost	Automobile Travel Cost
Brown (7)	Vancouver	-0.36	
Gillen (8)	Toronto	-0.31	
McGillivray (9)	San Francisco		-0.37
Train (10)	San Francisco		-0.32
Charles River Associates (11)	Pittsburgh		-0.27
Warner (12)	Chicago		-0.26
Lave (13)	Chicago		-0.19

the site by other modes, or an increase in the total number of automobile trips. Thus, traffic congestion and air pollution throughout the metropolitan area may actually be aggravated. There is also the possibility that, if a sufficient number of additional cars are drawn to the site, these problems may grow worse rather than better even in the local area where parking requirements are imposed.

Abundant evidence exists that lower prices for parking do indeed increase the demand for automobile travel. Table 3 gives various estimates of the elasticity of demand for travel to work by automobile with respect to both parking cost and the total cost of driving (driving cost includes operating expenses and tolls as well as parking charges). Although the estimates vary somewhat, they consistently suggest that lower parking prices do divert existing travel to automobiles from other modes.

This suggestion is reinforced by survey evidence that compares the travel modes chosen by commuters facing different parking prices. Using a sample of 275 government employees working in the Civic Center area of downtown Los Angeles, Francis and Groninga (14) investigated the effect of parking subsidies on mode choice for the trip to work. Of the sample, 135 were employees of Los Angeles County who received free parking if they chose to drive. The remaining 140 were federal employees, among whom those who drove paid an average of about \$0.70/day to park. The percentage of employees in each of these two groups who used the various modes of travel to work are given below (14):

Mode	Employees (%)		Difference
	County (free parking)	Federal (unsubsidized parking)	
Drive alone	72	40	-44
Carpool	16	27	+69
Transit	12	33	+175

Significantly higher fractions of the unsubsidized federal employees traveled to work in carpools or by bus, and a higher proportion of the subsidized county employees drove to work. However, the dramatic difference between the two groups' mode shares probably overstates the effect of differences in parking prices. Because the average salary of those who had access to subsidized parking was somewhat higher than that of those who were required to pay for parking, a higher percentage of the former group would have been expected to drive even in the absence of parking-price differences. Yet, in each of three income groups, the fraction of automobile commuters was significantly higher among those who were able to park free, which suggests that lower parking prices can induce commuters of widely varying incomes to change from transit to automobile for the trip to work. They imply a parking-price elasticity of aggregate demand for work trips by automobile of -0.29, which is consistent with the range reported in Table 3.

A similar elasticity of demand for automobile work trips with respect to parking price is also implied by the evidence of travelers' responses to changing parking prices. In 1975, the Canadian government began charging 70 percent of the average commercial rate for parking it had formerly provided free to its employees who work in the central district of the Ottawa-Hull metropolitan area (15). The following table gives aggregate travel-mode percentages before and after the discontinuance of free parking for almost 4000 commuters who responded to a survey administered shortly after the parking policy was changed:

Mode	Commuters (%)		
	Before Parking Charges	After Parking Charges	Change
Drive alone	34.9	27.5	-21
Carpool	10.5	10.4	-1
Transit	42.3	49.0	+16
Other	12.3	13.1	+7

Although by U.S. standards the proportion of employees commuting by automobile was quite low, even when parking was free, more than 20 percent of those who initially commuted by car changed to transit or other modes in response to the imposition of nominal parking fees [about \$1 Canadian (\$1.0172 U.S.) per day]. These data are consistent with a parking-price elasticity of the number of work trips by automobile of -0.24 (16), which is again in reasonable agreement with the estimates given in Table 3.

Although there is a convincing argument that reduced parking prices do divert existing travel from other modes to automobiles, the evidence that automobile trips can be either diverted from other destinations or newly generated by reduced parking prices is more sketchy. Two reactions to a parking-price decrease would be expected: The total number of trips that use parking in the zoned area would be expected to increase, and the average duration of parking time associated with trips should lengthen as the price falls. Both of these reactions represent increases in the quantity of parking services consumed, measured by parking-space

hours consumed during some specific time period (Figure 1). Whether zoning achieves one of its intended objectives--alleviating traffic congestion in and en route to downtown--depends in part on how the required additional parking supply is used.

Although measurements of the composition of an increase in the quantity of parking services consumed as the price falls are not readily available, some idea about this response can be inferred from related information. Let

- Q = number of parking-space hours sold per time period,  
 q = number of parking-space occupancies (i.e., the number of trips that require parking of any duration),  
 t = average duration of parking occupancies,  
 R = gross revenue from parking operations, and  
 P = average parking price per hour.

Then the total number of parking-space hours sold is  $Q = qt$ , which yields revenue given by  $R = PQ = Pqt$ .

What is of interest is the response to a change in the hourly price of parking. Differentiating revenue with respect to price yields

$$dR/dP = Pq(dt/dP) + Pt(dq/dP) + qt \quad (1)$$

Hence,

$$(dR/dP)(P/R) = (dt/dP)(P/t) + (dq/dP)(P/q) + 1 \quad (2)$$

or

$$\eta_R = \eta_t + \eta_q + 1 \quad (3)$$

where  $\eta_i$  is the elasticity of variable  $i$  with respect to  $P$ .

From a review of responses by travelers and parking operators to a 25 percent municipal parking tax that was imposed and later reduced by the city of San Francisco, Kulash (17) infers values of two of these parameters. Estimates of  $\eta_q$ , the price elasticity of the number of trips downtown, fall in the range of -0.2 to -0.4, which corresponds closely with the range of values given in Table 3. Yet operating revenue seems to be more elastic with respect to observed price changes: Kulash's computations imply values of  $\eta_R$  ranging from -0.4 to -0.6. In conjunction with Equation 3 above, the indicated range of elasticities of  $t$ , the average parking stay, is -1.0 to -1.4.

Thus, the apparent greater sensitivity of revenues to a parking-price change than of the number of trips can apparently be reconciled by a change in the average duration of parking occupancy associated with trips. Although the total number of trips shows an inelastic response to price changes, the duration of trips may change more than proportionately when price varies. This can occur not only because the parking stay per trip changes, the obvious response, but also because of substitution between trips that require short- and long-term parking. Such substitution would occur, for example, if the number of work trips increased in response to a parking-price reduction more than the number of trips that require short-term parking (for shopping, recreation, or various other purposes). The experience with the San Francisco municipal parking tax suggests that travel for all purposes varies markedly in response to parking-price changes, although automobile travel for work trips may be more sensitive to parking price than automobile travel for other purposes.

The collective implication of this evidence is that lower parking prices increase the demand for

automobile trips, primarily by inducing people who travel by other modes to begin driving instead. Reduced parking prices seem particularly likely to increase the fraction of work trips made by automobile, most of which are made during morning and evening peak hours. Because automobile travel demand is already heavy at those times, the effect of even marginal increases in the number of vehicles using urban streets and highway networks can be a pronounced slowing of travel speed and an increase in aggregate travel time. Another consequence of this increased congestion can be higher pollution levels, since peak-hour travel contributes disproportionately to air pollution in some cities (18).

Aside from their effects on the urban transportation market, parking requirements may also cause serious distortions in the urban land market. Where a zoning ordinance requires provision of more parking spaces than are justified by the price they command, the excess spaces result in a financial loss in proportion to the scale of the building, just as would a tax per unit of floor space. This effective parking "tax"--the difference between the marginal cost of providing additional parking and the revenue that it will yield--is a clear disincentive to the redevelopment of older areas, because the zoning requirements apply only to new construction and changes in parking requirements are not applied retroactively to existing buildings. Since the marginal cost of providing more parking spaces at a site increases dramatically for underground or multistory structures, the tax per square foot of additional building space increases more than proportionally with building size, an obvious disincentive to high-density development.

Another land-market effect of parking requirements may be a change in the spatial pattern of new development in the downtown area. This indirect tax levied on new development by parking requirements is particularly burdensome in areas where land values and building densities (and thus the cost of providing parking) are high in relation to parking price--for example, in areas that are already well served by mass transit. Thus, the parking tax would tend to shift new development away from areas that are best served by mass transit toward areas where the demand for automobile travel and parking is highest. Such a tendency may counteract other local policies that are designed to encourage development in areas easily accessible by transit.

#### CONCLUSIONS

Although the reasons for resorting to land use zoning in an attempt to improve resource allocation in the urban transportation market are understandable, the unintended effects of such a course of action can actually aggravate certain aspects of the problem it is intended to remedy. Minimum parking requirements for commercial development are a good example: If a zoning-mandated increase in the supply of parking reduces the parking price, a substantial increase in the number of trips that use long-term parking may result. The number of trips that require short-term parking would also be expected to increase if parking rates are lowered.

Consequently, an attempt to solve downtown congestion problems via minimum parking requirements may backfire and not only aggravate problems of surface street circulation in the downtown area but also add to congestion on regional transportation routes that serve the downtown. In addition, the problems of air pollution and energy consumption, themselves often the targets of other policies



adopted by local governments, may be exacerbated by the resulting increase in automobile travel.

This analysis suggests that the inclusion of requirements for a minimum amount of parking space in zoning regulations should be reconsidered. In the meantime, local planning departments should adopt the policy already used experimentally by some--i.e., allow adjacent establishments whose peak travel demands occur at different times to credit the same parking facilities toward their required supply.

As usual, such policies are easier to prescribe than to implement, partly because of the recurrent argument that additional parking is necessary to encourage trade and employment in downtown areas. This view apparently stems from the realization that, if new construction is not required to provide parking for all additional traffic attracted to a site, the price of parking for those in adjacent buildings may be driven up by the increase in the demand for parking space. Still, the widespread view that construction of additional commercial floor space without accompanying parking will lead to more congestion, higher parking prices for everyone, and a resulting decline in the number of people coming downtown ignores the fact that, if the demand for travel by automobile to a site increases, the private market will act to allocate additional resources to the supply of parking there. The chief effect of minimum parking requirements would seem to be merely to guarantee that parking spaces remain priced below the cost of providing them. If the price of parking is at or above the cost of providing it, there is no obvious reason why developers would not provide it on their own, even in the absence of the requirement.

An additional weakness of the argument that parking requirements are necessary to encourage people to travel (i.e., drive) downtown is that most parking requirements apply citywide, with the result that more cars are driven and parked--parked throughout the city, incidentally, and not just downtown. In fact, many cities have a "downtown exception," so that fewer parking spaces are required per square foot of building space in the CBD area than in other parts of the city. For instance, the data given in Table 1 show that the requirement in the Los Angeles CBD is 1 parking space/1000 ft<sup>2</sup> of building area whereas it is 1 space/500 ft<sup>2</sup> elsewhere. The effect of the different parking requirement may be to make CBD locations relatively less rather than more accessible by automobile compared with other parts of the city. One should not, however, extend this reasoning to conclude that downtown parking requirements should be increased. In any case, it is a mistake to identify the health of a downtown area with the number of vehicles that can be driven or parked there. If one considers the effect of an increased number of parking spaces on the demand for all modes of transportation to downtown areas, including public transit and carpooling, the net result is unlikely to be beneficial.

Although certain of the consequences alleged here are speculative, this review certainly provides reason to suspect that parking requirements may have some unintended and undesirable effects in both the transportation and land markets. The evidence reviewed here illustrates the potentially counterproductive results of intervening in the land market to solve problems that originate outside it. Unwisely used, zoning may actually aggravate many problems, including some that it is intended to solve.

#### ACKNOWLEDGMENT

Helpful comments on this paper were offered by Douglas R. Lee, Jose A. Gomez-Ibanez, and various Transportation Research Board referees.

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## Abridgment

# Parking Management Study for Lancaster, Pennsylvania

WILLIAM G. ALLEN, JR.

The results of a parking study conducted for Lancaster, Pennsylvania, are summarized. There were two primary reasons for the study: (a) Residents were concerned about the preemption of curb spaces in residential areas by long-term, nonresidential parkers, and (b) in recent years, the city has been required to subsidize the operation of the Lancaster Parking Authority because a decline in the use of the authority's facilities has created a gap between revenues and expenses. The study included a review of existing information on parking problems in Lancaster and several surveys designed to provide data on parking characteristics. The existing parking system is described in terms of facility type and occupancy. The central area of Lancaster was divided into subareas, and an analysis of the problems of each subarea is presented. Issues of ineffective enforcement and the poor financial condition of the municipal revenue parking system are reviewed. The recommended program consists of several strong measures for controlling parking space and stabilizing finances. Stricter control of curb space is suggested, including a residential parking-permit system. Several enforcement-related actions are proposed, such as revision of the meter system, increased fines, and improved equipment for controlling garage revenue. Finally, moderate increases in municipal parking rates, along with increased garage use, can eliminate the parking authority's revenue shortfall over the next five years.

In their efforts to preserve and revitalize the historic and compact central area of Lancaster, Pennsylvania, city officials have constantly had to deal with the conflict over accommodating the automobile and its large space requirements versus the narrow streets and historic nature of the downtown and its environs. This conflict has become most evident in the competition for use of on-street parking space in residential areas.

Lancaster has a population of 56 000. Its central area is characterized by houses tightly clustered on small blocks and by a mixture of private and semiprivate institutions, commercial establishments, and other land uses. This pattern of mixed development creates conflicting parking demands among employees, shoppers, and residents. The areas of greatest conflict are located adjacent to the major activity centers--hospitals, colleges, and industrial facilities.

Another major concern is the fact that the city has provided three major parking garages in the heart of the central business district (CBD). Downtown Lancaster has traditionally been the center of commercial and retail activity in the region, but recent economic conditions have caused a decline in downtown activity. This has resulted in a reduction in parking demand and revenues that has adversely affected the city's finances.

## EXISTING PARKING SYSTEM

The parking system under study consists of approximately 13 600 spaces. Peak parking occupancy within the study area is 8950 spaces, or 66 percent of available space. Peak parking occupancy in the study area between 10:00 a.m. and 12:00 noon on survey days is categorized below by type of parking facility (alley parking and illegal parking are not counted):

Type of Facility	No. of Spaces		Occupancy (%)
	Available	Used	
Metered curb space	652	413	63
Nonmetered curb space	3 038	2193	72
Municipal lots	124	96	77
Municipal garages	2 078	1139	55

Type of Facility	No. of Spaces		Occupancy (%)
	Available	Used	
Commercial lots	1 668	1302	78
Special use (private)	6 014	3807	63
Total	13 574	8950	66

As the table indicates, a large part of the system is privately owned and cannot be directly affected by public parking policy. Overall, occupancy is moderately high except for the municipal garages. Within the study area, the areas of highest occupancy are near the CBD and around the two hospitals.

The central area of Lancaster was divided into subareas (see Figure 1). The specific problems of these subareas can be summarized as follows:

1. CBD core--Available space in the CBD core is underused. Furthermore, there is sufficient space available to accommodate the total projected parking needs of the downtown area, based on demand in the peak shopping season and foreseeable CBD core "in-fill" development.

2. Downtown fringe area--The major problems of the downtown fringe area are the preemption of free on-street space by parkers destined for the CBD, a shortage of designated short-term space for the patrons of retail establishments, and a lack of convenient curb space for residents on many blocks. A windshield postcard survey and a license-plate survey verified the use of curb spaces by commuters in residential areas.

