The effects of environmental information provision on plastic bag use and marine environment status in the context of the environmental levy in Greece

Charalampos Mentis$^1$ · George Maroulis$^1$ · Dionysis Latinopoulos$^2$ · Kostas Bithas$^1$

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Abstract
The focus of this study is to examine the level of awareness, as well as the impacts of environmental information provision, regarding plastic bag consumption in Greece, taking into consideration the effects of plastic pollution in the marine environment within the framework of the environmental levy. This study was conducted through the use of two structured questionnaires as web-based surveys. The aim of both questionnaires was to explore citizen attitudes towards the marine environment in addition to their preferences with regard to the implementation of a program aimed at marine conservation and the reduction of plastic bag use. Data on plastic bag consumption at a national level were also incorporated. This research was carried out according to the contingent valuation method aimed at estimating citizen willingness-to-pay (WTP) on both structured questionnaires. The first questionnaire utilized the minimal legal WTP (ML-WTP) model resulting in 834 responses in total, while the second questionnaire applied a double-bounded dichotomous choice method and amassed 713 responses in aggregate. Based on the results of the first questionnaire, pre-existing environmentally friendly behaviour was further enhanced by the introduction of the environmental levy on plastic bags. The second questionnaire revealed that marine conservation is based both on collective as well as individual responsibility. This study provides evidence that the utilization of both economic and non-economic measures may be very effective in considerably reducing plastic bag consumption and its detrimental impact on the marine environment.

Keywords  Plastic bags · Information provision · Environmental preferences · Consumer behaviour · Behaviour change intervention · Environmental levy

1 Introduction

Sustainable development and sustainability as concepts are currently subjected to a number of threats on a global scale that already have and will continue to negatively affect societies and human beings. Our modern lifestyle is strongly based on consumerism, characterized
by a plethora of needs constantly emerging as a result of the throw-away society. Plastics, and plastic bags in particular, are produced in abundance worldwide, acting as a symbol of this particular lifestyle, while at the same time constituting an important environmental issue of global proportions due to the associated marine plastic pollution.

Plastic bags are typically regarded as the most common type of carrier bags for shopping in markets, as they offer several practical advantages (Hopewell et al., 2009). They have also been widely marketed both as necessary and as a consumer right (Suh et al., 1994; Afroz et al., 2017). Plastic bags, for the most part, are offered free of charge to the consumers, thus making the need to carry along reusable bags unnecessary, although their environmental impact due to their improper disposal is disproportionally high. Plastic bags are manufactured from non-renewable natural resources and are strongly associated with environmental pollution and potential human health hazards, as they are predominantly found along the coasts and ocean gyres in massive quantities (Bhuyan et al., 2021). They require approximately 20–500 years or more to degrade, while several additional factors such as the precise material used, its structure, sunlight exposure and the levels of humidity also contribute to this process (Barnes et al., 2009; Derraik, 2002; Edwards & Meyhoff, 2011).

In addition, plastic bags contain certain chemical additives, characterized by different levels of toxicity, which in turn may negatively affect both human health and the environment (Hahladakis et al., 2018; Cherif Lahimer et al., 2017; Muthu et al., 2011). These particular additives may pollute the ground, water and air, thus contributing to the creation of the greenhouse gas effect and inducing climate change (Royer et al., 2018; Teuten et al., 2009). Plastic bags (single-use mainly) are among the most prominent plastic waste items traditionally based on the linear economy model. Furthermore, their production has been linked to the generation of significant energy demands as well as energy losses, thus highlighting their unsustainable consumption pattern across the world (OECD, 2011).

Marine litter and debris composed of plastics have adverse effects on marine biodiversity as well as on marine and coastal ecosystems, while public safety may also be at risk from a series of infectious diseases discovered in both marine species and humans due to marine plastic contamination and the process of biomagnification (Barnes et al., 2009; Derraik, 2002; Fendall & Sewell, 2009; Gregory, 1996; Lozano & Mouat, 2009; Ng & Obbard, 2006; Ryan et al., 2009; Thompson et al., 2004). A multitude of research is currently being carried out on the exact origins, deterioration process, and deleterious effects of plastics on human beings and ecosystems alike. On a global level, many resources and a great deal of money have been spent on this effort and on various mitigation strategies on marine plastic pollution and plastic waste. In particular, the effective management of plastic waste is associated with numerous challenges, taking into account that in 2015, approximately 60–99 million Mt (metric tons) of plastic waste and debris were produced worldwide (Crowley, 2020; Lebreton & Andrady, 2019), while almost 11.1 billion plastic pieces were scattered across the Asia-Pacific region, therefore augmenting the vulnerability coral reefs to various diseases (Lamb et al., 2019).

