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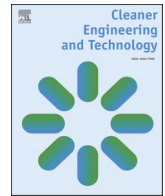
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# Exploring the adoption of pay-per-month business models: A theoretical framework and behavioral analysis in the context of white goods in Guayas province, Ecuador

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## ABSTRACT

In response to increasing environmental concerns, this study explores the adoption of a pay-per-month (PPM) model in the white goods sector in Guayas province, Ecuador, within the framework of the circular economy (CE). The research integrates the Theory of Planned Behavior (TPB) and Norm Activation Model (NAM) to assess consumer behavior and preferences. Using a Discrete Choice Experiment (DCE), data were collected from 3267 respondents, evaluating the impact of psychographic factors on PPM model acceptance for products like refrigerators, stoves, and washing machines. Results show that ecological intentions, personal norms, and attitudes significantly influence acceptance. The study reveals that greater consumer education and policy incentives on the environmental benefits of PPM models can drive higher adoption rates. This research contributes to the existing literature by providing a comprehensive framework that merges TPB and NAM methodologies, addressing gaps in understanding consumer motivations in circular business models such as PPM. Additionally, while the focus is on Guayas, the insights gained may have broader applicability in similar developing regions. However, the study also acknowledges limitations related to geographic and socio-economic differences, suggesting avenues for future research to explore the PPM model's viability across diverse contexts.

## 1. Introduction

Driven by the global environmental concerns and raw materials scarcity, circular business models (CBMs) have emerged as the best alternative solution to the current unsustainable linear business as usual. CBMs can help the circularity of manufacturing companies through value retention processes (product reuse, repair, and refurbish, and component harvesting, remanufacturing and recycling) reducing the need for virgin raw materials, optimizing the resource use and improving the waste problem all along the product lifecycle (Smol et al., 2024). One key factor to close the material loop involves the efficient collection of middle-use and end-of-use products through the management of reverse logistics. Middle-use products can be repaired and refurbished and resend for another cycle and end-of-life components of products can be harvested, remanufactured and/or recycled. Recycled

material, and still good and remanufactured components can reenter the economy minimizing the environmental impacts of waste (Hidalgo-Crespo et al., 2024).

Product-as-a-Service (PaaS) is a type of circular business model aiming to improve the circular loop of the products addressing different sustainability challenges (Tukker, 2004). The practical variation of promoting service delivery through PaaS instead of the traditional sale of physical products, can promote other affordable offers such as maintenance, repair, and reuse (Elzinga et al., 2020), increasing the product durability. This can encourage clients to adopt innovative business models that are both affordable and high-quality. Leasing business models such as pay-per-month (PPM), offers companies the opportunity to keep the ownership of a product. The customer profits from the accessibility to high-quality products that most of the times are very expensive and in a normal situation out of budget, together with the

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assurance of a functional product during the whole contract time (Tukker, 2004). The company in return receives a monthly fee (Elzinga et al., 2020), the access to data on the use of the product, the possibility to repair and reuse it in other cycles with different customers, and the control on the recovery of parts, remanufacturing and recycling of materials (Bressanelli et al., 2017). The application of PPM model is particularly interesting for white goods, since they are products with a high resource consumption and whose functionality can be offered through leasing (Hidalgo-Crespo et al., 2024). White goods represent a big market opportunity given that an average European household counts with around 15 and their manufacture consume approximately 6 million tons of raw materials, where steel and polymers account for almost 80% (CECED, 2017; De Kwant et al., 2021).

There are many initiatives of businesses offering PPM option for white goods (original equipment manufacturers, retailers, and independent companies). One previous study mentions seven different companies offering flexible pay-per-month flexible subscription products like washing machines, fridges, stoves, vacuum cleaners, and others in Europe. These offers often include maintenance, repairs, and reverse logistics, such as refurbishing products after use for secondary usage (Golinska-Dawson et al., 2024). In addition, some initiatives worth mentioning are BlueMovement powered by BOSCH and Electrolux that offer highly energy efficient white goods, enabling consumers to lower costs while contributing to the reduction of carbon emissions (BSH Home Appliances Group, 2021; AB Electrolux, 2022). Once the initial rental period concludes and the consumer terminates the contract, the appliances are retrieved, refurbished, and reintroduced into the market for use by another consumer.

Few research however has been performed on the matter of PPM model. For instance, Mulat et al. (2019) found households willingness to pay a monthly fee for the correct waste management in Injibara town. On the matter of PPM models for white goods, only one research paper and one master thesis were found to the best of the authors knowledge. Through discrete choice experiments and counting methods, it was found that the pay-per-month model was Ecuadorian population's second choice for washing machines with 29%, after the traditional buying option with almost 60% (Hidalgo-Crespo et al., 2023), and similarly, that 23% of Dutch consumers would choose the pay-per-month option after the preferable buying option with 55% (Rombouts, 2019). Both studies found the most influential factors were the age, education and income level of the household head, closely followed by the offered services, showing that consumers value not only the attributes of the washing machines but the convenience of the services integrating the pay-per-month model (Hidalgo-Crespo et al., 2023; Rombouts, 2019). While both OEM's and research initiatives offer many advantages to both consumers and companies, the weak support from local institutions (governmental and not) for the development of circular business models (Phan, 2024), the lack of literature for emerging economies on consumer perceptions of sustainable business models and their willing behavior towards them (Khan et al., 2022), the product cost, life cycle, quality, aesthetics, service conditions, the consumer's financial capacity and values (Oghazi and Mostaghel, 2018), and the attractive retailer offered credit alternatives (Hidalgo-Crespo et al., 2023), are some of the barriers impeding their deeper reach in the market.

The combination of two well-known psychographic theories, namely the Theory of Planned Behavior (TPB) and the Norm Activation Model (NAM) comprises the interplay of cognitive and social characteristics (Ajzen, 1991; Gilal et al., 2024; Han and Stoel, 2017) with moral and ethical dimensions (Schwartz, 1977; Kácha and van der Linden, 2021) offering a deeper comprehension of the factors that influence consumers' circular choices. The merging of the constructs of both theories may influence the intentions of the population to behave ecologically (Esfandiari et al., 2021; Liu et al., 2017a; Zhang et al., 2017). When looking at the literature on the consumers' willingness and acceptance of different circular business, circular economy, and green models, as well as the acceptance of PaaS models such as renting, leasing, and

pay-per-month, through the lens of TPB and/or NAM, a search conducted on the Scopus database identified 380 articles as shown in Table 1. Cluster analysis can help illustrate the trends and gaps in research as well as the main ideas discussed. For instance, Fig. 1 shows the co-occurrence network of the 380 identified papers with a minimum number of occurrences per keyword of three. The network has 60 connected keywords and eleven clusters. Cluster 3 is the only one related to the use of both psychographic theories on consumer behavior, green purchase intentions and willingness to pay. White goods or appliances are not associated in any of the clusters. After reviewing the abstracts, only 28 articles were found relevant, and four areas of scientific inquiry that have dominated research agendas were identified by the authors: (a) sustainable and circular consumer purchase behavior, (b) consumer adoption of circular business models, (c) consumer acceptance of sustainable electrical and electronic products, and (d) renewable energy consumer adoption.

For the first category, the revised studies analyze the environmental awareness, willingness to pay, and perceived green value, with barriers such as cost and trust issues (Nguyen, 2024; Fauzi et al., 2024; Sajjad et al., 2024; Alam et al., 2024; Mubarakah et al., 2024; Müller et al., 2021; Mai et al., 2023; Mohammed et al., 2020; Chao and Yu, 2024; Vo, 2018; Chandel and Gopal, 2019; García-Salirrosas et al., 2024; Nekmahmud and Fekete-Farkas, 2020; Zhang et al., 2023). For the second category, found studies focus on the acceptance of take-back management, leasing, pay-per-use, and online rentals, across various industries, including textiles, fashion, and carsharing, highlighting their sustainability potential (Elzinga et al., 2020; Wang and Song, 2024; Tu and Hu, 2018; Shamsi et al., 2023). The third category located studies converging on understanding consumer behavior and willingness to adopt sustainable products, particularly energy-saving appliances and remanufactured products, including lawn mowers (Zhang et al., 2020; Kabel et al., 2020, 2021). For the final fourth cluster, the reviewed papers converge on consumer adoption of renewable energies and electric vehicles, emphasizing sustainability and pro-environmental decision-making (Ud Din et al., 2023; Bhutto et al., 2021; Gumasing et al., 2023; Nketiah et al., 2022a; Srivastava et al., 2023; Le and Tran, 2024). All studies predominantly rely on structured surveys with sample sizes ranging from 118 to over 1200 respondents, analyzed using quantitative frameworks like structural equation modeling (SEM) and regression analysis. TPB and extensions incorporating constructs like environmental consciousness, perceived risks, personal norms are central to these investigations.

Even though, past studies suggest that individuals with high ecological intentions are likely to invest time in performing actual green behaviors and choose circular business models (Fishbein and Ajzen, 1975; Hidalgo-Crespo and Amaya-Rivas, 2024), intention and actual behavior are two very different things. In fact, previous research validated that those ecological intentions correspond to only 28% of the variance of the actual behavior (Sheeran, 2002), meaning that high shifts in intentions often translate into small actual behavioral changes (Sheeran et al., 2016). One alternative to measure the drivers of actual behaviors without having to follow people in their daily routine is

**Table 1**  
\*Search terms using Scopus.

Boolean Operators	Search String	Categories	Quantity
	1st Search	"acceptance" OR "willingness"	466,699
AND	2nd Search	"PaaS" OR "Product-as-a-Service" OR "rent*" OR "leas*" OR "pay-per-month" OR "circular model" OR "green model" OR "circular economy"	24,164
AND	3rd Search	"Theory of planned behavior*" OR "TPB" OR "norm activation model" OR "NAM" OR "norm activation"	380

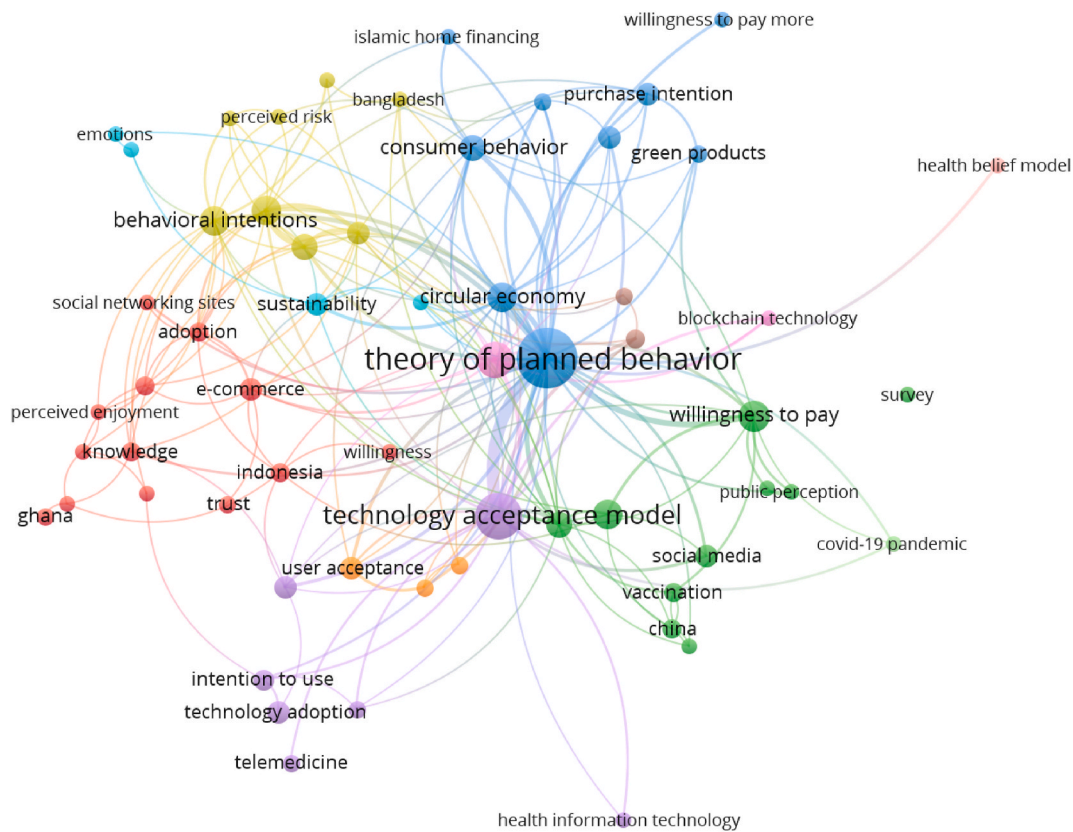


Fig. 1. Co-occurrence analysis of the research performed on the acceptance of CBMs.

through discrete choice experiments (DCE). This tool has already proven its efficacy in different fields, such as health, environment, transportation, and mobility (Börger and Hattam, 2017; Cassar, 2023; Ortiz et al., 2023; Schatzmann et al., 2024), however, to the best of the authors’ knowledge, it has never been used combined with psychographic theories for measuring the acceptance of CBMs. Providing the population with different alternatives and making them select their preferred choice, permits to have more reliable information on how they would act in the real world (Galekop et al., 2024).