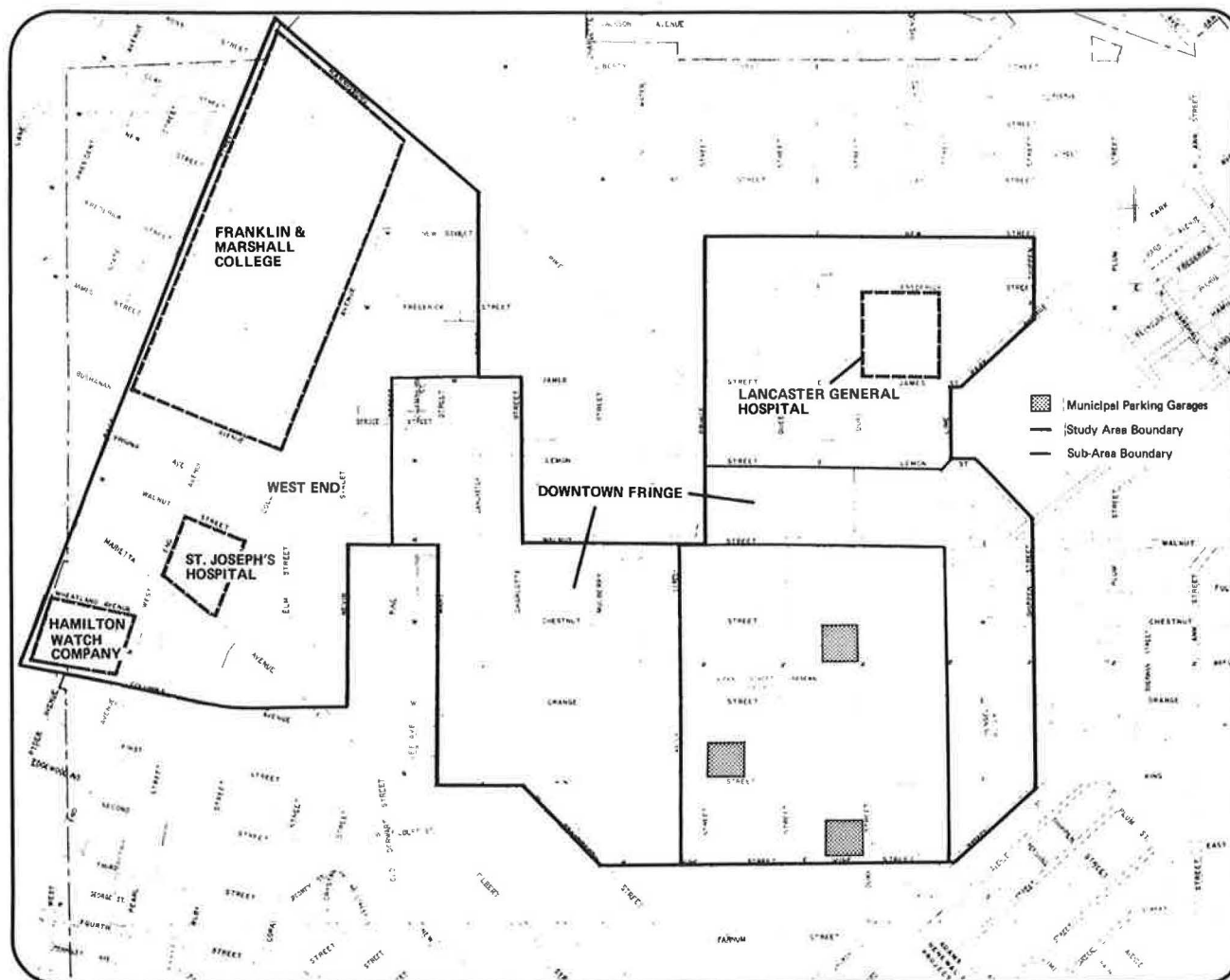
3. General Hospital area--The major problem in the area around Lancaster General Hospital is that curb space that should be available to residents is preempted by hospital, clinic, and other nonresidential parkers to a degree that constitutes a nuisance to residents. In addition, there is a shortage of designated short-term space for patrons of commercial establishments, since many of the short-term curb meters are being used by long-term parkers. Data on parking location and walking destination indicate that there is a pattern of people parking on the fringes of downtown and the neighborhoods near St. Joseph's Hospital and walking three or more blocks to their final destinations.

4. West End area--The basic problem in the West End is that St. John's Hospital does not provide sufficient off-street parking space and this results in preemption of residential parking spaces by visitors and employees. Other parking generators, including Franklin and Marshall College and the Hamilton Watch Company, are not able to prevent their parkers from using residential curb space.

## Enforcement

The current level of parking enforcement does not appear to be effective in discouraging illegal parking, especially given the low fine structure for parking violations. For example, the fine for parking overtime at a meter is \$1.00, and the cost to park in a municipal garage for 8 h is \$2.80. A fine structure that is lower than parking fees does not encourage the proper use of the revenue parking system.

Figure 1. Lancaster study area including subareas that have specific parking problems.



It was also noted that many meters do not function properly, which results in improper use of space (i.e., long-term parkers using short-term spaces) and lost revenue. In addition, under the current system for controlling municipal garage revenue, parkers can cheat the system without being caught.

The local towing ordinance is very restrictive about the conditions under which a vehicle, no matter how illegally parked, may be towed. The city is not authorized to impound vehicles.

Parking enforcement should serve two primary purposes: to ensure the proper use of available municipally controlled space and to ensure that the parking system generates the proper level of revenues. The problem in Lancaster is that current enforcement efforts do not act as a deterrent to the misuse of the parking system.

Financial Status of the Parking System

The financial status of the Lancaster Parking Authority is determined in large part by the use of the three downtown municipal garages owned and operated by the authority. In recent years, the loss of retail activity from the downtown has contributed to a decline in the use of all three garages. Construction and acquisition of these

garages were financed by the use of revenue bonds issued by the authority, which is an autonomous agency. However, the bonding arrangements are such that the city government is legally obligated to make up any differences between expenses and revenues. In the past few years, a large gap between expenses and revenues has developed.

The current rate structure of the Lancaster Parking Authority is such that meter parking is less expensive per hour than garage parking. Motorists therefore tend to use meter spaces more frequently and for longer periods than garage spaces. In other words, parkers (logically) take advantage of less expensive space where possible. Convenient access to final destination is the major motivation for garage use, whereas the cost and availability of alternative spaces are important factors motivating nonuse of the garages.

PARKING PRINCIPLES

A number of parking principles and objectives were derived from discussions with citizens and city officials. These principles and the experience of other cities provided the basis for analyzing the parking needs of the city of Lancaster and developing a responsive program. Among these principles are the need for (a) control of all

public parking in the central area, (b) revision of rate and fine structures to influence the proper use of parking space, (c) increased enforcement, (d) more stringent parking-space requirements in the zoning ordinance, and (e) giving residents high priority in the allocation of and control over limited curb space.

#### RECOMMENDATIONS

Based on an examination of existing parking characteristics, applicable principles and strategies used in other areas, and input from citizens and elected officials, this study developed the parking management recommendations discussed below.

#### Control of Parking Supply

##### CBD Core

The basic strategy in the CBD core is to improve the on-street meter system. This involves eliminating unproductive meters, relocating some meters to areas that require increased short-term parking supply, and installing new meters in some areas. In addition, all unregulated curb space in the core would be eliminated.

##### Outside CBD Core

The city should implement a residential parking-permit program for the entire central area outside the core. The city would define eligible areas, but it would be left to the residents of each block to request implementation of the permit system on their block. Without a permit, curb parking on blocks where the system is implemented would be limited to 2 h (from 7:00 a.m. to 6:00 p.m. weekdays). Only residents of the block could get an annual permit. Residents could obtain a temporary permit for visitors. Service vehicles would be excluded from the permit requirement. Residents would be assessed an annual permit fee of \$10 to defray the continuing administrative and capital costs of the program. However, the city would need to subsidize program implementation for the first year.

Other recommendations for the area outside the CBD core include selective use of long-term meters near major parking generators, an expanded program of city assistance to residents who wish to construct off-street spaces on private property, and a review of the parking requirements in the zoning ordinance.

#### Enforcement

The Lancaster Parking Authority should immediately replace its entire meter system with a combination of short- and long-term meters. The existing system for controlling garage revenue also requires replacement in order to reduce the potential for fraud and misuse.

Fines for parking violations in the city should be increased according to the principle that fines should exceed normal daily parking costs. This would involve an increase of \$2 for most violations so that the minimum fine would be \$3 and the majority of parking fines would be \$5 or \$6.

A stronger city towing ordinance is needed to ease the process of towing cars illegally parked at off-street spaces and in parking-authority lots as well as cars parked illegally on public or private property.

#### Finances

Increases in the revenues of the parking authority will come from greater use of revenue-producing parking spaces and increased parking rates. The controls imposed by the adjustment of the meter system and the proposed ban on long-term parking in residential areas will reduce the attractiveness of alternative spaces for many parkers. The destinations of most of the parkers whose spaces would be eliminated are convenient to one of the municipal garages. Increased use of the garages will also result from increased development activity downtown and improved use of existing vacant floor space.

The last parking-rate increase occurred in February 1977, when the \$0.35/h rate for the garages was put into effect. An analysis of alternative rate schedules shows that meter and garage operating revenues can be expected to increase by as much as 80 percent based on the highest alternative rate schedule and the demand resulting from the on-street control program and near-term CBD development.

Since the opportunity for the authority to reduce operating and debt service costs is not great, this study assumed that the only change in expenditures is that operating expenses will increase by 6 percent/year. A comparison of projected costs and revenues indicates that the authority will not become financially self-sufficient unless parking rates are increased and maximum use is made of available space as a result of the parking regulation program and projected development.

#### CONCLUSIONS

The study discussed in this paper was unique in that it was more concerned with parking management than with supply. This study has shown that even a city the size of Lancaster can have many of the same parking problems as larger cities. The issues of commuter parking in neighborhoods, insufficient spaces for hospital and college parkers, and changing land uses are just as real in a small city as in a larger one.

Many of these problems have resulted from a piecemeal approach to parking needs. In the past, problems were attended to as they arose in specific locations instead of on a neighborhood or an areawide basis. The fact that almost all of the parking problems are related to each other and must be solved by using a systematic approach is also characteristic of large cities.

A noteworthy aspect of the study was the high degree of citizen input. Citizen complaints were the main reason for performing the study, and various mechanisms of citizen participation (key-person interviews, a postcard survey, and public meetings) were helpful in guiding the entire study process. Parking is often an emotional and politically sensitive issue, and the ability to involve citizens, elected officials, and other civic and business leaders in the study process is vital to a successful study.

The recommendations of this study are consistent with the transportation system management philosophy of implementing a series of mutually supportive actions that result in a synergistic effect. Some of the proposed strategies are rather forceful for a city like Lancaster but are necessary to solve the mix of problems that was identified. It is to Lancaster's credit that city officials are now actively engaged in implementing the recommendations of the study in a systematic attack on the parking management problems of the area.



# Impacts of Municipal Parking-Fee Increases in Downtown Chicago

BOB KUNZE, CHERI HERAMB, AND TIMOTHY MARTIN

The results of a study that investigated the impacts of substantial fee increases at Chicago's eight downtown city-owned parking facilities are reported. Changes in parking patterns were determined for each of the municipal facilities from data routinely collected by the Bureau of Parking and surveys of time-stamped parking receipts. The effects on parking fees and use at nearby privately owned facilities and on transit ridership were also explored by using data from surveys of parking tax returns submitted by commercial facilities, a historical review of their rate schedules, and discussions with private operators. The January 1978 fee increases stimulated a drop-off in overall use at each of the municipal facilities, although slightly more revenue was generated. Vehicles, usually driven by commuters, that enter on weekdays before 9:30 a.m. and park all day decreased by 72 percent (this drop-off was still evident one year after the increase). Apparently, most parkers increased their use of transit rather than divert to other parking facilities. Because of the availability of space in the midday hours and new short-term fees that remained lower than those at nearby, privately owned facilities, short-term parking increased at the municipal facilities. These effects are consistent with the city's objectives for its central area—i.e., lowering peak-period congestion and pollution, providing parking space for business patrons, and increasing transit use. It is concluded that the restructuring of parking fees has potential benefits if parking is in short supply, if local government controls a major portion of the supply, and if good transit service is available.

Facilities for automobile parking are an essential component of the transportation network in a city's central business district (CBD). Without convenient and reasonably priced parking, trips that require the convenience or security of an automobile will be diverted to other locations or eliminated, thus threatening the profitability of CBD shops and businesses. However, because of either environmental concerns or economic pressures that force a higher use of the land, only a limited amount of the CBD can be devoted to parking. Consequently, how this parking capacity is used affects the economy of the core area, the quality of its environment, and the use of transit facilities that serve the downtown.

Beneficial effects are likely to be realized if the trip makers who are most dependent on the automobile have priority access to core-area parking supply. These trip makers are patrons of commercial and retail services. Patrons who lack access to convenient and reasonably priced parking are more likely than commuters to alter their destination than to switch to a transit or ridesharing alternative. Although some existing parking capacity must be accessible to commuters, providing too much for these parkers may needlessly reduce the space available to business patrons, aggravate peak-period congestion and pollution, and reduce transit ridership and revenues.

The local government has most control over its municipal parking facilities. By adjusting fees at these facilities, the municipality can discourage the use of its facilities by commuters and thereby maximize the availability of space to business patrons. This may be particularly important where parking capacity is in short supply. Unfortunately, certain circumstances may result in relatively low fees that bring about just the opposite result. Revenues needed to meet expenditures generated by a municipal facility are likely to be much less than those required of a comparable, privately owned facility. This is because the municipality typically exempts its facility from paying property taxes, is not interested in a return on its

investment in the facility, and can finance its construction more cheaply than can the private sector. In addition, some costs (administrative costs, for example) may not be reflected in the facility's budget. As a result, municipalities can and often do charge less for parking than the private sector. These lower fees encourage additional automobile trips and divert ridership and revenues from transit. The more commuters are motivated to drive, the less they will patronize transit services and the fewer spaces will be open to patrons.

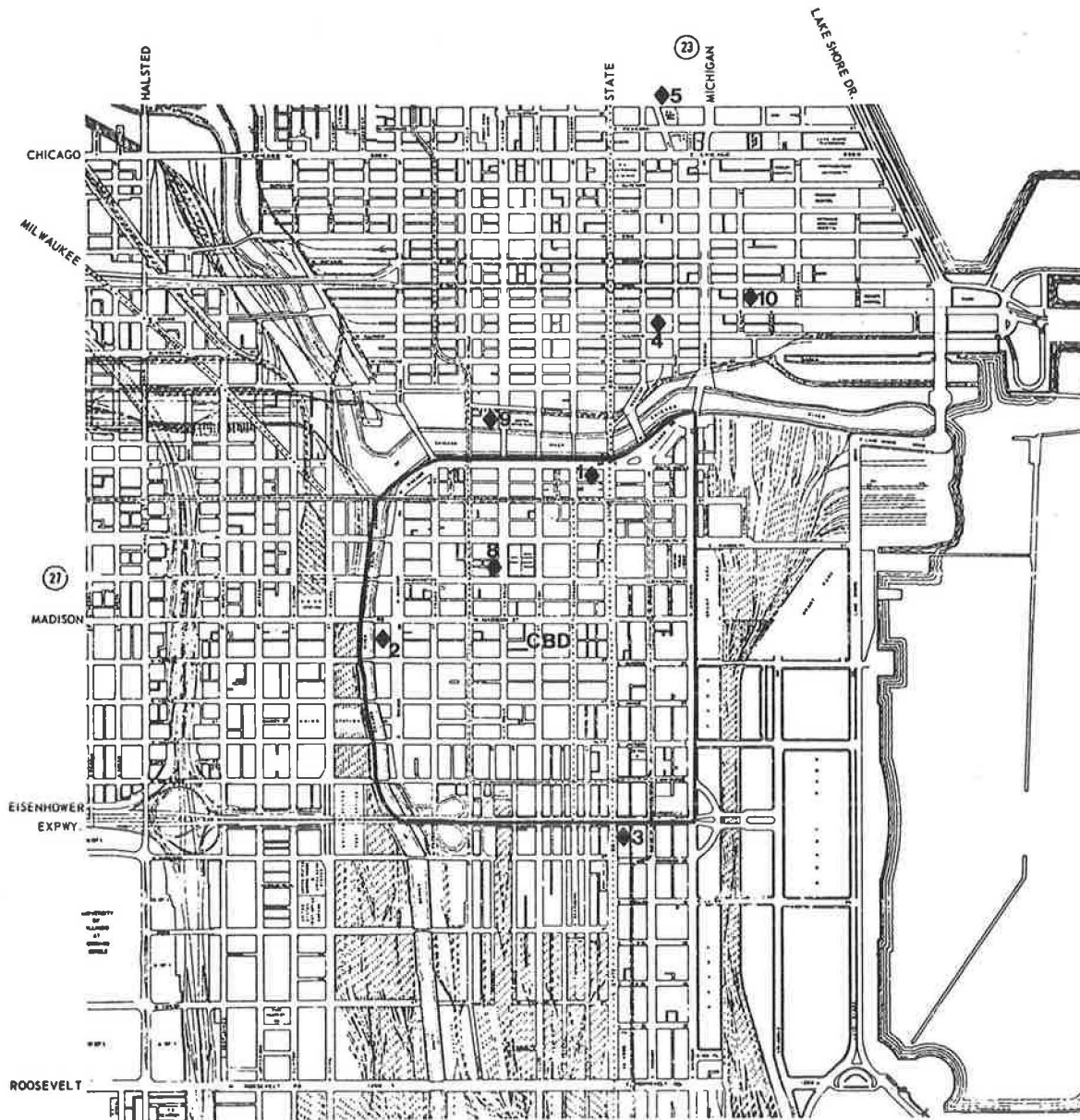
The situation described above prevailed at municipal facilities located in the downtown area of Chicago. For a period of 10 years, fees at these facilities were unchanged. In 1977, fees for all-day parking and monthly parking permits were typically 50 percent less than comparable fees at nearby, privately owned facilities. Commuters made heavy use of the city facilities; they were filled to near capacity by the end of the peak travel period. Although fees for short-term (patron) parkers were also low, most spaces were taken by all-day parkers. Fees for all-day parkers ranged from about \$1.50 to \$2.80. For many commuters, this cost was comparable to the cost of using public transit or commuter rail.