Marine and coastal ecosystems are considered among the most crucial and productive ecosystems worldwide, but they are at present seriously threatened by plastic waste (Andrady, 2011; Barnes et al., 2009; Cole et al., 2011; Engler, 2012; Galgani et al., 2015; Chatterjee & Sharma, 2019; Bhuyan et al., 2021). People are highly dependent on the ocean and coasts for their survival and well-being as they provide a plethora of resources which are in turn associated with a number of socio-economic benefits. These include food provision, water quality maintenance, natural shoreline protection against storms and floods, maintenance of the basic global life support systems, and the
provision of a sturdy basis for tourism as well as other cultural and spiritual benefits (UNEP, 2006).

Over one third of the global population resides in coastal areas and on small islands, a proportion that represents approximately 4% of our planet’s total land area (UNEP, 2006), while more than 7.5 billion people around the world depend on oceans for resources and leisure (Steffen et al., 2011; Chatterjee & Sharma, 2019; Egessa et al., 2020; Bhuyan et al., 2021). Fisheries have been linked to generating substantial revenues from marine and coastal areas, providing direct employment to over 38 million people worldwide (UNEP, 2006). Coastal tourism has become one of the fastest growing sectors of global tourism, generating a large proportion of many developing countries’ Gross Domestic Product (GDP) and providing employment for many people, especially in small island states and local communities (IUCN, 2009; Heckwolf et al., 2021; Russi et al., 2016). In this context, the global shipping industry is seen as an essential part of the marine economy as the volume of international trade has approximately tripled relative to the 1990’s, while in the case of the USA, the marine economy contributed around $397 billion to the GDP in 2019 and tourism and recreation (including recreational fishing), in particular, contributed $235 billion during the same year (NOAA, 2021).

The adverse economic and environmental implications of plastic waste, and especially plastic bags, have attracted a great deal of global attention, resulting in certain measures and precautions being taken to reduce plastic consumption. Contemporary scientific evidence and data on a global level, coupled with the potential negative impacts on marine species and human health associated with plastic waste reinforce this view (Chauhan et al., 2021; Lebreton et al., 2018; Revel et al., 2018; Wright & Kelly, 2017; Xie et al., 2021). Many governments and governmental authorities worldwide have utilized economic instruments combined with command-and-control strategies in order to reduce plastic bag consumption rates, the effectiveness of which depends on the proper combination of measures, as well as certain geographical factors. In particular, in Ireland the introduction of a tax per plastic bag led to a tremendous decline in plastic bag use (Convery et al., 2007). However, in the case of Botswana, the tax levied on plastic bags did not discourage consumers from using them (Madigele et al., 2017).

Numerous studies have examined the effects of applying these types of market-based environmental policy measures to mitigate the negative environmental impacts associated with products such as plastic bags. These measures usually entail charge systems (taxes, levies, fees), market friction reductions, tradable permits, partial or complete bans, and government subsidy reductions aiming at gradually phasing out the use of this type of product which is of harmful to the environment (OECD, 2001; Sterner, 2003; Stavins, 2002;; He, 2012 ). On certain occasions, an assortment of measures, along with specific variations are applied (bans according to μm—micrometres) (Rivers et al., 2017), promoting environmental awareness (Latinopoulos et al., 2018), recycling and waste management solutions, etc. (UNEP, 2018).

Public awareness, perception, knowledge, behaviour and attitudes have lately been acknowledged as critical factors in mitigating contemporary environmental threats. Based on Masud et al. (2015), it can be deduced that knowledge and awareness coupled with risk perception may positively influence changes in favour of pro-environmental behaviour. In addition, attitude and cognition are also regarded as important parameters for environmental preservation (Patchen, 2006; Schultz & Oskamp, 1996). Afroz et al. (2017) note that citizens who have acquired more information gradually become confident with respect to this knowledge, and tend to establish pro-environmental behaviours.
Information provision can be instrumental in altering people’s behaviour when both the quantity and quality of information and data are low. In the case of information and awareness-raising actions, accuracy and clarity are deemed critical for effectiveness. People may be inclined to adopt pro-environmental behaviours or express concern with respect to the environmental impact of their consumption patterns, but they lack proper knowledge. The provision of additional information, in association with certain behavioural instruments such as descriptive and injunctive norms, has proven successful in affecting consumer behaviour regarding environmental issues (Jessoe & Rapson, 2014; Alpizar et al., 2020; Carlsson et al., 2020). The widespread use of free-of-charge plastic bags indicates a discrepancy between the environmental concerns of individuals and their consumer choices.

