Economic Valuation of Reducing Submerged Marine Debris in South Korea

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Abstract: Submerged marine debris (SMD) scattered between sea level and the bottom of the sea damages the habitats of marine life and threatens its growth in South Korea. The collection of SMD is more difficult and expensive than that of coastal and floating debris. The government is trying to achieve a 33% reduction in SMD by 2023 by expanding its collection, which requires huge additional investments and additional information about the economic value or benefits of the reduction. This article seeks to conduct an economic valuation of the reduction by employing contingent valuation (CV), which asks people to indicate their willingness to pay (WTP) for the reduction. A dichotomous choice CV survey was undertaken with 1000 households by a professional survey firm through person-to-person interviews during July 2019. Overall, people understood the CV questions well and reported the WTP responses for a hypothetical market successfully created with CV. Although 37.9% of interviewees stated zero WTP, the average of the yearly household WTP was estimated as 5523 Korean won (KRW) (USD 4.92). This value ensures statistical significance. The population’s WTP for the reduction would be KRW 110.30 billion (USD 99.75 million) per year over the next five years. It was found that the reduction is socially beneficial since the value was greater than the costs involved in the reduction.

Keywords: submerged marine debris; economic valuation; contingent valuation; economic benefit; willingness to pay

1. Introduction

The “plastic-free” movement is taking place around the world with plastic waste emerging as a serious environmental problem. In particular, the ocean often becomes the final destination for plastic waste, resulting in problems such as the creation of an island made up of plastic waste [1]. Waste containing plastics that flows into the ocean is called marine debris. The marine debris containing plastic is being pointed out as a global pollution problem [2], and various discussions and international agreements to strengthen regulations to reduce marine debris in the future are under way [3–7].

In line with this international situation, South Korea has tried to reduce marine debris. Marine debris in the past was mostly composed of decomposable materials, but postindustrial marine debris consisting of synthetic materials such as plastics cannot be decomposed. Due to its high buoyancy, plastic goods move thousands of miles into the ocean current and threaten marine ecosystems and wildlife [2]. Marine debris also causes damage to the economy and the marine environment [8]. Thus, in order for the marine ecosystem to provide sustainable services, it is urgent that the marine debris be proactively managed [9,10].
Three sides of the Korean Peninsula are surrounded by the sea, with the result that the country actively engages in fishing and trading activities. There are numerous ports and fishing ports on the East Sea, the South Sea, and the West Sea (the Yellow Sea). Moreover, rivers are connected to the sea. Inevitably, the country’s geographical situation provides a route for land-based waste to flow into the sea. The inflow of waste through the rivers flows into the stream due to increased flow rates caused by a rainy season or typhoon. Currently, the country is actively carrying out policies and projects to mitigate floating marine debris on the coast [11], which is one type of marine debris.

It is difficult to identify the distribution and inflow path of the other type of marine debris, known as submerged marine debris (SMD), because it is located at the bottom of the sea. It is relatively easy and cheap to collect floating marine debris, but collection of SMD is expensive because it requires divers and special equipment. In addition, the disposal cost of marine waste in South Korea, approximately KRW 2.24 million (USD 1995) per ton in the case of sunken fishing net, is about eight times higher than that of land waste, which is approximately 270,000 Korean won (KRW) (USD 240) per ton. The SMD from the ocean as well as SMD flowing from land into the ocean has a negative impact on the marine environment. For instance, destruction of habitats of marine life, deterioration of the quality of marine products, threat to maritime safety, and damage to marine resources can arise [12,13]. In summary, although SMD is not classified as special waste, the collection of SMD is more difficult and expensive than that of coastal and floating debris because it is submerged at the bottom of the sea and requires special equipment and diving personnel to collect.

The South Korean government has established a legal basis for marine debris management at the national level and has pursued various polices to reduce marine debris, such as prevention, collection, and publicity. In particular, the government is trying to achieve a 33% reduction in SMD by 2023 by expanding its collection. The government’s intent is to develop a collection system that considers the effects of SMD on the marine ecosystem and to pursue the collection of SMD in a way that reflects the use of space and ecological characteristics. Since the reduction requires a considerable amount of investment, the government is interested in the value people place on reducing SMD [1,14]. From an economics’ point of view, people’s willingness to pay (WTP) for the reduction is interpreted as the economic value or benefits ensuing from the reduction [15,16]. Whether or not the reduction is socially beneficial can be determined through comparing the economic benefits with the costs involved in the reduction.

