# FACTORS AFFECTING CARBON CREDIT CONTRIBUTIONS VIA RIDE-HAILING APPS IN VIETNAM

## HÀNH VI TIÊU DÙNG XANH TRÊN NỀN TẢNG SỐ: CÁC YẾU TỐ ẢNH HƯỞNG ĐẾN VIỆC ĐÓNG GÓP TÍN CHỈ CARBON QUA ỨNG DỤNG GỌI XE TẠI VIỆT NAM

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**ABSTRACT**

This study investigates the determinants of users' intentions to purchase carbon credits via a ride-hailing application, offering insights into voluntary carbon offsetting behavior on digital platforms. Based on data collected from a structured survey of 408 ride-hailing service users in Vietnam, the study applies multivariate regression analysis to examine five factors: environmental awareness, social influence, perceived ease of use, price awareness, and marketing communication. The results reveal that environmental awareness, ease of use, and marketing communication positively influence users' willingness to contribute, while price awareness negatively affects their intention to contribute. Social influence shows a weaker yet significant positive impact. These findings have practical implications for digital platform providers and policymakers, promoting sustainable consumer behavior by enhancing platform design, communication strategies, and pricing transparency. The study contributes to the literature on green consumption by contextualizing voluntary carbon offsetting within mobile app ecosystems in a developing country setting.

**Keywords**: Carbon credits; Consumer behavior; Ride-hailing app; Sustainable consumption; Voluntary carbon offsetting.

**TÓM TẮT**

Nghiên cứu này phân tích các yếu tố ảnh hưởng đến ý định đóng góp mua tín chỉ carbon của người dùng ứng dụng gọi xe tại Việt Nam, góp phần lý giải hành vi bù đắp carbon tự nguyện trên nền tảng số. Dữ liệu khảo sát từ 408 người dùng được phân tích bằng hồi quy đa biến, kiểm định năm yếu tố: nhận thức môi trường, ảnh hưởng xã hội, mức độ dễ sử dụng, nhận thức về giá và truyền thông tiếp thị. Kết quả cho thấy nhận thức môi trường, mức độ dễ sử dụng và truyền thông tiếp thị có ảnh hưởng tích cực, trong khi nhận thức về giá tác động tiêu cực đến ý định đóng góp. Ảnh hưởng xã hội có tác động yếu hơn nhưng vẫn đáng kể. Nghiên cứu cung cấp hàm ý thực tiễn cho các nền tảng số và nhà hoạch định chính sách trong việc thúc đẩy tiêu dùng bền vững và đóng góp vào lý thuyết tiêu dùng xanh trong bối cảnh các quốc gia đang phát triển.

**Từ khóa**: Tín chỉ carbon; Hành vi người tiêu dùng; Ứng dụng gọi xe; Tiêu dùng bền vững; Bù đắp carbon tự nguyện.

## 1. Introduction

Growing awareness of corporate sustainability initiatives has significantly shaped corporate strategies and consumer behavior, with voluntary carbon offsetting emerging as a prominent trend (Kim et al., 2018). Voluntary carbon offsetting is an initiative in which firms purchase carbon credits to compensate for their emissions, driven by both reputational benefits and climate action goals (Broekhoff et al., 2019; Franki, 2022). Customers can also support this initiative by choosing to purchase carbon credits as a product add-on. However, the lack of standardized, transparent methodologies for measuring and verifying carbon credits that firms purchase, together with the reliance on firms' self-reported data and limited

communication, often leads to inconsistent quality and questionable efficacy of the offset program (Pan et al., 2022). These issues erode consumers' confidence, hinder their participation in carbon offset programs, and ultimately delay meaningful climate action. In this context, studying the factors influencing customers' participation in carbon credit purchases is vital for understanding motivations and crafting strategies to increase voluntary carbon offsetting, promoting sustainable consumption and climate action.

Recently, many transportation firms, including airlines, freight forwarding companies, and ride-hailing companies, have adopted voluntary carbon offset programs. Using the contingent valuation method, Lim and Yoo (2014) found that awareness of renewable energy and pro-environmental attitudes significantly predicted passengers' willingness to pay for carbon offsets in the rail sector. Similarly, Jou and Chen (2015) applied a spike model showing that education, flight frequency, and awareness of aviation emissions positively influenced airline passengers' offset intentions, while concerns over online payment risks acted as deterrents. Cordes et al. (2024) identified five major determinants in the airline context, including demographics, travel behavior, environmental attitudes, characteristics of offset programs, and airline communication efforts. More recently, Park et al. (2024) employed the Theory of Planned Behavior (TPB) to investigate offset intentions among air travelers in Korea, confirming the roles of attitudes, subjective norms, and perceived behavioral control. In the road transport sector, Gupta (2016) revealed that education, income, and environmental awareness significantly affected Indian passengers' acceptance of a carbon tax. Despite the richness of existing research, several gaps still remain: (1) Little attention has been paid to ride-hailing firms, where consumer awareness of carbon offset options is still limited; (2) Most studies focus on high-cost services like airlines, while users of more affordable services such as ride-hailing may be more price-sensitive, potentially leading to different behavioral patterns; (3) The literature is dominated by studies in developed countries, leaving offset behavior in developing contexts underexplored. To fill these gaps, our study aims to investigate the factors influencing the carbon credit contribution intention of ride-hailing app users, focusing on an urban city of Vietnam.

Advancements in technology have significantly transformed urban transportation, leading to the emergence of new mobility options for commuters. Ride-hailing platforms such as Lyft, Uber, and Grab represent a modern form of door-to-door shared mobility (Nguyen-Phuoc et al., 2020). These services have reshaped urban travel behavior by offering users real-time tracking, transparent pricing, and convenient pick-up arrangements (Nguyen-Phuoc et al., 2019). These services act as a substitute for both traditional taxi services (Zhong et al., 2022) and public transit (Zhang and Zhang, 2018). Over the past decade,

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the ride-hailing sector has grown rapidly, attracting over 2 million users in North America and nearly 5 million worldwide. Within their first five years of operation, such platforms served more than 250 million passengers (Clewlow and Mishra, 2017).

Vietnam is a developing country where public transport is largely limited to bus and metro services. Therefore, ride-hailing has quickly gained popularity. Grab introduced its first service in Vietnam, GrabTaxi, in 2014 and has since become a dominant player in the urban transport market (Roscher, 2018). Following Grab's success, other local platforms such as FastGo, Uber, and Bee have entered the market. Today, ride-hailing services are increasingly regarded as an informal form of public transport in Vietnam. Despite the success of ride-hailing services in Vietnam's market, especially in urban areas, some companies have been accused of greenwashing by offering customers carbon offsets that are likely "junk" or questionable. This concern, though unconfirmed, can erode customers' confidence in participating in the offsetting program. Thus, studying the motivation of customers to participate in carbon offset contributions is essential and can provide practical implications to both firm management and policymakers.

