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Intention to Use Reusable Shopping Bags in an Emerging Economy: A Bayesian Mindsponge Framework (BMF) Analysis

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Research Article

Keywords: Reusable shopping bag, single-use plastic bag, Norm Activation Model, Theory of Planned Behavior, Mindsponge Theory, Vietnam

Posted Date: September 30th, 2024

DOI: https://doi.org/10.21203/rs.3.rs-4912525/v1

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Additional Declarations: No competing interests reported.

Abstract

Single-use plastic (SUP) bags at supermarkets have detrimentally exacerbated the plastic waste and dump in landfills. Reusable shopping bags are a feasible solution to alleviate plastic production and consumption, particularly in an emerging economy. The study examined the intention to use reusable shopping bags instead of SUP bags, driven by personal norms and planning behavior. Bayesian Mindsponge Framework (BMF) analysis was employed on a dataset of 536 Vietnamese consumers. The study found that instead of obligation, voluntary contribution to reduce plastic bag pollutant is predominant. Findings also indicate that enhancing public awareness and knowledge regarding environmental protection is significantly important. Some demographic characteristics, such as age, education, members in household, and incomes also moderate the relationship between driving factors and intentions. Finally, this study prescribes some policy implications and practical solutions to reduce and gradually restrict SUP in Vietnam.

1. Introduction

Background on Vietnam Plastic Pollution

In recent decades, Vietnam has frequently dealt with the impacts of climate change and severe environmental crises. One of the most significant ecological destruction is attributed to the excessive production and consumption of plastic materials. Vietnam was ranked in the top five (5) countries in terms of mismanaged plastic waste mass [1]. The plastic industry in Vietnam annually generates a staggering 2.8 to 3.1 million tons of plastic waste. Most of these waste end up in landfills, waterways, and oceans due to inadequate management practices of treating plastic waste [2,3]. In fact, about 90% of plastic waste is dumped into landfills and ends up in incineration damaging the natural environment. Only roughly 10% is effectively recycled and reused [2,3]. The consequences of this plastic pollution phenomenon, in the end, have become an urgent environmental concern.

Plastic pollution is detrimental for habitats and human beings [4]. In particular, plastic pollution: (i) leads to the death of marine and terrestrial wildlife, disrupts natural habitats; and (ii) contaminates food chains through microplastics (i.e., fragments of plastic less than five [5] millimeters in size). These microplastics gradually accumulate in marine organisms, destroying their endocrine system and causing reproductive problems. Additionally, the accumulation of plastic debris in waterways and oceans threaten aquatic life, disrupts ecosystems, and hinders fishing activities. Relatedly, plastic pollution can generally harm human life. For example, toxic substances released during the degradation of plastics threaten people's overall health. People also have more incurred economic costs associated with waste management and environmental remediation. Hence, plastic pollution adversely impacts on habitats and ecosystems [4].

The environmental impact of plastic waste in Vietnam is severe. According to a World Bank Report in 2022, plastic waste accounts for 94% of total waste in Vietnam [3]. Fig.1. highlights the top ten plastic items in Vietnam. The most prevalent plastic waste is soft plastic fragments (17.40%), followed by

fishing gear 1 (16.60%) and fishing gear 2 (13.00%). Plastic bags size 1 account for 8.40%, while styrofoam food containers make up 7.40%. Hard plastic fragments represent 6.10%, and straws comprise 4.60%. Other food wrappers and other plastic items contribute smaller proportions, with crisp/sweet packages at only 3.10%. Plastic bags are the most common plastic waste, comprising 26% of the total. A shocking 71% of the surveyed coastlines were ‘extremely dirty’. Relatedly, the societal impacts include: (i) health risks from exposure to toxic substances released during the degradation of plastics; and (ii) significant economic costs associated with waste management and environmental remediation efforts. Approximately 80 tons of plastic waste and nylon bags are discarded daily in cities like Hanoi and Ho Chi Minh City [28]. This growing volume of waste poses a critical threat to the country's ecological balance and public health.

Governmental Concerns and Legal Actions

Recognizing the urgency of plastic waste matters, the Vietnamese government has taken several initiatives to address these issues. In 2020, the Prime Minister issued Directive No. 33/CT-TTg about strengthening plastic waste management, recycling, treatment, and reduction [5]. This directive underscores the government’s commitment to tackling plastic pollution and promoting sustainable practices. Furthermore, Article 73 of the Law on Environmental Protection No. 72/2020/QH14 explicitly states the responsibilities of organizations and individuals in limiting the use, reduction, classification, and disposal of single-use plastic waste and non-degradable plastic packaging. This Article also indicates the prohibition of the direct disposal of plastic waste into our biosphere [6]. Later, a supplement of the Law on Environmental Protection through Decree No. 08/2022/ND-CP outlines a specific roadmap to restrict the production and import of SUP products, non-degradable plastic packaging, and microplastic products [7]. This Decree proposes measures to encourage the recycling and use of recycled plastic products. Policies such as imposing taxes on plastic bags, banning SUPs, and providing incentives for eco-friendly alternatives are integral to a broader strategy toward sustainable consumption. These measures are designed to reduce the environmental footprint of plastic waste and foster a culture of environmental responsibility among citizens and businesses [7]. To further incentivize the plastic waste recycling industry, the Vietnamese government is implementing financial incentives, including establishing investment funds, corporate income tax exemptions, and import tax exemptions for equipment and technology. The Prime Minister also approved the national action plan for marine plastic litter by 2030 through Decision No. 1746/DQ-TTg [8]. To sum up, the Vietnamese government makes great efforts in legal documentation and is committed to reducing and eliminating plastic waste during this decade.

Circular Plastic Waste in Vietnam

In addition to the Vietnamese legal framework, some businesses and authorities seek solutions to harness the power of science and innovation in recycling plastic waste. A transformation of plastic waste into a valuable resource is one of the feasible solutions via the circular economy, which benefits both the environment and the economy. Nguyen and colleagues have developed a plastic cycle toward

circular economy practice in Vietnam. The authors analyzed the data-driven basis on imported, single/multiple, and recycle/disposal flows and proposed plastic waste management solutions, particularly emphasizing the expanding producer's responsibility in plastic production [9]. At the local level, Nguyen and colleagues underscore the need to extend the life cycle of plastic products and reduce plastic waste generation, minimizing the environmental impact in urban and riverside areas [10].

As part of these broader efforts to tackle plastic waste, one (1) critical aspect that requires immediate attention is reducing the use of SUP. In fact, the World Bank Country Director for Vietnam stated that rapid economic and urbanized development had caused a nationwide plastic pollution crisis, in which SUP items make up a large portion of plastic pollution in Vietnam [2]. Replacing SUP bags with reusable shopping bags is a critical strategy in this endeavor. Promoting reusable shopping bags at supermarkets or retail stores has become crucial in mitigating plastic waste's environmental impacts. However, several barriers and challenges prevent shoppers from changing their awareness, attitudes, and common behaviors from using plastic bags to adopting reusable shopping bags. Understanding these challenges and the factors driving the adoption of reusable bags is crucial for developing effective strategies to encourage this shift.

Replacing SUP Bags with Reusable Shopping Bags

Promoting the use of reusable shopping bags at supermarkets or retail stores has become significantly crucial in mitigating the environmental impacts of plastic waste. Some barriers and challenges prevent shoppers from changing their awareness, attitudes, and common behaviors regarding the use of plastic bags and reusable shopping bags. Thus, several factors drive the adoption of the former one:

(i) Shopper's own motivation. Consumers' awareness and advocacy on environmental protection play a pivotal role in encouraging the use of reusable shopping bags. Consumers motivated to protect the environment are more likely to adopt sustainable practices, including bringing their own bags when shopping. Consumers and the community should be aware of the contemporary issues of the environment and change their behavior seriously. Using reusable bags not only reduces plastic waste, but also fosters individuals' and communities' responsibility in managing personal waste.

(ii) Government enforcement. Effective policies and regulations are essential in promoting reusable and biodegradable bags. Government initiatives such as banning SUP bags, implementing taxes, and offering incentives, can significantly reduce plastic waste.

(iii) Retailers' actions. Retailers can benefit from encouraging reusable bags by reducing the costs of providing SUP bags. This cost-saving measure can also align with corporate social responsibility goals and enhance the brand image of retailers committed to sustainability.

Research Gaps and Importance of Research

Despite the considerable benefits of using reusable shopping bags, a research gap in understanding the factors that influence their attitudes and behaviors needs to be filled in. Previous studies have primarily

focused on the environmental impacts of plastic waste in Vietnam [10, 27-29]. Still, there is limited research on the behavioral and psychological aspects that drive consumers to switch to reusable bags. Understanding these factors is essential for developing effective strategies to increase the adoption of reusable shopping bags and reduce plastic pollution.

This study aims to address these gaps by exploring the association between the sociological and psychological aspects of Vietnamese shoppers to the intentional adoption of reusable shopping bags. We further investigate some demographic characteristics that interacted with these associations. Most previous socio-psychological studies relevant to consumer behaviors used the frequentist statistical method; however, this study embraces the Bayesian statistics by using Bayesian Mindsponge Framework (BMF) analytics – a novel and innovative research method proposed by Vuong and his colleagues [11,12]. This approach is best fitting with studying human psychology and behavior in the ecosystem [13]. Additionally, we integrated three underlying theories: (i) Theory of Planned Behavior, (ii) Norm Activation Theory, and (iii) Bayesian Mindsponge Frameworks in the study, possibly generating a novel approach to this topic. The contributions of this research are significant for policymakers, businesses, and environmental agencies to design feasible interventions that stimulate sustainable consumer behavior in Vietnam.

Research Questions

This study seeks to answer the following research questions:

i. What factors impact the intention to use reusable shopping bags among consumers in Vietnam?; and
ii. How does the intention to use reusable shopping bags interact with demographic characteristics including age, educational qualification, number of family members in a household, and personal income?

This study potentially provides an overarching understanding of consumers' motives to adopt reusable shopping bags by addressing these questions. This understanding can offer far-reaching implications for governmental authorities, business entities, and communities to diminish plastic garbage and promote environmental sustainability in Vietnam and other countries as well.

This study consists of five (5) main sections. The introductory section presents the importance of research and research questions. The second section highlights the theoretical background and BMF research method. The next section exhibits the research result and then followed by the findings and practical implications as discussed in Section 4. Finally, we provide conclusions about the study.

2. Methodology

2.1 Theoretical background

A study on a social and psychological topic relying on a specific underlying theory should be favorable, but its findings and results could reflect a limited perspective on the discussed matter. However, incorporating some theoretical backgrounds explaining the complex behavior such as pro-social and pro-environmental intentions and behaviors, could reach a consensus since its results provide a comprehensive and nuanced understanding on individuals' intentions and behaviors. Hence, this study encompasses three essential theories: The Theory of Planned Behavior (TPB), the Norm Activation Model (NAM), and the Bayesian Mindsponge Framework (BMF), as follows:

Theory of Planned Behavior (TPB)

Theory of Planned Behavior (TPB) is a widely used research model for understanding customer behaviors in recent decades [14,15]. TPB illustrates that behavioral intentions are driven by attitudes toward the behavior, subjective norm, and perceived behavior control [14,15]. Then, the favorable intention produces the behavior. The significant impact of these predictors may vary. For example, La Barbera and Ajzen studied that perceived behavioral control calibrates the effects of subjective norms and attitudes on intentions. It means that higher perceived behavioral control strengthens the attitude-intention relation but weakens the norm-intention relationship (16). While some studies confirm the significance of subjective norms and attitudes in predicting intentions, the role of perceived behavioral control is less consistent, with some research finding no significant effect [17]. These findings highlight the complexity of factors influencing behavioral intentions, and the need for context-specific cases in TPB application. There is also the influence of the TPB across various fields including consumer behavior [14], entrepreneurship [17], and environmental study [18]. This study investigates the pro-environmental intention driven by the TPB factors along with the most influential theory in intentional behavior, namely Norm Activation Model (NAM).

Norm Activation Model (NAM)

A commonly used model explaining the behavioral outcomes relevant to altruistic behavior is the Norm Activation Model (NAM), proposed by Schwatz in 1977 [19]. The NAM has been widely applied in predicting prosocial and pro-environmental behaviors and intentions [20,21]. The central element of this model is personal norm, defined "as feelings of moral obligation not as intentions" [19]. Two main determinants of personal norms are the awareness of the consequences of individuals' behavior and the feeling of responsibility to perform well [19,20]. Some studies [20, 22] validate the NAM, demonstrating its effectiveness as a mediator in predicting prosocial behaviors in the social and environmental setting. Personal norms mediate the effects of problem awareness and general values on pro-environmental behavior [22]. Onwezen and his colleagues extend the NAM model in which personal norm is mediated by anticipated pride and guilty within the integrated NAM-TPB model [21]. Harland and colleagues underscored the importance of incorporating additional situational and personality dimensions as mediated predictors of pro-environmental behavior, potentially enhancing the explanatory power of personal norms in the model [23]. Finally, these state-of-the-art studies regarding the NAM raise the diversified factors boosting prosocial and pro-environmental actions.

Bayesian Mindsponge Framework (BMF) Analysis

The Bayesian Mindsponge Framework (BMF) analysis has considerably gained attention among scholars and practitioners as a novel and innovative method for social and psychological research [11,12]. This method combines the mindsponge mechanism and Bayesian analysis. On the one hand, mindsponge theory describes a mechanism of information processing where the sponge is absorbed and rejects new ideas or perspectives into the core value of mind. On the other hand, Bayesian statistics use the Markov chain Monte Carlo (MCMC) algorithm to estimate posterior results instead of using p-value as frequentist statistics [24]. The mindsponge theory also explains how individuals recognize new cultural values into their respective set of core values and understand how people adapt and observe to external culture settings [24]. Regarding the usage of reusable shopping bags, attitudes are shaped by moral norms, lifestyle, and environmental knowledge, which influence intentions to use them. Nguyen and his colleague express the Mindsponge culture, which is characterized by entrepreneurship and result-oriented thinking, and can be employed to promote sustainable behaviors (e.g., using reusable shopping bags) [12,13]. The Mindsponge culture can encourage individuals to imbibe an eco-surplus mindset, which is critical in tackling environmental issues. Therefore, embracing the mindsponge theory can entail sustainable development through adaptive thinking and creative performance [12].

Comparative Analysis of Reusable Shopping Bags in Vietnam

Research on Vietnam's use of reusable shopping bags shows several key findings. Makarchev and his colleagues posits that plastic bag consumption among Vietnamese consumers remains prevalent and many consumers are resistant to following plastic bag bans [25]. These authors name two (2) socio-demographic and seven socio-psychological predictors significantly associated with plastic bag use [25]. Nguyen used the integrative model of TPB and NAM studying on the 536 Vietnamese consumers and included that personal norm and attitude have a stronger impact on intentions [26]. Similarly, Tran and colleagues adopted the TPB model and Contingent Valuation Model to estimate the willingness to pay for switching to bring shopping bags in Vietnam. The results indicated that attitude, social norms, perceived behavior, and eco-literature have no significant effects on willingness to pay, but eco-literature does. It suggests that consumers with having well-knowledge of the environment opt for bringing their own bags instead of paying for plastic bags use [27]. A case study in Hanoi city shows that SUP bags are the most frequently used to shop in Vietnam and these bags are reused as kitchen bin liners with a high rate at 68.85%. However, most of them end up in landfills [28]. Policies on plastic bags reduction by imposing tax and garbage separation at source are favorable, but challenging in expedition of these policies [28]. Liu and colleagues recommended the targeted multi-dimensional reforms and a mix of bottom-up and top-down approach along the entire supply chain to overcome current situations in Vietnam [28]. The study of Truong and colleagues is consistent with Liu's study that consumers being highly aware of environmental effects in Hanoi tend to bring shopping bags. The retailers' promotional programmes encourage young consumers to bring their own bags. Social motivation moderates the association between environmental concerns and pro-environmental behaviors [29]. To sum up, recent studies on Vietnamese consumer behavior highlights that there is an increasing interest in sustainable

consumption at supermarkets or retailing stores. Shoppers in big cities (i.e., Hanoi) have highly environmental concerns and are likely to bring their own bags to shop. But some factors such as personal attitude and norm, social pressure and motivations need to be explored more in this study.