Awareness-raising campaigns combined with more traditional economic instruments may also have behavioural spillover effects on citizens’ behaviour. In particular, positive pro-environmental behavioural spillover effects have been documented multiple times in relation to different conceptual frameworks (Thøgersen, 1999; Thøgersen and Ölander, 2003; Van der Werff et al., 2013; Lanzini & Thøgersen, 2014; Thomas et al., 2016). In this regard, an environmental fee on plastic bags may be perceived as a psychological instrument as well, affecting citizens’ behaviour, not only for financial reasons but also for environmental ones (Thomas et al., 2019). From this perspective, participants in information campaigns may better comprehend the environmental motivations behind a policy measure such as a plastic bag charge, thus generating support for similar environmental policy measures due to the spillover effects. In this context, it would be useful to investigate the impacts of certain environmental policy measures via the utilization of information and data on consumers’ choices derived both before and after the implementation of these types of policy changes.

This paper aims at the investigation of the effects on consumer behaviour of applying these types of measures, in particular a plastic bag levy in the case of Greece introduced on 1 January 2018 and increased as of 1 January 2019. This paper incorporates the contingent valuation method (CVM) to explore how this practice affected consumer behaviour in relation to plastic bag demand, while also examining the environmental attitude of Greek citizens regarding eco-friendly alternatives to plastic bags. Within the context of this research, an investigation was carried out to determine whether the demand for plastic bags has been influenced by other factors besides the environmental levy. For this purpose, two online surveys were conducted on a national level. Both questionnaires revealed interesting results regarding plastic bag consumption and the effectiveness of policy measures concerning plastic bags and marine conservation.

2 Literature review

There has been a steady increase in research focusing on the effects of alternative plastic bags policies/measures on consumer’s behaviour. In this regard, it would be useful to classify these policies according to the particular types of measures applied, i.e., taxes, environmental fees/levies, bans, legislative measures, and awareness raising campaigns.

Taxes, subsidies, levies, fees, and charges fall under the category of economic instruments aimed at changing consumer behaviour indirectly via price manipulation (Nahman & Godfrey, 2009). The implementation of these types of measures has been greatly favoured, particularly in the case of developing countries, in view of certain advantages
they may offer, such as cost-effectiveness, incentives for innovation, economic efficiency, and generation of revenue (Madigele et al., 2017; Nahman & Godfrey, 2009).

With regard to plastic bags, Convery et al. (2007) in Ireland, Defra (2018) in England, Dunn et al. (2014) in Logan, Utah (USA) along with Homonoff et al. (2017) in Chicago, Illinois (USA), the State of Israel (2018), Dikgang et al. (2012) in South Africa, Martinho et al. (2017) in Portugal, Sandalci (2019) in Turkey, and Asmuni et al. (2015) in Malaysia examined the effects of plastic bag taxes in each of the above-mentioned countries/states. In essence, the taxation on plastic bags generated a substantial decline in plastic bag demand and consumption, whereas once consumers get accustomed to the price, the policy tends to lose its momentum and effectiveness. A number of studies, such as He (2012) in China, Muralidharan and Sheehan (2016) in the USA, Ocean State Job Lot (2018) in New England (USA), OpinionWorks (2013) and the Alice Ferguson Foundation (2015) in Washington, DC (USA), Sortino (2019) in Suffolk County, NY (USA), Homonoff (2015) in Montgomery County, MD (USA) and Senturk and Dumludag (2021) in Turkey explored the efficiency of a more traditional market-based instrument, such as plastic bag fees. Based on their results, it would be accurate to say that these kinds of fees may prove to be reasonably successful in decreasing the use of plastic bags, while also shifting consumer behaviour towards re-usable solutions in an effort to avoid the fee.

Jakovcevic et al. (2014) in Argentina and Poortinga et al. (2013) in the UK investigated the impact of charging for plastic bags, thus revealing that consumers tend to bring their own bags for shopping in order to avoid the charge, while on several occasions this particular measure did not encourage people to change their shopping habits (plastic bag use) for the better. With regard to placing a ban on single-use plastic bags, Gupta (2011) in India, Sharp et al. (2010) in Southern Australia and Santos et al. (2013) in Brazil concluded that consumers are usually motivated to bring their own bags for shopping or to choose more eco-friendly solutions. The implementation of plastic bag bans proved to be successful in other cases as well, such as those described by Sapuay (2012) in the Philippines and in the Ministry of Infrastructure and the Environment (2017) in Netherland. However, a ban on plastic bags is also likely to prove ineffective when there is insufficient monitoring.

