Urban Partnership Agreement and Congestion Reduction Demonstration Programs:

Lessons Learned on Congestion Pricing from the Seattle and Atlanta Household Travel Behavior Surveys

April 2014

Report for Federal Highway Administration

Submitted by the Volpe Center

U.S. Department of Transportation
John A. Volpe National Transportation Systems Center

Volpe

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE ***(DD-MM-YYYY)***	**2. REPORT TYPE**	**3. DATES COVERED** ***(From - To)***
4-17-2014	Final	2010 – 2014

4. TITLE AND SUBTITLE

Urban Partnership Agreement and Congestion Reduction Demonstration Programs: Lessons Learned on Congestion Pricing from the Seattle and Atlanta Household Travel Behavior Surveys

5a. CONTRACT NUMBER

5b. GRANT NUMBER

6. AUTHOR(S)

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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) AND ADDRESS(ES)

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5c. PROGRAM ELEMENT NUMBER

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Federal Highway Administration

8. PERFORMING ORGANIZATION REPORT

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT

13. SUPPLEMENTARY NOTES

14. ABSTRACT

This paper presents lessons learned from household traveler surveys administered in Seattle and Atlanta as part of the evaluation of the Urban Partnership Agreement and Congestion Reduction Demonstration Programs. The surveys use a two-stage panel survey approach to analyze the impacts of the federally sponsored variable tolling programs on corridor users' daily travel choices and opinions. Key lessons learned are that pricing does influence travel behavior (as expected), particularly with respect to route choice and the timing of trips. Pricing does not appear to have a noticeable impact on telecommuting, and impacts on mode choice and occupancy depend on the design of the tolling project and the regional context. In addition, the surveys found that travelers utilizing the priced facility notice and appreciate the improvement to traffic conditions and that attitudes toward tolling change with direct experience. The key implications of these lessons learned are that: near term shifts in mode or carpool size require programmatic support; public communication and community involvement are critical; and regional factors influence public attitudes toward tolling.

15. SUBJECT TERMS

Congestion pricing, tolling, household travel behavior, survey research

16. SECURITY CLASSIFICATION OF:

a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**	**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	Unclassified Unlimited	22	**19b. TELEPHONE NUMBER** ***(include area code)***

INTRODUCTION

While the application of Congestion Pricing strategies continues to increase in major metropolitan areas across the United States, there remains very little data collected to measure the impacts of road pricing on traveler behavior. This lessons learned report presents key cross-cutting observations from a household panel survey that was conducted in Seattle and Atlanta as part of the national evaluation of the Urban Partnership Agreement (UPA) and Congestion Reduction Demonstration (CRD) Programs. The purpose of the survey was to measure the impacts of road pricing on traveler behavior. This report synthesizes findings across the two panel surveys, highlighting similarities and differences in traveler response.[1] Since traveler response depends on the details of the specific pricing strategy, the overall regional transportation network and other local, contextual factors (such as gas prices, telework conditions and local economy), the role of these elements is addressed when drawing comparisons across the two sites, which differed in their pricing approach as well as other factors.

BACKGROUND

As part of its *National Strategy to Reduce Congestion on America's Transportation Network*, the United States Department of Transportation (U.S. DOT) created the Urban Partnership Agreement (UPA) and Congestion Reduction Demonstration (CRD) programs to promote innovative and integrative approaches to reducing travel delays. The UPA/CRD programs provided Federal funding and technical assistance to metropolitan areas committed to pursuing a coordinated "4 Ts" approach to congestion, comprising tolling, transit, telecommuting, and technology. Recipients included Atlanta, Los Angeles, Miami, Minnesota, San Francisco, and Seattle.

The UPA/CRD programs placed a strong emphasis on evaluation, so that other metropolitan areas could learn from the experiences of the UPA/CRD sites. The information gathered from the overall evaluation will also be used to inform federal policy-making related to mobility, congestion and facility pricing. As one component of the evaluation, the Federal Highway Administration (FHWA) funded a before-and-after household travel survey at two of the six UPA/CRD sites, Seattle and Atlanta, to gain insight into how the UPA/CRD tolling programs affected the travel behavior choices of local households. The traveler survey measured changes in route and mode choice, trip timing, origin and destination patterns, and telework that resulted from implementing various pricing related strategies. The survey was also designed to explore changes in travel and tolling-related attitudes and equity impacts.

A brief description of the study corridors and the road pricing strategies deployed are presented below.

[1] For detailed survey findings, please see the final survey reports for each site. [Links/citations to be provided]

