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Paper No. 00-1619

PREPRINT

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Transportation Research Board

79th Annual Meeting

January 10, 2000

Washington, D.C.

Effective Transportation Demand Management: The Results of Combining Parking Pricing, Transit Incentives, and Transportation Management in a Commercial District Bordering the Central Business District of Portland, Oregon

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ABSTRACT

The Lloyd District is a high-density commercial and residential district located a short distance from downtown Portland, Oregon. Parking and transportation problems in the District have been a source of increasing contention for nearly a decade. As a result, in September of 1997, the City of Portland implemented a Lloyd District Partnership Plan, which consists of a number of elements aimed at curbing SOV use for the commute to and from the District. This plan included parking pricing in the form of meters, where on-street parking had previously been free; discounted transit passes; and other transportation demand management (TDM) strategies.

This research assesses the effects of these strategies on travel and parking behavior, with an emphasis on the relationship between parking pricing and mode choice. A random sample of 1000 employees in the Lloyd District was surveyed about their travel and parking behavior before and after the installation of the new meters.

This research finds that during the one year that had elapsed between the implementation of the Lloyd District transportation management programs and the survey information collected by this study, the drive-alone mode for the trip to work by employees in the Lloyd District had decreased by 7 percent. For the District as a whole, the drive-alone commute share is now about 56 percent. The program's strategies that have emerged as the most significant in effecting this decrease are the installation of the meters and the discounted transit pass program.

Key words: transportation demand management, parking, transit

INTRODUCTION

The Lloyd District is a high-density commercial and residential district located a short distance from downtown Portland, Oregon, across the Willamette River (see Maps 1 and 2). Parking and transportation problems in the District have been a source of increasing contention for nearly a decade. In addition to the Lloyd Center Shopping Mall, the District is home to two high-density retail streets, as well as the Oregon Convention Center, Rose Garden Arena, and Memorial Coliseum. Shoppers have competed with event-goers, District employees, downtown commuters, and residents for increasingly scarce on- and off-street parking, nearly all of which has, until recently, been free.

Perhaps more important than the scarcity of parking is that downtown commuters have used free on-street parking spaces to "park and ride" into downtown Portland, taking advantage of any one of the several transit lines (including light rail) running through this District with great frequency to Portland's central business district (CBD). Since parking in the CBD is priced, the existence of free parking in the Lloyd District encouraged single-occupancy-vehicle (SOV) use by commuters to an extent that conflicted with the region's overall transportation goals of reducing SOV.

As a result, in September of 1997, the City of Portland, in concert with the regional transit provider and the District's transportation management association (TMA), implemented a Lloyd District Partnership Plan, that consists of a number of elements aimed at curbing SOV use for the commute to and from the Lloyd District. This plan included parking pricing, improved transit service, and other transportation demand management (TDM) strategies deployed by the TMA.

The purpose of this study was to assess the impact of the Lloyd District Partnership Plan with respect to changes in mode choice, parking price paid, and other outcomes such as change in work hours or work place as a means of adjusting to the plan. The particular emphasis was on the relationship between parking pricing and mode choice.

This paper will provide a background to the Lloyd District Partnership Plan, a brief overview of the literature regarding the relationship between parking prices and mode split, an overview of the methodology used to assess the plan's impact, a presentation of the findings of the research, and, finally, a discussion and interpretation of those findings, with an emphasis on recommendations for policy makers.

Background to the Lloyd District Partnership Plan

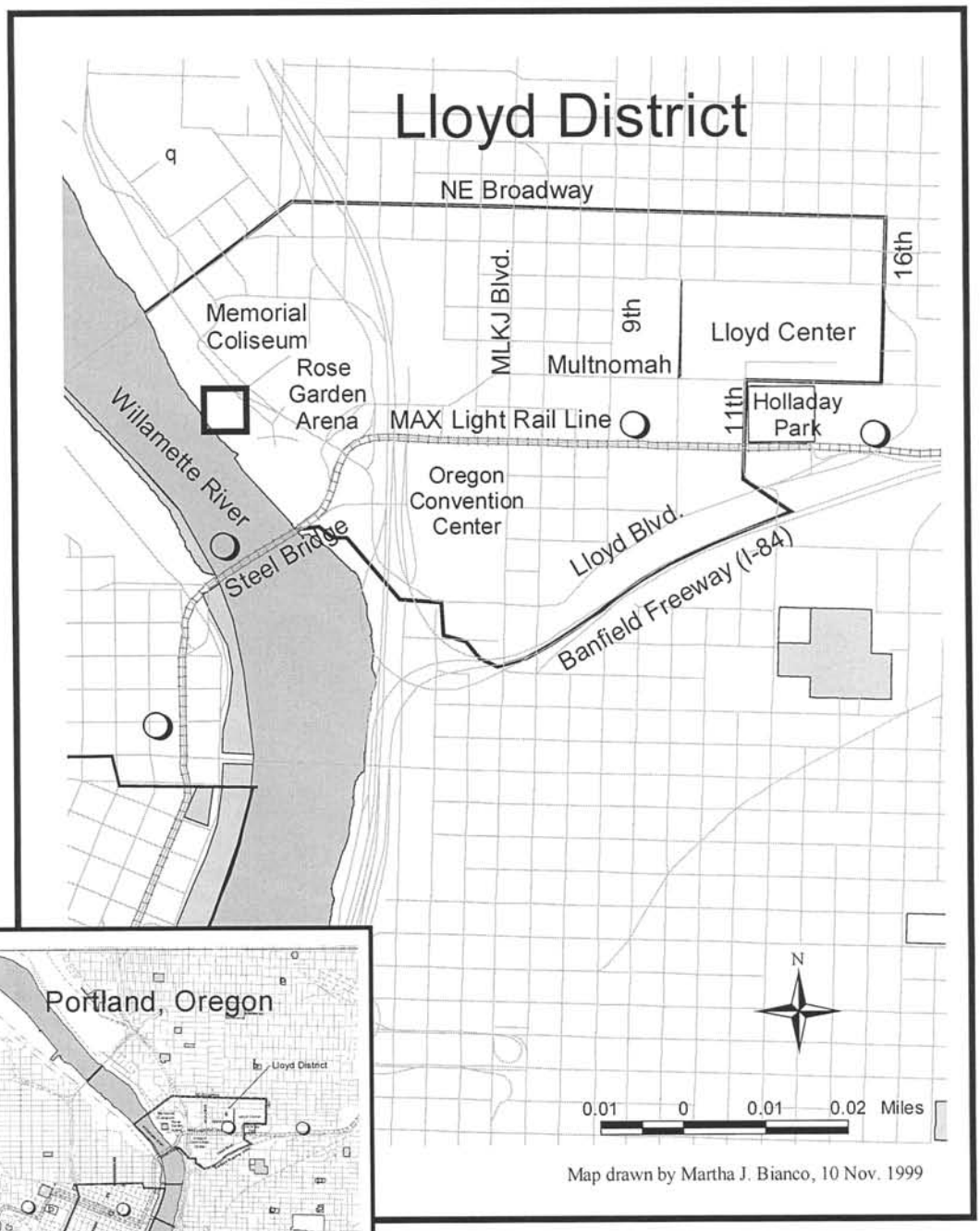
There are two overarching guiding policies behind the Lloyd District Partnership Plan that implemented the transportation management programs this report assesses. These two policies are Portland's Central City Transportation Management Plan and the state Department of Environmental Quality's Employee Commute Options (ECO) Rule. A brief overview of these two guiding policies provides the context for the Lloyd District Partnership Plan elements assessed in this report.

The Central City Transportation Management Plan

In 1990, the City of Portland began development of the Central City Transportation Management Plan (CCTMP). The Association for Portland Progress, a coalition of downtown business interest; Tri-Met, the region's transit provider; the state Department of Environmental Quality (DEQ); the Portland Development Commission; and Metro, the regional planning agency, worked together to develop a plan whose ultimate goal was to provide for a projected 75,000 new jobs and 15,000 new housing units within the central city by the year 2010.

The CCTMP project called for dividing the central city into eight districts, of which the Lloyd District is just one – but one that is very close to the downtown core and expected to capture 20 percent of the new jobs and 13 percent of the new housing units.

