When Safety Is Not Free: Mitigating the Transportation Pink Tax Through Safety-Oriented Policy Interventions

Caiyin Dong[1], Chenyang Wu[2], Hyungchul Chung*[3], Sisi Jian[4], Tiantian Chen*[5]

[1] Cho Chun Shik Graduate School of Mobility,
Korea Advanced Institute of Science and Technology, South Korea
Email: cydongst@kaist.ac.kr
[2] School of Aeronautics, Northwestern Polytechnical University, Xi'an, China
Email: cywu@nwpu.edu.cn
[3] Urban Planning and Design, Xi'an Jiaotong-Liverpool University, Suzhou, China
Email: hyungchul.chung@xjtlu.edu.cn
[4] Department of Civil and Environmental Engineering,
The Hong Kong University of Science & Technology, Hong Kong, China
Email: cesjian@ust.hk
[5] Cho Chun Shik Graduate School of Mobility,
Korea Advanced Institute of Science and Technology, South Korea
Email: nicole.chen@kaist.ac.kr

ABSTRACT

Influenced by sociocultural norms and ongoing safety shortcomings in urban transportation systems, women frequently perceive a higher personal risk during routine travel. Building on the concept of the "pink tax" in consumer markets, this study introduces the notion of a transportation pink tax as a gendered safety-compensation burden, the additional expected monetary cost that women incur when safety concerns prompt compensatory behaviors, such as choosing more expensive travel modes. Using a stated preference (SP) experiment conducted in Shanghai (N = 785; 391 females and 394 males), we examine mode choice among metro, ride-hailing, and autonomous robotaxi services. Both multinomial and mixed logit models are employed to estimate gender-differentiated preferences and derive willingness-to-pay (WTP) for safety-related attributes. The results indicate that women place significantly higher marginal utility on safety-enhancing features, including female ride-hailing drivers, advanced in-vehicle security systems, and improved lighting, reflecting a greater safety-compensation premium in their utility functions. For example, women's WTP for advanced security measures exceeds that of men by 3.90, 26.05, and 27.86 CNY for short-, medium-, and long-distance trips, respectively. Importantly, we show that this marginal safety premium translates into a tangible cost burden when women shift toward higher-cost modes under unsafe conditions. Policy scenario simulations indicate that enhancing metro safety, through measures such as shorter walking distances, CCTV installation, increased security patrols, and improved lighting, could raise women's metro usage and reduce their monthly travel expenditures by approximately 60–115 CNY, thereby alleviating the gendered safety-compensation burden. These results suggest that transportation gender inequities arise not from inherent preference differences, but from structural safety externalities that disproportionately impact women. Implementing safety-by-design principles in public transit and emerging autonomous mobility services can therefore lower gendered cost burdens and foster more equitable urban mobility.

Keywords: Gendered mobility; Transport safety; Pink tax; Safety externalities; Mode choice modeling.

1. INTRODUCTION

Transportation plays a critical role in fostering social participation and equity by enabling access to employment, education, and daily activities (Lucas, 2012). A growing body of evidence indicates that women experience higher levels of perceived insecurity and greater exposure to harassment in public transport settings (Ceccato & Loukaitou-Sideris, 2022). These safety concerns are not inherent to women themselves but are shaped by structural factors, including the built environment, surveillance conditions, crowding, and prevailing social norms (Borker, 2024; Dubey et al., 2025). Consequently, gendered differences in perceived safety can lead to unequal mobility experiences.

In the context of transportation, such price differentials are rarely explicit. Instead, safety shortcomings may prompt compensatory behavioral adjustments. When women perceive higher personal risk in specific travel environments, they may shift to modes or features that offer greater perceived safety, such as ride-hailing services, female drivers, or enhanced in-vehicle monitoring, even if these alternatives involve higher monetary costs.

In this study, we define the transportation pink tax not as direct price discrimination, but as a gendered safety-compensation burden, the additional expected monetary cost women incur when structural safety deficiencies prompt shifts toward higher-cost travel options. When baseline safety conditions are inadequate, women may face a systematic trade-off between personal safety and monetary expenditure.

