Title
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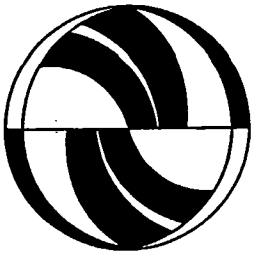
Publication Date
1990-05-01



The Determinants of Ridesharing: Literature Review

Keith Hwang
Genevieve Giuliano

Working Paper
UCTC No. 38

The University of California
Transportation Center

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The Determinants of Ridesharing: Literature Review

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Working Paper
May 1990

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I. INTRODUCTION

This paper summarizes the literature on the effectiveness of employee ridesharing programs. It provides the conceptual and empirical basis for our evaluation of AQMD's mandatory ridesharing ordinance, Regulation XV. We review the literature on the following topics: 1) employee ridesharing behavior and attitudes, 2) relationships between workplace characteristics and ridesharing behavior, 3) impacts of public programs on ridesharing behavior and, 4) effectiveness of employer-based ridesharing programs. We begin with a brief introduction on the origins of the current policy interest in ridesharing and the development of Regulation XV.

II BACKGROUND OF THE STUDY

Traffic congestion and air pollution have become major public issues in U.S. metropolitan areas. Faced with inadequate financial resources for major transportation improvements, and often with environmental constraints that preclude major improvements, public decision-makers are increasingly turning toward strategies that attempt to reduce congestion and air pollution by "managing" travel demand. Transportation demand management, or TDM, is a derivative of transportation system management, or TSM. TSM focuses on increasing the efficiency or productivity of the transportation system by means of both supply and demand oriented strategies such as ramp metering, signal coordination, provision of high occupancy vehicle lanes,

etc.(e.g. Interplan Corp, 1975; USEPA, 1974). Demand management strategies have become particularly important in heavily congested urban areas where the conventional supply side or traffic engineering TSM options have already been widely implemented or exhausted, and where reduction of peak vehicle trips is perceived to be the only short-term solution available (Giuliano and Golob, 1990). Demand management programs also may be favored in areas where TSM options are available but politically unpopular because of environmental concerns.

TDM programs have been implemented in a number of different ways. By far the most common are voluntary employer-based ridesharing programs. Company ridesharing programs have a long history. Company buses, carpools, and staggered work shifts were widely used during World War II. The earliest of the current generation of programs were established at large employer sites in response to the energy crisis of 1973. Voluntary programs were actively encouraged by government agencies at all levels, as well as by the availability of subsidized rideshare matching and marketing services and employer tax benefits. These voluntary programs have been widely implemented by downtown area employers.

Increasing congestion, particularly in areas experiencing rapid employment growth, has been the motivating factor in the establishment of mandated ridesharing programs. These include project specific programs required as a condition of development, as well as local or area-wide

programs implemented by local ordinance. Ridesharing programs have become one of the favored mitigation strategies for new commercial developments (Deakin, 1988). These programs are intended to reduce peak period trips and thus reduce the impact of new development on the local transportation system. Mandated programs typically do not have enforceable performance standards (e.g. specific ridesharing or trip reduction targets) that must be met. Rather, requirements include submission of plans, provision of specific services, etc..

Local or areawide TDM programs have only recently been implemented. These programs are mandated by ordinance and apply to all employers meeting applicable criteria within the jurisdiction. Often, these are downtown areas or large suburban employment centers experiencing heavy peak period congestion. The purpose in all cases is to reduce the volume of peak period traffic. Most recently, TDM programs have been mandated for cities or counties (Ferguson, 1990b).

Regulation XV, which was introduced in July, 1988, is the most ambitious TDM regulatory effort to date. It mandates significant reductions in AM peak period trips for all companies in the South Coast Air Basin with 100 or more employees, estimated to be about 8,000 different companies. Each company must annually submit a plan for achieving its designated vehicle occupancy goal, with the goal determined by geographic location (downtown, central city, or suburb).