A Lloyd District Task Force, a local citizens committee, began working with the City to develop a comprehensive plan for the District. This led to the establishment of the Lloyd District Transportation Management Association (LDTMA) in 1994, with a 15-member board representing neighborhood and business interests in the area. The LDTMA has played a major role in implementing the transportation management programs under review in this study.



Map 1. Lloyd District.

Map 2. Lloyd District in relation to downtown Portland.

Employee Commute Options (ECO) Rule

In 1996, Oregon's DEQ established the ECO rule to be in compliance with the Clean Air Act Amendments of 1990, which require that trip-reduction measures be implemented in air quality maintenance areas (AQMAs) to achieve or maintain compliance with the National Ambient Air Quality Standards. The ECO rules were developed by Oregon's state legislature in 1993. The most salient requirement of the ECO rule is that, within Portland's AQMA, any employers of 50 or more employees have to develop a plan that will achieve a 10-percent reduction in work-destined auto trips over three years (certain employers are exempt if they face significant constraints such as insufficient access to transit).

The Lloyd District Partnership Plan

The Lloyd District Partnership Plan is a concerted effort by the member organizations of the Lloyd District Transportation Management Association (LDTMA), the City of Portland, and Tri-Met (the regional transit agency), to provide a strategy for implementation of the Central City Transportation Management Plan (CCTMP).

Elements of the Plan

There are six elements in the Lloyd District Partnership Plan:

- Fixed-route service element, which includes three direct express am/pm transit routes to the Lloyd District business core
- Facility improvements, providing for a concentration of passengers and buses, convenience of transfers, and passenger amenities
- Rideshare and bicycle improvements
- Parking management strategies, including parking meters activated on most streets within the district; limitations on new parking supply; maximum parking ratios; and carpool metered spaces
- Marketing plan, including the Tri-Met ***PASSport***, which allows participating employers to purchase discounted passes for employees at their work site; Tri-Met's Emergency Ride Home program; and communication and promotion activities on the part of all three partners, the LDTMA, the City, and Tri-Met
- Program evaluation, to be undertaken by each partner—the LDTMA, Tri-Met, and the City. Tri-Met, in particular, was required to fulfill very specific evaluation requirements as set forth in the ECO rule.

LITERATURE REVIEW

There is limited literature on the relationship between parking pricing and mode choice and even less on the relationship between TDM programs, as administered by TMAs, and mode choice. The studies that do exist regarding TMAs and TDM have found a generally weak relationship between transportation demand management – in the absence of pricing – and mode choice (Ferguson and Davidson 1995, Giuliano 1992, Orski 1991).

While many factors affect mode choice, a number of analysts have suggested that the price of parking has been a primary factor. Most commuters choose to drive alone because most employee parking is free. Transportation economist John Kain considers the effect of free parking for employees to be so significant that the elimination of employer-paid parking incentives should *precede* consideration of congestion pricing. He even suggests that eliminating parking subsidies might in many instances mitigate the need for congestion pricing at all (Kain 1994). Anthony Downs favors market-priced parking over congestion pricing because it is easier to administer and because it does not pose as much a threat to privacy (Downs 1992).

While these analysts and others assume that parking price is an important factor in mode-choice decisions, research on this relationship has not been definitive. For a variety of reasons, it has been difficult to assess how policy intervention in parking markets would be transmitted to and affect commuters' choices. Despite limitations, existing research continues to suggest a link between the price of parking and transit ridership. The San Francisco County Transportation Authority, for example, conducted a 1995 travel behavior survey and found that when parking costs exceed transit fares by 20 to 30 percent, commuters tend to take transit as opposed to drive alone. The survey revealed that 47 percent of the employees who drove alone reported that they either park free or in employer-paid parking. Only 12 percent of the transit riders indicated that they would have had free or employer-paid parking ("San Francisco Survey" 1996).

In *Strategies to Attract Auto Users to Public Transportation*, Dueker, Strathman, and Bianco (1998) concluded that while certain transit-service variables have an effect on mode share, the probability that drivers would pay to park has a relatively larger impact. When the likelihood of paying to park doubles from .05 to .10, the percentage of people choosing SOV drops from 77 to 67, and the percentage of those choosing transit increases from 10 to 21. This study also found, however, that the combined effect of increased transit frequency and parking price has the greatest impact on transit share.

The changes in the predicted shares for transit and SOV in Dueker, Strathman, and Bianco are consistent with the outcomes of other studies, including Strathman and Dueker (1996), Gillen (1977) and Willson (1985, 1992). Gillen found the price elasticity of demand for parking to be relatively inelastic, at -0.31. The Dueker, Strathman, and Bianco study showed that the decision to drive alone is somewhat more sensitive to parking prices. They found that, based on a monthly parking price of $80, the price elasticity of demand for parking in urban Portland is -.58 with respect to SOV use and -.43 with respect to carpooling. These results are also presented in Peng, Dueker, and Strathman (1996).

METHODOLOGY

This study was conducted as part of research funded by the City of Portland for its assessment obligation. The City's overarching research goal was to assess the effect of the parking meter installation on those streets in the Lloyd District where on-street parking had previously been free. Although an analysis of changes in trip destinations and land uses as a result of the parking pricing would provide important evidence of the spatial impacts of pricing, study of these phenomena is most appropriately conducted over the long term and hence was outside the scope of this research. In addition, certain land use changes have been required as *part of* the overall program, so it may prove challenging to isolate land use changes that result from market versus regulatory forces.

Because this study was not commissioned until 1998, a year after the transportation demand management program had already been underway, it was not possible to administer both baseline and a follow-up survey. Instead, a single survey asked respondents to compare their travel behavior now with their behavior during the period before the program – specifically, before the installation of the parking meters.

Survey and Sampling Techniques

Sampling Frame

The sampling frame consisted of all employers with a 97232 Zip Code, determined by the researchers to correspond with the geographic parameters of the Lloyd District. This sampling frame contained 1370 employers, as of September 1998. The number of employees per employer firm varied, from 1 to 500 or more.[1]

1 The researchers contracted with the Portland, Oregon, office of infoUSA, a consulting division of American Business Information, Inc., to provide an electronic file of business-related data specific to this sampling frame.

Sampling Procedure

The researchers employed a multistage stratified random sampling procedure.[2] The first stage of the multistage sampling process involved drawing a random sample from the sampling frame of the 1370 Lloyd District employers. The sample sizes were stratified according to employer size, with smaller employers being sampled at a smaller rate than larger employers. The sampling process yielded 259 firms, or about 19 percent of the total number of firms.

Representatives from the City then contacted each of the 259 sampled firms. Each of these firms was asked to furnish the researchers with a listing of their employees. These employee lists then constituted the secondary sampling frame and the basis for the next stage in the sampling process. A saturation sample (i.e., 100 percent) of the 233 firms with 49 or fewer employees was drawn, for a total of 545 small-firm employees. From the remaining 26 firms with 50 or more employees, a random sample of about 50 percent was drawn, to bring the total number of employees up to 1000.

Response Rate

Surveys were mailed to employees at their employment address. Follow-up postcards were sent to all survey participants who had not responded to the initial mailing. Of 1000 surveys sent out, a total of 519 returned surveys were deemed valid for analysis, representing a 52-percent response rate.

FINDINGS WITH RESPECT TO MODE

Respondents were asked how they usually get to and from work now. Then, in order to control for the fact that not everyone working in the Lloyd District today worked there prior to the transportation management programs, the survey had respondents skip a number of questions related to mode change if they did not work in the District prior to August of 1997. The exclusion of people who did not work in the District both before and after the transportation management program meant that, although slightly more than 500 surveys were returned, there were not always 500 responses to all questions – particularly those related to mode change.

Out of the approximately 500 total respondents, 400 answered the direct question: Has the way you usually get to or from work changed between now and August of 1997, that is, before the parking meters were installed? Out of these 400 respondents, 23 percent indicated a change in mode from the period prior to the implementation of the meters to the present time. This is indicated in Figure 1.

Mode Shares Before and After Meter Installation

The sample was divided into three groups: all respondents, respondents whose employers participate in Tri-Met's ***PASSport*** program, and respondents whose employers do not participate in the program. The results below are based on mode *to* work, both before and after the parking meter installation.