2.2 Research framework

2.2.1 Variable selection

The dataset used in this study was extracted from Nguyen's survey in 2021, which collected 536 respondents on their behavior towards bringing their own shopping bags instead of using plastic bags [8]. Nguyen conducted the data collection, which was peer-reviewed and published in a paper in Data in Brief, in November 2020 in Vietnam (doi: https://doi.org/10.1016/j.dib.2021.107226). In general, Vietnam is an emerging economy in Southeast Asia with a population of less than 100 million people. Vietnam is ranked as one of top ten countries across the world in production and consumption of plastic products [1]. Nguyen gathered data on-site at top 10 supermarkets in Hanoi and Ho Chi Minh city and online approach randomly through 50 enterprises with diversified business sectors in November of 2020. On the one hand, the author directly distributed to consumers at the supermarkets with instructions (acceptance rate at 89.9%); on the other, the author sent questionnaires to individuals in some organizations through email with an acceptance rate at 54.2%. The survey collection generated the dataset of 536 Vietnamese consumers. The demographic characteristics include information about gender, age, educational qualification, job, marital status, number of family members, and income. For the customer behaviors, Nguyen collected data on intention to use, attitude, subject norms, perceived behavioral control, awareness of consequences, ascription of responsibility, and personal norm.

Table 1. Description of Variables

Variable	Description	Data type	Coding	Details
Intention	Intention to use own shopping bags instead of plastic bags at supermarkets	Continuous	Strongly disagree: 1 Disagree: 2 Neutral: 3 Agree: 4 Strongly agree: 5	Mean = 3.82 SD = 0.823
Personal norm	Moral obligation to perform or refrain from using single-use plastic bags at supermarkets.	Continuous	Strongly disagree: 1 Disagree: 2 Neutral: 3 Agree: 4 Strongly agree: 5	Mean = 4.11 SD = 0.873
Attitude		Continuous	Strongly disagree: 1 Disagree: 2 Neutral: 3 Agree: 4 Strongly agree: 5	Mean = 4.16 SD = 0.874
Subject Norms		Continuous	Strongly disagree: 1 Disagree: 2 Neutral: 3 Agree: 4 Strongly agree: 5	Mean = 3.52 SD = 0.933
Perceived Behavioral Control		Continuous	Strongly disagree: 1 Disagree: 2 Neutral: 3 Agree: 4 Strongly agree: 5	Mean = 3.77 SD = 0.905
Education	Educational levels	Categorical	Others: 1 High school graduation: 2 College/University graduation: 3	36 (6.72%) 114 (21.27%)

			Master/PhD graduation: 4	339 (63.25%)
				47 (8.77%)
Age	Age ranging from youth to old person	Categorical	Under 20: 1	56 (10.45%1)
			From 20 to 29: 2	208 (38.81%)
			From 30 to 39: 3	145 (27.05%)
			From 40 to 49: 4	48 (8.96%)
			From 50 to 59: 5	64 (11.94%
			Over 60: 6	15 (2.8%)
FamMembers	Numbers of family members	Categorical	Only 1: 1	41 (7.56%)
			From 2 to 4: 2	367 (68.47%)
			Upper 4	128 (23.88%)
Income	Personal income per month (million VND)	Categorical	Under 6: 1	77 (14.37%)
			From 6 to 10: 2	139 (25.93%)
			From 10 to 20: 3	184 (34.33%)
			From 20 to 30: 4	65 (12.13%)
			From 30 to 40: 5	41 (7.56%)
			Upper 40: 6	30 (5.6%)

From the dataset, we selected four (4) main continuous variables and categorical demographic information for our purpose of this study (Table 1). The dependent variable of Intention composed of three (3) items expressed the intention to use his/her own shopping bags instead of plastic bags at supermarkets. Four independent variables include Personal Norm, Attitude, Subject Norms, Perceived Behavioral Control (three [3] items for each variable). The detailed description of all items are presented

in Nguyen's paper [8]. The demographic characteristics are age, educational level, number of family members, and income.

2.2.2 Method rationale and conceptual model

Different from frequentist statistics, Bayesian analysis has gained considerable attention among scholars to analyze data in recent years. This study used the open-source software package for Bayesian network modelling and analysis, namely bayesvl R language, proposed by [9,10]. Bayesvl is a user-friendly regression modelling, explicitly visualized and eye-catching graphic model, and particularly free accessible-source software [9,10]. Bayesvl along with Bayesian Mindsponge Framework (BMF) is appropriate to examine the socio, psychological, and behavioural issues [11]. The bayesvl incorporates the Markov chain Monte Carlo (MCMC) simulation technique, facilitating a variety of research models [10].

The conceptual model in this study combines the NAM and TPB theory. Among these variables, Personal Norm (representative for NAM) and Attitude, Subjective Norm, and Perceived Behavioral Control (representative for TPB) are independent variables impacting intention to use own shopping bags. These associations are moderated by demographic characteristics (Age, Educational level, Family members, and Income). The conceptual model is shown in Fig.2. and the Bayesvl package returns the model in Fig.3.

2.3 Analysis and validation

As soon as establishing the Mindsponge-based model construction, we employed the Bayesian analysis in the next stage of BMF analytics. To check the model's goodness of fit, we used the Pareto-smoothed importance sampling leave-one-out (PSIS-LOO) diagnosis. The conditional value or k-values for fitting the model is shown in Table 2. The effective sample size (n_eff) and the Gelman-Rubin shrink factor (Rhat) in the trace plots show the reliable and qualified results when the Markov chain converges. The value of n_eff being larger than 1000 indicates the convergence of the Markov chain. Additionally, Rhat value should not exceed 1.1. We used the bayesvl package and ggplot2 in R packages to analyze Bayesian results and visualization.

Table 2. PSIS-LOO Goodness-of-fit

k-values	Condition
Below 0.5	Good
0.5-0.7	OK
0.7-1.0	Bad
More than 1	Very bad

3. Research Findings and Results

Prior to interpreting the simulated posterior model, we elaborated on the model's good-of-fitness using the PSIS-LOO diagnosis test. The test's estimated k-values are shown in Figure 4, indicating that most of the k-values are under 0.1, while a limited amount of k-values more than 0.1 (but all k-estimates are below 0.5). This PSIS-LOO test suggests that the constructed model is a good fit for the data.

We used the R package with the version 4.2.1, considered as "vigorous calisthenics" for Markov chains with 5000 iterations and 2000 times for the warmup period. The simulation took nearly two (2) minutes to complete the estimation. The simulated results indicating the diagnosis of the Markov chain convergence are illustrated in Table 3. All the coefficient' n_eff values are larger than 1000 and Rhat values are equal to 1, suggesting that the Markov chain model have converged well.

Table 3. Simulated posterior results

Parameters	Mean	SD	n_eff	Rhat
Constant	1.23	0.24	7213	1
Personal Norm	-0.06	0.06	6736	1
Education	0.10	0.01	8947	1
Age	0.04	0.01	13360	1
Family Members	0.01	0.01	9868	1
Income	-0.01	0.01	14282	1
Attitude	0.17	0.03	10616	1
Subjective Norm	0.05	0.03	12069	1
Perceived Behavioral Control	0.10	0.03	11188	1

We also use the trace plots of Markov Chain to illustrate the Markov chain central limit theorem in Fig. 5. The coefficients' Markov chains oscillate around an equilibrium, which suggests a good signal of convergence.

Similarly, the model's convergence signals can be examined in the Gelman-Rubin-Brook plots (Fig.6.) and autocorrelation plots (Fig.7.). The shrink factors in the Gelman-Rubin-Brook are volatile within the 0-1000 iterations but rapidly reduce to one prior to the 2000^{th} iterations (Fig. 6). The autocorrelation levels achieve nearly zero after a specific number of lag (i.e., 5) in the autocorrelation plots (Fig.7).

From the analysis, we found that the personal norm has a negative impact on the intention to use (=-0.06). However, we discovered the positive association between intention with attitude (=0.17), subjective norm (=0.05), and personal behavioral control (=0.10) (Fig.9.). The association is positively

moderated by Age, Education, and Family members, but negatively moderated by Income. The posterior distributions in the density plots are distributed on one specific side of the origin (Fig.10). These associations are also seen reliable.

Fig.10. illustrates the interaction between independent variables and dependent variables in the moderation role of Age, Education, Family Member, and Income. The x-axis represents the independent variables, while y-axis indicates the level of intention to use reusable shopping bags. The moderated variables are classified into three (3) groups (+1 standard deviation, neutral, and -1 standard deviation). In terms of age, personal norm, attitude and subjective norm seem to be not moderated by age, but personal behavioral control is positively moderated by age. It means that the elderly tend to control their personal behavior with the intention to use reusable bags rather than young people do. The young generation with the rapid lifestyle do practice their life in quick-temper by using SUP bags.

