

# Packaging and social signals associated with Vietnamese consumers' stated willingness to pay a premium for green last-mile delivery packaging

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## **Abstract:**

This study investigates the factors affecting Vietnamese consumers' willingness to pay extra for green express packaging in last-mile delivery. Using signalling theory and survey data from 416 participants, the research assesses the impact of environmental signals (eco-labels, recyclability information) and social cues (government policy, peer behaviour). The results show that clear and credible eco-information strongly increases willingness to pay, while recyclable or reused materials alone have little effect due to concerns over hygiene. Social cues-particularly government initiatives and peer influence-positively shape consumer willingness. Notably, only peer behaviour among individuals with green values moderates this effect. The findings recommend that businesses enhance eco-label clarity, governments expand green packaging incentives, and social campaigns leverage peer influence to promote sustainable choices.

**Keywords:** environmental signals, green express packaging, last-mile delivery, signalling theory, willingness to pay.

**Classification numbers:** 2.2, 2.3

## **1. Introduction**

The rapid growth of the e-commerce market has significantly increased consumer demand for last-mile delivery services, where plastic packaging remains the preferred material due to its affordability, durability, and effectiveness in protecting products during transit [1, 2]. However, its widespread use, particularly of non-recyclable plastics, poses serious environmental challenges. When improperly managed, plastic waste is often incinerated or sent to landfills, contributing to pollution and endangering both human health and ecosystems [3]. In response, sustainable alternatives such as paper and cardboard packaging have gained attention, though their adoption faces barriers including higher costs, limited durability, and increased resource demands [2, 4]. This creates a trade-off between operational efficiency and environmental responsibility that businesses must navigate.

Recently, consumers' environmental awareness has increased, leading to greater interest in environmental protection initiatives and commitments. As [5] noted, customers purchase eco-friendly products because they believe this is a strategy to mitigate adverse environmental impacts, improve personal health, and provide support for local sustainability. Recyclable or renewable packaging is increasingly viewed as a viable solution for waste reduction [6] and global demand is rising, projected to reach 22 million

tons by 2030 under regulatory and consumer pressure [7]. However, sustainable express packaging typically incurs higher costs than conventional plastic bags [8], and while some consumers are willing to pay a premium for eco-friendly options [9-11], others remain reluctant despite acknowledging the environmental risks posed by plastic [12]. This reluctance may stem from differing perceptions: while green products are often viewed as offering direct benefits, packaging is seen as disposable, making consumers less willing to pay extra. In fact, many previous studies have primarily investigated consumer willingness to pay (WTP) for green products in general retail settings, while green express packaging at the delivery stage has received limited attention [13]. This is especially true in emerging economies, where rapid e-commerce growth intersects with evolving environmental policies, such as in Vietnam.

While signalling theory has been widely used to explain how consumers interpret product cues in retail or shelf-based contexts, this study extends its application to delivery-stage packaging-a less visible, post-purchase component often overlooked in signalling literature [9, 14]. Unlike traditional product packaging, green express packaging in e-commerce logistics serves not only as protection but also as a medium for sustainability communication after purchase. Moreover, this study combines both packaging-level signals (e.g. eco-labels) and macro-level signals (e.g. policy, social norms)

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into a single framework and investigates how individual green values moderate these effects, an area rarely addressed in previous work [15]. However, few studies have examined how environmental and social signals jointly influence green behaviour in emerging economies. In Vietnam, where environmental policies are evolving and collectivist culture shapes peer influence, understanding these dynamics is crucial for promoting sustainable packaging adoption [14, 16]. This study responds to that need by examining how multidimensional environmental and social signals, viewed through the lens of signalling theory, influence Vietnamese consumers' willingness to pay more for green express packaging. Moreover, this research aligns with broader international goals such as the UN Sustainable Development Goal 12 on responsible consumption and production [17] enhancing its relevance in the global context.

In addition, this research aims to address the following key questions:

RQ1: Which express packaging signals influence consumers' willingness to pay more for green parcels?

RQ2: Which societal signals influence consumers' willingness to pay more for green express packaging?

RQ3: How does green perception moderate the effects of these signals on consumers' willingness to pay more for green express packaging?

By addressing these research questions, this study not only clarifies the distinct and combined roles of environmental and social signals in shaping green purchasing behaviour, but also highlights the moderating influence of individual green values, an underexplored factor in the context of emerging economies. Through the Vietnamese lens, where cultural, regulatory, and environmental factors intersect uniquely, this research aims to provide actionable insights for policymakers, logistics providers, and e-commerce platforms seeking to design more effective green packaging strategies. Ultimately, the study contributes to extending signalling theory beyond traditional marketing settings, emphasising its relevance in post-purchase, sustainability-driven contexts.

## 2. Literature review and theoretical framework

### 2.1. Signalling theory in green delivery packaging

Signalling theory, originally developed by [15], explains how individuals or organisations convey information to reduce asymmetry between parties. In green express packaging, it describes how post-purchase packaging serves as a communication tool, signalling environmental responsibility through elements such as minimalist design, biodegradable labels, or reused materials. Compared to theories such as the Theory of Planned Behaviour (TPB) or the Norm Activation Model (NAM), which focus on internal

motivations or norms, signalling theory is more applicable in contexts where consumers rely on limited external cues to infer sustainability [18, 19]. This makes it especially relevant in online delivery, where consumers cannot inspect packaging before purchase. Furthermore, prior studies confirm that signals such as eco-labels, material claims, or price positioning significantly influence perceived credibility and willingness to pay [20-22]. When these signals lack clarity or credibility, consumers may become sceptical, reducing their trust and engagement with green packaging claims [10].

These signals are particularly relevant in the express delivery sector, where packaging is primarily designed for transportation and protection, rather than presentation. Eco-labels or sustainable design elements serve as "green signals" to consumers, reducing uncertainty and influencing purchasing decisions [23-24]. However, misleading or weak signals can create scepticism or perceptions of greenwashing, thereby weakening trust [10, 25]. In this study, signalling theory is employed to investigate how various packaging-related signals impact consumers' willingness to pay more for environmentally responsible delivery.