Mode Shares for All District Employees

For all respondents, there was a 7-percent *decrease* in the drive-alone mode for the commute to work.[3] Most of those who moved from auto went to carpooling, which saw a 38-percent increase in share. In the Lloyd District, now that the transportation management programs are in place, the drive alone mode accounts for only 56 percent of the work trip. Transit accounts for 19 percent of the work trip, followed by carpool at 17 percent. By contrast, transit currently accounts for approximately 33 percent of the work trip to downtown Portland, while the drive alone mode accounts for 50 percent and carpool only about 10 percent. Regionwide, transit accounts for 5 percent of the work trip, drive alone 80 percent, and carpool 10 percent.[4]

Transit saw a small and questionable decrease in share. Because of self-selection among respondents to the survey, there is likely to be underreporting of transit share as a whole. There may be

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2 All random sampling was done with replacement, so as not to change the probability of any given case being selected. However, no case was included in the final sample twice. If a case (either an employer during the first stage or an employee during the second stage) had already been sampled, then a decision rule was employed of selecting the next nonsampled case.

[3] The 95% confidence interval for the difference in these proportions ($\pi_1 - \pi_2$) was *not* significant.

[4] All figures are for the home-based journey-to-work. CBD and regionwide figures are from Metro's 1994-95 Two-Day Household Survey.

other reasons that transit is underreported, as well.[5] The real message here is that the Lloyd District transportation management program resulted in a shift in SOV that was in the hoped-for direction. The other modes – bike, walking, and "other" – show large changes, but the actual percentages and numbers are unsubstantial. Figure 2 illustrates the mode shifts.

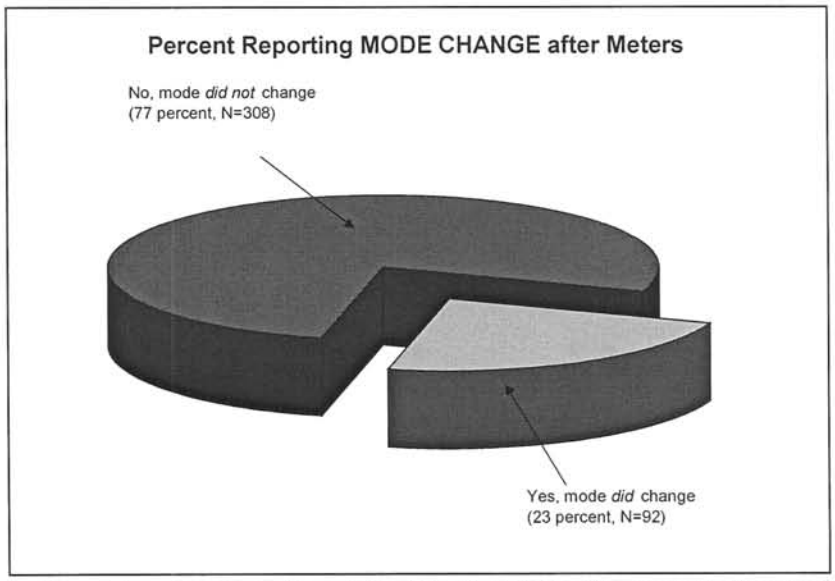

Figure 1. Percent Reporting Mode Change after Meter Installation (Source: PSU Survey, 1998).

*Mode Shares for **PASSport** Employees*

Because the survey did not ask respondents directly whether or not they use the Tri-Met ***PASSport***, this study defines ***PASSport*** employees as those who said that their employer offers a discounted Tri-Met pass. This does not necessarily mean that these employees use the ***PASSport*** themselves, only that they know that their employer offers it. Non-***PASSport*** employees are defined as those who indicated that their employer does not offer a discounted Tri-Met pass. As a rule, employers in the Lloyd District who have 50 or more employees are required to participate in the PASSport program, while those with fewer than 50 are not required to. Very small firms may participate, but it is not usually economically advantageous for them to do so.[6]

For ***PASSport*** employees, there was a 19-percent *decrease* in the drive-alone mode for the commute to work.[7] A substantial majority of those who moved from auto went to carpooling, which saw a 41-percent increase in share. Transit saw a 12-percent increase in share among these employees.

Again, the other modes – bike, walking, and "other" – show large changes, but the actual percents and numbers are unsubstantial. Here, the impressive findings are that those employees who are participating in Tri-Met's ***PASSport*** program are exhibiting major shifts away from the drive alone mode and toward either carpooling or transit for the commute to work. Figure 3 illustrates the mode shifts.

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[5] It should be noted that about 12 of the 20 or so respondents who chose "other" as a mode indicated some mode involving transit (e.g., bused to MAX or walked to bus). Thus, the transit share is underreported here, but by no more than a percentage point or so. It should also be noted that changes in bike and walk modes may have been impacted by the fact that respondents were asked to compare their mode of the previous summer (August) with the present year's fall (when the survey was administered).

[6] An employer participating in the ***PASSport*** program must purchase a ***PASSport*** from Tri-Met (at only a very modest discount) for all eligible employees in the firm, whether or not they use transit. The minimum purchase is $500 a year, which would cover about five employees annually. A small firm of five employees could purchase five ***PASSports*** for $500 and then attempt to sell them at their full cost to each of their employees. If only two of the employees actually purchased the ***PASSport*** for the full cost, the firm would realize a loss. Large firms are better positioned to purchase a large number of passes, sell a portion of them at a discounted price to their employees, and then realize a tax benefit as a result of subsidizing the rest of the cost.

[7] The 95% confidence interval for the difference in these proportions ($\pi_1 - \pi_2$) was *not* significant.

*Mode Shares for Non-**PASSport** Employees*

The transportation management program has not had a positive impact on the non-***PASSport*** employees, who actually show a 2-percent *increase* in the drive-alone mode[8] and a 36-percent *decrease* in transit, although carpooling has increased by 20 percent. Figure 4 shows the mode shares and percentage change.

FINDINGS WITH RESPECT TO PARKING

As discussed earlier, on-street parking within the District had been free until the installation of meters in the fall of 1997. At that time, the City installed short-term (two-hour) meters on most streets within the District, at a rate of $0.75 per hour, which is 20 to 30 percent less than the pricing of meters in the Central Business District (CBD).

Long-term (five-hour) meters were installed at the outer fringes of the district and, until 10 a.m., are reserved for carpoolers (who must display a carpool permit costing $30 per month). Thereafter the cost for other drivers is $0.35 per hour.

There are no meters on the two major commercial thoroughfares, Broadway and Weidler. The lack of meters on these streets is a combined result of the fact that business owners expressed significant concern about how meters might affect retail business and the fact that along many portions of those thoroughfares, there are no parking lanes anyway.

As for surface and structure parking, there is one major shopping center in the District, the Lloyd Center Mall, which has free surface and structured parking for its employees and customers. The Lloyd Cinema, located across the street from the Mall, has a large (free) surface lot, open to theater and Mall customers and employees. Both facilities restrict access to their parking accommodations until 9 a.m., which discourages CBD-destined commuter "park-and-ride" parking.

There are a number of parking structures in the District located near or on the site of other District employers. Most of these have been charging for parking, although the rates have, again, been 20 to 30 percent lower than CBD parking rates.

The Central City Transportation Management Plan (CCTMP) for the District has instituted maximum parking ratios of 2 spaces per 1000 square feet on new office building development in the District and a mandatory review process for parking supply for any other type of new development. There is also a prohibition of any new commuter parking, although 4-hour shopper parking continues to be allowed, with review. Surface lots greater than 40,000 square feet are prohibited.

Changes with Respect to Parking Location

The key finding with respect to parking location is that most employees have apparently responded to the installation of the parking meters not by diverting to another mode, but by moving to another parking location – in some cases demonstrating a willingness to pay for what was once free (parking). As expected, the percentage of those who park on the street, but not at meters, has dropped significantly (because the number of on-street nonmetered spots has dropped substantially).[9] Only a small percentage of employees have been parking at other types of locations than those discussed above. Use of on-street carpool spaces has not changed significantly and remains low in terms of percentage of all those who drive and park (less than 1 percent for the entire sample). Of those who drive and park, the percentage of those who park in off-street parking – either employer provided or non-employer provided – has increased.

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[8] The 95% confidence interval for the difference in these proportions ($\pi_1 - \pi_2$) *was* significant.