The plan must include an annual survey of employees and must be updated every year. The Regulation also requires that each employer have a trained ridesharing coordinator on site. Submission and implementation of an approved plan is mandated by law; however, achievement of the vehicle occupancy goal is not required. Regulation XV is part of a massive regulatory program to bring the South Coast Air Basin into compliance with clean air goals.

III. DETERMINANTS OF COMMUTE MODE CHOICE

1. Employee Ridesharing Behavior and Attitudes

There is an extensive literature on employee mode choice. Results of numerous empirical studies indicate that key explanatory factors include the following: travel time, cost and convenience, household characteristics, and auto availability (Margolin and Misch, 1978; Duecker et.al., 1977; Horowitz and Sheth, 1978). National survey data indicate that the majority of U.S. workers drive alone to work (U.S. Department of Commerce, 1984; U.S. Department of Transportation, 1986). Carpooling and other forms of ridesharing are restricted to a few important submarkets: long distance commuters, commuters destined for the CBD, and those with limited access to personal autos. Several studies have found that carpoolers travel significantly farther to work than do commuters who drive alone (Kendall, 1975; Margolin and Misch, 1978; Richardson and Young, 1982; Teal, 1987; Giuliano, Levine, and Teal, 1990). Teal (1987)

demonstrates this relationship using 1977-78 National Personal Transportation Survey (NTPS) data (See table 1).

Table 1. Ridesharing vs. Trip Distance

Trip Distance	Carpool	Drive Alone	Public Transit	Total
≤5mi	14.2%	78.3%	6.5%	100%
≥15mi	24.2%	69.7%	6.1%	100%
≥25mi	34.4%	57.5%	7.8%	100%

Source: Teal (1987).

There are two main reasons for the higher propensity to carpool among long distance commuters. First, the extra time spent picking up or dropping off passengers makes up a relatively small portion of the total travel time for a long trip. Second, the cost of commuting increases with distance, so the potential of sharing this cost becomes more attractive for long distance commuters. Commuters working in the CBD are more likely to carpool or use transit because 1) CBD commutes are generally long, 2) peak traffic congestion makes driving less convenient, 3) CBD workers are more likely to pay for parking, and 4) transit service is more convenient and available (Pisarsky, 1987).

Carpooling is also more frequent among workers with lower incomes or less access to a private auto. Several studies have shown that carpooling is related to the ratio of autos to workers within the household (Teal, 1987; Giuliano, Levine and Teal, 1990). For example, the 1977 NPTS data show that, among households with fewer vehicles than workers, 30.7

percent of all automobile commuters are carpoolers, compared to only 16.3 percent when the vehicles per worker ratio is at least 1.0 (Teal, 1987).

Travel time has been identified as the single most important factor in determining mode choice, given access to a private auto (Valdez and Arce, 1990). Ridesharing modes are inferior to driving alone because of the extra time required to pick up or drop off passengers, or to wait to be picked up. As household incomes increase, value of time increases, and time considerations play an increasing role in mode choice decisions. Thus ridesharing has declined historically with rising affluence, and higher income workers are least likely to carpool, all other things held constant.

Attitudinal studies show that subjective factors also play a role in mode choice. Margolin and Misch (1978) found that perceptions of the carpooling situation--interpersonal rapport with potential car mates, social requirements of semipublic behavior, constraints on independence, and status as a passenger or driver in the carpool-- are more important to commuters than the objective attributes of carpooling such as cost or convenience. A recent study of suburban workers in Orange County, CA. revealed that the most frequently identified reason for not ridesharing was a preference for the freedom of driving alone (Glazer and Curry, 1987). Another recent study shows that only a very small percentage of commuters are willing to carpool with people outside their own family (Flannelly and McLeod, 1990).

Ridesharing studies also show that occupation affects mode choice. For example, a study of Pleasanton, CA. workers showed that professional employment was negatively associated with ridesharing (Cervero and Griesenbeck, 1988). Professional employees generally place a higher premium on flexible and convenient forms of transportation, and thus are more likely to drive alone. On the other hand, laborers constitute a sizable share of the ridesharing population due to their relatively low auto-ownership and their sensitivity to trip costs.

2. Workplace Characteristics

Workplace characteristics that affect employee ridesharing behavior include firm location and size. First, work location itself is related to factors such as transit availability and parking costs. Downtowns are the focus of regional public transit services and thus tend to be the most transit accessible workplace destination. Larger, more congested cities generally have extensive transit services available. Since land costs are also highest in downtown areas, workers are more likely to have to pay significant parking fees. These factors promote the use of alternative modes among downtown workers. For example, a Denver metropolitan area study showed that the availability of alternate transportation modes at the company location was positively correlated with the use of these modes (McClelland, et.al, 1981). Teal (1987) also documented a

strong negative correlation between transit availability and solo driving (See Table 2). Finally, parking characteristics at the workplace have a direct impact on mode choice, as will be further discussed in Section IV below.

Table 2: Mode Shares in different Types of Large SMSAs

	Mode shares		
Type of SMSA	Drive Alone	Carpool	Public Transit
Low-Medium Transit Use (n=29)	73.4%	20.2%	6.4%
High Transit Use (n=9)	56.1%	18.1%	25.8%
Difference	23.6%	10.4%	

Source: Teal (1987)

Work locations outside of downtown are not conducive to the use of alternative modes. Suburban workplaces are designed to accommodate the automobile; they are characterized by low densities, plentiful (and usually free) parking, and site designs that make transit and pedestrian access difficult (Cervero, 1986). Moreover, the shorter travel time and distance of suburban commutes further encourage the drive alone mode (Gordon, et.al, 1989).

Firm size is the second factor that may affect employee mode choice. A positive correlation between ridesharing and firm size is confirmed by several studies (e.g., Bhatt and Higgins,1989; Cervero and Griesenbeck, 1988). It is generally hypothesized that ridesharing is more prevalent in large firms because 1) the larger pool of employees provides more potential ridesharing matches, 2) there are economies of scale in providing ridesharing incentives, and 3) very large firms may have parking and access problems which motivate the

encouragement of ridesharing on the part of management. For example, a study of 432 Southern California firms showed that only 8 percent of firms with less than 250 employees provided any ridesharing incentives, while 74 percent of the largest firms (more than 1,000 employees) provided some type of incentive program (Ferguson, 1990a). The author concludes that public policy on ridesharing should focus on larger firms in order to produce results which are less costly, more effective, and thus more efficient. It also bears noting that large firms are more likely to be targets of ridesharing organizations' marketing efforts. Thus greater participation in ridesharing programs by large firms may also result from these marketing efforts.

Having workers concentrated in a single-tenant complex also works in favor of ridesharing; multi-tenant complexes, on the other hand, seem to hinder the formation of carpools and vanpools since coordination of ridesharing efforts among multiple employers tends to be much more complex than within a single company (Cervero and Griesenbeck, 1988). Coordination difficulties exist even when complexes consist of very large firms (Teal et.al, 1984).

3. Public Sector Strategies

The public sector has been involved in promoting ridesharing in an effort to control traffic congestion problems, particularly in areas experiencing rapid growth. Major strategies include provision of high occupancy vehicle

lanes, conditions on new development to provide ridesharing incentives, and local parking policy.

(1) HOV Lanes

The purpose of an HOV lane is to increase ridesharing by offering a travel time advantage to multiple occupant vehicles that can offset the extra time required to pick up and drop off passengers. Provision of HOV facilities is an increasingly common strategy for managing congestion in heavily congested corridors where peak period travel speeds are particularly low (Giuliano, Levine, and Teal, 1990). Using 1987 work trip survey data from the busy Route 55 HOV facility in Orange County, Giuliano, et al. compared the net changes in carpooling between carpoolers and solo drivers after the HOV project was implemented. As shown in Table 3 below, the Route 55 HOV project had a significant impact on carpooling behavior among peak period commuters, particularly those who are able to take full advantage of the HOV lane's travel time savings, but not among all commuters.

Table 3: Change in Carpooling Rate by User segment

Route 55	
All Commuters	2.99%
All Peak Period Commuters	3.54%*
Commuters who use more than half the lane	12.29%*

(* significance $p \leq 0.05$)

Source: Giuliano, Levine, and Teal (1990)

Carpoolers on Route 55 identified travel time savings as the most important reason for carpooling. Travel time

savings are also potentially attractive to current solo drivers. For example, a study that compared potential time savings with the individual's perceived likelihood of carpooling showed that the two factors are positively related, as shown in Table 4 below (Margolin and Misch, 1978). However, the large discrepancy in perceived likelihood of carpooling compared to the results of an actual project (Table 4 vs. Table 3) is important to note.

Table 4: Solo Drivers Who Would Carpool if Offered a HOV lane

HOV lane Portion of trip	Unlikely to Carpool(%)	Likely to Carpool(%)
One-quarter	51	37.1
One-Half	41.3	47.0
3-Quarters	33.9	57.9

Source: Margolin and Misch (1978)

(2) Conditions on New Developments

Concerns regarding the traffic impacts of large development projects have led to a rapid proliferation of efforts to mandate transportation-related controls. These controls are usually imposed in conjunction with use permits which are carried forward to the eventual owners and occupants. Unfortunately, research on the effectiveness of these efforts has only just begun. Only one such study has been published to date. This study compared the ridesharing rate at companies mandated by local ordinance to provide ridesharing incentives with that of neighboring companies not subject to the ridesharing ordinance, and found that although

the carpooling rate was significantly higher at the mandated companies, the drive alone share was not significantly different between the two groups. That is, the higher carpooling rate of the mandated group was offset by slightly higher rates of other alternative modes in the non-mandated group (Blankson and Wachs, 1990).

(3) Parking Policy

Many local jurisdictions are using parking requirements to reduce parking availability in an effort to discourage drive-alone commuting. Policies include parking space maximums rather than minimums, parking space offsets for contribution to ridesharing or transit programs, and flexible parking based on provision of on-site rideshare incentives such as preferential parking for carpools and vanpools (Higgins, 1985). In general, parking requirement relaxations based on ridesharing incentives, i.e., preferential parking for vanpools and carpools, bike lockers, and rideshare marketing efforts, have not brought the desired result of increased ridesharing (McClelland, et.al., 1981). However, developer-sponsored actions have proven effective in some cities where tight or expensive parking prevails, or where neighborhood residents have organized to prevent office commuters from parking on neighborhood streets (Higgins,1985).

Flexible parking requirements in support of ridesharing are a mixed blessing. Restrictive parking policy may not

only reduce the attractiveness of the area to potential developers, but also encourage spillover parking in other nearby areas. Moreover, the ability to enforce rideshare program requirements is often lacking. These research results suggest that localities must be cautious in the use of parking policy alternatives (Bhatt and Higgins, 1989; Feeney, 1989; McClelland, et.al., 1981).

IV. EFFECTIVENESS OF EMPLOYER-BASED RIDESHARING PROGRAMS

Regulation XV requires employers with 100 or more workers to reduce the number of peak period vehicle trip generated by their employees. Employers are free to develop their own strategies and incentives, subject to the approval of SCAQMD. This section discusses findings related to five types of strategies: marketing, matching service subsidies, alternative work hours, and parking management.

1. Marketing

Marketing provides indirect incentives for ridesharing. Employees are most commonly provided information on the availability of alternate transportation services. Other marketing incentives include free lunches, prize drawings, or other rewards to those who rideshare. Employers also may provide services that make ridesharing more convenient, such as on site banking service, or guaranteed ride home. Little research has been conducted on the impact of these types of

incentives. McClelland et.al,(1981) showed in their Denver study that publicity and convenience incentives were not significantly correlated with increased ridesharing, whereas financial incentives did have a positive effect.

2. Personalized Matching Service

Personalized matching service, which seeks to identify and bring together potential carpoolers, is one of the most widely utilized incentives. Ferguson's study (1990a) of large firms in the Los Angeles region found that personalized matching assistance in the absence of parking management strategies or direct ridesharing incentives was associated with a highly significant increase in the level of ridesharing at individual firms. With matching services, employees rideshare approximately 10 percent more than without it within each size category of firm (See Table 5). Larger firms had more efficient programs, presumably due to the economies of scale in providing the service and the existence of ridesharing coordinators fully devoted to the ridesharing services.

Table 5: Mode Split with/out Personalized Matching Assistance

Mode Split	with			without		
Firm Size (employees)	≥100	≥1000	≥10000	≥100	≥1000	≥10000
Drive Alone	80.67	78.46	74.74	91.38	88.94	85.81
Ridesharing	16.30	19.11	24.23	5.35	7.75	11.15
Public Transit	2.96	2.40	1.95	2.87	2.35	1.91

Source: Ferguson (1990a)

Personalized matching assistance for carpool and vanpool formation was found to be more successful when offered in combination with parking pricing and supply control measures (Ferguson, 1990b).

3. Subsidies

Subsidy programs such as direct subsidies to vanpools or transit pass programs are designed to make use of alternative modes cheaper and therefore more attractive relative to driving alone. It is widely believed that financial incentives can significantly increase ridesharing. One of the most successful programs was that of the Tennessee Valley Authority. TVA employees (a workforce of 4,200), in cooperation with the Nashville city administration, started operating commuter express buses and vans in 1973. A massive incentive program which included bus ticket discounts, parking discounts for carpoolers, and credits to vanpools was implemented, and its impact was significant. There was an immediate reduction of 12 percent in the number of employees

Table 6: Modal-use patterns of downtown Tennessee employees

Over Time -> Mode (%)	11/73	12/74	1/75	1/77	1/79
Drive Alone	65.0	42.0	30.0	18.0	17.0
Regular Bus	3.5	3.0	5.0	3.0	3.0
Express Bus		11.0	18.0	28.0	22.0
Carpool	30.0	40.0	42.0	41.0	40.0
Vanpool		1.7	3.0	7.0	16.0
Bike, Walk, etc.	1.5		2.0	3.0	2.0
Total Workforce	2950	3000	3100	3400	4200

Source: Wegmann and Stokey (1983)

driving alone to work (see Table 6). The number of express bus users and vanpool users also sharply increased, and these

trends continued over a number of years (Wegmann and Stokey, 1983).

4. Alternative Work Hours

Alternative work hours (AWH) programs are one of the most widely used TDM strategies. The purpose of AWH is to shift commute trips out of peak traffic periods, or to reduce the number of commute trips. There are three types of AWH schedules: staggered work hours (SWH), compressed work weeks (CWW), and flexible work hours (FWH). SWH schedules are those in which employees work organizationally defined blocks of hours either before or after the typical morning start times. The number of hours worked per day remains fixed. CWW schedules condense forty hours of work per week into fewer than five days. FWH schedules allow employees to have some degree of autonomy in the selection of starting and ending times for their work day. Many variations of FWH schedules exist.

Alternative work hours programs have been generally been enthusiastically embraced by employees (Roark, 1981; Jones and Harrison, 1983). For example, a 1988 survey of commuters in Orange County, CA., indicated that AWH is the most commonly mentioned change commuter would make in order to improve their commutes (Valdez and Arce, 1990). Alternate work hours programs that give employees more flexibility in determining their work schedule are more favorably perceived than those that do not (Giuliano & Golob, 1990).

The relationship between AWH and ridesharing has been the subject of extensive study, yet it continues to be unclear. Earlier studies indicated that AWH complements ridesharing by making it possible for employees to adjust to existing transit service schedules or to potential carpooling schedules (Jones and Harrison, 1983; Port Authority of New York and New Jersey, 1975). However, more recent studies show that AWH may be a substitute for ridesharing in suburban areas (Bhatt and Higgins, 1989; Cervero and Griesenbeck, 1988), or in areas with limited transit availability (U.S.FHWA, 1986; Jovanis, 1981). Because of its greater convenience in such areas, commuters may choose to shift their work schedule instead of their transport mode.

5. Parking Management

Parking management consists of either regulating the supply of employee parking or pricing parking so that the cost of driving alone increases relative to other alternatives. Recent parking management schemes have focused on restructuring the parking subsidy: employees are offered cash payments equal to the parking charge; this payment can be used to pay for parking or defray the cost of vanpooling, ridesharing or taking transit. The vast majority of employees do not pay for parking. Even in downtown areas, where the cost of providing parking is high, employees rarely pay the full cost of parking.

Willson, Shoup and Wachs (1989) examined the relationship between employer parking policies and commuter mode choice, and demonstrated that employer-paid parking was the single most important disincentive to ridesharing. Several case studies revealed that the proportion of employees who drive alone is much higher when free parking is provided than when the employee must pay for parking (See Table 7). Other factors such as the price and availability

Table 7: How Employer Paid Parking Encourages Solo Driving

Study Site	Solo Drive Share		Average Vehicle Occupancy	
	Employer pays for parking	Driver pays for parking	Employer pays for parking	Driver pays for parking
Warner Center(LA.)	90%	46%	1.08	1.55
Mid Wilshire (L.A.)	48%	8%	1.82	3.20
Century City (L.A.)	92%	75%	1.07	1.26
Civic Center (L.A.)	72%	40%	1.28	1.99
Ottawa (Canada)	35%	28%	2.55	3.11

Source: Willson, Shoup, and Wachs (1989).

of parking off-site, or the quality of transit service available also affect the response of employees to parking management efforts.

These findings are corroborated by case studies conducted in Hartford, CN, and Bellevue, WA, as well as studies of other large employment sites in the Los Angeles area (Kuzmyak and Schreffler, 1989; Willson et.al, 1989). For example, ARCO's ridesharing program is one of the most successful in the U.S.. ARCO operates commuter bus and vanpool service, and has had about 3/4 of the company's

employees ridesharing for the past several years. The success of ARCO's program is attributed in large part to the strategic pricing of its employee parking. While ARCO's program subsidizes employee parking costs, the price charged for parking is scaled to the number of vehicle occupants, and the company also offers a Transportation Allowance to employees which further encourages high occupancy vehicle travel (Kuzmyak and Schreffler, 1989).

V. SUMMARY AND CONCLUSION

Our review of the existing literature is summarized in Table 8. Conditions which favor or encourage ridesharing include large employment sites, good transit access, restricted parking, and long commutes. Conditions which discourage ridesharing include multiple employee sites, poor transit access, plentiful and/or free parking, and short commutes. Effectiveness of employer programs depends both on the nature of the incentives provided as well as the environmental characteristics of the employment site itself. For example, public transit subsidies will be more effective where transit service availability is high. The more effective strategies appear to be those that significantly affect the relative cost or convenience of solo driving. Thus, imposing parking charges on employees who previously had free parking, or providing cash subsidies for transit or vanpools equivalent in value to the parking subsidy will have

Table 8: Summary of the literature Review

Determinants of Ridesharing

	Favorable	Not Favorable
Locational Characteristics		
	Large firms	Small firm
	Single site	Multiple sites
	Downtown area	Suburban location
	High transit access	Limited transit access
	Restricted parking	
Employee/Trip Characteristics		
	Limited auto availability	≥ one auto per worker
	Long commute	Short commute
	Regular work schedule	Irregular work schedule
		Household constraints

Effectiveness of Ridesharing Incentives

More Effective	Less Effective
Parking Charges	Preferential Parking
Parking Restrictions	AWH
Transportation allowance	Marketing
	Matching Service
	Guaranteed Ride Home

a significant impact, whereas providing preferential parking for carpoolers and vanpoolers will have little effect, since it does not substantially reduce relative inconvenience of ridesharing.

It also bears noting that persuasion has not been effective. Research shows that appeals to altruism (such as, "you should carpool so that we will all enjoy cleaner air") may generate some volunteers for ridesharing, but unless backed up by some more tangible benefits to the individuals concerned, will not likely result in any long-term behavioral change (Bonsall et.al, 1984).

Finally, several researchers suggest that psychological factors are important in an individual's decision to rideshare. Concerns for personal space, resistance to being placed in forced social situations, racial and ethnic bias,etc. may all play a significant role in mode choice decisions (Bonsall,Spencer, and Tang, 1984; Levin, 1982). More research is required to understand how individual perceptions affect mode choice, and to develop incentive programs that address these issues.

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