Finally, on certain occasions, plastic bag bans have also been applied in conjunction with other measures such as fees on paper bags, as in the cases of Armstrong and O’Connell Chapman (2017) in Aspen, Colorado (USA), Taylor and Villas-Boas (2016) in Richmond, California (USA), Team Marine and Santa Monica High School (2013) in Santa Monica California (USA), and Romanow (2012) in San Jose, California (USA).

It is worth mentioning that the aforementioned economic instruments may have some common disadvantages. In particular, they require both proper public and political support in order to prove successful in gaining citizens’ trust and support as well as effective institutional mechanisms to adequately ensure their implementation (Bell & Russell, 2002; Nahman & Godfrey, 2009). As a result, the efficiency and influence of these instruments may be seriously diminished, especially in the case of the developing countries, which typically suffer from institutional deficiencies (Madigele et al., 2017; Russell & Vaughan, 2003).

Environmental threats have often been addressed via the use of command-and-control strategies aimed at changing consumer behaviour through the implementation of specific standards that must be achieved, while imposing non-compliance fines (Perman et al., 2003). Based on Santos et al. (2013) in Brazil, legislative actions replacing plastic carrier bags with purchasable compostable bags have considerably reduced the plastic bag consumption. In addition, awareness raising campaigns and environmental education/information programs have been promoted as quite promising measures/policies for mitigating
crucial environmental problems (such as reducing plastic bag use), while at the same time promoting environmental conservation. Zen et al. (2013) in Malaysia, de Groot et al. (2013) in England, Kaplan et al. (2018) in the USA, Ohtomo and Ohnuma (2014) in Japan, and Ari and Yilmaz (2017) in Turkey have shown that information campaigns are likely to increase environmental awareness, and therefore, to shift consumer behaviour towards reusable (bring your own bag) and/or eco-friendly shopping bags. An interesting case is that of Australia, where the coupling of an awareness-raising campaign with state-enacted policies (e.g. plastic shopping bag ban, recycling strategy, etc.) led to significant waste reductions in the marine environment (Willis et al., 2018).

3 Materials

The aim of the present study is to stimulate citizens’ preferences for the protection of the marine environment through the imposition of an environmental levy. In this context, a contingent valuation method (CVM) was conducted to properly estimate the monetary values for the associated non-marketed environmental goods and services (Arrow et al., 1993; Mmopelwa et al., 2005; Mustafa et al., 2014; Perman et al., 2003). In this context, an online survey approach—taking into consideration the substantial progress achieved within the area of online survey methodology (Dillman, 2000; Kramer et al., 2014; Murray et al., 2009; Wright, 2005)—was applied, aimed at obtaining a larger and more representative sample, while addressing the unforeseen circumstances which arose during the period under investigation (i.e. Covid-19 pandemic) (Wright, 2019).

The survey research was intentionally designed to address the following four key issues:

- To evaluate consumers’ reactions to the policy of charging for plastic bags (environmental levy), as of 1 January 2018;
- To evaluate consumers’ reactions regarding the new (higher) levies which applied as of 1 January 2019;
- To measure the degree to which the policy affected consumers’ habits/practices of using plastic bags, as well as their tendency to substitute single-use plastic bags with eco-friendly solutions and;
- To estimate citizens’ maximum willingness-to-pay (WTP) for using (consuming) plastic bags (15–50 μm, >50 μm).

As mentioned above, two structured questionnaires were used in web-based surveys applied to Greek consumers. The first questionnaire was used during the period October–December 2020 with a total of 834 responses collected. The second structured questionnaire was implemented during the period January–June 2021 with an aggregate of 713 responses collected.

Within the context of the first survey, a payment card was utilized to reveal citizen’s maximum WTP for different kinds of plastic bags (assuming that plastic bags, despite their environmental impact, may still offer a positive utility to consumers). Given the assumption that the chosen values represent the commitment (i.e., the legal obligation) to pay the stated amount, the minimal legal WTP (ML-WTP) model was used (Harrison & Kristrom, 1995). Given the different values from the payment card \(A_i\) and their respective frequencies \(P_i\) in the sample, it is possible to calculate the mean value of the WTP:
A simple descriptive analysis was then applied in order to summarize and illustrate all the above-mentioned results.

The focus of the second survey was twofold:

- To evaluate the responders’ preferences towards the marine environment and marine conservation and;
- To estimate the WTP for implementing a specific program that focuses on plastic bag use reduction and marine environment conservation.