[9] A number of employers are close enough to the boundaries of the metered district, that employees can still park on-street and walk. For example, Metro is only a few blocks from the end of the metered area.

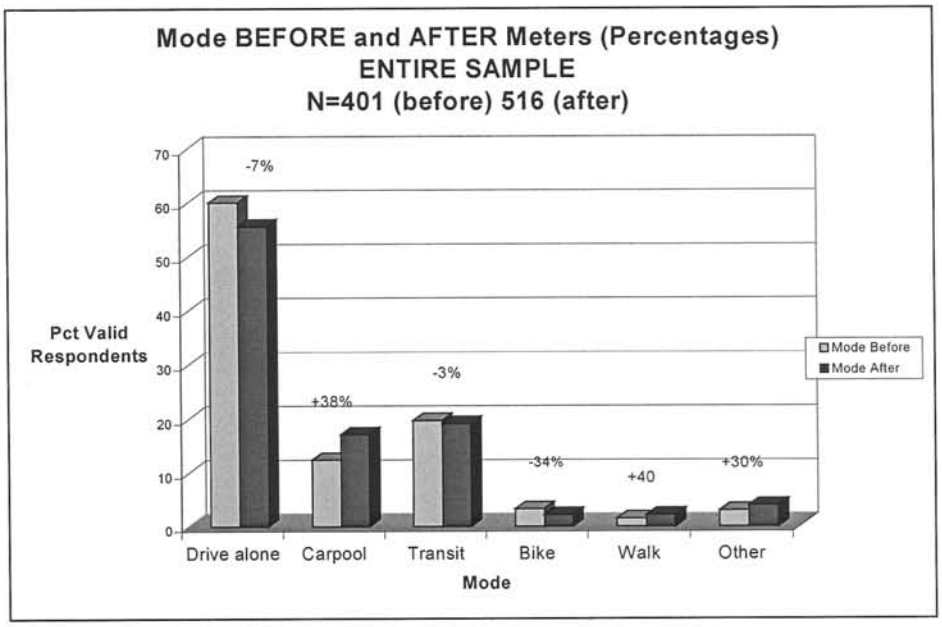

Figure 2. Mode Before and After Meters, Entire Sample (Source: PSU Survey, 1998).

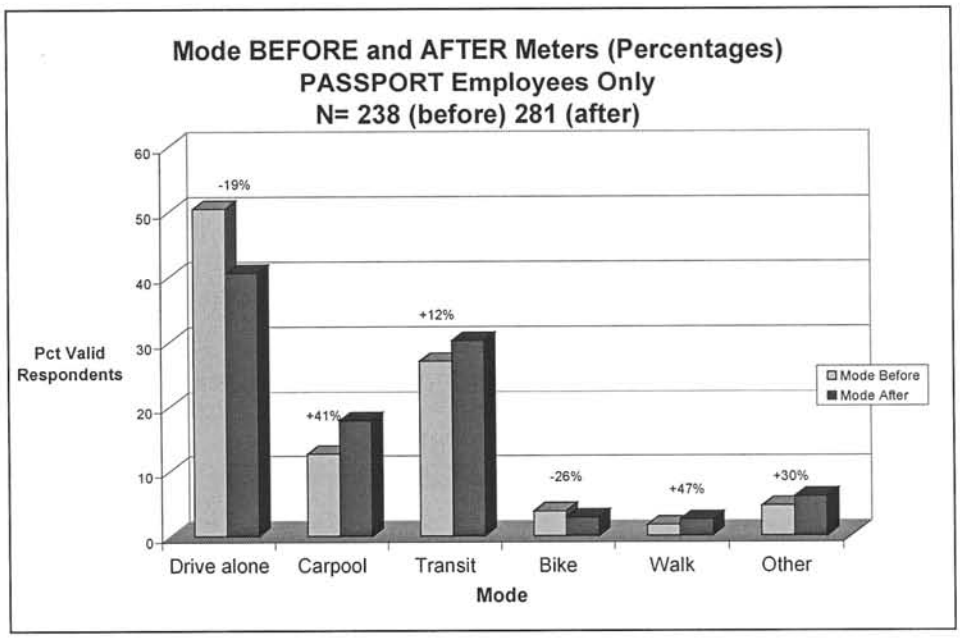

Figure 3: Mode Before and After Meters, ***PASSport*** Employees Only (Source: PSU Survey, 1998).

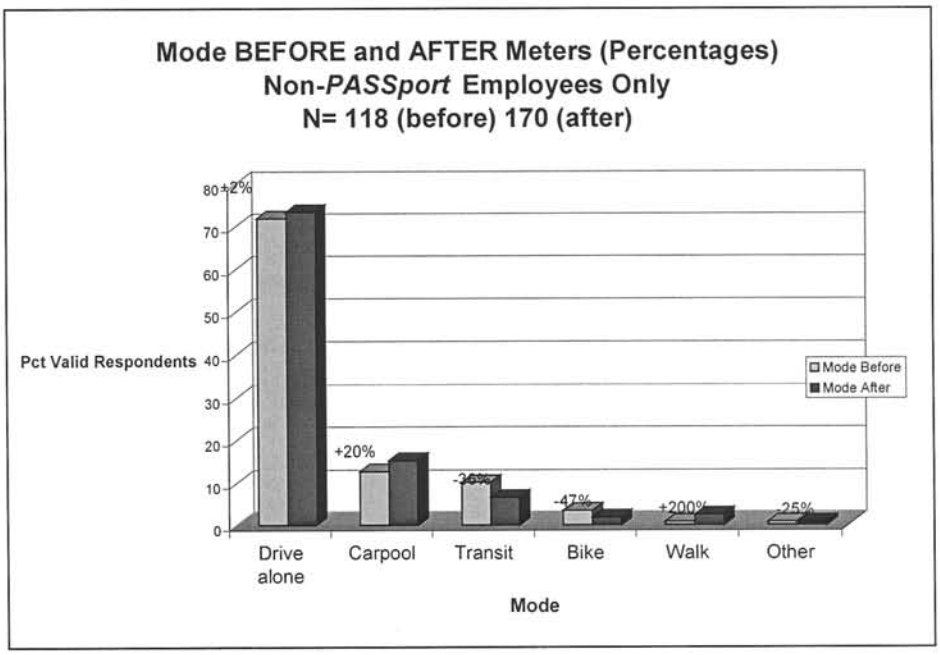

Figure 4: Mode Before and After Meters, Non-***PASSport*** Employees (Source: PSU Survey, 1998).

It is not entirely clear why these individuals were not parking in employer-provided parking prior to the meter installation. As a later section reveals, the percentage of employees parking for free in employer-provided parking increased after the meter installation. If free off-street parking had been available to employees before the meter installation, why wouldn't they have used it instead of parking on the street? There are several possible explanations, including (a) free employer-provided parking was previously available but either not known to the employee or considered by the employee to be less desirable than on-street parking (e.g., for reasons of convenience and/or safety); (b) employer-provided parking was previously available, but it was not free, and after the meter installation some employers may have chosen to subsidize off-street employee parking that had previously been available to employees only at a cost; and (c) employer-provided parking was previously *not* available, so some employers leased new parking spaces to provide to their employees at a subsidy.

Changes with Respect to Parking Prices Paid Before and After Meter Installation

All Lloyd District Employees in the Sample

As Figure 8 indicates, before the parking meters were installed, the majority (61 percent) of employees who drove and parked in the Lloyd District paid nothing to park. This declined by 24 percent to only 46 percent of all those who currently drive and park. Now a majority of employees who drive and park in the Lloyd District are paying *something*. Whereas the average hourly parking price paid before meter installation was about $0.34, it is now $0.37.[10]

[10] These are the average hourly rates for employees who paid a nonzero price. The averages for all employees, including those who paid zero, was $0.13 before the installation of the meters and $0.21 after.