While prior research has explored models like take-back management, leasing, and pay-per-use, little attention has been given to the pay-per-month model, particularly in developing countries of South America such as Ecuador. Additionally, even though most studies rely on the theory of planned behavior and its different possible extensions, none of them have combined both TPB and NAM to assess consumers’ intentions to choose between different models, including pay-per-month ones. More importantly, there is no previous research combining these frameworks with discrete choice experiment to capture real-world applicable behaviors. In order to attain these gaps, this study proposes a discrete choice experiment (DCE) to measure the Guayas (Ecuador) populations’ actual green behavioral patterns when selecting between different business model offers including the pay-per-month model, and to analyze the drivers affecting population’s green choices, the study also provides a theoretical framework integrating the Theory of Planned Behavior and the Norm Activation Model.

## 2. Research framework

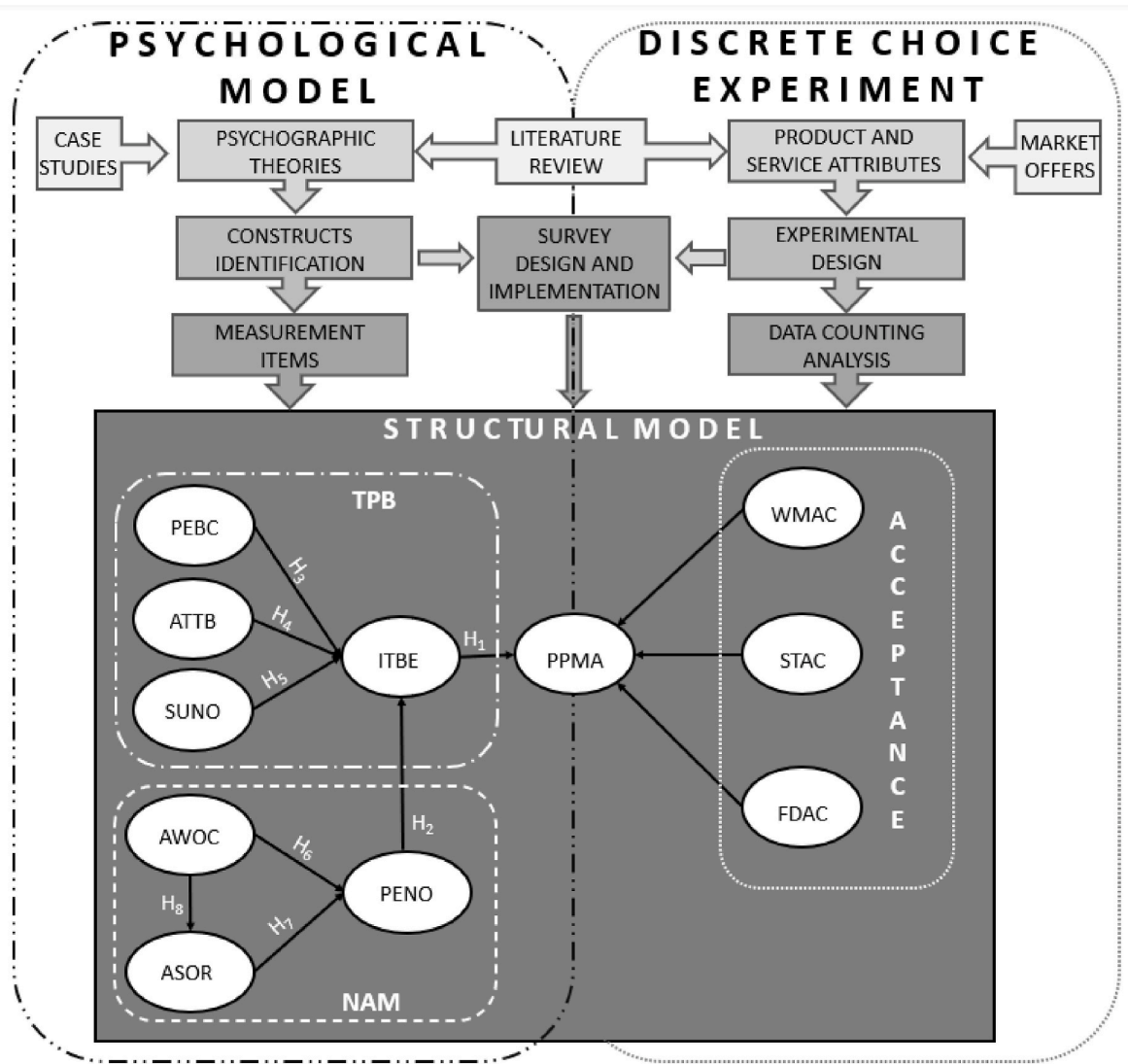
The current investigation integrates two widely recognized and utilized psychographic theories, namely the theory of planned behavior and the norm activation model, with one of the most commonly employed social experiments for assessing the tangible behavioral intention within a specific population—the discrete choice experiment,

as depicted in Fig. 2. White goods, specifically fast-moving consumer goods (FMCG) such as washing machines, refrigerators, and stoves, were chosen because to their broad use, frequency, and environmental impact when not appropriately redistributed through recovery channels.

### 2.1. Discrete choice experiment

In our discrete choice experiment, respondents were given three models for each category of white good: two linear (pay-cash and pay-credit) and one circular (pay-per-month). The pay-cash strategy follows the traditional technique of acquiring the product directly from the retailer. In contrast, the pay-credit model is purchasing the product from the store over a 12- to 24-month credit period, with often high interest rates resulting in a final payment equal to twice or triple the product’s initial cost. The pay-per-month approach required a monetary monthly payment for the lease of the white goods.

As a first step, product and service attributes needed to be identified for the three white goods. For this purpose, a literature review was performed to obtain the most used service attributes for the pay-per-month business model and the most popular retailers’ websites in Ecuador were reviewed to get the product attributes that were mentioned for the white appliances. Following the research of Rombouts (2019) for laundry solutions, service attributes such as contract time (6–72 M), monthly fee (10–35 USD), maintenance (included or not), moving service (included or not), take-back (included or not), and after sales services (included or not) were identified. For the case of product attributes, different Ecuador retailers’ websites were reviewed identifying some common for all three white goods, such as price in cash, price in credit, energy label (B/A/A+/A++/A+++), and brand. Particular identified product attributes for washing machines were capacity (pounds), number of washing cycles, type (manual/semi-automatic/automatic), control panel (digital/knobs/hybrid), type of load (frontal/upper), inverter (yes/no). For the case of fridges, identified product



**Fig. 2.** Proposed research framework. **Note.** ATTB: Attitude Toward Behavior, ASOR: Ascription of Responsibility, AWOC: Awareness of Consequences, FDAC: Fridge Acceptance, ITBE: Intentions to Behave Ecologically, PEBC: Perceived Behavioral Control, PENO: Personal Norms, PPMA: Pay-per-Month Acceptance, STAC: Stove Acceptance SUNO: Subjective Norm, WMAC: Washing Machine Acceptance.

attributes were capacity (liters), control panel (yes/no), inverter (digital/physical/none), ice dispenser (yes/no), water dispenser (yes/no). Lastly, for the case of stoves, identified attributes were number of burners, type of fuel (electricity/liquified petroleum gas), oven (yes/no).

As a second step, the experimental design was prepared. For this purpose, ten different washing machines, fridges, and stoves were selected for the experiment. The criteria of choices were twofold. Firstly, the most popular sold white goods were filtered, and secondly, five price ranges were acknowledged (as the five social classes available for the population and furtherly explained in the survey design sub-section) by ordering the FMCG by price and dividing by five the subtraction of the highest and lowest prices. Two FMCG (washing machines, stoves, and fridges) were taken from every price range and its product attributes were noted, to make a total of ten per each of them. Using Excel, the comparison between the three choices (pay-cash, pay-credit, and pay-per-month) were prepared using the ten different choices of every white good.

The experiment consisted of ten different sheets for comparison of the three choices per white good (giving a total of thirty sheets) using different product and service attributes in every sheet (see Fig. 3 for an example of a sheet). These sheets were uploaded as figures into ArcGIS Survey option and respondents were given the three options to choose

from (A, B, and C). To get the most realistic answer possible from respondents, following every page with choices, they had one page asking the following: “if you had to change your white good tomorrow for your household, would you still choose this? with the options of Yes or No (Rombouts, 2019).

As a third step, the data counting analysis was performed for every respondent. Despite being a type of descriptive statistics, counts analysis is a popular way for presenting results because it provides a quick and automated calculation of the frequency with which a specific payment model or attribute level is chosen (Rombouts, 2019). This analysis determined the frequency of ‘wins’ for option C for every type of white good for each respondent, taking into consideration that the respondent also selected yes in the following question, stating that they in fact would select that option if they had to change their white good tomorrow. This meant that ending this step, every respondent had a score for the acceptance of pay-per-month model for every white good from 0 to 10.

For the last fourth step, in order to incorporate the score acceptance in the structural model, every answer for the acceptance of washing machines (WMAC), stoves (STAC), and fridges (FDAC) were transformed to a five-point Likert scale with the following rule: scores between 0 and 2 would be one, scores between 3 and 4 would be two,

Payment Model	Pay - Cash	Pay - Credit	Pay-per-month
Brand	XXX	XXX	YYY
Capacity (litres)	525	525	751
Cost	1068.98 USD	2,002.50 USD (18 payments of 111.25 USD)	30.00 USD per month
Control Panel	No	No	Yes
Inverter	NO	Yes	Yes
Ice Dispenser	NO	Yes	Yes
Water Dispenser	NO	Yes	Yes
Product Class	Upper	Basic	Upper
Contract Period (cancellable per month here after)	-	-	36 months
Circular / Sustainable Product	NO	No	Yes
Services			Yearly Maintenance & Free moving service & User-Advice & End of Life Handling
Energy Label	A++	A++	A+++

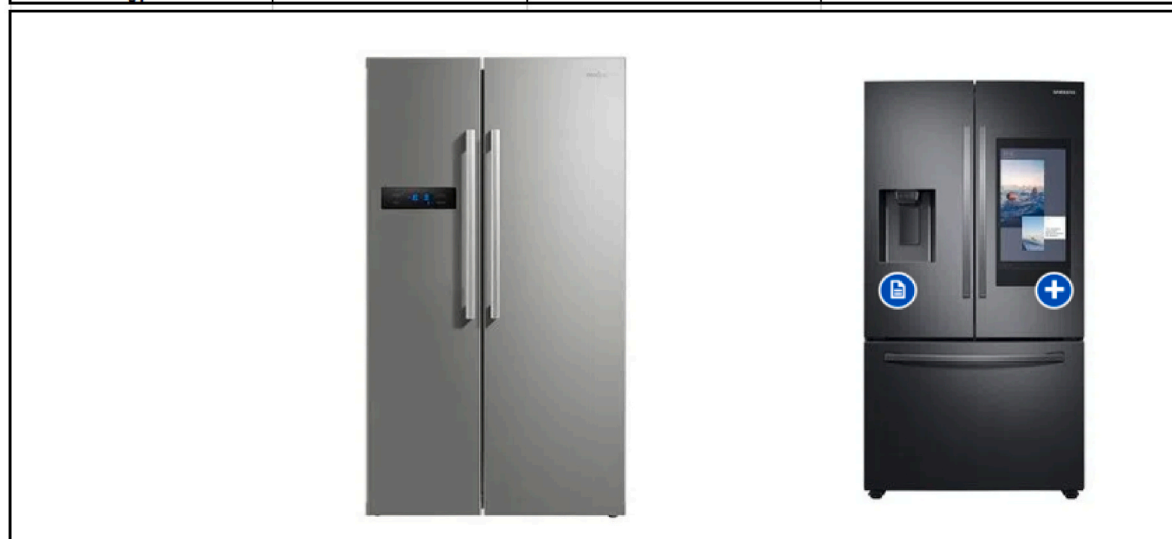


Fig. 3. Excel-based example of comparison of the three choices for fridges.

scores between 5 and 6 would be three, scores between 7 and 8 would be four, and finally scores between 9 and 10 would be five. Together, these three items formed the construct named pay-per-month acceptance (PPMA).

2.2. Psychological model

The study applied two well-known psychographic theories: the theory of planned behavior and the norm activation model. To predict and understand human behavior based on personal beliefs, the Theory of Planned Behavior (TPB) offers a proven framework that validates an individual’s intentions to behave ecologically (ITBE) driven by three constructs, attitudes toward the behavior (ATTB), subjective norms (SUNO), and perceived behavioral control (PEBC) (Ajzen, 1991). On the other hand, to predict and understand human altruistic engaged behavior based on internal norms and values, the Norm Activation Model offers a proven theoretical basis. The model is composed of three constructs, namely awareness of consequences (AWOC), ascription of responsibility (ASOR), and personal norms (PENO) (Schwartz, 1977).

Through a 5-point Likert scale validated measuring questions, the present research assessed all six combined constructs (ATTB, SUNO, PEBC, AWOC, ASOR, and PENO) driving the ITBE construct (Joshi et al., 2015). The intentions to behave ecologically were assessed by 11 items, being the biggest construct, following perceived behavioral control and awareness of consequences were assessed through 6 items each, and

lastly, attitude towards behavior, personal norms, and subjective norms were assessed through 5 items (Fishbein and Ajzen, 1977; Taylor and Todd, 1995; Tu and Hu, 2018; Yuriev et al., 2020). (For more information, refer to the survey in the supplementary material).

2.3. Survey design and implementation

An online survey using ArcGIS Survey123 (Felke, 2024, v. 3.14.256) software tool was created to collect information from the selected population regarding the acceptance of PaaS models in Guayas. ArcGIS Survey123 is a mobile application that enables the digital collection of survey data in the field, while also capturing photos and spatial coordinates. One previous research recommends this tool for data collection purpose, since it offers a user-friendly mobile app that facilitates traditional survey data collection, adaptable for use in areas with low internet connectivity, while also enabling the acquisition of geospatial data, such as photos and GPS coordinates (Felke, 2024).

The survey consisted of four components: The first part (five sheets) demanded socio-demographic information of both the household head and their family members. Drawing from prior research conducted in the corresponding field, the questionnaire sought data pertaining to the gender, age, educational attainment, and income of the head of the household (typically the primary breadwinner), along with general family details including household size and social standing (Hidalgo et al., 2018; Hidalgo-Crespo et al., 2019, 2021). For the measurement of

the social status, we used the same principles used by [Hidalgo-Crespo et al. \(2019\)](#) and stratified each household into five different socio-economic: low (LSEG), middle-low (MLSEG), middle (MSEG), middle-high (MHSEG), and high (HSEG).

The second part of the survey (two sheets) involved the collection of the information from all 7 construct items identified in the previous section. The respondents were offered a 5-point Likert scale for all 41 measurement items going from 1 (totally disagree) to 5 (totally agree). The 5-point Likert scale offers a highly reliable, simple, and valid technique to measure different psychological constructs with precision ([Ryser, 2023](#); [Chomeya, 2010](#)).

The discrete choice experiment was performed in the last section of the survey due to its extent and no to contaminate the psychographic model. In order to measure the acceptance of the pay-per-month business model, a total of sixty sheets were used (20 per white good). The section alternated one image comparing the three types of business model with different attributes (pay-cash, pay-credit, and pay-per-use) followed by another page confirming their choice in the previous page asking “if they would choose the option if they needed to change the white good the next day”.

Before the survey was implemented, the questionnaire was administered to twenty people as a pre-test. The participating respondents provided their feedback on the matter of clarity, misspellings, or questions formulated in a leading way. Once this process was over, the questionnaire was meticulously improved according to respondents’ feedback.

#### 2.4. Sample target

This study covers the analysis of the Guayas province, the most populated of all 24 provinces in Ecuador. It is situated in the southwest of the country and counts with approximately 4.4 million people, accounting for 24.5% of the total country’s population (see [Fig. 4](#)). It is

composed of 25 cantons, being the most populated ones, and accounting for more than 80% of the province’s total population, Guayaquil (62.5%), Duran (6.2%), Daule (5.1%), Milagro (4.5%), Samborondón (2.2%), Naranjal (1.9%), and El Empalme (1.8%) ([INEC, 2022](#)). Guayas is distinguished from other parts of the nation by its tropical environment, which features high temperatures all year round. During rainy season (between December and May), the province suffers from high humidity levels and rainfall. On the contrary, during the dry season (between June and November), the province’s weather is characterized by colder night temperatures and almost none rain precipitations ([Litardo et al., 2021](#)).

The target population for this particular research covers all family heads older than eighteen years old and that have the authority to make decisions in representation of the whole family unit ([Bookwalter et al., 2006](#)). Through a set of personal interviews and an online questionnaire, the respondents provided their answers, minimizing the possibility of incomplete surveys ([Kinnear and Taylor, 1996](#); [Sekaran, 2000](#)). The experiment started in July 2022 and lasted two months.

#### 2.5. Sample size

[Barclay et al. \(1995\)](#) introduced the 10-times rule, which has since become widely recognized in the PLS-SEM literature ([Memon et al., 2022](#)). According to this rule, the minimum sample size should be determined by the larger of two criteria: (1) 10 times the greatest number of formative indicators used to measure a single construct, or (2) 10 times the highest number of structural paths pointing to a particular latent construct in the structural model ([Hair et al., 2017](#), p. 24). Later, it was suggested the need of 15–20 observations per studied variable ([Hair et al., 2019](#)). From the point of view of statistics for infinite populations, they require a minimum sample of 384 to achieve 95% of confidence level and 5% of error.

The current study consists of eight constructs and forty-seven items.

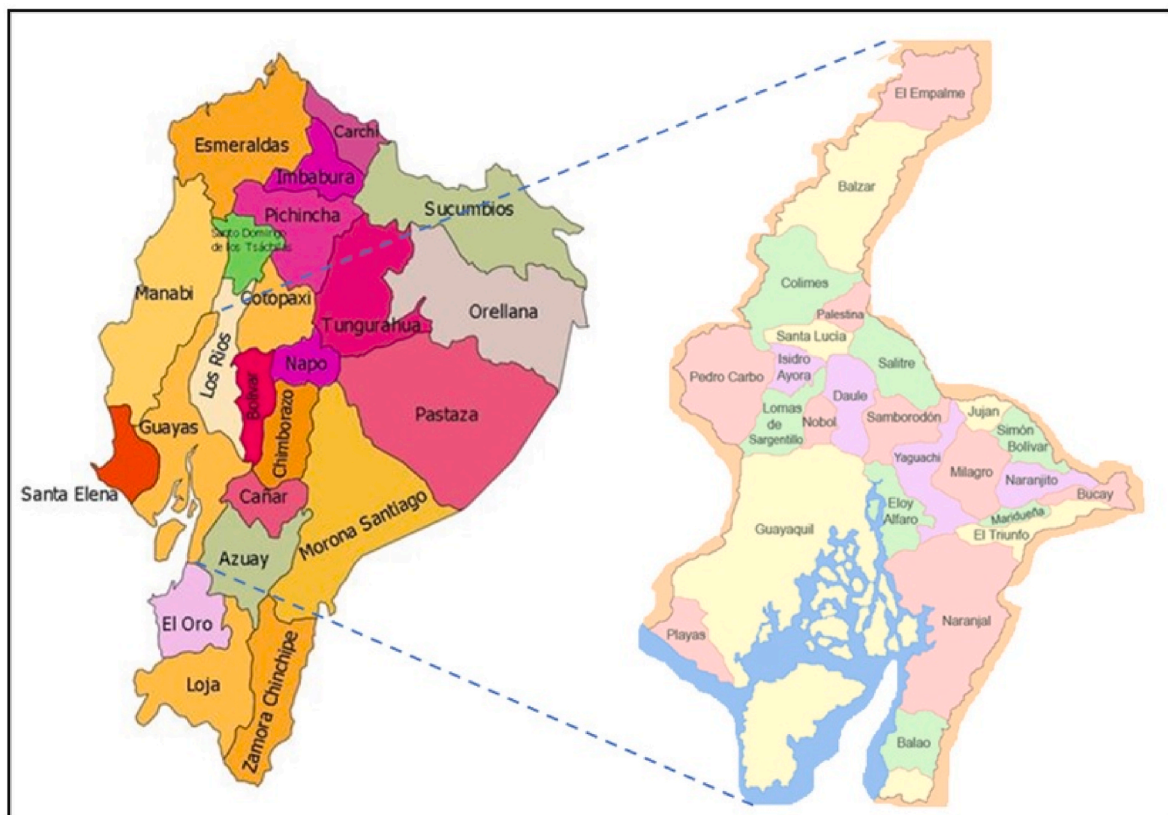


Fig. 4. Ecuador, Guayas Province and its 25 cantons.

The greatest number of items for a construct occurs with the intention to behave ecologically that counts with 11 items, and the total number of structural paths according to the research framework is eleven. Following all three rules, it is Hair et al. (2019) that gives the highest sample size with 820 (47 times 20). However, the study achieved a total of 3267 validated surveys, providing 99% confidence level with a 2.25% margin of error.

## 2.6. Data collection and cleansing

The data collection involved 390 students from two indigenous universities located in Guayaquil City. For this, a research project was created and presented to students that belonged to environment related courses of the penultimate semester of the bachelor of Industrial Engineering. The project offered bonus points to the interested students. All the interested registered students were aged between 24 and 30 years. Through different sessions with every course, the objectives and planning of the project were introduced to the students. To obtain a significant sample, every participated student was asked to register ten households (their own included). To do so, students had to go talk to the family heads, explain the project and ask for their participation. Students could register their own neighbors or family that did not live with them as long as these households remained inside the province of Guayas. Once, all the households were registered, each course was given a training on the contents of the survey and on the use of the survey tool feature of the Geographical Information System (GIS) software. Informed consent was obtained, confirming the interviewees' anonymity and acceptance for the information to be utilized for research purposes. To ensure the students ethical performance, they had to include a picture of them with the surveyed people during the interview and upload it on GIS together with the GPS location of each household.

From the 3805 total responses, 236 were excluded due to the fact that these population to the question in the DCE always answered no for all three choices, leaving 3569 responses. Meaning that this part of the population after reading all thirty pages of section three of the survey, they always selected "No" to the question "if they would choose the option if they needed to change the white good the next day". Removing responses from surveyed people who constantly answered "No" to all options (both circular and linear) indicate indifference and low engagement in the survey questions that could skew the results impacting the validity of all the data (Pearce et al., 2021). Following, other 302 responses were discarded considering values of the standard deviation of less than 0.3 not acceptable from the psychographic theories measurement items. Low standard deviations could indicate a lack of variability, which might not capture the full range of potential responses, potentially limiting the depth of analysis or masking underlying differences in perspectives (Teh et al., 2016). The similarity of answers may imply that the respondents did not have differing opinions or experiences regarding the items measured (Bais et al., 2020), indicating a lack of engagement with the survey items or acquiescence bias (Kam and Meyer, 2015). Different research has shown that a high variability of responses is essential to allow a more nuanced understanding of participants psychographic characteristics (Egleston et al., 2011; Tourangeau et al., 2010). Finally, a total of 3267 valid responses passed to the next section. To achieve this, standard deviation was calculated for all 47 items that were involved in section 2 of the survey, knowing that each respondent could answer always in the 5-point Likert Scale.

## 2.7. Structural model

The structural model (Fig. 1) merged both psychographic theories with the pay-per-month acceptance found with the discrete choice experiment. The structural model analyses the interactions of the four constructs from TPB with the three constructs from NAM and how they affect the PPMA. The following subsections state the hypotheses development for the structural model.

### 2.7.1. Intentions to behave ecologically

ITBE refers to a person's conscious intention or decision to engage in a given conduct. It indicates the individual's motivation and willingness to engage in the behavior and is influenced by a number of elements, including ATTB, SUNO, and PBC. ITBE are a significant predictor of future ecological behavior because they reflect the individual's willingness to act and level of commitment to the action; however, this is not always the case because other external factors may impact the behavior (Ajzen, 1991). Several studies have linked the beneficial effects of ITBE to actual ecological behavior. These studies examine consumer intentions to buy sustainable apparel (Frommeyer et al., 2022), reuse end-of-life garments (Oluwadamilola Olufemi Rotimi et al., 2024), and drive hybrid electric vehicles in China (Wang et al., 2016). Based on this, the following hypotheses are generated.

**H1.** Intention to behave ecologically has a positive effect on the pay-per-month model acceptance.

### 2.7.2. Perceived behavioral control

Perceived behavioral control (PEBC) refers to an individual's confidence level in their own means to carry out a particular behavior, following both internal and external factors that may accelerate or hinder (prior experience or anticipated challenges) their perception on the level of difficulty to perform said behavior (Ajzen, 1991). Green product acquisition (Liobikiene et al., 2016), environmental product purchasing in India (Amit Kumar, 2021), the choice of eco-friendly smart home technologies (Zhang and Liu, 2022) and electronic waste recycling willingness to pay (Koshta et al., 2022) are some of the constructs positive influenced by PEBC. Based on this, the following hypotheses are generated.

**H3.** Perceived behavioral control has a positive effect on citizens' intention to behave ecologically.

### 2.7.3. Attitude toward behavior

Attitude toward behavior (ATTB) refers to an individual's self-perception of their actions, driven by their positive or negative attitudes and beliefs which impacts on whether they regard said behavior as positive or negative. A variety of factors can influence their regard, such as personal experiences, cultural norms, and societal influences (Ajzen, 1991). Client's willingness to pay for circular products (Fu et al., 2017), the choice to purchase organic clothing and energy-efficient home appliances (Zhang et al., 2019), the intention to participate in a PET bottle waste recycling scheme in Indonesia (Amirudin et al., 2023), and the drivers to purchase refurbished laptops (Jiménez-Parra et al., 2014), are some of the examples of the positive influence of ATTB. Based on this, the following hypotheses are generated.

**H4.** Attitude toward behavior has a positive effect on citizens' intention to behave ecologically.

### 2.7.4. Subjective norms

Subjective Norms (SUNO) refer to an individual's perception of the importance of a particular behavior and its approval by important member of their surroundings. In other words, it is a measure of the perceived pressure or the social effect of others on an individual's activity performance (Ajzen, 1991). Studies indicate the strong positive influence of SUNO on different ecological behaviors such as buying green products (Zhuang et al., 2021), the younger generation's readiness to pay more for smartphones with ecolabels (Bigerna et al., 2021), recycling electronic waste (Vijayan et al., 2023), and electing to repurchase electric vehicles (Hasan, 2021). Based on this, the following hypothesis is stated.

**H5.** Perceived behavioral control has a positive effect on citizens' intention to behave ecologically.

### 2.7.5. Personal norms

Personal Norms (PENO) refer to an individual's self-standards (values, morality, beliefs and principles) serving as foundation of their own conceived norms that guide their behavior. These standards, which determine the moral worth of an individual's activities impacts, are created during the growth of the individual through their personal experiences, cultural influences, and social interactions (Schwartz, 1977). Personal norms have proven to positively influence several ecological intentions, such as pro-environmental behaviors (Majeed et al., 2023), recycling intentions (Nketiah et al., 2022b), electric vehicle adoption (Hoang et al., 2022), and sustainable clothing purchases (Lin et al., 2023). Based on this, the following hypothesis is developed.

**H2.** Personal norms have a positive effect on citizens' intention to behave ecologically.

### 2.7.6. Ascription of responsibility

Ascription of responsibility (ASOR) refers to the acceptance of an individual's consequence of their actions, as well as having a sense of responsibility to act better and to assist other in doing so, once they are aware of the situation (Schwartz, 1977). Green product consumption (Hong et al., 2024), the choice of electric vehicles (He and Zhan, 2018), responsible consumption and recycling intentions (Lee et al., 2023), and friendly tourist behavior in parks (Park et al., 2022), are ecological behaviors that have been positively influenced by ascription of responsibility in the literature. Based on this, the following hypothesis is generated.

**H7.** Ascription of responsibility has a positive effect on personal norms.

### 2.7.7. Awareness of consequences

Awareness of Consequences (AWOC) refers to an individual's consciousness or the impact of their actions on their surroundings and how they can affect the well-being and experiences of others (Schwartz, 1977). Awareness of consequences have been proven before to be precursor of personal norms when an individual intends to act ecologically friendly in different situations including pro-environmental behaviors and environmental complaint intention (Zhang et al., 2017), farmers' intention to conserve water (Savari et al., 2021), people's desire to use more sustainable mobility (Liu et al., 2017), and national park visitors' green behavior (Esfandiar et al., 2021). Given this, the following hypothesis is generated.

**H6.** Awareness of consequences has a positive effect on personal norms.

Going further, previous research has identified that an individual's realization of the impact of their daily activities on their surroundings and other people drives a sense of responsibility on the individual making them react accordingly leading to pro-environmental behaviors. The dependence of ascription of responsibility with the awareness of consequences has been observed in various contexts such as general environmental behavior (Gärling et al., 2003), ecological practices among youngsters traveling (Kiatkawsin and Han, 2017), the interest of Indians in electric vehicles (Singh et al., 2023), and the intentions of public employees to engage in pro-environmental actions (Fang et al., 2019). Based on this evidence, the following theory is proposed.

**H8.** Awareness of consequences has a positive effect on ascription of responsibility.

## 3. Results

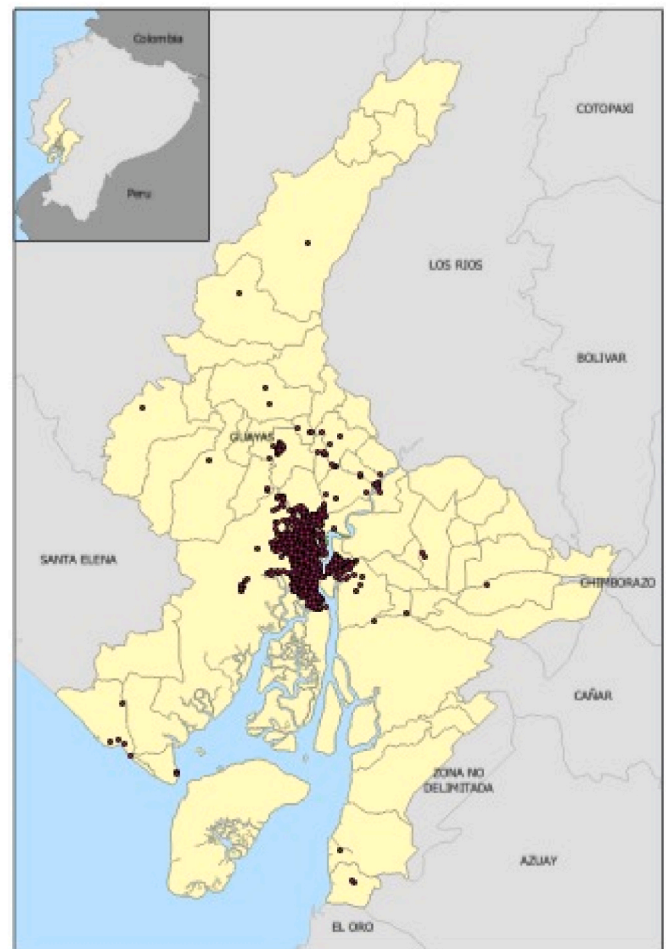
### 3.1. Sampled population characteristics

With the help of ArcGIS Survey123 tool, the location of the household of every surveyed person was obtained. From the 3267 gathered

points, 83.7% came from Guayaquil, 6.9% from Duran, 5.6% from Daule, 2.2% from Samborondon, and the last 1.6% from other 19 cantons. It is notable that the data gathering collected information from four out of twenty-five covering 16% of cantons, however in terms of population, the survey was performed in four cantons that cover 76% of the total population of the province (see Fig. 5), validating this way the representability of this sample for the whole Guayas area. As shown in the population statistics in Table 2, the sample is most prominent composed of male individuals, aged between 37 and 58 years old, with at least an university education level and an average monthly family revenue of 420 USD.

### 3.2. Measurement model

The gathered data was modeled through partial least squares structural equation (PLS-SEM) with the help of SmartPLS software version 4.2. Previous studies have used partial least square equation structural equation modeling (PLS-SEM) for environment related psychographic studies and produced strong and trustworthy results (Li et al., 2020; Wang et al., 2019; Ayob et al., 2017). Due to its non-parametric nature and its adaptability, PLS-SEM can handle different complex research models and data dimensions, even those that are not visible at first and handle. In addition, small and large sample sizes can be integrated in the interface obtaining similar residual distributions, making SmartPLS-SEM the ideal interface for measurement models (Hair et al., 2019).



**Fig. 5.** Ecuador, Guayas Province and its 25 cantons. **Note:** Dark red dots represent the dispersion of the households covered by the project in Guayas Province.

**Table 2**  
Data demographics.

Variable	Categories	Frequency	Percentage <sup>a</sup>
Gender	Male	2164	66.24
	Female	1103	33.76
Family Size	1	98	3.00
	2	360	11.02
	3	744	22.77
	4	924	28.28
	5	672	20.57
	6	281	8.60
	>6	188	5.75
Age of household head	<26	236	7.22
	26–36	605	18.52
	37–47	979	29.97
	48–58	963	29.48
	59–69	379	11.60
	>69	105	3.21
	None	51	1.56
Education of household head	Primary School	325	9.95
	High School	1461	44.72
	Bachelor	1266	38.75
	Post-Graduate	164	5.02
	LSEG	14	0.43
Social Status of the family	MLSEG	448	13.71
	MSEG	1347	41.23
	MHSEG	116	3.55
	HSEG	298	9.12
	None	127	3.89
Income of household head	<420	1472	45.06
	421–840	860	26.32
	841–1260	544	16.65
	1261–1680	145	4.44
	1681–2100	60	1.84
	>2100	59	1.81

Note.  
<sup>a</sup> All percentages are based on a total sample of 3267 respondents.

The first step to assess reliability of the measurement model was to perform a convergent validity analysis on the different indicators (44 items in total). From all the indicators (items), 42 passed the threshold of 0.5 and those that did not pass were deleted and can be found in Table 3 with an X. All the eight constructs exceeded the respective criterions of Cronbach’s alpha, composite reliability (CR), and average variance extracted (AVE) (0.7, 0.7, and 0.5, respectively). These values indicate high internal consistency and reliability, dependability between the constructs, and adequate convergent validity.

As a second step, following Campbell and Fiske (1959), the constructs’ discriminant validity was assessed and validate to prove the lack of statically significant association between them. This is necessary to confirm the distinctness of each construct and their importance in the model. As shown in Table 4, all the square roots of the average extracted variance were superior to those of the other constructs when compared, as can be seen in the diagonal of the table (Fornell and Larcker, 1981), meaning that when compared, each construct outperforms the others.

### 3.3. Structural model assessment

As a third step, the structural validity of the model was computed. The validity of the previous stated hypotheses indicating the relationships among the constructs and their statistical significance was assessed.

H<sub>1</sub> assesses if the intention to behave ecologically has a significant and positive effect on pay-per-month acceptability. The study found a substantial positive correlation ( $\beta = 0.136$ ,  $p < 0.001$ ) between the intention to behave environmentally and pay-per-month acceptability. Therefore, H<sub>1</sub> was supported. Even though, the intentions show statistical significance, this study reveals its moderate effect, highlighting the intention-behavior gap persistence, meaning that only high intentions are not sufficient to adopt PPM model, because concerns about

**Table 3**  
Assessment of measurement model reliability.

Variable	Item	Outer loading	Cronbach’s $\alpha$	AVE	Composite Reliability
Attitude toward behavior (ATTB)	ATTB1	0.844	0.918	0.690	0.918
	ATTB2	0.840			
	ATTB3	0.838			
	ATTB4	0.819			
	ATTB5	0.813			
Perceived Behavioral Control (PEBC)	PEBC1	0.947	0.819	0.532	0.853
	PEBC2	0.741			
	PEBC3	0.632			
	PEBC4	0.531			
	PEBC5	X			
	PEBC6	X			
Subjective Norms (SUNO)	SUNO1	0.926	0.904	0.653	0.914
	SUNO2	0.889			
	SUNO3	0.732			
	SUNO4	0.812			
	SUNO5	0.651			
Intentions to Behave Ecologically (ITBE)	ITBE1	0.566	0.949	0.638	0.954
	ITBE2	0.728			
	ITBE3	0.781			
	ITBE4	0.811			
	ITBE5	0.745			
	ITBE6	0.823			
	ITBE7	0.837			
	ITBE8	0.860			
	ITBE9	0.843			
	ITBE10	0.881			
	ITBE11	0.863			
Personal Norms (PENO)	PENO1	0.867	0.926	0.713	0.926
	PENO2	0.850			
	PENO3	0.807			
	PENO4	0.854			
	PENO5	0.844			
Awareness of Consequences (AWOC)	AWOC1	0.865	0.943	0.734	0.943
	AWOC2	0.850			
	AWOC3	0.862			
	AWOC4	0.838			
	AWOC5	0.860			
	AWOC6	0.864			
Ascription of Responsibility (ASOR)	ASOR1	0.842	0.885	0.721	0.887
	ASOR2	0.817			
	ASOR3	0.886			
Pay-per-month Acceptance (PPMA)	WMAC1	0.508	0.800	0.602	0.857
	FDAC2	0.891			
	STAC3	0.867			

reliability and affordability may provoke hesitation.

H<sub>2</sub> examines whether perceived behavioral control has a significant and positive effect on the intention to behave environmentally. The study found that perceived behavioral control has a significant beneficial impact on pay-per-month acceptability ( $\beta = 0.119$ ,  $p < 0.001$ ). Therefore, H<sub>2</sub> was supported. Due to this strong relationship, structural barriers such as limited accessibility or complex procedures or perceived risks should be avoided, given that they may weaken consumers’ intentions to adopt PPM model.

H<sub>3</sub> examines whether personal norms have a significant and positive effect on the intention to behave ecologically. Personal norms have a considerable favorable impact on eco-friendly behavior ( $\beta = 0.459$ ,  $p < 0.001$ ). Therefore, H<sub>3</sub> was supported. The high impact of personal norms (PENO) on intentions (ITBE) suggests that individuals’ moral obligations toward environmental protection serve as a critical motivator, possibly amplified by cultural or regional emphasis on sustainability. Consumers may feel morally compelled to subscribe to the PPM model as part of their contribution to promoting sustainable business models.

H<sub>4</sub> examines whether attitudes toward conduct have a significant and positive effect on the intention to behave ecologically. The study found that attitudes about conduct have a significant beneficial impact on the intention to behave environmentally ( $\beta = 0.251$ ,  $p < 0.001$ ). Therefore, H<sub>4</sub> was supported. This significant influence aligns with

**Table 4**  
Discriminant validity Assessment.

Constructs	ASOR	ATTB	AWOC	ITBE	PPMA	PEBC	PENO	SUNO
Ascription of Responsibility (ASOR)	<b>0.949</b>							
Attitude Toward Behavior (ATTB)	0.889	<b>0.931</b>						
Awareness of Consequences (AWOC)	0.894	0.874	<b>0.896</b>					
Intention to Behave Ecologically (ITBE)	0.826	0.811	0.840	<b>0.899</b>				
Pay-per-Month Acceptance (PPMA)	0.128	0.137	0.124	0.136	<b>0.776</b>			
Perceived Behavioral Control (PEBC)	0.677	0.730	0.628	0.681	0.097	<b>0.829</b>		
Personal Norms (PENO)	0.904	0.925	0.883	0.818	0.138	0.695	<b>0.845</b>	
Subjective Norm (SUNO)	0.592	0.662	0.527	0.616	0.082	0.820	0.609	<b>0.808</b>

TPB’s main premise which state that positive attitudes, shaped by a consumer’s perception of PPM model benefits (costs savings, convenience, environment), are strong predictors of behavioral intentions.

H<sub>5</sub> examines whether subjective norms have a significant and positive effect on the intention to behave environmentally. Subjective norms significantly increase the intention to behave ecologically ( $\beta = 0.027, p < 0.05$ ). Therefore, H<sub>5</sub> was supported. Even though there is a small influence of social expectations and peer behavior on consumers’ decision making, in regions where social expectations for sustainable behavior are low can limit the influence of subjective norms.

H<sub>6</sub> assesses if awareness of consequences has a significant and beneficial effect on personal norms. The study found that being aware of repercussions positively impacts personal norms ( $\beta = 0.894, p < 0.001$ ). Therefore, H<sub>6</sub> was supported. The strong coefficient leads to believe that consumers awareness and understanding of the benefits of leasing instead of owing appliances can be a precursor of the adoption of PPM model.

H<sub>7</sub> examines whether ascription of responsibility has a significant and positive impact on personal norms. The study found that assigning responsibility has a considerable beneficial effect on personal norms ( $\beta = 0.571, p < 0.001$ ). Therefore, H<sub>7</sub> was supported. Consumers who admit the repercussion of their actions on the environment and its conservation are more likely to adopt the PPM model.

H<sub>8</sub> assesses whether being aware of the consequences has a significant and beneficial impact on responsibility allocation. The study found that understanding of consequences has a considerable favorable impact on assigning blame ( $\beta = 0.372, p < 0.001$ ). Therefore, H<sub>8</sub> was supported. The high coefficient value suggests that awareness of consequences play a pivotal role by fostering an individual’s self-sense of accountability for their actions, implying that emphasizing the environmental and economic benefits of the PPM model could significantly enhance adoption.

The results are presented in Table 5 and Fig. 6.

### 3.4. Mediation analysis

The mediation role of intentions to behave ecologically (ITBE) between the TPB and NAM constructs (ASOR, AWOC, PENO, ATTB, PEBC,

**Table 5**  
PLS-SEM model analysis.

Hypotheses	$\beta$	SD	t-value	p-value	Results
H1: ITBE - > PPMA	0.136	0.019	7.253	0.000***	Supported
H2: PEBC - > ITBE	0.119	0.032	3.731	0.000***	Supported
H3: PENO - > ITBE	0.459	0.054	8.445	0.000***	Supported
H4: ATTB - > ITBE	0.251	0.058	4.372	0.000***	Supported
H5: SUNO - > ITBE	0.072	0.029	2.448	0.014*	Supported
H6: AWOC - > PENO	0.894	0.009	100.464	0.000***	Supported
H7: ASOR - > PENO	0.571	0.046	12.367	0.000***	Supported
H8: AWOC - > ASOR	0.372	0.046	8.102	0.000***	Supported

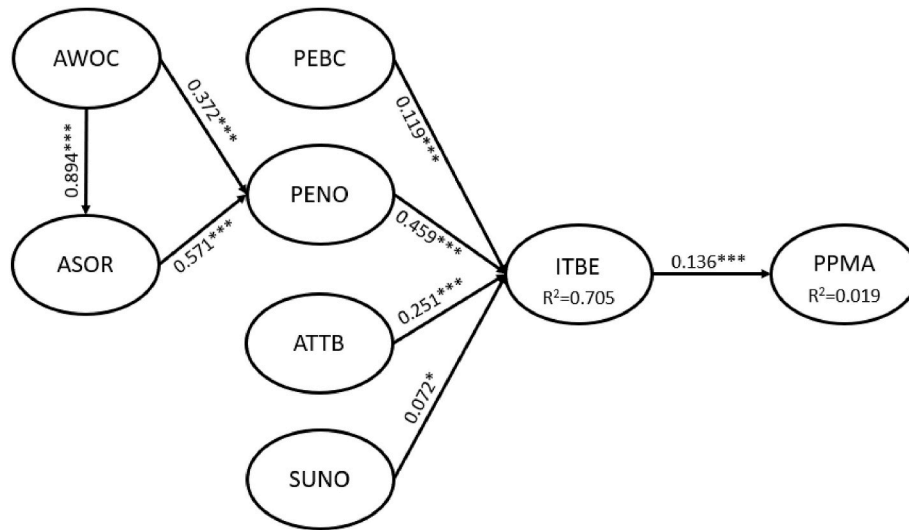
**Note.** p-value = probability value, t-value = t – statistics, SD = Standard Deviation, and  $\beta$  = Beta Coefficient. Statistically validity occur at \*p < 0.05, \*\*p < 0.01, and \*\*\*p < 0.001. ATTB: Attitude toward behavior, PEBC: Perceived behavioral control, SUNO: Subjective norm, ITBE: Intention to behave ecologically, PPMA: Pay-per-Month Acceptance, PENO: Personal Norms, AWOC: Awareness of Consequences, and ASOR: Ascription of Responsibility.

and SUNO) and the acceptance of the pay-per-month model (PPMA) for white goods was assessed as shown in Table 6. In general, the results revealed statistically important indirect mediation of all TPB and NAM constructs and PPMA, being personal norms the most important. However, their modest strength suggests that additional factors, such as external barriers (e.g., cost, accessibility, or convenience) and contextual influences (e.g., cultural norms or infrastructure), may play a significant role in shaping consumer behavior and bridging the intention-behavior gap. Additionally, ITBE direct effect on PPM acceptance ( $\beta = 0.119, p < 0.001$ ) confirms its significant role in predicting consumer behavior, however, its moderate strength aligns with the intention-behavior gap often observed in other TPB studies, where strong intentions do not always translate into actions due to external barriers or personal constraints.

### 3.5. Explanatory power

The evaluation of the explanatory power ( $R^2$ ) refers to the analysis on the importance of each dependent variable on the independent ones (Table 7). In simpler words, it means how much the variance of independent variables are affected by their dependent predictors (Rigdon, 2012) on a scale from 0 to 1, being significant those  $R^2$  values higher than 0.26, moderate those between 0.13 and 0.26, and weak those between 0.02 and 0.13 (Cohen, 1988; Shmueli and Koppius, 2011). However, in many environmental studies,  $R^2$  values higher than 0.10 can be considered elevated enough, validating all the independent constructs (ITBE, PENO, and ASOR) with high explanatory power, and PPMA with a weak explanatory power. Weak explanatory power for PPMA underscores the persistence of the intention-behavior gap, indicating that additional variables (perceived risks, convenience, or trust) may need to be incorporated into the model. On the other hand, high explanatory power for both ITBE, PENO, and ASOR, proves the robustness of both theoretical frameworks in predicting ecological intentions.

Once, the explanatory power was calculated, the impact size ( $F^2$ ) of the dependent variables can offer an understanding on the most impacting ones, quantifying the strength of the link connecting dependent and independent constructs in the PLS-SE model. To understand the impact size, values between 0 and 1 are given, and the strength of these values are evaluated with the weak, moderate, and high scale, being 0.35, 0.15, and 0.02 the corresponding limits (Cohen, 1988). This can allow to further favorize the improvement of these constructs among the population, as for instance, ITBE on PPMA with a moderate effect, ATTB with a moderate importance on ITBE, and lastly, both AWOC and ASOR, high importance on PENO. The effect size analysis reveals strong influences of moral constructs like ASOR on PENO and moderate impacts of AWOC and ATTB on ITBE. However, weak effects of ITBE on PPM acceptance and SUNO on ITBE highlight the need to address many perceived customer barriers to enhance adoption. Finally, given that all the predictive values ( $Q^2$ ) of the independent constructs was higher than 0, the present model suggests predictive importance.



Note: \*p<0.05, \*\*p<0.01, \*\*\*p<0.001  
 AWOC: Awareness of Consequences, ASOR: Ascription of Responsibility, PENO: Personal Norms, ATTB: Attitudes toward behavior, PEBC: Perceived behavioral control, SUNO: Subjective norms, ITBE: Intention to behave ecologically, PPMA: Pay-per-Month Acceptance.

Fig. 6. Structural extended TPB model.

**Table 6**  
 The mediation of Intention to Behave Ecologically in the Model.

Relationship	Total Effects	Direct Effect	Indirect Effects of TPB constructs			
	Coefficient	Coefficient	TPB Constructs	Coefficient	Percentile bootstrap 95% confidence interval	
					Lower	Upper
ITBE - > PPMA	0.136 (7.253)***	0.119 (3.731)***	PEBC	0.016 (3.324)***	0.007	0.027
			PENO	0.063 (5.512)***	0.042	0.086
			ATTB	0.034 (3.641)***	0.018	0.054
			SUNO	0.010 (2.243)*	0.002	0.019
			AWOC	0.023 (4.250)***	0.014	0.035
			ASOR	0.036 (5.270)***	0.024	0.050

Note. \*p-value <0.05; \*\*p-value<0.01; \*\*\*p-value<0.001; ITBE: Intention to behave ecologically, PEBC: Perceived Behavioral Control; PENO: Personal Norms; ATTB: Attitudes towards Behavior; SUNO: Subjective Norms; AWOC: Awareness of Consequences; ASOR: Ascription of Responsibility.

**Table 7**  
 Explanatory power.

Predictor(s)	Outcome(s)	R <sup>2</sup>	F <sup>2</sup>	Q <sup>2</sup>
ITBE	PPMA	0.019	0.021	0.023
PEBC	ITBE	0.705	0.013	0.678
PENO			0.013	
ATTB			0.027	
SUNO			0.006	
AWOC	PENO	0.845	0.179	0.681
ASOR			0.422	
AWOC	ASOR	0.799	3.984	0.668

Note. PPMA: Pay-per-Month Acceptance; ITBE: Intention to behave ecologically; ATTB: Attitude Toward Behavior; PEBC: Perceived Behavioral Control; SUNO: Subjective Norms; PENO: Personal Norms.

**4. Discussion**

As noted in the introduction, arguably the biggest barrier to the prediction of green behaviors with psychographic theories is the possible biases (metrics, acquiescence, and social desirability) due to the gathering of these behaviors with some Likert-scaled questions, asking directly the population the likeliness of them performing said behavior (Lee et al., 2002; Dietz et al., 2007; Westland, 2022). These biases are avoided through the implementation of the discrete choice experiment.

First the use of an online interface with GIS survey tool avoids the social desirability bias, since the interviewer was just there to explain the survey and connect the respondent to it. Second, giving two traditional options (pay-cash and pay-credit) and introducing a circular one with the pay-per-month option and after asking the respondent to state if they would actually select the previous option if they had to change their white good avoids the social desirability bias. Third, through the counting method and transformation to Likert Scale, the metrics bias is also avoided.

The results of this research on the acceptance of pay-per-month model for white goods highlight the significant role of personal norms and attitudes towards behavior in shaping ecological intentions, which is consistent with the results of Zhang et al. (2023) that emphasize the important roles of personal responsibility and green moral and cognitive drivers in sustainable decision making. ATTB were found critical also in shaping ecological intentions for adopting electric vehicles, eco-labeled products, and remanufactured products such as lawn mowers (Alam et al., 2024; Kabel et al., 2020, 2021; Bhatto et al., 2021). PENO were demonstrated to strongly predict the adoption of circular products, particularly in furniture (Mubarakah et al., 2024), and renewable sources, where moral and environmental responsibility played a crucial role (Nketiah et al., 2022a).

While this research identified a weak influence of subjective norms (SUNO) on intentions, reflecting low social pressure, other studies, such

as those examining green furniture and eco-labeled products, highlighted social norms as an influential construct (Mubarokah et al., 2024; Bhatto et al., 2021). However, other study found that social pressures had variable effects depending on cultural and demographic contexts (Gumasing et al., 2023). This underscores the importance of tailoring normative messaging to specific societal settings.

Additionally, this research underscores the persistence of the intention-behavior gap, particularly though the modest influence of ecological intentions (ITBE) on PPM acceptance. This is in line with other research observing different barriers (e.g., perceived risks, trust issues, the need for supportive infrastructure, culture, product availability and policy interventions), highlighting the need for addressing them when shaping PPM adoption (Gumasing et al., 2023; Kabel et al., 2021; Nekmahmud and Fekete-Farkas, 2020)

Finally, this research claims the broader applicability of integrating the Theory of Planned Behavior (TPB) with constructs from the Norm Activation Model (NAM) in diverse contexts, while also addressing the gaps in capturing practical and structural barriers, an area underexplored in previous research. These insights contribute to advancing theoretical frameworks and improving practical strategies for promoting circular economy practices globally.

#### 4.1. Theoretical implications

The integration of two well-renowned psychographic frameworks, the theory of planned behavior and the norm activation model provides a robust framework for understanding and predicting consumer acceptance of the pay-per-month model. By extending the theory of planned behavior with the constructs of the norm activation model, the predictive acceptance of the pay-per-month model for white goods is more useful than the TPB model alone, as shown with the positive influence of ITBE on PPMA. The strong impact of constructs such as personal norms and attitude towards behavior on the intentions to behave ecologically, underscores the importance of both intrinsic motivations and practical capabilities in shaping pro-environmental behavior, highlighting the need to integrate moral obligations and attitudinal constructs into consumer behavior for circular business models acceptance. Additionally, TPB constructs, namely ATTB, PEBC, and SUNO, together with NAM constructs, namely PENO, AWOC, ASOR, partially mediate the relationship between ITBE and PPMA, reassuring the importance of both theories working together to improve the model's predictive power.

Interestingly, even though PEBC, PENO, ATTB, and SUNO, all affect the ITBE, according to the impact size, the most important constructs are ATTB and PENO. The moderate impact of perceived behavioral control on intentions highlights the interplays between internal and external control factors, suggesting that future TPB based models should account for contextual constraints, such as costumers and country's financial conditions, service availability and other regional or country level consumers' perceived constraints that could affect the adoption of circular business models, (e.g., the fact that owing high quality and expensive appliances could influence robberies in an already dangerous country). Finally, while the subjective norms construct was found significant suggesting that cultural and social contexts play a critical role in moderating the intentions as recognized by TPB framework, its weak coefficient value suggests that normative influences are less pronounced for the study area, suggesting an individualistic society. This poses a problem for the acceptance of the PPM model due to the weaker reliance on collective norms and social influences, especially for developing world cultures where ownership and independence are synonyms of property and autonomy. Meanwhile, the critical role of ASOR and AWOC in the development of PENO, underscore that assigning personal responsibility for environmental outcomes significantly strengthens ecological intentions.

The present research demonstrates that obtaining the actual behavior intention, in this case for the acceptance of pay-per-month business model for white goods, using a discrete choice experiment is very

effective and can be combined with typical psychographic theories in a structural model and that through structural equation modeling these intentions of behaviors can be predicted in some level. Collectively, the combined TPB-NAM framework demonstrates moderate predictive utility, with PENO and ATTB emerging as the most impactful constructs. However, the weak explanatory power of ITBE on PPM acceptance and the intention-behavior gap suggest that future models should integrate external factors, such as economic and environmental constraints together with the consideration of socio-economic and demographic characteristics.

#### 4.2. Practical implications

With the information from the discrete choice experiment, policy-makers and businesses can identify the trade-offs consumers are willing to make (cost/convenience ratio) and design tailored offerings that maximize acceptance. Different consumer segments can be identified with the data from the DCE and targeted interventions, such as personalized marketing campaigns or policy incentives, can be based on their segments' preferences. For instance, policymakers can leverage financial incentives on the access to energy-efficient white goods and/or offering different subsidies for the participation on environmental-friendly business models to attract more population. Similarly, other policies encouraging public-private stakeholders alliances should be promoted, such as the formalization of the curbside collection, reverse logistics, the product maintenance and refurbishment during the use phase, and the remanufacturing and recycling at the end of life.

Joint marketing efforts from business and policymakers should highlight the environmental and moral benefits by personalizing the environmental benefits and linking them to moral obligations, strengthening personal norms (PENO) and fostering positive attitudes towards behavior (ATTB). These strategies should aim at making the population visualize the cumulative societal and ecological benefits of adopting the PPM model aligning their individual values while reinforcing their intrinsic motivations. This can be achieved by tangible and comprehensive presentation of these benefits, such as carbon footprint calculator, landfill life extension, and providing clear metrics on energy savings and how they translate in electricity bill reduction. To further increase positive personal norms, given their important role in the development of intentions and final acceptance of PPM model, educational campaigns emphasizing the ecological benefit of waste reduction and energy efficiency to activate consumers moral obligations should be set in motion.

Due to the low effects of subjective norms, in order to drive the acceptance of the PPM model in the study area recognized as an individualistic society, businesses and policymakers need to focus on strengthening intrinsic motivations while highlighting the perceived benefits and individual advantages like cost savings, convenience, and accessibility to top-notch smart appliances which normally they would not have access to in the traditional lineal economy due to their high prices. Communication strategies should emphasize the tangible individual benefits showcasing social proof (e.g., testimonies and user statistics). The incorporation of American and European traditions in Ecuadorians festivities such as thanksgiving, Halloween, Three Kings' Day, together with the influence of Spanish textile companies (Mango, Zara and others) on individuals way of dressing provide sufficient proof of Ecuadorians high level of philoxenia, showing affection and/or admiration for foreign products and habit. This highlights the importance of selecting well-known international celebrities from USA or Europe for these communication strategies.

Different businesses (OEMs or retailers) who supply or intend to provide white goods on a pay-per-month basis should implement strategies such as offering transparent pricing, robust customer support, flexible subscription (e.g., free trials, simplified subscription process, and no-penalty for contract withdrawals) and/or quality guarantees. These targeted recommendations provide a roadmap for translating the

research findings into actionable policy measures and business strategies.

#### 4.3. Limitations and future work

The reliance on the intention to behave ecologically, as the sole predictor coming from the theory of planned behavior, can limit the models' power to predict actual behavior, accounting for an increment in the gap between intentions and actions. While the combination of both the theory of planned behavior and the norm activation model significantly translates into the formation of ecological intentions, these intentions only moderately translate into acceptance of the pay-per-month model with a weak explanatory power. These limitations call for the inclusion of external factors, such as socio-demographic-economic conditions, cultural norms, and policy frameworks, to better predict behavior.

Another restriction on the generality of this study's findings is the current study's concentration on particular cities in Ecuador's Guayas province. It is unclear whether the findings here can be extrapolated to the whole country due to the lack of data from other geographical areas and other climate conditions. Additionally, even though the current study primarily uses survey data and psychometric scales, it leaves out other crucial factors like prior leasing experience, cost sensitivity, and ownership preferences that could affect the choice of PPM business model.

To improve the external validity and generalizability of the findings, it is advised that future studies include data from a variety of geographical regions and climates, and incorporate consumer preferences and macro- and microeconomic factors into the PPM model's acceptance framework in order to offer a more thorough understanding. Future research should also look into exploring the impact of socio-demographic and economic variables on the psychographic framework and on the discrete choice experiment data. Frequency analysis of DCE could help identify different consumer segments and their characteristics. Correlation, regression and variance analysis could further uncover relationships between key variables offering deeper understanding of their individual and collective influence in the PPM acceptance.

## 5. Conclusions

Research on sustainable business models is becoming more popular as a result of the issues posed by e-waste, and the Product-as-a-Service (PaaS) model is one possible remedy. By prioritizing service subscriptions over outright product ownership, PaaS challenges traditional paradigms, aligning economic activity with circular business model principles. For fast-moving consumer goods (FMCG) like washing machines, stoves, and fridges, PaaS offers a pathway to reduce waste and enhance resource efficiency. However, adoption of such models, particularly in developing economies like Ecuador, faces several social, technical, political, and cultural barriers.

The present study addressed these gaps by measuring the drivers of the population to accept a pay-per-month model by integrating the norm activation model and the theory of planned behavior. Key findings highlight the significant roles of personal norms, awareness of consequences, and attitudes toward behavior in shaping ecological intentions and acceptance of pay-per-month models. The use of a discrete choice experiment further validated the intention-behavior relationship, offering nuanced insights into consumer preferences for PPM model features.

The results demonstrate that increasing consumer awareness of the environmental and economic benefits of PPM models can significantly enhance their acceptance, thereby promoting circular economy practices. Practical implications include the need for targeted educational campaigns, transparent pricing structures, and strategies to address barriers such as trust and convenience. These findings contribute to the literature by providing a framework that is adaptable to other emerging

economies with strong cultural attachments to ownership and high upfront costs for electrical and electronic equipment.

Furthermore, this framework can be extended to other service-based offerings and tested in diverse socio-economic contexts. For instance, replicating the study in developed economies could reveal contrasts in adoption behavior, driven by differing cultural and economic factors. By integrating additional social and cultural variables, future research can broaden the relevance of this model, enhancing its application across global markets.

In conclusion, this study provides valuable insights into the adoption of PPM models for white goods in Ecuador's Guayas province, underscoring the role of combined TPB and NAM frameworks in predicting ecological intentions. The research contributes both theoretical and practical knowledge, offering actionable strategies for promoting sustainable consumption patterns and advancing the global transition to circular business models.

#### CRediT authorship contribution statement

**J. Hidalgo-Crespo:** Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **J.L. Amaya-Rivas:** Writing – original draft, Validation, Resources, Methodology, Formal analysis. **J.D. Cabrera-Abad:** Writing – original draft, Resources, Methodology, Investigation. **Andreas Riel:** Writing – review & editing, Validation, Supervision, Software, Resources.

#### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.clet.2025.100915>.

#### Data availability

Data will be made available on request.

#### References

- AB Electrolux, 2022. Electrolux launches 'Appliance-as-a-Service' program to promote circular economy. <https://www.electroluxgroup.com/en/for-the-better-22127/>.
- Ajzen, I., 1991. The theory of planned behavior. *Organ. Behav. Hum. Decis. Process.* 50 (2), 179–211. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T).
- Alam, S.S., Ho, Y.H., Ahmed, S., Lin, C.Y., 2024. Predicting eco-labeled product buying behavior in an emerging economy through an extension of the theory of planned behavior. *Rev. Gestão Soc. e Ambiental* 18 (9), 1–34. <https://doi.org/10.24857/rgsa.v18n9-039>.
- Amirudin, A., Inoue, C., Grause, G., 2023. Assessment of factors influencing Indonesian residents' intention to use a deposit-refund scheme for PET bottle waste. *Circular Economy* 2 (4), 100061. <https://doi.org/10.1016/J.CEC.2023.100061>.

- Amit Kumar, G., 2021. Framing a model for green buying behavior of Indian consumers: From the lenses of the theory of planned behavior. *J. Clean. Prod.* 295, 126487. <https://doi.org/10.1016/J.JCLEPRO.2021.126487>.
- Ayob, S.F., Sheau-Ting, L., Abdul Jalil, R., Chin, H.-C., 2017. Key determinants of waste separation intention: empirical application of TPB. *Facilities* 35 (11/12), 696–708. <https://doi.org/10.1108/F-06-2016-0065>.
- Bais, F., Schouten, B., Toepoel, V., 2020. Investigating response patterns across surveys: do respondents show consistency in undesirable answer behaviour over multiple surveys? *Bull. Méthodol. Sociol.* 147–148, 150–168. <https://doi.org/10.1177/0759106320939891>.
- Barclay, D., Higgins, C., Thompson, R., 1995. The partial least squares (PLS) approach to Causal modeling: personal Computer adoption and Use as an illustration. *Technol. Stud.* 2, 285–309.
- Bhutto, M.H., Shaikh, A.A., Sharma, R., 2021. Factors affecting the consumers' purchase intention and willingness-to-pay more for electric-vehicle technology. *Proceedings of The International Conference on Electronic Business 21*, 167–180. ICEB'21, Nanjing, China, December 3–7, 2021.
- Bigerna, S., Micheli, S., Polinori, P., 2021. New generation acceptability towards durability and reparability of products: circular economy in the era of the 4th industrial revolution. *Technol. Forecast. Soc. Change* 165, 120558. <https://doi.org/10.1016/J.TECHFORE.2020.120558>.
- Bookwalter, J.T., Fuller, B.S., Dalenberg, D.R., 2006. Do household heads Speak for the household? A research Note. *Soc. Indic. Res.* 79 (3), 405–419. <https://doi.org/10.1007/s11205-005-4925-9>.
- Börger, T., Hattam, C., 2017. Motivations matter: Behavioural determinants of preferences for remote and unfamiliar environmental goods. *Ecol. Econ.* 131, 64–74. <https://doi.org/10.1016/J.ECOLECON.2016.08.021>.
- Bressanelli, G., Perona, M., Saccani, N., 2017. Reshaping the washing machine industry through circular economy and product-service system business models. *Procedia CIRP* 64, 43–48. <https://doi.org/10.1016/J.PROCIR.2017.03.065>.
- BSH Home Appliances Group, 2021. Looking to a Sustainable Future of Business with BlueMovement. BSH Stories. [https://stories.bsh-group.com/en\\_DE/article/looking-to-a-sustainable-future-of-business-with-bluemovement-43571](https://stories.bsh-group.com/en_DE/article/looking-to-a-sustainable-future-of-business-with-bluemovement-43571).
- Campbell, Donald T., Fiske, Donald W., 1959. Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychol. Bull.* 56 (2), 81–105. <https://doi.org/10.1037/h0046016>.
- Cassar, E., 2023. Evaluating Mobility as a Service for sustainable travel among young adults. *Transp. Res. Procedia* 72, 4159–4166. <https://doi.org/10.1016/J.TRPRO.2023.11.359>.
- Chandel, A., Gopal, K., 2019. Organic food acceptance: an application of the theory of planned behavior. *Int. J. Recent Technol. Eng.* 7 (6S5), 1748–1752. [F131204766519/19](https://doi.org/10.131204766519/19).
- Chao, C.M., Yu, T.K., 2024. How emotions and green altruism explain consumer purchase intention toward circular economy products: a multi-group analysis on willingness to be environmentally friendly. *Bus. Strat. Environ.* 33 (4), 2803–2816. <https://doi.org/10.1002/bse.3632>.
- Chomeya, R., 2010. Quality of psychology test between Likert scale 5 and 6 points. *J. Soc. Sci.* 6 (3), 399–403. <https://doi.org/10.3844/jssp.2010.399.403>.
- Cohen, J., 1988. *Statistical Power Analysis for the Behavioral Sciences*, second ed. Lawrence Erlbaum Associates, Publishers, Hillsdale, NJ.
- De Kwant, C., Rahi, A.F., Laurenti, R., 2021. The role of product design in circular business models: an analysis of challenges and opportunities for electric vehicles and white goods. *Sustain. Prod. Consum.* 27, 1728–1742. <https://doi.org/10.1016/j.spc.2021.03.030>.
- Dietz, L., Bickel, S., Scheffer, T., 2007. Unsupervised prediction of citation influences. In: *Proceedings of the 24th International Conference on Machine Learning*. ACM, pp. 233–240.
- Egleston, B.L., Miller, S.M., Meropol, N.J., 2011. The impact of misclassification due to survey response fatigue on estimation and identifiability of treatment effects. *Stat. Med.* 30 (30), 3560–3572. <https://doi.org/10.1002/sim.4377>.
- Elzinga, R., Reike, D., Negro, S.O., Boon, W.P.C., 2020. Consumer acceptance of circular business models. *J. Clean. Prod.* 254, 119988. <https://doi.org/10.1016/J.JCLEPRO.2020.119988>.
- Esfandiari, K., Dowling, R., Pearce, J., Goh, E., 2021. What a load of rubbish! The efficacy of theory of planned behaviour and norm activation model in predicting visitors' binning behaviour in national parks. *J. Hospit. Tourism Manag.* 46, 304–315. <https://doi.org/10.1016/J.JHTM.2021.01.001>.
- European Committee of Domestic Equipment Manufacturers (CECED), 2017. *Material Flows of the home appliance industry*. Report. <http://www.materialflows.eu/>.
- Fang, W.T., Chiang, Y. Te, Ng, E., Lo, J.C., 2019. Using the norm activation model to predict the pro-environmental behaviors of public servants at the central and local governments in Taiwan. *Sustainability* 11 (13). <https://doi.org/10.3390/SU11133712>.
- Fauzi, M.A., Hanafiah, M.H., Kunjuraman, V., 2024. Tourists' intention to visit green hotels: Building on the theory of planned behavior and the value-belief-norm theory. *J. Tourism Futur.* 10 (2), 255–276. <https://doi.org/10.1108/JTF-01-2022-0008>.
- Felke, T.P., 2024. ArcGIS Survey123: a case study using spatial technology to examine food access. *J. Technol. Hum. Serv.* 42 (1), 25–40. <https://doi.org/10.1080/15228835.2023.2292084>.
- Fishbein, M., Ajzen, I., 1977. Belief, attitude, intention, and behavior: an introduction to theory and research. *Philos. Rhetor.* 10, 130–132. Available online: <https://philpapers.org/rec/FISBAI>. (Accessed 5 July 2023).
- Fornell, Claes, Larcker, David F., 1981. Evaluating structural equation models with Unobservable variables and measurement error. *J. Mark. Res.* 18 (1), 39–50. <https://doi.org/10.2307/3151312>.
- Frommeyer, B., Wagner, E., Hossiep, C.R., Schewe, G., 2022. The utility of intention as a proxy for sustainable buying behavior – a necessary condition analysis. *J. Bus. Res.* 143, 201–213. <https://doi.org/10.1016/J.JBUSRES.2022.01.041>.
- Fu, L., Zhang, Y., Xiong, X., Bai, Y., 2017. Pro-environmental awareness and behaviors on Campus: evidence from Tianjin, China. *Eurasia J. Math. Sci. Technol. Educ.* <https://doi.org/10.12973/ejmste/77953>.
- Galekop, M.M.J., Veldwijk, J., Uyl-de Groot, C.A., Redekop, W.K., 2024. Preferences and willingness to pay for personalized nutrition interventions: discrete choice experiments in Europe and the United States. *Food Qual. Prefer.* 113, 105075. <https://doi.org/10.1016/J.FOODQUAL.2023.105075>.
- García-Salirrosas, E.E., Escobar-Farfán, M., Gómez-Bayona, L., Moreno-López, G., Valencia-Arias, A., Gallardo-Canales, R., 2024. Influence of environmental awareness on the willingness to pay for green products: an analysis under the application of the theory of planned behavior in the Peruvian market. *Front. Psychol.* 14, 1282383. <https://doi.org/10.3389/fpsyg.2023.1282383>.
- Gärling, T., Fujii, S., Gärling, A., Jakobsson, C., 2003. Moderating effects of social value orientation on determinants of proenvironmental behavior intention. *J. Environ. Psychol.* 23 (1), 1–9. [https://doi.org/10.1016/S0272-4944\(02\)00081-6](https://doi.org/10.1016/S0272-4944(02)00081-6).
- Gilal, F.G., Shaikh, A.R., Yang, Z., Gilal, R.G., Gilal, N.G., 2024. Secondhand consumption: a systematic literature review and future research agenda. *Int. J. Consum. Stud.* 48 (3). <https://doi.org/10.1111/ijcs.13059>.
- Golinska-Dawson, P., Zysnarska, Z., Pender, A., 2024. Assessment of the maturity of product-as-a-service business models for household appliances from the perspective of R strategies in Circular Economy. *Procedia CIRP* 122, 1083–1088. <https://doi.org/10.1016/j.procir.2024.02.038>.
- Gumasing, M.J.J., Bayola, A., Bugayong, S.L., Cantona, K.R., 2023. Determining the factors affecting Filipinos' acceptance of the use of renewable energies: a pro-environmental planned behavior model. *Sustainability* 15 (9), 7702. <https://doi.org/10.3390/su15097702>.
- Hair, J.F., Hult, G.T.M., Ringle, C.M., Sarstedt, M., 2017. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, second ed. SAGE Publications.
- Hair, J.F., Risher, J.J., Sarstedt, M., Ringle, C.M., 2019. When to use and how to report the results of PLS-SEM. *Eur. Bus. Rev.* 31, 2–24.
- Han, T.-I., Stoel, L., 2017. Explaining socially responsible consumer behavior: a meta-analytic review of theory of planned behavior. *J. Int. Consum. Market.* 29 (2), 91–103. <https://doi.org/10.1080/08961530.2016.1251870>.
- Hasan, S., 2021. Assessment of electric vehicle repurchase intention: a survey-based study on the Norwegian EV market. *Transp. Res. Interdiscip. Perspect.* 11, 100439. <https://doi.org/10.1016/J.TRIP.2021.100439>.
- He, X., Zhan, W., 2018. How to activate moral norm to adopt electric vehicles in China? An empirical study based on extended norm activation theory. *J. Clean. Prod.* 172, 3546–3556. <https://doi.org/10.1016/J.JCLEPRO.2017.05.088>.
- Hidalgo, J., Coello, S., González, Y., 2018. The determinants of household electricity Demand in marginal Ecuador: a case study at Monte Sinai. In: *Proceedings of the 16th LACCEI International Multi-Conference for Engineering, Education, and Technology: "Innovation in Education and Inclusion."* Latin American and Caribbean Consortium of Engineering Institutions. <https://doi.org/10.18687/laccei2018.1.1.312>.
- Hidalgo-Crespo, J., Amaya-Rivas, J.L., 2024. Citizens' pro-environmental behaviors for waste reduction using an extended theory of planned behavior in Guayas province. *Cleaner Engineering and Technology* 21, 100765. <https://doi.org/10.1016/j.clet.2023.100765>.
- Hidalgo-Crespo, J., Amaya, J., Jervis, F., Moreira, C., Crespo-Vaca, T., Zabala-Ortiz, G., Coello-Pisco, S., 2019. Waste-to-energy incineration: evaluation of energy potential for urban domestic waste in guayaquil. *RISTI 2019 (E23)*, 392–403.
- Hidalgo-Crespo, J., Moreira, C.M., Jervis, F.X., Soto, M., Amaya, J.L., 2021. Development of sociodemographic indicators for modeling the household solid waste generation in Guayaquil (Ecuador): Quantification, characterization and energy valorization. In: *Paper Presented at the European Biomass Conference and Exhibition Proceedings*, pp. 252–259.
- Hidalgo-Crespo, J., Riel, A., Zwolinski, P., Wandji, C., Amaya-Rivas, J.L., 2023. Measuring the level of acceptance from the population of Guayas Province for different PaaS models: the case of the washing machine. *Procedia CIRP* 116, 462–467. <https://doi.org/10.1016/J.PROCIR.2023.02.078>.
- Hidalgo-Crespo, J., Riel, A., Duberg, J.V., Bunodiene, A., Golinska-Dawson, P., 2024. An exploratory study for product-as-a-service (PaaS) offers development for electrical and electronic equipment. *Procedia CIRP* 122, 521–526. <https://doi.org/10.1016/j.procir.2024.01.076>.
- Hoang, T.T., Pham, T.H., Vu, T.M.H., 2022. Examining customer purchase decision towards battery electric vehicles in Vietnam market: a combination of self-interested and pro-environmental approach. *Cogent Business & Management* 9 (1). <https://doi.org/10.1080/23311975.2022.2141671>.
- Hong, Y., Al Mamun, A., Masukujaman, M., Yang, Q., 2024. Significance of the environmental value-belief-norm model and its relationship to green consumption among Chinese youth. *Asia Pac. Manag. Rev.* 29 (1), 127–140. <https://doi.org/10.1016/J.JAPMRV.2023.10.002>.
- INEC (National Institute of Statistics and Censuses), 2022. Main results of the census in the province of Guayas. Retrieved from [https://www.censoecuator.gob.ec/wp-content/uploads/2023/10/Info\\_Guayas.pdf](https://www.censoecuator.gob.ec/wp-content/uploads/2023/10/Info_Guayas.pdf).
- Jiménez-Parra, B., Rubio, S., Vicente-Molina, M.A., 2014. Key drivers in the behavior of potential consumers of remanufactured products: a study on laptops in Spain. *J. Clean. Prod.* 85, 488–496. <https://doi.org/10.1016/J.JCLEPRO.2014.05.047>.
- Joshi, A., Kale, S., Chandel, S., Pal, D., 2015. Likert scale: explored and explained. *Br. J. Appl. Sci. Technol.* 7 (4), 396–403. <https://doi.org/10.9734/BJAST/2015/14975>.

- Kabel, D., Ahlstedt, S., Elg, M., Sundin, E., 2020. Consumer purchase intention of remanufactured EEE products: a study on robotic lawn mowers in Sweden. *Procedia CIRP* 90, 79–84. <https://doi.org/10.1016/j.procir.2020.01.091>.
- Kabel, D., Elg, M., Sundin, E., 2021. Factors influencing sustainable purchasing behaviour of remanufactured robotic lawn mowers. *Sustainability* 13 (4), 1954. <https://doi.org/10.3390/su13041954>.
- Kácha, O., van der Linden, S., 2021. The moderating role of moral norms and personal cost in compliance with pro-environmental social norms. *Current Research in Ecological and Social Psychology* 2, 100020. <https://doi.org/10.1016/j.cresp.2021.100020>.
- Kam, C.C.S., Meyer, J.P., 2015. How Careless responding and acquiescence response bias can influence construct Dimensionality: the case of Job Satisfaction. *Organ. Res. Methods* 18 (3), 512–541. <https://doi.org/10.1177/1094428115571894>.
- Khan, S.A.R., Shah, A.S.A., Yu, Z., Tanveer, M., 2022. A systematic literature review on circular economy practices: challenges, opportunities and future trends. *Journal of Entrepreneurship in Emerging Economies* 14 (5), 754–795. <https://doi.org/10.1108/JEEE-09-2021-0349>.
- Kiatkawsin, K., Han, H., 2017. Young travelers' intention to behave pro-environmentally: merging the value-belief-norm theory and the expectancy theory. *Tour. Manag.* 59, 76–88. <https://doi.org/10.1016/j.tourman.2016.06.018>.
- Kinncar, T.C., Taylor, J.R., 1996. *Marketing Research: an Applied Approach, fifth ed.* McGraw Hill, New York.
- Koshta, N., Patra, S., Singh, S.P., 2022. Sharing economic responsibility: assessing end user's willingness to support E-waste reverse logistics for circular economy. *J. Clean. Prod.* 332, 130057. <https://doi.org/10.1016/j.jclepro.2021.130057>.
- Le, N.T.T., Tran, K.T., 2024. Predicting the intention to install solar photovoltaic panels in emerging market: the role of consumer innovativeness, knowledge, and support for government incentives. *J. Open Innov. Technol. Mark. Complex.* 10, 100423. <https://doi.org/10.1016/j.joitmc.2024.100423>.
- Lee, J.W., Jones, P.S., Mineyama, Y., Zhang, X.E., 2002. Cultural differences in responses to a likert scale. *Res. Nurs. Health* 25 (4), 295–306. <https://doi.org/10.1002/nur.10041>. Wiley.
- Lee, S.H.N., Chang, H.J., Julie, Zhao, L., 2023. The importance of personal norms and situational expectancies to sustainable behaviors: the norm activation and situational expectancy-value theories. *J. Retailing Consum. Serv.* 73, 103371. <https://doi.org/10.1016/j.jretconser.2023.103371>.
- Li, Lanlan, Ming, Huayang, Yang, Ranran, Luo, Xuan, 2020. The impact of policy factors and users' awareness on electricity-saving behaviors: from the perspective of Habits and Investment. *Sustainability* 12 (12), 4815. <https://doi.org/10.3390/su12124815>.
- Lin, C.A., Wang, X., Yang, Y., 2023. Sustainable apparel consumption: personal norms, CSR expectations, and Hedonic vs. Utilitarian Shopping value. *Sustainability* 15 (11). <https://doi.org/10.3390/SU15119116>.
- Liobikiene, G., Mandravickaitė, J., Bernatoniene, J., 2016. Theory of planned behavior approach to understand the green purchasing behavior in the EU: a cross-cultural study. *Ecol. Econ.* 125, 38–46. <https://doi.org/10.1016/j.ecolecon.2016.02.008>.
- Litarido, J., Hidalgo-León, R., Soriano, G., 2021. Energy performance and benchmarking for university classrooms in hot and humid climates. *Energies* 14 (21), 7013. <https://doi.org/10.3390/en14217013>.
- Liu, Y., Sheng, H., Mundorf, N., Redding, C., Ye, Y., 2017. Integrating norm activation model and theory of planned behavior to understand sustainable Transport behavior: evidence from China. *Int. J. Environ. Res. Publ. Health* 14 (12). <https://doi.org/10.3390/IJERPH14121593>.
- Mai, K.N., Nhan, D.H., Nguyen, P.T.M., 2023. Empirical study of green practices fostering customers' willingness to consume via customer behaviors: the case of green restaurants in Ho Chi Minh City of Vietnam. *Sustainability* 15 (4263). <https://doi.org/10.3390/su15054263>.
- Majeed, S., Kim, W.G., Kim, T., 2023. Perceived green psychological benefits and customer pro-environment behavior in the value-belief-norm theory: the moderating role of perceived green CSR. *Int. J. Hospit. Manag.* 113, 103502. <https://doi.org/10.1016/j.ijhm.2023.103502>.
- Mohammed, A., Homaid, A., Alaswadi, W., 2020. Factors influencing green purchase behaviour among young consumers in Saudi Arabia. *Transnational Marketing Journal* 8 (1), 51–73. <https://doi.org/10.33182/tmj.v8i1.887>.
- Mubarakah, A., Riady, B.A., Simanjuntak, E.R., 2024. Circular economy in customizable furniture: Applying norm activation model and the impact of green product perception to willingness to pay more. *Pakistan Journal of Life and Social Sciences* 22 (2), 8336–8349. <https://doi.org/10.57239/PJLSS-2024-22.2.00629>.
- Mulat, S., Worku, W., Minyihun, A., 2019. Willingness to pay for improved solid waste management and associated factors among households in Injibara town, Northwest Ethiopia. *BMC Res. Notes* 12 (1), 401. <https://doi.org/10.1186/s13104-019-4433-7>.
- Müller, J., Acevedo-Duque, A., Müller, S., Kalia, P., Mehmood, K., 2021. Predictive sustainability model based on the theory of planned behavior incorporating ecological conscience and moral obligation. *Sustainability* 13 (8), 4248. <https://doi.org/10.3390/su13084248>.
- Nekmahmud, M., Fekete-Farkas, M., 2020. Why not green marketing? Determinants of consumers' intention to green purchase decision in a new developing nation. *Sustainability* 12 (19), 7880. <https://doi.org/10.3390/su12197880>.
- Nguyen, H.T.T., 2024. Promoting sustainable consumption and circular economy: the intention of Vietnamese youth consumers to purchase products made from recycled plastics. *Chinese Journal of Population, Resources and Environment* 22, 194–203. <https://doi.org/10.1016/j.cjpre.2024.06.011>.
- Nketiah, E., Song, H., Adu-Gyamfi, G., Obuobi, B., Adjei, M., Cudjoe, D., 2022a. Does government involvement and awareness of benefit affect Ghanaian's willingness to pay for renewable green electricity? *Renew. Energy* 197, 683–694. <https://doi.org/10.1016/j.renene.2022.07.139>.
- Nketiah, E., Song, H., Cai, X., Adjei, M., Obuobi, B., Adu-Gyamfi, G., Cudjoe, D., 2022b. Predicting citizens' recycling intention: incorporating natural bonding and place identity into the extended norm activation model. *J. Clean. Prod.* 377, 134425. <https://doi.org/10.1016/j.jclepro.2022.134425>.
- Oghazi, P., Mostaghel, R., 2018. Circular business model challenges and lessons learned—an industrial perspective. *Sustainability* 10 (3), 739. <https://doi.org/10.3390/su10030739>.
- Oluwadamilola Olufemi Rotimi, E., Kalantari Daronkola, H., Topple, C., Johnson, L., 2024. Behavioural determinants of consumers' intention to reuse end-of-life garments in Australia. *Cleaner Logistics and Supply Chain* 10, 100138. <https://doi.org/10.1016/j.clscn.2023.100138>.
- Ortiz, C.A., Avila-Santamaría, J.J., Martínez-Cruz, A.L., 2023. Dairy farmers' willingness to adopt cleaner production practices for water conservation: a discrete choice experiment in Mejía, Ecuador. *Agric. Water Manag.* 278, 108168. <https://doi.org/10.1016/j.agwat.2023.108168>.
- Park, C.Y., Lee, S.J., Lee, C.K., Reisinger, Y., 2022. Volunteer tourists' environmentally friendly behavior and support for sustainable tourism development using Value-Belief-Norm theory: moderating role of altruism. *J. Destin. Market. Manag.* 25, 100712. <https://doi.org/10.1016/j.jdmm.2022.100712>.
- Pearce, A., Harrison, M., Watson, V., Street, D.J., Howard, K., Bansback, N., Bryan, S., 2021. Respondent understanding in discrete choice experiments: a scoping review. *Patient - Patient-Centered Outcomes Research* 14 (1), 17–53. <https://doi.org/10.1007/s40271-020-00467-y>.
- Phan, V.P., 2024. Is a circular economy model for a developing country feasible? A discussion from the perspective of Mekong Delta of Vietnam. *Circular Economy and Sustainability* 4 (1), 63–74. <https://doi.org/10.1007/s43615-023-00281-2>.
- Rigdon, E., 2012. Rethinking partial least squares path modeling: in praise of simple methods. *Long. Range Plan.* 45 (5–6), 341–358.
- Rombouts, S.T., 2019. Consumer acceptance of product-service systems: A discrete choice experiment on laundry solutions. Master's thesis, Utrecht University. <https://studenttheses.uu.nl/handle/20.500.12932/35312>.
- Ryser, V.-A., 2023. Measuring Psychological Constructs. FORS Guide No. 22, Version 1.0. Swiss Center of Expertise in the Social Sciences FORS, Lausanne. <https://doi.org/10.24449/FG-2023-00022>.
- Sajjad, A., Zhang, Q., Asmi, F., Anwar, M.A., Bhatia, M., 2024. Identifying the motivating factors to promote socially responsible consumption under circular economy: a perspective from norm activation theory. *J. Retailing Consum. Serv.* 76, 103544. <https://doi.org/10.1016/j.jretconser.2023.103544>.
- Savari, M., Abdeslahi, A., Gharechae, H., Nasrollahian, O., 2021. Explaining farmers' response to water crisis through theory of the norm activation model: evidence from Iran. *Int. J. Disaster Risk Reduct.* 60, 102284. <https://doi.org/10.1016/J.IJDRR.2021.102284>.
- Schatzmann, T., Molloy, J., Axhausen, K.W., Schatzmann, T., Molloy, J., 2024. Implementing web-based discrete choice experiments in transportation. 12th International Conference on Transport Survey Methods 76, 586–595. <https://doi.org/10.1016/J.TRPRO.2023.12.079>.
- Schwartz, S.H., 1977. Normative influences on altruism. *Adv. Exp. Soc. Psychol.* 10 (C), 221–279. [https://doi.org/10.1016/S0065-2601\(08\)60358-5](https://doi.org/10.1016/S0065-2601(08)60358-5).
- Sekaran, U., 2000. *Research Methods for Business: A Skill-Building Approach, third ed.* John Wiley & Sons, New York.
- Shamsi, M.A., Anwar, I., Chaudhary, A., Akhtar, S., Ahmad, A., 2023. Sustainable transition through circular textile products: an empirical study of consumers' acceptance in India. *Sustainability* 15 (13656). <https://doi.org/10.3390/su151813656>.
- Sheeran, P., 2002. Intention—behavior relations: a conceptual and empirical review. *Eur. Rev. Soc. Psychol.* 12 (1), 1–36. <https://doi.org/10.1080/147927721430000003>.
- Sheeran, P., Maki, A., Montanaro, E., Avishai-Yitshak, A., Bryan, A., Klein, W.M., Miles, E., Rothman, A.J., 2016. The impact of changing attitudes, norms, and self-efficacy on health-related intentions and behavior: a meta-analysis. *Health Psychol.* 35 (11), 1178–1188. <https://doi.org/10.1037/hea0000387>.
- Shmueli, G., Koppius, O.R., 2011. Predictive analytics in information systems research. *MIS Q.* 35 (3), 553–572.
- Singh, H., Singh, V., Singh, T., Higuera-Castillo, E., 2023. Electric vehicle adoption intention in the Himalayan region using UTAUT2 – NAM model. *Case Studies on Transport Policy* 11, 100946. <https://doi.org/10.1016/J.CSTP.2022.100946>.
- Smol, M., Marcinek, P., Duda, J., 2024. Circular business models (CBMs) in environmental management—analysis of definitions, typologies and methods of creation in organizations. *Sustainability* 16 (3), 1209. <https://doi.org/10.3390/su16031209>.
- Srivastava, A., Gautam, V., Sharma, V., 2023. Does consideration for future consequences matter in consumer decision to rent electric vehicles? *Energy Policy* 181, 113726. <https://doi.org/10.1016/j.enpol.2023.113726>.
- Taylor, S., Todd, P.A., 1995. Understanding information technology usage: a test of competing models. *Inf. Syst. Res.* 6, 144–176.
- Teh, S.Y., Othman, A.R., Sulaiman, S., Mohamed-Ibrahim, M.I., Mohd Razha-Rashid, M., 2016. Application of mean and standard deviation in questionnaire surveys: construct validation. *Jurnal Teknologi* 78 (6), 99–105. <https://doi.org/10.11113/jt.v78.8358>.
- Tourangeau, R., Groves, R.M., Redline, C.D., 2010. Sensitive topics and reluctant respondents: Demonstrating a link between nonresponse bias and measurement error. *Public Opin. Q.* 74 (3), 413–432. <https://doi.org/10.1093/poq/nfq004>.
- Tu, J.-C., Hu, C.-L., 2018. A study on the factors affecting consumers' willingness to accept clothing rentals. *Sustainability* 10 (11), 4139. <https://doi.org/10.3390/su10114139>.

- Tukker, A., 2004. Eight types of product–service system: eight ways to sustainability? Experiences from SusProNet. *Bus. Strat. Environ.* 13 (4), 246–260. <https://doi.org/10.1002/BSE.414>.
- Ud Din, S., Wimalasiri, R., Ehsan, M., Liang, X., Ning, F., Guo, D., Manzoor, Z., Abu-Alam, T., Abioui, M., 2023. Assessing public perception and willingness to pay for renewable energy in Pakistan through the theory of planned behavior. *Front. Energy Res.* 11, 1088297. <https://doi.org/10.3389/fenrg.2023.1088297>.
- Vijayan, R.V., Krishnan, M.M., Parayitam, S., Anantharaman Duraisami, S.P., Saravanaselvan, N.R., 2023. Exploring e-waste recycling behaviour intention among the households: evidence from India. *Cleaner Materials* 7, 100174. <https://doi.org/10.1016/J.CLEMA.2023.100174>.
- Vo, T.Q., 2018. Customers' awareness and willingness to pay regarding organic fruits and vegetables. *Eurasian Journal of Analytical Chemistry* 13 (4), 181–188.
- Wang, S., Song, Z., 2024. Exploring the behavioral stage transition of traveler's adoption of carsharing: an integrated choice and latent variable model. *Journal of Choice Modelling* 51, 100477. <https://doi.org/10.1016/j.jocm.2024.100477>.
- Wang, S., Fan, J., Zhao, D., Yang, S., Fu, Y., 2016. Predicting consumers' intention to adopt hybrid electric vehicles: using an extended version of the theory of planned behavior model. *Transportation* 43 (1), 123–143. <https://doi.org/10.1007/S11116-014-9567-9/TABLES/5>.
- Wang, B., Li, J., Sun, A., Wang, Y., Wu, D., 2019. Residents' green purchasing intentions in a developing-country context: integrating PLS-SEM and MGA methods. *Sustainability* 12 (1), 30. <https://doi.org/10.3390/su12010030>.
- Westland, J.C., 2022. Information loss and bias in likert survey responses. In: Trujillo, C. A. (Ed.), *PLOS ONE*, vol. 17. Public Library of Science (PLOS), e0271949. <https://doi.org/10.1371/journal.pone.0271949>, 7.
- Yuriev, A., Dahmen, M., Paillé, P., Boiral, O., Guillaumie, L., 2020. Pro-environmental behaviors through the lens of the theory of planned behavior: a scoping review. *Resour. Conserv. Recycl.* 155, 104660. <https://doi.org/10.1016/j.resconrec.2019.104660>.
- Zhang, W., Liu, L., 2022. How consumers' adopting intentions towards eco-friendly smart home services are shaped? An extended technology acceptance model. *Ann. Reg. Sci.* 68 (2), 307–330. <https://doi.org/10.1007/S00168-021-01082-X/FIGURES/2>.
- Zhang, X., Geng, G., Sun, P., 2017. Determinants and implications of citizens' environmental complaint in China: integrating theory of planned behavior and norm activation model. *J. Clean. Prod.* 166, 148–156. <https://doi.org/10.1016/J.JCLEPRO.2017.08.020>.
- Zhang, L., Fan, Y., Zhang, W., Zhang, S., 2019. Extending the theory of planned behavior to explain the effects of cognitive factors across different Kinds of green products. *Sustainability* 11 (15), 4222. <https://doi.org/10.3390/SU11154222>, 2019, Vol. 11, Page 4222.
- Zhang, Y., Xiao, C., Zhou, G., 2020. Willingness to pay a price premium for energy-saving appliances: role of perceived value and energy efficiency labeling. *J. Clean. Prod.* 242, 118555. <https://doi.org/10.1016/j.jclepro.2019.118555>.
- Zhang, C., Tang, L., Zhang, J., Wang, Z., 2023. Using social network analysis to identify the critical factors influencing residents' green consumption behavior. *Systems* 11 (5), 254. <https://doi.org/10.3390/systems11050254>.
- Zhuang, W., Luo, X., Riaz, M.U., 2021. On the factors influencing green purchase intention: a meta-analysis approach. *Front. Psychol.* 12. <https://doi.org/10.3389/FPSYG.2021.644020>.

### Further reading

- Memon, H., Ayele, H.S., Yesuf, H.M., Sun, L., 2022. Investigation of the physical properties of yarn produced from textile waste by optimizing their proportions. *Sustainability* 14, 9453.