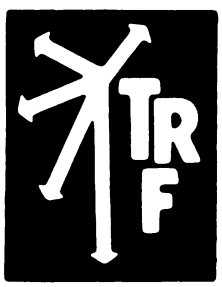
Indexed by PAIS

JOURNAL OF THE TRANSPORTATION RESEARCH FORUM

Volume 36 Number 1 1996



TRANSPORTATION RESEARCH FORUM

A SURVEY APPROACH FOR THE ACCEPTABILITY OF HIGHWAY TOLLING AND CONGESTION PRICING IN TEXAS

by Chungwon Lee, Christopher Oswald**, Randy B. Machemehl*, Mark Euritt*, and Rob Harrison**

SUMMARY

Attitudes toward tolling in Texas were analyzed, using a stated preference survey. A mail back questionnaire was sent to 6011 randomly selected individuals in Texas. The survey with follow-up mail elicited 2388 responses, resulting in a 40% response rate. Conclusions include the following:

- The survey results show that most Texans will accept toll roads, especially as an alternative to fuel tax increases. Tangible benefits of toll road use as perceived by users generally increase public support. Thus, toll roads can be seriously considered as a Texas transportation funding alternative.
- Few Texans support congestion pricing and most respondents who do support pricing are currently experiencing high congestion levels. The imposition of tolls on currently non-tolled facilities is opposed by most Texans.
- More respondents are willing to pay for travel time savings than for travel time reliability or maintenance improvements. Although maintenance is ranked higher in importance than travel time savings or reliability, most respondents are satisfied with current maintenance levels and are therefore not motivated to pay for improved maintenance.
- By eliminating toll related inconvenience, AVI systems offer great potential for increasing driver usage and support. Frequent users of existing toll facilities tend to have higher incomes. However, income level has no clear effect upon attitudes toward tolls versus other funding mechanisms.

ABSTRACT

This study attempts to explore Texas public attitudes toward tolling and congestion pricing through a stated preference survey. A carefully designed survey scheme with an incentive and follow-up mailing elicited 2,388 responses, resulting in a 40 percent response rate. Majority of Texans consider highway tolling as an acceptable non-traditional transportation funding method. This acceptability is enhanced through the provision of travel time benefits and improved maintenance by toll roads. The majority are, however, opposed to tolling as a congestion pricing mechanism. Electronic toll collection (ETC) systems for automatic vehicle identification (AVI) are not currently popular in use but provide strong potential opportunities for attracting more drivers to tolled facilities.

INTRODUCTION

Constant dollar transportation expenditures have dropped by more than half since 1960 (Lockwood, Caldwell and Williams 1992). Traditional transportation funding sources such as fuel taxes and vehicle registration fees are being redirected at all government levels to fund non-transportation related programs (Isser, Ballouz, and McFarland 1992). Hence, state and local governments are searching for new sources. The age-old toll road is making a comeback as one of these. A study sponsored by The Urban Transportation Monitor shows 80% of the transportation professionals surveyed indicated that they were either actively planning toll roads or would be doing so in the foreseeable future ("Widespread Interest in Toll Roads" 1988). California, Colorado, Florida, Georgia and Virginia have begun construction or operation of toll facilities in the past 3 years (FHWA 1993). The federal government is assisting this effort by funding up to 50% of non-interstate system toll road construction, rehabilitation, and feasibility assessment through the States' annual apportionment from the Federal Highway Trust Fund.

Texas currently has three tolled highways--the Hardy Toll Road, the Dallas North Tollway and the Sam Houston Tollway (Oswald 1994). These roads, totaling 64 miles in length,

serve heavily urbanized areas. At this time, tolls are being considered as a funding mechanism for at least four Texas highway projects. In Texas, however, tolls have only been used to fund facilities in urban areas where comparable (Interstate class) alternate routes are available. Tolls have not been imposed in rural areas, nor have they been imposed on existing non-tolled urban highways. In addition, tolling policy has never been used to achieve a societal goal such as trip reduction through congestion pricing. As a result, comparatively little is known about how Texans will respond to increasing highway toll use. This paper attempts to explore Texans' attitudinal nature toward tolling and congestion pricing through survey techniques. A similar survey was performed in Colorado (Kimley-Horn and Associates, Inc. 1993).

METHODOLOGY

Stated Preference Framework

Survey data can be classified into two distinct categories, (1) revealed preference (RP) data, and (2) stated preference (SP) data. RP data truly reflects choice behavior because it relies on choices that have actually been made in the marketplace. SP techniques, however, rely on obtaining choice behavior in response to hypothetical situations (Kroes and Sheldon 1988). As for data validity, RP data is preferable to SP data because RP data is directly connected to actual choice behavior. Despite this fact, Kroes and Sheldon (1988) note four disadvantages of RP studies. Among them the following two are important in the scope of this study: (1) the inability of RP methods to address conditions that are not presently in existence, and (2) the requirement that explanatory variables be objectively measurable.

Texas' toll road experiences are limited as described above and therefore the survey questionnaire must contain hypothetical situations. This study is concerned with "addressing conditions that are not presently in existence" and some explanatory variables such as maintenance and safety are not objectively measurable. Therefore, an SP approach was required.

Response Validity of SP Method

A significant disadvantage of SP methods is that individuals' stated preferences may not be indicative of their true choice behavior. Wardman (1988) enumerates two possible reasons as to why SP behavior may diverge: (1) systematic bias in SP responses or (2) difficulty in carrying out the SP task.

In terms of systematic bias, respondents to SP surveys tend to overstate their responses to hypothetical situations. This biasing effect can be countered by relying on relative valuation rather than on absolute valuations. For example, benefits to be valued should take relative forms such as time savings, travel time reliability improvements, etc. Additional problems can be caused by what Mitchell and Carson (1989) term strategic bias. This occurs when respondents deliberately shape their answers to influence study outcome or conclusions. In this study, protest responses in the valuation section were observed as a potential strategic bias source. Details will be presented later in the benefit valuation results section.