For the estimation of the WTP, after the description of the various recommended policies and measures, a double-bounded dichotomous choice method was employed. According to this approach, the respondents evaluate both proposed willingness-to-pay values consecutively, while their basic response is represented by the following equation:

\[ WTP_{DB} = X' \beta + e \] (2)

where \( WTP_{DB} \) represents a vector of values of the dummy response variable, \( X \) is a matrix of values of explanatory variables, \( \beta \) is a vector of explanatory variables, and \( e \) is a vector of error terms.

The initial question was “whether the respondent was willing to pay a lump sum of money each year for the implementation of the proposed environmental conservation program”. The follow-up value depends on the respondent’s reaction to the initial bid value. Therefore, if the initial bid value was rejected, the follow-up bid was half as much, whereas if the initial bid value was accepted, the follow-up bid value was doubled (Fig. 1).

![Decision tree for willingness to pay](image-url)
Assuming that WTP is distributed in the population according to a normal cumulative distribution function, a bivariate probit approach was adopted, as proposed by Cameron and Quiggin (1994). According to this approach, the two discrete-choice responses are modelled as single-bounded (i.e. two correlated WTP equations with jointly distributed normal error terms). This model can be used to calculate the mean WTP for the first and the second question, as well as to provide useful information about the variables that are important for each of these questions. The following specification was used:

\[
WTP_{DB1} = a_1 + \beta_1 Bid1 + \sum_{i=2}^{n} \beta_i x_i + e_1
\]

\[
WTP_{DB2} = a_2 + \beta_1 Bid2 + \sum_{j=2}^{m} \beta_j x_j + e_2
\]

\[
\rho = \text{corr}[e_1, e_2]
\]

where WTP_{DB1} and WTP_{DB2} are the binary values (responses) to the dichotomous choice questions, x_i are the explanatory variables and \(\beta\)'s are the coefficients to be estimated.

4 Results and discussion

4.1 First survey: WTP for using plastic bags

Both questionnaires revealed interesting results regarding plastic bag consumption and the effectiveness of policy measures concerning plastic bags and marine conservation. On the one side, plastic bag use has radically decreased over the last 3 years, after the levy on plastic bags was imposed. Substitutes were used amply, while the respondents’ choice of avoiding plastic bags was mainly motivated by environmental concerns. On the other hand, the respondents clearly showed their increased concern about the status of the marine environment in Greece due to pollution, and that they were adequately informed on those issues. However, it is worth noting that only half of them stated that they were willing to pay a fixed sum (per year) in order to finance the proposed management program that will reduce plastic bag pollution and enhance marine conservation.

Concerning the first questionnaire, and with regard to consumers’ reactions towards the policy of a plastic bag levy, there was a uniform question concerning plastic bag usage (15–50 μm, > 50 μm and bio-degradable) in three distinct periods. The selection of these time periods was not arbitrary as they coincided with the imposition of the levies on plastic bags.

The periods were the following:

- Prior to 2018 (before the introduction of a plastic bag levy in Greece)
- After 1 January 2018, when a levy (0.04€) on plastic bags 15–50 μm was introduced for the first time and;
- After 1 January 2019, when an increased levy (0.09€) on plastic bags 15–50 μm was imposed;
Figure 2 depicts the situation prior to 2018, in 2018 and in 2019. Prior to 2018 (i.e. before the introduction of a plastic bag levy), lightweight plastic bags (15–50 μm) were widely used (only 89 responders stated a zero use), while multiple-use plastic bags (>50 μm) were not so popular (485 responses with zero use).

The following period, just after the levy imposition (2018), plastic bag usage started to decrease. More specifically, 216 respondents stated that they had not used any lightweight plastic bags (15–50 μm). In fact, the plastic bag levy seemed to trigger a substitution towards multiple-use plastic bags (>50 μm) (425 responders had not used any multiple-use plastic bags). This can be attributed to the fact that supermarkets have begun promoting these bags as an alternative to lightweight plastic bags from 2018 onwards when the levy was first imposed. In 2018, the maximum number of every type of plastic bag per person did not exceed 10 per visit to the grocery store.

The following year (2019), the above-mentioned trends were further supported by the increased levy. Thus, plastic bag usage was further decreased, while a great proportion of the respondents—almost double those of the previous year—did not use any kind of plastic bag. There seemed to be a continuous substitution towards multiple-use plastic bags (326 responders did not use any of them). The maximum amount of every type of plastic bag did not exceed 6 per visit to the grocery store, signifying a 40% reduction as compared with 2018. Regarding single-use plastic bag substitutes, in addition to multiple use plastic bags, cloth bags and shopping trolley bags were the main eco-friendly alternatives (Fig. 3).