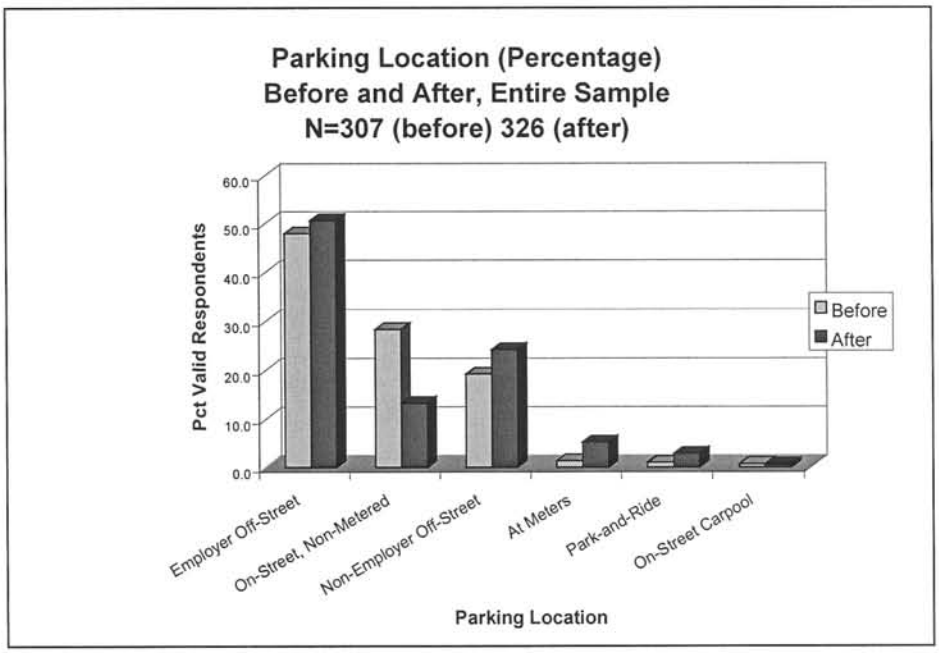

Figure 5. Parking Location, Before and After, Entire Sample (Source: PSU Survey, 1998).

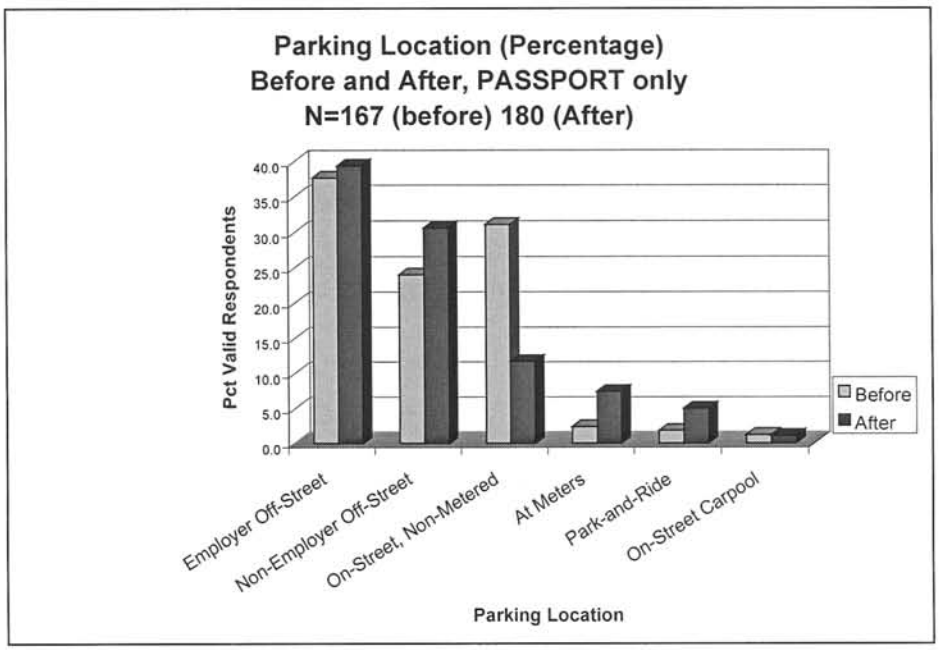

Figure 6. Parking Location, Before and After, ***PASSport*** Employees (Source: PSU Survey, 1998).

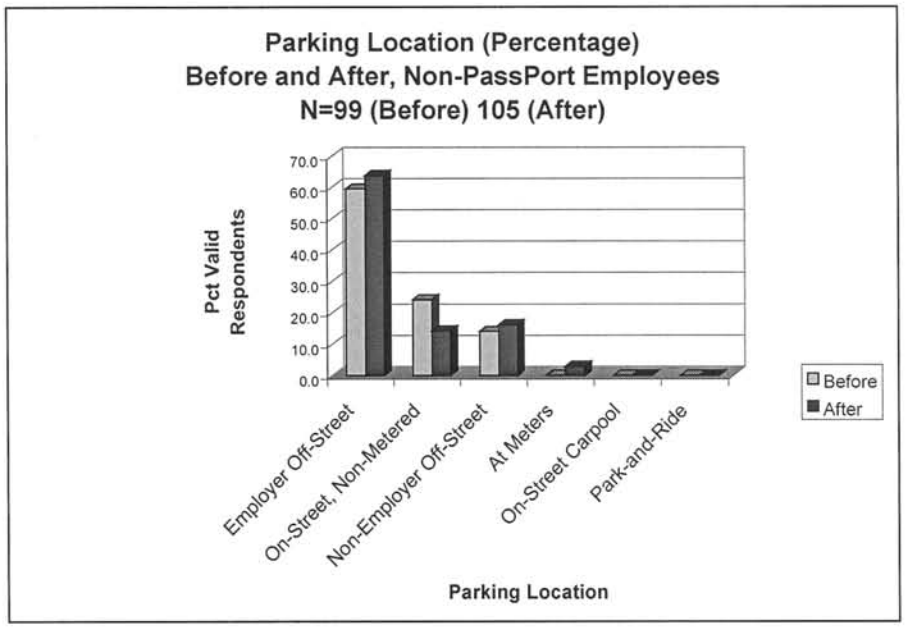

Figure 7. Parking Location, Before and After, Non-***PASSport*** Employees (Source: PSU Survey, 1998).

PASSport *Employees*

Even among ***PASSport*** employees who drove and parked, a large percentage (47 percent) parked for free before the installation of the meters (a majority, however, did pay *something* – an average of $0.34 per hour). As Figure 9 shows, after the meter installation, this group responded much more strikingly than did the sample as a whole, with only 28 percent now parking for free, and the remainder paying an average of $0.36 per hour to park.[11]

*Non-**PASSport** Employees*

Finally, as Figure 10 illustrates, the installation of meters has had the smallest effect on non-***PASSport*** employees who drive and park, a vast majority of whom parked for free both before (82 percent) and after (74 percent) the installation of the meters. Although the number of non-***PASSport*** employees who drive and park for free has decreased by 10 percent, the average hourly price paid has actually dropped, from an average of $0.39 to $0.36.[12]

[11] Again, the averages reported here are for those who paid a nonzero price. Average hourly parking prices, when those who parked for free are included, were $0.18 before the meters and $0.28 after the meters.

[12] Because the percentage of employees in this category who pay zero is so large, the averages calculated to include the zero prices are infinitesimal. These before and after averages of $0.39 and $0.36 are based on those few employees who have been paying a price.

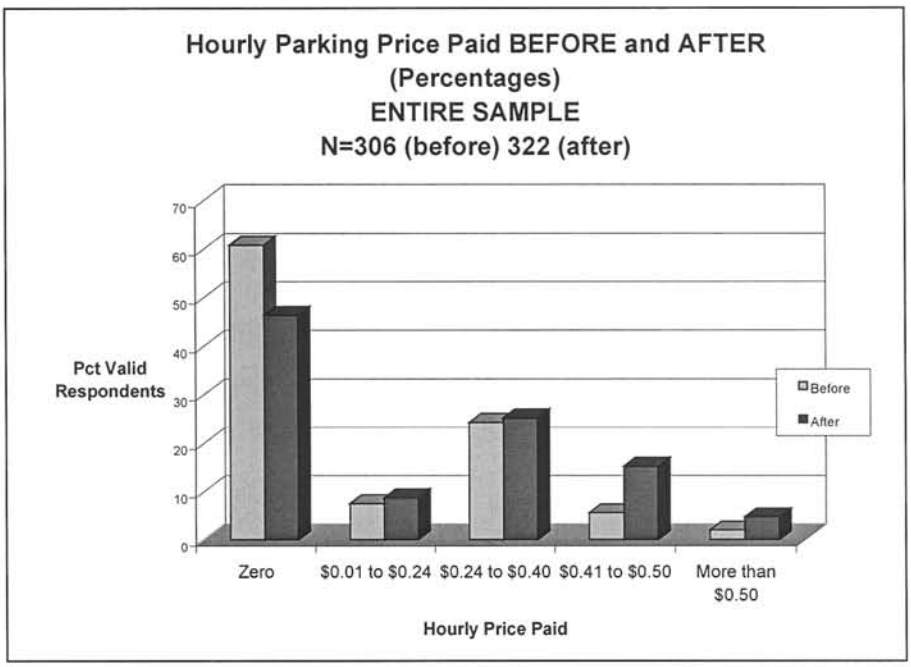

Figure 8. Hourly Parking Price Paid Before and After, Entire Sample (Source: PSU Survey, 1998).