Given the education qualification, it is clear that the higher level of the educational group has a likelihood to use reusable bags, but the lower level of the education group also intensively increases their intention far more than the educated group, in terms of personal norm. This finding implies the necessity of educating and training the group with lower educational level potentially increasing their intention and behavior. For the family members, the household with few members (1 or 2) under the pressure of subjective norms tend to increase the intention to use reusable shopping bags rather than other groups. This result indicated that the group with one or two members in the household has a tendency to use reusable shopping bags than the group with three or four members in the household. Finally, under the pressure of subjective norms, groups with high income also use reusable shopping bags. The more income they attain; the more likelihood they use the reusable shopping bags.

4. Discussion

The current study employed the Bayesian Mindsponge Framework analysis on the dataset of 536 Vietnamese consumers to examine the non-linear relationship between factors impacting the use of reusable shopping bags in supermarkets. The estimated results suggested that the consumers' attitude toward green consumption is the most influential factor impacting the intention to use. However, the personal norm is negatively associated with intention. It can be explained that consumers practice green consumption by using reusable shopping bags in the voluntary way instead of obligating them to do so. It makes sense that people tend to be against what they are forced to do. The second and third impacts are perceived behavioral control and subjective norms. These results suggested that enhancing the consumers' attitude toward the green economy became important. The authorities should frequently hold workshops and educational programmes to gain the awareness and attitude to sustainable consumption. Specially, the educational and training programmes should aim to young generations (i.e., Gen Z) as the moderated result of age suggested in this study. The older shoppers are good at controlling their perceived behavior as compared to the young generations.

It is also obvious that well-educated people pay serious attention to green consumption rather than others. Hence, the national policy at the long-term period should enhance higher education and continue to set education as a national priority. Increasing the rate of undergraduate and graduate learners in Vietnam. In fact, among South East Asia, the ratio of students enrolled in higher education institutions is quite low. Hence, strengthening the higher education and addendum of environmental science and climate change in curriculum becomes urgent and significant these days [12].

Households with one (1) or two (2) members were strongly influenced by others, while households with three (3) or four (4) members were less influenced by others. In other words, single persons or young couples are strongly influenced by others or society in their behaviors. This finding is consistent with the social culture in Vietnam, where the sense of community is highly appraised. Under the pressure of community and society, people with high incomes tend to be economical and energy-saving behavioral consumption rather than the people with low income. For the long term, increasing household income per capita through economic development in a sustainable manner is one of the national policies. Affluent people have a likelihood to save.

5. Concluding remarks

This study investigated the driven factors of personal norm, attitude, subjective norm, perceived behavioral control influencing intention to use reusable shopping bags in supermarkets in an emerging country like Vietnam. The associations also were tested the moderation role of age, educational qualification, numbers of family members at households, and personal income. We used the BMF analytics with the dataset of 536 participants in Ha Noi and Ho Chi Minh City of Vietnam. We discovered that personal norms have a negative effect on intention, suggesting that the motivation to bring own shopping bags stems from customers' own awareness, but not the obligation from social perspectives. Among driving factors, attitude has the strongest impact on intention. Therefore, initiatives in training and workshops to enhance the public awareness is significantly necessary. However, for the long term strategy, policies on restrictions and gradual bans of the plastic bags in supermarkets and retail stores are of importance on terminating the plastic bags. From the authorities, a plastic tax or fee should be a considerable action. For the business operations, retailers should consider the price-reducing tactics when consumers use their own shopping bags. For manufacturing and production, manufacturers have responsibility to protect the environment through Extended Production Responsibility and encourage the use of biodegradable packaging. A feasible solution to reduce plastic pollution not only sticks to consumers, but also all stakeholders should be involved to tackle this wicked problem.

Declarations

Author contributions

Study conception and design: T.V. Tran, M.T. Le; Acquisition data: T.V. Tran; Analysis and interpretation of data: T.V. Tran, M.T. Le; Drafting manuscript: T.V. Tran, M.T. Le, M.M. Amancio; Critical revision: M.T. Le,

M.M. Amancio; Final approval: M.M. Amancio; Statistical expertise: T.V. Tran, M.T. Le; Administrative, technical, or logistic support: M.M. Amancio.

Funding

The authors also hereby declare that financial support will be received upon the publication of this article. De La Salle University and O.P. Jindal Global University will support the authors through the fund provision for the article processing charge (APC).

Data Availability

The dataset generated for this research can be found here: https://doi.org/10.1016/j.dib.2021.107226. Further enquiries can be directed to the corresponding author.

Code availability

R language with the package of bayesvl.

Ethical Statement

This research employs publicly accessible data disseminated on ScienceDirect: https://doi.org/10.1016/j.dib.2021.107226. The dataset is devoid of any personally identifiable information and has been isolated from its original context.

Informed Consent to Participate

The study utilized the survey collection generated from 536 Vietnamese consumers from open sources (Data in brief). As this secondary does not entail primary data collection from human objects or compromise their privacy, ethical approval was deemed unnecessary.

Competing Interests

The authors declare that they have no competing interests.

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Figures

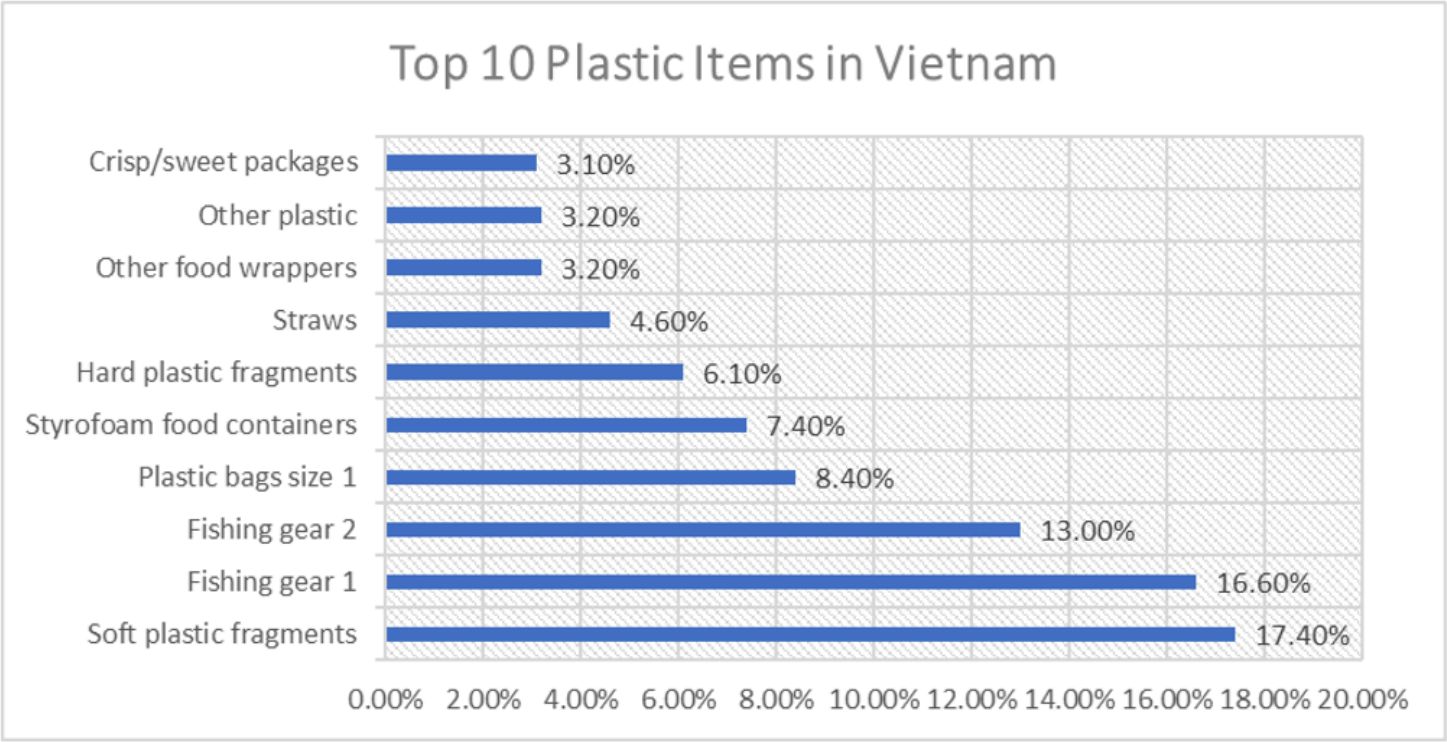

Figure 1

Top 10 Plastic Items in Vietnam. (Source: [3])