Our study contributes to the literature on sustainable consumer behavior by examining voluntary carbon offset contributions in the context of ride-hailing services, particularly in developing countries. It applies an empirical approach within a digital platform context, offering a framework to assess consumer participation in environmental initiatives via app-based services. The findings provide actionable insights for ride-hailing firms to enhance platform usability, improve environmental communication, ensure transparency, and leverage social influence to promote green consumer engagement.

The remaining parts of the paper are structured as follow: Section 2 reviews the relevant literature and develops the research hypotheses grounded in established theoretical frameworks. Section 3 outlines the research methodology, including the sampling strategy, questionnaire design, and measurement constructs. Section 4 presents the empirical results, comprising descriptive analysis, reliability and validity assessments, exploratory factor analysis, and multivariate regression. Finally, the paper concludes with a discussion of the key findings and their theoretical and managerial implications.

## 2. Literature Review and Research methodology

### *2.1. Carbon credit and carbon offset*

*Carbon credit*

A carbon credit represents a tradable certificate that permits the emission of one metric ton of carbon dioxide ($CO_2$) or an equivalent amount of other greenhouse gases (United Nations Framework Convention on Climate Change, n.d.). Carbon credits are central to both compliance and voluntary carbon markets, where organizations can purchase or trade emission allowances to meet regulatory or self-imposed environmental goals (Wetterberg et al., 2024). These markets function through domestic and international mechanisms, including emissions trading systems, cap-and-trade programs, and voluntary offset schemes.

*Carbon offset*

Carbon offsetting refers to the practice of compensating for greenhouse gas (GHG) emissions by investing in projects that reduce, avoid, or remove an equivalent amount of GHG emissions from the atmosphere (Broekhoff et al., 2019). This mechanism allows individuals, businesses, and organizations to assume environmental

responsibility by supporting initiatives such as forest conservation, afforestation, renewable energy deployment, and energy efficiency improvements. In return, participants receive carbon credits, which are tradable instruments in voluntary carbon markets.

The willingness of enterprises to engage in carbon offset markets is influenced by both objective factors (e.g., offset mechanisms, carbon product trading systems, regulatory penalties, and carbon quota allocation) and subjective factors (e.g., enterprise type, capacity, energy source, geographic location, and familiarity with carbon trading schemes) (Zha et al., 2022).

Globally, carbon offsetting has become a mainstream strategy for climate action, with nearly two-thirds of the world's largest corporations adopting it to meet net-zero emission targets (Gabbatiss and Pearson, 2023). In response, governments develop regulatory frameworks to enhance transparency, ensure environmental integrity, and align offsetting practices with national and international climate goals, including Nationally Determined Contributions (NDCs) and mechanisms under the Paris Agreement (e.g., Article 6, CORSIA). Regulatory approaches vary across jurisdictions, ranging from mandatory reporting systems and emissions trading schemes (e.g., EU ETS) to official guidelines for voluntary carbon markets (Franki, 2022; Axelsson et al., 2024).

### *2.2. Hypothesis development*

The Theory of Planned Behavior (TPB) serves as a widely adopted framework for explaining and predicting individual behavioral intentions across various domains. According to TPB, intention to perform a specific behavior is primarily determined by three constructs: attitude toward the behavior, subjective norms, and perceived behavioral control (Ajzen, 1991). While these components offer strong explanatory power, TPB remains flexible and allows the inclusion of additional predictors if they contribute significantly to explaining behavioral variance (Ajzen, 1991, p. 199). This adaptability has led to its widespread application in fields such as transportation, environmental behavior, and carbon offsetting.

Attitude refers to an individual's overall evaluation of a behavior as favorable or unfavorable. It is shaped by behavioral beliefs (i.e., subjective expectations about the outcomes of the behavior) and the value placed on those outcomes. Multiple beliefs are often held simultaneously, and their cumulative evaluation forms an individual's attitude, which in turn influences behavioral intention (Ajzen, 2012).

In the context of carbon credits, consumers' environmental awareness reflects their perceived importance of contributing to environmental protection through financial support. Prior studies have emphasized that such awareness plays a pivotal role in shaping pro-environmental intentions. Kollmuss and Agyeman (2002) suggested that understanding the long-term consequences of consumption fosters behavioral change. Gupta (2016) also noted that environmental awareness, along with factors such as education, income, and age, significantly influences consumers' willingness to pay for carbon-related mechanisms, including carbon taxes.

We, therefore, propose our first hypothesis:

***H1: Environmental awareness positively influences the intention to contribute to carbon credit purchases on the ride-hailing application.***

Subjective norms capture the perceived social pressure to engage in or refrain from a behavior. They stem from normative beliefs regarding whether significant referents, such as family, friends, or colleagues, approve of

the behavior, coupled with the individual's motivation to comply with those expectations. In collectivist societies, such as those in East Asia, subjective norms play a particularly salient role in shaping pro-environmental behavior (Shi et al., 2017).

Consumers are increasingly aware of the social influences shaping their consumption behavior, particularly those stemming from family, peers, colleagues, and institutional norms. As noted by Krishnan and Koshy (2021), individuals are often guided by the views and expectations of their social reference groups. In parallel, growing environmental concerns have led consumers to place greater importance on purchasing eco-friendly and sustainability-oriented products. Empirical findings by Tao et al. (2021) further support this, showing that social influence was the most significant determinant of Chinese consumers' willingness to participate in voluntary carbon offsetting programs. Similarly, Du et al. (2018) found that individuals are more likely to adopt pro-environmental behaviors when encouraged by members of their social networks. In addition, Salazar et al. (2013) identified herding behavior in green consumption, although its impact may be moderate and influenced by contextual factors. This leads to our second hypothesis:

***H2: Social influence has a positive effect on the intention to contribute to carbon credit purchases on the ride-hailing application.***

While this study primarily builds upon the Theory of Planned Behavior (TPB) (Ajzen, 1991), three complementary theoretical perspectives are incorporated to strengthen the conceptual foundation of the extended model: the Technology Acceptance Model (TAM), Elaboration Likelihood Model (ELM), and Perceived Value Theory (PVT).

First, the construct *Ease of Use* originates from the Technology Acceptance Model (TAM) (Davis, 1989), which conceptualizes it as an individual's perception of the effort required to use a system or technology. Within the Theory of Planned Behavior (TPB) framework, *Ease of Use* can be interpreted as a situational determinant of perceived behavioral control (PBC), representing internal control beliefs about one's ability to perform a behavior with minimal difficulty (Ajzen, 1991; Taylor and Todd, 1995). In digital contexts, usability perception determines how easily consumers can navigate application interfaces, understand features, and complete voluntary actions such as carbon-credit contributions. Therefore, *Ease of Use* serves as a technology-specific extension of PBC, influencing both *perceived control* and *behavioral intention* toward sustainable digital behavior.

Perceived behavioral control (PBC) reflects an individual's assessment of their ability to perform a given behavior, taking into account internal capacities and external constraints (Ajzen, 1991). In the context of carbon offsetting, PBC is influenced by the time, cost, and knowledge required for participation. Tao et al. (2021) highlighted that reducing procedural and informational barriers can enhance consumers' perceived control. Similar results were reported by Liu et al. (2017) in consumer choices regarding low-carbon food, reinforcing the importance of PBC in shaping sustainable behaviors.

In the context of ride-hailing applications, ease of use (i.e., the degree to which an individual believes that using a particular system requires minimal effort) is found to significantly influence this service (Marinković et al., 2020). When a mobile app is designed in a user-friendly manner with a clear layout, transparent information display, and an intuitive interface, users are more likely

to explore its features and, ultimately, develop a stronger intention to use it, including the intention to contribute to its carbon credit offsets. We, thus, propose Hypothesis 3:

***H3: Ease of use has a positive effect on the intention to contribute to carbon credit purchases on the ride-hailing application.***

Meanwhile, the Perceived Value Theory (PVT) (Zeithaml, 1988) supports the inclusion of Price Awareness as a cognitive antecedent of behavioral intention. PVT conceptualizes perceived value as a trade-off between perceived benefits and perceived sacrifices, with price serving as the most salient component of the sacrifice dimension (Dodds et al., 1991). Price Awareness thus reflects consumers' evaluation of fairness and worthiness of paying an additional fee for environmental benefits, influencing attitudes and intentions through value assessment. Integrating PVT complements TPB by linking economic cognition to attitudinal formation, thereby enriching the theoretical scope of the extended TPB framework.

Within this framework, Price Awareness captures consumers' cognitive evaluation of whether the monetary contribution required is justified by the environmental and functional benefits they expect to receive. When the perceived value outweighs the cost, consumers are more likely to view the contribution as worthwhile and feasible, thereby strengthening their behavioral intention. Conversely, when prices are perceived as unfair or disproportionate to the ecological value offered, willingness to participate declines (Gupta, 2016; Dekhili and Achabou, 2013; De Medeiros et al., 2016). Hence, Price Awareness in this study reflects not only sensitivity to cost but also the perceived fairness and value-for-money assessment central to PVT, linking economic cognition to attitudinal and behavioral outcomes within the extended TPB framework.

Carbon credits possess several distinctive characteristics that differentiate them from conventional consumer goods. Unlike taxes or regulated environmental fees, carbon credits in voluntary markets are discretionary: consumers are not required to purchase them. This positions carbon credits closer to symbolic or luxury-like products, where contributions are motivated not by functional utility but by intangible outcomes, such as moral satisfaction, self-identity, or environmental signaling (De Medeiros et al., 2016). In contrast, for consumers with lower environmental involvement, such contributions may be perceived as non-essential surcharges. According to Lichtenstein et al. (1993), such consumers tend to associate additional costs with transaction value loss, leading to lower purchase intention. Furthermore, Conte and Kotchen (2010) demonstrate that the absence of clear co-benefits or quality signals in carbon offset markets diminishes perceived value, especially when price levels are not transparently justified.

In this light, perceiving carbon credits as an optional fee rather than a meaningful environmental investment can hinder contribution behaviors on low-cost, convenience-driven platforms like ride-hailing apps. Altogether, the relationship between price awareness and the intention to contribute to carbon credit purchases is still unclear. This leads to our fourth hypothesis:

***H4: Price awareness has a negative effect on the intention to purchase carbon credits on the ride-hailing application.***

Finally, the Elaboration Likelihood Model (ELM) (Petty and Cacioppo, 2012) provides a theoretical rationale for the construct Marketing and Communication. ELM posits two routes to persuasion: the central route, which involves careful consideration of

message arguments, and the peripheral route, which relies on heuristic cues such as source credibility, message framing, repetition, or design aesthetics. In digital environments, both routes often operate simultaneously to shape users' attitudes and behavioral intentions (Kitchen et al., 2014).

In the context of ride-hailing applications, Marketing and Communication captures these persuasive mechanisms, ranging from informative and data-driven environmental messages (central route) to visual appeal, endorsements, and in-app prompts (peripheral route). This theoretical grounding explains how communication exposure influences attitude, perceived behavioral control, and ultimately intention to contribute to carbon-credit purchases within a digital sustainability context.

Marketing and communication are essential drivers of pro-environmental behavior, particularly in promoting voluntary carbon credit contributions. Effective campaigns improve consumer awareness, build trust, and enhance perceived product value. Zhan et al. (2025) show that eco-label recognition and message framing significantly increase willingness to pay for low-carbon products, especially when perceived quality is emphasized. Similarly, Geng et al. (2022) highlight that ecological awareness, product trust, and tailored communication positively affect the willingness to pay for low-carbon vegetables, particularly among environmentally conscious consumers.

For ride-hailing platforms, where carbon credit purchases are optional and price-sensitive, persuasive communication can shift consumer perception from cost to contribution. Therefore, marketing and communication are expected to positively influence users' willingness to support carbon offset initiatives. This leads to our final hypothesis:

***H5: Marketing and communication have a positive effect on the intention to contribute to carbon credit purchases on the ride-hailing application.***

The proposed research model is summarized in Figure 1.

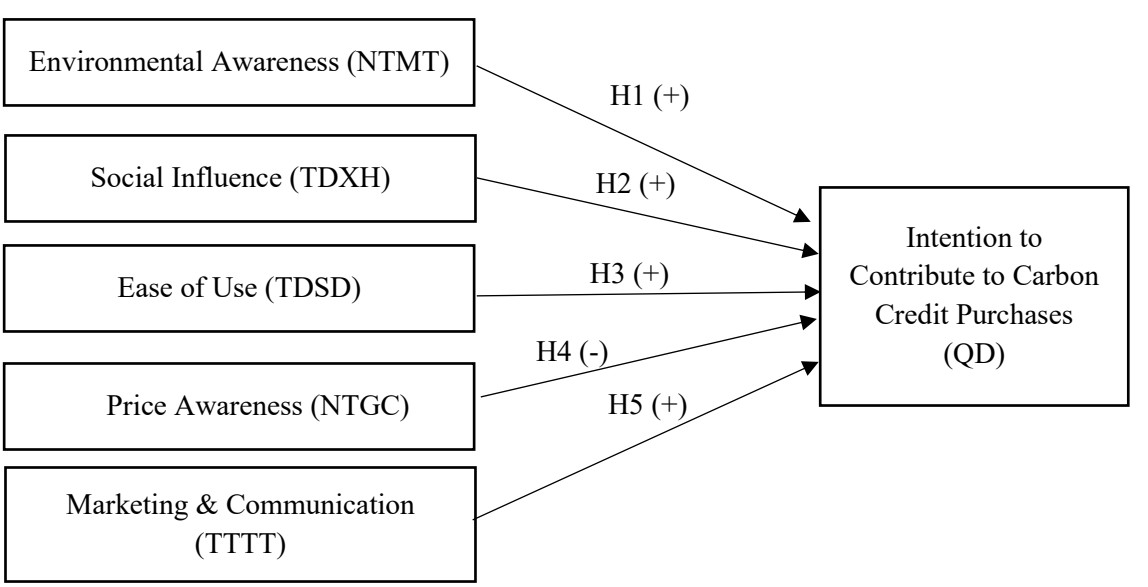


**Figure 1.** The proposed model of factors influencing the intention to contribute to carbon credit purchases.

### *2.3. Survey questionnaire*

The survey was conducted in Vietnam, from January 1 to February 28, 2025, targeting active users of the Grab ride-hailing application. A nonprobability convenience sampling method was employed, and participants were recruited through online Grab user communities on Facebook and Zalo. To ensure the relevance and quality of responses, participants were required to meet two inclusion criteria: (1) being a Grab customer, and (2) having used the Grab application at least once per month. These two criteria are incorporated into the questionnaire as screening questions.