Figure 9. Hourly Parking Price Paid Before and After, ***PASSport*** Employees (Source: PSU Survey, 1998).

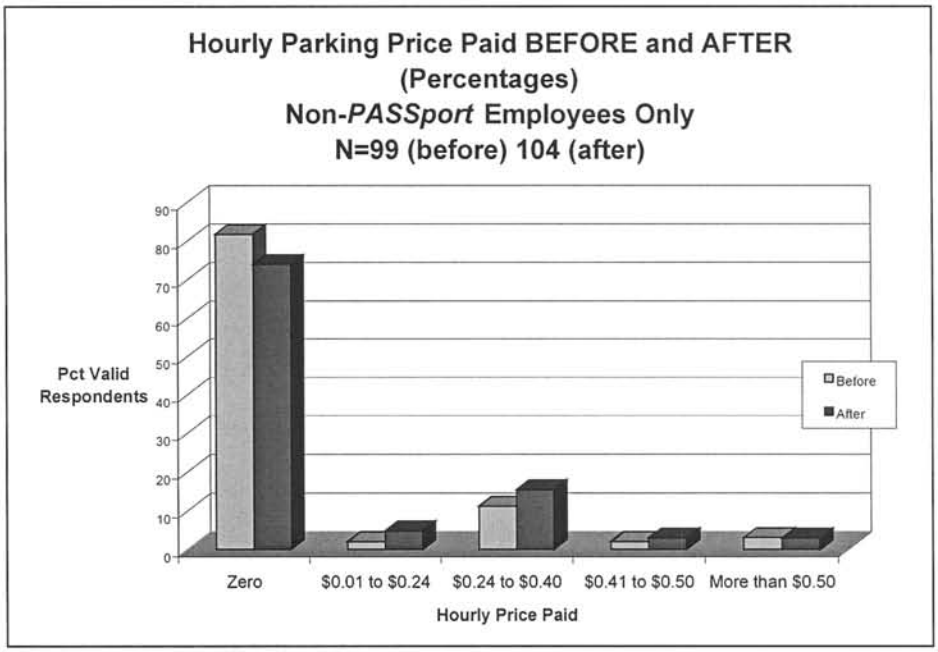

Figure 10. Hourly Parking Price Paid Before and After, Non-***PASSport*** Employees (Source: PSU Survey, 1998).

Relationship Between Parking Location, Mode and Parking Price Paid

This section examines the entire sample only, before and after the installation of the meters. In analyzing the relationship between two variables, such as parking price and parking location, the ability to determine statistical significance depends on there being a fairly high number of observations. However, because so few people paid for parking either before or after the meters, the sample size would only have been further compromised through division into ***PASSport*** and non-***PASSport*** groups. The interest here was in assessing whether the price of parking paid affected where employees in the district park and how they commute, for both the before and after periods.

Parking Location and Parking Price

As Tables 1 and 2 indicate, of those employees who drive and park in the Lloyd District, 48 percent of those parking for free parked in employer-provided off-street accommodations, compared with 64 percent after the meter installation. Of those who paid in the range containing the average for the District ($0.24 to $0.40 per hour), a large percentage parked in non-employer-provided accommodations before (49 percent) and after (47 percent) meter installation. Of those paying well above average (the "more than $0.50" category), 50 percent had been parking in employer-provided accommodations before the meters; after the meters the percentages were somewhat more evenly distributed among all parking locations. Perhaps the most important finding of this analysis is that those who currently park for free are most likely to be parking in employer-provided, off-street accommodations.[13]

[13] These findings are all statistically significant, with a Pearson χ^2 value of 113 or better (12 d.f.), $p < .001$. Because there were sparse cells—i.e., few observations in some categories, such as employees paying more than $0.50 per hour in any but employer-provided accommodations—these results should be interpreted with some caution.

TABLE 1: HOURLY PARKING LOCATION BY HOURLY PARKING PRICE PAID (PERCENTAGE)
BEFORE METER INSTALLATION, ENTIRE SAMPLE, N=303
(Source: PSU Survey, 1998)

Hourly Parking Price / Parking Location	Zero	$0.01-$0.24	$0.24-$0.40	$0.41-$0.50	More than $0.50
Employer-Provided Off-Street	47.8	47.8	47.3	25.0	50.0
Non-Employer-Provided Off-Street	5.4	17.4	48.6	37.5	33.3
Other (park-and-ride, carpool, free on-street)	46.7	30.4	4.1	25.0	16.7

TABLE 2: HOURLY PARKING LOCATION BY HOURLY PARKING PRICE PAID (PERCENTAGE),
AFTER METER INSTALLATION, ENTIRE SAMPLE, N=321
(Source: PSU Survey, 1998)

Hourly Parking Price / Parking Location	Zero	$0.01-$0.24	$0.25-$0.40	$0.41-$0.50	More than $0.50
Employer-Provided Off-Street	64.2	46.4	38.3	56.5	40.0
Non-Employer-Provided Off-Street	2.7	17.9	46.9	57.1	20.0
Other (park-and-ride, carpool, free on-street)	32.4	25.0	7.4	10.2	20.0
On-Street Meters	0.7	10.7	7.4	6.1	20.0

Commute Mode and Parking Price

Regarding the relationship between parking price paid and commute mode, Tables 3 and 4 show that those who paid nothing for parking prior to the meter installation were clearly more likely to drive alone than use any other mode to work. The only pricing category where the likelihood that employees would use transit (31 percent) was at all similar to the likelihood that they would drive alone (44 percent) was in the higher pricing category of $0.41 to $0.50 per hour (there were, however, only six observations in this category).[14]

Comparing these trends with the period *after* the meter installation reveals that at all but the top two pricing levels, the drive-alone mode is still the most likely mode, although the likelihood that a commuter will drive alone has declined somewhat at all price levels (except the $0.41 to $0.50 level).

At the zero price, commuters are more likely to be carpoolers than before the meters; this is interesting, given that now carpool permits cost $30 per month. Some carpool respondents may either not consider the cost of the monthly permit as a parking fee or may in fact not be parking in carpool-permit spots.

The other noteworthy finding here is that at the top pricing category, commuters are now somewhat more equally likely to drive alone (40 percent), take transit (27 percent), or use some other form (20 percent); they are least likely to carpool (13 percent). This is not unexpected, given the fact that carpoolers are usually least able to afford higher parking prices.

[14] As with the previous analyses, these findings are all statistically significant, with a Pearson χ^2 value of 29 or better (12 d.f.), $p < .005$. Again, because there were few observations in some categories (e.g., employees paying more than $0.50 per hour prior to the meter installation), these results should be interpreted with some caution.