On January 1, 1978, the city raised fees at its downtown facilities with the intention of increasing revenues. As part of a comprehensive evaluation of the city's parking policies, the impacts of these fee increases on parking and travel patterns were investigated. Analysis of the rate change was considered important because rates increased dramatically and because the increases considerably reduced the differential between the parking rates at city facilities and those at privately owned commercial facilities. Downtown Chicago is well served by transit, especially during the morning and evening peak periods. Since the number of all-day parkers at the eight facilities was large and fees increased the most for these parkers, a fee-induced diversion to transit by all-day parkers could be expected.

The findings of this study indicate a substantial drop-off (72 percent) in the number of vehicles parked all day (6-12 h) during the week. Since increased use was not evident at neighboring private parking facilities, many of the former all-day parkers at city-owned facilities may be using transit. Small increases in short-term parking (vehicles parked for a maximum of 3 h) were observed, however, at five of the eight municipal downtown facilities, apparently as a result of the increased availability of space after the morning peak period and because fees for short-term parkers, although increased, remained lower than those at nearby commercial facilities.

The results reported in this paper should have relevance for municipalities and public agencies that provide parking facilities, especially for cities in which a large portion of the total downtown parking supply is in municipal facilities, parking capacity is in limited supply, and peak-hour transit service is good.

Figure 1. Chicago central area showing location of eight downtown city parking facilities.



◆2: Facility Location and Identification Number

#### BACKGROUND

Chicago's eight downtown city-owned parking facilities are located in an area commonly referred to as the "central area" (see Figure 1). Most are found in or within walking distance of the CBD. The Chicago CBD is a 1-mile<sup>2</sup> area that is intensely used by business and government offices, retail shops, restaurants, and theaters. Currently, there are about 37 000 theater seats, 8200 dwelling units and hotel rooms, and 85 million ft<sup>2</sup> of other types of floor space. Employment, which continues to grow, exceeds 325 000.

Surveys conducted in 1970 still provide an accurate picture of travel patterns to the CBD. Of the more than 400 000 automobile and transit trips made to the CBD on a typical weekday, transit is the predominant mode. Approximately 250 000 of these

trips are work trips, of which 75 percent are made on transit (1). This extensive use of transit can be attributed to roadway congestion, costly parking, and the exceptionally high level of CBD-oriented transit service. The public transit user has a variety of modes from which to choose: Six rapid transit lines, 12 commuter railroad lines, and 50 bus routes cover the CBD. Peak-hour headways are quite small, averaging about 5 min for buses, less than 4 min for rail rapid transit lines, and less than 10 min for most commuter rail lines.

In spite of the predominant importance of transit, many automobiles converge on the CBD. About 50 percent of the people who come to the CBD for purposes other than work use an automobile. On a typical weekday, 30 000 private automobiles enter the CBD between 7:00 and 9:00 a.m. (2). Because of the large number of automobiles converging on the

Table 1. Parking fees at eight city facilities before and after fee increase.

Facility No.	Address	No. of Parking Stalls	Time Period	Fee (\$)		
				Before Increase	After Increase	Change (%)
1	11 West Wacker	717	1 h	0.80	1.25	56
			8 h	2.65	4.25	60
			Monthly permit	33.00	63.00	91
2	20 South Wacker	1247	1 h	0.90	1.15	28
			8 h	2.15	3.65	70
			Monthly permit	33.00	63.00	91
3	535 South State	650	1 h	0.90	1.15	28
			8 h	1.90	4.15	118
			Monthly permit	28.00	53.00	89
4	506 North Rush	969	1 h	0.75	1.15	53
			8 h	1.75	3.90	123
			Monthly permit	28.00	58.00	107
5	875 North Rush	420	1 h	0.90	1.25	39
			8 h	2.15	4.25	98
			Monthly permit	33.00	65.00	97
8	120 North Lasalle	495	1 h	0.90	1.25	39
			8 h	2.40	4.25	77
			Monthly permit	43.00	58.00	35
9	320 North Lasalle	622	1 h	0.80	1.15	44
			8 h	2.65	3.65	38
			Monthly permit	28.00	58.00	107
10	535 North St. Clair	198	1 h	0.90	1.15	28
			8 h	2.15	3.65	70
			Monthly permit	28.00	58.00	107

CBD, there is considerable congestion throughout the peak travel period. Although air quality in the central area has improved in recent years, the area is a "nonattainment area" with respect to U.S. Environmental Protection Agency standards for carbon monoxide.

The service areas of the city-owned facilities on the CBD fringe are somewhat less intensely used than the CBD. Like the CBD, however, these areas exhibit a high level of transit use, peak-period traffic congestion, and problems with air quality.

There are about 70 000 off-street parking spaces in the area shown in Figure 1, approximately 18 000 in the CBD. The vast majority (85 percent) are available to the public for a fee. Accessory parking, which is private and serves a particular building or land use, makes up the remainder. In addition, there are at most a few thousand curbside metered spaces. The maximum duration of parking permitted at these meters is 2 h; in the CBD, it is 30 min. There are very few unrestricted curbside spaces in the central area. Parking facilities are heavily used on weekdays, partly because of continued growth in office space throughout the central area and the prohibition on the construction of new commercial parking facilities in the CBD. This prohibition, which has been in effect since 1972, has contributed to a reduction of 10 percent, or 2000 spaces, in CBD parking supply.

The eight city-owned garages account for 5300 parking spaces. This amount is a relatively small proportion of the total central-area parking supply. For example, the three city facilities located in the CBD account for only about 15 percent of the total off-street spaces. The city facilities vary in capacity from 198 to 1247 spaces. Except for garage 10, the smallest garage, these facilities are larger than nearby privately owned garages. Thus, each city facility does account for a large portion of the parking supply within a few blocks of that facility. Because a majority of the neighboring land use is office space, use of these facilities during the day on weekdays is quite high in comparison with use during evenings and weekends (except at garage 5, which, although it is near offices, is also near restaurants, nightclubs, and residences).

On January 1, 1978, municipal parking fees were

raised for the first time in 10 years. Fees for short-term parking were increased less than those for long-term parking. For example, the increases ranged from 38 to 56 percent for 1 h of parking, from 38 to 123 percent for 8 h, and from 35 to 107 percent for a monthly parking permit (see Table 1). The median 8-h parking fee at the eight facilities was \$2.15 before the increase and \$4.05 after the increase. Although the increases were large, on the average the new short-term fees were less than, and the new long-term fees were about equal to, comparable fees at nearby parking facilities. A survey of 65 public off-street parking facilities in the CBD--about 40 percent of the total--indicated a median 1-h parking fee of \$1.75, compared with \$1.15 for the eight municipal facilities. The median fee for 8 h was \$4.15, compared with \$4.05 for the city facilities. Although the major reason for raising rates was to increase local revenues, another consideration was the need to continue to provide the short-term parker, who is most often a patron of a commercial or retail establishment, with a lower fee than that found at other parking facilities.

#### DATA SOURCES

The primary purpose of this research was to assess the effect of increases in municipal parking fees on the number, duration, and accumulation of vehicles parked at city-owned facilities. Data for this purpose were readily available from the Bureau of Parking. These data included semimonthly revenue summary sheets, daily revenue reports, and time-stamped parking-receipt stubs for each facility.

The semimonthly summary sheets for a month provide the total number of parkers for each day of the month, the number of monthly parking tickets sold, the number of parkers for each fee level for that month, and the revenue collected. Fee levels were broken down to parking-duration equivalents (e.g., \$1.25 is 2-3 h) to derive the number of parkers who parked for various lengths of time. Semimonthly summary sheets were collected for the month of May for the years 1976 through 1979.

Time-stamped receipts from the midweek days of the second week in May of 1977 and 1978 were surveyed. These receipts permitted more thorough analyses of rate-induced changes in parking-duration

patterns than did the semimonthly and daily revenue sheets, since daytime parkers could be separated from evening parkers. Furthermore, the receipts could be used to determine the level of accumulation of vehicles and occupancy of parking spaces throughout the day both before and after the rate changes. To check the accuracy of the data obtained from the time-stamped receipts, comparisons were made between these data and the daily and semimonthly revenue sheets. The number of time receipt stubs was within 5 percent of the total number of parkers indicated by Bureau of Parking records, and the number of vehicles parked for various durations of time, as indicated by the receipts, differed by no more than 10 percent from that indicated by the daily revenue sheets.

The analysis of May data was emphasized for a number of reasons. Since May 1978 was four months after the date of the rate change, any rate-induced changes would have had time to stabilize. In addition, other traffic data, such as CBD cordon counts, are conducted in early May, and weather-induced changes in parking patterns were less likely to occur in May than at other times, particularly December through February. By using these data, both the immediate and long-term changes in parking duration could be investigated.

Additional data on parking patterns at city parking facilities were obtained from the quarterly parking tax returns submitted to the city's Department of Revenue by all commercially operated parking facilities. These returns provided the total number of hourly and monthly-permit parkers at each facility for each month during the 1976-1978 period. These data made it possible to study past trends in use of the city facilities and the immediate and long-term effects of the fee increase on these trends.

Although the rate-induced effects on use of privately owned parking facilities and on transit ridership were an important concern, precise determination of these effects was not possible because data could not be readily collected. The parking tax returns of nearby, privately owned parking facilities were surveyed to determine the extent to which these facilities picked up any of the large numbers of parkers who stopped using the city's parking facilities. At best, these data would only reveal a major shift from city facilities to nearby facilities. To investigate the immediate effect of the parking-fee increases on rates at privately owned facilities, surveys of parking rates were conducted immediately before and immediately after the rate change--in December 1977 and early February 1978, respectively.

Transit ridership to the central area of Chicago is so high and passenger estimation so imprecise that it would be impossible, by using existing transit data, to detect whether or not there were shifts from parking in public garages to riding transit. Nevertheless, the extent of the diversion to transit could be indirectly inferred from changes in use at parking facilities near the city facilities, from the nature of the changes that did occur at the city facilities, and from discussions with operators of parking facilities.

In this paper, short-term parking refers to vehicles parked for a maximum of 3 h, and long-term parking refers to vehicles parked for at least 5 h (both hourly and monthly parking). When long-term parking is more narrowly defined, it is so indicated. Monthly parking refers to parking on a monthly permit. At the eight downtown city-owned facilities, these monthly parkers are almost exclusively weekday parkers who park their vehicles for a few hours or more during the day.

## IMPACTS OF RATE INCREASE

### Use of City-Owned Facilities

For each of the eight city-owned parking facilities, four impacts of the rate change were investigated: changes in use during 1978 in comparison with 1977, changes in parking duration (overall and by time of entry), changes in levels of vehicle accumulation and occupancy throughout the day, and sales of monthly parking tickets.

#### Parking Patterns Before the Fee Increase

All eight city facilities were heavily used before the fee increase. By the end of the morning peak travel period, 75 percent or more of the spaces were occupied. By late afternoon, occupancy levels began to decrease rapidly. Only facilities 3 and 5 had much weekday evening use. Only facility 5 had a level of weekend use comparable to that for a typical weekday. The weekday pattern--high occupancy levels between 9:00 a.m. and 3:00 p.m.--resulted from considerable use of these facilities by long-term parkers, especially those that arrived before 9:30 a.m. and parked for 6-12 h (see Tables 2 and 3).

At six of the eight facilities, considerably more than 50 percent of all vehicles parked in a month were parked on a long-term basis. This included vehicles parked 3 h or more on an hourly basis and vehicles parked with monthly permits, most of which are used by all-day parkers during the day (Table 2). The two exceptions, facilities 8 and 9, attracted a large number of short-term parkers (49 and 40 percent, respectively) because of their close proximity to buildings that house government functions.

The high proportion of long-term parkers at these eight facilities was greater than the proportions found at nearby, privately owned commercial parking facilities. The heavy use of the city facilities and the high proportion of long-term parkers are attributable largely to the rate structures at these eight facilities: Fees were much lower than at nearby facilities (at least 25 percent less), especially fees for monthly parking permits and long-term hourly parkers.

#### Changes in Parking Patterns

After the fee increases, there were decreases in the number of parkers and in the average length of time a vehicle was parked. These decreases, which were still evident 17 months after the increase, were the result of decreases in vehicles parked 3 h or more and in the sale of monthly parking permits.

Sales of monthly parking permits in May 1978 averaged 27 percent less than in May 1976 and May 1977. Permit sales in May 1979 were 24 percent less than sales before the fee increases. Other months showed comparable drop-offs (see Figure 2). At five of the eight facilities, the drop-offs in the second half of 1978 were equal to or greater than the drop-offs that occurred in the first few months after the January 1, 1978, increase. One facility (facility 8) did, however, show an overall increase in monthly ticket sales after the January 1, 1978, fee increase. To increase the occupancy of space vacated by hourly parkers after the rate increases, the operator of facility 8 increased the availability of monthly parking permits, which, before the fee increases, were in heavy demand but sold in limited quantities. The 35 percent increase in the monthly permit fee at facility 8 was also much less than the increases at the other facilities (at least 89 percent).



Table 2. Use of city parking facilities: 1976-1979.

Time Period	Change from Use in Base Years (%)		Percentage of All Cars Parked		
	1978	1979	Base <sup>a</sup>	1978	1979
<b>Facility 1</b>					
0-3 h	-21	-34	40	51	50
3-5 h	-36	-51	15	16	15
5-24 h	-59	-65	25	16	16
Monthly <sup>b</sup>	-42	-43	17	16	18
Total <sup>c</sup>	-39	-48			
<b>Facility 2</b>					
0-3 h	+24	+58	19	32	34
3-24 h	-43	-42	60	44	39
Monthly <sup>b</sup>	-13	-12	21	23	20
Total <sup>c</sup>	-23	-10			
<b>Facility 3</b>					
0-3 h	-12	-22	39	59	57
3-24 h	-68	-78	58	34	26
Monthly <sup>b</sup>	-32	-29	5	7	7
Total <sup>c</sup>	-45	-50			
<b>Facility 4</b>					
0-3 h	+42	+46	9	20	17
3-5 h	+9	+67	6	10	12
5-24 h	-62	-48	53	32	35
Monthly <sup>b</sup>	-24	-12	32	38	36
Total <sup>c</sup>	-36	-21			
<b>Facility 5</b>					
0-3 h	-27	-12	39	50	55
3-5 h	-35	-33	22	26	24
5-24 h	-71	-74	29	15	12
Monthly <sup>b</sup>	-43	-32	9	9	9
Total <sup>c</sup>	-43	-37			
<b>Facility 8</b>					
0-3 h	+16	+12	51	64	64
3-5 h	-16	-21	14	13	13
5-24 h	-52	-58	30	16	14
Monthly <sup>b</sup>	+46	+74	4	7	8
Total <sup>c</sup>	-8	-11			
<b>Facility 9</b>					
0-3 h	+14	+5	60	72	72
3-5 h	-12	-5	7	6	7
5-24 h	-37	-35	11	7	8
Monthly <sup>b</sup>	-38	-49	22	14	13
Total <sup>c</sup>	-5	-9			
<b>Facility 10</b>					
0-3 h	+26	+14	13	23	20
3-5 h	+15	-2	8	14	11
5-24 h	-64	-59	35	18	20
Monthly <sup>b</sup>	-27	-19	43	44	47
Total <sup>c</sup>	-29	-19			
<b>All Facilities</b>					
0-3 h	+2	+1	34	49	47
3-24 h	-50	-50	47	32	32
Monthly <sup>b</sup>	-27	-24	18	18	19
Total <sup>c</sup>	-27	-24			

<sup>a</sup>Base = (May 1976 + May 1977)/2.