In emerging market contexts, previous studies have underscored the importance of innovation capacity, ESG orientation, and stakeholder responsiveness in shaping green practices and consumer attitudes. Numerous studies have emphasised the role of innovation, stakeholder engagement, and ESG strategies in influencing organisational behaviour and consumer attitudes in emerging markets [26-29]. These findings support the relevance of green initiatives and contextualise consumer responses to sustainability signals, particularly in transitional economies such as Vietnam.

### 2.2. Multidimensional signals from the environment

Signalling theory also acknowledges that message interpretation is influenced by the broader environment, including social and policy contexts. In Vietnam, the government has implemented frameworks such as Decree No. 08/2022/ND-CP [30], which mandates Extended Producer Responsibility (EPR), requiring companies to take greater accountability for their packaging waste. This regulation acts as a strong macro-level signal, shaping both business practices and consumer expectations around sustainable packaging [31]. In green packaging, multidimensional signals are classified into two categories: packaging-level cues (e.g. recyclable materials, eco-labels) and macro-level influences (e.g. social norms, government policy).

At the packaging level, signals such as recyclable content or reused packaging aim to highlight environmental value. However, prior studies show that these attributes may also trigger negative perceptions due to concerns

about contamination or product quality degradation [32, 33]. Eco-labels and clear green information, when supported by third-party certification, help reduce ambiguity and build trust [34-35].

From the environmental context, government incentives and evolving social norms also play a crucial signalling role. Public policies such as subsidies for green packaging or environmental taxes send institutional cues encouraging eco-conscious consumption [36]. Likewise, consumer behaviours such as public green participation or social media advocacy can act as behavioural signals influencing peer decisions [37-38].

Lastly, how consumers interpret these signals depends on their personal green perception-their values, concern, and awareness regarding environmental protection. Consumers' green perception, defined as their environmental awareness, values, and attitudes, significantly influences how they interpret external signals [9, 39]. Individuals with strong green values are more attuned to both policy and social signals; however, prior research suggests they may respond differently depending on the perceived credibility and relevance of the source. For example, institutional cues (e.g. government policy) may require cognitive alignment with personal norms, while social cues (e.g. peer behaviour) trigger affective or normative conformity responses [38, 40]. Therefore, this study explores whether green perception moderates each signal type differently, potentially enhancing the effect of peer norms more than institutional mandates.

### 2.3. Research hypotheses

The role of green express packaging in last-mile delivery has emerged as a key signal of environmental responsibility in the e-commerce sector. However, consumer responses to this signal are not uniform; they depend on factors such as the clarity of the messaging and the individual's environmental values. This section delves into the conceptual foundations of signalling theory and draws on empirical studies to outline the development of the research hypotheses. By integrating these insights, the study aims to explore how different types of signals, both institutional and social, impact consumers' willingness to pay for environmentally friendly packaging. Based on this framework, the following hypotheses are proposed to further examine the factors shaping consumer behaviour in this context.

While recyclable and reused materials are intended to promote environmental sustainability and contribute to circular economy principles, they often provoke mixed consumer reactions. Although these materials help reduce landfill waste and minimise resource consumption [41], they may also be perceived as inferior in terms of quality or hygiene. This phenomenon, known as "perceived contamination", creates psychological discomfort,

particularly in contexts where packaging cleanliness is closely linked to product safety, such as in food or cosmetics [32-33]. G. Lin, et al. (2022) [42] and Y.G. Gencer (2016) [43] further emphasise that reused materials can lead to a diminished sense of value or freshness, especially when they are not communicated clearly. If not carefully managed, these associations can weaken the positive effect of sustainability on consumer decision-making and reduce willingness to pay a premium [44]. Recent studies [13, 20] confirmed that clear, credible packaging cues such as eco-labels and green claims are essential to enhance trust and support consumer willingness to pay.

*H1: The recyclable and used attributes of express packaging negatively affect consumers' willingness to pay more.*

Packaging that includes clear and credible environmental information, such as recyclability symbols, third-party certifications, or biodegradable claims, acts as a strategic communication tool to reduce information asymmetry [18-19]. These signals help consumers recognise the environmental value of packaging, especially when such claims are backed by external validation [34]. M. Gupta (2021) [45] and S.G. Tawde, et al. (2024) [39] found that transparent and informative labelling boosts trust and enhances perceived product quality. On the other hand, vague or exaggerated claims can lead to confusion or scepticism, commonly known as greenwashing [46]. From the perspective of signalling theory, the credibility and clarity of such eco-information determine its effectiveness in influencing willingness to pay more for sustainable alternatives. Based on this, the study proposes:

*H2: Eco-friendly information on packaging positively affects consumers' willingness to pay more.*

Macro-level signals such as public policy frameworks and social norms exert a substantial influence on consumer behaviour. Social norms, encompassing what is perceived as socially acceptable or desirable, can shape sustainable behaviours by triggering conformity or social approval mechanisms [40, 47]. Simultaneously, government regulations, including environmental taxes, incentives, or Extended Producer Responsibility (EPR) frameworks, serve as institutional signals for legitimising and promoting sustainable consumption [36]. In Vietnam, policies such as Decree No. 08/2022/ND-CP on EPR send strong messages to both businesses and consumers about the importance of adopting eco-friendly practices and environmental responsibility. Prior studies show that such aligned institutional and social cues enhance consumers' willingness to pay for green alternatives [48]. Hence, the following hypothesis is proposed:

*H3: Government policies and social norms positively influence consumers' willingness to pay more.*



In today's interconnected world, consumer behaviours—especially sustainable actions—are increasingly shaped by the actions of others. When individuals observe peers using green packaging or advocating for sustainability online, these behaviours serve as social proof, indicating that such actions are appropriate and beneficial [37, 49]. This phenomenon is especially influential in collectivist cultures or digital environments where public actions—such as unboxing content or eco-themed user reviews—are easily visible and widely shared [38, 50]. These forms of consumer engagement generate symbolic value and reinforce normative expectations, making consumers more receptive to green packaging even at a higher price point [51]. Consequently, peer behaviour becomes a powerful form of signalling that can alter perceived value. Thus:

*H4: Consumers' engagement positively affects the willingness of consumers to pay more.*

Consumers' green perception, defined as their environmental awareness, values, and attitudes, significantly influences how they interpret external signals [9], [39]. Those with a strong green mindset are more sensitive to packaging cues, policy signals, and social behaviours, and more inclined to align their choices with sustainability goals [52]. In contrast, consumers with low environmental concern may require stronger external signals or visible social engagement to be persuaded [53]. C. Cong, et al. (2023) [9] suggest that green values moderate the relationship between signal type and behaviour, especially in pricing contexts. Additionally, familiarity and cultural resonance may alter how individuals perceive environmental claims [54]. Accordingly, this study proposes that green perception not only drives direct willingness to pay but also moderates how consumers respond to different types of environmental signals.