TABLE 3: COMMUTE MODE BY HOURLY PARKING PRICE PAID (PERCENTAGE)
BEFORE METER INSTALLATION, ENTIRE SAMPLE, N=301
(Source: PSU Survey, 1998)

Hourly Parking Price / Mode	Zero	$0.01-$0.24	$0.25-$0.40	$0.41-$0.50	More than $0.50
Drive alone	77.2	72.7	83.6	43.8	66.7
Carpool or vanpool	13.0	18.2	13.7	12.5	16.7
Transit	5.4	9.1	1.4	31.3	16.7
Other	4.3	0.0	1.4	12.5	0.0

TABLE 4: COMMUTE MODE BY HOURLY PARKING PRICE PAID (PERCENTAGE)
AFTER METER INSTALLATION, ENTIRE SAMPLE, N=321
(Source: PSU Survey, 1998)

Parking Price / Mode	Zero	$0.01-$0.24	$0.25-$0.40	$0.41-$0.50	More than $0.50
Drive alone	68.5	64.3	79.0	45.8	40.0
Carpool or vanpool	18.8	21.4	14.8	14.6	13.3
Transit	8.1	10.7	4.9	33.3	26.7
Other	4.7	3.6	1.2	6.3	20.0

WHY EMPLOYEES CHANGED THEIR BEHAVIOR

The survey asked employees to rank the top three reasons for changes, if any, in travel behavior. Of the entire sample of respondents who did report a change in travel behavior for the trip to work, 25 percent said that their No. 1 reason for doing so was unconnected to any transportation demand management (TDM) program – that is, they changed for reasons related to their life-style and, therefore, presumably not subject to impact by TDM. Nearly 22 percent, however, reported that the existence of the new meters was the No. 1 reason behind their change, followed by nearly 19 percent who cited the ***PASSport*** program as the chief reason. These results are shown in Figure 11.

In ranking their No. 2 reasons for change in travel behavior, nearly 36 percent of the employees who changed behavior indicated the ***PASSport*** program as their No. 2 reason, while about 7 percent cited the parking meters as their second reason.

Transit availability ranked moderately high as both a first choice (about 12 percent of the respondents cited this factor) and as a second choice (16 percent). It should be noted, however, that "transit availability" (the phrase used on the survey) could be interpreted by respondents both positively (greater availability) or negatively (less availability). Auto costs (not shown in Figure 11) were not cited at all as a first choice, although about 11 percent of the respondents did cite it as a No. 2 reason.

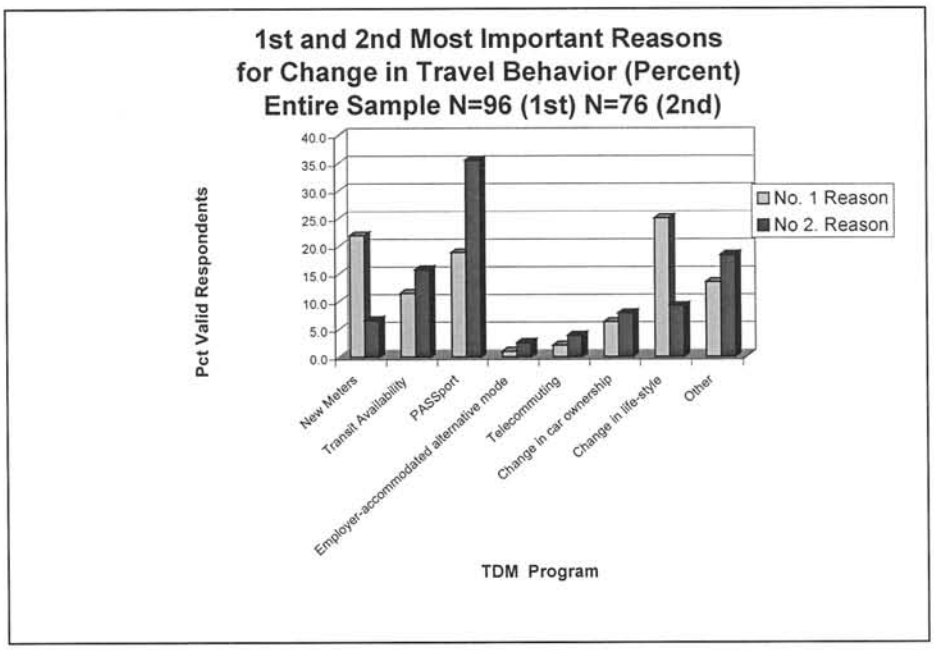

Figure 11. First and Second Most Important Reasons for Change in Travel Behavior, Entire Sample (Source: PSU Survey, 1998).

SOCIODEMOGRAPHIC IMPLICATIONS

This survey also asked respondents questions about gender, work status (part time or full time), marital status, monthly income, household size, and race. In general, the majority of respondents to this survey report that they

- are female (56 percent survey respondents versus 52 percent Portland as a whole)[15]
- work full time (89 percent survey respondents)
- are married or partnered (67 percent survey respondents)
- are white (88 percent survey respondents versus 85 percent Portland as a whole)
- are in the highest two income categories (52 percent survey respondents versus 24 percent Portland as a whole)
- live in households of either one or two members (60 percent survey respondents)
- do not have children under 18 years of age living at home (61 percent survey respondents versus 74 percent Portland as a whole)

These data suggest that the survey respondents are more likely than the Portland population as a whole to be female, white, high income, and have children at home. These discrepancies are difficult to interpret, but likely reflect a self-selection bias in the sample that misrepresents the population of Portland as a whole and, as a result, under- or overrepresents the relationship between certain demographic variables and travel behavior. These issues should be kept in mind when considering the findings in the following sections.

[15] All Portland data from the 1990 U.S. Census.

The Relationship Between Sociodemographics and Transportation Programs in the Lloyd District

Mode by Income Quintile

There is little statistical difference among the income quintiles with respect to mode choice.[16, 17] Before the installation of the meters, the majority of respondents chose to drive alone. Despite the lack of variability, there does appear to be a slight trend toward those in the top income quintile being more likely than others to drive alone, whereas those in the bottom income quintile tended to be more likely to choose transit relative to the other quintiles. After the installation of the meters, those in the top income quintile remained the most inclined to continue to drive alone.[18] In fact, for this quintile, the drive alone mode has increased, while it has decreased for the other quintiles. Nevertheless, for all quintiles except the third, the majority of respondents still drive alone (for the third quintile, the majority are divided among carpooling, transit, and other). There were no remarkable patterns between income and the other modes.

Parking Price Paid by Income Quintile

Before the meter installation, those in the lower income quintiles were the least likely to pay for parking. This remained true after the meter installation, although for all income quintiles, respondents are more likely to pay for parking than before. Those most likely to pay the highest prices for parking are in the third, fourth, and fifth quintiles. These results, however, are not statistically significant and only suggest trends.[19]

CONCLUSIONS

During the one year that had elapsed between the implementation of the Lloyd District transportation management programs and the survey information collected by this study, the drive alone mode for the trip to work by employees in the Lloyd District had decreased by 7 percent. For the District as a whole, the drive alone commute share is now about 56 percent.

The majority of the respondents to this survey indicated that their employers participate in Tri-Met's ***PASSport*** program. For these respondents, results were even more striking: the drive-alone mode decreased by 19 percentage points to only 41 percent of the total commute share. For this group, transit use has risen by 12 percentage points, to over 30 percent of the commute share. Clearly, the presence of a ***PASSport*** program at these respondents' place of employment is a strong indicator of the hoped-for shifts in mode—even if all of the employees at these firms are not using the ***PASSport*** themselves all of the time. The fact that many of these employees indicate that they have *increased* their use of parking in non-employer-provided off-street parking suggests that what is valuable for these employees is the flexibility and availability of options. Some days they may use transit; other days, they may drive and pay to park.

Those employees who indicated that their employer did not offer a ***PASSport*** appear to be the most intransigent in terms of hoped-for mode shifts. Not only has this group *increased* their drive-alone share, but they seem to have adjusted to the installation of the parking meters by parking in either employer- or non-employer-provided off-street parking, rather than by shifting to another mode.

The presence of the parking meters has clearly made a difference for all employees working in the Lloyd District. Before the meters were in place, 61 percent of all District employees who drove parked for free. Of those 61 percent who parked for free, 77 percent drove alone. After the meters were in place, 46

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[16] In fact, the Pearson χ^2 for this analysis is 14.35, 12 d.f., $p < .30$, thus indicating little differentiation.

[17] To assess the effect of household income, we calculated income quintiles based on monthly household income, controlling for household composition. We first created a quasi-interval-level household composition variable, **hhsizdep**, which classified respondents into categories based on marital status (single or married/partnered), household size (including the respondent), and whether or not the respondent had children under the age of 18 living at home. The values ranged from 1 (single, no children) to 11 (single or married/partnered, with five or more children). We then calculated a midpoint value for each of the five income categories and treated this midpoint value as an interval-level variable, **incinter**. To arrive at a proxy variable (**hhsizin**) that would capture both income and household composition, we divided **incinter** by **hhsizdep** to arrive at an index, **hhsizin**, household monthly pretax income, controlling for household composition. Based on a frequencies tabulation, we then divided this new income variable into five categories comprising roughly 20 percent of the respondents, and used this to create the income quintiles. Although the income quintiles do correspond to income ranges that control for household composition, it is more useful to think of the quintiles in terms of percentage of the population.