Regarding the difficulty in carrying out the SP task, Wentland and Smith (1993) give useful information. Wentland and Smith recently published results of an extensive study on the validity of survey responses, reporting three broad causes of response error in survey contexts: (1) inaccessibility of information to the respondent, (2) problems of communication and (3) motivational factors. Several methods can be used to minimize response error. Provision of contextual cues, ability of questionnaire to establish rapport with respondents, avoiding sensitive questions, obtaining respondent commitment to the survey, and reducing the specificity required by questions will reduce response error. A final conclusion reported by Wentland and Smith is that binary response questions elicit more accurate data than questions that have more than two response categories. However, questions with multiple response categories provide much richer data. Thus, when designing the survey instrument there is a tradeoff between response validity and information richness .

With the above observations, several measures were undertaken for the successful survey: (1) The questionnaire was kept as short as possible. (2) Attitude questions were posed in a binary format. (3) A conscious effort was undertaken to establish rapport with respondents through survey and cover letter verbiage.

Analysis Methods

Analysis procedures were selected to be in concert with levels of measurement attained through each question. Certain data items yielded only nominal level measurements and for these contingency tables were used. Several questions are designed to elicit binary responses and for these discrete choice models were developed.

Binary probit was selected to analyze attitudinal responses related to congestion pricing because the model is capable of identifying and comparing factors that affect choices.

TELEPHONE BASED PILOT SURVEY

Goal, Questionnaire Design and Sampling

An initial telephone based pilot survey was performed for residents of Austin, Texas. The goal of the pilot survey was obtaining fundamental toll road acceptability information and testing the selected survey techniques.

Unlike the very detailed Colorado phone survey (Kimley-Horn and Associates, Inc. 1993), the list of questions was kept very short, requiring 5 to 10 minutes for an interview. Therefore, instead of concentrating on exhaustive scenario enumeration, the survey focused on identifying sensitivity to three general toll facility benefits: (1) reduced travel time, (2) improved highway maintenance, and (3) improved travel time reliability. Travel time reliability refers to the difference between a driver's expected and actual arrival time. Although this toll road benefits list is far from exhaustive, it includes the three most prevalent benefits mentioned in literature (Gittings 1987; Fixler 1987).

The questionnaire consisted of questions for (1) respondent's trip making, toll road experience and sensitivity to the three benefits, and (2) demographic and socio-economic informa-tion. A random sampling procedure designed to produce approximately 150 observations was developed from the residence pages of the Austin Southwestern Bell Phone Book.

Pilot Survey Results

From August 3 to August 25, 1993, 158 individuals were surveyed on weekday evenings (Monday-Thursday) from approximately 5:45 PM until 9:00 PM. This strategy was adopted in order to catch as many members of a household in their homes as possible.

Aggregate responses indicated 65% of the respondents were making work trips and the average one way trip time is 19.8 minutes, which is very close to 20.2 minutes reported by another recent Austin study (Jou and Mahmassani 1994). Only 7% of the respondents used toll roads more than once a month. This low percentage is not surprising considering the fact that Austin does not have any local toll road.

Table 1 contains attitudinal information developed through the responses. Forty-six percent of respondents preferred tolls to fuel taxes as a road funding source. Surprisingly, 61% of respondents supported the conversion of existing free roads to toll roads if congestion could be relieved. The order of preference for the three benefits was reliability, maintenance, and time saving. Though the order could be changed with benefit and toll levels, it is obvious that people are concerned with maintaining good trip time reliability as well as minimizing trip time. Thus, one might assume that congestion pricing should be combined with advanced traveler information systems providing drivers with high trip reliability benefits.

MAIL BACK SURVEY

Goal and Questionnaire Design

A mail survey format was selected for the detailed study for its ability to convey long and/or complex questions. Survey goals included determining institutional and operational arrangements under which highway tolling is acceptable to the public. The survey also examined respondent willingness to pay for possible toll road benefits. This attitudinal study would be an informative bridge to congestion pricing as an advanced demand management tool.

The questionnaire consists of the following four sections as shown in Appendix A.

- Operational/Institutional Arrangements (Section A): Section A was designed to identify respondent current perceptions of Texas' highway system, highway funding source preferences, opinions of congestion pricing, and opinion of toll road operational policies.
- Current Behavior/Past Experience (Section B): Section B captures current travel behavior and its relationship to individual propensity to accept tolling. It focuses on: (1) trip purpose, type and frequency, (2) current travel conditions and geographic factors, and (3) toll road experience.
- Benefit Valuation (Section C): Section C was designed around three benefits: (1) improved maintenance, (2) reduced travel time, and (3) improved travel time reliability. These three benefits were chosen because they were found to be significant route choice determinants in other stated preference studies (Kroes and Sheldon 1988; Bovy and Bradley 1986), and they were positively valued by the pilot survey respondents. Ranges of

Table 1

Pilot Survey Toward Toll Roads for !58 Residents in Austin

	Tolls	Fuel Tax	Don't Know
Preferred funding source	46%	49%	6%
	Support	**Not Support**	**Don't Know**
Converting free roads to toll roads for congestion relief.	61%	33%	6%
Benefit Questions[a]	Yes	No	Don't Know
30% travel time saving	47%	52%	1%
Better maintenance	57%	40%	3%
Reliability within 5 minutes	68%	28%	4%

[a]Respondents were asked if they would pay a toll between 25 cents and a dollar on commuting or regular trips for each benefit.

these three benefits were selected relative to control conditions providing comparative benefit valuation data. Control conditions included a 15 mile trip distance, 30 minute average trip time and 50 minute maximum trip time. Individuals were asked to value six scenarios in which one benefit varied between moderate and substantial levels and all other benefits were at a zero relative provision level. Perceptions of importance of each benefit were rated using a five point scale.

- Socioeconomic Characteristics (Section D): Section D provides respondent socioeconomic characteristics.

Sampling and Implementation Details

Because of little information about tolling and pricing attitudes across Texas, sampling on any exogenous demographic or geographic factors was not possible. Furthermore, the desire of the organization funding the study was to determine statewide attitudes. Thus, a random sample on the basis of population alone was chosen.

The primary source of bias in a mail survey is non-response bias because non-response is often non-random. Although non-response bias can rarely be eliminated entirely, its effects can be minimized, as illustrated by Dillman (1978). Simple measures such as carefully crafting the cover letter, sending one follow-up mailing, and including incentives can improve response rates with little incremental cost (Dillman 1978; Church 1993). Therefore, this study used a two stage mailing. In the first stage, respondents were sent a questionnaire, a cover letter, and a non-monetary incentive in the form of an Official Texas Highways Travel Map. The incentive was chosen for its low cost and study pertinence. The second stage mailing was sent only to first stage non-respondents and consisted of a replacement questionnaire and a revised cover letter.

ANALYSES OF MAIL SURVEY

Response Rate Information and Weighting Scheme

The first stage included 6,011 individuals randomly selected across Texas and was mailed during April 4-8, 1994. The resulting 1,721 responses amounted to a 29% response rate. In the second stage, follow-up mail was sent on May 8, 1994 to individuals who had failed to respond one month after the first mailing. The follow-up mailing elicited over 667 additional responses, resulting in a 40% response rate. Satisfaction with the response rates must be tempered with the realization that not all respondents returned a completed questionnaire. Although the worst of these was not usable, many partially completed surveys did contain useful information. As a result, the exact response numbers are different among questions. Appendix A contains a general response summary.

Comparisons of survey respondent characteristics with the 1990 Texas census, indicated gender and age distributions were

skewed. Males composed 75.7% of the respondents and individuals over 60 years of age were over represented. This over representation could bias the attitude and valuation data. Therefore, raw survey data were factored using weights from the 1990 Texas census. These included percentages of state population segments who were male under 60, female under 60 and people over 60 (40.9, 39.8 and 19.3 percent respectively).

Most Frequent Trip Characteristics

As indicated in Table 2, 71% of respondents report their most frequent trip is work related followed by shopping and recreation. The weighted work trip proportion becomes 76% because the over 60-age group has a smaller work trip proportion. Respondents' trip frequencies mirror their trip purpose, with 72% making their most frequent trip at least 5 times a week. Driving alone is the dominant mode of the most frequent trips. Thus, the drive alone work trip is the largest trip purpose and mode combination forming 65% of the total. Averages of trip distance and time for drive alone work trips in several cities were calculated . Average trip times in Austin and Dallas were 21.3 and 25.4 minutes, respectively and are very similar to those reported in Jou and Mahmassani's study (20.2 and 24.6 min, respectively).

Current Toll User Characteristics

The data contain 349 respondents who are currently using toll roads at least once a month and these provided all answers for toll-related questions. As indicated in Table 3, during the average toll road trip, they pay about $1, drive a 12.5 mile toll segment and have a 17 minute time saving. Approximately 13% indicate they are "electronic toll tag" users.

The question regarding reasons for toll road use produced three frequently cited responses including "time saving (82%)", "less congestion (53%)," and "reliable travel time (48%)." Additional reasons were: "better maintenance (25%)," "safety (18%)" and "no alternative route" (3%). About 86% of current users stated that road maintenance is very important. Only 25% chose maintenance as a reason for choosing to pay tolls. In other words, although maintenance is rated highly, the possibility of choosing toll roads because of better maintenance is much less likely than travel time related reasons. This discrepancy can be explained because most current toll road users have well maintained alternative routes. This implication is supported by the fact that only 4% of respondents rate Texas' highway system poorly, and 13% rate maintenance on their routes poorly (refer to Figure 1).

Aggregate Attitude Results

As shown in Figure 1, about 74% of the respondents rate the Texas highway system excellent or above average. On five point scales, respondents report the roads they use are well maintained (median rating, 4), but somewhat congested (median rating, 3). This opinion, as well as reluctance to paying increased taxes and fees, caused majority of respondents (67 %) to indicate Texas is spending the right amount of money on its highway system.

Tolls are a surprisingly acceptable method of funding highway improvements. Table 4 shows the response to funding preference and indicates 59% of the respondents chose tolls over fuel tax increases. However, the practical significance is a bit questionable because the binary format of the question can result in a respondent's choice of tolls, not because of true preference for tolls, but because of his/her dislike of fuel taxes. Such a situation indicates a strong resistance to fuel tax increases. According to Table 4, 52% of the individuals choosing tolls did so because they believe tolls a more direct way to charge drivers. An additional 9% indicate good past experiences with toll facilities as their reason for favoring tolls. However, 29% of the respondents do explicitly note their toll choice is driven by their reluctance to see fuel taxes raised. This is consistent with results from the Colorado study of Kimley-Horn and Associates, Inc. (1993) although Texas' anti-tax sentiments are more pronounced.

Individuals preferring fuel taxes are much more divided on the reasons. The most popular reason is, "I shouldn't have to pay to use the roads (28%)." It indicates that fuel taxes are not strongly perceived as road use charges by large numbers of Texans. This finding supports the supposition that fuel taxes in the U.S. have not been charged at a rate high enough to significantly affect driver perceptions. Thus, current fuel taxes may not be capable of significantly influencing trip making behavior and may not be a viable congested area demand management tool.

The next most popular reasons for fuel tax preferences are "I don't want to stop to pay the toll (18%)," "Tolls are expensive (14%)," and "I want to avoid traffic jams at toll booth (11%)." The 29% of respondents, stating "I don't want to stop ...," or "I want to avoid traffic jams ...,"

Table 2

Most Frequent Trip Characteristics

Question	Answer	Frequency	% (weighted[a])
Trip purpose (total: 2,367)	Work	1,679	71 (76)
	Shopping	471	20 (16)
	Child Care	29	1 (2)
	Recreation	127	5 (4)
	Other	61	3 (2)
Frequency of the most frequent trip (total: 2,337)	5 or more days a week	1,676	72 (75)
	2-4 days a week	458	20 (18)
	1 day a week	79	3 (2)
	More than 1 per month	82	3 (3)
	Less than 1 per month	42	2 (2)
Mode (total: 2,366)	Car (drive alone)	2,209	93 (93)
	Carpool	112	5 (5)
	Transit	18	1 (1)
	Combination of modes	19	1 (1)
	Other	8	0 (0)

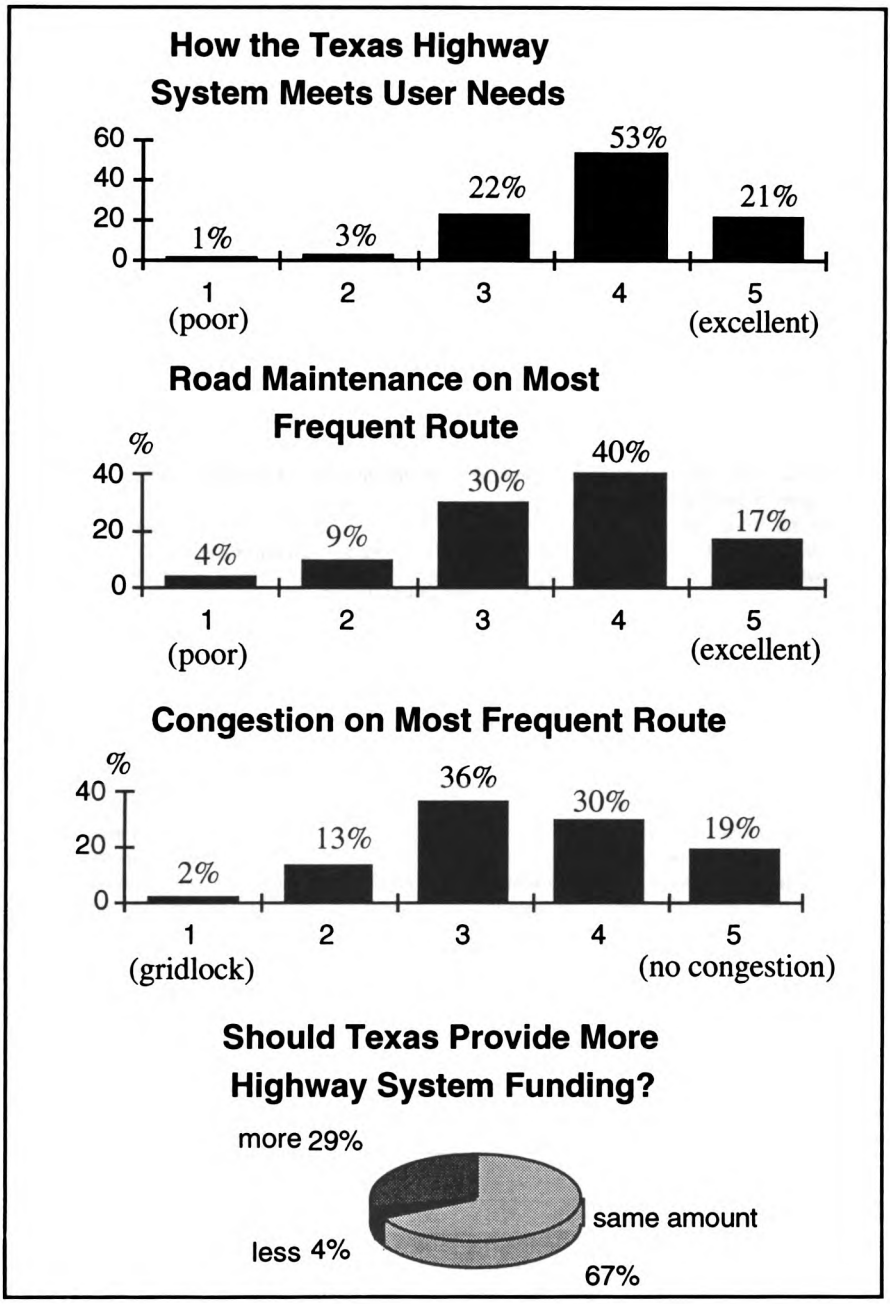
[a]Weighting factors: 0.409 (male under 60), 0.398 (female under 60) and 0.193 (people over 60).

Table 3

Statistics of at Least Once a Month Toll Road Users

Toll Road	Frequency	Avg. Toll	Avg. Toll Road Segment Driven	Avg. Time Saving by Toll Road	Toll Tag Users
Sam Houston	168	$1.39	14.5 miles	18.7 min	8%
Hardy	37	$1.16	16.1 miles	18.2 min	16%
Dallas North	130	$0.63	9.3 miles	15 min	20%
Others	14	$0.86	9.6 miles	17.9 min	0%
Total	349	$1.06	12.5 miles	17.2 min	13%

Figure 1
Overall Texas Highway System Evaluation[a]



[a] Not weighted by the demographic factors for little difference.

Table 4

Funding Source Preference and Reason

Source	Frequency	Reason for the Preference	%[a]
Toll	1,335	Tolls charge users directly for road use.	52
	59%	I don't want fuel tax raised.	29
		Tolls lead to faster road improvements.	8
		I've had good experiences with toll roads.	9
		Other	2
		Total	100
Fuel Tax	940	I shouldn't have to pay to use a road.	28
	41%	I don't want to stop to pay toll.	18
		Toll roads are expensive.	14
		I want to avoid traffic jams at toll booths.	11
		All should pay for funding roads.	7
		I've had bad experiences with toll roads.	5
		Tax is more fair/equitable.	3
		Other	14
		Total	100

[a]Weighted percentage is not given because of little difference.

Table 5

Benefits Importance Evaluation

	Weighted Percentage Responses (Cumulative %)[a]				
Benefit	1	2	3	4	5
Maintenance	55 (55)	31 (86)	10 (96)	3 (99)	1 (100)
Trip time	40 (40)	26 (66)	20 (86)	9 (95)	5 (100)
Reliability	43 (43)	30 (73)	18 (91)	6 (97)	3 (100)

[a]"Very important" rates as 1, and "not important" as 5.

form a potential tolling market once AVI/ETC become popular and eliminate these inconveniences. Note that only 13% of the current toll road users in this survey are toll tag users (Table 3). Thus, AVI systems have much room for expansion into the Texas tolling market.