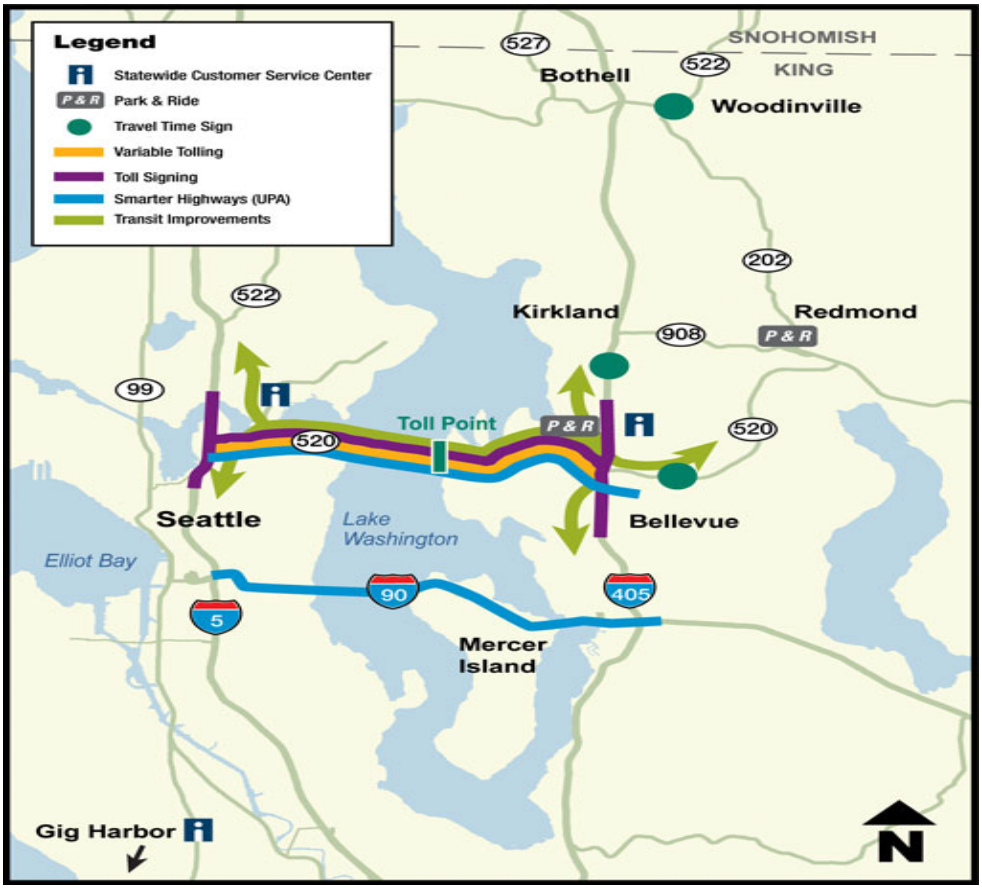
Seattle UPA

The centerpiece of the Seattle UPA project is variable, time-of-day pricing (tolling) of all lanes of the Evergreen Point Bridge, which carries State Route 520 (SR-520) across Lake Washington near downtown Seattle (see Figure 1). At the time of the proposed Seattle UPA program, SR-520 was nearing the end of its usable life, and toll revenues would be used to fund the construction of a new bridge.

Under the program, tolls were imposed on the SR-520 bridge, which had been toll-free for many years, with rates higher in peak periods in order to manage demand. Toll collection is fully automated; vehicles without an electronic toll transponder are identified using license plate recognition and billed by mail. The Seattle local partners also committed to improving public transit service in this corridor, with the equivalent of 90 additional one-way bus trips during the weekday peak period and additional park-and-ride spaces. The UPA's technology components include new highway signage showing current travel times, as well as an Active Traffic Management (ATM) or "Smarter Highways" system on SR-520 and Interstate 90. ATM uses overhead freeway signs to control lane usage and to implement variable speed limits during congested periods, reducing the follow-on effects of incidents. The local partners also included plans to expand their efforts to promote telecommuting, ridesharing, and flexible work schedules.

The only other direct route across the lake is the Interstate 90 Bridge, located approximately 4 miles south of SR-520. Many commuters view the two bridges as potential substitutes for each other, depending on their particular origin and destination and current traffic conditions. I-90 also provides the only road access to Mercer Island. An arterial, SR-522, runs around the northern end of the lake and is also used an alternative to SR-520 for some trips.

Figure 1: Seattle UPA Project



Atlanta CRD

The Atlanta CRD project involved the conversion of an existing high occupancy vehicle lane (HOV) to a dynamically priced high occupancy toll lane (known as the “Express Lanes”), combined with an increase in the occupancy requirement from 2+ to 3+. No additional capacity was added in the corridor. This HOV-2 to HOT-3 conversion was implemented along a 16 mile stretch of I-85 in northeast Atlanta, from I-285 in DeKalb County to Old Peachtree Road in Gwinnett County (see Figure 2). Another key element of the CRD project was the new requirement that all “Express Lane” users must have a Peach Pass transponder. Prior to traveling in the Express Lanes, users must register (online or by phone) in either toll mode status (single occupant or 2 person vehicles) or non-toll mode status (3+ person vehicles, motorcycles, or alternative fuel vehicles). Transit service in the corridor is comprised of peak hour Express Bus service. As part of the CRD project, the local partners added three new bus routes and invested in three new Park and Ride locations, along with the expansion of another park and ride facility. One of the new routes (Mall of Georgia) commenced in August 2010, while the other two new routes (Hebron Baptist Church and Hamilton Mill) started service during the summer of 2011. Other strategies pursued as part of the CRD project included the

deployment of ITS technologies (dynamic message signs and automated enforcement technologies), and transportation demand strategies to encourage 3+ carpooling.

The I-85 general purpose lanes remain a toll-free alternative, and travelers in the corridor have other nearby route options, including Buford and Lawrenceville Highways, both of which run parallel to I-85.

Figure 2: Atlanta CRD Project

Note: The I-985 & SR 20 Park and Ride added capacity. The new Park & Ride facilities include Hamilton Mill and Hebron Baptist Church in Dacula (the latter is not shown on this map). Cedars Mill was planned but not constructed.

OVERVIEW OF SURVEY METHOD AND ADMINISTRATION

A panel survey was conducted in both the Seattle and Atlanta regions, in which individuals in the same households were surveyed "before" and "after" the implementation of road pricing in order to assess changes in travel behavior. The survey consisted of a demographic household questionnaire, 2-day travel diary, and follow-up questions on current travel patterns and attitudes.

The population of interest for this survey consisted of corridor users -- defined as drivers, transit users and vanpoolers -- and the adult members of their households. Each of these populations was sampled as follows:

- Drivers on the corridor were identified via license-plate capture photography on sections of I-85 and Buford Highway (which runs parallel to I-85) in Atlanta and SR-520 and I-90 (the alternate bridge across Lake Washington) in Seattle. License plate capture

occurred during peak hours at each site. In Atlanta, license plates were captured in the HOV lane as well as the general purpose lane to ensure the sampling of carpoolers.