In relation to respondents’ WTP for using plastic bags, Figs. 4 and 5 show the respondents’ willingness to pay for lightweight plastic bags (15–50 μm) and for multiple-use plastic bags (>50 μm), respectively. It should be noted that in both cases the most frequent answer (350 answers for the case of lightweight plastic bags and 279 responses for the case of multiple-use plastic bags) was the zero-bid answer (a choice related to those who are not using plastic bags). The highest WTP value was equal to €1 for the case of the lightweight plastic bag and equal to €3 for the case of the multiple-use plastic bag. The mean and median WTP values for the case of the lightweight plastic bags were found to be equal to 0.008€ and 0.05€, respectively. Concerning the multiple-use plastic bags, the mean WTP value was equal to 0.011€ (i.e., 35% higher than the lightweight bag), while the median was equal to 0.1€ (i.e., double the value of the lightweight bag). It should be also noted that the most frequent response for lightweight plastic bags was 0.15€/bag (140 responses), which is higher than the existing levy of 0.09€, while for the multiple-use plastic bags (>50 μm) the most frequent response was 0.2€/bag (166 responses).
Fig. 3 Plastic bag substitutes

Fig. 4 Willingness-to-pay (WTP) for a lightweight plastic bag (15–50 μm)

Fig. 5 Willingness-to-pay (WTP) for a multiple-use plastic bag > 50 μm
As the number of zero-value responses ("0 €—I do not use any plastic bags") is very high, it is interesting to investigate how the responders justified their choice. The two most frequent responses are "I want a universal ban on the circulation of plastic bags" (190 responses) and "I do not buy plastic bags (disposable, reusable) because I consider them harmful to the environment" (169 responses). It is therefore obvious that the main reason for not using plastic bags are mainly environmental protection issues, rather than economic justifications (e.g., the answer "limited income" received only 24 responses) (Fig. 6).

4.2 Results of the second survey: WTP for environmental protection from plastic pollution

Regarding the second questionnaire, it is worthwhile to present the qualitative findings on the participants' opinions, awareness level and considerations about the marine/coastal
environment and its protection (from plastic pollution). As shown in Fig. 7, more than half of the respondents were alarmed by the current condition of the marine environment in Greece. More specifically, all development activities are to a certain degree considered as threats to the marine environment (Fig. 8). However, central waste management and excessive use of plastic in leisure activities are considered the most important (62% and 74% totally agree in each case respectively). Similarly, all goals for marine protection are considered important, with protection of biodiversity and increased awareness campaigns/environment education being the most crucial (77% totally agree for both) (Fig. 9). Further questions concerned the respondents’ awareness regarding environmental protection and plastic. Almost all of the respondents (98%) were aware of the harmful effects of plastic on the marine environment, while 89% knew that there are related EU Directives for plastic bag reduction.

Nevertheless, just over half the respondents (54%) were willing to pay a lump sum of money each year in order to introduce and implement a marine conservation program focused on plastic bag reduction. Those who answered negatively were basically concerned about whether the money collected would be spent on such policies (42% of zero bids), while a further 43% of the non-willing respondents argued that such programs are an obligation of the state. Based on the recommendations of Arrow et al. (1993), both of these categories were seen as protest bidders and were excluded from the analysis. It should be noted that the identification of protest bidders is very crucial in CVM studies due to the fact that it has a significant effect in terms of welfare and the aggregation of values.

Table 1 presents the distribution of the participants’ responses for the initial and the follow up bid values. According to these results it is obvious that the Yes/Yes answer constantly decreases as the initial bid amount increases. Namely, for the case of Bid1 = €10, a positive answer to both bid amounts corresponds to more than half of the respondents (51.3%), but when the initial bid increases to 40€, the probability of answering yes twice

![Fig. 8](image_url) Relative importance of several threats for the coastal/marine environment of Greece (1 = not important to 5 = very important)
is only 18.5%. On the other hand, it should be noted that the probability of answering “no” increases slightly when the bid amount is increased, indicating that most of the respondents (who are not considered as protest voters) are willing to pay the lower amount offered in the second bid.

Table 2 presents the variable names used in the model and their meanings. Several bivariate models were tested in order choose the best fit, using the Log-likelihood test. The final model selected is presented in Table 3. Based on these results, a significant negative relationship is found (as expected) in both bid variables (the higher the bid amount, the lower the probability of answering “yes” to the WTP question). Concerning the first question (first bid), a higher probability of answering “yes” is expected in those individuals with higher incomes, higher awareness about the marine environment (MarEnv) and also in those who attribute greater importance to plastic waste management (D_waste). On the other hand, concerning the second equation, income and the importance given to plastic waste still remain as (statistically) important determinants of choice. However, two other variables that were found to have a positive effect are the...
frequency of consuming fresh fish from the local market (Freq-fish) and the importance
that respondents attribute to climate change for the marine environment (D-climate).