<sup>b</sup>Monthly parkers = monthly permit sales X assumed average use of 20 times/month.

<sup>c</sup>Includes vehicles parked with special permits and vehicles parked more than 24 h.

Most vehicles that park at the city facilities are parked on an hourly basis. At the end of 1978, all city facilities had significantly lower levels of hourly parking than they had one year earlier. At five of the eight facilities, the sustained

decreases in hourly parkers (determined by comparing levels of use at the end of 1978 with those at the end of 1977) were equal to or greater than the decreases in the first few months after the fee increases. An upward trend in use is evident during 1978 at the other three facilities, however. At facility 4, where the upward trend is quite dramatic, fee increases for long-term hourly parkers were greater than those at the other facilities; consequently, the large initial drop-offs (more than 40 percent less than 1977 levels) may reflect an initial reluctance on the part of many parkers to pay the large increases. This reluctance may have subsided among those who eventually found that the new fees were comparable to those at nearby, privately owned facilities (Figure 2). In spite of these upward trends, the number of hourly parkers in May 1979, 17 months after the fee increase, was still 24 percent less than the number before the fee increase (Table 2).

Most of the decrease in hourly parkers is attributable to the decrease in vehicles parked 3 h or more. The number of these vehicles in both May 1978 and May 1979 was 50 percent less than the average number parked in May 1976 and May 1977 (Table 2). The drop-off in long-term parking for vehicles that arrived before 9:30 a.m. and parked 6-12 h was particularly large: 72 percent (Table 3). The drop-off for vehicles that arrived after 9:30 a.m. and parked 6-12 h was only 46 percent. Although long-term parkers experienced the largest fee increases (generally 90 percent or more), this drop-off of 72 percent still approximates an elasticity of at least -0.75, which suggests that demand by the long-term, daytime parker is quite sensitive to price. The large fee increases for long-term parkers and the availability of other travel alternatives (transit, carpool, and other parking facilities) were probably responsible for this greater-than-expected drop-off.

Before the fee increases, daytime, long-term parking fees at the city facilities were clearly a bargain in comparison with fees at nearby, privately owned facilities. This was reflected in occupancy levels, which were generally near capacity by the end of the morning peak travel period. As Figure 3 shows, more space was available after the fee increase (May 1978) than before (the days shown for each facility are the same day of the week for 1977 and 1978). Since the plots in Figure 3 exclude vehicles parked with monthly parking permits, the decrease in occupancy levels was even greater than that indicated. For all eight facilities, the peak occupancy level on a weekday in May 1978--45 percent--was more than 50 percent less than the peak occupancy level on a weekday in May 1977--about 97 percent. The occupancy levels in May 1979 were probably somewhat greater than those for May 1978 because of slight increases in monthly and long-term hourly parking that occurred after May 1978.

The apparent increase in vehicles parked for a maximum of 3 h after the fee change was probably a result of the greater availability of space and new short-term rates that remained less than those at nearby facilities. The number of short-term parkers in May 1978 was 2 percent higher than the number before the fee increase. There was an increase at five of the facilities. The greatest increase occurred at facility 9, partly because of an unusually high number of weather-related court cases at the traffic court across from the facility. Nevertheless, there was more short-term parking in May 1979 than there was before the fee increase (Table 2). The slight increase in short-term parkers includes not only short-term parkers who did not previously use the city facilities but also

**Table 3. Parking duration at city facilities for vehicles arriving before 9:30 a.m.: 1977 and 1978.**

Facility	Year	Number of Vehicles by Length of Time Parked					Total Before 9:30 a.m.		Total After 9:30 a.m.	24-h Total <sup>a</sup>
		0-3 h	3-6 h	6-9 h	9-12 h	>12 h	Number	Percent		
1	1977	53	39	93	73	11	269	29	646	915
	1978	35	23	24	14	8	104	20	417	521
2	1977	215	59	247	521	56	1098	85	199	1297
	1978	160	41	116	206	49	572	62	345	917
3	1977	55	56	164	227	32	534	49	563	1097
	1978	26	23	18	19	9	95	22	343	438
4	1977	10	34	249	308	56	657	81	152	809
	1978	31	24	78	41	15	189	46	223	412
5	1977	11	17	71	40	13	152	26	433	585
	1978	4	1	7	5	5	22	10	208	230
8	1977	59	51	95	53	21	279	35	512	791
	1978	84	31	41	23	6	185	26	537	722
9	1977	245	44	72	33	5	399	33	805	1204
	1978	263	29	40	16	2	350	31	783	1133
10	1977	4	12	59	48	12	135	71	55	190
	1978	5	5	13	10	1	34	34	65	99
All (% change)		-6.7	-43.3	-67.9	-74.4	-53.9	-56		-13.2	-35.1

Note: Same two days of the week (Tuesday, Wednesday, or Thursday) were used for each facility. Numbers of vehicles for a particular time period are averages of the number parked for that length of time on each of the two weekdays.  
<sup>a</sup>Excludes vehicles parked with monthly parking permits.

**Figure 2. Percentage change in use of city parking facilities in 1978 compared with 1977.**

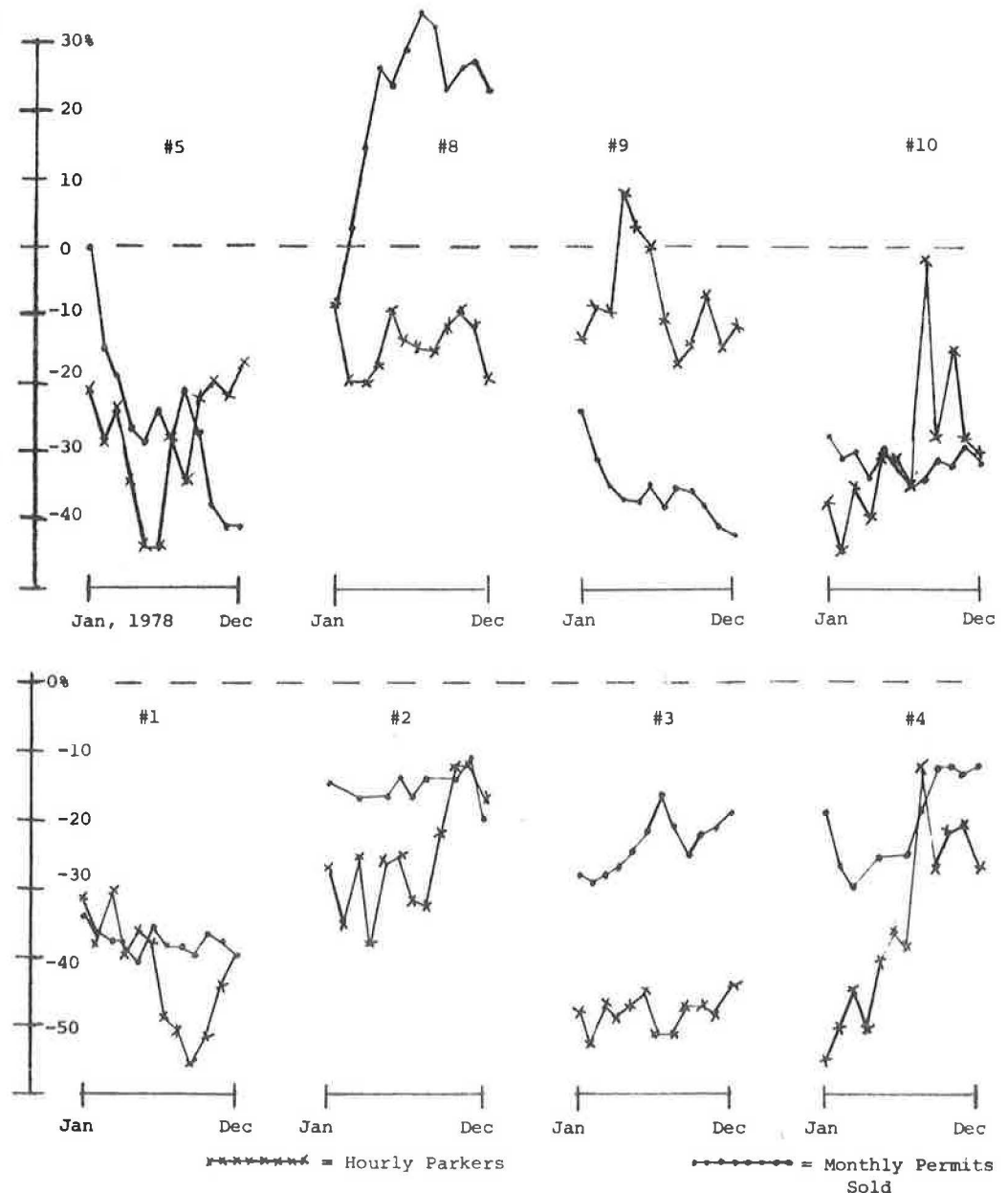
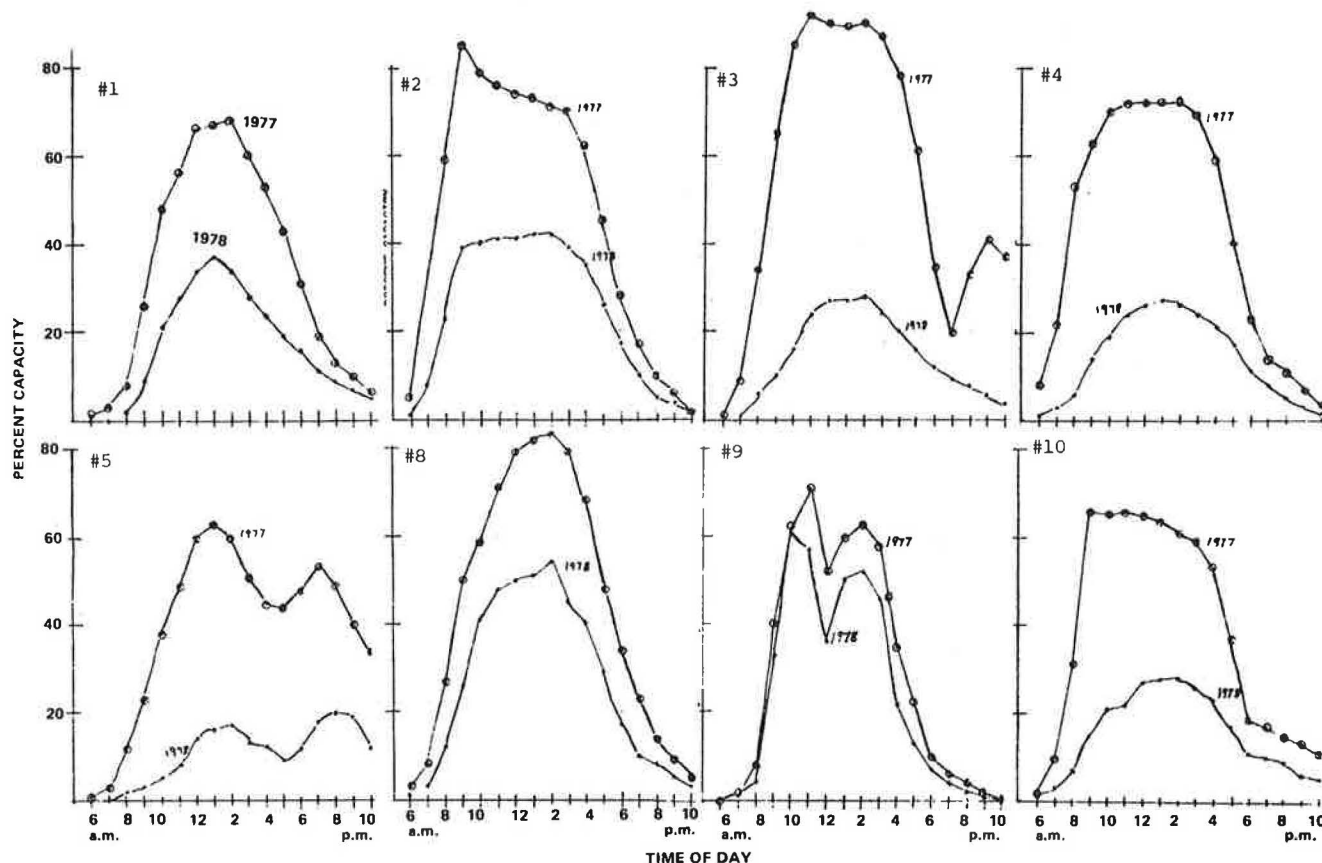


Figure 3. Accumulation of parked vehicles at city facilities: 1977 and 1978.



perhaps some regular users of these facilities who shortened their length of stay in order to save money.

Although the increase in short-term parkers after the rate increase was small, the proportion of vehicles parked for a maximum of 3 h increased substantially because of the large drop-offs in monthly parking and long-term hourly parking. The proportions of vehicles parked for a maximum of 3 h were 34 percent before and 49 and 47 percent after (May 1978 and May 1979, respectively) the fee increase (Table 2).

Use of Privately Owned Facilities

In 1968, rate structures at city-owned and privately owned CBD parking facilities were comparable. In the next 10 years, while city rates remained the same, rates at private facilities steadily increased, escalating rapidly in recent years. By 1978, fees at city parking facilities located in or near the CBD generally averaged no more than 75 percent of comparable fees at nearby privately owned facilities. Lower city fees attracted a higher proportion of commuters (i.e., long-term hourly and monthly parkers). Occupancy levels at the end of the morning peak period were higher at city facilities than at private facilities. Although short-term parkers could also get cheaper rates at city facilities than at privately owned facilities, relatively few spaces were available after the morning peak travel period. Because the fee increases implemented at city facilities were large and the overall drop-off was substantial (28 percent, or 54 000 vehicles, in May 1978), it was decided to investigate what impacts the changes in fees at

municipal facilities had on rates and use at privately owned facilities. By analyzing patterns of use at privately owned facilities, the study might be able to determine the extent to which long-term parkers were diverted to transit.

Fees at privately owned parking facilities are adjusted periodically to reflect increased operating costs, a large proportion of which goes to labor. Surveys of parking fees were conducted to determine whether parking operators made special adjustments to their fees in response to the city's fee increases. Most often they did not. Of 201 facilities surveyed, 6.5 percent (13) of the facilities raised their rates within six weeks after the city implemented its new rates. This finding was consistent with the comments made by several operators of parking facilities, who stated that what the city did with regard to its rates had little bearing on their rates.

There appear to be two exceptions, however. The first was one operator who stated that he would (and did) adjust his rates as a result of the city's action. This apparently affected several facilities in the downtown area. In the other case, 7 of the 13 facilities that did adjust their rates were located within three blocks of city facility 3. It is not certain that these increases were in response to the fee increases at facility 3, but it is possible since, in contrast to the situation at other city garages, rates at facility 3 were now higher than those at surrounding privately owned facilities. The all-day rate at facility 3 increased from \$1.90 to \$4.15, and the monthly rate increased from \$28 to \$53. The median all-day parking rate at the 7 private facilities located near facility 3 was approximately \$3.15 before the

**Table 4. Change in use at privately owned parking facilities near city facilities 2 and 3.**

Item	Facility 2 <sup>a</sup>		Facility 3 <sup>b</sup>	
	Monthly Ticket Sales	Hourly Parkers for Month	Monthly Ticket Sales	Hourly Parkers for Month
Number of times 1978 month was				
Higher than same month in 1977	29	31	30	38
Same as same month in 1977	2	0	7	0
Lower than same month in 1977	41	41	47	46
Total number of comparisons	72	72	84	84

Note: Total months compared = 12 times the number of facilities surveyed.

<sup>a</sup>Six private facilities were surveyed.

<sup>b</sup>Seven private facilities were surveyed.

increase and \$3.65 after the increase. Perhaps operators at these 7 facilities expected increased demand by all-day parkers at their facilities because of the radical increases in the all-day and monthly fees at facility 3. Because of this expected increase in demand relative to supply, rates were adjusted upward but usually not above those at facility 3. Analysis of use at facility 3 for January 1978 and subsequent months does indicate a large drop-off in all-day parkers but little or no change in short-term parkers.

Over the long term, the fee increases at city facilities might have had more of an effect on fees at nearby private facilities if the increases had affected use at these nearby facilities. But this did not appear to happen.

Data on the number of hourly parkers and sales of weekly and monthly parking permits were collected for 13 private parking facilities within a two- to three-block radius of city facilities 2 and 3. These two city facilities were chosen because each had a large absolute decrease in the number of parkers. It was assumed that, if a large proportion of the parkers who stopped using the city facilities switched to nearby private facilities, it should be evident in the levels of use at private parking facilities in the vicinity of city facilities 2 and 3. Apparently a large proportion of the parkers who stopped using city facilities did not switch to nearby parking facilities. In a comparison between 1977 and 1978 levels of use at neighboring facilities, there were more parkers in most months in 1977 than in 1978 (see Table 4). Unfortunately, the data are inadequate to determine relatively small changes at nearby facilities that may be related to changes in fees or use at the city facilities.

The tentative conclusion is that most of the former users of city facilities 2 and 3, and probably most of the former users of the other city parking facilities, switched to transit or possibly to carpools rather than drive and park at a facility near the city facility at which they formerly parked. This conclusion appears to be supported by the 72 percent reduction in vehicles that arrived during the morning peak period and parked all day. The availability of transit and other alternatives (such as carpooling) is greatest for these parkers. Furthermore, few of these parkers are likely to have discontinued their trips to the central area, since most are employed there and are unlikely to change their jobs because of an increase in parking costs. In addition, because commuters travel regularly,

their increased outlay for parking would be more conspicuous in comparison with that of the noncommuter, who faces less of an increase and would likely have paid the increase less often than a commuter. Parkers at other times, however, have fewer alternatives to the automobile, and they had little to gain by switching to another parking facility, since the new fees at city facilities were generally not greater than those at nearby facilities. A major operator of parking facilities in the central area reinforced this conclusion by stating that noticeable increases in the use of those of his facilities located near the municipal facilities were not evident and that most of the parkers who stopped using these facilities probably changed to transit.

There were perhaps some small changes in the pattern of use at private parking facilities in the vicinity of the municipal facilities:

1. Some short-term parkers may have been diverted from nearby commercial facilities to city facilities because of the greater availability of space and slightly lower short-term parking fees.

2. Some long-term parkers who used a city facility before the fee change may have decided to patronize a facility that was more convenient to their destination, since after the fee increases there was little difference between the fees at municipal and nearby privately owned facilities.

3. A relatively small number of parkers may have been able to realize a saving in their parking fees by switching from a city facility to a nearby privately owned facility. This may have occurred at city facility 3 because the new fees for long-term parking at this facility were higher than those at a few of the nearby private facilities. Facility 3 showed the largest drop-off in parking of any of the city's facilities.

Unfortunately, the data at hand were not appropriate for determining such relatively small changes.

#### CONCLUSIONS AND DISCUSSION

The major effects of restructuring the fees at city parking facilities were the following:

1. Long-term parking decreased overall by about 50 percent and by 72 percent for vehicles arriving before 9:30 a.m. on weekdays.

2. There was slightly more short-term parking after the fee increase than before.

3. The fee-induced changes in parking patterns were still evident 17 months after the increase.

4. Although the absolute number of parkers decreased, revenue generated by the eight city facilities increased.

5. The effects on the amount and duration of parking, rate structures, and revenues at privately owned facilities were minimal.

6. There is evidence to indicate that former long-term parkers shifted from parking at city facilities to using transit.

The manner in which fees at city facilities were increased and the impacts these fee increases had on parking and travel patterns in the Chicago central area are consistent with the goals of enhancing the economic viability of the central area, improving environmental quality, and augmenting transit ridership and revenues.

As a result of the large drop-off in long-term daytime parking, there is capacity for further increases in short-term parking. Short-term parkers are frequently dependent on the automobile, re-

quiring a car for package delivery, shopping purchases, banking large amounts of cash, and trips to or from areas that are inaccessible by transit. But, as patrons of retail and commercial establishments, they are essential to the economic health of the CBD. In addition, since they typically travel in the off-peak period, the environmental effects of their trips are less damaging.

The fee increases at city parking facilities apparently motivated automobile drivers to shorten the length of time they parked or to use other alternatives such as transit. Reducing the number of automobile trips to the central area during the morning peak periods reduced pollution, energy consumption, and interference with bus and pedestrian flow. In the aggregate, the reduction in peak-period automobile congestion in the CBD was small. City facilities in the CBD (facilities 1, 2, and 8) experienced a total decrease of about 850 in vehicles parked before 9:30 a.m. Even if all of these vehicles no longer entered the CBD during the morning peak period, the number of private automobiles entering the CBD during this period (35 000-40 000) would have decreased by not more than 2 percent. The number of all vehicles--i.e., private automobiles, taxis, and buses--would have decreased by less than 1 percent.

Nonetheless, if the focus is narrowed to the roadways surrounding a particular municipal facility, the reduction in vehicles is evident. For example, before the increase there were long waiting lines at facility 8, which is located across from City Hall. The lines often extended north beyond the intersection of LaSalle and Randolph Streets, interfering with pedestrian and vehicle flows on both streets. The noticeable reduction in the number of waiting vehicles after the fee increase resulted in improved traffic flow, particularly for pedestrians and buses. Southbound buses on LaSalle Street, which could rarely unload passengers at the northwest corner of LaSalle and Randolph because waiting cars blocked access to the curb, can usually do so now.

The increase in the availability of parking space after 9:30 a.m. was, however, more significant. Since almost all of the 850 vehicles would have remained in the CBD after 9:30 a.m., this loss represents about a 6 percent decrease in the approximately 14 000 private automobiles that accumulate in the CBD by about 9:30 a.m. (2). The impact on the availability of parking after the peak period is more significant because, although the city parking facilities account for only about 15 percent of the CBD supply, they accommodated a more-than-proportionate share of the vehicles that entered and parked in the CBD during the morning peak period.

The impacts of the fee increase on commercial parking facilities and their customers appear to have been minimal. Although some short-term parkers at these facilities may have diverted to city facilities, the number is small and has probably been compensated for to some degree by the diversion of long-term parkers from city facilities to private facilities. Perhaps, since rates are now more similar in a given sector, there will be a more even distribution of available spaces and less "cruising" to find a cheaper or an open parking space.

Although revenues generated by the eight city facilities increased after the fees increased, the increase was not as much as anticipated because the decrease in use was greater than expected. It is possible that, if rates had been increased gradually over the preceding 10 years, the drop-off in use would have been less and revenues greater.

Rates should perhaps be reviewed and adjusted at

least every two years so that they will assist in promoting the city's goals for the central area. Fees for long-term parking should be made comparable to those at nearby commercial facilities; fees for short-term parking should continue to be somewhat less than fees at nearby facilities. Such a rate structure would favor the central-area patron, who is often dependent on the automobile for travel, rather than the central-area employee, who generally has greater access to high-level transit service.

Consideration might be given to experimenting with the rate structure at one or two city parking facilities. Short-term fees could actually be reduced and long-term fees significantly increased on weekdays when the competition for space is heaviest. The impacts on parking and travel patterns at both city and nearby private parking facilities could then be studied, and the results could be useful as input to future decisions on parking fees for the central area. For example, the results might be useful in deciding how to structure rates in relation to existing or new facilities that are intended to revitalize the downtown area (e.g., the State Street Transit Mall, currently under construction in downtown Chicago). By picking only one or two facilities in areas of heavy parking demand, the potential adverse impacts on the revenues of any parking facility would probably be small.

Although impacts on peak-period congestion and the availability of midday parking in Chicago were small, fee increases could have a much greater impact in other downtown areas where a large portion of the parking capacity is found in municipal facilities. This would be especially true if transit alternatives were available and if other parking management strategies were applied. Zoning can be used to limit or prohibit new parking facilities (as previously mentioned, the city of Chicago has prohibited the development of any new parking in the CBD, and the amount of spaces is being reduced by attrition). As this research indicates, restructuring of municipal parking fees can possibly contribute to better use of the existing parking supply, including both off-street and on-street parking.

Other, more radical strategies for reducing the problems of peak-period automobile congestion in the CBD are available. The harmful effects of peak-period congestion are the product of trips made both to and through the CBD. Kulash (3) collected information on the level of through traffic in about a dozen major cities and suggested some programs for reducing through trips, including increasing the absolute cost of the through trip by means of gasoline taxes and various road pricing schemes, reducing the time and dollar costs of alternative modes, and prohibiting private automobiles from using delineated zones. Such programs will, however, probably be more difficult to implement than more conventional approaches to traffic management.

It is unlikely that the changes in parking fees at municipal facilities in Chicago would have resulted in such a drastic drop in long-term parkers had there not been an extensive network of high-quality transit service available. The attractiveness of transit can be enhanced if interceptor parking is provided along major corridors, either in outlying areas or on the fringe of the CBD, and if transit fares are relatively low in comparison with the cost of the automobile trip. Consequently, adequate transit services and incentives should be incorporated with strategies aimed at better parking and traffic management. In the interests of the downtown economy, the overall program, while providing for an improved environment, should enhance or



maintain accessibility to the core by automobile.

#### ACKNOWLEDGMENT

We appreciate the cooperation and assistance of the Chicago Department of Revenue and the Bureau of Parking in providing many of the data used in this research. Our thanks go to the staff of the Chicago Department of Planning--City and Community Development, who contributed to the research project.

The major source of funds for the project from which this paper was developed was the Urban Mass Transportation Administration, U.S. Department of Transportation. The contents of this paper reflect our views, and we, not the sponsoring agency, are responsible for the facts and the accuracy of the data presented.

## Employer-Subsidized Parking and Work-Trip Mode Choice

DON H. PICKRELL AND DONALD C. SHOUP

The widespread practice of employer-subsidized parking is a significant but often overlooked determinant of mode choice for the journey to work. Experiences in several major cities are examined, and estimates are made as to how many of those who are offered employer-paid parking decide to drive alone to work rather than commute by other modes. It appears that approximately 20 percent of those who now drive alone and receive free parking would form carpools or begin using public transit if they were required to pay for parking at the workplace. This estimate is derived from comparisons of the behavior of commuters of similar characteristics who park free and who pay to park and from the results of the imposition of parking charges for parking formerly provided free. The major incentive for employers to provide free parking appears to be the fact that, as a fringe benefit, free parking escapes income taxation. Enforcing the reporting and taxation of its cash value, however, is a difficult and predictably unpopular task. Two policies intended to extend employer parking subsidies to work travel by modes other than the single-occupant automobile are recommended: tax-exempt travel allowances and carpool parking subsidies. Both policies could lead to significant increases in carpooling and transit use at very low or no public expense.

In metropolitan areas throughout the United States, offering employees either free or partly paid parking is a common practice of both private and government employers. Nationwide, as many as 85 percent of all those who commute by automobile in urban areas park free of charge (1), and most of those who park at their employers' expense work in downtown areas, where parking is most costly to provide. In the Los Angeles central business district (CBD), for example, almost one-third of the 100 000 employees who arrive daily by automobile report that they pay nothing to park, and another quarter pay only the nominal cost of participating in an employee permit system. Advertised parking rates in the Los Angeles downtown area average almost \$35/month. This suggests that parking subsidies offered by private and government employers in the area total almost \$30 million annually (2).

In a 1977 memorandum to the Secretary of Transportation, acting administrator Charles F. Bingman of the Urban Mass Transportation Administration reported that in Washington, D.C., the federal government alone provides free parking for about 30 000 of the 140 000 automobiles that enter the central em-

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*Publication of this paper sponsored by Committee on Parking and Terminals.*

ployment district daily as well as partly paid parking (at \$5-\$20/month) for another 10 000 cars. In an area where posted rates average almost \$50/month (3), this amounts to a continuing federal subsidy for automobile travel of well over \$20 million/year, half the combined capital outlay for building the Shirley Highway Busway and for acquiring nearly 100 specially equipped buses intended to attract commuters out of their automobiles (4).

The federal government may be the most generous provider of parking subsidies in the Washington, D.C., area, but it is by no means the only one: When subsidies offered by private employers are included, almost 40 percent of all parking facilities (some 65 000 spaces) in the metropolitan area are made available at no charge to their users (3). This brings the total cash value of employer-provided subsidies for automobile travel to almost \$40 million/year.

Employer-subsidized parking also appears to be commonplace in Canadian urban areas. Transport Canada (5) reports that 85 percent of all Canadian automobile commuters working in urban areas are provided with free parking at their places of employment. In Ottawa, for example, the federal government provided free parking for almost 40 000 employees until 1975, when fees equal to 70 percent of downtown commercial rates were imposed in federal parking facilities.

#### FREE PARKING AND WORK-TRIP MODE CHOICE

The surprisingly widespread practice of subsidized parking is a significant but generally overlooked influence on commuters' choices among travel modes. In both downtown and suburban employment centers, the cost of parking can be a substantial component of the total cost of the trip to work by automobile. Daily parking rates as high as \$3.50 are common in some areas of downtown Los Angeles, for example, and rates as high as twice this figure prevail in other urban areas such as Washington, D.C., and New York City. When such charges are paid

by the motorist, they represent a significant fraction of the total cost of already expensive and time-consuming trips. By offering free or partly subsidized parking, employers thus substantially reduce the price their employees pay to travel to work by automobile. Because those employees generally are not offered an equivalent price reduction for travel to work by carpool or public transit, they are more likely to drive alone to work than they would be if forced to bear the full cost of parking.

U.S. Department of Transportation (DOT) data for 1976 (6) show that the cost of operating a medium-sized automobile in a typical urban area averages \$0.074/mile, of which \$0.036 represents fuel costs. For a representative 10-mile suburb-to-downtown commuting trip (the national average), even a nominal \$2.00 charge at the destination represents more than half of the total dollar cost incurred over the round trip. If, as Quarmby (7), Landing (8), and others argue, commuters perceive the cost of automobile mileage to include only fuel expenses, parking fees may represent as much as three-quarters of the combined dollar outlays on the basis of which driving alone is compared with other modes available for the journey to work. For those who work in downtown areas, the cost of parking can be far higher than in this modest example, as the price of almost \$50.00/month in downtown Washington suggests. Because the price of off-street parking is highest in the most congested areas, free parking perversely gives the greatest cost reduction to drivers headed for areas where congestion is already worst and where public transit often provides its best service.

To recipients of subsidized parking, its cost is comparable to the other, more notorious external costs motorists impose on one another and on the transportation system. Like the time delays drivers impose on one another on congested facilities and the health and property damages that result from their contributions to air pollution, it becomes a cost that is borne by persons other than those responsible for it. The value of the subsidy inherent in free parking can be even larger than the more frequently cited subsidies implicit in allowing motorists to congest urban streets and pollute the air. Again, using Los Angeles as an example, Elliott (9) estimates that congestion and pollution costs imposed by an automobile driver over the course of a typical round trip to work may be as high as \$2.50, yet an employer's offer of free parking at the trip's destination can represent a subsidy of up to \$4.00/day (1).

The cost of parking does differ in one important respect from the costs of congestion and pollution: Unlike these other external costs, parking cost seems comparatively easy to transfer to those who impose it through policy measures. Accurate estimation of the costs of congestion and pollution has proved extremely difficult, and the various proposals for charging them to their perpetrators all involve substantial outlays for metering and collecting charges. Such "transaction costs" can significantly reduce the benefits these policies promise, since they must be accounted among the costs of their implementation. Because transferring the full cost of providing parking to commuters involves no such outlays, it is likely to be far simpler and cheaper to accomplish than other measures designed to bring the price of peak-hour automobile travel into closer conformity with the total cost it imposes on society.

Still, in deciding whether an ambitious policy to change employer subsidy practices is warranted, it is important to assess how extensively current offers of free parking encourage employees who would

otherwise carpool or use public transit to drive to work instead. By estimating the effect of employer-paid parking on the travel mode decision, the contribution of subsidized parking to problems stemming from the underpricing of automobile use can be separated from those stemming from the failure to tax exhaust emissions, price road capacity, or deregulate crude oil price. Only if removing parking subsidies promises a significant reduction in peak-hour automobile travel are the public policy changes necessary to foster their withdrawal likely to prove worthwhile. Because parking subsidies appear to be offered more frequently to employees than to shoppers, travelers conducting personal business, or recreational travelers, it is particularly important to examine their effect on travel mode choice for the trip to work.

EVIDENCE OF THE EFFECTS OF FREE PARKING

Two direct ways to estimate the effects of employer parking subsidies are (a) to observe changes in the travel modes used by commuters whose free parking is withdrawn and (b) to compare differences between the travel modes chosen by commuters who are eligible for free parking and those chosen by otherwise identical commuters who are not eligible for free parking. The following discussion reviews a variety of evidence of the effects of both changes and differences in parking prices on commuting behavior. Although adequate controls for fully isolating the effect of parking price from effects of other variables are in some cases lacking, studies conducted in Los Angeles, Ottawa, and Washington, D.C., consistently show that free parking markedly increases the proportion of employees who drive alone to work. Taken together, they suggest that 20 percent of automobile drivers who now park at their employers' expense would be induced to join carpools or begin using transit for the trip to work if they were charged for the parking they now receive free.

Discontinuance of Free Parking for Canadian Government Employees

On April 1, 1975, the government of Canada discontinued the provision of free parking to its employees and began charging a price equal to 70 percent of commercial rates for comparable parking (5). The proportions of survey respondents in Ottawa who commuted by various modes before and after the removal of parking privileges for government employees are given below (other includes bicycle, walk, taxi, and ice skate; sample size = 3782):

Mode	Commuters (%)		Change
	Before Parking Charges	After Parking Charges	
Drive alone	34.9	27.5	-21
Carpool	10.5	10.4	-1
Transit	42.3	49.0	+16
Other	12.3	13.1	+7

As the table indicates, the number of persons driving alone decreased by more than 20 percent, bus ridership increased substantially, and commuting by various other modes (including ice skating!) increased slightly. Although the fraction of employees who carpooled remained almost constant, this reflected the finding that the number of carpools who switched to other modes--predominantly transit--was almost exactly offset by the number of

former drivers and bus users who switched to car-pooling.

Table 1 examines an unusual feature of the data collected in the Transport Canada study: the fraction of former automobile drivers who cited various reasons for switching to a new travel mode. By far the most common reason for changing commuting behavior--and the reason cited by two-thirds of all automobile drivers who changed to other modes--was the substantial reduction in the parking subsidy drivers formerly enjoyed. Table 1 confirms the indication in the preceding text table that the primary effect of the parking-price change has been the shift to bus travel among former automobile drivers.

Another important aspect of the Ottawa case is the fact that, among a group of highly paid employees, the imposition of seemingly modest parking charges led to a pronounced shift from driving alone to other modes. The average annual income reported by survey respondents was almost \$17 000 (in 1975 currency, \$1.00 Canadian = U.S. \$1.0172); yet, even in the presence of the strong, positive influence of income on the probability that a commuter will choose to drive alone to work, parking price appears to play a pivotal role in determining which mode is selected.

Further evidence to this effect drawn from the Transport Canada survey (6, Exhibits 4.16 and 4.32, Table 5) is given below (sample size = 3782):

Annual Income (1975 Canadian \$)	Employees Driving Alone (%)			Change (%)
	Before	After		
	Parking Charges	Parking Charges		
<10 000	27	25		-7
10 000-15 000	37	31		-16
15 000-20 000	33	25		-24
20 000-25 000	40	28		-30
25 000-30 000	50	36		-28
>30 000	49	31		-37

Although a positive correlation of income with the likelihood that an individual will drive to work persists even after the imposition of parking charges, the fraction of high-income drivers shifting to other modes actually exceeds that among lower-income drivers.

Although it is certainly an implausible result, the finding that a higher proportion of upper-income drivers switched to other travel modes may be partly explained by the fact that more of this group initially received free parking. Since demand for parking facilities among federal employees exceeded supply when spaces were offered free, access to spaces was rationed on the basis of seniority in government employment. Because of the association

Table 1. Reasons cited by Ottawa drivers for switching to other travel modes after withdrawal of free parking in 1975.

Mode to Which Drivers Switched	Reason Cited for Switching (%)			
	Imposition of Parking Charges	Improved Bus Service	Change in Automobile Availability	Other <sup>a</sup>
Carpool	70	0	10	20
Transit	68	18	4	10
Other <sup>b</sup>	55	0	9	36
All	67	14	5	14

<sup>a</sup>Including weather and various other reasons.

<sup>b</sup>Including bicycle, walk, taxi, and ice skate.

of higher salaries with seniority, permits for free access to parking spaces were more commonly held by higher-income employees, as the following table indicates (6, Exhibits 4.16 and 4.36):

Annual Income (1975 Canadian \$)	Survey Respondents in Income Class (%)	Total Permits Held by Class (%)
<10 000	29	11
10 000-15 000	21	18
15 000-20 000	24	26
20 000-25 000	14	21
25 000-30 000	7	14
>30 000	5	10

Since those who did not hold permits were required to pay market rates for parking if they chose to drive, only permit holders were confronted with a parking-price increase when government-provided free parking was eliminated.

The table above indicates that roughly the same number of permits--about 10 percent of the total issued--was initially distributed among each of the lowest and highest income groups, the latter of which was only about one-sixth as large as the former. Thus, a higher-income driver was far more likely to be confronted with a significant parking-price increase (about \$1/day) than a driver of relatively low income, which makes much less surprising the observation that the fraction of drivers switching modes increases with income.

#### Public Employee Parking in the Los Angeles Civic Center Area

Francis and Groninga (10) investigated the effect of parking subsidies on mode choice for the journey to work by using a sample of 275 government employees who work in the Civic Center area of downtown Los Angeles. Of the sample, 135 were employees of Los Angeles County who received free parking if they chose to drive to work. The remaining 140 were federal employees who paid for their own parking if they commuted by automobile. Those federal employees who did park paid an average of about \$16/month at the time of the study.

The distribution of employees in the two groups by travel mode for the work trip is given below (10):

Mode	Employees (%)		Difference (%)
	County (free parking)	Federal (unsubsidized parking)	
Drive alone	72	40	-44
Carpool	16	27	+69
Transit	12	33	+175

This table indicates a startling difference in the behavior of the two groups. The share of federal employees who drive to work alone is 44 percent lower than the share of county employees who do so, and the share of federal employees who commute by carpool or public transit is more than twice that of county employees.

Examination of the differences in commuting behavior for selected subgroups of the samples of county and federal employees suggests that variables other than parking price account for only a small portion of the dramatic differences in travel behavior between the two groups. Data given in Table 2 show that, among men, women, and three different income classes, the drive-alone share among employees who pay to park was from 29 to 45 percent less than the drive-alone share among similar employees who have free parking available.



**Table 2. Travel mode for selected subgroups of Los Angeles Civic Center employees with and without free parking.**

Subgroup	Mode	Modal Share (%)		Difference (%)
		County Employees (free parking)	Federal Employees (unsubsidized parking)	
Sex				
Males	Drive alone	82	52	-37
	Carpool or transit	18	48	+167
Females	Drive alone	66	36	-45
	Carpool or transit	34	64	+88
Income <sup>a</sup> (\$)				
<6000	Drive alone	57	35	-39
	Carpool or transit	43	65	+51
6000-8500	Drive alone	80	39	-51
	Carpool or transit	20	61	+205
>8500	Drive alone	80	57	-29
	Carpool or transit	20	43	+115
Total sample	Drive alone	72	40	-44
	Carpool or transit	28	60	+114

<sup>a</sup>Annual income in 1968 U.S. dollars.

**Table 3. Travel mode for employees in Century City (Los Angeles).**

Mode	Modal Share (%)			Difference Between Free and Pay (%)
	Employees Parking Free	Employees Partly Paid for Parking	Employees Who Pay to Park	
Drive alone	92	85	75	-18
Carpool	4	9	12	+200
All other <sup>a</sup>	4	6	13	+225

<sup>a</sup>Including public transit, walk, and bicycle.

Although the available controls do not completely account for the effect of factors other than parking price on commuters' travel-mode decisions, the consistent differences in commuting behavior within each subgroup clearly show that parking subsidies exert a strong influence on how employees commute to work.

County employees who drove estimated the cost to their employer of supplying their parking to average about \$0.55/day, about 20 percent below the average price paid by the unsubsidized federal employees. When asked what they would do if the parking subsidy they estimated they received were added to their paychecks and they were required to pay the market price to park, 19 percent of these county employees stated that they would continue to drive but would park at a more distant (and presumably cheaper) space and 17 percent stated that they would find another means of travel to work. The remaining 64 percent responded that they would continue to drive and pay their estimate of the cost of providing the space they now receive free of charge.

Although the data reported by Francis and Groninga (10) are not entirely conclusive, they do make it difficult to argue that parking subsidies to employees do not induce a substantial number of employees to drive to work alone. In fact, the data suggest that, if parking subsidies were removed, there would be extensive switching to carpooling and mass transit. One other point suggested by this

evidence is particularly important to note: The difference in commuting behavior between subsidized and unsubsidized drivers implies that a significant number of those who now drive alone would form carpools for the trip to work if their parking subsidies were rescinded. Because carpooling is a particularly important strategy for more effective use of existing transportation investments, in that accommodating additional carpool travel requires no new capital investments and no operating subsidy to be met at public expense, this is a significant finding. Furthermore, it suggests that eliminating employer-paid parking could be a valuable means of increasing the effectiveness of carpool promotion efforts.

Employer-Subsidized Parking in Century City, California

A 1976 survey of more than 3500 employees working in a new office, retail, and entertainment subcenter in the Century City area of Los Angeles also shows that commuting behavior is strongly influenced by the availability of parking subsidies. More than half of the survey respondents reported that they could park for free if they chose to drive to work, another 16 percent were offered partially subsidized parking, and the remainder paid the full cost of parking if they chose to drive. At the time of the survey, parking prices in the Century City area averaged about \$40/month at indoor garages and approximately half the garage rate at outdoor lots.

Table 3 gives the modal distribution of travel to work among those who are offered full, partial, or no parking subsidies. The drive-alone share among employees who pay for their parking is 19 percent less than that among those who can park free at their employer's expense. Although none of the three groups displays a high rate of use of carpools, transit, or other nondriver modes, the nondriver share among commuters who pay for parking is more than three times as high as that among commuters who can park free.

The data in Table 3 clearly suggest that parking subsidies discourage carpooling and use of mass transit. These data must be interpreted cautiously, however, since there are no controls for the effects of variables other than parking price on mode choice. In particular, higher-income employees, who are more likely to drive to work anyway, are probably more frequent recipients of employer-subsidized parking. Other factors that influence mode choice may also be correlated with the availability of parking subsidies. Nevertheless, such factors would have to exert a strong influence on mode choice to produce these pronounced differences in travel behavior among such a large sample of commuters.

Subsidized Parking at the University of California, Los Angeles

The faculty, staff, and students of the University of California, Los Angeles (UCLA), together account for about 40 000 daily trips to the campus, approximately two-thirds of which are by single-occupant automobile. Almost all of those who do commute to campus by automobile park in spaces provided by the university at various locations on and off campus. The university charges \$9/month for a parking permit, and the demand at that low price exceeds the available supply. Monthly parking rates in adjacent Westwood average about \$35/month.

Faculty and staff members are given priority in the distribution of permits, and the remaining permits are rationed among student applicants on the basis of a complex formula that involves distance

from residence to campus, access to the campus via freeway and transit routes, and university seniority as well as employment status, location, and schedule. About 2400 faculty and 11 000 administrative staff members receive annual parking permits; about 8500 students also receive them during each of three academic terms each year.

To obtain information about the travel patterns of students who apply for and are denied parking permits, the UCLA campus parking service surveyed 500 students selected randomly from among those who were denied a parking permit in the fall of 1977. These data can be used to estimate the effects that an increased supply of campus parking spaces would have on the travel behavior of those who now apply for but are denied a parking permit.

The table below gives the distribution of travel modes eventually chosen by 402 off-campus residents who were on the waiting list for campus parking permits during October 1977 (other includes motorcycle, bicycle, and walk):

<u>Mode</u>	<u>Percentage</u>
Drive alone	60.2
Carpool (with permit holder)	3.7
Transit	20.1
Other	15.9

As the table indicates, approximately 40 percent of those applicants who were denied a parking permit subsequently chose to commute to UCLA without driving their cars. In the past, this choice of another travel mode by those on the waiting list for a parking permit has been largely responsible for the annual disappearance of the waiting list over the course of the academic year. The survey results also demonstrate that comparatively few of those who chose other modes for campus-bound travel experienced a hardship as a result. Almost 75 percent of those who chose to drive even without a parking permit reported dissatisfaction with their current travel arrangements, whereas less than half of those who chose other modes reported similar dissatisfaction. In fact, some 40 percent of the group who chose a mode other than driving indicated that they were satisfied to some degree with their commuting arrangements.

If all students on the waiting list had been offered parking permits, those now not driving would presumably have chosen instead to drive to the campus. This assumption is confirmed by the results of a second questionnaire administered later to many of those on the waiting list, which indicated that 20 percent of those on the initial waiting list had accepted permits offered them after the start of the fall academic term. Another 60 percent of those responding had already reapplied for a permit for the following term by the time of the initial survey, demonstrating their continuing desire for access to campus parking facilities at less than the market price.

These findings suggest that, if more campus parking spaces are provided, 40 percent of the recipients of new parking permits would be new drivers diverted from buses, carpools, or other modes. In fact, the number of those seeking parking permits who now carpool or use modes other than the automobile is by itself sufficient to more than fill a new and very expensive expansion of the campus parking supply. A \$4.28 million parking structure now under construction on the UCLA campus will provide 355 additional spaces (at a cost of more than \$12 000/space) to be offered at \$9/month to those who now travel to the campus without driving their automobiles.

### Shirley Highway Experiment

Another source of direct evidence of the effects of parking subsidization is the extensive set of survey data assembled in connection with the evaluation of commuters' responses to express bus service on exclusive lanes of the Shirley Highway in Virginia (11). The survey procedure included interviews with automobile commuters who tried riding the bus but switched back to driving after a trial period. They constituted about one-quarter of all automobile users who responded to the survey.

The survey results show that one of the responses most commonly cited by those who tried the bus service but switched back to driving was that the bus was too expensive. Among this group, 19 percent cited the expense of the bus service as their reason for driving. The only response cited as frequently (also cited by 19 percent of the group) was the "inconvenience" of the bus. Round-trip fares for the express service averaged about \$1.25, and the average annual income of automobile users was almost \$20 000. Half of those who responded that the bus was too expensive reported having free parking available at their places of employment. The average price paid by automobile drivers who did not receive free parking was \$1.20/day at the time of the survey (12). This implies that a parking subsidy was high enough to be pivotal in the mode-choice decisions of many Shirley Highway commuters.

### SUMMARY

The studies cited in this paper indicate that for many commuters the price of parking is a key variable in the mode-choice decision for work trips; moreover, they consistently demonstrate that the offer of free parking at work increases the number of commuters who drive to work alone. Because this evidence is drawn from case studies, it may appear that the results are particular to each case and may not apply to other circumstances. However, the consistency of the findings despite the diversity of the settings strongly suggests that free parking at work does indeed draw a large number of commuters to travel by single-occupant automobile. When all of this evidence is considered together, the best estimate is that 20 percent of commuters who now drive alone and park free would choose another travel mode if they were required to pay for the parking they now receive at no charge.

The nation will obviously never meet its proclaimed goals of energy conservation, environmental protection, and transportation efficiency if so much parking remains free of charge. The harm caused by parking subsidies is not so much the overuse of parking itself but the increased driving it causes. This distorted incentive to drive increases not only traffic congestion but also air pollution and energy consumption, so that the harmful effects of free parking extend well beyond the transportation sector.

### EQUITY OF FREE PARKING

The widespread provision of parking subsidies also raises two important questions of equity. First is the question of fairness between those who do park at their employer's expense and those who (whether because they are not offered prepaid parking or choose not to drive to work despite its availability) do not. Second is a more subtle question of the distribution of benefits among those who do take advantage of employer parking subsidies.

Employer parking policies in the aggregate are inequitable insofar as they arbitrarily subsidize the travel of a limited group of automobile users

without extending commensurate benefits to either unsubsidized automobile users or those who commute by other modes. The policies of individual employers who offer subsidized parking are also unfair in themselves insofar as they fail to reimburse employees who commute by public transit for even the nominal fares they incur. Nor do they offer two employees who agree to carpool together a subsidy as large as the combined total of what each would receive if they drove separately. These generous fringe-benefit payments by employers to automobile drivers are partly underwritten by reduced salary payments to nondrivers, an income-transfer scheme that, while probably unintended, is nevertheless unfair, for several reasons.

The nondriver group contains a disproportionate share of low-income earners, minorities, and women. For example, in 1970 the median annual income of transit riders in the Washington, D.C., urban area was \$6200, whereas that of automobile drivers, many of whom receive another \$600/year in after-tax income in the form of employer-subsidized parking, was \$9600/year (3). Transit riders are, of course, subsidized heavily through public financing of the capital outlays and operating deficits of the transit system, but it is also true that automobile commuters are generously subsidized at public expense in a variety of less obvious ways (8). Thus, the combined effect of public and private transportation subsidies may well be weighted in favor of higher-income commuters by employer parking policies.

Other research shows that more than three times as many nonwhites as whites travel to work by public transit in U.S. urban areas (13). Finally, the survey of commuters in downtown Los Angeles reported in this paper showed a much smaller proportion of females among those receiving subsidized parking than among those required to pay for their parking (10). The inescapable conclusion is that the considerable benefits of employer-paid parking accrue predominantly to persons not usually identified as being among the nation's disadvantaged.

Employer subsidy practices also pose a similar question of equity within the group of commuters who do take advantage of them. Among the recipients of such benefits, the value of the subsidy inherent in free parking might appear to be uniformly distributed among employees of varying income, since everyone receives the same privilege. But, because free parking is a fringe benefit that typically escapes income taxation, its after-tax value increases with employee salary and the correspondingly increasing marginal tax rate on earned income.

As an illustration of how rapidly the value of free parking increases with income, the following table gives the increase in taxable income that would be equivalent to a tax-exempt parking subsidy of \$50/month:

<u>Taxable Income of Married Couple Filing Jointly (\$)</u>	<u>Marginal Federal Income Tax Rate (%)</u>	<u>Annual Taxable Income Equivalent of \$50 Monthly Parking Subsidy (\$)</u>
4 200	15	706
15 200	25	800
31 200	40	1000
47 200	50	1200
91 200	60	1500

As the table indicates, much larger taxable salary equivalents for free parking go to the highest-income employees. At the other extreme, an employee whose income is too low to be subject to income taxation would value a free parking subsidy no more

than an equivalent increase in taxable income. In addition, employees who would choose not to drive their automobiles when required to pay the full cost of parking evidently value the free-parking privilege at less than the cost to the employer of providing it. Such employees--who would prefer to receive the value of the subsidy in cash--are not an insignificant fraction of current parking-subsidy recipients, according to the evidence reviewed above.

Yet the table above also shows an important reason why free parking is so popular among those who do take advantage of it. For those who drive to work, the tax-exempt status of free parking can make it worth far more than a salary increase equal to the cost of parking, and employees who now park free understandably want to keep this privilege. An obvious but unpromising way to eliminate this tax incentive for employers to provide free parking would be to treat the value of parking provided to employees as taxable income, just as the value of housing and other benefits provided to employees is now treated. In fact, the Commissioner of Internal Revenue, in a July 1977 interview in U.S. News and World Report, suggested that the value of free parking provided to employees must be considered taxable income.

Taxation of parking fringe benefits is a predictably unpopular approach, however, and even determining the value of free parking for tax purposes would hardly be simple. A case can even be made that travel to work is a cost incurred in earning a living and should therefore legitimately remain untaxed. Furthermore, any policy changes intended to encourage employers to remove the parking subsidies they now offer must recognize the understandable, if presumptuous, interest of drivers in continuing to have low-priced parking available.

RECOMMENDATIONS

Two courses of action are worth considering as alternatives to the policy of taxing the value of parking fringe benefits as income to employees. The first can be implemented only by the federal government, but the second can be implemented by any employer, public or private. Either policy would lead to a substantial reduction in commuting by single-occupant automobile, and neither would impose any cost on employers or employees.

Tax-Free Travel Allowance

The first alternative is to amend the Internal Revenue Code to permit employers to pay employees a tax-exempt travel allowance in lieu of free or subsidized parking. In order to pay employees this tax-free travel allowance, the employer would certify to the Internal Revenue Service (IRS) that employees are provided no further parking subsidies of any kind. Both employers who now offer their employees subsidized parking and those who do not could be allowed to pay the tax-exempt travel allowance (employers who do not subsidize their employees' transportation could provide the travel allowance by classifying part of each employee's wages as tax exempt). They could thus make their employees better off without increasing total wage payments, so that employers who are not part of the free-parking problem would receive some reward.

In order to be allowed to begin paying their employees the tax-free travel allowance, employers who now provide subsidized parking would be required to certify to the IRS that they had discontinued the practice. The employer's certification could be subject to audit, if necessary, in order to verify that any parking spaces controlled by the employer

are provided to employees--or, for that matter, to anyone who is willing to pay--only at the market price for parking in the immediate vicinity, with no waiting list for spaces at the price charged. Thus, an employer who now offers free parking could either begin offering employees a tax-free travel allowance or continue to offer free parking, but not both.

If employees "cashed out" their current parking privileges in exchange for a tax-free travel allowance of equivalent value, they could not later win back their free-parking privilege without having to give up the tax-free allowance because the employer would be prohibited from giving both. If the permitted size of the tax-exempt travel allowance is equal to the price of free parking, employees could then choose freely among competing travel modes on the basis of service quality and cost. Any automobile commuter could continue driving alone by using the allowance to pay for parking, but those who decide to carpool could split the cost of parking and use some of the travel allowance for other purposes. Others will choose not to commute by automobile at all once the travel subsidy is offered separately from the use of free parking. Again, judging from the evidence presented here, this latter group could include as many as 20 percent of drivers whose parking privileges were converted to a tax-exempt travel allowance.

The main advantage of a tax-exempt travel allowance is that it would eliminate the employer's federal income tax incentive to give employees free parking. The tax exemption would recognize that commuting is a cost of earning income and at the same time remedy the distortion in the relative prices of travel by different modes that results from employer-subsidized parking.

If this simple reform were adopted, employer-paid parking would tend to disappear with little or no opposition from either employers or employees. Employees would, however, begin to face the full market price of parking in their work-trip decisions. According to the research findings presented here, the resulting reduction in the number of automobile work trips would be large enough to produce a noticeable reduction in energy consumption, air pollution, and traffic congestion.

A tax-exempt travel allowance would also be much more fairly distributed than is free parking because it would benefit the entire working population, not just those who drive to work. Those who now park free would simply be exchanging a tax-free fringe benefit in the form of a free parking space for a tax-free travel allowance. Whereas each would benefit only if the allowance exceeded the market value of their free parking space, those who did not already have the free-parking privilege would benefit by the full amount of the new travel allowance. Thus, the new tax exemption would mainly aid low-paid workers, who are now the least likely to park free. In effect, the federal government could "buy" the elimination of employer-paid parking by reducing income taxes for the working poor.

When this research was done, it was felt that the proposal could be tested during the implementation of President Carter's executive order imposing parking charges on all employees of the Executive Branch of the federal government. If the "windfall" increase in federal parking revenues were returned to federal employees in the form of a travel allowance, all employees would be treated equally, regardless of how they got to work, and the artificial incentive to drive provided by subsidy practices would be eliminated.

### Carpool Parking Subsidies

The second proposal is best explained by an example. Take the case of an employer who pays \$50/month for off-street parking spaces that are in turn offered to employees for only \$25/month. This common sort of arrangement has the advantage of giving a tax-exempt fringe benefit of \$25/month to employees who drive to work.

Suppose that this employer decides to allow carpoolers to park free. Those continuing to drive alone would pay the same \$25 parking price as before, but two drivers who each pay \$25/month for parking could now park free by carpooling and save a bit more by splitting the driving costs. The cost to the employer would not rise because the employer would simply be paying one subsidy of \$50/month for one parking space instead of two subsidies of \$25 for two parking spaces. Indeed, a carpool of three employees can be granted a free \$50/month parking space plus a cash subsidy of \$25/month at no more cost to the employer than the parking subsidy for three employees who each drive alone to work and pay \$25/month to park. The general principle is that a two-person carpool can be given a parking subsidy twice as large as that given to an employee who drives alone, a three-person carpool can be given a subsidy three times as large, and so on, at no additional cost to the employer.

As an example, recall that one quarter of the almost 100 000 persons who drive to downtown Los Angeles park free and another quarter pay \$5.00/month or less for parking while the market price for parking is \$35.00/month. Those employers who now offer free parking to employees could also offer free parking and a cash bonus of \$35.00/month to any two drivers who form a new carpool without increasing the total subsidy cost. Each new carpooler would receive free parking and an extra \$17.50/month in cash as the reward for sharing a ride. Likewise, each member of a newly formed three-person carpool could be given free parking and almost \$25.00/month at no increase in the employer's total outlay. And those driving alone would still park free.

A few employers already give some preference to carpoolers, but no one seems to have argued that this practice can be vastly expanded without costing employers, or anyone else, anything. Carpool parking discounts would complement other strategies--such as exclusive freeway lanes for buses and carpools, ramp metering, and mass transit subsidies--to reduce the social costs of excessive automobile use. But offering cheaper parking, or even payments, to carpoolers is the only one of these transportation strategies that is free.

### ACKNOWLEDGMENT

The research summarized in this paper was supported by the U.S. Department of Transportation under its Program for University Research. We are grateful to Charles Hedges, Gabriel Roth, Martin Wachs, Douglass Lee, and John Kain for their comments and enthusiasm.

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## Discussion

Donald A. Morin

Pickrell and Shoup have done an excellent job of describing the extent to which free or greatly subsidized parking for employees does bias mode choice in favor of commuting by automobile. The only part of the paper with which I disagree is, unfortunately, the last section, in which the authors describe two alternative solutions.

Their first alternative is to amend the Internal Revenue Code to permit employers to pay employees a tax-exempt travel allowance in lieu of free or subsidized parking. Although this certainly has merit from the standpoint of equity, it is an action that employers can take now, even without the additional benefit of having the travel allowance provided tax free. One employer, the American Hospital Supply Corporation (AHSC) in Evanston, Illinois, has done just this. As of the beginning of 1978, AHSC converted the total amount of money that they were spending to lease parking spaces in order to provide free parking to their employees who commuted by automobile into a cash transportation allowance that was then distributed equally among all employees.

A solution to the disparity between the value of employer-subsidized parking being nontaxable income to the employee while an equivalent cash transportation allowance is taxable income is not essential. Suffice it to note that the accepted practice it not to declare the fair market value of

employer-provided parking as "income in kind" and therefore part of an employee's taxable income. The IRS has never made any ruling that concurs with this "accepted practice". Neither has the IRS issued any guidelines that specify that it is the accepted practice. It would seem that rather than try to change the Internal Revenue Code to include another tax-exempt category--that of the "cash travel allowance in lieu of subsidized parking"--to resolve the disparity, an equally strong case could be made for determining that the fair market value of employer-provided parking be treated as taxable "income in kind".

The authors' second alternative solution is for employers to provide reduced parking charges for carpool parking. This approach to reducing the amount of automobile commuting involves very serious problems in the areas of cost-effectiveness, impact on other transportation modes, administrative control, and equity.

In relation to cost-effectiveness, this approach could only be implemented at no additional cost to the employer (as stated by the authors) if all of the employees who were commuting by automobile were doing so as solo drivers and if no employees who use a nonautomobile mode (e.g., transit, walk, bicycle, or taxi) decided to carpool instead--a very unlikely situation. Table 4, which is based on the authors' example of \$25/month employee carpool subsidy, shows that it would cost the employer an additional \$25/month for each space used by those carpooling before the plan was implemented. If the average vehicle occupancy of employees commuting by automobile were 2 persons/automobile before the plan started, the cost to the employer would double under the new plan even if no employee changed commuting mode.

As for the impact on other transportation modes, it can be shown by the same example that it would also be negative. Each employee who formerly commuted by transit, walked, or rode a bicycle would be offered \$25/month as an incentive not to do so but to carpool instead. This is borne out by the Seattle project on reduced carpool parking rates, which was evaluated by Olsson and Miller (14). Of those who took part in this program, about 40 percent of the new carpoolers formerly used transit, another 38 percent were carpoolers who now got reduced parking charges, and only 22 percent were new carpoolers coming from the 1 person/automobile mode.

Defining what is a legitimate carpool, in order for the carpooler to receive the \$25/month benefit, would create administrative control problems. If it is on the basis of the employees saying that they are in carpools, then the employer would be put in the position of having to check up on the honesty of each carpooling employee to ensure that the number of "phantom" carpools is minimized. If it is on the basis of the employees being in the automobile as it arrives at the parking facility, is a daily check to be made of every car and its occupants? If an otherwise legitimate carpooling employee is not going to be in the automobile for a certain day because he or she is on vacation, sick, or traveling on company business, does the employee lose the entire \$25 monthly carpool payment or just the one-day proportional share?

As for the equity issue, it would seem that an employer would have a difficult time explaining the new plan in the name of reducing automobile use to those employees who walk, use transit, or bicycle to work, since these employees would not get the \$25 monthly payment while employees who carpool would.

All of the above concerns with the authors' solution to the problem of subsidized parking can be

**Table 4. Net parking cost to employer for 100 employees before and after implementation of carpool parking subsidy.**

Commuting Condition	No. of Spaces Needed	Cost Category	Before Subsidy <sup>a</sup>	After Subsidy <sup>b</sup>
All at 1 person/car	100	Employer	100 × \$50 = \$5000	100 × \$50 = \$5000
		Employee	100 × \$25 = \$2500	100 × \$25 = \$2500
		Net cost to employer	\$2500	\$2500
Ten percent by other than car, 40 percent at 1 person/car, 50 percent at 2 persons/car	65	Employer	65 × \$50 = \$3250	65 × \$50 = \$3250
		Employee	65 × \$25 = \$1625	40 × \$25 = \$1000
		Net cost to employer	\$1625	\$2250
All at 2 persons/car	50	Employer	50 × \$50 = \$2500	50 × \$50 = \$2500
		Employee	50 × \$25 = \$1250	50 × \$0 = \$ 0
		Net cost to employer	\$1250	\$2500
Fifty-five percent at 1 person/car, 22 percent at 2 persons/car, 15 percent at 3 persons/car, 8 percent at 4 persons/car <sup>c</sup>	73	Employer	73 × \$50 = \$3650	73 × \$50 = \$3650
		Employee	73 × \$25 = \$1825	55 × \$25 = \$1375
				11 × \$0 = \$ 0
				5 × \$25 = \$ 125
				2 × \$50 = \$ 100
Net cost to employer			\$1825	\$2500

<sup>a</sup>Employer pays \$50 to lease each parking space; employee pays employer \$25 for space.

<sup>b</sup>Employer pays \$50 to lease each parking space; employees driving alone pay employer \$25 for space, and employees who commute 2

<sup>c</sup>persons/car pay employer nothing for space.  
Average automobile occupancy = 1.4 persons.

overcome by taking the direct approach of stopping the employer-provided subsidy to employee automobile parking. If this were viewed as just the employer benefiting by taking away a fringe benefit (even though the fringe benefit was given only to employees who commuted by automobile and was more valuable to employees who did not carpool), the employer could take the same amount that was being spent on subsidizing parking and distribute it equally to all employees as AHSC has done. In addition, should the employer wish to devote more effort in the form of personnel time and/or money to encourage less automobile commuting, as more and more are doing, then there are a host of actions that can be taken. These include actions such as brokering vanpooling, subscription bus service, assigning the choice parking spaces to vehicles with the largest number of occupants, permitting flexitime so that employees who wish to rideshare with others do not have a time constraint, and many others, ranging from actively assisting employees to find other ridesharers and establishing a company policy of not holding employees past the normal quitting time to prizes for lucky winners of a company-sponsored ridesharers' lottery. All of these are being done in varying degrees by some employers. More and more are joining in as top management recognizes the need to do so.

My closing observation has to do with the final sentence in the authors' paper: "But offering cheaper parking, or even payments, to carpools is the only one of these transportation strategies that is free". To repeat the economist's often-used phrase, "There is no such thing as a free lunch!"

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#### Authors' Closure

We appreciate Morin's detailed comments on the two policy proposals contained in our paper. However, we completely disagree with both his assessment of them and his counterproposal to enforce the taxation of the market value of employer-provided parking as

earned income. We would like to respond to each of the points offered in Morin's discussion in the order in which they were raised.