This paper attempts to determine the economic value or benefits of the reduction of SMD by collecting and exploring people’s WTP for the reduction. For this purpose, a survey-based economic technique called a contingent valuation (CV) method was adopted, and the results from a CV survey of 1000 interviewees are reported.

In South Korea, SMD occurs mainly through three channels. First, waste from the land or riverside flows into the river when heavy rain falls, and then into the sea through the estuary. If the nature of these wastes is investigated, more than 90% consists of trees and grass, although some of it is household waste such as waste appliances, waste plastics, and waste vinyl. It is impossible to identify the polluters in these cases. Therefore, it is difficult to find the polluters and make them pay for the cost of collecting SMD. In fact, the polluters may be ordinary people.

The second SMD channel consists of fishing-related waste that is intentionally or accidentally thrown into the ocean. Fishermen’s fishing gear, fishing nets, waste nets, Styrofoam for buoys, and feed bins for cultivating aquatic products are flowing into the ocean. In the case of fishing-related waste, fishermen could be charged with SMD collection costs since they are clearly the polluters. However, not all fishermen discharge waste into the ocean. It is not easy to accurately identify the polluters. In addition, in South Korea, fishermen are exempt from various taxes and are given subsidies because their income levels are lower than those of other occupations. Therefore, imposing a financial burden on fishermen is not a very feasible alternative.

Third, waste intentionally or accidentally dumped by coastal inhabitants or islanders also flows into the ocean. Likewise, it is not easy to figure out who among these residents has leaked waste,
and their income levels are low, making it difficult for them to bear new burdens even if they are polluters.

In summary, identifying the causal provider of SMD is not easy and, even if it is possible, imposing collection costs is not socially acceptable. In the end, the central government has no choice but to collect and utilize SMD through the funds raised from taxes paid by the general public. Thus, the framework of this study, which randomly selected 1000 households nationwide and asked WTP questions, was reasonable. This is because the polluters are not economic players such as certain companies, but an unspecified majority of the general public.

The effects of SMD belong to the category of negative externalities, which have many other economic effects. The economic effects of SMD are summarized in three ways. First, there is a decrease in tourism income owing to marine environment pollution by SMD. When SMD flows onto the beach, the number of visitors decreases, which, in turn, reduces the income of accommodations and shops near the beach. Second, there is economic damage that occurs to fishermen. SMD caught in a net causes damage to fish catches or fishing nets. In addition, SMD caught in a ship screw can lead to a ship accident, resulting in huge economic losses. The third effect of SMD is a national economic loss due to transboundary pollution. When SMD crosses the border along the current, transboundary pollution occurs, which can cause conflicts between countries.

These various economic effects of SMD can affect the public’s WTP for reducing SMD. Therefore, in order to control these effects, it was assumed in the study that everything remained in its current state except for the change in the goods to be assessed. The assessed goods presented to respondents in this study reflected a 33% reduction of SMD by 2023 as compared to the business-as-usual (BAU) state, assuming that there are no economic effects on SMD.

There are three sections in the subsequent content of the paper. Section 2 reports materials and methods. Section 3 shows the main results of the analysis. Conclusions are presented in Section 4.

2. Materials and Methods

2.1. Survey Implementation and Data Collection

In order to collect CV data, the method of deriving the WTP from respondents; the payment vehicle, unit, and period; the method of survey; and the sample size had to be determined [17]. First, out of four methods of open-ended questions, bidding game questions, payment card questions, and dichotomous choice (DC) questions, which have been used in the literature as methods of eliciting WTP, this study adopted the DC question method. This was because the DC question method has been most frequently employed in the literature and possesses various merits, such as incentive compatibility and mitigation of the respondents’ cognitive burden [18]. In addition, Korea Development Institute [19] and Arrow et al. [20] present methodological guidance to be followed in applied CV research. For example, the survey correctly explained to respondents that there exist substitutes for the good, that the respondents’ income is limited, and that consumption of other goods should be reduced to pay the WTP they have reported. In addition, this survey evaluated one of the many projects that the government should undertake. As will be explained below, this study tried to follow most of these guidelines.

Six important points had to be determined in order to conduct an actual field survey with a well-made CV questionnaire. First, the method of survey should be determined. This study adopted a person-to-person interview, which can facilitate the delivery of information rather than utilizing a relatively low-cost telephone, mail, or Internet method. In addition, the survey was conducted by experienced interviewers belonging to a professional opinion research institute.