To address this gap, we designed a stated preference (SP) experiment to examine mode choice among metro, ride-hailing, and autonomous robotaxi services in Shanghai. By incorporating safety-related attributes, including driver gender, in-vehicle monitoring, security patrols, and lighting conditions, into the choice experiment, we estimate how variations in safety conditions shape gender-differentiated mode preferences.

Using multinomial logit (MNL), we first identify gender differences in sensitivity to safety attributes and estimate willingness-to-pay (WTP) for safety enhancements. This study makes three key contributions. First, it reconceptualizes the transportation pink tax as a structural safety-compensation mechanism, rather than merely a reflection of preference differences. Second, it provides quantitative estimates of gender-specific safety premiums and connects them to mode substitution and resulting expenditure outcomes. Third, it demonstrates how targeted safety interventions in public transport systems can alleviate gendered monetary burdens and foster more equitable urban mobility.

2. SURVEY DESIGN AND DATA COLLECTION

2.1 Stated preference experimental design

The stated preference experiment included three travel modes representing distinct combinations of cost structures and safety configurations: metro, ride-hailing, and robotaxi services. Attribute selection was informed by prior research on gendered safety, platform-based mobility services, and autonomous vehicle adoption, as well as by contextual considerations specific to Shanghai's transportation system. The experiment incorporated two broad categories of attributes: trip-related attributes and safety-related attributes. A full summary of all attributes and levels is presented in Table 1.

Table 1. Attributes and attribute levels in the SP experiment

Attribute		Metro	Ride-hailing	Robotaxi
Travel period		Morning peak (7:00-9:00) | Daytime off-peak (9:00-17:00) | Evening peak (17:00-20:00) | Nighttime off-peak (22:00-00:00)		
Travel cost (CNY)	**Short trip**	3 | 4 | 5	Daytime off-peak: 20 | 25 | 30 Peak hours: 30 | 35 | 40 Nighttime off-peak: 25 | 30 | 35	Daytime off-peak: 15 | 20 | 25 Peak hours: 25 | 30 | 35 Nighttime off-peak: 20 | 25 | 30
	Medium trip	3 | 5 | 7	Daytime off-peak: 25 | 30 | 35 Peak hours: 30 | 40 | 50 Nighttime off-peak: 25 | 35 | 45	Daytime off-peak: 20 | 25 | 30 Peak hours: 25 | 35 | 45 Nighttime off-peak: 20 | 30 | 40
	Long trip	5 | 7 | 10	Daytime off-peak: 40 | 50 | 60 Peak hours: 40 | 60 | 80 Nighttime off-peak: 40 | 55 | 70	Daytime off-peak: 35 | 45 | 55 Peak hours: 35 | 55 | 75 Nighttime off-peak: 35 | 50 | 65
In-vehicle travel time (min)	**Short trip**	10 | 15 | 20	Daytime off-peak: 15 | 25 | 35 Peak hours: 20 | 30 | 40 Nighttime off-peak: 15 | 20 | 25	Daytime off-peak: 15 | 25 | 35 Peak hours: 20 | 30 | 40 Nighttime off-peak: 15 | 20 | 25
	Medium trip	15 | 20 | 25	Daytime off-peak: 20 | 30 | 40 Peak hours: 20 | 35 | 50 Nighttime off-peak: 20 | 25 | 30	Daytime off-peak: 20 | 30 | 40 Peak hours: 20 | 35 | 50 Nighttime off-peak: 20 | 25 | 30
	Long trip	25 |30 | 35	Daytime off-peak: 35 | 50 | 65 Peak hours: 40 | 60 | 80 Nighttime off-peak: 30 | 40 | 50	Daytime off-peak: 35 | 50 | 65 Peak hours: 40 | 60 | 80 Nighttime off-peak: 30 | 40 | 50
Waiting time (min)		Daytime off-peak: 3 | 5 | 7 Peak hours: 1 | 3 | 5 Nighttime off-peak: 3 | 5 | 7	Daytime off-peak: 1; 3; 5 Peak hours: 5 | 7 | 10 Nighttime off-peak: 5 | 7 | 10	Daytime off-peak: 1 | 3 | 5 Peak hours: 5 | 7 | 10 Nighttime off-peak: 5 | 7 | 10
Total walking distance (km)		1 | 1.5 | 2	N/A	0 | 0.2 | 0.4
Ride-hailing driver gender		N/A	Female | Male	N/A
Security measures in vehicles		No | In-carriage CCTV | In-carriage CCTV + security staff patrols	No | Mobile-app safety monitoring | Mobile-app safety monitoring + in-vehicle camera	
Walking path environment		No street lighting | Basic street lighting | Busy street with sufficient lighting	N/A	No street lighting | Basic street lighting | Busy street with sufficient lighting



Figure 1. Introduction to the choice tasks

An orthogonal fractional factorial design was employed to generate statistically independent combinations of attribute levels. The design produced 18 choice tasks for each trip-distance category (short, medium, and long). To reduce respondent cognitive burden, the design was divided into three blocks of six choice tasks each. Respondents first indicated their typical daily trip distance category and were then assigned to the corresponding distance-specific design. Within each category, respondents were randomly allocated to one of the three blocks, resulting in each individual completing six choice tasks.

Each choice task presented the three alternatives simultaneously. Prior to the experiment, respondents were instructed to assume they were traveling alone under typical weather conditions in Shanghai. To anchor decisions in a consistent and policy-relevant context, we provided a brief vignette introducing the choice setting (Figure 1). A sample choice scenario is shown in Figure 2.

Travel period	Nighttime off-peak (22:00-00:00)		
Given travel distance (respondent-specific)	Short trip (5 km)		
Alternatives	**Metro**	**Ride-Hailing Services**	**Autonomous Robo-Taxis**
Travel cost	4 CNY	35 CNY	20 CNY
In-vehicle travel time	15 Minutes	15 Minutes	20 Minutes
Waiting time	7 Minutes	5 Minutes	7 Minutes
Total walking distance (and corresponding walking time)	2 km (About a 25-minute walk)	—	No walking required
Ride-hailing driver gender	—	Female	—
Security measures adopted by the transport mode	In-carriage CCTV cameras + security staff patrols	No security measures	Mobile-app safety monitoring features
Walking path environment	Busy street with sufficient lighting	—	—
I would choose:			

Figure 2. Example of a SP choice scenario

2.2 Measurement of Attitudinal Constructs

Given the central role of perceived safety in mode choice, the survey incorporated attitudinal items to capture latent psychological factors that may influence travel behavior. Two constructs were measured: sensitivity to personal safety and trust in autonomous driving technology. Each construct was operationalized using three statements adapted from prior research on transport safety perception and technology acceptance. Respondents reported their agreement on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). The complete list of items is provided in Table 2.

Table 2. Measurement items for attitudinal constructs

Items and Statements
a) Sensitivity to Personal Safety
o I worry about harassment or other offensive behavior when using ride-hailing services.
o Before riding, I consider the driver's gender, age, platform ratings, and other information that may affect my sense of safety (e.g., whether the driver is properly registered).
o To ensure my safety, I typically share my trip with friends or family or enable location-sharing features.
b) Trust in Autonomous Driving Technology
o I believe autonomous driving systems can make effective decisions in response to unexpected incidents.
o I believe autonomous driving technology is gradually maturing.
o I hope to have the opportunity to personally experience autonomous vehicles.

2.3 Sample Characteristics

The survey was administered online to Shanghai residents aged 20–40 via the Huixiang questionnaire platform. The finalized survey was administered between September and November 2025, yielding 800 completed responses. Data quality was ensured through a multi-stage screening process. After applying these criteria, 785 valid responses remained for analysis, comprising 391 female and 394 male participants.
The sample is nearly gender-balanced and broadly aligns with the city's gender distribution. Educational attainment exceeds the city average, a common pattern in online SP surveys.

3. RESULTS AND DISCUSSION

3.1 Determinants of Mode Choice Behavior

3.1.1 Effects of Trip-Related Attributes

This section analyzes how trip-related and safety-related attributes, travel experiences, attitudinal factors, and socio-demographic characteristics influence mode choice. Table 3 presents gender-differentiated parameter estimates from the MNL models.
The alternative-specific constants indicate that the metro is intrinsically preferred over ride-hailing and robotaxi services for both genders, reflecting its well-established role in daily commuting. As expected, travel cost has statistically significant negative coefficients across all modes and trip distances. Increases in travel time also produce significant disutility for short- and medium-distance trips, whereas the effect is not statistically significant for long-distance trips.
Waiting time for ride-hailing and robotaxi services is not statistically significant. In contrast, total walking distance for metro and robotaxi services has a statistically significant negative effect, with a consistently stronger impact on female respondents.

3.1.2 Effects of Safety-Related Attributes

For ride-hailing services, the presence of a female driver significantly increases utility for both genders, with a more pronounced effect for female passengers. Prior studies suggest that female drivers are perceived as more cautious and less risk-prone (Song et al., 2021), and gender-matching mechanisms may reduce perceived harassment risks. Similarly, in-vehicle CCTV cameras and security patrols in metro systems, as well as app-based monitoring and in-vehicle cameras in ride-hailing and robotaxi services, significantly enhance utility. These results align with evidence that

visible surveillance and monitoring mechanisms improve perceived safety in shared transport environments (Abusafia et al., 2025). Across modes, the effects of these security measures are larger for female respondents, indicating that safety enhancements generate greater utility gains for women. Improved lighting along walking routes also increases the likelihood of choosing metro and robotaxi services.

3.1.3 Effects of Attitudinal and Experiential Factors

Metro is treated as the reference alternative when interpreting attitudinal and experiential effects. Respondents with higher trust in autonomous driving technology are significantly more likely to choose robotaxis, with the effect notably stronger among women. Individuals with higher personal safety sensitivity are more likely to choose robotaxis, particularly among female respondents. This suggests that robotaxi services are perceived as mitigating certain in-vehicle risks associated with human drivers.

Travel experiences further reveal gender-differentiated behavioral responses. Female respondents who reported privacy invasions on public transport are more likely to shift to ride-hailing services, indicating a willingness to incur higher travel costs for a more private environment. In contrast, the corresponding effect for male respondents is weaker. Similarly, women who experienced a driver intentionally moving closer during a ride-hailing trip are more likely to choose robotaxis, whereas this effect is not statistically significant for men.

3.1.4 Effects of Socio-Demographic Characteristics

Among women, higher educational attainment, full-time employment, higher income, and stable living arrangements are associated with a greater likelihood of choosing ride-hailing or robotaxi services. These patterns likely reflect both greater financial capacity and stronger preferences for privacy and comfort. Conversely, women in more financially constrained circumstances, such as students, low-income earners, or those living with children, are more likely to rely on metro services. Male respondents exhibit a different pattern. For example, among men, living with children is associated with a higher likelihood of choosing ride-hailing or robotaxi services. This contrast likely reflects differences in how household responsibilities interact with mode preferences. For women, childcare responsibilities may coincide with tighter household budgets, reinforcing reliance on lower-cost modes. For men, however, co-residence with children may increase the value placed on scheduling flexibility and direct routing, thereby enhancing the relative appeal of door-to-door services.

Table 3. MNL model estimation results

Variable	Female (N = 391)						Male (N = 394)					
	Metro		Ride-Hailing		Robotaxi		Metro		Ride-Hailing		Robotaxi	
	Coef.	Z value	Coef.	Z value	Coef.	Z value	Coef.	Z value	Coef.	Z value	Coef.	Z value
ASC	*reference*		-2.05***	-3.76	-2.00***	-3.96	*reference*		-1.47***	-3.01	-1.48***	-3.06
Trip-Related Attributes:												
Travel Cost (Short trip)	-0.44***	-3.78	-0.06***	-2.74	-0.08***	-3.25	-0.32**	-2.49	-0.05**	-2.02	-0.08***	-3.82
Travel Cost (Medium trip)	-0.27***	-7.46	-0.05***	-4.19	-0.02***	-3.29	-0.20***	-5.87	-0.04***	-3.63	-0.04***	-6.22
Travel Cost (Long trip)	-0.11**	-2.36	-0.04***	-4.87	-0.02***	-3.02	-0.16***	-3.47	-0.04***	-4.79	-0.04***	-5.61
In-Vehicle Travel Time (Short)	-0.07***	-2.94	-0.08***	-4.54	-0.02#	-1.54	-0.06**	-2.19	-0.06***	-2.74	-	-
In-Vehicle Travel Time (Medium)	-0.01#	-1.04	-0.04***	-3.55	-0.02***	-2.59	-0.05***	-3.7	-0.03***	-3.33	-0.02***	-3.29
Waiting Time (Morning peak)	-0.13***	-3.54	-	-	-	-	-	-	-	-	-	-
Total Walking Distance	-0.65***	-5.42	N/A		-0.88***	-2.83	-0.44***	-3.69	N/A		-0.85 ***	-2.71
Safety-Related Attributes:												
Female ride-hailing driver	N/A		0.81***	5.76	N/A		N/A		0.14#	1.09	N/A	
In-vehicle security measures:												
No additional security measures	*reference*						*reference*					
In-carriage CCTV /Mobile-app monitoring	0.43***	3.35	0.84***	5	0.51***	4.11	0.33***	2.68	0.64***	4.19	0.20*	1.66
In-carriage CCTV + security patrols / Mobile-app monitoring + in-vehicle camera	0.55***	4.65	0.88***	5.08	0.87***	6.92	0.39***	3.37	0.79***	4.87	0.61***	4.78
Walking Environment:												
No lighting facilities	*reference*						*reference*					
Basic lighting facilities	-	-	N/A		0.92***	4.34	-	-	N/A		0.77***	3.81
Busy Street with Sufficient Lighting	0.28*	1.84	N/A		0.58***	3.81	0.39**	2.56	N/A		0.21#	1.37
Attitudinal & Experience Factors:												
Trust in Autonomous Driving Technology			-	-	0.34***	6.44			-	-	0.21***	4.13
Sensitivity to Personal Safety			-	-	0.20***	3.26			-	-	0.13***	3.03
Weekly frequency of using public transportation (PT)			-0.05#	-1.62	-0.06**	-2.5			-	-	-	-
Invasions of privacy on PT (covert photography/stalking)			0.43*	1.87	-	-			0.31#	1.36	-	-
Driver intentionally moved close/attempted contact			-	-	0.25#	1.34			-	-	-	-
Socio-Demographic Factors:												
Education:												
Bachelor's degree			0.53***	2.68	0.49***	3.25			-0.30*	-1.78	0.47***	3.89
Master's degree or above			0.38#	1.3	0.48**	2.17			-0.63***	-2.68	-	-
Marital status: Single			0.26#	1.12	0.26	1.57			0.32**	2.03	0.30**	2.38
Living arrangement:												
Living with children			-0.40**	-2.04	-0.36**	-2.48			0.45***	2.88	0.43***	3.34
Living with spouse/partner			0.52**	2.35	0.29*	1.75			-	-	-	-
Employment type:												
Student			-0.42#	-1.47	-0.46*	-1.74			0.93***	2.84	-	-
Full-time employee			-	-	0.41***	2.94			0.18#	1	0.25*	1.73
Monthly income:												
Above 20,000 CNY			1.08***	3.31	0.55**	2.05			-	-	0.36**	2.09
Below 7,000 CNY			-0.27*	-1.76	-0.35***	-3.12			-0.81***	-4.84	-0.47***	-3.75
Car purchase purpose:												
Private & safer for female family			0.41#	1.11	0.64**	2.38			1.54***	3.01	0.65**	1.97
Freedom/weekend trips			-0.63**	-2.05	-0.71***	-3.13			-	-	-	-
Ease peak-hour commuting / avoid crowding PT			0.37#	1.08	-	-			-0.76*	-1.71	-	-
Model Fit Statistics:												
Number of cases	4710											
Number of parameters	105											
Log-likelihood of constants only model	-4811.63											
Log-likelihood at convergence	-4216.54											

Notes: ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively;
# indicates not statistically significant at 10% level, but $|Z| > 1$.

3.2 Willingness-to-Pay for Safety Enhancements

Table 4 presents WTP estimates for safety-related attributes across different travel distances. WTP values derived from the alternative-specific constants indicate that respondents generally prefer the metro over ride-hailing and robotaxi services. The more negative values observed for women suggest a greater compensation requirement relative to men under otherwise comparable conditions.

Women generally exhibit higher WTP for safety-related improvements. For robotaxi services, the female–male WTP gap increases with travel distance, reaching 27.86 CNY for advanced security measures on long-distance trips, compared with 26.05 CNY and 18.75 CNY for advanced and basic measures on medium-distance trips, and approximately 4 CNY for short-distance trips. These findings suggest that security enhancements in autonomous mobility contexts confer greater marginal utility for women, particularly as exposure duration increases.

In ride-hailing services, women also exhibit higher WTP for app-based safety monitoring, although the gender gap is relatively modest, with a maximum difference of 3.68 CNY on long-distance trips. A notable exception is in-vehicle cameras, where women do not display higher WTP than men. This pattern may reflect the dual nature of surveillance technologies, which provide safety assurance while simultaneously raising privacy concerns.

Importantly, gender differences in WTP do not directly translate into differences in actual expenditures; rather, they reflect differential marginal valuation of safety improvements. The gendered safety-externality burden emerges when inadequate baseline safety conditions prompt compensatory shifts toward higher-cost travel modes.

Table 4. Estimated WTP for safety-related attributes (CNY)

Travel Distance	Variable	Female (N = 391)		Male (N = 394)		WTP gap (Female−Male)	
		Ride-hailing	Robotaxi	Ride-hailing	Robotaxi	Ride-hailing	Robotaxi
Short Trip	**ASC**	-37.19	-25.47	-31.93	-17.64	-5.26	-7.83
	Female driver	14.58	N/A	2.99	N/A	11.59	N/A
	In-vehicle security measures:						
	Mobile-app safety monitoring	15.15	6.44	13.93	2.44	1.22	4.00
	Mobile-app safety monitoring + camera	15.90	11.16	17.04	7.26	-1.14	3.90
Medium Trip	**ASC**	-44.28	-94.60	-41.03	-37.41	-3.25	-57.19
	Female driver	17.36	N/A	3.84	N/A	13.52	N/A
	In-vehicle security measures:						
	Mobile-app safety monitoring	18.04	23.92	17.90	5.17	0.14	18.75
	Mobile-app safety monitoring + camera	18.94	41.44	21.89	15.39	-2.95	26.05
Long Trip	**ASC**	-54.56	-98.77	-42.53	-37.41	-12.03	-61.36
	Female driver	21.39	N/A	3.98	N/A	17.41	N/A
	In-vehicle security measures:						
	Mobile-app safety monitoring	22.23	24.97	18.55	5.17	3.68	19.80
	Mobile-app safety monitoring + camera	23.33	43.25	22.69	15.39	0.64	27.86

4. POLICY RECOMMENDATIONS

4.1 Policy Scenario Simulations

Based on policy scenario simulations using the estimated model, Table 5 presents changes in metro choice probabilities under enhanced safety conditions. Baseline probabilities are derived from the current scenario estimated by the MNL model. The simulations show that reducing total walking distance by 50%, installing CCTV cameras inside carriages, combining CCTV with security patrols, and improving lighting along walking paths increase the probability of choosing the metro by 5.04%, 7.47%, 9.61%, and 5.52%, respectively.

These shifts in choice probabilities translate into tangible cost implications. For example, a female traveler making 60 trips per month would experience a 5% increase in metro usage as roughly three additional metro trips. Assuming an average cost differential of 20 CNY between the metro and higher-cost alternatives, this corresponds to a monthly saving of approximately 60 CNY.

Under more comprehensive safety improvements, such as combining CCTV with security patrols, monthly savings could reach around 115 CNY. These figures do not represent direct compensation payments, but rather reductions in expected expenditures resulting from decreased reliance on higher-cost modes.

Table 5. Changes in women's mode choice probabilities under enhanced metro safety scenarios

Policy scenarios	Mode Share Changes			Estimated monthly savings (CNY)
	Metro	Ride-Hailing	Robotaxi	
Base case#	46.56%	16.56%	36.88%	
Total walking distance reduced by 50%	**+5.04%**	-1.42%	-3.62%	60
Security measures				
Presence of in-carriage CCTV	**+7.47%**	-2.42%	-5.05%	90
Presence of in-carriage CCTV + security staff patrols	**+9.61%**	-3.09%	-6.52%	115
Walking Environment				
Presence of busy streets with sufficient lighting	**+5.52%**	-1.74%	-3.78%	66

4.2 Policy Recommendations

4.2.1 Transitional Pricing Mechanisms

While structural safety improvements should remain the primary goal, economic instruments can serve as transitional measures where infrastructure or operational upgrades cannot be implemented immediately. The WTP estimates show that women assign higher marginal value to specific safety features, particularly in robotaxi contexts. Rather than framing these differences as a direct "price gap," they can guide targeted pricing strategies aimed at reducing the economic burden of safety-driven mode substitution. For instance, platforms could provide discounted access to enhanced safety features during nighttime travel or in higher-risk areas. Similarly, governments could incentivize operators to integrate gender-responsive safety provisions without passing the full cost onto users.

4.2.2 Heterogeneity-Aware Service Design

The heterogeneity analysis reveals considerable within-gender variation in preferences for safety-related attributes, indicating that uniform safety interventions may be inefficient. Platforms could therefore implement flexible, opt-in safety configurations that allow passengers to select protection levels aligned with their individual needs. For example, optional female-driver matching or enhanced pick-up lighting could be offered dynamically rather than universally mandated. Such differentiated service design reduces unnecessary resource allocation while addressing heterogeneous safety valuations. Crucially, this approach avoids assuming homogeneous preferences within gender groups and aligns with the evidence that safety valuation varies significantly across individuals.

4.2.3 Safety-by-Design Principles for Robotaxi Systems

The larger WTP differences observed in robotaxi services suggest that perceived uncertainty in autonomous contexts amplifies the marginal value assigned to safety features. If such features are offered only as add-ons, they risk creating a stratified safety environment, in which basic

protection becomes a premium service. To prevent this, safety-by-design principles should be incorporated as default system features. These may include transparent emergency response protocols, real-time remote operator intervention, clearly communicated data governance standards, and pick-up/drop-off infrastructure designed for visibility and surveillance. Embedding safety as a standard feature reduces the likelihood that emerging mobility systems generate new forms of gender-differentiated burden.

5. CONCLUSIONS

The concept of a "pink tax" in transportation rarely manifests as direct fare discrimination but instead emerges as a structural safety-compensation burden, where inadequate baseline safety conditions lead women to shift toward higher-cost travel options. Using a SP experiment in Shanghai, this study analyzes mode choice among metro, ride-hailing, and robotaxi services under varying safety conditions. The results reveal systematic gender differences in the valuation of safety attributes: women gain greater marginal utility from female ride-hailing drivers, enhanced in-vehicle monitoring, and improved lighting, and place substantially higher value on security measures, particularly in robotaxi services. Policy simulations indicate that improving metro safety can reduce women's safety-compensation burden by increasing metro use and lowering safety-driven mode substitution. Overall, the findings suggest that gender inequality in urban mobility is shaped not only by differences in preferences but also by the structural organization of safety within transport system.

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