[18] Pearson $\chi^2 = 18.66$, 12 d.f., $p < .10$.

[19] For the "before" analysis, Pearson $\chi^2 = 20.85$, 16 d.f., $p < .20$. For the "after" analysis, Pearson $\chi^2 = 17.09$, 16 d.f., $p < .40$. In both cases, about 50 percent of the cells are sparse, suggesting that these results should be interpreted with caution.

percent of all District employees who drive park for free. Of those 46 percent who continue to park for free, about 69 percent drive alone.

Despite the integrated and reinforcing "package" approach of the Lloyd District's transportation management programs, there are still groups of employees who have not made a significant shift in their commute mode as a result of any one or a combination of parking pricing, increased transit availability, and the ***PASSport***. For the most part, these people appear to fall into one or more of three groups:

- Those who need their car for either trip-chaining purposes related to household maintenance, such as childcare, or for purposes related to their job
- Those who report not having convenient access to transit
- Those who can afford to pay for off-street parking or who receive free employer-provided parking

In this regard, it is important to bear in mind that there may be some people who, from an economics perspective, are on the margin in mode choice. They may use their car for trip-chaining, childcare, or work, but would prefer *not* to spend their money on auto use or parking, saving it for other purposes. Yet, because they require the flexibility of the auto, they pay to park even though they see the cost as burdensome. A number of such individuals express a willingness or desire to use transit, if they could, and some even do, when their schedule allows.

The one alternative these individuals seem willing to consider is carpooling, which still allows them access to a vehicle. Many individuals seem reluctant to shift from auto to transit, which they consider too slow, unsafe, or inconvenient for their needs. There are also a large number of respondents whose commute behavior is determined by life-style concerns that the District's transportation management programs simply cannot address.

On the other hand, a number of people seem to have increased their use of transit for trips other than the commute or on occasions for the commute. In this regard, they express an appreciation of the ***PASSport***. Still, while a number of people expressed satisfaction with Tri-Met, most people were not happy about the new meters.

The surveys also revealed a lack of information among some respondents, despite the significant attempts made by the Lloyd District Transportation Management Association, the City, and Tri-Met to disseminate information. Open-ended comments suggest that ongoing public relations activity may be important if mode shifts are to continue. There is also an indication that for mode shift to increase, parking restrictions (including increased pricing), however unpopular, need to be expanded.

The sociodemographic analyses revealed some differences among income quintiles with respect to how people are responding to the transportation management programs. People in the higher income quintiles were and still are the most likely to drive alone. People in the lowest quintile were the most likely to use transit, although before the meters, the majority drove alone. After the meter installation, these individuals were more likely to shift to carpool than to transit.

These sociodemographic relationships are difficult to interpret, but suggest that a "one-size-fits-all" approach cannot work. The Lloyd District program has recognized that from the beginning, by emphasizing commute options (including bicycling and telecommuting) and by being flexible enough so that those who need to drive can, even if they don't do so every day and even if they incur some financial hardship. The challenge continues to be to reach those individuals who may not be particularly auto dependent, but can afford to pay the increased parking prices, so drive anyway. These individuals may not respond until pricing reaches such a high level that the resulting inequity for lower-income groups outweighs the societal gain of the mode shift.

Another challenge is to reach those individuals who have misconceptions about the availability of the ***PASSport***, transit service, or transit safety. In this case, continued educational outreach may be the answer.

As mentioned, the Lloyd District program consists of a "package" of complementary and reinforcing strategies. The ones that have emerged as the most significant are the installation of the meters and the ***PASSport*** program. For the entire sample, nearly 22 percent cited the new meters as the No. 1 reason they have changed their travel habits, with 19 percent citing the ***PASSport***. As a No. 2 reason, nearly 36 percent cited the ***PASSport*** program.

Clearly, the two programs are equally essential in a transportation management program. The meters provide the drive-alone disincentive, while the ***PASSport*** provides the transit incentive. Without the ***PASSport***, and the increased transit service, those diverted from the drive-alone mode would have fewer

choices. Without the meters—even with a ***PASSport*** program in place—there would be little incentive for many individuals to give up the drive-alone mode.

Has the Lloyd District Transportation Demand Management program been a success? Looking at the present mode split, the answer is a qualified yes. There are some limitations to this analysis, as well as as-yet unanswered questions about the program's overall cost and its transferability to other parts of Portland, let alone other parts of the U.S.

The analytical limitations are twofold. One, financial constraints limited the sample size and, despite a reminder postcard, yielded only about 400 observations. This number was insufficient in many cases to provide for robust statistical analysis, thus making it difficult to make conclusions about the population of Lloyd District employees as a whole. The other analytical limitation is self-selection bias introduced by the fact that those who chose to answer and return the survey were, for the most part, in a higher income category than the average for that District. This raises a question about the extent to which certain types of trips, particularly transit, may have been underreported. Other research (Tri-Met 1999) has also shown that those who choose to participate in the ***PASSPort*** program tend to be single, under 35 years of age, transit dependent, and favorable in general toward transit. Those who do not participate in the ***PASSPort*** program tend to be over 35, married or divorced/separated, auto users, with a slightly less favorable attitude toward transit; they also ride transit infrequently. Thus, there may also be bias as a result of the fact that most of the respondents to this survey were ***PASSPort*** employees. It is difficult to speculate how this bias might compound or counteract the self-selection bias.

There are other concerns that make it impossible to render a verdict of other than only qualified success for the Lloyd TDM programs. A primary concern is that, while this study found a 7-percent decline in SOV overall, that decline was not statistically significant. It also clear that the most important factors affecting individuals' mode choice have *nothing* to do with *any* of the TDM programs, but are rather those life-style factors over which public policy has no control. This makes it difficult to attribute the mode shifts directly to the TDM programs.

Another important concern is that it is very difficult to assess the overall costs of these programs. Tri-Met clearly benefits through selling permits to 100 percent of qualifying employees in firms with 50 or more employers. Although the cost of these permits is discounted to the employer, in is unlikely that in any case 100 percent of the qualified employees use them. And although Tri-Met is adding service at benchmark amounts of passes sold in the District, farebox revenues are also being collected on those routes. As for employers, while they incur a cost in purchasing the passes, they have the option of selling the passes for the full cost or at a subsidized, reduced cost. If they choose the latter course, they may claim a tax benefit. On the other hand, it is not known whether this tax benefit offsets the administrative burden of participating in and managing the other program elements (hiring a transportation coordinator or adding those duties to an existing employee, setting up telecommuting, etc.). In addition, the burden on individuals who have had to make significant changes in their life-style as a result of the parking pricing cannot be known.

Despite these drawbacks to both the study and the program, the results are encouraging and do point in the right direction in terms of using both SOV disincentives (parking pricing) in combination with alternative-mode incentives (discounted transit, bike programs, etc.) to reduce SOV for the commute. But these programmatic elements alone are not enough. Coordination among agencies and support by area businesses, as well as committed staff, are also essential.

The success of the Lloyd District programs could not have occurred without the coordinated efforts of the City and Tri-Met. In addition, the role of the Lloyd District Transportation Management Association (LDTMA) in helping coordinate outreach and educational efforts and in brokering support by area businesses cannot be overemphasized. The same is true of the transportation coordinators (TCs) who work at the individual firms to assist their employees with understanding and participating in the LDTMA programs. While the Lloyd District program is, again, a package of reinforcing strategies that have depended on coordination by the City and Tri-Met, the LDTMA and the individual TCs are the front-line implementers that bring it all together.

In sum, the successes of the Lloyd District programs have depended on multiple and coordinated efforts by several partners and many individual, dedicated front-line TCs. With continued attention at all levels and in all areas (specifically pricing and transit improvements), the drive alone mode share should continue to decline and achieve hoped-for levels in a timely manner. But investment in similar programs elsewhere and continued study of the costs, benefits, and net effects, are also in order.

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