Second, the size of the sample had to be determined. In this study, the population was all households in South Korea, and the population size is 19,971,359. The appropriate sample size had to be determined from this, with a 95% confidence level usually considered. In addition, a sample error of 5% is widely applied in South Korea, but a sample error of 3.1% was adopted in this
study for more rigidity. The appropriate size of the sample was thus derived as approximately 1000, and 1000 observations were collected for the final analysis. Although a larger sample is better, it is important to size the sample at an appropriate level because the cost of the survey increases accordingly. In this regard, the size of the sample was set at 1000 following the suggestion of Korea Development Institute [19] and Arrow et al. [20]. In particular, since the costliest method of a person-to-person individual interview was conducted in this study, the sample size of 1000 was considered large enough and appropriate.

Third, the unit of the survey had to be determined. In this study, households were chosen out of individuals and households. This was because Korea Development Institute [19] proposed the use of households as a unit of the CV survey. In addition, conducting surveys of individuals may cause an issue as to what to do with the population when expanding the sample value to the population value. In other words, whether to include people under 20 or over 65 years of age who may lack economic ability can have a significant impact on the analysis results. On the other hand, conducting a survey of households is free of this issue. To improve the reliability of the data, the participants from households were limited to the household owner and his/her spouse, who have the actual burden of tax payment.

Fourth, the payment period must be determined. Naturally, the longer the payment period, the larger the total WTP, and the shorter the payment period, the smaller the total WTP. Therefore, it is important to reasonably determine the payment period. In this survey, payment was due for the next 10 years. This was because this period has been used in most applied CV works conducted in South Korea.

Fifth, the payment vehicle had to be fixed. The payment vehicle was decided as the yearly household income tax. Income tax is the most widely applied payment vehicle in empirical CV research for South Korea as it has the advantage of being relatively familiar to interviewees and not tied to everyday spending. In addition, Korea Development Institute [19] suggests as a guideline for applied CV studies that yearly household income tax should be used as a means of payment.

Sixth, the method of eliciting WTP responses had to be determined. Instead of the direct open-ended question method, the close-ended question method most widely applied in the literature was adopted. Of several close-ended questions, a DC question asking if an interviewee is willing to pay a specific amount was employed. The main part of the survey questionnaire in this study is given in Appendix A.

Various versions of the DC question are actually found in the literature. This study tried to apply a one-and-one-half-bounded (1.5B) model. Cooper et al. [21] proposed the model, which has several advantages [22–26]. The procedure of applying the model can be explained in the following manner. First, two bid amounts, $D_L$ and $D_H$ ($D_L < D_H$), should be determined through preliminary investigation. Half of all respondents were asked to agree on payment after presenting the smaller ($D_L$) of the two amounts first. If “yes” was responded, the higher bid ($D_H$) was presented and an additional question about its payment was asked. If “no” was stated to $D_L$, an additional question was not needed. The remaining respondents were given a higher amount ($D_H$) first. If “yes” was reported, an additional question was not asked. However, if “no” was answered, the lower amount ($D_L$) was presented to the respondent. Thus, six responses were possible: “no,” “yes-no,” “yes-yes,” “no-no,” “no-yes,” and “yes.”

This study sought to take a closer look at the cases of “no” and “no-no” responses among these. Responses that indicated no intention of paying a lower amount ($D_L$) were further classified into zero WTP and WTP greater than zero and less than a lower amount ($D_L$). Therefore, a further question was asked to identify to which of the two classifications the “no” and “no-no” responses belonged. To this
end, a further question was presented about whether the interviewee had no intention of paying a dime, i.e., to check for a zero WTP. The final number of cases was, therefore, eight:

\[
\begin{align*}
I_{q}^{YY} &= K(D_{q}^{H} < E_{q}) = K(\text{qth answer is “yes-yes”}) \\
I_{q}^{YN} &= K(D_{q}^{L} < E_{q} \leq D_{q}^{H}) = K(\text{qth answer is “yes-no”}) \\
I_{q}^{LY} &= K(E_{q} \leq D_{q}^{L}) = K(\text{qth answer is “no-yes”}) \\
I_{q}^{NN} &= K(E_{q} = 0) = K(\text{qth answer is “no-no”}) \\
I_{q}^{Y} &= K(D_{q}^{H} < E_{q}) = K(\text{qth answer is “yes”}) \\
I_{q}^{NY} &= K(D_{q}^{L} < E_{q} \leq D_{q}^{H}) = K(\text{qth answer is “no-no-yes”}) \\
I_{q}^{NNY} &= K(E_{q} \leq D_{q}^{L}) = K(\text{qth answer is “no-no-yes”}) \\
I_{q}^{NNN} &= K(E_{q} = 0) = K(\text{qth answer is “no-no-no”})
\end{align*}
\]

where \(I\) and \(J\) are binary variables with zero or one, \(q\) indicates \(q\)th interviewee, and \(K(\cdot)\) is an indicator function. If the proposition in parenthesis is true, the function has a value of one. Otherwise, the function has a value of zero.