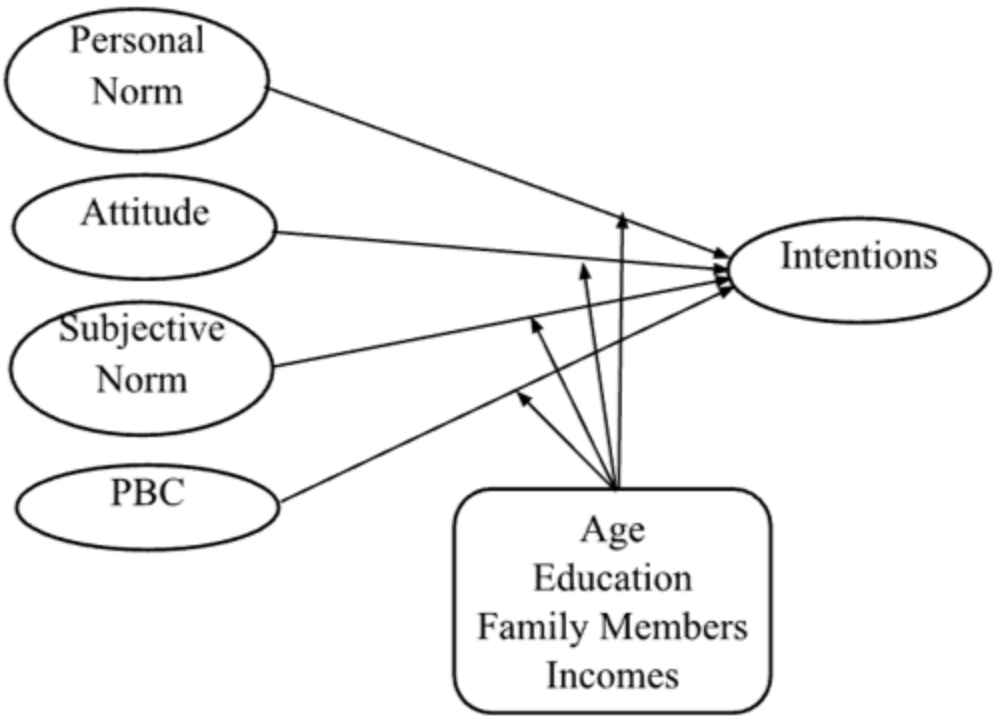

Figure 2

Conceptual research model

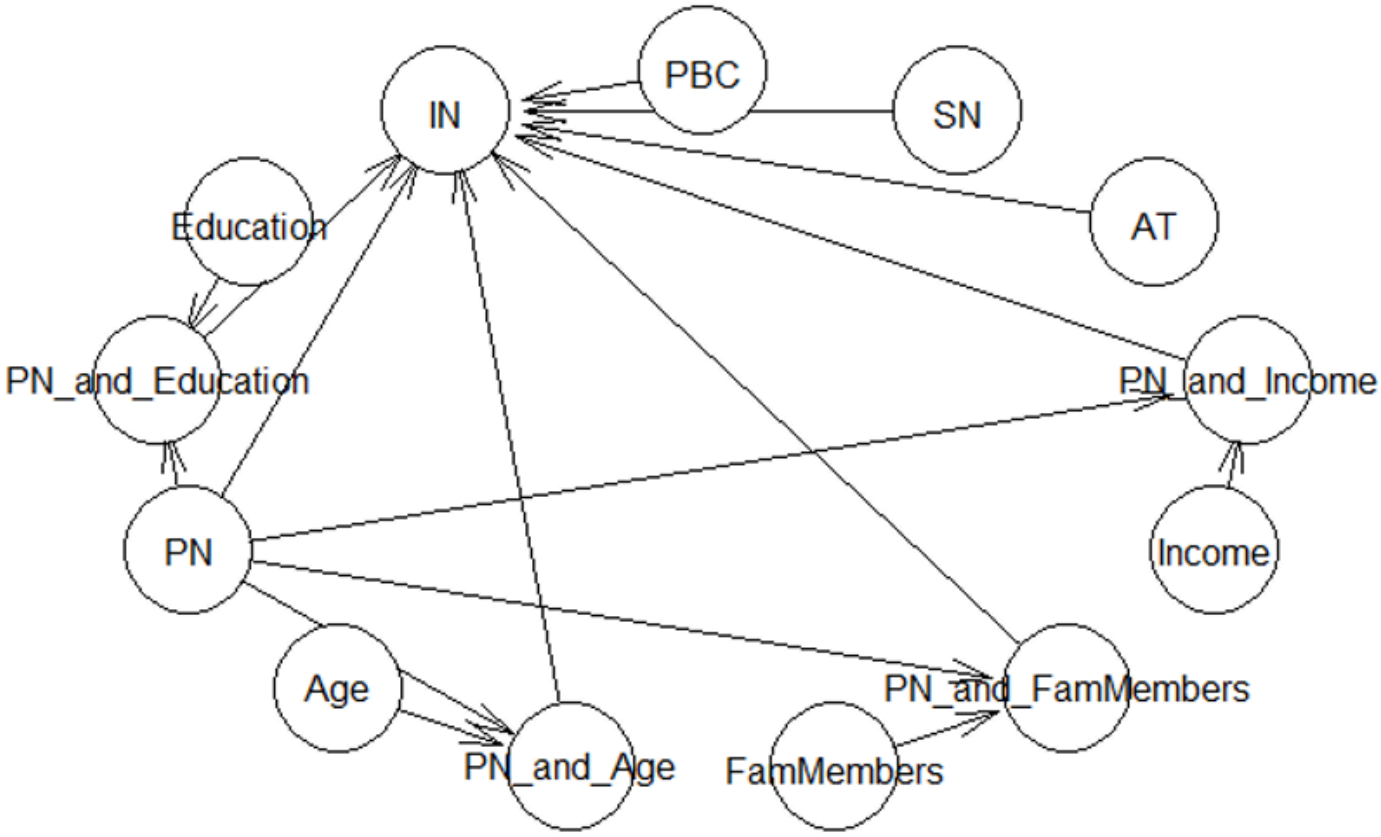

Figure 3

TPB-NAM-based research framework with Bayesvl

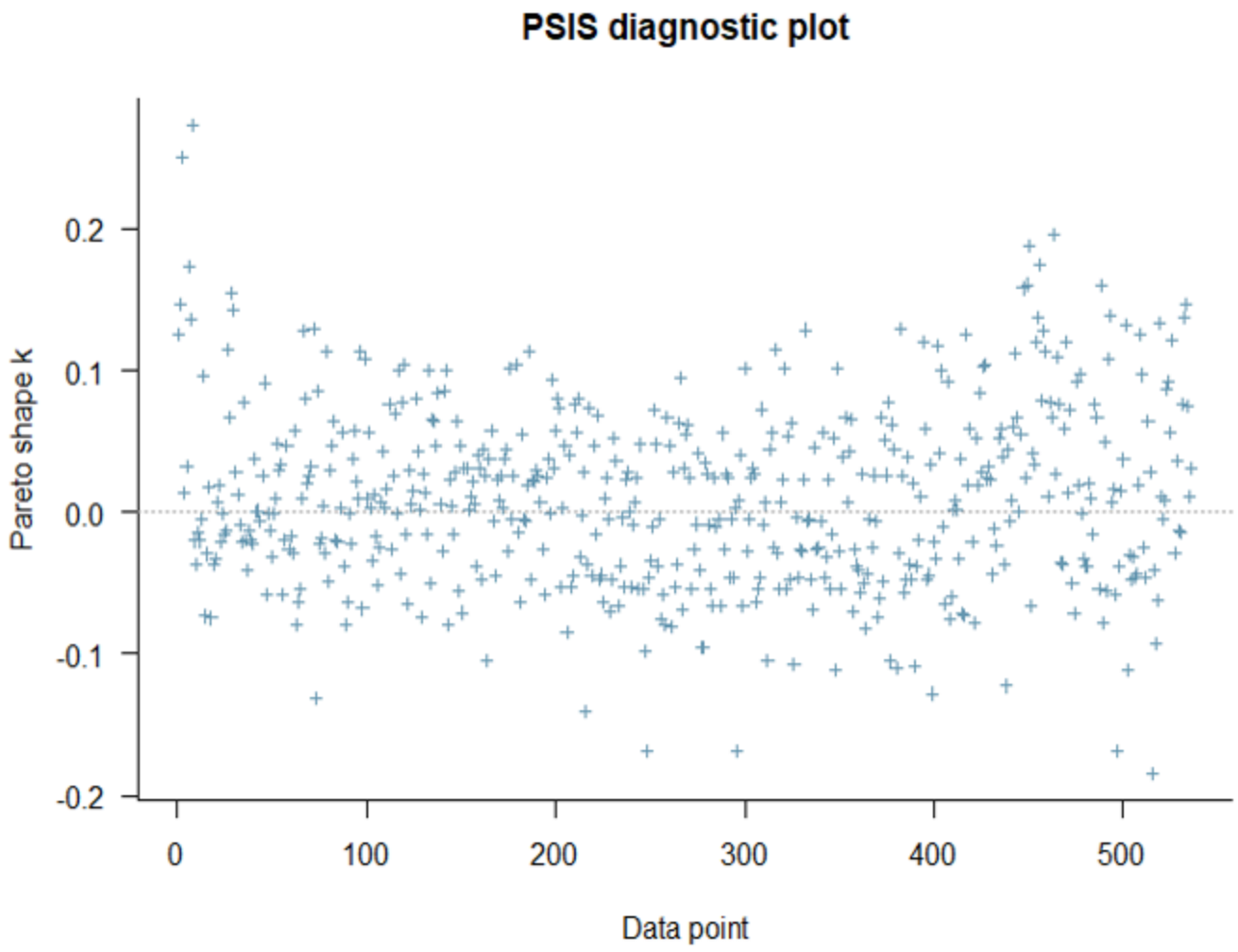

Figure 4

PSIS-LOO diagnostic plot

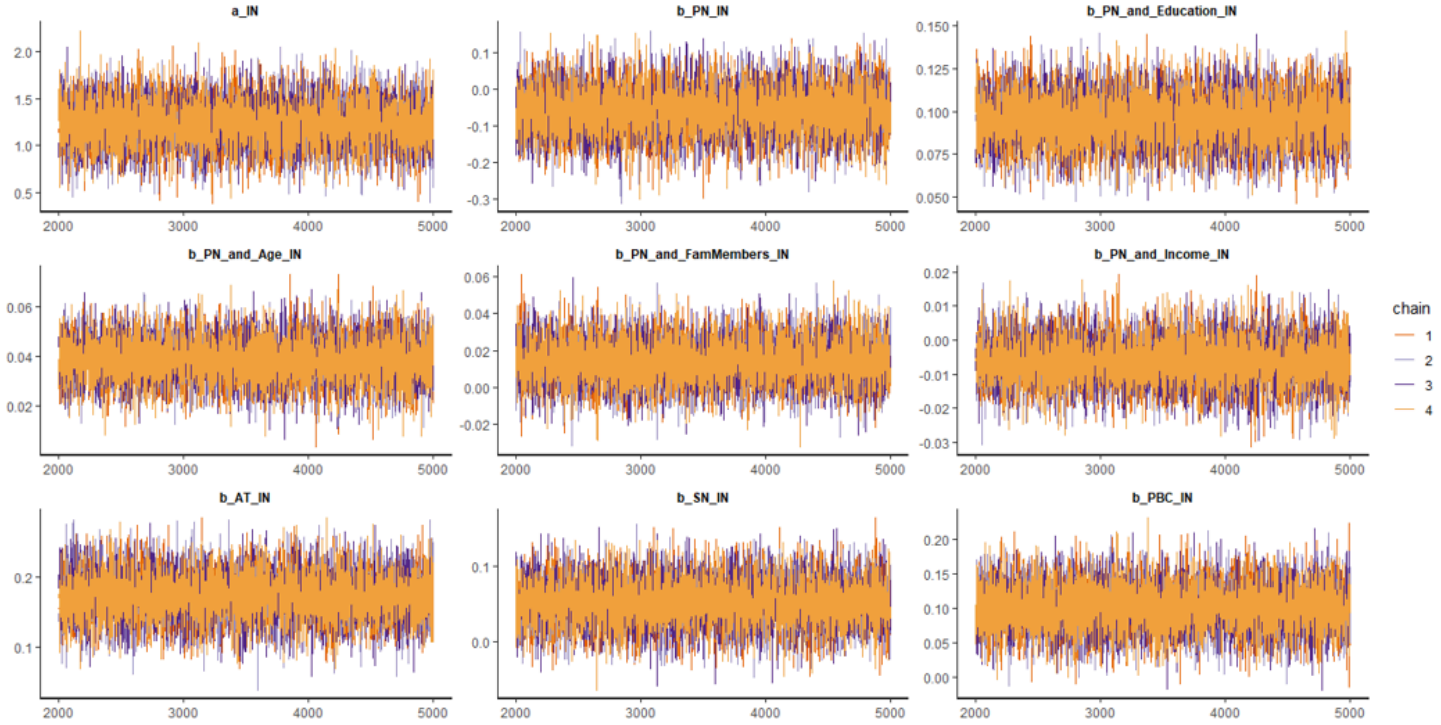

Figure 5

Trace plots of MCMC draw coefficients in the model

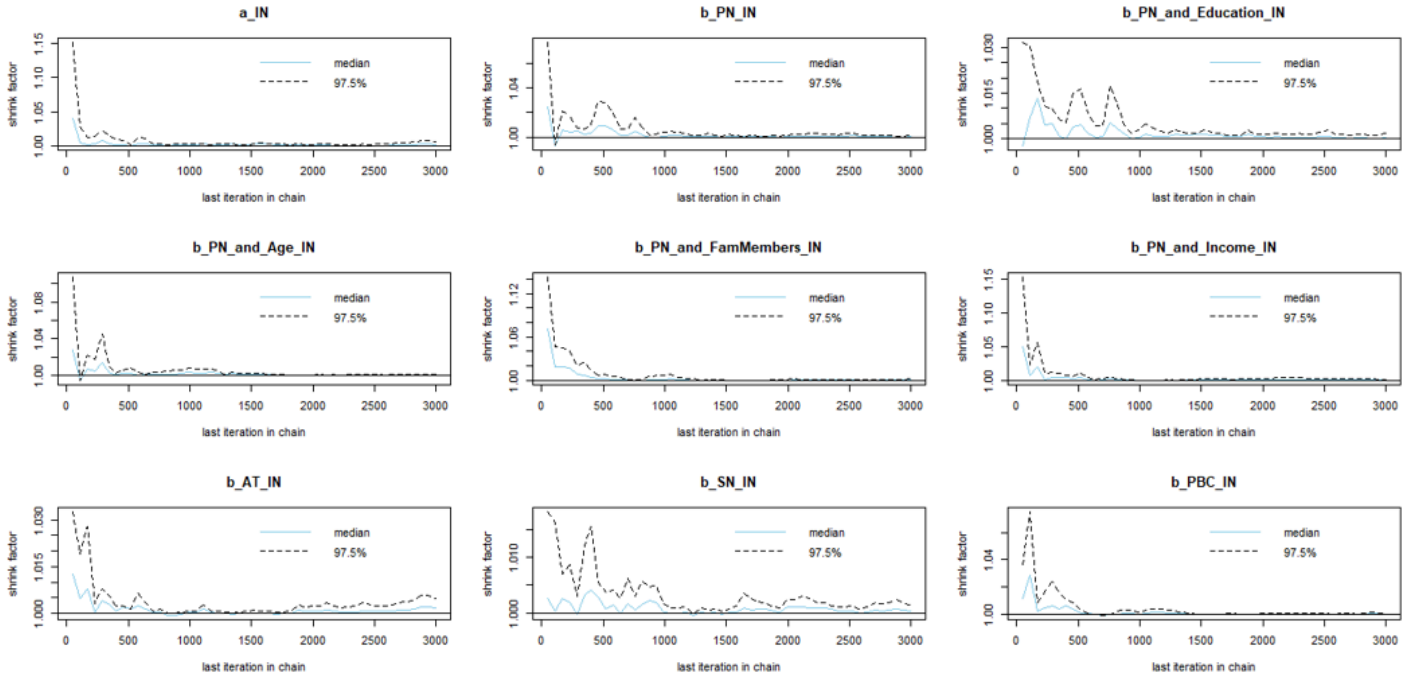

Figure 6

Gelman-Rubin-Brook plots of the constructed model

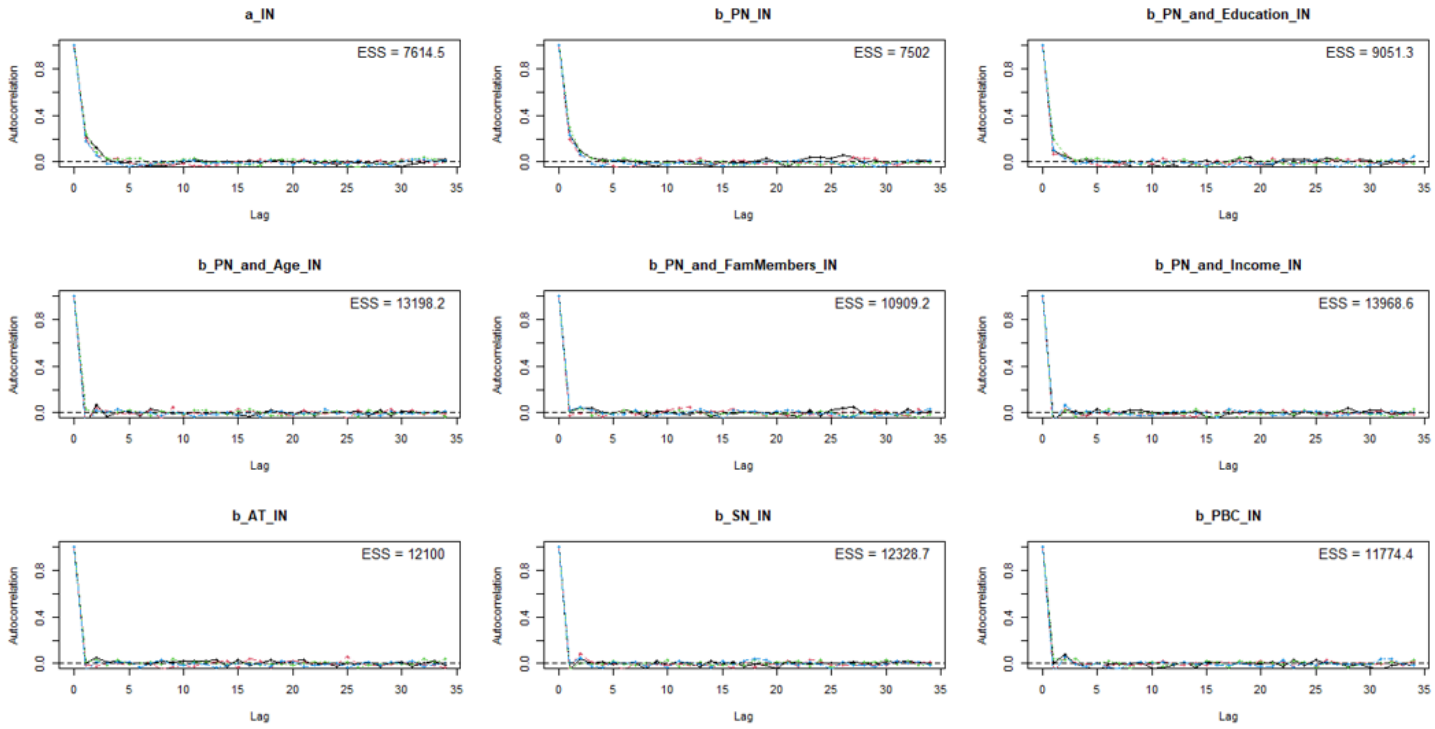

Figure 7

Autocorrelation functions plots of coefficients

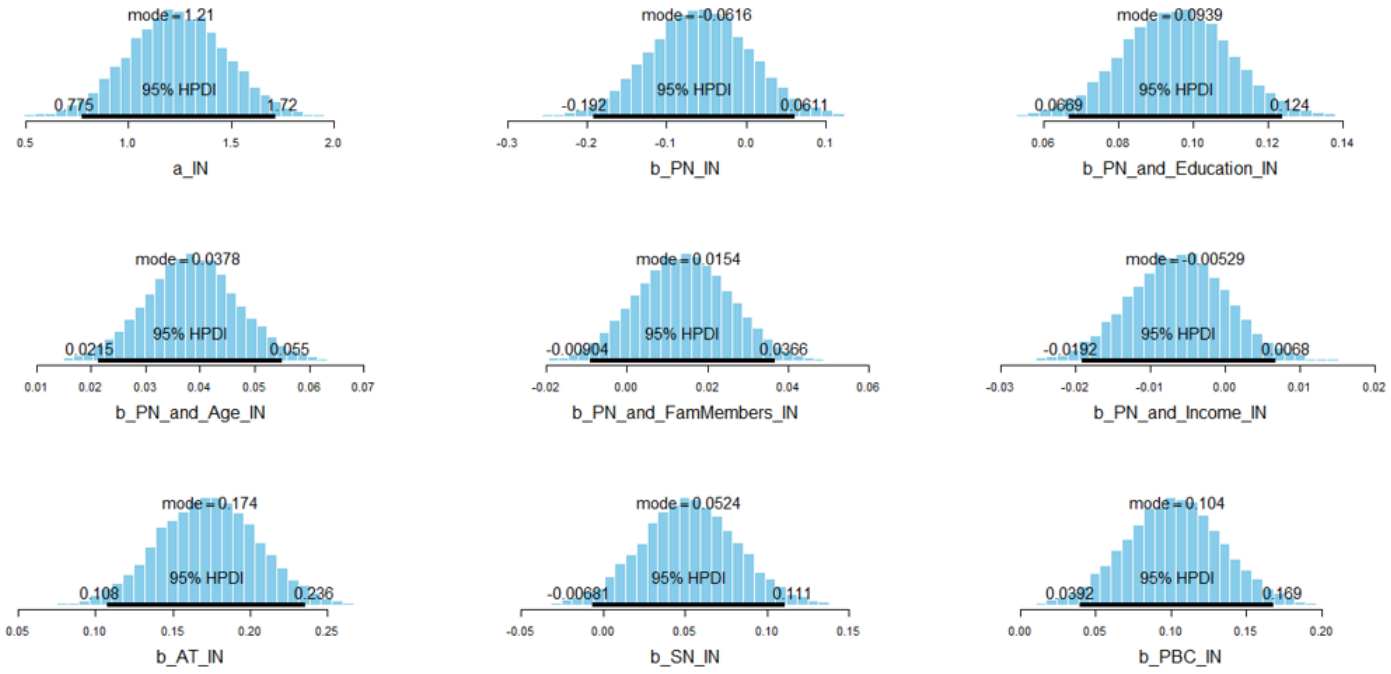

Figure 8

Posterior distributions of the constructed model

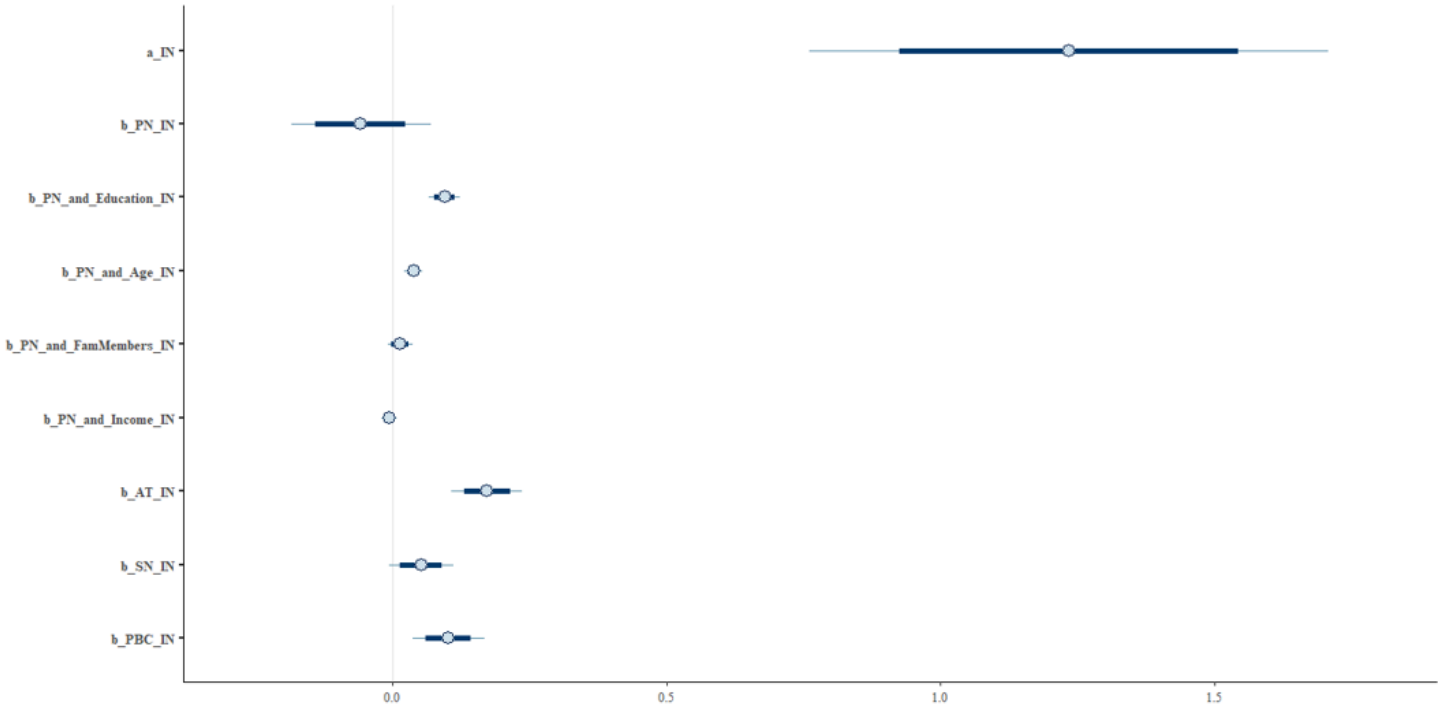

Figure 9

Interval plots of coefficients

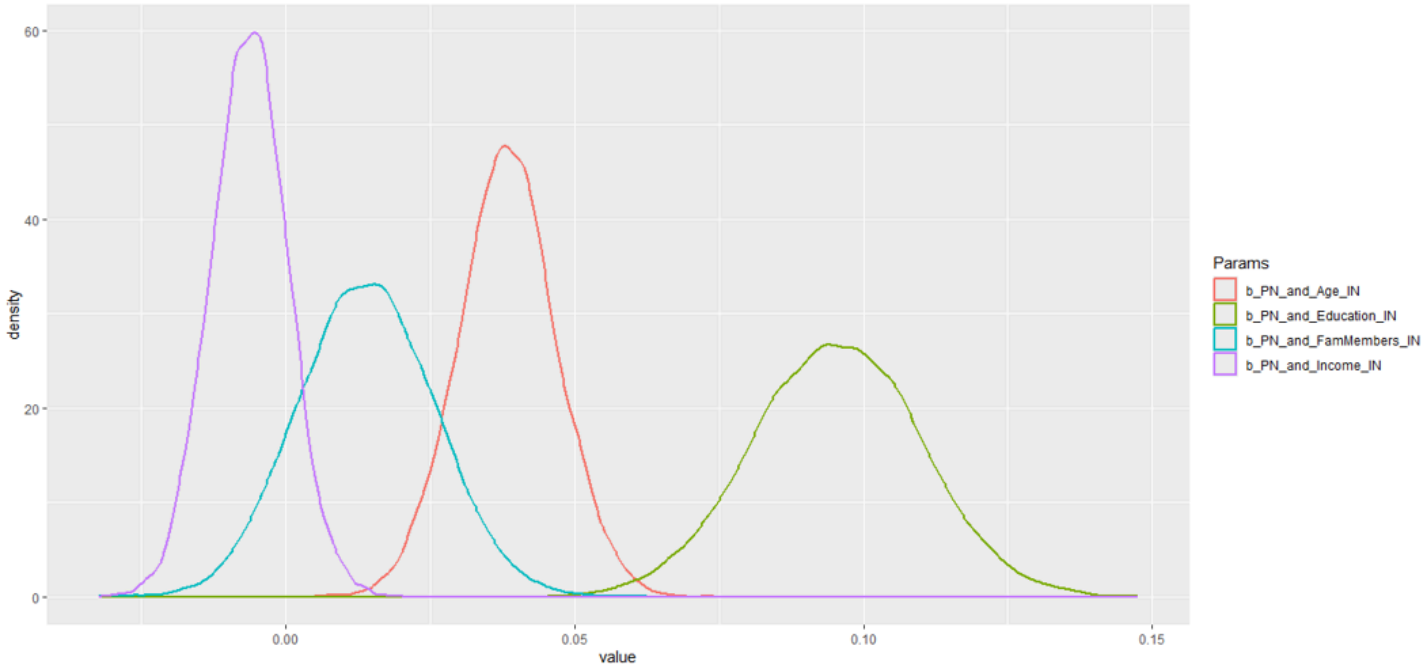

Figure 10

Density plot 2

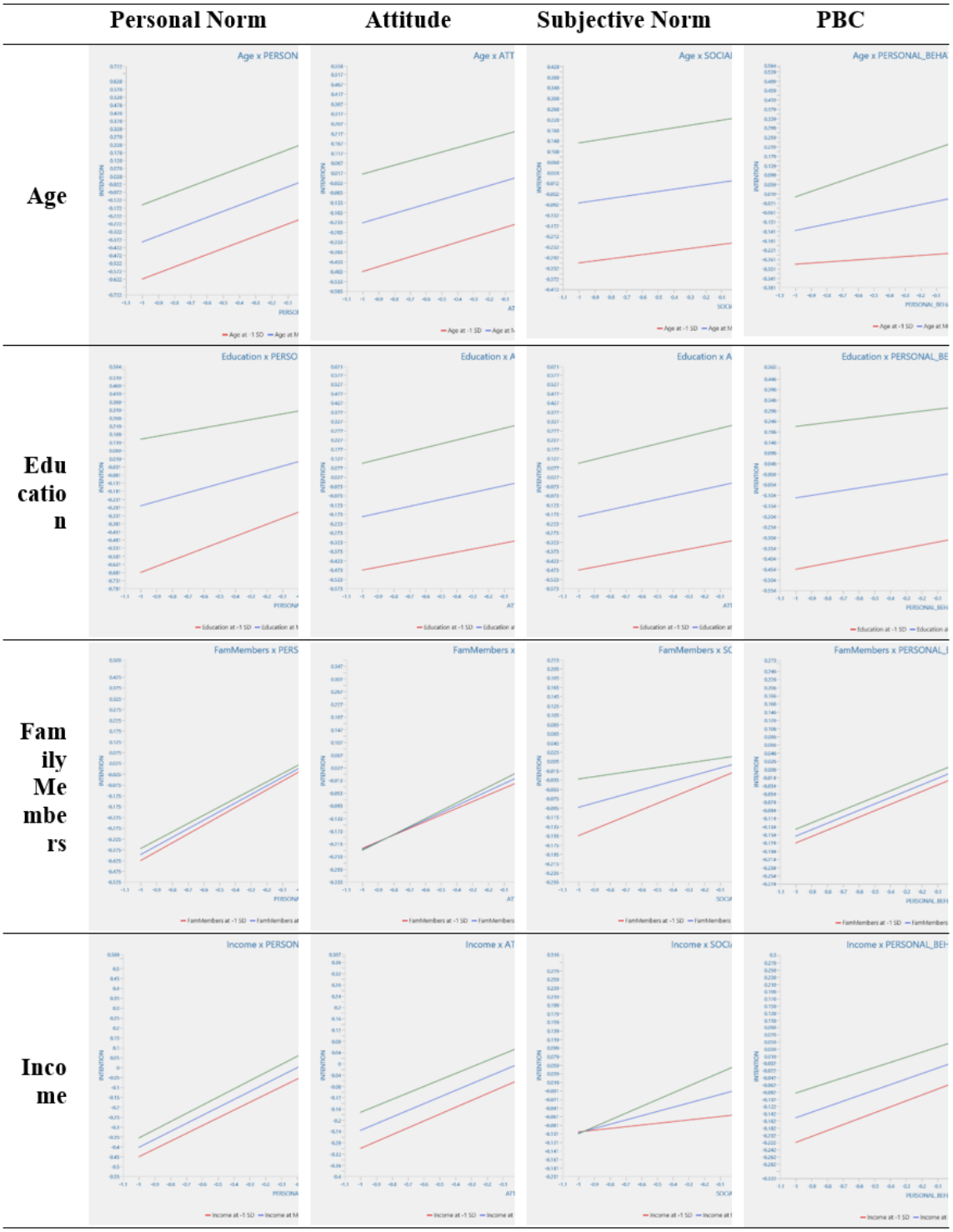

Figure 11

Interactions among variables and characteristics

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Appendix.docx