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GREEN DELIVERIES ON A BUDGET: HOW SUSTAINABILITY AND COST SHAPE VIETNAMESE E-COMMERCE CONSUMER CHOICES

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ABSTRACT

This exploratory research provides a study to examine the relationships between perceived sustainability (PS) and perceived cost (PC) on consumer attitudes (AT), intention to use (IU), and actual choice of delivery methods (DM) in e-commerce in Vietnam under Stimulus-Organism-Response (S-O-R) framework. PS has a positive effect on AT, indicating that there is increasing ecological awareness, while PC has a negative effect on AT, indicating cost sensitivity. AT is a strong predictor of IU, but IU has little influence on DM. Instead, AT causes behaviour, and so the latter one suggests intrinsic values may drive sustainable behaviour more than intentions. Age and gender have no significant effect, but income negatively affects AT, consumers with higher income may see the existence of eco-friendly options as inconvenient. An Importance-Performance Map Analysis (IPMA) results reveal PS can be considered a high-performance strategic driver of AT and PC a barrier. The findings advise businesses to focus on sustainability communication and provide financial incentives to ease cost issues. Policymakers need to promote sustainable logistics adoption via subsidies and public-private partnerships to alleviate cost barriers and encourage green last-mile solutions through policies and incentives promoting affordability.

Keywords: *Sustainable Delivery, Consumer Attitudes, Perceived Cost, Perceived Sustainability, Last-Mile Delivery, Vietnam*

1. INTRODUCTION

The growth of e-commerce has transformed consumer purchasing behaviour globally, redefining expectations for convenience, speed and delivery flexibility. In 2025, the global online retail sales are expected to exceed USD 6 trillion, creating a lot of demand for logistics systems to be more efficient while taking care of the environment (Statista, 2024; UNCTAD, 2023). Among all stages of the logistics chain, last-mile delivery is acknowledged as the most resource-intensive, most expensive, and most environmentally damaging of the components of the entire logistics chain, being responsible for a large proportion of overall distribution cost and urban carbon emissions (Mavhungu, 2019; Mangiaracina et al., 2019; Niemeijer and Buijs, 2023). Sustainability and environmental performance have increasingly become important business and consumer concerns, and the knowledge of variables that promote adopting green delivery strategies is critical to this work. The significance of these factors is even stronger in Vietnam.

The nation has become one of the fastest growing e-commerce markets in Southeast Asia due to the fast digitalization, increase in consumer purchasing power, and widespread adoption of online shopping platforms (Nguyen et al., 2021). On top of this rapid expansion has put pressure on logistics providers, who, being most of them, depend on traditional delivery types, contribute significant congestion, pollution and transportation cost, especially in dense cities such as the densely populated cities of Ho Chi Minh City and Hanoi (Thi et al., 2025). Sustainable and eco-friendly services are being embraced by Vietnamese consumers even though environmental consciousness is high; there are little to no sustainable delivery solutions being adopted due to fear of cost, lack of infrastructure, and uncertainty about their sustainable use (Amaya et al., 2025). This distance between the consumer and the environmentally friendly aspect of green delivery in sustainability, with the consumer as the target market and their demand is found to be as the global demand curve of growing. In addition, despite the heightened international awareness about sustainability, there are scant empirical references on the effects of perceived sustainability on consumer behaviour in last mile delivery. Most published research has addressed consumption of green products, environmental attitudes, or sustainable purchasing behaviour more generally (White et al., 2019; Nguyen, 2023; Tran and Nguyen, 2023). This has made the area of sustainable logistics, especially among developing nations, under researched. In addition, only a few studies investigate environmental (perceived sustainability) and economic (perceived cost) factors independently in forming consumer preferences for delivery methods which indicates research gap. Finally, to fill this gap, the research aims at investigating how perceived sustainability (PS) and perceived cost (PC) influence consumer attitudes (AT), behavioural intention (IU), and selection of actual delivery method (DM) in Vietnam's e-commerce industry by using the Stimulus-Organism-Response (S-O-R) model.

Moreover, S-O-R is especially applicable in this application, for it directly explains how external delivery-related stimuli (e.g., perceptions of sustainability, perceived cost) are stimuli that serve as drivers which orient a consumer's internal judgement (attitudes) to be followed up by subsequent responses (intention and choice of delivery method). Although such alternative perspectives as Theory of Planned Behaviour (TPB) highlight intention formation (Ajzen, 1991), they do not foreground the potential for exogenous stimuli in the form of market-facing logistics cues, which lies at the heart of last-mile delivery decision making. Compared to other technology-driven adoption models (e.g., TAM and UTAUT), the model of S-O-R is better designed to account for the overlapping role that sustainability and cost perceptions play as situational triggers, thereby rendering it well-suited to consumer decisions in e-commerce logistics (Ting and Ahn, 2025). In this way, the S-O-R framework offers a holistic framework for interpreting how external stimuli condition internal cognitive evaluations, influencing behaviour outcomes (Vafaei-Zadeh et al., 2025). Applying this framework for sustainable last-mile delivery enables to deeper understand the psychological mechanisms involved in the decisions made by consumers, and to what extent positive attitudes are converted into behaviour, making the well-known intention–behaviour gap (Vermeir and Verbeke, 2006) even more challenging. As controls, demographic variables — age, gender, income are included to maximize the explanatory power of the model. While previous research argues that demographic and environmental demographics strongly impact consumers' attitudes of environmental stewardship and sustainable consumption behaviour, results are mixed and context-dependent (Rawat, 2015; Szulc-Obłoza and Żurek, 2024). The addition of these variables offers a more complex analysis of consumer heterogeneity in the context of Vietnamese fast-growing digital economy. The present study adds to literature in three aspects.

Firstly, it expands the S-O-R framework into a new research area, applying it in the perspective of sustainable last mile delivery in an emerging economy, and as a result, broadening theoret-

ical analysis of environmentally friendly consumer behaviour. Secondly, it has offered novel evidence toward understanding the process by which sustainable last-mile delivery adoption depends on attitudes, showing that these are the factors that directly determine delivery-method choice and intention does not translate into behaviour in this context. Thirdly, by bringing perceived sustainability and perceived cost together as parallel stimuli, the study shows how economic friction (perception of cost) can dampen favourable evaluations even when perceptions of sustainability are strong, which is in the e-commerce logistics setting of an emerging market. These findings are of relevance when it comes to emerging markets like Vietnam as countries move towards sustainable and efficient delivery systems, the model will be adopted increasingly more quickly.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

The sustainability in supply chain management has attracted significant attention due to the increasing awareness of consumer demand for green business tactics and pressure from environmental regulation (Li and Xiong, 2025). Sustainability management requires a harmonization of eco-friendly practices throughout sourcing, production and distribution for the least pollution and the same operationally viable operations (Mangiaracina et al., 2019). This focus is especially noticeable for logistics, such as last-mile transport, which delivers the most carbon emissions to customers in the whole supply chain (Niemeijer and Buijs, 2023). Important strategies to reduce carbon footprints, optimise energy-efficient vehicles and improve fuel efficiency, including environmentally friendly use of transportation modes such as electric vehicles and cargo bikes (Andrei et al., 2024). The last-mile delivery process plays an important role in determining customer satisfaction, but it is still one of the most resource consuming and environmentally intensive logistics phases with most energy and environmental challenging stages of last-mile delivery (Thi et al., 2025). Although old world is characterised by a high-technology delivery practices, persistent shortcomings, especially poor delivery patterns in terms of low delivery density and frequent redeliveries, have motivated attention to alternative solutions like parcel lockers, click-and-collect services, and eco-delivery mode and green delivery solutions (Andrei et al., 2024). The trade-off between cost, convenience and environmental sustainability poses unique challenges in emerging markets such as Vietnam. Although public perception was positive regarding sustainability, uptake of cost-intensive green delivery methods (e.g., electric vehicles, drones) has been limited by both economic and infrastructure constraints (Nguyen et al., 2021). The present research adopts a S-O-R framework to investigate consumer behaviour in the context of external stimulus–internal judgment (organism), which influences behavioural outcomes (Vafaei-Zadeh et al., 2025). The S-O-R framework is utilized widely in developed markets, but its application in developing countries such as Vietnam is still limited, where cultural and economic conditions strongly influence consumer responses (White et al., 2019). Despite the recognition among recent Vietnamese studies of the burgeoning consumer market around green consumption or the crucial role of attitudes of consumers in sustainable choices (Nguyen, 2023; Tran and Nguyen, 2023), the gap remains in sustainable delivery methods. In particular, the focus of this work is PS, PC, AT, IU and DM relationships in the sustainability last-mile preferences in Vietnam. Demographic variables such as age, gender and income are included as control variables to bolster the explanatory power of the model. From this conceptual background we derive the following hypotheses:

Hypothesis 1 (H_1): Perceived sustainability positively and significantly affects consumers attitudes towards last-mile delivery solutions.

Hypothesis 2 (H_2): Perceived cost significantly and negatively affects consumer attitudes toward last-mile delivery methods.

Hypothesis 3 (H_3): Consumer attitudes significantly and positively influence the intention to use sustainable last-mile delivery methods.

Hypothesis 4 (H_4): The intention to use sustainable last-mile delivery methods has a significant and positive effect on actual choice of delivery mode.

Hypothesis 5 (H_5): Consumer attitudes significantly and positively influence the choice of sustainable last-mile delivery methods.

Hypothesis 6 (H_6): Age significantly influences consumer responses toward sustainable last-mile delivery methods.

- *H_{6a}: Age significantly influences consumer attitudes toward last-mile delivery methods.*
- *H_{6b}: Age significantly influences the intention to use sustainable last-mile delivery methods.*
- *H_{6c}: Age significantly influences the actual choice of sustainable last-mile delivery methods.*

Hypothesis 7 (H_7): Gender significantly influences consumer responses toward sustainable last-mile delivery methods.

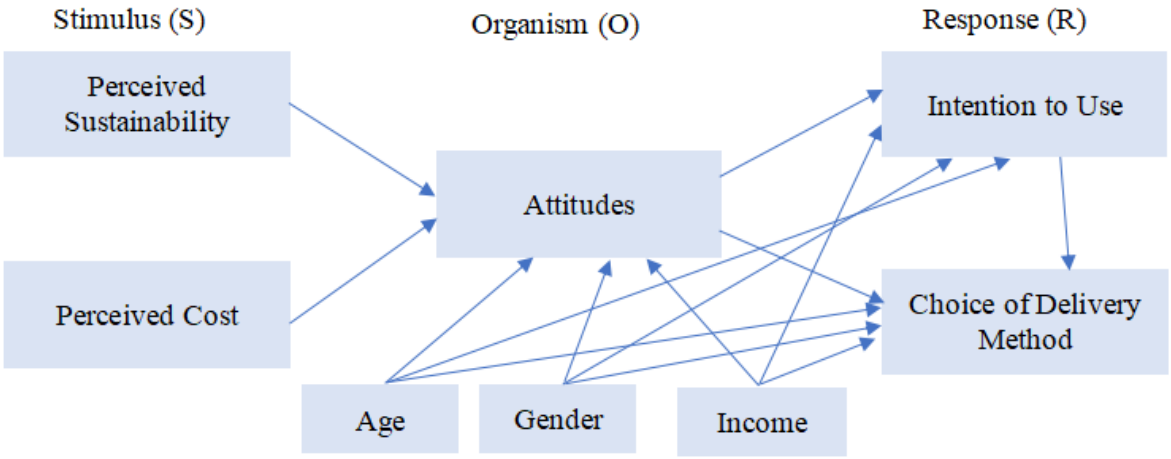
- *H_{7a}: Gender significantly influences consumer attitudes toward last-mile delivery methods.*
- *H_{7b}: Gender significantly influences the intention to use sustainable last-mile delivery methods.*
- *H_{7c}: Gender significantly influences the actual choice of sustainable last-mile delivery methods.*

Hypothesis 8 (H_8): Income level significantly influences consumer responses toward sustainable last-mile delivery methods.

- *H_{8a}: Income level significantly influences consumer attitudes toward last-mile delivery methods.*
- *H_{8b}: Income level significantly influences the intention to use sustainable last-mile delivery methods.*
- *H_{8c}: Income level significantly influences the actual choice of sustainable last-mile delivery methods.*

Figure 1 presents the structural model of the study.

Figure 1. Structural model



Source: Authors' Creation

3. RESEARCH METHODS

The methodological design of this study follows a three-stage analytical sequence to ensure rigor and consistency. First, exploratory factor analysis (EFA) was applied to identify latent

constructs and verify data suitability. Second, confirmatory factor analysis (CFA) validated the measurement model, confirming convergent and discriminant validity. Third, structural equation modelling using PLS-SEM tested hypothesized relationships. This sequential approach enhances construct validity, mitigates common-method bias, and aligns with established recommendations for behavioural studies employing small to medium samples (Sarstedt et al., 2021).

3. 1. DATA

This study involved a structured online questionnaire containing primary data collected via (*Appendix 1*). The survey was provided electronically in 2024 to a diverse sample (n=120) of e-commerce consumers in Vietnam, in which 120 valid responses were obtained. The sample size in this study is relatively modest but fulfils minimum standards for exploratory and confirmatory factor analysis. According to Hair et al. (2019) and Ringle et al. (2016), PLS-SEM and alpha-factoring are suitable for small sample studies ($\geq$ 100 cases) using communalities $>$ 0.50 with factor loadings $\geq$ 0.60, such as in this dataset. Furthermore, the goal of the study was exploratory with the goal of pattern discovery not population generalization, thus indicating methodological adequacy of the sample size. All submissions were checked for humanity using Google reCAPTCHA v3 and all points surpassed the 0.5 cutoff threshold recommended by Xu et al., (2022).

The questionnaire consisted of two parts, with one serving to capture demographic characteristics of respondents and the second addressing the constructs associated with last-mile delivery behaviour. Items in the latter section were measured using a five-point Likert scale from strongly disagree to strongly agree. It is important to emphasize that the DM construct is used as a self-reported behavioural proxy and reflects past behaviour, involving when people have selected sustainable delivery options in the past, and the likely near-term behaviour would be in accordance with such preferences, under the same delivery environment. This method represents the lived experience of e-commerce delivery decisions which in part is habitual and is driven by constraints, but also allows the respondents to report their propensity toward a choice when choices are presented overtly.

3. 2. ESTIMATION METHODS

This research investigates the structural relationships between PS, PC, AT, and IU in determining DM preferences in Vietnam and adjusts for age, gender, and income. According to Shojaei (2024), a multivariate data analysis approach was performed, which initially involved EFA to search for latent structures and then CFA to test the measurement model. EFA helps identify underlying patterns in data and CFA helps to evaluate the theoretical factor structure, improving the construct validity and reliability (Brown, 2015; Rogers, 2022; Brown and Moore, 2012). To validate the model, PLS-SEM was used to test the hypothesized relationships, which is also used in other similar research studies (Shojaei and Almansour, 2025). We focused on PLS-SEM because it is effective with small samples, is resilient to non-normal variables (Ringle et al., 2016) and suits ordinal data (like Likert-scale items) (Mukminin et al., 2020). Demographic characteristics of participants are shown in Table 1. To demarcate younger groups from older subjects, an age cutoff of 24 was used, which was consistent with demographics of Vietnam those aged 15-24 years for early entry into the labour market and 25-54 for peak working years (Index Mundi, 2023). A twenty million VND threshold for income was included for separating low/middle income and high income among them as national estimates of income (Cimigo, 2023). It would allow further examination of consumer behaviour across economic segments.

Table 1. Statistical results of demographic variables

Criteria		Frequency	Percentage
Age	< 24	44	36.7%
	≥ 25	76	63.3%
	Total	120	100%
Gender	Female	83	69.2%
	Male	37	30.8%
	Total	120	100%
Monthly Income	<20 million dong	53	44.17%
	>21 million dong	67	55.83%
	Total	120	100%

Source: Authors' Calculations

Descriptive statistics for key variables, such as online shopping frequency, familiarity with sustainable delivery, PS, PC, AT, IU and DM, are provided in Table 2. Such data reflect participants' perceptions, behaviours, and preferences. Table 2 presents standard statistical indicators such as sample size (n = 120), minimum and maximum values, median, standard deviation (SD), skewness, and kurtosis for each construct. To maintain content validity, each latent variable was calculated with multiple items namely PS (PS1-PS4), PC (PC1-PC4), AT (AT1-AT4), IU (IU1-IU4), DM (DM1-DM4). This multi-item nature lends itself to an in-depth evaluation of the constructs' dimensions. Although the descriptive statistics are useful for understanding central tendency and dispersion, the distribution deviates from normality. Based on the thresholds advocated by Kline (2023), skewness and kurtosis values indicate that several variables are not normally distributed. The existence of these deviations confirms that PLS-SEM is appropriate, robust to violations of normality, and appropriate for the analysis of ordinal data obtained using Likert-scale instruments.

Table 2. Summary of the descriptive statistics

Construct	Question	N	Minimum	Maximum	Median	Std. Deviation	Skewness	Kurtosis
Online Shopping Frequency	Q5	120	1	4	2	0.695	0.692	3.028
Familiarity with Sustainable Delivery	Q6	120	1	4	3	0.961	0.810	2.666
PS	PS1	120	1	5	4	1.164	-1.266	3.964
	PS2	120	1	5	3	1.033	0.000	2.310
	PS3	120	1	5	4	1.066	-1.548	5.095
	PS4	120	1	5	4	1.011	-1.007	3.903
PC	PC1	120	1	5	4	0.778	-0.737	3.927
	PC2	120	1	5	3	0.839	0.249	2.591
	PC3	120	1	5	4	0.970	0.669	2.928
	PC4	120	1	5	4	0.873	-1.171	4.822

Construct	Question	N	Minimum	Maximum	Median	Std. Deviation	Skewness	Kurtosis
AT	AT1	120	1	5	3	0.820	0.046	2.934
	AT2	120	1	5	4	0.837	-1.340	6.148
	AT3	120	1	5	4	0.816	-0.966	5.208
	AT4	120	1	5	4	0.809	-1.180	5.369
IU	IU1	120	1	5	4	0.857	-1.238	5.662
	IU2	120	1	5	4	0.832	-0.546	3.754
	IU3	120	1	5	4	0.855	-0.500	3.803
	IU4	120	1	5	4	0.765	-0.835	5.028
DM	DM1	120	1	5	3	1.028	-0.238	2.393
	DM2	120	1	5	3	1.073	-0.211	2.207
	DM3	120	1	5	4	0.998	-0.285	2.403
	DM4	120	1	5	4	1.045	-0.925	3.199

Source: Authors' Calculations

3. 3. MEASUREMENT MODEL ASSESSMENT

To ensure the validity and reliability of the measurement instruments, a two-stage approach was adopted consisting of Exploratory Factor Analysis (EFA) followed by Confirmatory Factor Analysis (CFA). This sequential approach aligns with recommendations by Hair et al. (2019), Brown (2015), and Shojaei (2024) for behavioural research employing latent constructs.

3. 3. 1. EXPLORATORY FACTOR ANALYSIS (EFA)

To assure conceptual clarity, EFA was conducted separately for the dependent variables (AT, IU, DM) and independent variables (PS, PC) (Gorsuch, 2014; Tabachnick and Fidell, 2001). Sampling adequacy has been verified for those two groups. The KMO for the dependent variables was 0.869 and Bartlett's test was significant ($\chi^2 = 721.546$, df = 55, $p < 0.001$), thus proving that the selection was suitable for factor extraction. For the independent variables, the KMO was 0.662 and Bartlett's test was significant ($\chi^2 = 221.27$, df = 28, $p < 0.001$) (Hair et al., 2019). Based on the Kaiser criterion (eigenvalues > 1.0) of Kaiser and Rice (1974), three factors were selected for the dependent variable group, accounting for 56.6% of total variance. IU1-IU4 loaded to factor 1, DM1-DM3 to factor 2, and AT1-AT4 to factor 3. Item DM4 showed cross-loading issues, and it was dropped. Varimax rotation was implemented based on low inter-factor correlations (<0.32), according to Corner (2009). The model fit had been satisfactory, with an RMSR of 0.04 (Kline, 2023). Two factors for the independent variables explained 45.09% of the variance. PS1, PS3, and PS4 loaded on the first factor and PC2, PC3, and PC4 loaded on the second factor. Items PS2 and PC1 were excluded because of low loadings (<0.30). The RMSR value was 0.075 which suggested an adequate model fit. Inter-factor correlations were negligible and suggest that orthogonal rotation should be used. The results confirm the straightforwardness of factor structures in each group and provide a solid ground for subsequent CFA.

3. 3. 2. CONFIRMATORY FACTOR ANALYSIS (CFA)

CFA was conducted on the refined item set to validate the measurement model. Multiple fit indices demonstrated satisfactory model performance: SRMR = 0.078 (<0.08), DULS = 1.580 (>0.90), DG = 0.480 (<2.0), and NFI = 0.550 (Almansour et al., 2025; Shi et al., 2020; Ringle and Sarstedt, 2016). These values collectively indicate that the model adequately reproduces the covariance structure of the data. Convergent validity was established through factor loadings, Composite Reliability (CR), Average Variance Extracted (AVE), and Cronbach's alpha. All constructs exceeded recommended thresholds (CR > 0.70; AVE > 0.50; loadings > 0.60) as suggested by Hair et al. (2017) and Vafaei-Zadeh et al. (2025). Perceived sustainability (PS), perceived cost (PC), attitudes (AT), intention to use (IU) and delivery method choice (DM) all demonstrated strong internal consistency.

3. 3. 3. DISCRIMINANT VALIDITY

Discriminant validity was assessed using both the Fornell–Larcker criterion (Fornell and Larcker, 1981) and the Heterotrait–Monotrait (HTMT) ratio (Henseler et al., 2015). For all constructs, the square root of each AVE exceeded its correlations with other variables, confirming discriminant validity. HTMT values remained below the 0.90 threshold (Vafaei-Zadeh et al., 2025), further supporting construct distinctiveness. In addition, the low inter-construct correlations further confirmed that each latent variable captured a unique conceptual domain, reducing concerns regarding construct redundancy. Together, the Fornell–Larcker and HTMT assessments provide strong evidence that the measurement model meets the required discriminant validity standards for behavioural research.

3. 3. 4. FINAL MEASUREMENT MODEL

The final measurement model showed strong reliability, convergent validity, and discriminant validity across all constructs, as evidenced by the removal of four low-performing items (PS2, PC1, DM4, and one cross-loading indicator). The retained indicators were examined as item removal might reduce construct domain coverage, and each of them was expected to represent the original construct conceptual meaning as specified in the measurement purification procedures (Ayob et al., 2017). The remaining perceived sustainability and perceived cost items continue to capture core aspects of environmental benefit and price sensitivity, respectively, whereas the items that were retained as delivery-method indicators represent self-reported choice tendency under availability constraints, since latent constructs refer to the operationalisation of indicators that constitute factors of consumption (Bollen, 1989). However, due to indicator deletion being a form of construct operationalization that requires refinement, the results must be treated as applying to the retained facets of each construct rather than the whole conceptual domain. Together with CFA results, those EFA results serve as robust support for the quality of the measurement model and a solid foundation for further structural model analysis (Sarstedt et al., 2021). The resulting retained items present a significantly strengthened measurement structure that is tailored for measurement across respondents for each construct. This refined model provides a reliable and theoretically coherent groundwork for testing the structural relationships put forward in this study.

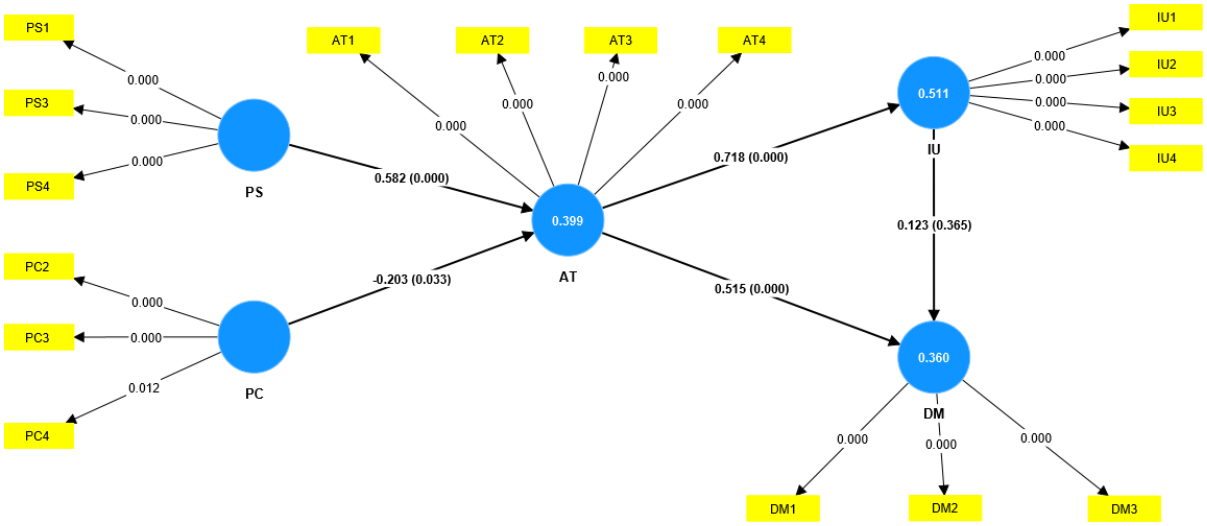
4. HYPOTHESES TESTING RESULTS

4. 1. STRUCTURAL MODEL RESULTS (PLS-SEM)

To evaluate the first five hypotheses, PLS-SEM was employed using 5,000 bootstrap samples, following the recommendations of Hair and Alamer (2022) to ensure robust estimation

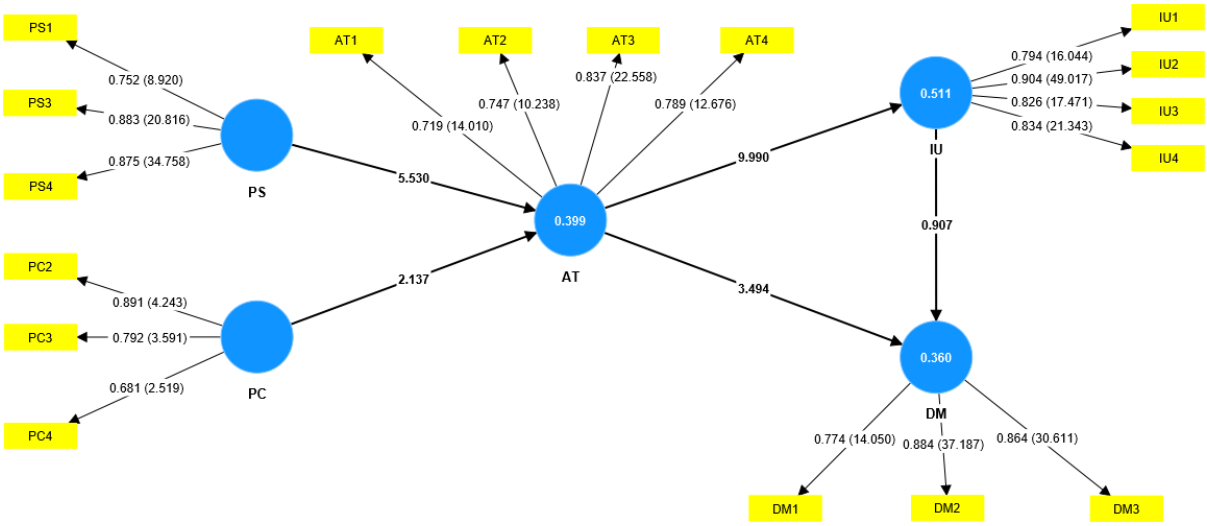
of standard errors and significance levels. The structural model results, including path coefficients and associated p-values, are presented in Figure_2. Additionally, Figure_3 displays the corresponding t-values and outer loadings, providing further insight into the significance and strength of the hypothesized relationships.

Figure 2. Structural model with path coefficients and p-values



Source: Authors' Calculations

Figure 3. Structural model with t-values and outer loading



Source: Authors' Calculations

Table 3 depicts hypothesis testing results using PLS-SEM with 95% confidence intervals. The direct effects presented are indicative of the strength and direction of the constructs associated at the structural model. This analysis reveals that PS has significant and positive impact on AT, showing that consumers who see delivery methods as sustainable are more inclined to hold favourable attitudes toward them. PC, in contrast, has a significant and negative effect on AT, indicating that greater perceived costs are related to less favourable consumer attitudes towards sustainable delivery. AT was also found to have a strong positive influence on IU, implying that positive consumer perceptions translate into a higher likelihood of intending to adopt sustainable delivery methods. In contrast, IU did not produce a significant change in DM, suggesting that intention alone may not lead to behavioural change, likely because

of external constraints or practical limitations. AT also has a statistically significant positive effect on DM, indicating that consumers with positive attitudes are expected to be inclined to conform to their preferences.

Table 3. Path coefficients and hypothesis testing results without controls

Hypothesis	Relationship	Path Coefficient (β)	STDEV	T-Value	P-Value	Result
H1	PS->AT	0.582	0.105	5.530	0.000	Supported
H2	PC->AT	-0.203	0.095	2.137	0.033	Supported
H3	AT->IU	0.718	0.072	9.990	0.000	Supported
H4	IU->DM	0.123	0.136	0.970	0.365	Rejected
H5	AT->DM	0.515	0.147	3.494	0.000	Supported

Source: Authors' Calculations

4. 2. STRUCTURAL MODEL RESULTS WITH CONTROL VARIABLES

To maximise model accuracy and to account for potential confounding effects, age, gender, and income level were entered as control variables in the structural model. These demographic variables were chosen by theoretical considerations together with their frequent use in behavioural and consumer research (Sarstedt et al., 2021). We introduced all three variables concurrently, as suggested by Becker et al. (2013), noting that combining control variables in conjunction minimizes the impact of omitted variables and ensures the adjustment of heterogeneity in observed data. As shown in Table 4, all the VIF values calculated for the relationship level are already well below the recommended cutoff value of 3.3 (Vafaei-Zadeh et al., 2024; Daoud, 2017), so the result of multicollinearity among the predictor constructs has not appeared as the result. The highest value of the VIF (2.174) was observed from the AT to DM path, which comes comfortably within the acceptable threshold. The low VIF value of Age, Gender and Income across the paths also further supported their statistical independence. And these findings reaffirm the strength of the structural model and the stability of the estimated relationships, because the interpretation of path coefficients isn't compromised by multicollinearity.

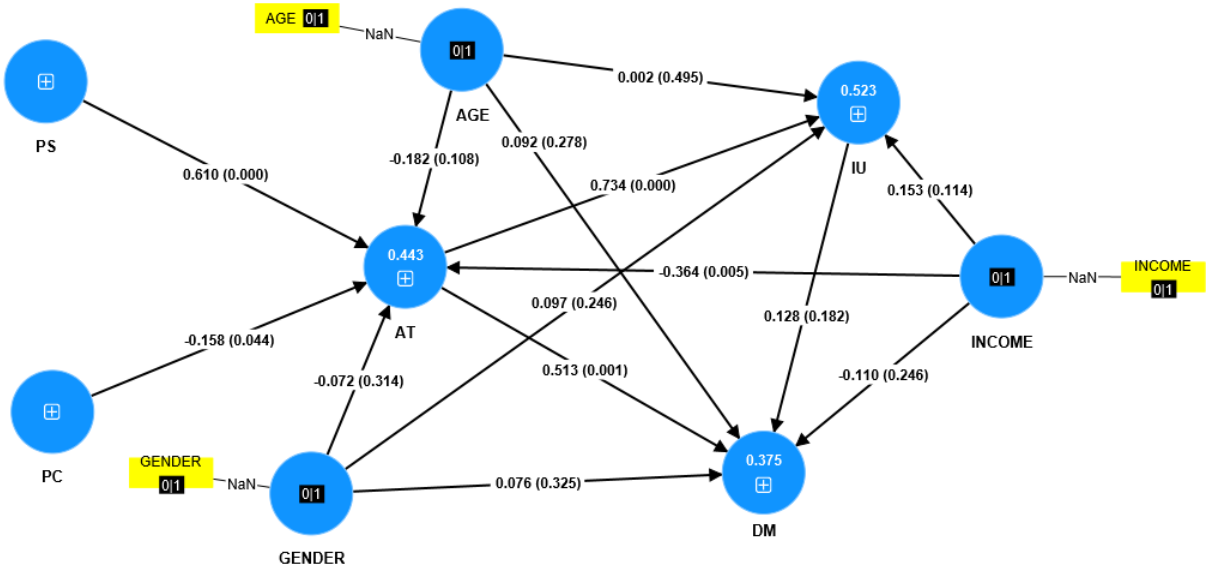
Table 4. VIF values

Dimension	VIF
AT -> DM	2.174
AT -> IU	1.044
IU -> DM	2.098
PC -> AT	1.103
PS -> AT	1.087
Age -> AT	1.083
Age -> DM	1.015
Age -> IU	1.015
Gender -> AT	1.051
Gender -> DM	1.041
Gender -> IU	1.037
Income -> AT	1.067
Income -> DM	1.039
Income -> IU	1.028

Source: Authors' Calculations

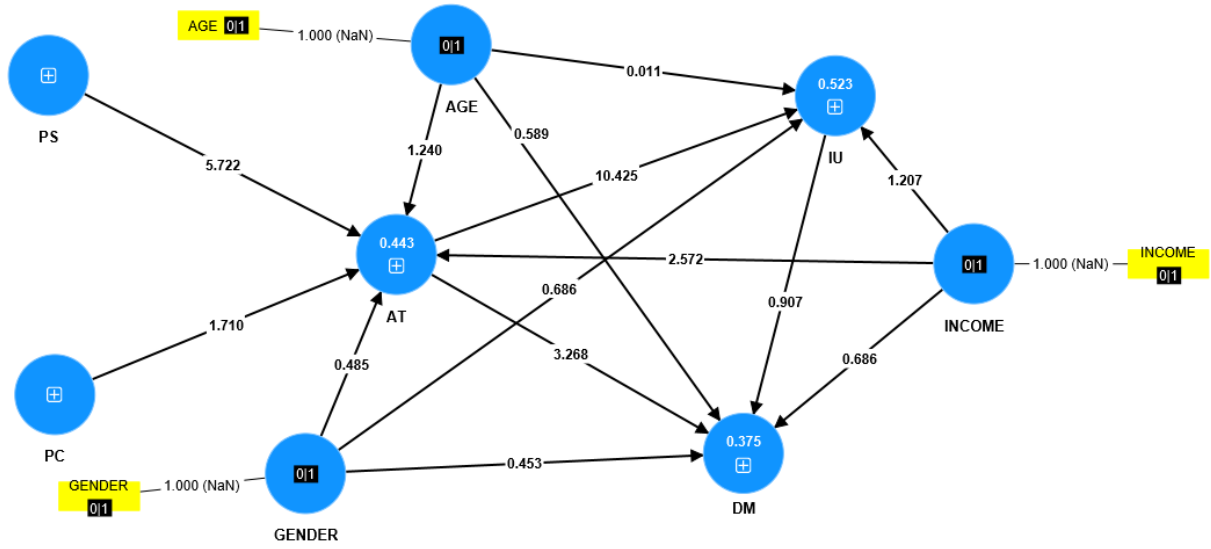
The results of the structural model incorporating control variables, including path coefficients and p-values, are presented in Figure_4, while Figure_5 displays the corresponding t-values and outer loadings.

Figure 4. Structural model with control variables showing path coefficients and p-values



Source: Authors' Calculations

Figure 5. Structural model with control variables showing outer loading and t-values



Source: Authors' Calculations

Table 5 summarizes the effects of age, gender, and income level as control variables on AT, IU, and DM. The results indicate that age and gender do not have statistically significant impacts on any of the outcome variables. In contrast, income level exhibits a significant negative effect on AT, suggesting that individuals with higher incomes hold less favourable views. While prior studies report mixed findings regarding the role of income in shaping consumer behaviour, the current result aligns with Szulc-Obłoza and Żurek (2024), who emphasize the complex and context-dependent nature of income's influence on sustainability-related attitudes. One possible explanation is that high-income individuals may perceive sustainable delivery methods as involving trade-offs such as longer delivery times or reduced convenience, which diminishes their appeal. These findings highlight the need to consider contextual and perceptual factors when examining the role of demographic characteristics in sustainable consumer behaviour.

Table 5. Path coefficients and hypothesis testing results with controls

Hypothesis	Relationship	Path Coefficient (β)	STDEV	T-Value	P-Value	Result
H6a	AGE->AT	-0.182	0.147	1.240	0.108	Rejected
H6b	AGE->IU	0.002	0.144	0.011	0.495	Rejected
H6c	AGE->DM	0.092	0.156	0.589	0.278	Rejected
H7a	GENDER->AT	-0.072	0.148	0.485	0.314	Rejected
H7b	GENDER ->IU	0.097	0.141	0.686	0.246	Rejected
H7c	GENDER ->DM	0.076	0.168	0.453	0.325	Rejected
H8a	INCOME->AT	-0.364	0.142	2.575	0.005	Supported
H8b	INCOME ->IU	0.153	0.126	1.207	0.114	Rejected
H8c	INCOME ->DM	-0.110	0.160	0.686	0.246	Rejected

Source: Authors' Calculations

4. 3. IMPORTANCE–PERFORMANCE MAP ANALYSIS (IPMA)

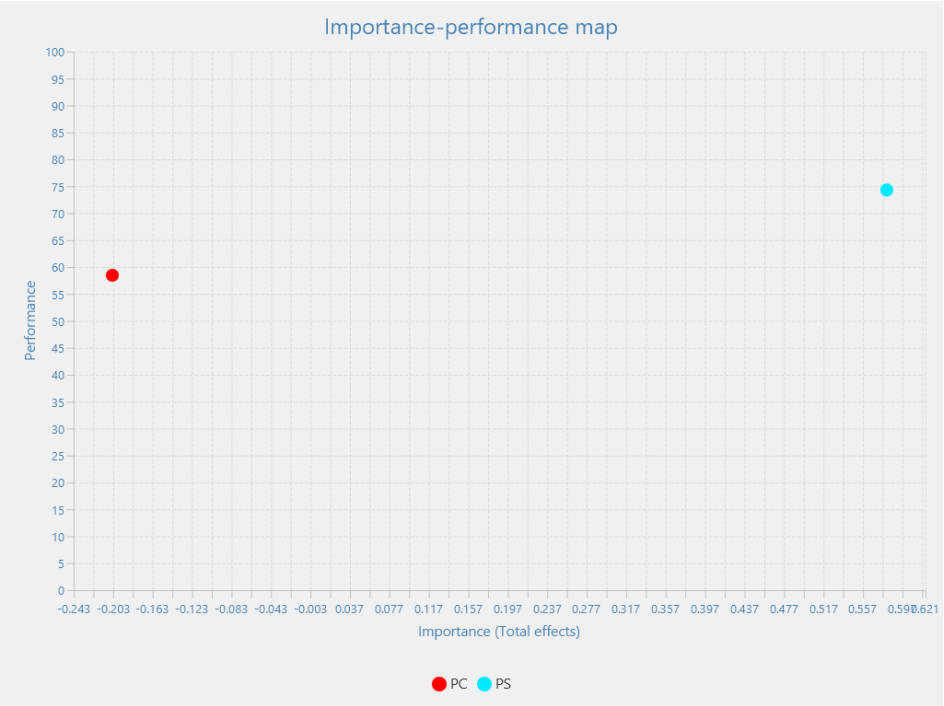
The results of the IPMA were designed to provide a richer managerial perspective than one could obtain with the standard path coefficient analysis, and AT was employed as the target construct. IPMA combines the importance (i.e., total effects) and performance (i.e., average latent variable scores) of exogenous constructs to prioritise strategic interventions (Sarstedt et al., 2021). It can be seen through Table 6 that PS possesses the largest positive total impact on AT and strong performance score. This shows that people already consider last-mile delivery as sustainable, and reinforcing messages related to sustainability might make consumers more positive in relation to their attitudes. On the other hand, PC presents a negative importance value and a relatively lower score on the performance metric. The negative importance value and relatively low performance score indicate that the cost still represents a major obstacle in the creation of positive consumer attitudes about sustainable delivery alternatives. These results (Figure_6) in visual form result in two major managerial issues. First, organisations should maintain the position of sustainability as a strategic differentiator to shape consumers' attitudes. Second and perhaps most importantly, corporations would need to tackle 'perceived cost barriers', whether that's by cutting down on true costs, providing economic inducements, or communicating effectively the value proposition through sustainability over the long-term. When applied in combination, these strategies can drive alignment of consumer perception with organizational sustainability objectives.

Table 6. IPMA Results for AT

Construct	Importance	Performance
PS	0.582	74.300
PC	-0.203	58.471

Source: Authors' Calculations

Figure 6. Importance–Performance map for exogenous constructs affecting AT



Source: Authors' Calculations

4. 4. DISCUSSION

The present study explored the associations between perceived sustainability (PS) and perceived cost (PC) on consumer attitudes (AT), intention to use (IU) and actual delivery method choice (DM) in the e-commerce industry in Vietnam based on the Stimulus–Organism–Response (S-O-R) framework. PS appears to significantly predict AT, indicating that a consumer will appraise sustainable options more favourably upon sustainability awareness in a positive way, while PC negatively affects AT, suggesting that financial worries are still a barrier to green delivery adoption. AT is highly predictive of IU, consistent with the planned behaviour theory and previous work in predicting higher behavioural intentions from positive attitudes. Nevertheless, IU provides no effect on DM, while AT affects DM. Real sustainable decisions are affected more by intrinsic motivations and moral norms than by intention. The intention-behaviour gap could be driven by situational constraints like platform defaults, delivery availability, time pressure and price differences at checkout that override previous intentions. In contrast, attitudes do seem to have an immediate influence on delivery choice under bounded rationality. Out of the demographic controls, age and gender had no significant effects on AT, IU, or DM, while income had a negative effect on AT, which can imply that wealthier consumers take sustainable delivery as less convenient. According to the IPMA results, PS was highly important and achieved high performance, and PC had negative importance and weaker performance. In all, the results indicate that both sustainability awareness and cost perceptions affected not only consumer perceptions and behaviours of sustainable last-mile delivery adoption, but also supported our findings and extended the S-O-R model, suggesting that these attitudes could also operate as predictors of behaviour, bypassing intention.

5. CONCLUSION

The findings of this study contribute to the knowledge on consumer behaviour in sustainable logistics by indicating that perceived sustainability is a strong driver of attitudes and perceived cost acts as a barrier to attitudes toward sustainability. Findings also validate the importance of the Stimulus-Organism-Response model in Vietnam's e-commerce setting and indicate a primary mediating role of attitudes on external perceptions and behavioural outcomes. Sustainable consumption behaviours are thus influenced not just by environmental value considerations but also by consumers' perceived trade-off of economy and convenience. With respect to management, the results suggest that firms should emphasize sustainability as a competitive benefit. As perceived sustainability is positively and strongly related to attitudes, organizations should support credible sustainability signalling at the point of delivery selection, which includes the use of verified green labels, emissions information and sustainability badges on checkout pages. Eco-labelling, carbon-neutral delivery badges, and clear communication of environmental value can add trust and value. On the other hand, perceived cost barriers should be addressed using incentives, loyalty programmes and bundling green delivery with premium services. As perceived cost has a negative effect on attitudes, pricing strategies should target factors that decrease the perceived premium of green delivery, such as time-limited vouchers, free green upgrades above a certain basket threshold, and cost-sharing campaigns with logistics partners. Similarly, by identifying the adverse correlation between income and attitudes, it would be clear that higher-income consumers, who may prioritise speed and convenience, should be targeted by presenting green delivery as a form of premium convenience, for example through reliable delivery windows and service guarantees, rather than only as an ethical option. Policy wise, the results indicate that regulations should address economic friction resulting from sustainable last-mile delivery. As perceived cost is negatively affecting attitudes, regulators should implement policy interventions (such as subsidies for green logistics providers, tax incentives for low emission e-commerce firms, or public-private partnerships) to reduce unit delivery cost. In Vietnam, with a price-sensitive market, information-led interventions to promote sustainability implementation may be less successful than targeted incentives. There are also a few limitations that indicate directions for future research. Firstly, the sample size (n = 120) permits exploratory inference but limits statistical power and sensitivity to subgroup comparisons; further efforts should be made by utilizing larger samples to enable stronger multi-group analyses and model extension. Second, the large proportion of female respondents may limit the gender-balanced approach to parameter estimation if the perceptions of sustainability, as well as delivery preferences, vary according to gender, and should be approached using stratified or gender-balanced sampling in future studies. Third, self-reported measures may be subject to common-method variance and social desirability bias; future studies, for example, could include behavioural data, like how people choose delivery options or transactions on the platform and introduce procedural or statistical remedies. Lastly, the online nature of the survey might limit the generalisability of the sample as more respondents might be digitally active consumers, thus indicating the need for future studies to take advantage of mixed-mode collection of data and cross-regional sampling to corroborate and further extend these results to the bigger population of Vietnam engaging in the e-commerce sector.

Disclosure statement

No potential conflict of interest was reported by the authors.

Data availability

The data of this study is available and can be shared upon request.

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6. APPENDICES

6. 1. APPENDIX 1: QUESTIONNAIRE

1. Do you agree to participate in this survey and provide the necessary information for research purposes?
    - o Yes
    - o No

Part 1: Demographic Information

2. Age
    - o 18–24
    - o 25 or more
3. Gender
    - o Female
    - o Male
4. Monthly Income (VND)
    - o Under 20 million
    - o Above 21 million
5. Frequency of Online Shopping
    - o Rarely (1–2 times per year)
    - o Occasionally (1–2 times per month)
    - o Frequently (1–2 times per week)
    - o Very frequently (more than twice per week)
6. Awareness of Sustainable Delivery Options
    - o Very familiar
    - o Somewhat familiar
    - o Not very familiar
    - o Not at all familiar

Part 2: Main Questionnaire

Please indicate your level of agreement with each statement using the following scale. 1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly Agree

Construct 1: Perceived Sustainability

(Adopted from White et al., 2019 ; Gleim et al., 2013)

1. I believe that eco-friendly delivery options reduce environmental impact.
2. I am aware of sustainable practices in last-mile delivery.
3. I feel that using eco-friendly delivery options supports environmental protection.
4. I think that companies offering sustainable delivery options are more socially responsible.

Construct 2: Perceived Cost

(Adopted from Kumar and Anbanandam, 2020 and Govindan and Chaudhuri, 2016)

1. I believe that sustainable delivery options are generally more expensive than regular options.
2. I am less likely to choose eco-friendly delivery options due to their cost.
3. The high cost of sustainable delivery options affects my willingness to use them.
4. I would prefer a standard delivery option if the sustainable one costs significantly more.

Construct 3: Consumer Attitudes Toward Sustainable Delivery

(Adopted from White et al., 2019, Paul et al., 2016 and Gleim et al., 2013)

1. Choosing eco-friendly delivery options is important to me.
2. I view sustainable delivery options positively.
3. I feel good about supporting companies that offer eco-friendly delivery.
4. I would consider the sustainability of delivery methods when choosing a delivery service.

Construct 4: Behavioural Intention to Use Sustainable Delivery

(Adopted from Nguyen et al., 2021, Gleim et al., 2013 and Kim and Choi, 2005)

1. I am likely to choose eco-friendly delivery options in the future.
2. I plan to support companies that offer sustainable delivery methods.
3. If given a choice, I would opt for a more sustainable delivery method.
4. I intend to pay more attention to delivery options' sustainability in the future.

Construct 5: Delivery-Method Choice (self-reported past behaviour and near-term choice likelihood)

(Adopted from White et al., 2019, Nguyen et al., 2021, Gleim et al., 2013 and Vermeir and Verbeke, 2006)

1. I have chosen sustainable delivery options in the past when available.
2. In recent purchases, I have considered the environmental impact of delivery options.
3. I am willing to pay a small premium for eco-friendly delivery options in future purchases.
4. Given two similar options, I am likely to choose the more sustainable delivery method.

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