#### TRAVEL ALLOWANCE VERSUS SUBSIDIZED PARKING

Regarding the proposal to permit employers to pay a tax-exempt travel allowance in lieu of subsidizing their employees' parking, it is of course true that any employer can now convert the value of parking subsidies it offers to a travel allowance that would be distributed among all employees. The problem is that there is no incentive, except perhaps recognition by a few employees of the U.S. DOT, for employers to do this. Because the value of free parking escapes income taxation while a cash travel allowance would not and, according to the 1969 Nationwide Personal Transportation Survey, more than 75 percent of those who drive to work use employer-provided free parking, employers are deterred from "cashing out" the parking subsidies they now offer by the fact that doing so would make the vast majority of their employees worse off. In fact, they face exactly the opposite incentive: to make parking available to all of their employees who want it at the subsidized price.

Probably the strongest evidence that employers will not end their current offers of subsidized parking unless they are offered some incentive is the fact that only one employer in the United States is known to have voluntarily done so. Even more convincing may be the refusal of DOT itself to stop providing free parking to its own employees until directed to do so by executive order of the President, despite insistence from within its own ranks that this policy was hypocritical and unfair to its own employees. On at least one recent occasion, the IRS has clarified its position that the value of free parking must be considered taxable income, but it is apparently unprepared to follow this declaration with the substantial commitment of resources that would be required to annually assess the market value of employer-provided parking and enforce its reporting by recipients.

#### REDUCED PARKING CHARGES FOR CARPOOLS

Morin's Table 4 exaggerates the likely cost to employers of offering reduced parking charges for carpools because it assumes that none of those who now drive alone would begin carpooling if they were

offered a parking discount as an incentive to do so. For example, in the fourth commuting condition in the table, which comes closest to the actual current situation, if as few as one in five of those initially driving alone joined carpools, the cost to the employer would decrease.

Furthermore, if such an offer did draw some current transit riders into carpools for work trips, this would not necessarily be an undesirable result. Most analyses of the deteriorating financial situation of public transit operations have concluded that among the most important causes is the peaking of transit demand during morning and evening commuting hours (15,16). In addition, because carpool travel entails a level of fuel consumption per passenger mile that is among the lowest of all travel modes, diverting some transit commuters to carpools might well reduce energy consumption as well as operating losses incurred by public transit authorities (17,18). The "administrative control" problems of such a scheme are now at least as severe with employee parking-permit schemes. The problem of "phantom" carpools evidently was nowhere more severe than in DOT's own parking garage when no such carpool discount scheme was in effect.

The objection to carpool discounts on equity grounds now applies even more strongly to employer parking-subsidy plans that do not offer carpool discounts, since carpoolers receive a smaller subsidy than those who drive alone. Although the proposal would not correct the inequity between automobile commuters and those who use transit,

bicycle, or walk, it would at least correct the inequity between the different classes of automobile users, carpoolers, and those who drive alone. Finally, all of the ridesharing promotion activities Morin applauds are not only subject to exactly the same objections that he raises to the carpool discount proposal but are also likely to prove no more effective in encouraging carpooling while consuming considerably more of employers' time and resources.

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*Publication of this paper sponsored by Committee on Parking and Terminals.*

#### *Abridgment*

## Maintenance of Park-and-Ride Facilities in New Jersey

ROBERT A. INNOCENZI

An overview of the maintenance and cost experiences of park-and-ride facilities now owned by the New Jersey Department of Transportation is presented. A brief description is given of how the department became involved in the operation of park-and-ride facilities—initially subsidizing the maintenance of privately owned facilities and eventually constructing its own rail park-and-ride facility at MetroPark Station on the present Northeast Corridor Line. Department-maintained and municipally maintained park-and-ride facilities are compared in terms of costs and effectiveness. The state of New Jersey is in the process of finalizing the acquisition of more than 130 rail stations with associated parking, and the New Jersey Department of Transportation is developing a plan to effectively deal with the maintenance and service needs of these facilities. The proposed policy, which calls for local operation and management of state-owned rail stations and park-and-ride facilities, is outlined.

The New Jersey Department of Transportation (DOT), like most state DOTs, evolved from a typical highway department. The New Jersey DOT became involved in public transportation with the creation in 1966 of the Commuter Operating Agency (COA). This has led to the expanding state program of financial support of privately owned rail and bus companies. Until the beginning of the 1970s, park-and-ride facilities in the state were constructed and operated by the private transit companies. The COA supported the maintenance of these facilities, no matter how minimally, through the financial assistance program. However, there was no major direct involvement by staff of the state DOT or COA.

After a few demonstration projects, the department, using federal highway funding, initiated its first regional rail park-and-ride project: construction of the first phase of the MetroPark facility.

#### PRESENT PRACTICE

Currently, the state of New Jersey is the owner of five rail park-and-ride facilities. Of these five facilities, four (Princeton Junction, Little Silver, Middletown, and Waldwick) are locally operated and maintained through lease agreements between the state and the local municipality. The MetroPark Station park-and-ride lot is maintained by the state DOT.

In 1971, the New Jersey DOT constructed the initial parking lot at the MetroPark Station on what is now known as the Northeast Corridor Line. The original lot had a capacity of 818 parking spaces. On-site parking was expanded in 1974 to 1334 spaces. Because of congestion problems, department maintenance crews undertook minor expansion and restriping of the lot in the summer of 1979 to accommodate compact cars and provide an additional 178 spaces, for a total of 1512 spaces. All parking at MetroPark is currently on a paved lot directly in front of the station. Parking is free, and the lot is filled beyond capacity every day.

With its excellent vehicle access via the Garden

State Parkway and NJ-27, MetroPark is one of the most heavily used facilities in the state, and parking demand is increasing each year. It is the only park-and-ride facility in New Jersey that is both owned and operated by the state. The Construction and Maintenance Unit of the state DOT maintains the lot by using highway maintenance crews. Since no additional personnel or resources were made available when this responsibility was assigned, and MetroPark must compete with the state highway network for the attention of the understaffed maintenance force, the unit is unable to maintain the MetroPark facility to a satisfactory level. For example, in the winter months, snow removal and salting on roads take priority over snow removal at MetroPark.

The major problem at MetroPark is the lack of patrolling to make sure that all cars are legally parked. Despite the availability of more than 1500 delineated spaces, there are approximately 200 illegally parked cars daily, which results in considerable congestion. Cars are parked in every conceivable spot, and the overflow extends down the adjacent roads. Spaces specifically designated for handicapped drivers are taken by anyone. Even with the recent improvements to the lot, maneuvering in the facility is difficult. The state lacks the manpower to properly patrol the lot and has been unsuccessful in securing a maintenance and policing agreement with the local municipality, Woodbridge Township.

Recently, the New Jersey State Police have provided assistance to enforce parking regulations. The state DOT is currently working with Middlesex County to effect local operation of the facility. Patrolling and enforcement of parking regulations are key items that a local entity could provide and thereby eliminate congestion and other related parking problems. Because of the congested situation, cleaning and sweeping of the lot during the day are practically impossible.

Since highway maintenance is the first objective of maintenance crews assigned to the area, the Construction and Maintenance Unit maintains the facility on an as-needed basis. This amounts to directing attention to the facility only after a backlog of maintenance needs has built up.

In 1973, the New Jersey DOT constructed a 430-space rail park-and-ride facility at Princeton Junction on the Northeast Corridor Line in West Windsor Township. In a lease agreement between the state, West Windsor Township, and the West Windsor Parking Authority, the Parking Authority agreed to lease the newly constructed parking facility and to be responsible for the complete maintenance, control, and jurisdiction of the lot, including paying for electricity, toll collection facilities, associated sidewalks, and operation of the facility. The lease specifies that the facility is to be a nonprofit operation and parking fees are to be established to cover operating and maintenance expenses and provide a 10 percent contingency reserve for major repair work. Under local jurisdiction, the facility is closely maintained and supervised. The West Windsor Parking Authority is continually complimented for the lot's neatness, pleasantness, and efficiency. Parking fees are collected by the sale of monthly tickets, and the present parking fee is \$5.50/month. Since many permit holders do not use the lot on a day-to-day basis, the West Windsor Parking Authority oversells permits to ensure full use.

At Little Silver Station in the borough of Little Silver on the North Jersey Coast Line, the New Jersey DOT constructed a 385-space park-and-ride lot in 1972. The township operates and maintains the

facility under a lease agreement with the state. The lot is a well-kept and attractive facility. Parking fees are \$0.50/day at 53 metered spaces, \$18.00 for six-month permits, and \$30.00 for one-year permits.

At Middletown Station in Middletown Township on the North Jersey Coast Line, the New Jersey DOT constructed a 1210-space park-and-ride facility in 1974. In 1973, the state and Middletown entered into a lease agreement in which the township agreed to assume maintenance and operational responsibility for the facility. This large park-and-ride facility is in excellent condition and is well maintained by the township. Parking is by permit at \$35/year.

In 1978, the department initiated the construction of a 155-space park-and-ride lot at Waldwick Station in the borough of Waldwick on the Consolidated Rail Corporation (Conrail) main line and subsequently leased the lot to the borough for their operation and maintenance. Parking permits are sold at \$2.50/week, \$10.00/month, and \$100.00/year. This lot became operational in the spring of 1979, and operational cost figures are not yet available for comparison with the costs of other facilities.

Capacity and use data for the four facilities for which data were available are summarized below:

<u>Facility</u>	<u>Total No. of Spaces</u>	<u>Approximate Use (%)</u>
MetroPark	1512	100
Princeton Junction	430	>100
Middletown	1210	85
Little Silver	385	75

Table 1 gives 1978 maintenance costs for the four state-owned rail park-and-ride facilities for which cost data were available. MetroPark cost figures were obtained from the Construction and Maintenance Unit of the state DOT; costs for the three leased facilities were obtained from 1978 financial reports that the municipalities are required to submit to the state under the terms of the lease agreements.

From the data for total annual cost and annual cost per 100 spaces, it appears that the state maintains the MetroPark facility the most economically. However, the state devotes minimal attention to MetroPark because of manpower shortages. Therefore, although it is true that maintenance costs are low, the corresponding level of maintenance in terms of quality and frequency is also low. As previously stated, MetroPark competes with the New Jersey highway network for maintenance by an understaffed highway maintenance crew, and as a result the department's crews cannot provide the day-to-day maintenance required.

If one compares MetroPark with a facility of similar size, such as Middletown, one can see that costs for the Middletown facility are much higher across the board. The Middletown facility is maintained to a higher standard and includes frequent power sweeping and complete landscaping functions, such as mowing, trimming, fertilizing, and plant replacement. Currently, there is no enforcement of parking regulations at MetroPark. Annual security costs associated with the other facilities range from \$412 to \$1530/100 spaces. It is obvious, therefore, that a major cost element is missing from the cost per 100 spaces for MetroPark. In almost all categories, the annual maintenance cost per 100 spaces for various items is considerably lower at MetroPark than at the other facilities. This results from the lower level of maintenance quality and frequency at MetroPark.

The municipally leased facilities are maintained



**Table 1. Maintenance costs in 1978 for four New Jersey park-and-ride facilities.**

Category	Maintenance Item	Annual Cost (\$)							
		MetroPark		Princeton Junction		Middletown		Little Silver	
		Total	Per 100 Spaces	Total	Per 100 Spaces	Total	Per 100 Spaces	Total	Per 100 Spaces
1	Snow removal and ice control	1660	124	10 995	2557	4 640	384	924	240
2	Sweeping and removal of litter	1800	135	180	42	4 931	408	152	39
3	Grass, shrub, and weed control	750	56	2 526	587	11 543	954	1 046	272
4	Security	0	0	3 026	704	4 990	412	5 889	1530
5	Lighting	4700	352	2 199	511	17 658	1459	1 841	478
6	Miscellaneous (drainage, restriping, signs, etc.)	120	9	459	107	1 941	160	1 784	463
Total		9030	676	19 385	4508	45 703	3777	11 636	3022

more frequently, and many maintenance needs are handled through service contracts. For example, Princeton Junction is maintained by a parking authority that has no maintenance force. The West Windsor Parking Authority has maintenance service contracts for all of the categories shown except lighting. Costs are higher with service contracts, but the frequency and quality of maintenance are also higher.

Middletown and Little Silver maintain their facilities through a combination of municipal forces and maintenance service contracts. Items such as snow removal, sweeping, litter removal, and mowing are handled by the municipal maintenance forces and therefore reflect a lower cost. Items such as drainage cleaning, restriping, and lighting may require maintenance contracts.

As Table 1 clearly shows, great variations in cost per 100 spaces exist between the various park-and-ride facilities. These costs vary for a number of reasons, such as size, design features, condition, and the priority each municipality places on a particular maintenance need as part of its maintenance policy. For example, Middletown keeps its facility clear of litter and dirt through the frequent use of power equipment for sweeping and litter removal. As a result, its annual cost for this activity--\$408/100 spaces--far exceeds that of any other facility. The frequency of maintenance and the use of power equipment vary with each municipality for categories 1, 2, and 3 in Table 1. As a result, the costs vary widely. Security costs vary according to the number of police on patrol, the number of vehicles used, and the number of hours the facility is patrolled. For example, Middletown uses only one policeman (and one vehicle) 2 h each day to enforce parking ordinances, and this low security effort is reflected in the low annual cost of \$412/100 spaces. Annual lighting costs (including electricity, bulb replacement, and minor electrical repairs) vary from \$352/100 spaces for the adequately lit facility at MetroPark to \$1459/100 spaces for the extensively lit facility at Middletown (Middletown is lighted by ninety-six 400-W mercury vapor lights).

Although administrative costs are not specifically reflected in Table 1, approximate annual administrative costs for Princeton Junction, Middletown, and Little Silver in 1978 were, respectively, \$12 689, \$2745, and \$848. This would indicate that administrative costs amount to approximately 40, 6, and 7 percent, respectively, of the total annual operating and maintenance expenses for these three facilities. Administrative costs at Princeton Junction are very high because the facility is maintained by a fully staffed parking

authority and it is the only facility the authority currently operates. As the authority assumes responsibility for additional facilities, the administrative costs assigned to Princeton Junction should be reduced. Since municipalities, on the other hand, use existing staff on a time-sharing basis, the administrative cost of maintaining their facilities is low. If one disregards the high administrative cost at Princeton Junction as not being representative, approximately 10 percent of the total annual operating and maintenance expenses for a municipally controlled park-and-ride facility can reasonably be assumed to consist of administrative expenses.

Table 1 illustrates that keeping park-and-ride facilities in excellent condition requires a yearly maintenance expenditure ranging from approximately \$3000 to \$4500/100 spaces. As pointed out previously, the specific costs depend on design features and the degree of maintenance and security provided at the facility. MetroPark's annual cost of \$676/100 spaces falls decisively short of this range, and the lack of adequate maintenance and operational control results in an unattractive and disorderly facility. The MetroPark figure, therefore, should not be used as a realistic comparative cost figure. Experience indicates that a cost of \$3000-\$4500/100 spaces for maintenance and security is a reasonable figure to use for estimating purposes.

**FUTURE PROGRAM AND POLICY**

On September 15, 1978, the state of New Jersey exercised its option to take title to most of the rail properties in the state used in commuter rail service, which were conveyed to Conrail on April 1, 1976, under the terms of the Regional Rail Reorganization Act of 1973, as amended. Consequently, the state is in the process of acquiring 130 station parcels, including associated parking facilities. As a consequence of these acquisitions, the New Jersey DOT is developing a policy on the operation and management of station facilities. The objectives of the draft policy are to (a) encourage local pride, (b) improve the standard of maintenance and security, (c) minimize state and local costs, and (d) retain limited control to ensure full access to the commuter rail system.

Although the draft policy limits discussion to rail station facilities, it is the department's intention to apply the same policy concepts to the management of bus and rail park-and-ride facilities. This policy is an outgrowth of the arrangements currently in existence at the rail park-and-ride facilities described in this paper.

The policy has been developed to effect the transfer of facility operating, maintenance, and security responsibility from the state, by way of a nominal fee for lease, to municipalities within a relatively short period of time. In general, this leasing policy gives the municipality the right to use and administer the buildings and parking facilities in the manner it deems most appropriate so long as adequate, clean, and safe commuter facilities,

including parking, are maintained.

Only through local supervision of and daily attention to maintenance and service needs can New Jersey's many park-and-ride facilities be maintained in a safe, attractive, and orderly condition to better serve the needs of the state's public transit users.

*Publication of this paper sponsored by Committee on Roadside Maintenance.*