WTP values were estimated according to the results of this model and were found equal
to 44.2€ and 46.2€, for each bid amount (i.e. for each equation) respectively. So, it turns
out that the two estimates are very close to each other, which result on average in an
average WTP equal to 45€/year.

Based on these results, most of the respondents have evidently expressed their increased
concern about the current status of the marine environment in Greece resulting from plas-
tic pollution. In addition, the policy goals related to marine protection and conservation
are deemed important, while biodiversity preservation and increased awareness campaigns
along with environment education are seen as most crucial. The implementation of a uni-
versal ban on the circulation of plastic bags is considered highly acceptable, whereas quite
a few people deliberately choose not to use plastic bags, driven mainly by environmental
concern, rather than economic/cost justifications.

In recent years, many countries have decided in favour of implementing relatively soft
measures to reduce plastic waste pollution. These measures mostly include voluntary
agreement, and informative instruments along with certain legislative requirements such as
the implementation of the environmental levy on plastic bags (Wilts et al., 2019). Stricter
measures tend to include total or partial banning of specific types of plastics, based on
their characteristics. In addition, several countries have already legislated against the use
of plastic bags (particularly single-use) with Ireland and Denmark among the most suc-
cessful ones (Clean Up the World, 2008). However, aiming at maximizing the effectiveness
of a ban on the use of plastic bags, it is important to clearly state the impending penalties
for consumers and shop-owners alike should they fail to comply. In addition, information
 provision may contribute greatly towards emphasizing and further clarifying the negative
environmental impacts of plastic bag use in marine and coastal ecosystems, thus inducing a
pro-environmental (consumer) behaviour.

Therefore, the implementation of the environmental levy per plastic bag in the case of
Greece offered the opportunity to conduct a specific survey in order to investigate the

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| Variable name | Meaning |
|--------------|---------|
| val Y1       | First bid (amount of money asked in the first WTP question) |
| valY2        | Second bid (amount of money asked in the second WTP question) |
| MarEnv       | Level of awareness about marine pollution in Greece (5-point Likert scale: 1 = low, 5 = very high) |
| D_waste      | How important is plastic waste management for the marine environment? (5-point Likert scale: 1 = low, 5 = very high) |
| D-fishing    | How important is overfishing for the marine environment? (5-point Likert scale: 1 = low, 5 = very high) |
| D-climate    | How important is climate change for the marine environment? (5-point Likert scale: 1 = low, 5 = very high) |
| Freq_fish    | Frequency of consuming fresh fish from the local market (1 = every day, 6 = never) |
| Crit_greek_fish | How important is it to buy fish, whose country of origin is Greece? (5-point Likert scale: 1 = not important, 5 = very important) |
| Income       | Average family income (in €) |
| Fam_member   | Number of family members in respondent’s household |
The effects of environmental information provision on plastic bag consumption and preferences for protecting the marine environment during this particular time period.

### 5 Conclusions and recommendations

The findings of this study indicate that citizens are relatively well aware of the environmental hazards related to plastic bags and acknowledge that it is crucial to protect and preserve the marine environment. Nevertheless, certain deficiencies in environmental education also exist, rendering which can make it difficult for consumers to translate their environmental knowledge into consumer behaviour.

Both questionnaires yielded interesting results regarding plastic bag consumption and the effectiveness of relevant policy measures. Specifically, the first questionnaire revealed strong environmentally friendly behaviour which was boosted by the introduction of the environmental levy on plastic bags. Plastic bag consumption has been effectively and drastically reduced since 2018. However, it can be argued that this plastic bag

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### Table 3 Results of bivariate probit models

| Equation | B     | s.e   | z     | p-value |
|----------|-------|-------|-------|---------|
| **Equation 1** |       |       |       |         |
| Const    | −1.13774 | 0.16111 | −7.062 | 0.000*** |
| valY1    | −0.0255717 | 0.00594755 | −4.300 | <0.0001*** |
| Fam_memb | −0.0226303 | 0.0145552 | −1.555 | 0.1200 |
| Income   | 2.84672e−05 | 7.58185e−06 | 3.755 | 0.0002*** |
| Freq_fish | 0.00818052 | 0.0915585 | 0.08935 | 0.9288 |
| Crit_greek_Fish | 0.0840060 | 0.0629894 | 1.334 | 0.1823 |
| D_waste  | 0.148490 | 0.0690180 | 2.151 | 0.0314** |
| D_fishing | 0.123708 | 0.0804898 | 1.537 | 0.1243 |
| D_climate | −0.0428186 | 0.0715459 | −0.5985 | 0.5495 |
| MarEnv   | 0.147549 | 0.0810773 | 1.820 | 0.0688* |
| **WTP (C.I.)** | 44.2 | (31.0–57.4) | | |