The questionnaire was administered in Vietnamese, with a brief explanation of key terms (e.g., "carbon credit" and "voluntary contribution") included at the beginning to ensure clarity. A pilot test involving 50 respondents was conducted to verify question wording, item reliability, and overall survey comprehension. As no significant issues were identified, the instrument was finalized and distributed for the main data collection. Responses with duplicate IP addresses, failed screening questions, or unrealistically short completion times were excluded from the final dataset.

The survey instrument comprised three sections: (1) screening questions to verify respondent eligibility; (2) demographic profiling (e.g., gender, age, education, marital status, employment status, and income); and (3) items measuring factors influencing users' intention to contribute to carbon credit purchases via the application, using a 5-point Likert scale.

The measurement scales were adapted from relevant domestic and international studies, based on the proposed research framework. The questionnaire items used to assess influencing factors are summarized in Table 1.

A total of 456 responses were collected. To ensure data validity, screening criteria were applied: participants were required to (i) be current users of ride-hailing applications, and (ii) be users living in urban cities. After excluding ineligible cases, 408 valid responses were retained for subsequent analysis.

**Table 1.** Summary table of scales and observed variables

| No | Scale | Code | Observed Variables | Source |
|---|---|---|---|---|
| 1. | Environmental Awareness | NTMT1 | I am aware that my personal actions have an impact on the environment | Hoang et al. (2018) Zhao et al. (2014), Nguyen-Phuoc et al. (2022) |
| 2. | | NTMT2 | I am concerned about the declining quality of the environment | |
| 3. | | NTMT3 | I often think about how green consumption can improve the environment | |
| 4. | | NTMT4 | Purchasing carbon credits via the ride-hailing application is a means of protecting the environment | |
| 5. | | NTMT5 | Supporting environmental protection enhances my sense of personal responsibility | |

| No | Scale | Code | Observed Variables | Source |
|---|---|---|---|---|
| 6. | Social Influence | TDXH1 | My purchasing intentions are influenced by members of my family | Ajzen (2002), Javid et al. (2022), Nguyen-Phuoc et al. (2022) |
| 7. | | TDXH2 | Most of my close contacts believe that I should purchase carbon credits to help businesses reduce emissions and protect the environment | |
| 8. | | TDXH3 | The government currently encourages consumers to take responsibility in reducing $CO_2$ emissions | |
| 9. | | TDXH4 | Many people around me purchase carbon credits through ride-hailing applications | |
| 10. | Ease of Use | TDSD1 | The user interface design of the ride-hailing application facilitates users' access to information about carbon credit purchases. | Marinković et al. (2020) |
| 11. | | TDSD2 | Users find it easy to make payments for carbon credit purchases on the ride-hailing app. | |
| 12. | | TDSD3 | Transparent information about how the contributed payments for carbon credits are used helps users make informed decisions. | |
| 13. | Price Awareness | NTGC1 | The cost of contributing to carbon credit purchases on the application is reasonable. | Dung et al (2019) |
| 14. | | NTGC2 | The cost of contributing to carbon credit purchases on the application is clearly disclosed. | |
| 15. | Marketing and Communication | TTTT1 | Advertising information about carbon credit contribution encourages me to spend more on green products and services. | Nguyen-Phuoc et al. (2022), Dung et al (2019) |
| 16. | | TTTT2 | I support contributing to carbon credit purchases on the platform because I recognize the company's environmental vision and commitment. | |
| 17. | | TTTT3 | I support contributing to carbon credit purchases on the platform due to the strong dissemination of environmental messages. | |
| 18. | Intention to Contribute to Carbon Credit Purchases | QD1 | I consistently choose to pay for carbon credits on each ride via the ride-hailing platform. | Javid et al. (2022), Nguyen-Phuoc et al. (2022) |
| 19. | | QD2 | I recommend this option to my family and friends. | |
| 20. | | QD3 | I am willing to contribute to carbon credit purchases on the application to help reduce environmental pollution | |

*Source: Compiled by the authors*

### *2.4. Statistical analysis*

In this study, SPSS Statistics 26.0 was employed to perform an Independent Samples T-Test and One-Way ANOVA to examine carbon credit contribution intention among ride-hailing app users. Subsequently, a multivariate regression model was applied to identify and evaluate the factors influencing users' willingness to to purchase carbon credits.

## 3. Test results and analyses

### *3.1. Analysis of sample profile and the differences by variables*

Table 2 summarizes the demographic characteristics of the 408 valid respondents. The sample is predominantly female (63.7%) and young (76.7% aged 18-35), indicating the widespread adoption of ride-hailing services among digitally literate urban users. A high level of educational attainment is observed, with 95.1% holding at least a bachelor's degree, suggesting strong service expectations and purchasing power. In terms of income, 40.2% reported earnings between VND 10-20 million per month, while 17.4% indicated no personal income, likely representing students. Full-time employees (60.3%) and students (24.3%) form the majority of users. Usage frequency is relatively high, with 41.4% using the service several times per month, 33.3% several times per week, and 10% daily, reflecting the platform's embeddedness in daily urban mobility.

Table 2 also reports group differences in carbon credit contribution intention across demographic and behavioral segments. Statistically significant differences are found by education level (Sig. = 0.027) and ride-hailing usage frequency (Sig. = 0.047). Respondents with postgraduate qualifications recorded the highest contribution score (M = 4.03), suggesting a link between education and environmental commitment. Similarly, more frequent users, especially those who engaging several times per week (M = 4.05) or daily (M = 4.07), exhibit a higher willingness to contribute, suggesting that habitual use fosters responsiveness to sustainability features. No significant differences are observed for gender, age, income, or occupation, indicating these variables have limited influence on contribution intention. These findings highlight the importance of education-focused communication and frequent user engagement in promoting voluntary carbon offsetting.

### *3.2. Reliability analysis*

To assess the internal consistency of the measurement scales, item-total correlations were computed for each item, with a threshold of 0.4 adopted as the minimum acceptable value (Nunnally, 1978). Items with item-total correlations below this threshold were removed to improve the reliability of the scales. As shown in Table 3, two items, NTMT5 and TDXH1 did not meet the criterion and were subsequently excluded from further analysis.