The WTP data obtained from a CV survey conducted on 1000 households during July 2019 is summarized in Table 1.

### Table 1. Willingness-to-pay data obtained and used in this study.

| Bid Amount \(a\) | “yes-yes” | “yes-no” | “no-yes” | “no-no” | “yes” | “no-no-yes” | “no-no-yes” | “no-no-no” | Number of Observations |
|-------------------|-----------|---------|----------|---------|------|-------------|-------------|------------|-----------------------|
| 1000              | 3000      | 20 (14.0) | 19 (13.3) | 7 (4.9) | 26 (18.2) | 31 (21.7) | 12 (8.4) | 3 (2.1) | 25 (17.5) | 143 (100.0) |
| 2000              | 4000      | 26 (18.2) | 10 (7.0) | 8 (5.6) | 27 (18.9) | 29 (20.3) | 11 (7.7) | 5 (3.5) | 27 (18.9) | 143 (100.0) |
| 3000              | 6000      | 18 (12.6) | 13 (9.1) | 10 (7.0) | 30 (21.0) | 30 (21.0) | 13 (9.1) | 9 (6.3) | 20 (14.0) | 143 (100.0) |
| 4000              | 8000      | 20 (14.0) | 12 (8.4) | 14 (9.8) | 26 (18.2) | 15 (10.5) | 12 (8.4) | 18 (12.6) | 26 (18.2) | 143 (100.0) |
| 6000              | 10,000    | 14 (9.9) | 13 (9.2) | 18 (12.7) | 26 (18.3) | 20 (14.1) | 5 (3.5) | 16 (11.3) | 30 (21.1) | 142 (100.0) |
| 8000              | 12,000    | 16 (11.3) | 15 (10.6) | 13 (9.2) | 27 (19.0) | 16 (11.3) | 10 (7.0) | 17 (12.0) | 28 (19.7) | 142 (100.0) |
| 10,000            | 15,000    | 12 (8.3) | 12 (8.3) | 20 (13.9) | 28 (19.4) | 11 (7.6) | 8 (5.6) | 20 (13.9) | 33 (22.9) | 144 (100.0) |
| **Totals**        | **126 (12.6)** | **94 (9.4)** | **90 (9.0)** | **190 (19.0)** | **152 (15.2)** | **71 (7.1)** | **88 (8.8)** | **189 (18.9)** | **1000 (100.0)** |

Notes: \(^a\) Unit is Korean won (USD 1.0 = KRW 1122.8 at the time of the survey). \(^b\) Numbers reported in parentheses mean the percentage of the number of observations.

2.2. Method: CV

The CV method has various advantages and disadvantages. Three advantages are as follows. First, unlike revealed preference approaches, such as the hedonic price technique and the travel cost technique, CV is a stated preference technique and can be used to estimate the economic value that explicitly includes non-use value. Second, from an economic point of view, the CV technique can theoretically provide an accurate estimate of the economic value or benefits from the supply of a certain good, while the revealed preference techniques have room for underestimation or overestimation. Third, since the validity and reliability of the CV approach is proven to some extent in the literature [22–26], the CV approach has been a widely applied one.

The CV method also has three disadvantages. First, the application of CV is more costly than that of other economic techniques because a survey of many respondents is essentially needed. For researchers facing budget constraints, the application of CV may be restrictive. Second, a valuation through CV based on the data collected using the questionnaire can be subject to various biases, as it can be influenced by the content of the questionnaire, the attitude of the interviewer, and the operation of the survey method. Third, since CV techniques are based on stated responses gathered from people instead of human behavior, people are less likely to believe in the value obtained by using CV.

The DC question method has several merits and demerits. There are two typical merits to the DC method. First, it is quite familiar to respondents. Even if a person has not experienced a referendum, the type of question is similar to deciding whether to buy a good on the market. Therefore, people can answer DC questions without much difficulty. Second, it is incentive compatible for people to respond.
People buy a certain good if their utility from the purchase and consumption of it is greater than or equal to the price of the good; they do not otherwise buy the good. If a person’s WTP is greater than the presented bid, she/he will answer “yes” and otherwise “no.” There is no reason to take a strategic behavior when a person is faced with the DC question.

The DC method has two demerits. First, the use of the DC question results in discrete interval data rather than continuous point data. This makes an econometric analysis of the CV data less statistically efficient than other value elicitation methods such as open-ended questions. Thus, the use of the DC method requires the collection of a large number of observations and demands a large survey cost. Second, a pretest survey is required to determine a list of bid amounts to be presented to the respondents, resulting in costs associated with the pretest survey and longer application period than other methods.

Reducing SMD is a typical nonmarket good. A nonmarket good means that it cannot be traded in the usual market. A good traded in the market is easily valued, but a nonmarket good does not have a market and its value is not well observed [27]. Therefore, for the purpose of assessing the economic benefits ensuing from the reduction, it is necessary to create a hypothetical market for the reduction and hypothetically trade the reduction in the market. A CV method is a typical economic method that can be done in this way, and it has been widely utilized in the literature [28–34]. The CV technique uses a questionnaire to explain the good to be assessed to the randomly chosen potential consumers and then to make a hypothetical transaction, leading them to reveal their WTP for consuming the good [35–39]. Next, the researcher estimates the WTP model and calculates the average WTP by applying an econometric model to the WTP data collected from a survey.

Therefore, the first thing a researcher should do for the application of CV is to carefully make the questionnaire. CV questionnaires usually have three components. The first component addresses questions about potential consumer perceptions and experiences toward the good being assessed. The second component presents an explanation of the good to be evaluated and a question about the WTP. Questions about the individual characteristics of the consumers are shown in the third component.

The most important part of the CV questionnaire is the explanation of the good under investigation. The good should be identical for all respondents and should be accurately described in the questionnaire. The BAU state, which can be a reference for valuation, and the target state to be assessed should be clearly described. In other words, the object of valuation in CV is the amount of the WTP to obtain a change from the BAU state to the target state. Moreover, the policy measures associated with how to get the change should be fully explained. The policy measures presented in the CV survey were the establishment of a scientific forecasting system for early prediction of inflows and travel paths of marine debris, and research and development on how to collect and treat the SMD.

2.3. Modeling the CV Data

As mentioned earlier, this study attempted to explicitly deal with zero WTP in analyzing the DC CV data. To this end, the spike model given in Kriström [40], Habb and McConnell [41] and Yoo and Kwak [42] was applied. Hanemann’s [43] approach to modeling DC CV data was also used. Therefore, the CV data model used in this study was the 1.5B DC spike model. The 1.5B DC spike model can explicitly reflect zero WTP as well as positive WTP responses. The mean WTP estimate obtained from analyzing the 1.5B DC spike model using a total of 1000 observations was considered reasonable in its use for information about the benefits ensuing from the reduction. For the application of this model, the cumulative distribution function (cdf) of WTP had to first be defined. This study adopted a logistic function that is almost always applied in the spike model. Thus, the cdf, $M_E(\cdot)$, can be specified as:

$$M_E(E; \tau_0, \tau_1) = \begin{cases} 
1 + \exp(\tau_0 - \tau_1 E) & \text{if } E \geq 0 \\
0 & \text{if } E < 0
\end{cases}$$

(2)
where \( \tau_0 \) and \( \tau_1 \) are parameters of \( M_E(\cdot) \). If \( E = 0 \), the equation in the first line on the right side becomes the spike. Thus, the spike means \( \text{Pr}(E = 0) \). \( E \) is a bid presented to respondents and \( \text{Pr}(\cdot) \) means a probability.

Concerning the model, the log-likelihood function can be specified as:

\[
\ln L = \sum_{q=1}^{1000} \left( \left( I_Y^Y + f_q^Y \right) \ln \left[ 1 - M_E(E_H^q; \tau_0, \tau_1) \right] \\
+ \left( I_Y^N + f_q^N \right) \ln \left[ M_E(E_H^q; \tau_0, \tau_1) - M_E(E_L^q; \tau_0, \tau_1) \right] \\
+ \left( I_N^Y + f_q^{NN} \right) \ln \left[ M_E(E_L^q; \tau_0, \tau_1) - M_E(0; \tau_0, \tau_1) \right] \\
+ \left( I_N^N + f_q^{NNN} \right) \ln M_E(0; \tau_0, \tau_1) \right) \tag{3}
\]

Maximum likelihood (ML) estimation method relates to obtaining parameter estimates that maximize the log-likelihood function. This study employed the ML estimation method. Thus, the estimates for \( \tau_0 \) and \( \tau_1 \) were obtained by maximizing Equation (3). In addition, the mean WTP was derived from Equation (2) as \([44,45]\):

\[
\left( \frac{1}{\tau_1} \right) \ln \left[ 1 + \exp(\tau_0) \right] \tag{4}
\]

3. Results and Discussion

3.1. Estimation Results

The results obtained through an application of maximum likelihood estimation to the model, Equation (3), are given in Table 2. The dependent variable is the probability of responding “yes” to a suggested bid. As the value of the bid becomes greater, the probability should be reduced. The coefficient estimate for bid amount is negative and statistically significant at the 1% level. This is quite reasonable. Given that the sample proportion of “no-no” and “no-no-no” responses, that is, zero WTP was 37.9%, the estimated spike of 0.3859 implies that the data were well represented by the spike model. Moreover, the spike secures statistical significance at the 1% level.

| Variables                  | Coefficient Estimates (t-Values) |
|---------------------------|---------------------------------|
| Constant                  | 0.4645 (7.31) \(^\#\)            |
| Bid amount \(^a\)         | -0.1724 (-21.16) \(^\#\)        |
| Spike                     | 0.3859 (25.62) \(^\#\)           |
| Yearly household mean WTP | KRW 5,523 (USD 4.92)             |
| t-value                   | 13.70 \(^\#\)                   |
| 95% CI \(^b\)            | KRW 5055 to 6076 (USD 4.90 to 5.41) |
| 99% CI \(^b\)            | KRW 4896 to 6284 (USD 4.36 to 5.60) |
| Sample size               | 1000                            |
| Log-likelihood            | -1330.22                        |
| Wald statistic (p-value) \(^c\) | 656.28 (0.000)                  |

Notes: \(^a\) The unit is 1000 Korean won (USD 1.0 = 1122.8 at the time of the survey). \(^b\) CI indicates confidence interval. \(^c\) The null hypothesis is that all the parameter estimates are jointly zero. The \(^\#\) means statistical significance at the 1% level.

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The Wald test can be employed for the specification test of the model. The null hypothesis is that the estimated coefficients for bid amount as well as constant terms are not distinguishable from zero. In other words, the hypothesis implies the meaninglessness of the model. The statistic was 656.28. Since this value is sufficiently large, the hypothesis could be rejected without deficiency. In addition, the \( p \)-value for the statistic was 0.000. Thus, the model possessed statistical significance.

The yearly household average WTP for the reduction was obtained as KRW 5523 (USD 4.92). Uncertainties can be involved in the estimation of the average. In such cases, it may be a good idea to
report confidence intervals together rather than just point estimate. To this end, this study adopted a parametric estimation technique developed by Krinsky and Robb [46] to present a confidence interval for the average. This method assumed that the estimates of the constant term and coefficient for the bid amount, given in Table 2, followed a bivariate normal distribution and produced an empirical distribution of the mean WTP by extracting the coefficients from this distribution and calculating the mean WTP 5000 times. Cutting the appropriate proportion from the left and right sides of this empirical distribution can find 95% and 99% confidence intervals. In other words, to find 95% and 99% confidence intervals, 2.5% and 0.5% are cut from the left and right sides of the distribution, respectively. Table 2 also reports them.

The results presented in Table 2 do not contain other covariates related to the interviewee’s characteristics. However, other factors could influence the likelihood of reporting “yes” to an offered bid. For instance, some variables concerning the interviewee, such as gender, household income, and education level, can be introduced. A model including some covariates can be considered for investigating the possible effects of such variables. For this purpose, four variables were reflected in the model with covariates. Basic information about the covariates is described in Table 3.

### Table 3. Information about some variables considered in this study.

| Variables | Definitions | Mean   | Standard Deviation |
|-----------|-------------|--------|--------------------|
| Education | Education level of the respondent in years | 14.10  | 2.23               |
| Income    | Monthly income of the respondent’s household (unit: million Korean won = USD 891) | 4.91   | 2.14               |
| Head      | Dummy for the respondent’s being head of household (0 = no; 1 = yes) | 0.53   | 0.50               |
| Age       | Age of the respondent (unit: years) | 47.78  | 9.20               |

Table 4 shows the estimation results of the model containing the variables described in Table 3. The Wald statistic for the specification test of the model was 607.79. This indicates that the null hypothesis of the model’s being meaningless was rejected, considering that its p-value became 0.000. One of the purposes of estimating the model with covariates is to check for internal consistency or theoretical validity. Except for the estimated coefficient for Head variable, all the coefficient estimates were statistically significant. Thus, it seems that the model employed in this paper secured internal consistency. As explained above, the sign of the coefficient means the direction of the effect of the variable on the likelihood of responding “yes” to a provided bid. The coefficient estimates for Education, Age, and Income variables had statistical significance. Respondents with higher levels of education had a higher possibility than respondents with lower levels of education. The age of the respondents was negatively correlated with the possibility. An interviewee with a higher income was more likely to answer “yes” to a proposed bid than an interviewee with a lower income. Contrary to our prior expectations, the estimates of the coefficient for the Head variable was not statistically significant at a level of 10%. Whether or not the respondent was the head of the household did not affect the respondent’s determination of WTP for the reduction. This was quite an interesting finding because it is often thought in the country that this variable will affect the respondent’s decision on WTP.

The important purpose of estimating a model containing covariates is to verify the theoretical validity or internal consistency of the model. The model used in this study appeared to be meeting these since the estimation results were overall significant. Table 4 also presents the yearly household average WTP estimate and its confidence intervals. The mean WTP was KRW 5412 (USD 4.82), which is not much different from the results given in Table 2 (KRW 5523 or USD 4.92). In addition, the confidence intervals were much the same as those given in Table 2.
Table 4. Estimation results of the model containing the variables described in Table 3.

| Variables                       | Estimates | t-Values |
|---------------------------------|-----------|----------|
| Constant                        | −1.1772   | −1.80 *  |
| Bid amount \(^a\)               | −0.1803   | −21.29 **|
| Education                       | 0.1252    | 3.90 **  |
| Income                          | 0.1221    | 4.32 **  |
| Head                            | −0.1881   | −1.54    |
| Age                             | −0.0122   | −1.66 *  |
| Spike                           | 0.3769    | 24.65 ** |
| Yearly household mean willingness to pay | KRW 5412 (USD 4.82) | 21.01 ** |
| \(^b\) 95% CI                   | KRW 4946 to 5965 (USD 4.41 to 5.31) |
| \(^b\) 95% CI                   | KRW 4778 to 6123 (USD 4.26 to 5.45) |
| Sample size                     | 1000      |          |
| Log-likelihood                  | −1297.06  |          |
| Wald statistic (p-value) \(^c\) | 607.79 (0.000) |          |

Notes: \(^a\) The unit is 1000 Korean won (USD 1.0 = 1122.8 at the time of the survey). \(^b\) CI indicates confidence interval. \(^c\) The null hypothesis is that all the parameter estimates are jointly zero. The * and ** indicate statistical significance at the 10% and 5% levels, respectively.

3.2. Discussion of the Results

This study investigated people’s WTP for reducing SMD in South Korea by 33% by 2023 by means of expanding SMD collection. It is possible to compare three sample characteristics with three population characteristics given in Statistics Korea [47]. First, the sample proportion of female persons can be compared with the population proportion of female persons. The first (50.0%) is not different from the second (49.9%). Second, three areas with a large number of households can be investigated. The sample proportions of Gyeonggi, Seoul, and Busan respondents were 23.9%, 20.1%, and 7.2%, while the population proportions of Gyeonggi, Seoul, and Busan respondents were 23.7%, 19.4%, and 7.0%, making no significant difference. Third, the average monthly income of households can be examined. The sample value was KRW 4.86 million (USD 4136) and the population value was KRW 4.92 million (USD 4187), almost the same. The authors also think that the population could be reasonably represented by the sample because sampling was entrusted to a specialized survey institute. Therefore, extending the results for the previously presented sample to the population would not be a problem.

One of the most important purposes of the applied CV study was to expand the location value of WTP obtained from the sample to the population. In this regard, we should have determined whether to use the location values for the sample. Usually, mean, median, and mode are used for location value. The median WTP obtained in this study was zero and the mean WTP was estimated to be positive. The mode WTP could not be computed because we used DC WTP question. It was necessary to determine which, of mean or median, to use. Median is known to be all the more robust than mean because mean is vulnerable to outliers but median is not. Median can be useful for identifying the central tendency of the sample, but it is not used for expanding a sample value to a population value because it can cause underestimation to overestimation in the expansion. Therefore, the mean WTP has been almost always employed in the literature to estimate population value using sample value.