Figure 2 indicates most Texans (64%) feel that tolls should be imposed on new facilities only. Finally, the majority of respondents (56%) want to limit the use of toll revenues to the toll road itself, rather than to fund other non-tolled highways as can be seen in Figure 3.

Benefit Valuation Results

Strategic Bias Effects and Mitigation Procedures - This section explains the procedure used to mitigate effects of strategic bias in the questionnaire Section C results. Strategic bias occurs when respondents deliberately shape their answers to influence study outcome or conclusions (Mitchell and Carson 1989). However, most cases of potential strategic bias are not obvious, making the identification extremely difficult. Without a direct strategic bias test, a second-best approach was utilized. "Protest voters" were defined as individuals who indicated a preference for fuel taxes and then indicated $0.00 for all six benefit valuation questions. Respondents meeting this criteria account for 8.7% of the total, which were removed in this benefit valuation analysis.

To verify this definition's efficacy, the reasons for fuel tax preference between protest and non-protest voters are compared (Oswald 1994). The comparison reveals the protest group cites "I shouldn't have to pay to use a road," and "I've had bad past experiences with toll roads," significantly more often than their non-protest counterparts. Note that these reasons indicate fundamental tolling opposition rather than convenience related opposition.

Valuation Data - The first element in questionnaire Section C obtains respondents' perceived importance of benefits, rated on a 5 point scale; the second element obtains respondents' willingness to pay for six hypothetical situations. As explained in the previous "MAIL BACK SURVEY" section, each benefit among the three varied between moderate and substantial levels relative to control conditions with all other benefits at a zero relative provision level. The control conditions included a 15 mile trip distance, 30 minute average trip time and 50 minute maximum trip time. Figure 4 displays average tolls respondents valued for the six scenarios of the three benefits.

Results of the benefit importance rankings appear in Table 5. Note that the question does not specify trip purposes. Thus, answers are overall assessments and contain comparative rather than absolute information regarding the three benefits. The overall order of relative importance was road maintenance, reliability and time saving.

In the benefit valuation, however, respondents were willing to pay more for travel time savings, followed by maintenance and reliability as appears in Figure 4. This pattern seems to be related to the fact that most Texans are satisfied with current Texas highway maintenance and do not feel like paying to get better highway maintenance.

Equity Issue and Toll Road Usage Experience

Equity Issue - Implementation of tolling and/or congestion pricing introduces an equity issue. All population segments should have equal transportation system use opportunities. It has been argued that road pricing is inequitable since poorer motorists are forced off the road. Tolls would be regressive in that the costs would fall most heavily on lower-income drivers. Even though road pricing can accomplish basic objectives by forcing some motorists to change modes, routes or trip making times, the inequity is politically undesirable. Equity has been a road pricing implementation barrier.

Using the survey data and contingency table methods, the effect of income level upon attitudes toward toll roads was examined. According to the test shown in Table 6, income level does not seem to affect the comparative preference between tolling and fuel taxes (p-value= 0.2429). The survey data containing information on toll road usage frequency for current toll road users permits testing the question, "Does income level significantly affect toll road usage frequency?" i.e., "Do higher income drivers use toll roads more frequently?" At a 5% significance level, the null hypothesis (no relationship) is rejected (p-value= 0.0480). Therefore, income does seem to affect toll road usage frequency contrary to the previous result that income does not effect preferences regarding tolling versus fuel taxes.

Impact of Toll Road Usage Experience- Many researchers ,suggest demonstration projects can help secure public support for toll roads or congestion pricing (Poole, Jr. 1991). To determine if toll road usage experience affects public attitudes, drive-alone working survey respondents were divided into two subgroups. One subgroup consists of respondents from Dallas and

Figure 2
Attitude Toward Tolling Policy

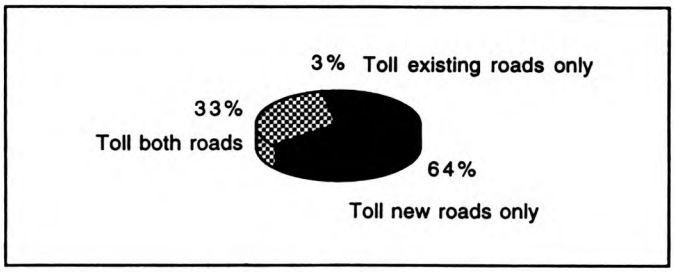


Figure 3
Attitude Toward Use of Collected Tolls

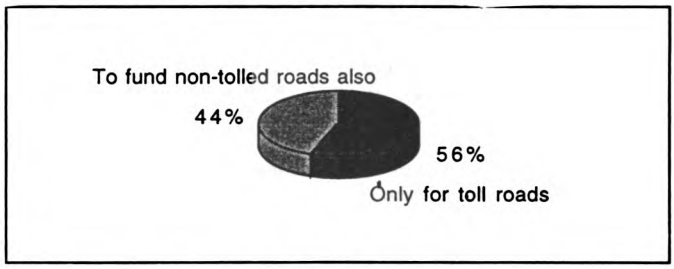
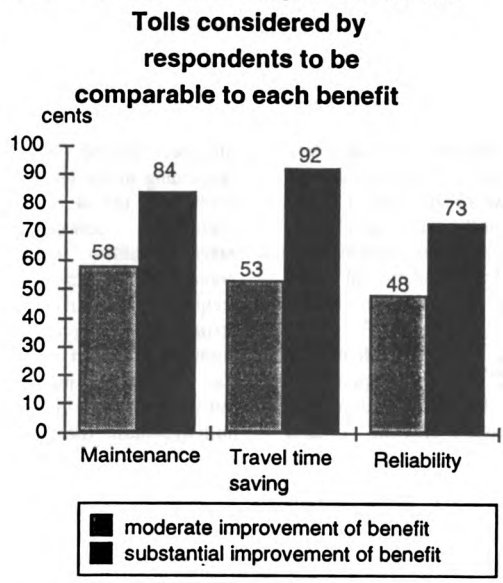


Figure 4
Benefits Valuation for Six Hypothetical Scenarios[ab]



[a] Not weighted by the demographic factors for little difference.

[b] Note on the six scenarios (refer to Appendix, Section C):

- Maintenance-- "Moderate improvement" means fewer potholes, more signs and better lighting than non tolled alternative roads. "Substanttial improvement" means no potholes, many more signs and much better lighting.
- Travel time-- "Moderate improvement" means 5 min time saving from 30 to 25 min. "Substantial improvement" means 15 min time saving from 30 to 15 min.
- Reliability-- "Moderate improvement" means 5 min reliability improvement from 20 to 15 min. "Substantial improvement" means 15 min reliability improvement from 20 to 5 min.

Table 6
Tests of the Significance of Income Level on Toll Road Attitudes

Tests	Chi-square statistics	d.f.	p-value[b]
Income vs. Tolling or Fuel Tax preference (for all respondents)	5.46557	4	0.2429
Income vs. Toll road usage frequency[a]	15.6395	8	0.0480

[a]Only for toll road users showing at least once a month frequency.

[b]p-value: probability of type I error by rejecting a true H_0

Houston where toll roads exist and the other includes respondents from San Antonio, El Paso and Austin, where no local toll road exists.

According to the chi-square test in Table 7, attitudes of the two subgroups are different at a 5% significance level. This result does not positively mean that toll road experience changes people's attitude because socio-economic heterogeneity among the cities could be significant. A trend, however, is obvious in that the percentage supporting tolls in Dallas and Houston is significantly larger (59%) than the other group (51%).

Congestion Pricing Attitudes

Because of distortion in the current road charging structure, for more than three decades, many researchers have proposed optimal pricing to accomplish price equal to social marginal cost (Walters 1961). From the viewpoint of demand management techniques, pricing on toll roads is a typical example of facility oriented congestion pricing. In the U.S. no comprehensive congestion pricing scheme has been implemented. Question A6 asks if people prefer congestion pricing, i.e. dynamic tolling in order to relieve congestion during rush hours.

The majority of respondents (80%) showed opposition to this congestion pricing concept. Seventy-five percent of the respondents who prefer tolls to fuel taxes were opposed to congestion pricing. This confirms the findings of other studies in the U.S. and Great Britain that congestion pricing is not publicly supported (Giulano 1992; Goodwin and Jones 1989). In the Colorado survey, 62% of the respondents were opposed to varying tolls among different periods of a day (Kimley-Horn and Associates, Inc. 1993).

Discrete level analysis was used to investigate what factors caused this opposition to the congestion pricing concept. A reliable discrete choice model for the whole data set could not be developed. However, subgroups identified by geographic location and trip making characteristics were investigated using a binary probit model (Ben-Akiva and Lerman 1991).

Table 8 describes the estimated model based upon a Houston work trip subgroup. Commuters are basically opposed to congestion pricing, however, as congestion becomes worse, congestion pricing becomes more palatable. Males support congestion pricing more than females and people over 60 years of age are more opposed than those under 60. This result implies that current congestion levels are important congestion pricing support indicators and any pricing implementation should focus on changing negative attitudes as well as improving technical aspects.

CONCLUSION

Survey results show that most Texans will accept toll roads, especially as an alternative to fuel tax increases. Tangible benefits of toll road use as perceived by users generally increasepublic support. Thus, toll roads can be seriously considered as a Texas transportation funding alternative.

Few Texans support congestion pricing and most respondents who do support pricing are currently experiencing high congestion levels. Imposition of tolls on currently non-tolled facilities is opposed by most Texans.

Respondents are willing to pay more for travel time savings than for travel time reliability or maintenance improvements. Although maintenance is ranked higher in importance than travel time savings or reliability, most respondents are satisfied with current maintenance levels and are therefore not motivated to pay for improved maintenance.

Table 7
Relationship Between Toll Road Usage Experience and Funding Preferences of Drive-Alone Working People

Area	Toll	Fuel tax	Total
Dallas and Houston where currently operating toll roads	261 (59%)	178 (41%)	439 (100%)
San Antonio, El Paso & Austin where currently no toll roads	108 (51%)	103 (49%)	211 (100%)
Chi-square test statistic = 3.9700, d.f. = 1, p-value < 0.05			

Table 8
Profit Model for Congestion Pricing Attitudes[a,b]

Explanatory variable	Coefficient (t-statistics)
Constant	-0.9254 (-1.900)
Speed (mile/hr)	-0.0126 (-1.620)
Congestion level dummy[c]	0.1177 (2.274)
Average trip time of the frequent trip (min)	-0.0090 (-1.617)
Most frequent trip (1 if work trip and 0 if others)	-0.3818 (-1.387)
Gender (1 if male and 0 if female)	0.5390 (2.571)
Age (1 if over 60 and 0 if under 60)	-0.3922 (-1.489)
Log-likelihood at zero	-238.44
Log-likelihood at convergence	-163.8
Likelihood ratio index	0.313
Adjusted likelihood ration index	0.284
Number of observations	344
Correctly predicted percentage	79.9

[a]Houston respondents making most frequent trips to metropolitan area at least once a week
[b]Choice set: 1 if supporting congestion pricing and 0 if opposing.
[c]This variable is measured by the number of times per week that traffic congestion causes delay on the most frequent trip.

By eliminating toll related inconvenience, AVI systems offer great potential for increasing driver usage and support. Frequent users of existing toll facilities tend to have higher incomes. However, income level has no clear effect upon attitudes toward tolls versus other funding mechanisms.

ACKNOWLEDGMENTS

This work was funded by the Texas Department of Transportation under the Study No.1322. The authors wish to acknowledge the valuable comments of anonymous referees.

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Appendix A: Mail Back Survey Questionnaire and Responses

Center for Transportation Research: Highway Financing Study

SECTION A The first section of the survey concerns your opinions about how the government should pay for road maintenance and construction.

A1) On a scale of 1 to 5, how would you rate Texas' highway system in meeting your needs?
1 (Poor) (0.9%) 2 (2.9%) 3 (22.3%) 4 (52.7%) 5 (Excellent) (21.2%)

A2) Currently the State Legislature spends about 8 cents of every government dollar on transportation-related programs. In your opinion, should Texas be spending more, less, or about the same amount of funds on the State's highway system?
1. More (29.3%) 2. Same Amount (67.0%) 3. Less (3.7%)

A3) Currently, most Texas transportation funding comes from motor vehicle fuel taxes. However, current transportation funding sources will be insufficient to provide current levels of highway service. To supplement these funding sources, Texas could raise the fuel taxes charged to all road users. Alternatively Texas could supplement highway funding by charging tolls only to the users of roads needing additional funds. Which type of funding would you prefer Texas to use?
1. Tolls (58.7%) Please answer A4 2. Fuel Taxes (41.3%) Please answer A5

A4) If you favor tolls, what is your **number one reason** for doing so?
1. Tolls charge users directly for road use. (52.0%) 2. I don't want fuel taxes raised. (29.5%)
3. Tolls will lead to faster road improvements. (8.2%) 4. I've had good past experiences with toll roads. (8.7%)
5. Other (1.6%)

A5) If you favor fuel taxes, what is your **number one reason** for doing so?
1. I don't want to stop to pay the toll. (17.6%) 2. I want to avoid traffic jams at toll booths. (10.8%)
3. Toll roads are expensive. (14.4%) 4. I shouldn't have to pay to use a road. (28.0%)
5. I've had bad experiences with toll roads. (4.9%) 6. All should pay for funding roads. (7.4%)
7. Tax is more fair/equitable. (3.3%) 8. Other (13.6%)

A6) If tolls were put on Texas roads, these tolls could be raised during rush hours to discourage unnecessary trips during the rush hour. This policy could relieve rush hour traffic congestion on the toll road. Are you in favor of such a policy?
1. Yes, tolls should be higher during rush hours on congested roads to relieve congestion. (20%)
2. No, if tolls are imposed they should be the same all day. (80%)

A7) Historically in Texas, tolls have been imposed only on newly-constructed roads. Some people have suggested tolls should also be imposed on existing roads to pay for improvements and maintenance on these roads. If Texas decides to use tolls, which policy would you prefer?
1. Toll new roads only. (63.6%) 2. Toll existing roads and new roads. (33.6%)
3. Toll existing roads only. (2.8%)

A8) Some believe that tolls should be used to fund improvements only on the highway where they are collected. Others believe that tolls should be used to fund improvements on non-tolled roads as well. **If Texas decides to use tolls, which policy would you prefer?**
1. Use tolls only to fund improvements on the toll road. (55.5%)
2. Use tolls to fund non-tolled roads' improvements. (44.5%)

SECTION B The following questions concern conditions of your local & regional transportation system. Your "most frequent trip" refers to the regular route that you travel during your most typical activities.

B1) What is the **primary purpose** of your **most frequent trip** from home?
1. Work/School. (70.9%) 2. Child care/Dropping children off at school. (1.2%)
3. Shopping/Other Errands. (19.9%) 4. Recreation/Leisure. (5.4%)
5. Other (2.6%)

B2) How do you travel during your **most frequent trip**?
1. Car(drive alone). (93.4%) 2. Carpool. (4.7%)3. Transit. (0.8%)
4. Other(bicycle, walk, taxi, etc.). (0.3%) 5. Combination of modes. (0.8%)

B3) How often do you make this round-trip?
1. 5 or more days a week. (71.7%) 2. 2-4 days a week. (19.6%)3. 1 day a week. (3.4%)
4. Less than once a week but at least once a month. (3.5%) 5. Less than once a month. (1.8%)

B4) How long is your most frequent trip, **one-way?** ____**miles** (median: 15 miles)

B5) On average, how much time does this trip take, **one-way?** ___**minutes** (median: 25 min)

B6) Thinking about your most frequent round trip, how often does your travel time exceed the average travel time you reported on question B5 because of problems with traffic flow (i.e. congestion, accidents, etc.)? (Answer appropriate response)
____ times per week **OR** ____ times per month (median: twice a week)

B7) On a scale of 1 to 5, how would you rate the maintenance on the roads you use to make your most frequent trip? (Circle one)
1 (Poor) (4.0%) 2 (9.2%) 3 (29.8%) 4 (40.3%) 5 (Excellent) (16.7%)

B8) On a scale of 1 to 5, how much traffic congestion do you experience on your most frequent trip?
1 (Gridlock) (1.9%) 2 (13.3%) 3 (35.7%) 4 (30.1%) 5 (No Congestion) (19.2%)

B9) Please check the boxes below that best describes the area around your home and the area around your most frequent destination. (one box for your home and one box for destination)

Description	B9 a Location of Home	B9b Location of Destination
1. **Large Metropolitan Area:** City of 500,000 or more, many suburbs, little open country.	35.4%	44.4%
2. **Medium Metropolitan Area:** City of 150,000 to 499,999, several suburbs, some open country.	16.1%	16.6%
3. **Small Metropolitan Area:** City of 50,000 to 149,999, few smaller towns in the area, much open country.	15.8%	16.2%
4. **Semi-Urban:** City of 10,000 to 49,999, few smaller towns in the area, much open country.	14.3%	10.3%
5. **Semi-Rural:** City of 2,500 to 9,999, one or two other towns in the area, mostly open country.	9.6%	6.9%
6. **Rural:** Town of less than 2,500 or entirely open country.	8.7%	5.8%

B10) How frequently do you use the following types of roads?

	[illegible]	[illegible]	[illegible]	Everyday
Tollway	1 (80.8%)	2 (10.0%)	3 (6.1%)	4 (3.1%)
Expressway/IH	1 (15.7%)	2 (10.9%)	3 (30.2%)	4 (43.2%)
City/Local Streets	1 (1.7%)	2 (1.6%)	3 (12.1%)	4 (84.6%)
Other Types	1 (50. %)	2 (11.9%)	3 (14.1%)	4 (23.1%)

If you use a toll road more than once a month, please answer the following questions. Otherwise go to SECTION C.

B11) What is the name of the tollway you use most? _____

B12) How much do you pay for one-way use of this toll road? ____ (median: $1.00)

B13) How long is the segment of the toll road that you use (in miles)?. ___miles (median: 13 miles)

B14) How much time do you save over other routes by using the toll road? ___ min (median: 17 min)

B15) Do you use devices that let you pay your toll without stopping (toll tags, etc.)?
1. Yes. (11.4 %) 2. No. (88.6 %)

B16) Why do you currently use toll roads? (circle up to three reasons)
1. No alternate routes to the toll road. (1.7%)
2. Toll road saves time. (35.7%)
3. Toll road has better travel time reliability than others. (20.1%)
4. Toll road is better maintained than others. (10.4%)
5. Toll road is safer than others. (7.4%)
6. Toll road is less congested than others. (23.7%)
7. Other (specify). _____ (1.0%)

SECTION C: Tolling roads would generate new funds that could be used to provide a variety of roadway improvements. Several of these possible benefits are listed below.

The first benefit toll-generated funds could provide is **improved highway maintenance.** The next three questions examine how much you value road maintenance.

C1) On a scale of 1 to 5, how important is **roadway maintenance** to you? (Circle one)
1 (very important) (54.1%) 2 (30.7%) 3 (10.4%) 4 (3.3%) 5 (not important) (1.5%)

C2) Suppose that you had to make a 15 mile trip that takes, on average, 30 min. to make. What is the highest toll you would pay to use a toll road that was maintained **moderately** better than alternate routes? This means the toll road would have fewer potholes, more signs, and somewhat better lighting than the roads you use today. (Please circle the highest toll you would pay to use this road.)

1. $2.5 or more (0.6%) 2. $2.0 (2.4%) 3. $1.5 (5.8%)
4. $1.0 (19.6%) 5. $0.5 (38.1%) 6. Would not pay toll (33.6%)

C3) Suppose that you had to make the same 15 mile trip, but this time the toll road was maintained **substantially** better than alternate routes. This means the toll road would have no potholes, a many more signs, much better lighting, and many fewer bumps than the roads you use today. What is the highest toll you would pay to use this road? (Please circle the highest toll you would pay.)

1. $2.5 or more (1.7%) 2. $2.0 (6.1%) 3. $1.5 (11.2%)
4. $1.0 (26.6%) 5. $0.5 (34.0%) 6. Would not pay toll (20.4%)

Additional funds by tolls could be used to reduce travel times by providing more direct routes, more lanes, and discouraging unnecessary trips. The next questions examine how much you value travel time savings.

C4) On a scale of 1 to 5, how important is **travel time** to you during the most frequent trip you mentioned in section B above? (circle one)

1 (very important) (33.6%) 2 (25.7%) 3 (21.8%) 4 (10.9%) 5 (not important) (7.9%)

C5) Suppose on average, **a 15 mile trip takes 30 min** on an existing non-tolled road. Suppose a toll road allows you to make the trip in **25 min (you save 5 min)** by providing a more direct and congestion-free route. What is the highest toll you would pay to use this road? (circle one)

1. $2.5 or more (0.6%) 2. $2.0 (3.4%) 3. $1.5 (5.2%)
4. $1.0 (16.4%) 5. $0.5 (32.9%) 6. Would not pay toll (41.5%)

C6) Suppose the toll road allows you to make the 30 minute trip in **15 min (you save 15 min).** What is the highest toll you would pay to use this road? (circle one)

1. $2.5 or more (2.6%) 2. $2.0 (7.2%) 3. $1.5 (12.3%)
4. $1.0 (28.3%) 5. $0.5 (31.5%) 6. Would not pay toll (18.1%)

A final benefit toll-generated funds could provide is **improved reliability.** Good reliability means that you would arrive at your destination close to the time you planned your arrival. Bad reliability means that you could arrive at your destination much later than you planned to arrive at the destination.

C7) On a scale of 1 to 5, how important is **reliability** to you during the most frequent trip you mentioned in section B? (circle one)

1 (very important) (35.6%) 2 (30.7%) 3 (20.4%) 4 (8.0%) 5 (not important) (5.4%)

C8) Suppose, on average, a 15 mile trip takes 30 min on an existing non-tolled road. However, the trip on this free roads has a **maximum** travel time of 50 min (20 min longer than expected). Suppose a toll road has the same average travel time as the free roads (30 min), but the **toll road** has a **maximum** travel time of only 45 min. What is the highest toll you would pay to use the toll road?

1. $2.5 or more (0.7%) 2. $2.0 (2.9%) 3. $1.5 (4.6%)
4. $1.0 (16.2%) 5. $0.5 (29.1%) 6. Would not pay toll (46.5%)

C9) Now, suppose the toll road has the same average travel time as the free road (30 minutes), but has a **maximum** travel time of only **35 min**. What is the highest toll you would pay to use the toll road?

1. $2.5 or more (1.3%) 2. $2.0 (4.7%) 3. $1.5 (9.3%)
4. $1.0 (23.9%) 5. $0.5 (33.6%) 6. Would not pay toll (27.2%)

SECTION D: Finally, we would like to know a little about you and your household. Your accurate responses to these questions will help us classify the results we obtain.

D1) What county do you live in? _____

D2) What is your gender? 1. Female (24.3%) 2. Male (75.7%)

D3) What is your age? (circle one)

1. Under 21 (0.3%) 2. 21-30 (6.8%) 3. 31-40 (21.2%)
4. 41-50 (24.3%) 5. 51-60 (17.8%) 6. over 60 (29.7%)

D4) How many vehicles do you have in your household? (including pickups & motorcycles) (median: two)

D5) How many people live in your household? _____ (median: two)

D6) How many people have a driver's license in your household? _____ (median: two)

D7) Which of the following categories describes your household's gross annual income?(before taxes)

1. under $20,000 (12.8%) 2. $20,000-40,000 (28.6%) 3. $40,000-60,000 (26.2%)
4. $60,000-80,000 (15.5%) 5. over $80,000 (16.9%)