Following item refinement, reliability analysis was conducted on the remaining 18 items. As presented in Table 4, all constructs achieved Cronbach's alpha coefficients exceeding the recommended threshold of 0.70 (Bujang et al., 2018), and all items demonstrated corrected item-total correlations above 0.4. These results indicate satisfactory internal consistency and support the unidimensionality of each construct. The reliability outcomes confirm that the data are suitable for Exploratory Factor Analysis (EFA).

### *3.3. Exploratory Factor Analysis*

The suitability of the dataset for factor analysis was assessed using the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity. The KMO value was 0.840 (see

Table 5), exceeding the minimum acceptable threshold of 0.5 and falling within the "meritorious" range, indicating sampling adequacy for factor analysis (Hair et al., 1995). These results confirm that the data were appropriate for conducting Exploratory Factor Analysis (EFA).

Principal component analysis with Varimax rotation and Kaiser normalization was subsequently performed. Five factors with eigenvalues greater than 1.0 were extracted. All factor loadings exceeded the recommended threshold of 0.70, and the model explained 78.56% of the cumulative variance, indicating a robust factor structure (Table 6).

**Table 2.** Distribution of sample

| | Criteria | Freq. | Percentage (%) | Mean | Sig. | Note |
|---|---|---|---|---|---|---|
| **Gender** | Male | 148 | 36.3% | 3.969 | 0.690 | Independent Samples Test |
| | Female | 260 | 63.7% | 3.930 | | |
| **Age Group** | 18 - 25 years old | 165 | 40.4% | 3.842 | 0.226 | One-Way ANOVA |
| | 26 - 35 years old | 148 | 36.3% | 4.032 | | |
| | 36 - 45 years old | 70 | 17.2% | 4.019 | | |
| | 46 - 55 years old | 23 | 5.6% | 3.899 | | |
| | Over 55 years old | 2 | 0.5% | 3.667 | | |
| **Education Level** | High School | 15 | 3.7% | 3.444 | 0.027 | One-Way ANOVA |
| | College | 5 | 1.2% | 4.000 | | |
| | Undergraduate | 216 | 52.9% | 3.904 | | |
| | Postgraduate | 172 | 42.2% | 4.035 | | |
| **Monthly Income** | No personal income | 71 | 17.4% | 3.873 | 0.765 | One-Way ANOVA |
| | Below 10 million VND | 67 | 16.4% | 3.846 | | |
| | 10 to 20 million VND | 164 | 40.2% | 3.982 | | |
| | 20 to 30 million VND | 56 | 13.7% | 3.976 | | |
| | 30 to 40 million VND | 24 | 5.9% | 4.042 | | |
| | Above 40 million VND | 26 | 6.4% | 3.987 | | |
| **Occupation** | Student | 99 | 24.3% | 3.835 | 0.156 | One-Way ANOVA |
| | Work from Home | 19 | 4.7% | 3.790 | | |
| | Full-time worker | 246 | 60.3% | 4.018 | | |
| | Part-time worker | 22 | 5.4% | 3.682 | | |
| | Retired | 2 | 0.5% | 3.500 | | |
| | Unemployed | 3 | 0.7% | 4.444 | | |
| | Other | 17 | 4.2% | 3.980 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Frequency of Using Ride-Hailing Services** | Several times per month | 169 | 41.4% | 3.905 | 0.047 | One-Way ANOVA |
| | Rarely (less than once per month) | 62 | 15.2% | 3.742 | | |
| | Several times per week | 136 | 33.3% | 4.047 | | |
| | Daily | 41 | 10.0% | 4.065 | | |

*Source: Sample data was collected and analyzed by the authors utilizing SPSS 26.0*

**Table 3.** Item-total statistics

| | **Scale Mean if Item Deleted** | **Scale Variance if Item Deleted** | **Corrected Item-Total Correlation** | **Cronbach's Alpha if Item Deleted** |
|---|---|---|---|---|
| NTMT1 | 16.922 | 4.657 | 0.624 | 0.757 |
| NTMT2 | 16.865 | 4.417 | 0.732 | 0.722 |
| NTMT3 | 16.927 | 4.334 | 0.718 | 0.725 |
| NTMT4 | 16.897 | 4.668 | 0.676 | 0.742 |
| NTMT5 | 16.635 | 5.849 | 0.241 | 0.863 |
| TDXH1 | 10.289 | 4.658 | 0.314 | 0.825 |
| TDXH2 | 10.453 | 3.954 | 0.676 | 0.632 |
| TDXH3 | 10.243 | 3.850 | 0.596 | 0.670 |
| TDXH4 | 10.456 | 3.821 | 0.661 | 0.634 |
| TDSD1 | 7.860 | 2.391 | 0.759 | 0.827 |
| TDSD2 | 7.892 | 2.416 | 0.808 | 0.784 |
| TDSD3 | 7.851 | 2.447 | 0.720 | 0.863 |
| NTGC1 | 3.976 | 0.565 | 0.650 | - |
| NTGC2 | 4.007 | 0.641 | 0.650 | - |
| TTTT1 | 7.669 | 2.217 | 0.737 | 0.917 |
| TTTT2 | 7.620 | 2.054 | 0.856 | 0.817 |
| TTTT3 | 7.593 | 2.026 | 0.828 | 0.841 |
| QD1 | 8.020 | 2.466 | 0.758 | 0.905 |
| QD2 | 7.873 | 2.564 | 0.816 | 0.850 |
| QD3 | 7.770 | 2.605 | 0.849 | 0.825 |

*Source: Sample data was analyzed by the authors utilizing SPSS 26.0*

**Table 4.** Result of Reliability Analysis

| Scale | CODE | Number of Observed Variables | | Cronbach's Alpha |
|---|---|---|---|---|
| | | Before | After | |
| Environmental Awareness | NTMT | 5 | 4 | 0.863 |
| Social Influence | TDXH | 4 | 3 | 0.825 |
| Ease of Use | TDSD | 3 | 3 | 0.876 |
| Price Awareness | NTGC | 2 | 2 | 0.787 |
| Marketing and Communication | TTTT | 3 | 3 | 0.902 |
| Intention to Contribute to Carbon Credit Purchases | QD | 3 | 3 | 0.902 |

*Source: Sample data analyzed by the authors utilizing SPSS 26.0*

**Table 5.** KMO and Bartlett's Test

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | 0.840 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 3,566.120 |
| | df | 105 |
| | Sig. | 0.000 |

*Source: Sample data analyzed by the authors utilizing SPSS 26.0*

**Table 6.** Rotated Component Matrix

| Rotated Component Matrix[a] | | | | | |
|---|---|---|---|---|---|
| | Component | | | | |
| | 1 | 2 | 3 | 4 | 5 |
| NTMT2 | 0.853 | | | | |
| NTMT3 | 0.792 | | | | |
| NTMT1 | 0.773 | | | | |
| NTMT4 | 0.773 | | | | |
| TTTT3 | | 0.875 | | | |
| TTTT2 | | 0.864 | | | |
| TTTT1 | | 0.735 | | | |
| TDSD2 | | | 0.857 | | |
| TDSD1 | | | 0.844 | | |
| TDSD3 | | | 0.763 | | |

| Rotated Component Matrix[a] | | | | | |
|---|---|---|---|---|---|
| | Component | | | | |
| | 1 | 2 | 3 | 4 | 5 |
| TDXH4 | | | | 0.833 | |
| TDXH3 | | | | 0.814 | |
| TDXH2 | | | | 0.800 | |
| NTGC1 | | | | | 0.905 |
| NTGC2 | | | | | 0.903 |
| Extraction Method: Principal Component Analysis.<br>Rotation Method: Varimax with Kaiser Normalization[a]. | | | | | |
| a. Rotation converged in 6 iterations. | | | | | |

*Source: Sample data analyzed by the authors utilizing SPSS 26.0*

### *3.4. Regression analysis*

The multiple regression model demonstrated a good fit with the data. As shown in Table 7, the adjusted $R^2$ value of 0.660 indicates that the five independent variables collectively explain 66% of the variance in the dependent variable. The Durbin-Watson statistic of 1.739 falls within the acceptable range (1.5-2.5), suggesting no evidence of first-order autocorrelation.

**Table 7.** Model Summary

**Model Summary[b]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson |
|---|---|---|---|---|---|
| 1 | 0.815[a] | 0.664 | 0.660 | 0.45403 | 1.739 |

a. Predictors: (Constant), TDXH, NTGC, NTMT, TDSD, TTTT

b. Dependent Variable: QD

*Source: Sample data analyzed by the authors utilizing SPSS 26.0*

ANOVA results in Table 8 further confirm model robustness, with an F-statistic of 159.060 and a significance level of 0.000 ($p < 0.05$). Table 8 shows that all Variance Inflation Factor (VIF) values are below 3, indicating no multicollinearity concerns. All five predictors—environmental awareness (NTMT), social influence (TDXH), perceived ease of use (TDSD), price perception (NTGC), and marketing communication (TTTT)—are statistically significant at the 5% level.

**Table 8.** ANOVA Results

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 163.945 | 5 | 32.789 | 159.060 | 0.000[b] |
| | Residual | 82.869 | 402 | 0.206 | | |
| | Total | 246.815 | 407 | | | |

a. Dependent Variable: QD

b. Predictors: (Constant), TDXH, NTGC, NTMT, TDSD, TTTT

*Source: Sample data analyzed by the authors utilizing SPSS 26.0*

Model diagnostics also help validate key assumptions. The P-P plot (Figure 2) and the residual distribution histogram (Figure 3) confirm the normality of residuals, with minimal deviation from a mean of zero. The scatter plot of residuals (Figure 4) shows a random distribution within the range of -3 to 3, indicating homoscedasticity and further validating the model's reliability (Pituch and Stevens, 2015). Based on the analysis results, the study proposes the following multiple linear regression model equation:

$$QD(y) = 0,089xTDXH + 0,123xNTMT + 0,328xTDSD + 0,456xTTTT - 0,092xNTGC$$

The regression results are reported in Table 9.

**Table 9.** Coefficients results

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | | | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | t | Sig. | Tolerance | VIF |
| 1 | (Constant) | 0.113 | 0.209 | | 0.540 | 0.589 | | |
| | TDSD | 0.339 | 0.038 | 0.328 | 8.821 | 0.000 | 0.603 | 1.659 |
| | NTGC | -0.102 | 0.032 | -0.092 | -3.169 | 0.002 | 0.990 | 1.010 |
| | TTTT | 0.502 | 0.042 | 0.456 | 11.925 | 0.000 | 0.572 | 1.748 |
| | NTMT | 0.159 | 0.045 | 0.123 | 3.485 | 0.001 | 0.669 | 1.494 |
| | TDXH | 0.097 | 0.037 | 0.089 | 2.595 | 0.010 | 0.707 | 1.414 |

a. Dependent Variable: QD

*Source: Sample data analyzed by the authors utilizing SPSS 26.0*

*Environmental Awareness - NTMT (H1)* exhibits a positive and statistically significant effect on carbon credit contribution intention ($\beta = 0.123$, $p < 0.05$). This result suggests that individuals with greater concern for environmental issues are more likely to engage in sustainable behaviors, aligning with prior studies by Kollmuss and Agyeman (2002), and

Gupta (2016). The findings underscore the pivotal role of environmental awareness in shaping green consumption. In the context of rising urban pollution, enhancing public understanding of the benefits of carbon credit contributions may offer a viable approach to promoting environmental responsibility in urban settings.

*Social Influence - TDXH (H2)* exerts a positive and statistically significant effect on users' contribution intention ($\beta = 0.089$, $p < 0.05$), though its magnitude is relatively modest compared to other predictors. This result aligns with previous findings by Salazar et al. (2013) and Krishnan and Koshy (2021), confirming that normative pressures from family, peers, and the broader community can encourage pro-environmental behavior. However, the lower standardized coefficient indicates that social influence is not among the dominant drivers in this context, especially when compared to perceived ease of use ($\beta = 0.328$) and marketing communication ($\beta = 0.456$). These results suggest that while social norms play a supportive role, they are secondary to platform design and informational engagement in motivating carbon credit contributions among ride-hailing app users in urban areas.

*Ease of Use - TDSD (H3)* demonstrates a strong and statistically significant positive effect on users' contribution intention ($\beta = 0.328$, $p < 0.001$). This result supports the empirical evidence presented by Marinković et al. (2020), who emphasized the critical role of usability in influencing technology adoption. Among all examined factors, ease of use emerges as one of the most influential predictors, exceeding the effects of environmental awareness ($\beta = 0.123$) and social influence ($\beta = 0.089$). These findings suggest that simplifying the carbon credit contribution process, through intuitive interface design and minimal user effort, is essential to enhancing participation, particularly among users with varying levels of technological proficiency.

The regression analysis reveals that *Price awareness - NTGC (H4)* exerts a negative and statistically significant influence on consumers' intention to contribute to carbon credit purchases via ride-hailing applications ($\beta = -0.092$, $p < 0.01$), thereby providing empirical support for Hypothesis 4. This result is particularly noteworthy as it challenges the commonly assumed positive relationship between price and perceived product quality or contribution level, especially in the context of symbolic and voluntary goods. This study indicates that in certain low-cost, convenience-oriented settings, such as ride-hailing services, premium pricing for carbon offset is often interpreted as a proxy for quality or moral value, thereby encouraging participation. Such findings are consistent with prior literature highlighting that price can function as a quality signal. For instance, Dekhili and Achabou (2013) emphasized that consumers accept price premiums for green products only when those prices are perceived as fair and clearly linked to environmental value. Similarly, De Medeiros et al. (2016) show that consumers are willing to pay more for green attributes, but this willingness is contingent on clear ecological justification and product performance. Our findings underscore the importance of price fairness, transparency, and value communication in shaping consumer responses to voluntary environmental contributions. It also provides meaningful insights into how price awareness, under certain conditions, may operate as a behavioral barrier rather than a motivator, particularly in digital micro-payment environments.

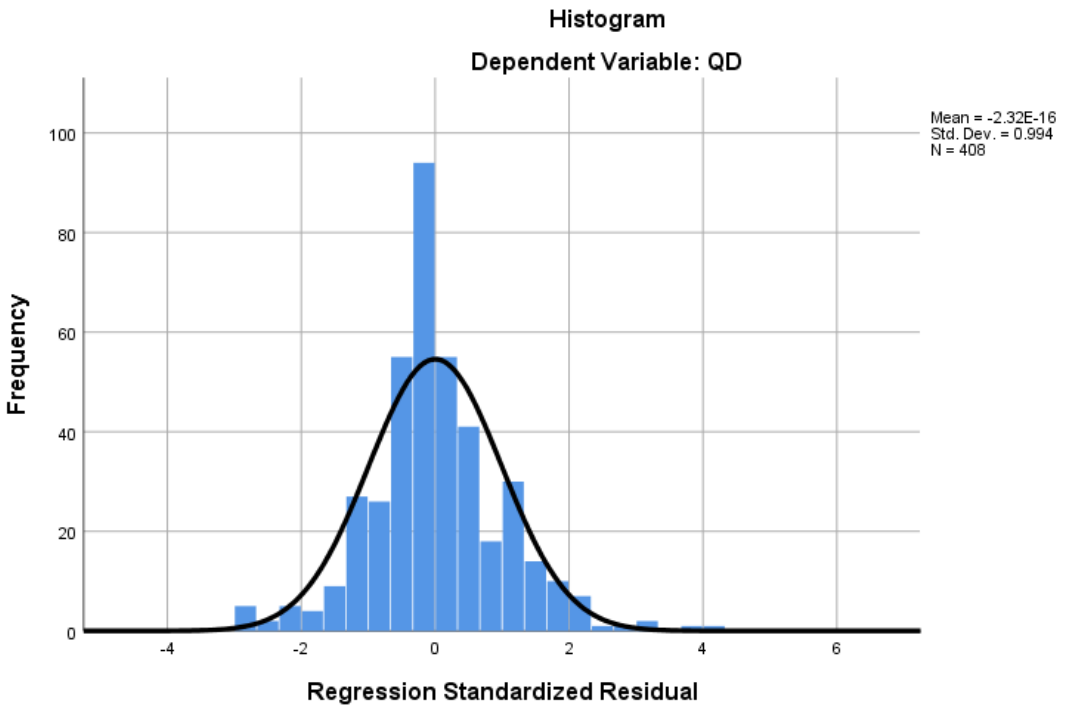


**Figure 2.** Histogram

*Source: Sample data analyzed by the authors utilizing SPSS 26.0*

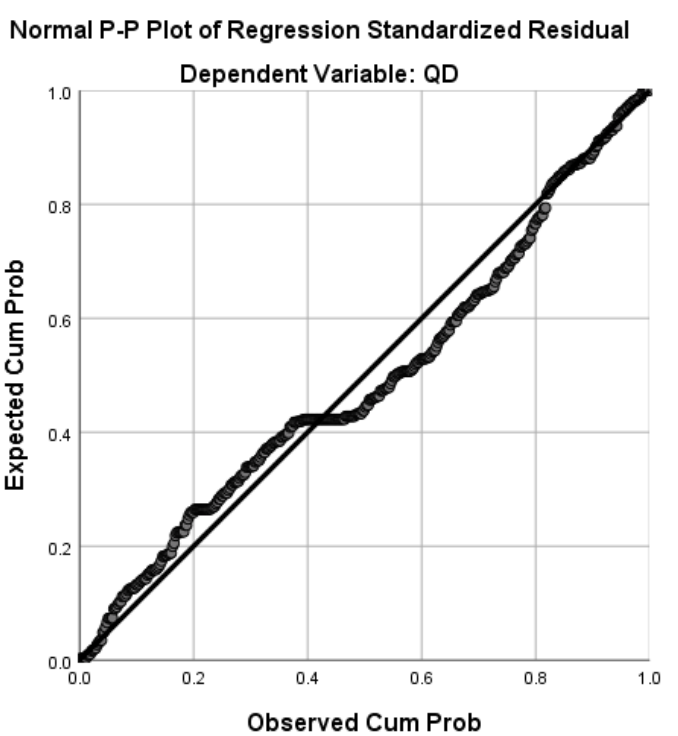


**Figure 3.** Normal P-P Plot of Regression Standardized Residual

*Source: Sample data analyzed by the authors utilizing SPSS 26.0*

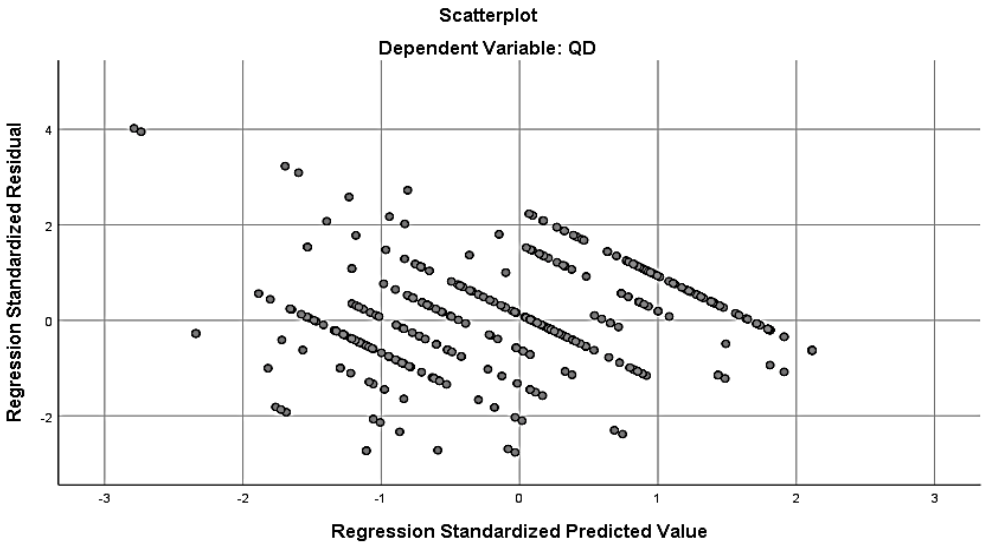


**Figure 4.** Scatterplot

*Source: Sample data analyzed by the authors utilizing SPSS 26.0*

Lastly, *Marketing and Communication - TTTT (H5)* is identified as the most influential factor in predicting users' willingness purchase carbon credits (β = 0.456, p < 0.001). This finding reinforces recent evidence by Zhan et al. (2025), which demonstrates that eco-label recognition and strategic message framing significantly enhance willingness to pay for low-carbon products. Similarly, Geng et al. (2022) highlight the importance of communication in raising ecological awareness and product trust, particularly among environmentally engaged consumers. These results underscore the effectiveness of tailored, informative campaigns in shaping user behavior, particularly on digital ride-hailing platforms where voluntary carbon offsetting remains nascent. The findings support the integration of persuasive communication with environmental education, transparency, and user experience design to promote active engagement in sustainability initiatives.