| **Equation 2** |       |       |       |         |
| Const    | −0.5111239 | 0.14609 | −3.499 | 0.0005*** |
| valY2    | −0.0110552 | 0.00382900 | −2.887 | 0.0039*** |
| Fam_memb | 0.000443470 | 0.0129195 | 0.03433 | 0.9726 |
| Income   | 1.50026e−05 | 7.12261e−06 | 2.106 | 0.0352** |
| Freq_fish | 0.184949 | 0.0909545 | 2.033 | 0.0420** |
| Crit_greek_Fish | −0.0917607 | 0.0610758 | −1.502 | 0.1330 |
| D_waste  | 0.227358 | 0.0684898 | 3.320 | 0.0009*** |
| D_fishing | 0.0176804 | 0.0789193 | 0.2240 | 0.8227 |
| D_climate | 0.150937 | 0.0686825 | 2.198 | 0.0280** |
| MarEnv   | 0.0264448 | 0.0787362 | 0.3359 | 0.7370 |
| **WTP (C.I.)** | 46.2 | (26.5–72.7) | | |
| **logL** | −534.5 | | | |
| **Rho (p-value)** | 0.12 | | | |

*Significant at 10%, **Significant at 5%, ***Significant at 1%
reduction was not only due to the levy. This is reflected by the choice of 0€ in the WTP question, where most of respondents explained their choice by using arguments related to environmental protection.

The second questionnaire showed that the respondents are very concerned about the degradation of the marine environment and that marine conservation should be based not only on collective but also on individual responsibility. They indicated that it is the state and the local authorities that should be primarily responsible for implementing waste management policies and measures. They also responded that excessive use of plastic in leisure activities seems to be a problem that is partly based on individual behaviour. This is also reflected by the choice of conservation goals, where awareness raising along with biodiversity are considered the most important policy goals. However, in practice, only half of the respondents were willing to pay for a conservation program. They expressed their mistrust for this kind of funding, and they advocated that it is primarily the state's obligation to carry out such programs.

It should be noted that the results of our survey reveal the relatively short-term effects of this measure (environmental levy). Hence, it will be necessary to examine the long-term effects as well, before reaching a conclusion. The application of monetary measures or incentives alone may be insufficient in the successful mitigation of plastic pollution. The effects incurred due to certain increases in shopping costs at the margin tend to become weaker for consumers with the passage of time (East & Hogg, 2000; He, 2010). In this sense, the environmental levy in the case of Greece may prove to be insufficient in further reducing plastic bag consumption as a stand-alone, long-term measure. Environmental policies with the main objective of reducing the use of plastic bags may be more effective when focusing on promoting and rewarding a “sustainable shopping” behaviour and lifestyle.

In cases where citizens (the general public) are not informed about certain public goods, previous research has shown that information provided can significantly contribute towards shaping preferences, as opposed to informing any existing preferences (Lamb, 2019). In addition, concepts such as biodiversity preservation are often non-negotiable, thus excluding any potential trade-offs with other goods (Spash & Hanley, 1995). Based on Lamb (2019), any changes in favour of environmental participation regarding pro-environmental activities should be further investigated together with similar expressions of pro-environmental behavioural in order to properly evaluate environmental preferences. In this sense, an increase in voluntary environmental participation may be counterbalanced by a decrease in another form of pro-environmental behaviour (e.g. charitable donations), therefore negating the positive effect and having no impact on environmental preferences (Lamb, 2019). In this context, mitigation solutions should be based on combining economic and non-economic measures for maximum efficiency. The utilization of measures that reinforce the feeling of responsibility through economic encouragements may also be effective. In this respect, pricing policies need to be supported with non-economic measures as in the case of information and awareness-raising campaigns, reinforcing public education, etc., for an optimum result.

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**Authors and Affiliations**

Charalampos Mentis¹ • George Maroulis¹ • Dionysis Latinopoulos² • Kostas Bithas¹

George Maroulis
georgios_maroulis@eesd.gr

Dionysis Latinopoulos
dlatinop@plandevel.auth.gr

Kostas Bithas
kbithas@eesd.gr

¹ Department of Economic and Regional Development, Institute of Urban Environment & Human
Resources, Panteion University, 29 Aristotelous St, 17671 Kallithea, Athens, Greece

School of Spatial Planning and Development, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece