Understanding Public Perceptions of Congestion Pricing – A U.S. Perspective

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ABSTRACT
Despite theoretical and practical advantages of congestion pricing as a policy instrument to reduce traffic congestion, implementation of such policies in the real world and especially in the U.S., faces public opposition, as observed in the context of New York City's recent congestion pricing policy. At the same time, there has not been adequate investigation of public perceptions (especially the perceived (un)fairness of congestion pricing) underlying such public opposition. In this study, demographic, employment, built environment, and attitudinal factors affecting individuals' perceived fairness of congestion pricing are examined, using data from the first wave of the Transportation Heartbeat of America (THA) Survey conducted from October 2024 through January 2025. Study findings suggest that more than 65 percent of Americans believe congestion pricing is unfair, and the percentage is higher for those who view travel as a positive experience, prefer a suburban lifestyle, commute frequently over long distances, own multiple vehicles, and are middle-aged. In contrast, those who feel a strong burden from traffic congestion, live in the New York City area, and have high formal educational attainment perceive congestion pricing as relatively fair. These results highlight the important role of personal attitudes and demographics in shaping fairness perceptions about congestion pricing. Policy implications of the findings are discussed.

Keywords: Transportation system fairness, transportation policy, congestion pricing, attitudes, lifestyle factors, multivariate econometric model

1. INTRODUCTION

Congestion pricing is a transportation policy instrument that is often viewed as a mechanism to reduce traffic congestion, improve traffic flow, and reduce vehicular travel and associated emissions by encouraging people to change travel choices and raise revenue for transportation infrastructure and public transit systems. Congestion pricing mechanisms may take several forms, including *cordon pricing* where a fee is charged to enter a specific area (usually a downtown zone) such as in London or Stockholm – and more recently, New York City; *area-wide pricing* where charges are levied during peak hours for driving anywhere within a defined zone; *variable tolls* on congested corridors with toll rates changing based on traffic congestion levels, with higher prices during rush hours; and *distance-based pricing* where charges are based on how far a driver travels in a congested area (*1*).

Although there has been interest in the concept of congestion pricing in the United States for many years, the policy is seeing particularly renewed interest in light of the recent implementation of the New York City congestion pricing policy. Launched in January 2025, the New York City implementation marked the first such initiative in the United States and has generated considerable controversy, with supporters lauding its potential to reduce congestion and raise revenue for public transit and detractors criticizing the policy for its regressive nature and potential loss of patronage for businesses and offices in the priced zone.

It is clear that public perceptions of congestion pricing are critical determinants of the potential acceptance and effectiveness of congestion pricing policies. Individual support for congestion pricing or similar policies is influenced by various factors, with perceptions of fairness appearing to be consistently significant and important in garnering support (*2*, *3*). While people generally recognize and value congestion relief and environmental benefits that may result from the implementation of a pricing policy, whether or not the pricing policy is considered fair tends to be more complex and challenging to fully comprehend (*4*). On the one hand, people may view congestion pricing as unfair if it disadvantages them personally; on the other hand, they may also consider it fair if they perceive the policy as bringing about broader societal benefits even at their own personal expense (*2*).

Because of the potential for pricing-based policies to bring about a variety of desired transport and societal outcomes, it is not surprising that there has been considerable interest in the study of perceptions of and attitudes towards pricing-based policies (besides examining the potential or actual impacts of such policies). A number of studies have examined the concept of fairness in the context of congestion pricing. For example, it was found that transport pricing policies were perceived as fairer when they were seen as protecting the environment for future generations and affecting everybody equally (*5*). A distinction was drawn between consumer and citizen perspectives in examining perceptions of fairness of congestion pricing policies (*6*). Consumer perspective reflected the economic welfare accrued to society due to the implementation of the congestion pricing policy, while the citizen perspective reflected the extent to which the policy aligned with individual social values and perceptions of fairness, independent of their personal economic interests. Other studies have examined fairness in broader terms beyond mere economic aspects. For example, it was emphasized that the concept of fairness should be expanded to consider potential for evasion of payment, accommodation of special groups such as persons with disabilities, and broad stakeholder engagement to ensure all voices are heard in policymaking (*7*). Research also found that one of the key aspects in assessment of fairness is the extent to which effective transport alternatives are available to the public (*8*).

Beyond fairness considerations, studies have examined issues related to transparency, perceived effectiveness, equity considerations, and general attitudes toward congestion pricing. A review of road pricing research highlights the importance of providing detailed information about pricing structures, including exemptions and billing procedures, in addressing implementation concerns (*9*). Research found that, although road pricing does not garner broad support among drivers, factors such as social norms, equity perceptions, and perceived effectiveness (in delivering benefits) are positively related to acceptance (*10*). Some studies also showed that latent attitudinal factors such as being pro-environment and pro-taxation affect support for congestion pricing (*11*), and that distrust related to fairness plays a greater role in determining acceptance than doubts about the potential effectiveness of the policy in delivering benefits (*12*). In contrast to the studies above that focus on perceptions, effectiveness, equity, and general attitudes, prior research has also examined other factors that affect acceptance towards congestion pricing. These include privacy, equity, simplicity, uncertainty (*13*), revenue reinvestment strategies (*14*, *15*), and availability of public transportation service as an alternative to driving to avoid paying the congestion fee (*16*).

Recent research has also found that, even when there is initial resistance to pricing based policies, acceptance tends to increase after implementation (*17*), with the use of the revenue derived playing a significant role in shaping post-implementation perceptions. A similar trend has been seen in the case of the New York congestion pricing policy. Public opinion appears to be shifting, with polls showing increased support for the program after its implementation (*18*).

In the US, limited experience with congestion pricing due to insufficient public support has provided little evidence of public perceptions toward such policies. This study aims to fill this critical gap to help inform the design and implementation of pricing policies in the United States, with a focus on congestion pricing (similar to that implemented in New York City). This research extends the body of literature by providing a comprehensive understanding of perceptions of congestion pricing in the United States based on a recent nationwide survey conducted in late 2024 and early 2025. The study explicitly accounts for attitudes and lifestyle preferences in assessing the factors that influence perceptions of fairness of congestion pricing measures. Using a Generalized Heterogeneous Data Model (GHDM) framework, the model system presented in this paper provides a systematic approach to assess the impacts of socio-economic, demographic, and attitudinal factors on public perceptions of congestion pricing fairness. Through this effort, the study provides insights on strategies that cities and communities could use to enhance public support for pricing policies, if they are contemplating such measures.

The remainder of this paper is organized as follows. The next section provides a detailed description of the survey and data set used in this study. The third section presents the modeling framework while the fourth section presents model estimation results in detail. The fifth section presents average treatment effects to illustrate the impacts of different variables and latent factors on perceptions of pricing. Finally, the sixth section offers concluding thoughts.

2. DATA DESCRIPTION

This section presents a summary of the survey and data set used in this study. An overall description of the survey and sample is presented first, while a more detailed description of endogenous variables and latent attitudinal factors is presented second.

2.1. Survey Overview and Sample Characteristics

The data used in this study is derived from the first wave of the Transportation Heartbeat of America (THA) Survey, conducted from October 2024 through January 2025 in the United States.

The THA Survey is a nationwide survey aimed at obtaining detailed information about people's socio-economic and demographic characteristics, traveler behavior and values, mobility patterns and choices, activity-travel demand, attitudes and perceptions, and lifestyle preferences and personality traits. The survey was administered to a nationwide online survey panel assembled by a commercial firm, with specific sample quotas specified for a wide array of socio-economic and demographic variables to ensure that the respondent sample captured the variation in attributes that exists in the population as a whole. A total of 8,212 responses were obtained for the nationwide THA survey. Following the collection of the survey data, built environment variables (population density, employment density, and network density) were appended to survey records using the Smart Location Database 3.0 (*19*). Since built environment data is provided at the census block group level while survey locations are at the zip code level, area-weighted averages are used for matching. This results in a final sample of 8,030 respondents after excluding unmatched records.

Table 1 shows the socio-economic and demographic characteristics of the final sample used in this study, along with the distributions of the endogenous variables of interest. In general, the sample exhibits distributions across attributes suitable for undertaking a multivariate econometric modeling exercise such as that undertaken in this study.

2.2. Endogenous Variables and Attitudinal Indicators

The endogenous variable of this study is *Congestion Pricing Unfairness*. This variable is derived from the survey question that asked respondents to rate the extent to which they agree with the following statement: *Congestion pricing (charging drivers at busy times) is unfair*. The distribution of responses to this statement is shown in the bottom panel of Table 1. The distribution shows that about 65 percent of respondents strongly agree or somewhat agree with this statement, indicating that a majority of respondents feel that congestion pricing is unfair. While 23.5 percent indicate that they are neutral about congestion pricing, a total of 12 percent somewhat disagree or strongly disagree with this statement – thus indicating that only a small minority of respondents feels that congestion pricing is not unfair. This finding is quite consistent with the strong public opposition to congestion pricing reported in other surveys (*18*).

The THA survey also included a battery of attitudinal statements designed to gather deep insights about respondent attitudes, perceptions, lifestyle preferences, personality traits, and opinions about various aspects of transportation systems, services, and policies. These attitudinal statements, measured using 5-level Likert scales, were used to construct a set of latent constructs that are treated as endogenous in the modeling framework. By including a set of attitudinal constructs in the model framework, it is possible to explicitly account for such factors and more accurately assess the influence of socio-economic and demographic variables on the key behavioral endogenous variable of interest. After extensive testing of alternative specifications and latent constructs with exploratory factor analysis (EFA) followed by a confirmatory factor analysis (CFA), three final constructs were developed and retained based on their statistical significance, behavioral intuitiveness, relevance to the key endogenous variable of interest, interpretability, and consistency with prior literature on factors influencing public opinion toward congestion pricing (*11*, *20*). The final constructs used in this study, as depicted in Figure 1, are: *Congestion Burden Perception (CBP)*, *Positive Travel Engagement (PTE)*, and *Suburban Lifestyle (SL)*.

The distributions of responses to attitudinal statements, which serve as the indicators of the underlying latent constructs, are shown in Figure 1. The CBP factor captures perceptions of traffic congestion as a burden and efforts made to avoid congestion; PTE represents a positive outlook toward travel experiences and making productive use of travel time; and SL reflects a preference for lower-density, privacy-oriented residential environments. As the distributions shown in Figure 1 are self-explanatory, a detailed discussion of each attitudinal statement is not provided here in the interest of brevity. In general, these attitudinal factors provide a rich basis for reflecting the influence of attitudes and perceptions in the joint econometric model system formulated and estimated in this study.

TABLE 1 Socio-Economic and Demographic Characteristics of the Sample

Individual Demographics (N=8,030)		***Household Characteristics (N=8,030)***	
Variable	%	**Variable**	%
Gender		**Household annual income**	
Female	53.3	Less than \$25,000	17.1
Male	46.7	\$25,000 to \$49,999	22.0
Age category		\$50,000 to \$99,999	30.5
18-24 years	12.6	\$100,000 to \$149,999	19.3
25-34 years	13.8	\$150,000 to \$199,999	7.1
35-44 years	20.0	\$200,000 or more	4.0
45-54 years	16.5	**Household size**	
55-64 years	15.8	One	19.4
65+ years	21.3	Two	32.8
Employment status		Three or more	47.8
Full-time worker	45.6	**Housing unit type**	
Part-time worker	10.9	Stand-alone home	66.6
Non-worker	43.5	Attached home/apartment	27.1
Education attainment		Other	6.3
High school or less	33.0	**Home ownership**	
Some college or technical school	29.5	Own	59.2
Bachelor’s degree(s)	22.7	Rent	35.5
Graduate degree(s)	14.8	Other	5.3
Race		**Vehicle ownership**	
Asian or Pacific Islander	7.6	Zero	8.5
Black	15.4	One	40.6
White	65.4	Two	34.1
Other	11.6	Three or more	16.8
Ethnicity		**Location**	
Hispanic	20.1	Urban	80.4
Non-Hispanic	79.9	Rural	19.6
Main Outcome Variable			
“Congestion pricing (charging drivers at busy times) is unfair.”			
Strongly agree			34.1
Somewhat agree			30.4
Neutral			23.5
Somewhat disagree			7.5
Strongly disagree			4.5

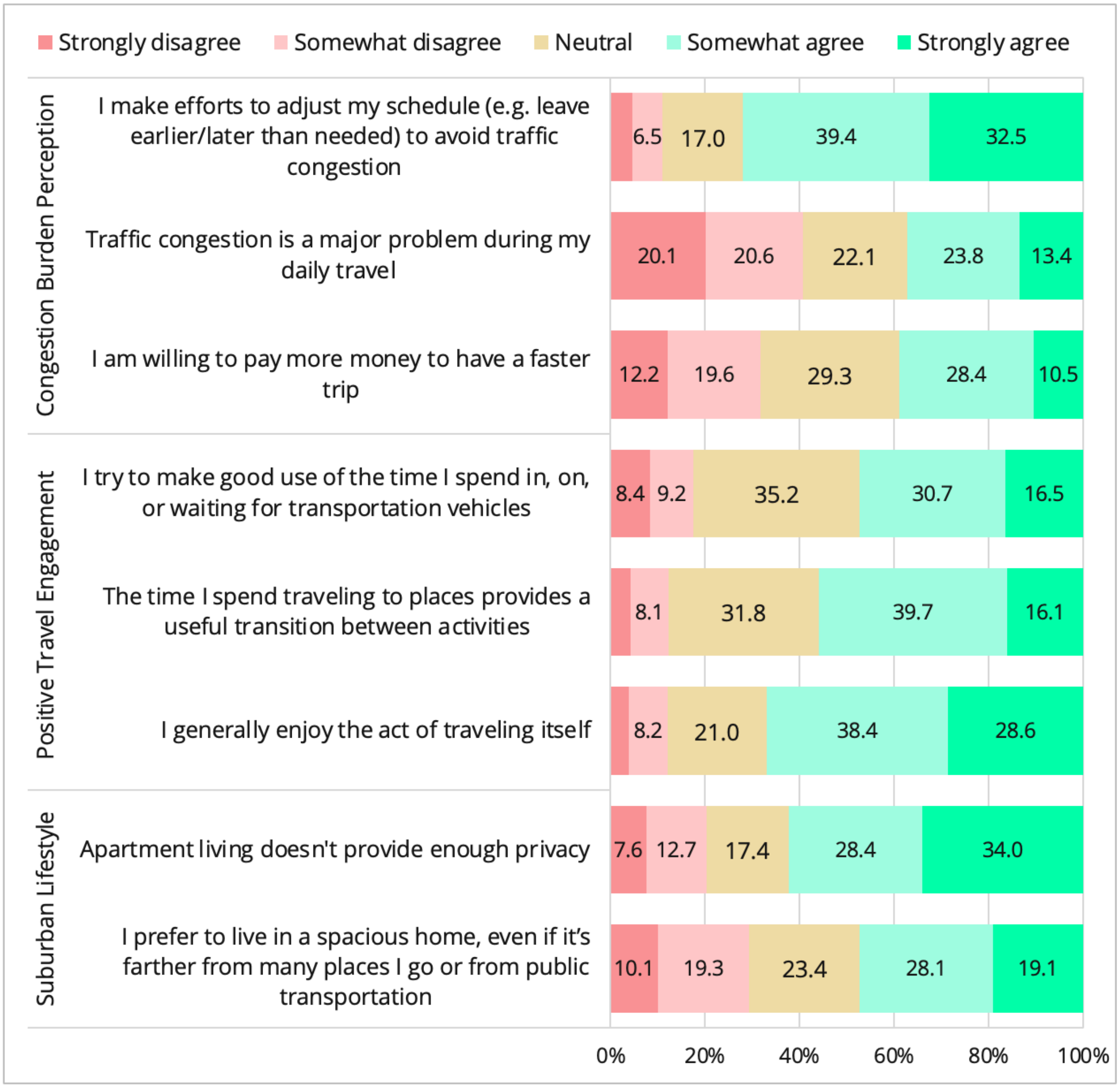

Figure 1 Agreement with attitudinal indicators defining latent constructs (N=8,030)

3. MODELING FRAMEWORK

This section presents the model structure and framework adopted in this study. A simplified representation of the overall model structure is depicted in Figure 2. The main outcome variable, *Congestion Pricing Unfairness*, appears on the right-hand side of the figure. Individual attributes that may be considered exogenous in nature for purposes of this study, such as socio-economic, demographic, and other characteristics, are depicted on the left-hand side of the figure. The exogenous variables influence the main outcome variable (congestion pricing unfairness) directly and indirectly through the three stochastic latent constructs positioned between the exogenous variables and the main outcome variable – Congestion Burden Perception (CBP), Positive Travel Engagement (PTE), and Suburban Lifestyle (SL). For simplicity of representation, the mappings of the latent constructs to their respective attitudinal indicators are not shown in the figure. The model structure accounts for a number of correlations as depicted by the curved double-arrows.

These error correlations account for shared unobserved attributes that simultaneously influence multiple endogenous variables.

The model system is estimated using the Generalized Heterogeneous Data Model (GHDM) framework and methodology, which is described in extensive detail in previous research (*21*). For purposes of brevity, the detailed model formulation and estimation methodology is not presented here, as the details of the formulation are not essential to interpret the model estimation results.

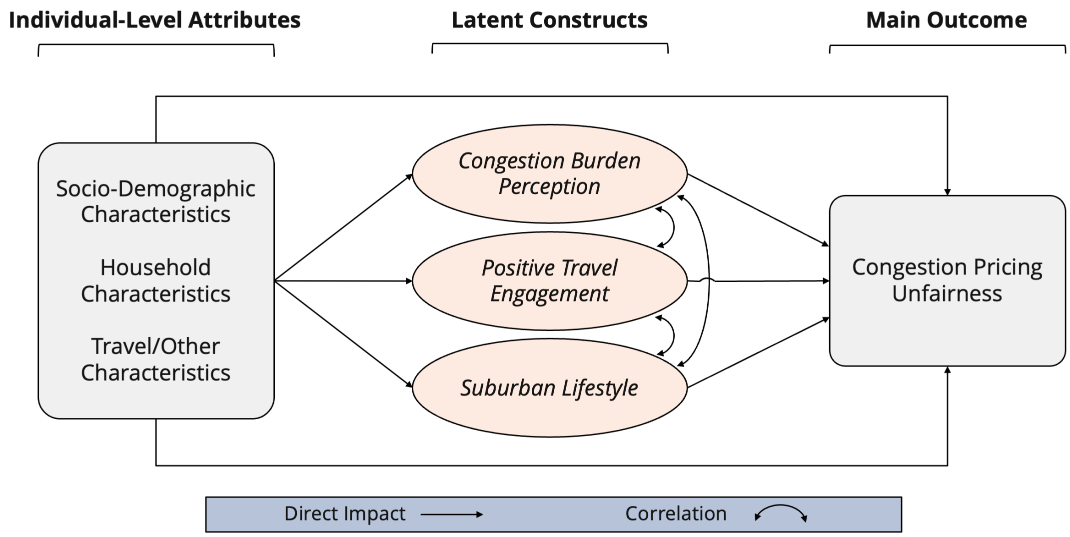

Figure 2 Model framework

4. MODEL ESTIMATION RESULTS

This section presents detailed model estimation results. The results for the latent construct model component are presented first, while the results for the behavioral outcome model are presented second.

4.1. Latent Construct Model Component

Results of the latent construct model component are presented in Table 2. The top half of the table shows the effects of exogenous variables on the three latent constructs, while the bottom half of the table presents the factor loadings for each latent construct. Focusing on the bottom half of the table, it is seen that the factor loadings are statistically significant and intuitive in sign and magnitude, thus signifying that the attitudinal statements are appropriate indicators of the latent constructs conceived for this study. Just above the factor loadings is the correlation matrix; it is found that there are significant error correlations among the three latent constructs.

The remainder of this subsection is devoted to a discussion of exogenous variable effects on the three latent attitudinal constructs. Females are found to exhibit lower levels of congestion burden perception, presumably because they drive fewer miles than males and hence do not perceive congestion as burdensome. They also have a lower positive travel engagement, likely arising from greater modal constraints and their shouldering household obligations and childcare responsibilities to a greater degree than males, thus limiting their travel flexibility and enjoyment (*22*). Compared to the youngest age group, those in the middle age groups of 24-44 years and 45-64 years are more suburban lifestyle oriented, consistent with the notion that households with adults in these age groups are more likely to have children and seek open space, larger homes, and good schools (*23*). Older individuals perceive congestion burden less, presumably because they have greater schedule flexibility, with those aged 65 years and over exhibiting the lowest level of congestion burden perception. Older age groups also depict lower positive travel engagement when compared with younger age groups, most likely because of intense activity-travel schedules (particularly for those 45-64 years, who are in their peak travel years) and the onset of mobility limitations (particularly for those 65 years and over) (*24*).

TABLE 2 Determinants of Latent Variables and Loadings on Indicators (N = 8,030)

Explanatory Variables (base category)		**Structural Equations Model Component**					
		Congestion Burden Perception		Positive Travel Engagement		Suburban Lifestyle	
		Coef	t-stat	Coef	t-stat	Coef	t-stat
Individual characteristics							
Gender (not female)	Female	-0.341	-8.14	-0.186	-5.52	na	na
Age (*)	25-44 years	na	na	na	na	0.205	4.52
	45-64 years	-0.437	-8.85	-0.233	-6.20	0.142	3.29
	65 years or older	-0.907	-13.75	-0.460	-9.61	na	na
Race and Ethnicity (*)	Non-Hispanic Black	na	na	0.347	7.47	na	na
	Non-Hispanic White	-0.361	-8.46	na	na	na	na
Education (*)	High school or lower	na	na	-0.151	-4.26	na	na
	Bachelor's or higher	0.247	5.60	na	na	-0.189	-4.86
Household characteristics							
Household income (less than $50,000)	$50,000-$99,999	0.397	8.00	0.199	5.02	0.264	6.07
	$100,000 or more	0.860	14.76	0.251	5.98	0.425	8.63
Presence of children (none)	One or more	0.168	3.67	na	na	0.118	2.78
Number of adults (three or more)	One	na	na	na	na	-0.216	-4.40
	Two	na	na	na	na	0.186	4.67
Correlations between latent constructs							
Congestion Burden Perception		1	na	0.588	23.74	0.397	14.76
Positive Travel Engagement				1	na	0.304	13.95
Suburban Lifestyle						1	na
Attitudinal Indicators							
I am willing to pay more money to have a faster trip		0.631	27.36				
Traffic congestion is a major problem during my daily travel		0.403	26.30				
I make efforts to adjust my schedule (e.g. leave earlier/later than needed) to avoid traffic congestion		0.142	10.46				
I generally enjoy the act of traveling itself				0.441	25.09		
The time I spend traveling to places provides a useful transition between activities				0.839	31.96		
I try to make good use of the time I spend in, on, or waiting for transportation vehicles				0.602	32.51		
I prefer to live in a spacious home, even if it's farther from many places I go or from public transportation						0.897	16.92
Apartment living doesn't provide enough privacy						0.409	20.48

Note: Coef = coefficient; "na" = not applicable; (*) Base category is not identical across the model equations and corresponds to all omitted categories.

Non-Hispanic Black individuals report a more positive travel engagement; they are more likely to use transit than other groups (*25*) and are able to put their travel time to good use. White individuals exhibit a lower level of congestion burden perception, presumably because they tend to reside more so in suburban and rural areas where congestion levels are lower. Individuals with low educational attainment are more likely to be dependent on alternative modes of transportation and work in service jobs with fixed schedules, thus reducing the positivity of their travel engagement. Higher educated individuals, on the other hand, are able to perceive a lower congestion burden because they have more flexible schedules; at the same time, they prefer urban living for the amenities that such environments provide (*26*).

Income effects show that higher income levels are associated with higher levels of congestion burden perception, positive travel engagement, and suburban lifestyle orientation. The first may be explained by the more intense work and commuting schedules and higher value of time (thus perceiving congestion as a burden) associated with those with higher incomes, the second possibly due to higher levels of vehicle ownership and the ability to use premium transit or ridehailing services that facilitate multitasking during travel (*27*), and the third presumably due to higher income individuals seeking nicer suburban locations with large homes for their residence. The presence of children further reinforces the suburban lifestyle orientation where households are seeking good schools, open space, and larger homes (*23*). At the same time, the presence of children appears to amplify the congestion burden perception, possibly a result of these households being time and schedule constrained (*28*) and feeling the ill-effects of congestion more so than others. Single adults eschew the suburban lifestyle orientation, while individuals in multi-adult households tend to embrace it. Overall, the model estimation results are consistent with expectations and behaviorally intuitive.

4.2. Model of Congestion Pricing Unfairness

Estimation results for the model of congestion pricing unfairness are presented in Table 3. The coefficients represent the influence of exogenous variables and stochastic latent constructs on the underlying latent propensity determining the level of unfairness associated with congestion pricing. Technically, in ordered-response models, even the sign of the coefficients does not unambiguously indicate the effect on each ordinal category, except for the two extreme ordinal unfairness categories of "strongly agree" and "strongly disagree". But, for presentation simplicity, this issue is overlooked with the understanding that the term "more unfair" (regarding congestion pricing) implies a high probability of choosing the "strongly agree" category, while "less unfair" implies a high probability of selecting the "strongly disagree" category. With that simplification, those with a higher congestion burden perception feel that congestion pricing is less unfair (i.e., more fair) as evidenced by the negative and significant coefficient. This is intuitive, as those who feel the burden of congestion may feel that congestion pricing is a fair way to alleviate congestion and make those who travel during congested periods pay their fair share. On the other hand, employed individuals who feel a higher congestion burden believe that congestion pricing is unfair. As employed individuals often need to adhere to fixed (peak period) commuting schedules, they may feel unfairly penalized (because they do not have the flexibility to travel during uncongested periods). Those with a higher positive travel engagement and a suburban lifestyle orientation are more likely to perceive congestion as unfair; as both these groups are likely to travel more (in frequency and distance) than other groups, it is not surprising that they would consider a congestion pricing scheme as punitive. These results signify that attitudinal latent factors are important determinants of perceptions (and hence acceptability) of congestion pricing schemes.

In terms of individual characteristics, those in the youngest age group perceive congestion pricing as less unfair (more fair), presumably because they use alternative modes more than others and drive less (*29*). Higher educated individuals also perceive congestion pricing as more fair (less unfair), likely due to awareness of the benefits of congestion pricing and a more pro-tax, pro-environment, pro-pricing approach to life (*11*). Black women also consider congestion pricing more fair; this demographic is more likely to use alternative modes of transportation (*30*) and may view congestion pricing as a fair way to make automobile users pay for traveling during congested periods and generate revenue to improve transit services. Individuals in high-income households (earning $100,000 or more per year) are also more likely to consider congestion pricing less unfair (or more fair). This is because they are more able to afford to pay when they do have to travel in peak periods, and are more able to adjust their schedules when they do not have to travel in congested periods (*31*). On the other hand, individuals in households with high vehicle ownership tend to consider congestion pricing as more unfair, presumably due to their dependence on and high use of the automobile to fulfill travel needs.

As expected, commute characteristics and location matter. Those who commute long distances (50 miles or longer) perceive congestion pricing as unfair, as this price is added on to their already high commuting costs. Similarly, those who commute to the workplace three or more days per week are also likely to feel disproportionately impacted by a congestion pricing scheme that they are not able to escape through schedule adjustments; hence frequent commuters also deem a congestion pricing scheme as more unfair compared to those who are able to work from home at least a part of the week. Interestingly, those in urban environments within New York State consider congestion pricing less unfair (more fair), signifying that the congestion pricing experiment in New York City is being viewed positively for its (potential) benefits on relieving congestion and generating revenue for enhancing transit service (*32*). It appears that context matters, greater awareness of the benefits of congestion pricing and the intended use of the revenue matters, and actual experience (in which the benefits are seen firsthand) matters.

Finally, ridehailing drivers in New York consider the scheme more unfair, as they feel unduly penalized by the scheme. Women in low density areas appear to perceive congestion pricing as more fair (than others) presumably because they do not travel during congested periods as much as their male counterparts (*33*). They may view congestion pricing as an appropriate mechanism for managing traffic congestion and pricing transportation infrastructure use during congested periods.

TABLE 3 Estimation Results of Congestion Pricing Unfairness Model (N = 8,030)

Explanatory Variables (base category)		**Congestion Pricing Unfairness** *Ordered (5-level): strongly disagree (1) to strongly agree (5)*	
		Coef	t-stat
Latent constructs			
Congestion Burden Perception		-0.096	-3.39
Congestion Burden Perception × Employed		0.145	5.15
Positive Travel Engagement		0.164	6.59
Suburban Lifestyle		0.100	4.88
Individual characteristics			
Age (25 years or older)	18 to 24 years	-0.080	-1.98
Education (some college or lower)	Bachelor's degree(s) or higher	-0.099	-3.37
Interaction term (*)	Black × Female	-0.152	-2.72
Household characteristics			
Household income (<$100,000)	$100,000 or more	-0.081	-2.44
Number of vehicles (zero or one)	Two or more	0.102	3.73
Commute, location, and other characteristics			
Commute distance (less than 50 miles)	50 miles or longer	0.181	2.12
Commute frequency (less than 3 days)	3 or more days per week	0.092	3.22
Interaction terms (*)	Urban area × New York State	-0.171	-2.88
	Ridehailing driver × New York State	0.181	1.45
	Female × Live in a low population density area (< 1.96 people/acre)	-0.081	-2.25
Thresholds			
1|2		-1.732	-47.96
2|3		-1.195	-36.20
3|4		-0.369	-11.88
4|5		0.439	14.26
Data Fit Measures		**GHDM**	**IOP**
Log-likelihood at convergence		-87702.86	-12123.63
Log-likelihood at constants		-92224.55	-12359.41
Number of non-constant parameters		85	9
Predictive log-likelihood at convergence		-11204.89	-12123.63
Constants-only predictive log-likelihood		-12359.41	
Predictive adjusted likelihood ratio index		0.206	0.051
Predictive Bayesian Information Criterion (BIC)		22727.8	24298.02
Average probability of correct prediction		0.357	0.221

Note: Coef = coefficient; "na" = not applicable. (*) Base category is not identical across the model equations and corresponds to all omitted categories.

Model goodness-of-fit measures are furnished in the bottom portion of Table 3. The performance of the GHDM, which accounts for error correlations among stochastic latent constructs is compared against that of an independent ordered probit (IOP) model that does not include latent constructs in the model specification. The GHDM is assessed on a number of goodness-of-fit metrics, including log-likelihood measures and predictive log-likelihood at convergence, predictive adjusted likelihood ratio index, predictive Bayesian Information Criterion (BIC), and average probability of correct prediction. The GHDM is found to offer a statistically superior goodness-of-fit across all measures, thus validating the use of the GHDM with correlated stochastic latent constructs embedded in the model specification. This model accounts for error correlations among endogenous latent constructs and explicitly captures the influence of latent attitudinal factors in shaping perceptions of congestion pricing fairness.

5. AVERAGE TREATMENT EFFECTS

This section presents a discussion of average treatment effects (ATEs) to illustrate the sensitivity of outcome variables to changes in exogenous variables. The notion of an ATE, which is widely used in econometrics to measure the potential impact of treatments, represents the mean causal effect of a treatment on an outcome across the entire population. This is defined as the expected difference in potential outcomes between the treatment and control (baseline) conditions.

As illustrated in the model structure (Figure 2), exogenous variables influence perceptions of congestion pricing fairness through multiple pathways: directly and indirectly via three latent constructs. Thus, the total ATE of a variable on congestion pricing fairness perception will include four possible components in this study, including the direct effect and three indirect effects routed through the three latent constructs. Table 4 displays the ATEs and the breakdown of the contribution of each component to the total ATE. The ATE in this context represents the change in percentage points of respondents who somewhat or strongly agree that congestion pricing is unfair, when comparing a scenario where all individuals possess the baseline level of an exogenous variable to a scenario where all individuals possess the treatment level of an exogenous variable.

The first three columns and the very final column of Table 4 show the total impact of changing an exogenous variable from the baseline level to the treatment level on the outcome (percent of individuals strongly or somewhat agreeing that congestion pricing is unfair). For instance, the second row indicates that, compared to a scenario where all respondents are aged 24 or under, a scenario where all respondents are aged 25-44 years would see an increase in the percentage of individuals strongly or somewhat agreeing that congestion pricing is unfair by 3.8 percentage points.

There are four columns in the table that present the relative magnitude and direction of the component effects transmitted through each latent construct and direct pathway. The absolute value of the relative contributions adds up to 100 percent, with the sign indicating the direction of impact (of the specific component) on the outcome variable. For example, in the case of the education variable, possessing a bachelor’s degree or higher decreases the proportion of individuals who somewhat or strongly agree that congestion pricing is unfair by 3.7 percentage points. The direct pathway accounts for 65.4 percent of the total effect, operating in the negative direction. Meanwhile, the indirect pathways through the congestion burden perception (CBP) and suburban lifestyle (SL) latent constructs account for 5.1 percent and 12.7 percent of the total effect, respectively, again in the negative direction. However, these effects are moderated by the indirect effect through the positive travel engagement (PTE) latent construct which accounts for 16.8 percent of the total effect, but in a positive direction (consistent with the result described in the previous section that those with a positive travel engagement propensity are likely to perceive congestion pricing as more unfair than those who do not possess such a propensity).

TABLE 4 Average Treatment Effects (ATEs) for Congestion Pricing Unfairness

Variable	Base Level (BL)	Treatment Level (TL)	Contribution through Latent Constructs or Direct Effect (%)				Congestion Pricing Unfairness		Total ATE
			CBP	PTE	SL	Direct effect	BL (%)	TL (%)	
Individual characteristics									
Gender	Male	Female	13.1	-37.7	0.0	49.2**	65.6	64.1	-1.5
Age	18 to 24 years	25 to 44 years	0.0	0.0	19.6	80.4	62.1	65.9	3.8
		45 to 64 years	9.1	-24.9	9.5	56.5	62.1	64.7	2.6
		65 years or older	14.8	-39.8	0.0	45.4	62.1	63.4	1.3
Education	High school or lower	Bachelor's degree or higher	-5.1	16.8	-12.7	-65.4	65.9	62.2	-3.7
Race and ethnicity	All other racial/ethnic groups*	Non-Hispanic White	100.0	0.0	0.0	0.0	64.6	65.0	0.4
		Non-Hispanic Black	0.0	40.6	0.0	-59.4**	64.6	63.6	-1.0
Employment	Unemployed	Employed	44.8	0.0	0.0	55.2	63.1	65.1	2.0
Household characteristics and others									
Income	Lower than $50,000	$100,000 or higher	-13.8	21.8	22.4	-42.0	64.3	63.4	-0.9
		$50,000 - $100,000	-16.7	46.1	37.2	0.0	64.3	66.0	1.7
Presence of children	None	One or more	-30.2	0.0	69.8	0.0	64.7	65.0	0.3
Number of adults	Three or more	One	0.0	0.0	100.0	0.0	64.7	63.9	-0.8
		Two	0.0	0.0	100.0	0.0	64.7	65.4	0.7
Vehicle ownership	Zero or one	Two or more	0.0	0.0	0.0	100.0	62.9	66.7	3.8
Urban × New York State	No	Yes	0.0	0.0	0.0	100.0	65.2	58.8	-6.4
Ridehailing driver in New York State	No	Yes	0.0	0.0	0.0	100.0	64.8	71.2	6.4

(*) The reference group includes Hispanic (any race) and non-Hispanic individuals of other races (e.g., Asian, Native American, Pacific Islander, or multi-race).
(**) The direct effects for non-Hispanic Black and male are caused by their corresponding interaction terms.

In some cases, an explanatory variable may not necessarily have a direct effect on the outcome variable. For example, the employment status variable itself affects neither the congestion burden perception (CBP) latent factor nor the outcome variable directly. However, employment status modifies commute characteristics, thereby influencing the relationship between the CBP latent factor and the outcome. Thus, the employment variable row reflects the influence of employment status on congestion pricing fairness perception through these indirect mechanisms.

The table shows that direct effects predominate in most cases, with their magnitude of contribution moderated by indirect effects routed through the latent constructs. The results in the table also illustrate how the indirect effects through latent constructs may counteract when direct effects are absent. For example, consider the variable corresponding to the presence of children. This variable has no direct effect on the outcome variable. However, it has a positive effect on congestion burden protection (CBP), which in turn has a negative effect on perceptions of unfairness of congestion pricing. At the same time, the presence of children has a positive effect on suburban lifestyle (SL) propensity, which in turn has a positive effect on perceptions of congestion pricing unfairness. Hence, the effect of presence of children is negative through CBP, but positive through SL – with a net positive total effect amounting to a modest 0.3 percentage points. Overall, it can be seen that adults aged 25-64 years, males, those with lower educational attainment, and individuals in households with multiple vehicles view congestion pricing as unfair and would constitute potential targets for customized message campaigns.

6. DISCUSSION AND CONCLUSIONS

Congestion pricing policies are viewed as strategies for mitigating congestion, reducing automobile-traffic induced externalities, and raising revenue to enhance multimodal mobility options. However, congestion pricing schemes often face considerable headwinds with low public support and limited societal willingness to embrace pricing-oriented transportation control and revenue generation measures. In the United States, only New York City has been able to implement a congestion pricing scheme successfully, although it too faces considerable opposition from certain groups who feel adversely impacted by the pricing scheme.

This study is aimed at shedding light on the factors that contribute to perceptions of unfairness of congestion pricing. The focus is on the notion of *unfairness* perceptions because it is these perceptions of *unfairness* that present challenges in garnering public support for such pricing schemes. The study objective is accomplished by analyzing data derived from the Transportation Heartbeat of America (THA) survey, a nationwide survey conducted in the United States in late 2024 and early 2025. The survey yielded a data set with more than 8,000 responses, providing rich information about socio-economic, demographic, travel behavior, and attitudinal characteristics. The survey also included specific questions probing the degree to which respondents feel that a congestion pricing scheme is unfair. This question served as the basis for the study.

The survey confirms that there is a widely held belief that congestion pricing is unfair. In this sample, 64.5 percent of respondents indicated that they strongly or somewhat agree that congestion pricing is unfair. Only 12 percent of respondents indicated that they strongly or somewhat disagree that congestion pricing is unfair. The descriptive statistical analysis was followed by an econometric model estimation effort in which the dependent variable was treated as an ordered response and the model structure included a series of correlated latent attitudinal constructs that were themselves treated as endogenous variables. This econometric model structure offered the ability to unravel the influences of different attitudinal constructs and socio-economic and demographic characteristics on perceptions of unfairness of congestion pricing.

It is found that middle aged individuals who are in their lifecycle stage of peak travel tend to feel more strongly that congestion pricing is unfair. Younger age individuals, on the other hand, feel that congestion pricing is more fair. Individuals who have higher educational attainment, live in higher income households, and live in urban areas of New York state are more likely to feel that congestion pricing is fair. Those who own more household vehicles, commute long distances, and commute more days of the week tend to feel more strongly that congestion pricing is unfair – consistent with the greater levels of automobile travel that these individuals undertake. Ridehailing drivers in New York feel that congestion pricing is unfair as it adversely impacts their revenue. Among attitudinal constructs, those who perceive and are more sensitive to the burdens of traffic congestion tend to feel that congestion pricing is fair, presumably because they are seeking congestion relief. Those who have a positive travel engagement (i.e., they like traveling) and prefer a suburban lifestyle tend to believe that congestion pricing is unfair, consistent with their higher levels of automobile travel.

The findings suggest that garnering support for congestion pricing schemes may prove to be challenging, as many in the US are automobile-dependent and live in suburbs necessitating travel over long distances. However, as the recent New York experience shows, realizing congestion relief benefits for real, while simultaneously deriving revenue for improving alternative transportation mode services (e.g., transit), could help enhance public support for such pricing schemes. In other words, raising awareness about the pricing scheme, ensuring that the implementation (collection) methods and use of revenue are clear and transparent to the public, and providing firsthand experience of the benefits of a pricing scheme (even on a trial basis) could go a very long way in garnering public support for a congestion pricing scheme. The congestion pricing scheme needs to appeal to a broad constituency. It needs to provide benefits to automobile travelers in the form of congestion relief, and it needs to provide benefits to those who want to use alternative modes of transportation (and avoid paying the congestion charge) through improved services. The heterogeneity in perceptions of congestion pricing unfairness found in this study points to the need to ensure that the congestion pricing scheme is crafted in a way that benefits all segments of society. Providing incentives for using alternative modes of transportation and fuel-efficient vehicles and accommodating exceptions or differential pricing levels for transportation disadvantaged populations, could also help enhance public support for congestion pricing. However, experience to date suggests that context matters and congestion pricing is unlikely to see much support in most contexts of the US; this is simply because congestion levels in a post-pandemic era in most cities are not so egregious that they would have the public believe such a pricing scheme is warranted and necessary in their locales.

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AUTHOR CONTRIBUTIONS
The authors confirm contribution to the paper as follows: study conception and design: H. Hwang, I. Batur, R.M. Pendyala, C.R. Bhat; data collection: D. Robbennolt, I. Batur, R.M. Pendyala, C.R. Bhat; analysis and interpretation of results: H. Hwang, I. Batur, D. Robbennolt, F. Yu, R.M. Pendyala, C.R. Bhat; draft manuscript preparation: H. Hwang, I. Batur, D. Robbennolt, F. Yu,

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