**Table 10.** Summary of regression results across subgroups

| Variables | Female | Male | ≤35 yrs | >35 yrs | UG and below | PG | <20 mil | >20 mil | Low Freq | High Freq |
|---|---|---|---|---|---|---|---|---|---|---|
| **TDSD** | 0.342*** | 0.306*** | 0.325*** | 0.325*** | 0.272*** | 0.393*** | 0.335*** | 0.317*** | 0.307*** | 0.363*** |
| **NTGC** | -0.116** | -0.051 | -0.079* | -0.143* | -0.078* | -0.119* | -0.087* | -0.172** | -0.089* | -0.098* |
| **TTTT** | 0.419*** | 0.522*** | 0.445*** | 0.474*** | 0.511*** | 0.396*** | 0.420*** | 0.589*** | 0.455*** | 0.442*** |
| **NTMT** | 0.141** | 0.100 | 0.156*** | 0.017 | 0.110* | 0.128* | 0.134** | 0.088 | 0.149** | 0.089 |
| **TDXH** | 0.088* | 0.084 | 0.089* | 0.131 | 0.101* | 0.068 | 0.086* | 0.103 | 0.095* | 0.086 |

a. Note. Dependent variable: QD

b. Significance levels: p <0.05 (*), p < 0.01 (**), p < 0.001 (***).

*Source: Sample data analyzed by the authors utilizing SPSS 26.0*

To ensure the comprehensiveness of the findings, the model was re-estimated across several subgroups (gender, age, income, and usage frequency). The results in Table 10 mostly remained consistent with the main regression model, confirming the stability of the theoretical framework while revealing segment-specific behavioral differences.

Subgroup regression analyses by gender, age, income, and usage frequency confirm the robustness of the proposed model while revealing meaningful behavioral heterogeneity. Across all subgroups, *Marketing and Communication* and *Ease of Use* consistently exert the strongest positive influence on users' intention to contribute to carbon-credit purchases, underscoring the universal importance of persuasive communication and platform usability in digital environmental engagement.

However, the relative strength of other predictors varies. *Environmental Awareness* and *Social Influence* are significant mainly among females, younger users, and low-frequency participants, those who are more responsive to moral and normative motivations. In contrast, males, older, and high-frequency users rely more on functional and informational cues, reflecting a pragmatic evaluation process. Moreover, *Price Awareness* shows a growing negative effect with female and higher-income users, indicating that economic reasoning becomes more dominant as users' financial awareness and capacity increase.

Overall, these findings suggest that while communicative and usability factors are universally important, the salience of moral, social, and financial considerations differs across demographic and behavioral segments. This reinforces the need for tailored communication and pricing strategies to enhance the inclusiveness and effectiveness of digital carbon-contribution programs.

## 4. Conclusion and recommendation

### *4.1. Theoretical implications*

This study makes several theoretical contributions to the literature on pro-environmental behavior and digital sustainability. First, it extends the Theory of Planned Behavior (TPB) to the context of voluntary carbon credit contributions in ride-hailing applications, a digital, micro-scale behavior that differs from traditional environmental actions such as recycling or energy saving. By testing TPB in a technology-mediated environment, the study broadens its explanatory power to include small yet scalable acts of environmental responsibility in the digital economy.

Second, the integration of Marketing and Communication and Ease of Use represents an important contextual expansion of TPB. The findings confirm that persuasive communication strategies and user-friendly interface designs substantially influence behavioral intention, not only through attitude formation but also via perceived behavioral control. This indicates that digital interaction cues, such as the of environmental messages or the design of seamless payment systems, can serve as external enablers of pro-environmental decision-making. The incorporation of *Ease of Use* from the Technology Acceptance Model (TAM) further refines TPB by emphasizing the operational dimension of perceived control in app-based settings.

According to the Theory of Planned Behavior (Ajzen, 1991), *attitude* plays an important role as an underlying mechanism linking beliefs to behavioral intention. In this study, we choose not to include this variable since our research focus is on the direct effects of the determinants on the intentions to purchase carbon credit. Future studies can explore this variable to uncover the underlying mechanisms that explain behavioral outcomes.

### *4.2. Practical implications*

This study highlights several factors influencing users' willingness to contribute to carbon credit purchases via ride-hailing applications in Vietnam. Key drivers include environmental awareness, perceived ease of use, marketing communication, and social influence, while perceived price exerts a negative effect. Users with postgraduate education and high service frequency demonstrate greater willingness to participate, suggesting that targeted strategies should focus on these segments.

To improve participation, ride-hailing firms are encouraged to pursue the following strategic directions:

*First*, a combined approach involving both communication and marketing innovation should be adopted to raise awareness and promote engagement. Interactive content such as short videos, infographics, and environmental storytelling can be deployed across digital platforms to explain how carbon credits function and to build emotional resonance. Transparency should be enhanced by publishing periodic $CO_2$ offset reports, collaborating with credible environmental organizations, and offering personal contribution dashboards within the app. Gamification strategies, such as contribution milestones, green badges, and leaderboards, can further stimulate user interest. Collaborations with influencers and integration may amplify outreach and foster sustained behavioral change.

*Second*, to streamline the user experience, the carbon credit contribution feature should be seamlessly integrated into the ride-booking or payment interface. Ride-hailing firms can simplify the process by enabling automatic micro-contributions per transaction and minimizing extra steps. Providing visual feedback on individual contributions and environmental outcomes can strengthen users' perceived impact and reinforce environmental behavior.

*Third*, adopting flexible pricing options can address financial concerns and accommodate diverse user segments. Rather than imposing a fixed amount, allowing users to choose their contribution level can improve perceived fairness and inclusiveness. Showing the corresponding environmental impact for each contribution tier is equally important.

*Fourth*, tailored strategies should be developed for specific user groups. Educational content, such as in-app articles, webinars, and academic collaborations, can engage highly educated users. Meanwhile, premium contribution packages, featuring exclusive rewards or partnerships with green brands, may appeal to high-income users. Moreover, ride-hailing platforms can partner with businesses to create corporate contribution schemes on behalf of employees or customers.

*Finally*, government agencies should complement corporate efforts by developing a transparent legal framework for carbon credits, conducting large-scale public communication campaigns, and piloting carbon offset programs in adjacent sectors such as e-commerce, logistics, tourism, and digital payment services. These interventions will help establish a broader ecosystem for voluntary carbon contributions and reinforce collective environmental responsibility.

This study is subject to several limitations. It focuses solely on urban areas in Vietnam, where there is a high concentration of ride-hailing service users. However, this limits the generalizability of findings to other regions. The use of self-reported data may also introduce bias in measuring actual behavior. In

addition, psychological factors such as moral obligation or trust in carbon offset mechanisms were not examined. The sample was skewed toward young, educated, and tech-savvy users, who are the frequent users of ride-hailing services. To address these limitations, future research should include diverse geographic areas, employ behavioral or experimental methods, and integrate additional psychological and institutional variables to provide a more comprehensive understanding of voluntary carbon offset participation.

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