- Transit riders were intercepted by survey staff at Park and Ride facilities and at transit stations in the corridor.
- Members of organized vanpools received an e-mail solicitation to participate; those who indicated interest provided their contact information on a survey website and were mailed a survey packet inviting them to participate.

A series of mailings was sent to the sampled registered vehicle owners and their household to encourage survey participation, including a pre-notification postcard, a survey invitation packet, and reminder postcards and e-mails, as necessary.

Incentives were offered as a means of boosting response rates, including a $15 Amazon gift card upon completion of the Wave 1 ("before") survey, and a $30 Amazon gift card upon completion of the Wave 2 ("after") survey. In addition, panel maintenance efforts were undertaken in between the two survey waves to keep respondents engaged and to encourage continued participation. Overall, the final sample size included 2,063 households (comprised of 3,698 adults) who completed both waves of the survey in Seattle and 1,655 households (comprised of 3,126 adults) in Atlanta.

Table 1: Survey Timeline and Sample Sizes

Timeline	Seattle	Atlanta
Before (Wave 1) Survey	November 2010	April/May 2011
Tolling implemented	December 2011	October 2011
After (Wave 2) Survey	April/May 2012	April/May 2012
Sample Size		
Households	2,063	1,655
Individuals	3,698	3,126
Response Rate	6%	4%

RECAP OF KEY FINDINGS: SEATTLE

Analysis of the survey results indicated that Seattle-area respondents made a number of changes to their travel patterns in response to the variable tolling of SR-520. In particular, while a drop in trips on the priced facility was to be expected, there was a significant drop in overall travel in the Lake Washington corridor that was not offset by higher off-corridor travel. Recorded trip segments fell about 14% overall, by 18% in the Lake Washington corridor (SR-520 and nearby alternatives I-90 and SR-522), and by 43% on SR-520 itself. Estimated VMT and elapsed time spent traveling showed comparable declines at both the individual and household level, suggesting that there were outright reductions in travel rather than simply shifts from one household member to another. These figures also track fairly closely with respondents' assessments of the changes they made to their typical weekly patterns, as well as to initial records of changes in actual roadway volumes. Reductions in travel tended to be most pronounced in discretionary categories such as shopping and dining.

There was also a significant shift to non-toll facilities. Among household survey respondents, nearly one-fourth of regular SR-520 users switched to using I-90 as their primary means of crossing the lake after tolling, and targeted follow-up questions showed that avoiding the toll was their primary motivation. Recorded trips on I-90 significantly increased as a share of corridor travel. This is broadly consistent with traffic volume data showing increases on I-90 after the start of SR-520 tolling. Based on the household diaries, shifts to public transit were smaller in absolute terms and the total number of transit trips was essentially unchanged. However, because overall corridor travel was down, transit mode share for cross-lake travel rose from 15% to 18%, and the share of regular commuters who reported using transit registered a net gain of 1.5 percentage points. Among those who were regular SR-520 drivers in the Wave 1 (before) survey, 8% had switched to public transit as their regular commuting mode in Wave 2 (after). Local ridership counts show much larger overall increases, possibly due to the fact that transit enhancements were launched well in advance of tolling, prior to this study's "before" survey.

Although many individual travelers reported making changes to their trip timing in response to SR-520 tolling, the *net* effects on the overall distribution of trips across the peak and off-peak periods were relatively minor. Telecommuting levels also appear to have been unaffected by the tolling program.

Vehicle occupancies on SR-520 rose slightly, with breakouts by trip purpose showing that much of the small increase came from non-work trips. In questions about typical commute patterns, there was no increase in regular carpooling.

On trip-by-trip questions about personal satisfaction with travel conditions, drivers who continued to use SR-520 and paid the toll reported being much more satisfied with their travel time, speed, and reliability after tolling. For example, for trips on SR-520, mean satisfaction with travel speed rose from 3.4 to 5.2 on a 7-point scale. Meanwhile, satisfaction with trips on I-90 fell only slightly, from 4.0 to 3.9 on the same 7-point scale. Transit riders were slightly more satisfied with travel times but slightly less satisfied with seating availability, presumably due to additional demand during peak periods.

Prior to tolling, the average household income of peak-period drivers on SR-520 was roughly $132,000 per year, reflecting its location in a high-income part of the metro area. Only about 8% of the study sample had incomes less than 300% of the federal poverty level. As such, caution is warranted in drawing conclusions about the impacts of tolling across income levels. That being said, the travel diaries did show clear differences on variables such as ownership of toll transponders, use of SR-520, tolls paid, and changes in personal travel. While higher-income households are paying the largest share of the tolls, the 8% of survey households who fell in the lowest-income group (under 300% of the poverty level) reported having reduced their cross-lake travel substantially – particularly for discretionary trips – and are more likely to report having switched to toll-free I-90, which could involve additional time, mileage and fuel costs due to a less direct routing.

On a direct opinion question, there was a small decrease post-tolling in the belief that tolls are unfair to low-income households, though a majority of respondents still hold this view. There

was also a slight increase in respondents' stated willingness to use a toll route. Opinion was divided on the question of whether SR-520 tolling had improved the respondent's travel in the region. The general pattern was favorable views from SR-520 drivers who chose to pay the toll, negative views from I-90 drivers, and neutral views from transit riders.

RECAP OF KEY FINDINGS: ATLANTA

Similar to Seattle, there was a significant decline in travel for both I-85 corridor trips (- 18%) and for non-corridor trips (-12%). Likewise, the Battelle National Evaluation found a decline in both person and vehicle throughput in the corridor. Despite overall declines, the *share* of trips on I-85 increased slightly, due to the fact that the drop in trips was smaller on I-85 (-12%) relative to other roads in the corridor (-33%). While overall travel on I-85 fell, the number of Express Lanes trips recorded in the travel diaries was roughly double the number of recorded HOV-2 trips. By contrast, using other sources of data (detector station data), the Battelle National Evaluation found a decline in peak period vehicle and person throughput in the Express Lanes.

According to the survey, the proportion of respondents using the priced facility increased from 7% to 11%. For the most part, new users were accessing the Express Lanes. Among those making weekly trips in the Express Lanes, two-thirds had typically not used the facility prior to pricing, when it operated as an HOV-2 lane.

A large majority of Express Lane trips were solo drivers who paid a toll (82%); only 9% were HOV3+ (including private vehicles and vanpools), 4% were 2-person carpools who paid a toll, and another 5% were AFV or motorcycles. Vehicle occupancy numbers confirm the increase in single occupant vehicles in the Express Lanes (vs. the HOV-2 lanes) – as vehicle occupancy dropped precipitously, from 2.22 to 1.18. However, tolling did not result in the wholesale break-up of carpools. Rather, many carpools shifted to the general purpose lanes, where vehicle occupancy increased from 1.07 to 1.18.

As measured in the survey, the conversion from an HOV-2 to a HOT-3 did not have a significant impact on mode choice. The large majority of respondents continued to drive alone for their trips, and while there was a very slight increase in vehicle occupancy on I-85 overall -- from 1.13 to 1.17 -- the increase resulted from a rise in intra-household carpooling that appeared unrelated to road pricing.[2] With regard to transit use, there is a slight increase in the share of trips that used any transit in the corridor, but the magnitude of the increase is quite small, from 2.6% to 3%. Among regular I-85 users, the percent indicating they typically commute by bus also increased slightly, from 2.5% to 3.9%.

In measures of trip satisfaction, Express Lane drivers (Wave 2) report being significantly more satisfied with their travel time, travel speed and trip predictability than HOV-2 drivers (Wave 1). For general purpose lane trips, there was no change in the trip satisfaction measures; a majority

[2] The Battelle National Evaluation found an overall decline in vehicle occupancy on I-85.

of peak hour users (approximately 60%) remained dissatisfied in both survey waves. When trip satisfaction for Wave 1 HOV-2 users is tracked across the two survey waves, we find a significant decline in satisfaction among this group (many of whom had shifted to the general purpose lanes when they could no longer use the HOV lane for free). On travel-related attitudes, we also see small shifts in opinion indicating a degradation in travel experience. Following tolling, respondents in the overall sample were somewhat more likely to experience unexpected delay on their trips and to perceive Atlanta highway driving as stressful.

In general, attitudes toward tolling became significantly more negative after the introduction of the Express Lanes. These data were collected approximately seven months after the start of tolling to allow travelers to adjust to the new system and to personally explore its benefits and costs. Respondents' willingness to use a toll route declined from 65% to 41%, and only 16% of all respondents affirmed that their travel along the I-85 corridor had been improved by the Express Lanes. Respondents who regularly use the Express Lanes, however, tended to be more satisfied, as 54% felt that their travel along I-85 had improved.

In addition, following the deployment of pricing, there was a significant decrease in the belief that highways tolls are unfair to people with limited incomes (from 74% to 57%). This decline occurred across all income groups, though magnitude of the change was smaller among the lower-income.

DISCUSSION OF LESSONS LEARNED

The following section of the report highlights key lessons learned on the impacts of road pricing on traveler behavior, based on the findings from the Seattle and Atlanta traveler surveys.

As expected, pricing does influence travel behavior.

One of the fundamental findings of both studies is that congestion pricing, even with relatively modest toll levels, can lead to significant shifts in traffic volumes, in choices of routes and lanes, and to a lesser extent in modes used, vehicle occupancies, and other aspects of personal travel. While this basic finding will not come as news to the transportation research community, results from both Atlanta and Seattle do provide additional confirmation of the influence of congestion pricing on daily travel choices.

Adding a price to their current optimal choice changes the equation for users; they must recalculate the benefits and costs of their options, and as the survey data reveal, this can result in different choices.

These findings are important because the broader public, especially in regions where deployment of pricing strategies has been limited or nonexistent, generally has a low level of awareness of pricing and understanding of its impacts. There can also be skepticism about the effectiveness of congestion pricing as a tool to reduce congestion, as distinct from a method of raising revenue. Indeed, even among Seattle survey respondents who had personally

experienced the reduced congestion on SR-520, this was sometimes described in focus groups and in open-ended comments as an unanticipated consequence or side-effect of tolling.

Travelers have a surprising amount of flexibility in their overall levels of travel.

It is sometimes argued that most peak-period commuters have little leeway to shift routes, modes, or times of travel – after all, most people would avoid rush-hour traffic if they had any choice in the matter. Much of the public is also skeptical that congestion pricing would cause many trips to be completely cancelled rather than simply shifted to another route or time. Yet diary data from the Seattle site show that over a roughly 18 month period, not only did respondents reduce their use of the priced route, but their total trips fell by 14%, their overall vehicle-miles traveled (VMT) decreased by 15%, and their average daily time spent traveling fell by 11 minutes (12%).[3] These changes are comparable to what has been recorded in successful employer-based Transportation Demand Management (TDM) programs that incorporate outreach and incentives. The "dropped" trips included all categories, but as expected they were disproportionately in discretionary categories such as shopping, dining, community activities and pickup/dropoff. Similarly in Atlanta, there was a significant drop-off in trip-making and VMT over the 12 month study period, particularly for shopping, dining, and pickup/drop-off trips.

Pricing can have a significant impact on route choice.

Regions contemplating the use of variable tolling should be aware of the potential for significant shifts in route choice and overall regional travel patterns, particularly when a free alternative route is available. In Seattle, for example, among survey respondents about 25% of former SR-520 users switched to the parallel I-90 and traffic volumes and congestion increased on that alternative route. (A very small number of drivers also shifted from I-90 to SR-520 to take advantage of the improved traffic conditions.) Shifting was less dramatic in Atlanta, where drivers could still travel in the general purpose lanes for free. Nonetheless, following the start of tolling, about one-third of respondents reported less frequent use of I-85, and the share of non-corridor trips rose by 2 percentage points.

Dependencies that impact pricing on mode choice and occupancy.

There were modest shifts to transit in both cities (though not statistically significant in Atlanta), and while vehicle occupancy increased slightly in each city, there were no significant increases in self-reported regular carpooling. This stands in contrast to the larger increases in average occupancy that have been observed with priced lanes that offer a carpool discount, suggesting

[3] Some of the decline in trip making may also be due to external factors. In Seattle, over the 18 month study period, gas prices increased significantly, from about $3 to $4 per gallon, which would tend to reduce travel demand. However, employment also increased during this period and WSDOT data indicate that overall statewide VMT increased as well.

that the design of the pricing program and its exemptions does play an important role in decisions about carpooling and that further research may be needed in the area of pricing's impacts on carpool decisions.

Indeed, vehicle occupancy by lane responded to the new pricing policy and vehicle occupancy requirements very strongly in Atlanta, where there was a significant increase in occupancy in the general purpose lanes and a significant decrease in the Express Lanes (a pattern also found in the Battelle National Evaluation). Two-person carpools that were previously using the HOV lanes were no longer eligible to use them for free, and tended to shift to the general purpose lanes rather than pay the toll. There was also an increase in three-person carpools using the general purposes lanes, even though these travelers were eligible to use the Express Lanes for free. This finding suggests that the Peach Pass registration requirements may have been an impediment to HOV-3 access of the Express Lanes. The survey data indicate that Peach Pass account holders were generally satisfied with the process of opening and managing their account, but there was greater ambivalence about having to change their toll mode status. Among households that did not purchase a Peach Pass, some respondents voiced concerns that the rules were "confusing" or "too complicated." Additional research is needed to explore how registration requirements impact the use of tolled facilities.

Pricing affects the timing of trips in complex ways.

In both Seattle and Atlanta, the general shape of the demand profile by time-of-day did not change significantly; the peak periods continued to have the greatest numbers of trips, though pricing was associated with lower overall trip volumes and some drivers shifted out of the peak period. At the same time, when looking just at the priced facilities themselves, there were some small but measureable increases in the *share* of vehicle trips that occurred during the peak period. In Atlanta, for example, the share of HOV/Express trips during the midday off-peak (9 AM to 3 PM) decreased, while the share of peak hour trips increased. These shifts are likely because the pricing program had succeeded in restoring free-flow conditions during this period, yielding more flexibility in scheduling trips, and because use of the tolled route was associated with time-constrained commute trips.

Pricing does not appear to have a noticeable impact on telecommuting.

In Seattle, the advent of tolling did not lead to any increase in telecommuting, whereas in Atlanta, there was a modest increase in telecommuting. In follow-up questions about changes in telecommuting habits, the biggest influence cited was work situation (seemingly unrelated to tolling). Nonetheless, a share of Atlanta respondents did mention transportation-related factors (such as saving money on commute costs and worse traffic) that might be attributable to tolling.

Travelers appreciate improved traffic conditions from variable tolling

This is another way of saying that the improvements in travel times on the tolled facility are not just reflected in abstract engineering measurements – they are actually noticed and appreciated

by travelers themselves, and led to greater levels of subjective trip satisfaction. Tolling led to large improvements in user satisfaction among SR-520 users in Seattle and among Express Lane users in Atlanta.

Table 2: Changes in Driver Satisfaction with "Travel Time"

(Based on trip diary data)

	Very Dissatisfied	Dissatisfied	Somewhat Dissatisfied	Neutral	Somewhat Satisfied	Satisfied	Very Satisfied
Atlanta: Express Lane Drivers							
Wave 1 I-85 Trips	14%	22%	16%	11%	10%	20%	7%
Wave 2 I-85 Trips	7%	12%	12%	9%	18%	31%	11%
Change	-7	-10	+6	-2	+8	+11	+4
Seattle: SR-520 Drivers							
Wave 1	11%	14%	14%	14%	13%	24%	10%
Wave 2	3%	3%	6%	9%	14%	39%	26%
Change	-8	-11	-8	-5	+1	+15	+16

Note: The Atlanta data track the trip satisfaction of Express Lane users, showing their I-85 trip satisfaction before pricing (when most of their trips were in the general purpose lanes) vs. their trip satisfaction post-tolling. Seattle data are for all trips on SR-520, which was toll-free in Wave 1 and had variable tolling in Wave 2.

At the same time, it should be noted that these gains in satisfaction did not apply across the board. There was a small decrease in satisfaction among I-90 users in Seattle, where traffic volumes increased, and among HOV-2 users in Atlanta, who could no longer use the lane free of charge.

Table 3: Changes in Driver Satisfaction with "Travel Time"

(Based on trip diary data)

	Very Dissatisfied	Dissatisfied	Somewhat Dissatisfied	Neutral	Somewhat Satisfied	Satisfied	Very Satisfied
Atlanta HOV-2 Users							
Wave 1 I-85 Trips	10%	11%	18%	10%	14%	28%	9%
Wave 2 I-85 Trips	18%	21%	9%	9%	16%	23%	5%
Change	+8	+10	-9	-1	+2	-5	-4
Seattle: I-90 drivers							
Wave 1	7%	12%	14%	14%	14%	27%	13%
Wave 2	5%	10%	14%	16%	14%	30%	11%
Change	-2	-2	0	+2	0	+3	-2

Note: The Atlanta data track the trip satisfaction of Wave 1 HOV-2 Lane users, showing their I-85 trip satisfaction before pricing (when most trips were in the HOV lane) vs. their trip satisfaction in Wave 2 (when most of their trips were in the general purpose lanes). Seattle data are for all trips on I-90, which was toll-free in both Wave 1 and Wave 2.

Attitudes toward tolling change with direct experience.

In Seattle, general attitudes toward tolling – such as expressed willingness to use a tolled route – shifted in a positive direction after the project was implemented, which is consistent with previous congestion pricing studies, and with the fact that trip-satisfaction levels had increased substantially for SR-520 drivers. In Atlanta, however, negative overall attitudes about tolling became more common than they were before the project. While Express Lane users had favorable experiences on the priced facility, HOV-2 users experienced a decline in satisfaction, and in the aggregate, a majority of peak hour general purpose lane users were dissatisfied both before and after pricing.

Table 4: Changes in Attitudes Toward Tolling: "I will use a toll route if the tolls are reasonable and I will save time"

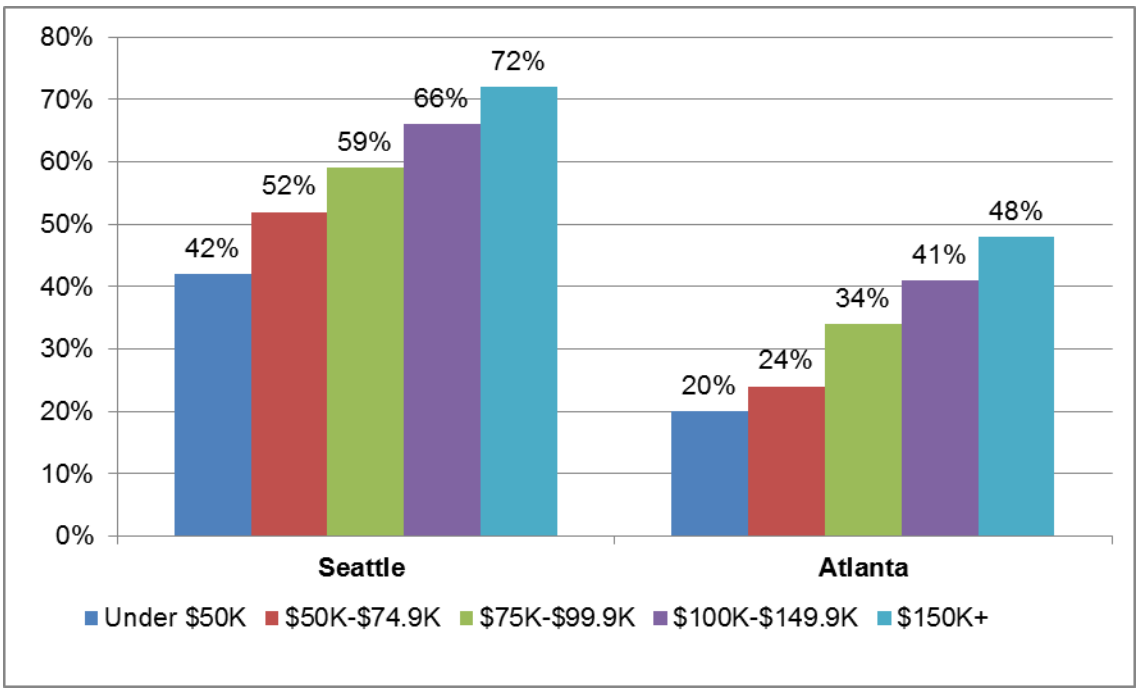
	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neutral (4)	Somewhat Agree (5)	Agree (6)	Strongly Agree (7)
Seattle							
Wave 1	10%	12%	11%	13%	21%	22%	10%
Wave 2	6%	6%	6%	13%	26%	30%	14%
Change	-4	-6	-5	0	+5	+8	+4
Atlanta							
Wave 1	4%	10%	7%	10%	17%	19%	33%
Wave 2	21%	15%	7%	13%	15%	18%	11%
Change	+17	+5	0	+2	-2	-1	-22

Data collected on the reasons for *not* purchasing a transponder also reveal differences between the two sites in overall attitudes toward tolling. In Atlanta, among the 66% of the sample who had not obtained a Peach Pass, among the reasons cited most often were "tolls are too expensive" (42%) and "against tolling, in general" (39%). By contrast, only 12% of those opting not to obtain a *Good to Go!* Pass cited general opposition to tolling. It should also be noted that the surveys were conducted approximately 5 to 7 months after the deployment of pricing, and in Atlanta, where residents are less familiar with tolling, it may take more time to overcome initial negative reactions.

There are demographic differences in responses to tolling, mostly related to income.

Although respondents of all income groups used the tolled facilities in both regions, the heaviest users were disproportionately from upper-income households. Transponder ownership and usage were both correlated with household income, and higher-income households paid the largest share of toll revenue collected. For example, in Seattle, households earning over $100,000 per year constituted only about half the sample, but paid over two-thirds of all recorded tolls.

Figure 3: Household Transponder Ownership by Income



While other demographic variables were generally less predictive of responses to tolling, there were some differences. In Seattle, SR-520 drivers who were lower-income and male, as well as those with less workplace schedule flexibility (which tends to correlate with lower income), were somewhat more likely to switch routes to avoid the toll rather than to stay on SR-520. In Atlanta, there were differences by race. Prior to tolling, Asians and Blacks were somewhat more likely than Whites to use the HOV-2 lane, but after tolling their use of the priced facility declined, such that Blacks were less likely than Whites to use the Express Lanes. These differences persist to some extent even when controlling for income (though small sample sizes do not allow us to draw firm conclusions).

Equity impacts can take many forms and present measurement challenges.

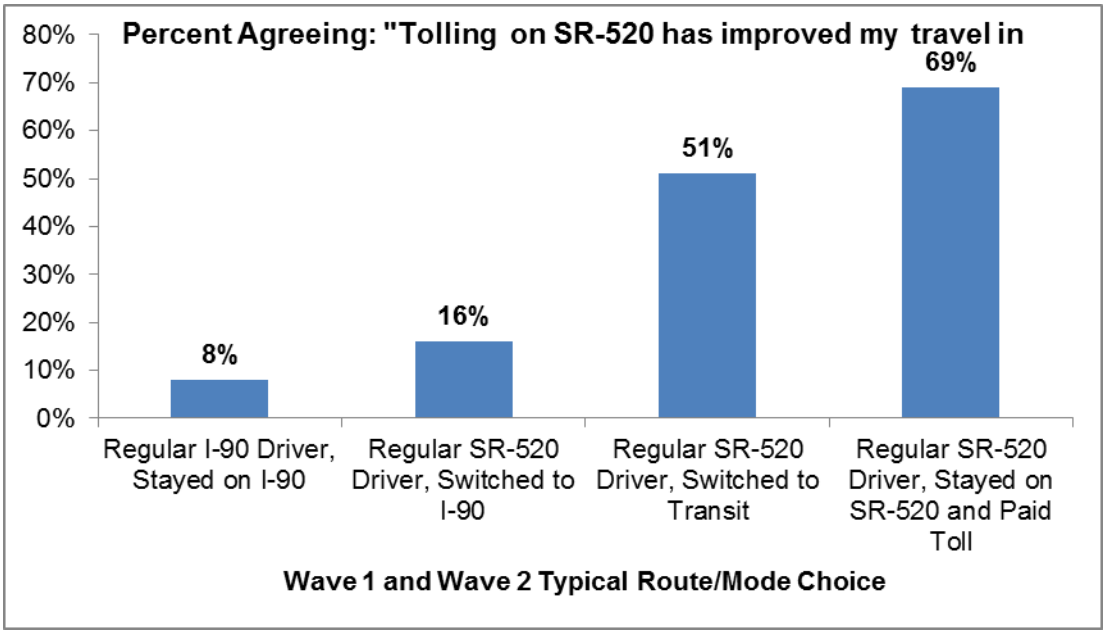
There are many forms of equity impacts and their relevance will vary for each project. In both Atlanta and Seattle, the very small numbers of low-income households among peak-period users makes it difficult to draw firm conclusions about income equity impacts. For tolling projects like Seattle (where revenue generation is a key objective), a comprehensive evaluation would also have to compare tolling against other mechanisms of raising transportation revenue, such as sales taxes, some of which could be highly regressive. These kinds of comparisons can also be difficult to perform because state DOTs do not typically have access to the kinds of household income, taxation, and expenditure data that normally reside in a revenue or taxation department.

In Seattle, *income* and *geographic* equity impacts were more salient, with concerns about the ability of lower-income travelers to afford the SR-520 tolls and the impacts on the I-90 corridor in

the southern half of the study area. Some low-income households have seen improvements because of the improved public transit in the SR-520 corridor, but there were equity impacts for those who drive and cannot readily change routes or modes. The lowest income group in Seattle experienced a significantly greater reduction in trips (overall as well as cross-lake), and shifted off of SR-520 more than any other group. More specifically, discretionary cross-lake trips fell by 51% among the lowest income group (those under 300% of the poverty level, who accounted for about 8% of the sample), whereas for other income groups discretionary trips fell by 19% to 27%.

The data suggest geographic equity impacts as well. Trip satisfaction declined slightly for I-90 drivers, while increasing significantly for SR-520 drivers. Moreover, I-90 users were much more likely than SR-520 users to say they were spending more time in traffic since tolling started, and conversely, they were less likely to feel that their travel in the region had improved as a result of the tolling.[4] This presents a geographic equity issue in that the benefits and costs of the tolling project were apparently not shared equally across different parts of the Seattle region.

Figure 4: Attitudes Toward Seattle Tolling Project by Typical Route/Mode Choice



In addition, the literature on equity indicates there are mobility externalities, because transportation projects often benefit some parties but worsen conditions for others. In Atlanta, for example, there was the possibility that former HOV-2 users would lose the mobility benefits they once enjoyed when they were no longer able to use the Express Lanes for free. As previously described in this report, HOV-2 users (e.g. those who made carpool trips in the HOV

[4] The same may be true for regular users of SR-522, an arterial that is also a toll-free alternative for some trips on SR-520; however, the study has very limited sample sizes for SR-522 trips.

lane in Wave 1) *did* experience a significant decrease in satisfaction, as many shifted to the general purpose lanes with the start of tolling. Conversely, Express Lane users were significantly more satisfied with their trips in Wave 2, and they were more likely to feel that the Express Lanes had improved their travel in their region.

CONCLUSIONS

Each pricing project is unique in the details of its tolling structure and incentives, as well as in the regional transportation context in which it operates. Nonetheless, in reviewing findings from the Seattle and Atlanta household surveys, several themes and lessons, highlighted below, emerge.

- As expected, pricing *does* influence travel behavior
- Travelers have a surprising amount of flexibility in their overall levels of travel
- Pricing can have a significant impact on route choice
- The impacts of pricing on mode choice and occupancy depend on the design of the tolling project and the regional context.
- Pricing affects the timing of trips in complex ways
- Pricing does not appear to have a noticeable impact on telecommuting
- Travelers utilizing the priced facility notice and appreciate the improvement to traffic conditions from variable tolling
- Attitudes toward tolling change with direct experience
- There are demographic differences in responses to tolling, mostly related to income
- Equity impacts can take many forms and present measurement challenges

These lessons learned suggest the following implications for regions that are considering the deployment of road pricing strategies.

Near term shifts in mode or increases in carpool size require programmatic support.

The survey findings indicate that travelers are much more apt to make changes to their number of trips, the timing of those trips, and their choice of route (or lane), than they are to make more fundamental shifts in their mode of travel. Switches to transit and carpooling likely require greater time to adjust personal schedules and habits and to coordinate with others. In Atlanta, the survey data indicate that the move from a 2-person carpool requirement to a 3-person requirement did not cause a large number of carpools to dissolve[5], but neither did it generate many new 3-person carpools, possibly because coordinating schedules among 3 people is simply too difficult in the short term. Telecommuting also appears to be a response that takes

[5] The Battelle National Evaluation did find a net decline in 2 and 3-person carpools during peak hours.

longer to evolve. Even in jobs for which telework is an option, commuters likely need time to adjust their work and home arrangements and supporting technology.

For regions contemplating congestion pricing, these are important considerations and suggest that additional community outreach and programmatic support may be needed to generate larger shifts in transit, carpooling, and telework. Minneapolis, for example, implemented an extensive telecommuting program, "Results Only Work Environment" (ROWE), which was funded by the state and managed by the Humphrey School of Public Policy. Analysis of the program found significant impacts with respect to reductions in peak hour trips and vehicle miles traveled for those participating in the program.

Make the user requirements for the priced facility as simple and convenient as possible.

While the survey data are not conclusive, there is some indication that Peach Pass user requirements may have been an impediment to HOV-3 access of the Express Lanes. Following the opening of the Express lanes, there was an increase in three-person carpools using the general purpose lanes, even though these travelers were eligible to use the Express Lanes for free, and when asked to rate their satisfaction with "changing your toll mode status," nearly half of Peach Pass users responded "not applicable," and 20% were dissatisfied (compared to 25% who were satisfied). This may be related to the perceived inconvenience of having to register as a 3-person carpool. Moreover, among households who did not purchase a Peach Pass, some respondents voiced concerns that the rules were "confusing" or "too complicated." To prevent the requirements from being a barrier to use, they should be as simple and convenient as possible. Additional research is needed to explore how user requirements impact the use of tolled facilities.

The more public communication, the better.

Agencies need to provide their customers with ongoing, clear communication that conveys the motivation for the road pricing strategy (e.g., how will the toll revenues be used); articulates how pricing will affect them, and provides information on their travel options in the corridor. Given the shifts in travel behavior that resulted from the deployment of pricing in Seattle and Atlanta, it is clear that travelers have some flexibility in their travel choices. Consequently, it becomes even more important to provide corridor users with sufficient information prior to the start of tolling, so they can optimize their travel choices. Through extensive communication, agencies can prepare the public for what lies ahead and minimize any surprises.

Agencies should anticipate that pricing will have differential impacts on corridor users.

By disrupting the status quo, road pricing creates inconveniences for some corridor users at the same time that it creates opportunities for others, necessarily resulting in a set of "winners" and "losers" in the region. In Atlanta, for example, existing HOV-2 carpoolers were clearly

dissatisfied when they could no longer the Express Lanes for free, while in Seattle, travelers on I-90 experienced greater dissatisfaction with conditions. In both Atlanta and Seattle we also found that transponder ownership and usage was correlated with income, as lower income households were less likely to own a transponder, and in Seattle, there was a disproportionate reduction of SR-520 trips among the lower income.

Prior to implementing a road pricing strategy, agencies need to understand how their customers will be impacted by pricing and need to plan for ways to offset these differential impacts. As discussed above, agencies should consider extensive public communication and programmatic support mechanisms. For example, as part of the Los Angeles CRD, an Equity Program has been implemented, providing low income households with an initial $25 balance on their transponder account, waiving the monthly maintenance fee, and enabling them to earn toll credits through the use of transit. Preliminary data suggest that drivers with these subsidized accounts are using the HOT lanes with the same frequency as drivers with regular accounts.

Strong community and civic engagement supports a positive response to road pricing.

In Seattle, SR-520 users who took advantage of the tolled option were clearly more satisfied with their driving experience post-tolling, and while SR-520 drivers who switched to I-90 and established I-90 users were somewhat less satisfied, *general attitudes toward tolling became more positive.* We posit that the extensive public outreach and the level of public input to the project played a role in influencing public attitudes toward tolling. In Seattle, tolling on SR-520 was one of several strategies considered to help defray the cost of building a much needed new bridge, and the public participated in the decision to pay for the new bridge using tolls. Moreover, an extensive public education campaign was conducted in the Seattle region to build support for this strategy.

Regional factors influence public attitudes toward tolling.

When agencies are planning and implementing road pricing strategies, it is critical to consider the regional context. In Atlanta, for example, tolling was relatively new to the metropolitan area; when the Express Lanes opened, the only other tolled facility in the region was GA 400, which charged only fifty cents in each direction (GA 400 discontinued tolling in November 2013). In regions where there is a lack of familiarity with tolling, there may be greater public misconception about the purpose of road pricing and greater opposition to tolling, in general. As a result, public communication and outreach becomes even more important and needs to be conducted early and often.

The data collected in Seattle and Atlanta offer valuable insights on the impact that different road pricing strategies can have on travel behavior and point to several broad conclusions for consideration in future road pricing projects. With nearly 36,000 trips logged in the Atlanta survey, and 50,000 trips in the Seattle survey, these data provide a rich resource for

researchers interested in exploring travel behavior. In particular, modelers can use this detailed data to help calibrate their models and to predict the impacts of road pricing.

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