This distinction is echoed in [21], who found that consumers with high environmental concern tend to be more discerning and demand stronger justification for green claims. Similarly, P. Plotkina, et al. (2025) [22] emphasised that green brand image and peer validation become particularly influential among eco-conscious buyers, reinforcing the role of social influence in shaping sustainable choices.

*H5a: Consumer's green perception moderates the relationship between attitudes towards recyclable and used packaging and willingness to pay more.*

*H5b: Consumer's green perception moderates the relationship between awareness of eco-friendly information on packaging and willingness to pay more.*

*H5c: Consumer's green perception moderates the relationship between government policy and norm awareness and willingness to pay more.*

*H5d: Consumer's green perception moderates the relationship between the perception of other consumers' engagement and willingness to pay more.*

Based on the hypotheses developed above, the proposed research framework is presented in Fig. 1. The model proposes that four multidimensional signals influence consumers' willingness to pay more, with consumers' green perception acting as a moderator.

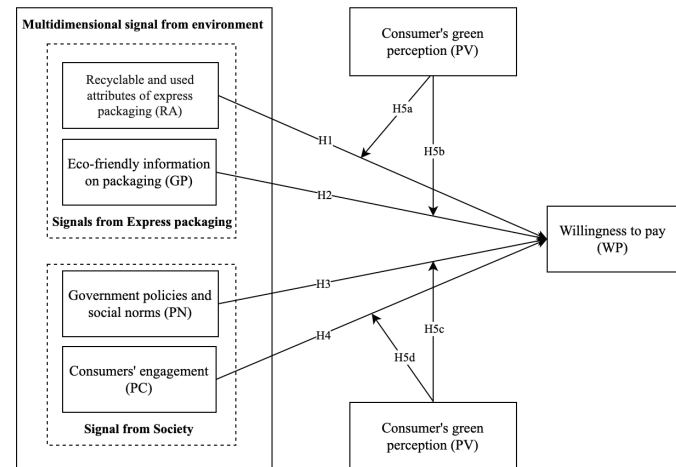


Fig. 1. Research framework.

### 3. Methodology

#### 3.1. Measurement and data collection

This study examines the impact of multidimensional environmental signals on customers' willingness to pay for green express packaging. The study focuses on Vietnamese customers (aged 18 years and above) who have purchased, or intend to purchase, products using green express packaging. In this study, the snowball sampling method was employed to recruit Vietnamese consumers who have experience with online shopping and receiving goods using green express packaging. Snowball sampling is a non-probability sampling technique in which initial participants refer other individuals who also meet the research criteria. This method is especially effective for reaching specific or hard-to-access populations, particularly when a complete sampling frame is unavailable [55].

The survey was distributed through both online and offline channels. The online version was administered via Google Forms and circulated through social media and email. The offline version was delivered using paper-based questionnaires distributed at local delivery hubs and eco-conscious retail locations. Most respondents were based in Ho Chi Minh City (HCMC), which is recognised as the leading region for e-commerce development in Vietnam due to its high internet penetration, consumer activity, and logistics infrastructure [56-57]. A smaller proportion of responses were collected from other provinces to ensure broader demographic inclusion, although at a lower percentage.

A survey questionnaire comprising 18 items was utilised to gather data for the assessment of six variables. These items were adapted from the previous studies on green express packaging and willingness to pay: three items for recyclable and used attributes of express packaging from G. Pretner, et al (2021) [25], three items for eco-friendly information on packaging [54, 58, 59], three items for government policies and social norms [4, 60, 61] three items for customers' engagement [59, 62, 63], three items for customers' green perception [64, 65]. Finally, three items for willingness to pay were adapted from research conducted by Y. Namkung, et al. (2017) [66]. All items were measured using a seven-point Likert scale.

A pilot test with 20 participants was conducted to evaluate the initial questionnaire's clarity and internal consistency. Cronbach's alpha was calculated for each construct, with values ranging from 0.71 to 0.82, indicating acceptable reliability [67]. Minor wording adjustments were made based on participant feedback to improve comprehension. After modifying the measurement scale, a formal survey was conducted with a sample size that met the basic requirements suggested by C. Ringle, et al. (2015) [68]. The responses were reviewed, and 34 cases were removed based on data quality criteria: (1) completion time under three minutes, and (2) suspicious response patterns. Responses were flagged if participants provided identical or highly repetitive answers across unrelated items, such as using the same rating across all Likert-scale variables or repeating short phrases in open-ended responses. These patterns indicated low engagement or inattentive response behaviour.

A total of 450 questionnaires were collected, of which 416 were deemed valid (92.4%). The detailed demographic characteristics of the 416 valid respondents are presented in Table 1.

Table 1. Sample characteristics.

| Measure | Category            | N   | Percent (%) |
|---------|---------------------|-----|-------------|
| Gender  | Female              | 235 | 56.5        |
|         | Male                | 181 | 43.5        |
| Age     | 18-23               | 125 | 30.0        |
|         | 24-30               | 189 | 45.4        |
|         | 31-40               | 68  | 16.3        |
|         | Above 40            | 34  | 8.2         |
| Income  | Under 4 million VND | 66  | 15.9        |
|         | 4-8 million VND     | 92  | 22.1        |
|         | 9-15 million VND    | 143 | 34.4        |
|         | Over 15 million VND | 115 | 27.6        |

### 3.2. Data analysis

A survey questionnaire comprising 18 items was utilised to gather data for the assessment of six variables, including recyclable and used attributes

of express packaging, eco-friendly information on packaging, government policies and social norms, consumers' engagement, consumers' green perception, and willingness to pay. The Partial Least Squares (PLS) approach using SmartPLS 3.0 was employed to assess the proposed hypotheses that were developed [68]. As it does not require data normality and enables the optimisation of correlations between latent variables and observed indicators, the PLS approach is appropriate for survey-based samples [67, 69]. J.F. Hair, et al. (2019) [67] state that three metrics are required to evaluate construct reliability and convergent validity: Cronbach's alpha ( $\alpha > 0.70$ ), composite reliability ( $CR > 0.70$ ), and average variance extracted ( $AVE > 0.50$ ). Discriminant validity was assessed using the Fornell-Larcker criterion, while predictive relevance was evaluated using the  $R^2$  values of the endogenous latent variables.

PLS-SEM utilises a composite-based estimation model, enabling the generation of consistent estimates while facilitating exploratory studies that integrate both explanatory and predictive perspectives [70]. Although covariance- and variance-based modelling techniques have been employed in prior research [71, 72], the inherent uncertainty of survey data may result in estimation errors. PLS-SEM, which does not require normally distributed data, is therefore more appropriate for mitigating estimation bias [73]. Furthermore, PLS-SEM allows for the estimation of complex measurement models and is suitable for multi-group analysis (MGA) [74]. Accordingly, this study employed SmartPLS 3 software to conduct the PLS-SEM analysis (Appendix 1).

## 4. Results and discussion

### 4.1. Measurement model assessment

Measurement model evaluation involves assessing the relationships between measurement items and latent variables, as well as determining the fit between the theoretical model and the sample data. This study employed composite reliability (CR) and Cronbach's alpha (CA) to assess internal consistency reliability. Hair et al. (2017) [75] determined that a CR value exceeding 0.7 signifies high reliability, while a CA value above 0.7 indicates good reliability. Table 2 demonstrates that the CR values for all latent variables exceed 0.8, while the CA values surpass 0.7, signifying a high level of internal consistency in the scale. Notably, the CA values for some constructs, such as green perception (0.734) and recyclable attitudes (0.738), are relatively close to the threshold of 0.7. However, both achieved high CR (above 0.85) and AVE (above 0.65), supporting acceptable reliability and convergent validity. These results suggest that the scale is adequate but may benefit from refinement in future applications.

According to the research conducted by J.F. Hair, et al (2012) [70], factor validity is assessed using the outer loadings index, with a threshold of  $\geq 0.7$  considered acceptable. The outer loading values presented in Table 2 all exceed 0.7; therefore, the measurement items are considered valid for further analysis. According to H. Cooper, et al. (2014) [76], convergent validity refers to the degree of correlation among observed variables measuring the same construct. To assess convergent validity, the average variance extracted (AVE) is used. J.F. Hair, et al. (2021) [77] propose that an AVE value of 0.5 or higher is acceptable, indicating that the latent variable explains more than half of the variance in its observed indicators, or that the scale demonstrates adequate convergent validity. If the AVE value is less than 0.5, it indicates that the latent variable does not sufficiently explain the observed variables and that measurement error may be present. As shown in Table 2, the AVE values of the research model range from 0.654 to 0.741, all exceeding the recommended threshold of 0.5. Therefore, the measurement scale of the model demonstrates satisfactory convergent validity.

**Table 2. Construct reliability (CR), Cronbach's alpha (CA), average variance extracted (AVE), and outer loadings.**

|    |     | Outer loadings | CA    | CR    | AVE   |
|----|-----|----------------|-------|-------|-------|
| GP | GP1 | 0.800          | 0.734 | 0.850 | 0.654 |
|    | GP2 | 0.856          |       |       |       |
|    | GP3 | 0.768          |       |       |       |
| PC | PC1 | 0.836          | 0.754 | 0.859 | 0.669 |
|    | PC2 | 0.798          |       |       |       |
|    | PC3 | 0.820          |       |       |       |
| PN | PN1 | 0.854          | 0.741 | 0.853 | 0.659 |
|    | PN2 | 0.812          |       |       |       |
|    | PN3 | 0.766          |       |       |       |
| RA | PV1 | 0.822          | 0.738 | 0.851 | 0.655 |
|    | PV2 | 0.799          |       |       |       |
|    | PV3 | 0.806          |       |       |       |
| WP | RA1 | 0.857          | 0.825 | 0.896 | 0.741 |
|    | RA2 | 0.842          |       |       |       |
|    | RA3 | 0.884          |       |       |       |

According to C. Fornell, et al. (1981) [78], discriminant validity is established if the square root of the AVE for each latent variable is greater than all correlations between that latent variable and the others. In other words, if the square root of the AVE of a latent variable exceeds the corresponding inter-construct correlations in both the same row and column, the construct can be considered distinct. As shown in Table 3, the square root

of the AVE for each latent variable in the measurement model is greater than the cross-construct correlation values with other latent variables in the same row and column. Therefore, all constructs satisfy the discriminant validity criterion proposed by Fornell and Larcker.

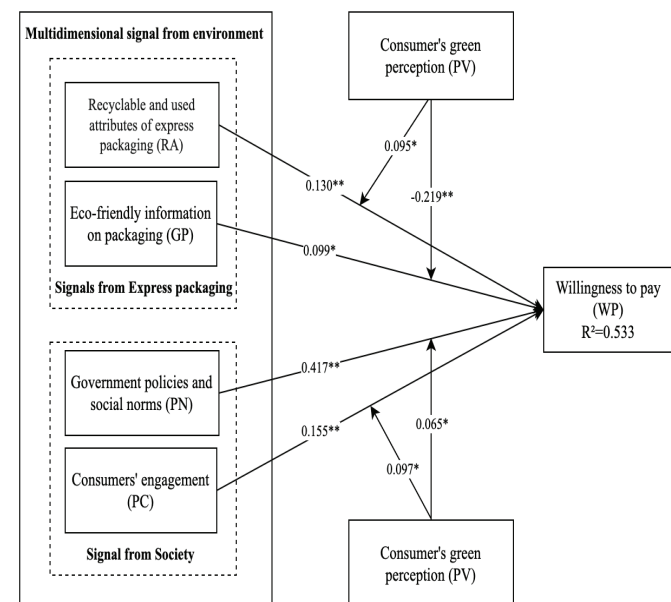
**Table 3. Fornell and Larcker criteria.**

|    | GP           | PC           | PN           | RA           | WP           |
|----|--------------|--------------|--------------|--------------|--------------|
| GP | <b>0.809</b> |              |              |              |              |
| PC | 0.621        | <b>0.818</b> |              |              |              |
| PN | 0.606        | 0.573        | <b>0.812</b> |              |              |
| RA | 0.562        | 0.488        | 0.502        | <b>0.809</b> |              |
| WP | 0.652        | 0.571        | 0.599        | 0.557        | <b>0.861</b> |

Bold numbers represent the square roots of AVEs.

## 4.2. Structural model assessment

The structural model was evaluated using  $R^2$ , variance inflation factor (VIF), and the significance of the path coefficients for hypothesis testing. The  $R^2$  value for the dependent variable, willingness to pay (WP), is 0.533, indicating that approximately 53.3% of the variance in WP is explained by the four independent variables: green perception (GP), policy cue (PC), peer norm (PN), and risk aversion (RA). According to J.F. Hair, et al. (2019) [67], this represents moderate explanatory power, which is considered acceptable in behavioural research. To ensure the robustness of the model, multicollinearity was assessed using VIF values. As shown in Table 2, all VIF values range from 1.370 to 2.018, which are well below the threshold of 3.3 [75], indicating that multicollinearity is not a concern among the predictors.



**Fig. 2. Statistical significance test results at research model.**  
Note: \*:  $p < 0.05$ ; \*\*:  $p < 0.01$ .



The path coefficient represents the regression coefficient within the path model and illustrates the relationships between latent variables in the SEM framework. J.F. Hair, et al. (2012) [70] describe bootstrapping as a technique that involves random sampling from the original dataset to repeatedly estimate the path model, thereby capturing variability in the data. The bootstrap standard error facilitates the computation of t-values and p-values, which are used to evaluate the statistical significance of the effects within the model. J.F. Hair, et al. (2012) [70] indicate that the t-value thresholds for a two-tailed test are  $\geq 1.65$  (p-value = 0.10),  $\geq 1.96$  (p-value = 0.05), and  $\geq 2.57$  (p-value = 0.01). A higher p-value indicates lower reliability of the hypothesis, whereas a p-value below 0.05 signifies a statistically significant relationship. Table 4 presents the path coefficient results, indicating the statistical support for six hypotheses and the rejection of two.

Table 4. Bootstrapping results and path coefficients.

|                   | Path coefficients | T-values | p values | Results       |
|-------------------|-------------------|----------|----------|---------------|
| H1: RA → WP       | 0.130             | 3.664    | <0.001   | Not supported |
| H2: GP → WP       | 0.099             | 1.990    | 0.047    | Supported     |
| H3: PN → WP       | 0.417             | 9.749    | <0.001   | Supported     |
| H4: PC → WP       | 0.155             | 4.051    | <0.001   | Supported     |
| H5a: PV x RA → WP | 0.095             | 2.159    | 0.031    | Supported     |
| H5b: PV x GP → WP | -0.219            | 4.001    | <0.001   | Not supported |
| H5c: PV x PN → WP | 0.065             | 2.035    | 0.042    | Supported     |
| H5d: PVx PC → WP  | 0.097             | 2.025    | 0.043    | Supported     |

### 4.3. Multigroup analysis

After analysing the data and testing the hypotheses using SmartPLS 3 software, the moderating effects were examined. PLS-MGA was employed in this study to conduct multigroup structural analysis. This study uses a seven-point Likert scale to assess respondents' personal green values and divides them into two groups based on the consumers' green perception questionnaire shown in Table 2. Respondents with low personal green perception are represented by the first group, which selected scores between 1 and 3, corresponding to *strongly disagree* to *disagree*. The second group represents respondents with high personal green values, who selected scores from 5 to 7 (*slightly agree* to *strongly agree*).

Of the 416 valid responses obtained, 341 respondents belong to the high personal green perception group (Group 2), while 75 respondents belong to the low personal green perception group (Group 1).

Table 5. Multigroup analysis results.

|         | Path coefficients-diff | p-value |         | p-value welch -satterwaith test |
|---------|------------------------|---------|---------|---------------------------------|
|         |                        | Group 1 | Group 2 |                                 |
| GP → WP | 0.036                  | 0.051   | 0.720   | 0.862                           |
| PC → WP | 0.312                  | 0.000   | 0.936   | 0.013                           |
| PN → WP | -0.007                 | 0.000   | 0.013   | 0.963                           |
| RA → WP | 0.045                  | 0.000   | 0.334   | 0.776                           |

When analysing the differences between the two groups for each relationship based on the path coefficients and p-values of Group 1 and Group 2, the authors found that the relationship between PC and WP is statistically significant for respondents with low personal green values (p-value = 0.000), but not statistically significant for respondents with high personal green values (p-value = 0.936) [79].

According to L. Matthews (2017) [80], the path coefficients - diff value is defined as the difference in standardised impact coefficients between two comparison groups. This index is used to assess differences in impact across groups and is calculated by subtracting the path coefficient value of Group B from that of Group A. In this study, Group A and Group B correspond to respondents with low personal green values and high personal green values, respectively. As shown in Table 5, the path coefficient-diff value for the relationship between PC and WP is 0.312, indicating that low personal green values exert a stronger influence on this relationship than high personal green values.

### 4.4. Discussion

This study applied signalling theory to explore how green express packaging attributes and broader societal cues influence consumers' willingness to pay (WTP) more for environmentally friendly delivery services in Vietnam. The findings offer a nuanced perspective on how different types of environmental signals-packaging-level, societal, and personal-interact to shape green behaviour.

First, at the packaging level, the study reveals diverging impacts. The presence of eco-friendly information on packaging (H2) positively affects WTP, confirming that clear, credible messages such as eco-labels, symbols, or verified claims serve as effective signals to reduce uncertainty and build trust. This aligns with the core tenets of signalling theory, which highlight the importance of auxiliary cues in bridging the gap between unobservable product attributes and consumer perception. This effect is consistent with M. Gorton, et al. (2021) [81], who emphasise that label credibility and third-party verification are central to enhancing consumer trust. Conversely, recent evidence also shows that graded or detailed eco-labels outperform generic claims, suggesting that design richness is crucial for maximising WTP [82]. In contrast, recyclable or reused packaging

materials (H1), although carrying environmental benefits, had a negative but significant effect on WTP. This suggests that consumers may associate such materials with perceived contamination or inferior quality, especially in the absence of strong information to counter these assumptions. These results are consistent with prior literature noting consumer concerns about reused packaging being unhygienic or second-hand in nature. Clearer communication strategies, such as hygienic certification, visual design adjustments, or third-party endorsements, could help mitigate this negative perception and enhance consumer confidence.

Second, societal-level signals show a stronger influence. Government policy and social norms (H3) positively impact WTP, reflecting the role of institutional mechanisms and collective behaviour in driving sustainable choices. National policies such as Decree No. 08/2022/ND-CP on Extended Producer Responsibility and the Green Growth Strategy have likely contributed to normalising eco-conscious consumption in Vietnam. Furthermore, consumer engagement (H4), observable through peer actions such as reusing packaging or sharing eco-friendly practices, exerts a positive effect, indicating that social proof and normative influence play a vital role in encouraging individual behaviour change. This finding resonates particularly well in the context of Vietnamese collectivist culture, where conformity to community standards and shared behaviours is a strong motivator. Peer-driven influence may function as a shortcut for trust, reinforcing behavioural norms without requiring deep cognitive processing. This interpretation is consistent with recent meta-analytic and empirical evidence showing that peer influence and social norms often outweigh formal policy instruments in shaping sustainable behaviour, especially among younger and socially connected populations [83-84]. The contrast with findings from mature markets, where policy tools are typically more effective, suggests that in urban, youth-heavy contexts such as Ho Chi Minh City, peer effects may dominate. While not explicitly grounded in social learning theory, the results suggest a possible direction for future research to examine how individuals emulate sustainable practices observed in their immediate environments.

Finally, the study examined the moderating role of green perception across multiple pathways. Among the four hypotheses (H5a-H5d), only H5d was supported, indicating that consumers with strong green values are more responsive to peer-related signals than to institutional or packaging messages. This reinforces the idea that individual values amplify the influence of socially driven cues, especially when those cues align with personal environmental priorities.

Notably, H5b, which examined whether green perception enhances the impact of eco-information, was statistically

significant but showed a negative interaction. This suggests that highly eco-conscious consumers may become more sceptical of generic or superficial green claims. Rather than reinforcing positive effects, strong green perception may intensify critical evaluation of claims lacking credibility, thus lowering WTP. This finding aligns with research documenting that eco-aware consumers tend to be more sceptical when exposed to vague or unverified environmental information [79, 85]. Distrust and scepticism towards green claims, including concerns about “greenwashing”, play a significant role. Environmentally conscious consumers are often more knowledgeable and attentive to sustainability issues. As such, they may scrutinise green signals more critically, especially if information lacks credibility, transparency, or third-party verification [86]. This interpretation is consistent with de S.V.F. Netto, et al. (2020) [85] and M. Gorton, et al. (2021) [81], who document that eco-aware consumers are more prone to scepticism when facing vague claims. If eco-friendly information on packaging is perceived as vague or misleading, highly aware consumers may discount such claims, resulting in a negative impact on their willingness to pay. This aligns with growing evidence that consumer scepticism is greater among individuals with stronger environmental values. Therefore, the negative moderation observed here should not be viewed as an anomaly but rather as an important boundary condition in signalling theory, where signal effectiveness depends not only on content but also on audience sophistication.

In summary, these findings suggest that the strength of packaging-, policy-, and peer-based signals is highly context-dependent. Label credibility, policy design and enforcement, and demographic and social conditions (such as urban, youth-heavy samples) together form the boundary conditions shaping signal effectiveness. By integrating these nuances, the study extends signalling theory beyond its traditional assumptions of uniform effects, demonstrating a more contingent and context-sensitive mechanism of consumer response [82-83].

## 5. Conclusions and management implications

### 5.1. Conclusions

This study explored how green signals at both the packaging and societal levels influence consumers' willingness to pay (WTP) more for eco-friendly express delivery. By applying signalling theory as the primary analytical lens, the research confirms that eco-friendly information on packaging, government policy, and peer influence all positively affect consumer WTP, whereas recyclable or reused packaging attributes alone show no significant effect unless clearly supported by credible cues. Among societal signals, both institutional trust (government



policy) and social proof (peer engagement) were found to exert strong influence, indicating that external environmental cues play a critical role in shaping consumer behaviour in emerging markets. Furthermore, consumers' green perception was found to selectively moderate these effects, particularly amplifying the influence of peer behaviour (H5d) while exhibiting a negative moderating effect for basic eco-information (H5b), suggesting a more critical mindset among highly eco-conscious consumers. These results point to an important conclusion: effective green marketing must go beyond material attributes and instead rely on message credibility, social context, and value alignment to resonate with diverse consumer segments.

Overall, the findings validate the proposed theoretical framework and contribute to extending signalling theory into the underexplored domain of post-purchase packaging in emerging markets. The results also offer theoretical contributions by demonstrating how green perception can both amplify and weaken signal effects depending on content type—a pattern not widely addressed in prior studies. In practical terms, these insights suggest that firms, particularly e-commerce and logistics providers, should not only invest in eco-friendly materials but also communicate their environmental value effectively. Policymakers can further reinforce green adoption by strengthening normative influence through public campaigns and institutional endorsement. Meanwhile, marketing professionals should leverage culturally resonant messages and social proof to activate peer-driven change. Ultimately, this study underscores that a multi-actor effort spanning policy, business, media, and consumer education is essential to shifting consumption towards more sustainable packaging.

### 5.2. Theoretical implications

This study contributes to the theoretical advancement of signalling theory by emphasising the differentiated roles of environmental cues in influencing consumers' willingness to pay (WTP) for green express packaging. Specifically, the findings demonstrate that the impact of green signals is not uniform across packaging-level, societal-level, and peer-based signals, and that consumers' green perception selectively moderates their effectiveness. While signalling theory traditionally focuses on the clarity and credibility of signals themselves, this study underscores that the receiver's internal disposition—particularly green perception—also shapes signal interpretation. This insight aligns with and extends previous research by showing that signalling effects are not merely message-dependent but also shaped by contextual and psychological factors.

For instance, consumers with high green perception amplify the influence of peer engagement cues (H5d), but may become more sceptical toward weak or generic

eco-information (H5b), as indicated by its significant yet negative interaction. This nuanced role of green perception contributes to prior research such as White et al. (2019) [87], which emphasised psychological levers, and builds on signalling literature by explicitly integrating attitudinal moderators.

These results reinforce earlier findings that green perception acts as a selective amplifier, enhancing the effectiveness of strong and credible signals while discounting vague or potentially misleading ones [61, 64, 88, 89]. Furthermore, this study highlights an important limitation of signalling theory: its relative inattention to emotional or habitual drivers of behaviour. While signalling theory emphasises rational evaluation of cues, it often overlooks the extent to which consumer decisions are shaped by habits and affective responses—factors that are critical to sustainable behaviour. For instance, habitual purchasing patterns and emotional attachment to convenience or cleanliness may override signal clarity, limiting message effectiveness despite strong eco-claims. Thus, this study contributes to the theoretical discourse by integrating cognitive, emotional, and habitual elements within the signalling framework and by demonstrating how these dynamics operate in a post-purchase context, an area rarely addressed in prior studies. These insights align with the perspectives of K. White, et al. (2019) [87], who emphasised psychological levers such as emotion and identity in sustainable behaviour, and B. Verplanken, et al. (2022) [90], who argued that habit can often override conscious intentions. Future research should further explore how emotional and habitual heuristics interact with green signals to provide a more comprehensive understanding of behaviour change mechanisms.

In sum, this study not only extends signalling theory by demonstrating the selective moderating role of green perception and contributes to the emerging stream of post-purchase signalling research, but also critiques the assumption of purely rational processing, proposing a broader framework that incorporates psychological and habitual dimensions.

### 5.3. Practical implications

To foster the adoption of green packaging in the e-commerce sector, both policymakers and businesses have important roles to play. Policymakers can contribute by introducing stronger financial incentives, such as tax deductions or grants, to encourage businesses to adopt sustainable practices [88, 91]. In Vietnam, the government has already taken a significant step with Decree No. 08/2022/ND-CP, which establishes the Extended Producer Responsibility (EPR) framework requiring companies to

manage the entire lifecycle of their packaging [30]. This regulatory shift encourages firms to invest in recyclable materials and reduce their environmental footprint, while also ensuring alignment with eco-labelling standards to build consumer trust.

On the business side, companies can further promote sustainable behaviour by fostering consumer engagement. One approach is the use of gamification strategies, such as offering reward points for actions like reusing packaging or sharing eco-friendly behaviours on social media. Recent studies show that gamification mechanisms-such as enjoyment, achievement, and social motivation-significantly increase consumer participation in sustainable behaviours [92-93]. However, as this study demonstrates, generic “green messaging” may be insufficient. Businesses should tailor communication strategies to different consumer segments, using detailed and fact-based messaging for highly eco-conscious consumers and benefit-focused or socially framed messaging for others [87].

Collaborating with influencers or implementing public campaigns can further amplify sustainability messages by leveraging social signals to motivate behavioural change. Systematic reviews demonstrate that influencers play a central role in shaping sustainable consumption decisions [94, 95], while empirical evidence from Vietnam confirms that subjective norms and greenwashing awareness significantly influence Generation Z’s green purchasing intentions [96]. Additionally, social influence-including perceived green value and environmental attitudes-has been shown to play a critical role in sustainable clothing purchase decisions [97].

Rather than relying solely on mainstream influencers, businesses may consider partnering with micro-influencers or community leaders whose values align more closely with the target audience, thereby enhancing message authenticity and trust. This approach aligns with findings that perceived authenticity determines whether influencer collaborations successfully build trust or, conversely, risk backfiring [98].

As this research demonstrates, individuals are more likely to engage in green actions when they observe others doing the same, highlighting the power of social proof as a motivator [38, 49]. Furthermore, green perception-reflecting the degree to which consumers care about environmental issues-plays a key role in shaping responses to green signals such as eco-labels or policy messages. The study therefore underscores the importance of environmental literacy campaigns, particularly for consumers who may be less familiar with the benefits of sustainable packaging. Rather than solely promoting green values, such campaigns should clearly communicate the practical advantages and tangible impacts of green packaging to help overcome scepticism [88, 91]. By combining effective policy measures, business

strategies, and engagement initiatives, stakeholders can create stronger momentum towards sustainable consumption, benefiting both environmental outcomes and long-term business performance.

#### **5.4. Limitations and future research**

This study has several limitations that should be acknowledged. First, the survey relied on self-reported data, particularly regarding consumers’ willingness to pay (WTP), which may be prone to hypothetical bias and social desirability effects, potentially inflating stated green behaviours. Specifically, hypothetical bias refers to the tendency of survey respondents to overstate their willingness to pay for green products or behaviours in hypothetical survey scenarios compared to their actual actions in real-market situations. Future studies are encouraged to incorporate behavioural data, such as actual purchase transactions, e-commerce platform analytics, or field experiments, rather than relying solely on self-reported intentions. In addition, experimental designs can help directly measure how different environmental signals, eco-labels, or peer influence affect willingness to pay.

Second, the sample primarily consisted of young, urban Vietnamese consumers, who may exhibit higher environmental awareness than the general population. This demographic bias may also explain why peer influence appeared particularly strong, reflecting the social media-driven behaviours of younger cohorts, while policy signals were less salient due to limited policy awareness within this group. While non-probability sampling methods are useful for reaching targeted or hard-to-access populations, they inherently reduce representativeness, making it challenging to extrapolate results to the entire Vietnamese consumer population. The predominance of respondents from Ho Chi Minh City, where e-commerce infrastructure and environmental awareness are relatively high, introduces potential urban bias; thus, the WTP and perceptions captured here may differ from those in rural regions or lower-income areas with less exposure to green packaging innovations or government campaigns. Additionally, due to the lack of randomisation, non-probability samples preclude the calculation of margins of error and robust statistical inference for the wider population [18, 67]. As such, caution is warranted when applying these insights beyond the study sample. Future research should employ probability-based sampling methods and aim for greater demographic and geographic diversity to enhance the external validity of the findings.

Third, the cross-sectional nature of the study prevents the establishment of causal relationships between variables. Cross-sectional designs provide only a “snapshot” of associations at a single point in time, making it impossible to determine whether changes in perceptions or exposure

to signals precede and cause changes in outcomes such as willingness to pay. Future research could adopt longitudinal or experimental designs to better assess how perceptions and behaviours evolve over time. Moreover, future studies should expand demographic and geographic coverage beyond urban populations and incorporate objective

behavioural data, such as purchase records or participation in green-marketing programmes. These approaches would strengthen the generalisability and practical relevance of future research results.

## APPENDICES

**Appendix 1. Original variables and modified variables.**

| Original Variables                   | Original questions                                                                                                                                                   | Modified Variables                                       | Modified Questions                                                                                                                                                                                                 | Source |
|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Recycled and Second-hand Attributes  | Consumers may attach negative quality values to recycled products.                                                                                                   | Recyclable and used attributes of express packaging (RA) | RA1 Consumers may associate negative quality perceptions with recycled express packaging.                                                                                                                          | [25]   |
|                                      | Consumers think used products may have a shorter lifespan.                                                                                                           |                                                          | RA2 Consumers perceive that second-hand express packaging might possess a reduced longevity.                                                                                                                       |        |
|                                      | Consumers perceive pollution from second-hand products.                                                                                                              |                                                          | RA3 Consumers recognise the negative environmental effects associated with second-hand express packaging.                                                                                                          |        |
| Green Information on Express Package | The provision of green information can improve consumers' perception of product value and their willingness to pay.                                                  | Eco-friendly information on packaging (GP)               | GP1 Giving consumers access to green information can increase their willingness to pay and their opinion of the value of the product.                                                                              | [54]   |
|                                      | The provision of green information increases perceived consumer effectiveness (PCE).                                                                                 |                                                          | GP2 The provision of eco-friendly information increases perceived consumer effectiveness                                                                                                                           | [58]   |
|                                      | I will read the label before purchasing the product and see if it is a recyclable, low-pollution, environmentally-friendly product.                                  |                                                          | GP3 Before making a purchase, I will check the product's label to make sure it is recyclable, low-pollution, and ecologically friendly.                                                                            | [59]   |
| Policy Guidance and Social Norms     | Government subsidies have a significant moderating effect on consumers' willingness to buy green products.                                                           | Government policies and social norms (PN)                | PN1 Government subsidies provide a considerable influence on the willingness of customers to purchase environmentally friendly products.                                                                           | [60]   |
|                                      | Government policy guidance can improve public awareness of environmental protection and promote social attention to green projects.                                  |                                                          | PN2 Government policy guidance has the potential to enhance public awareness regarding environmental protection and foster community interest in environmentally friendly projects.                                | [36]   |
|                                      | Information policies can improve consumers' understanding of recycling behaviour and its environmental benefits and change consumers' attitudes to a certain extent. |                                                          | PN3 Information policies have the potential to enhance consumers' knowledge of recycling practices and their associated benefits for the environment, as well as to influence consumers' attitudes to some degree. | [23]   |
| Participation of Other Consumers     | Consumers appear to trust other consumers and follow their actions.                                                                                                  | Consumers' engagement (PC)                               | PC1 It seems that individuals show a tendency to put their trust in the behaviours and decisions of those around them.                                                                                             | [62]   |
|                                      | The actions of peer consumers in similar purchase situations can affect how people perceive the quality of a product.                                                |                                                          | PC2 The behaviours showed by peer consumers in similar purchasing situations can influence individuals' perceptions on the quality of a product.                                                                   | [63]   |
|                                      | Signals stemming from other consumers' opinions and behaviours have a pronounced effect on consumers' quality impressions.                                           |                                                          | PC3 Signals originating from the opinions and behaviours of other consumers significantly influence the quality perceptions possessed by people.                                                                   | [85]   |
| Personal Green Values                | We are obliged to use recyclable express packaging.                                                                                                                  | Consumer's green perception (PV)                         | PV1 We are obliged to use recyclable express packaging.                                                                                                                                                            | [64]   |
|                                      | Usage behaviour of recyclable express packaging goes along with my principles of environmental protection.                                                           |                                                          | PV2 The usage behaviours of recyclable express packaging align with my commitment to environmental responsibility.                                                                                                 | [65]   |
|                                      | Consumers with high environmental concerns are more inclined to accept green behaviours.                                                                             |                                                          | PV3 Individuals with higher levels of environmental concern demonstrate an increased desire to embrace environmentally friendly behaviours.                                                                        | [39]   |
| Willingness to Pay                   | It is acceptable for me to pay more money for groceries that are packaged in an environmentally friendly way.                                                        | Willingness to pay (WP)                                  | WP1 I find it reasonable to spend extra money for products that are packaged in an environmentally sustainable express packaging.                                                                                  | [66]   |
|                                      | I feel proud to have environmentally friendly packaged products in my house though they are more costly than conventionally packaged products.                       |                                                          | WP2 I take pride in having environmentally friendly packaged products in my home, despite their higher cost compared to conventionally packaged alternatives.                                                      |        |
|                                      | I would be willing to spend more money in order to buy less environmentally harmful products.                                                                        |                                                          | WP3 I would be prepared to spend more money to acquire products that are less harmful to the environment.                                                                                                          |        |



## CRediT author statement

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## COMPETING INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this article.

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