As explained earlier, we conducted stratified random sampling using 16 strata. The sample size allocated to each stratum was decided based on the Census implemented by Statistics Korea in 2015. The sample size of each stratum was, thus, consistent with the population. In this study, the total value was calculated by multiplying the mean WTP by the number of households in the population instead of using a mean formula applied for stratified sampling.

The average of the household’s yearly WTP for the reduction was computed as KRW 5523 (USD 4.92). This sample value can be extended to the population. The population’s total WTP was derived as the multiplication of the relevant number of households by the average WTP. Since the
CV survey was conducted throughout the country, the relevant population became the entire country. There were 19,971,359 households when the survey was implemented [47]. The yearly population value would be KRW 110.30 billion (USD 99.75 million). Comparison of this value with the costs involved in the reduction is an interesting task.

An economic feasibility analysis of the reduction was tried as a final exercise. To this end, some prerequisites needed to be examined and determined. First, the period for the analysis had to be set. It was determined as five years, beginning from 2019 when the survey was implemented and when the reduction begins in 2023. Second, a social discount rate should be set. Concerning this, the government-run Korea Development Institute announced the suggested use of 4.5% as a social discount rate. This study adopted the value. Third, the time of “present” as a baseline for calculating the present value had to be set. In this study, this was set to be 2019, the time when the survey was conducted.

The next important information that was needed was benefits and costs arising from the reduction. As presented earlier, the economic benefits ensuing from the reduction would occur annually for 10 years, from 2019 to 2023. The costs largely relate to collection and treatment of SMD and were taken from “The Third Marine Debris Master Plan (2019–2023)” contained in Korea Ministry of Oceans and Fisheries [48]. The costs amounted to about KRW 6.69 billion (USD 0.60 million), KRW 10.20 billion (USD 0.91 million), KRW 11.22 billion (USD 1.00 million), KRW 12.35 billion (USD 1.10 million), and KRW 12.66 billion (USD 1.13 million) over the period 2019-2023, respectively. All benefits and costs are expressed in a 2019 constant price. The ratio of benefit over cost (B/C), which is one of the indicators for cost-benefit analysis (CBA), can be calculated from the constant values of benefits and costs. It is a simplification of the real CBA.

The present value of the benefits arising from the reduction was computed as KRW 1103.02 billion (USD 98.24 million) and that of the costs arising from the reduction became KRW 48.16 billion (USD 4.29 million). Thus, the net present value of the reduction became KRW 863.89 billion (USD 76.94 million), which is larger than zero and thus implies that the reduction passed the economic feasibility analysis. Furthermore, the ratio of benefit over cost was computed to be 18.93, which is larger than one, confirming the finding that the reduction secures economic feasibility. In conclusion, the reduction of SMD in South Korea is socially beneficial. Therefore, a continuous and stable reduction must be conducted.

4. Conclusions

South Korea is trying to reduce SMD by 33% by 2023 through expanding the collection of it. The implication from this study is all the more interesting since no research that has evaluated people’s WTP for reducing SMD is found in the literature. Therefore, this study can be a useful contribution to the literature. In particular, the information about the value people place on the reduction is widely demanded to determine whether the reduction has sufficient public support. For the purpose of providing this information to policymakers, this article empirically looked into people’s WTP for the reduction, employing data collected through a survey of 1000 households through person-to-person interviews during July 2019. In addition, the spike model was estimated not only using the entire sample data, including observations with zero WTP, but also only using observations with positive WTP. In this regard, the mean WTP estimate obtained for the sample can be extended over the population.

Judging from the comments of the supervisor and interviewers, the survey was implemented without difficulty and successfully enough to collect opinions representative of the population. Overall, people understood the CV questions well and reported the WTP responses in a hypothetical market successfully created with CV. Respondents stated a significant amount of WTP for the reduction. This study can provide three important policy implications. First, people’s WTP for reducing SMD was quantitatively assessed. Although 37.9% of interviewees stated zero WTP, the average of the yearly household WTP was calculated to be KRW 5523 (USD 4.92), which is not big compared to the average household’s annual income (KRW 58.9 million or USD 52.5 thousand). However, it has statistical
significance and can be utilized as a logical basis for the government to continue to push for reduction of SMD. In fact, the various CV empirical studies conducted in South Korea have often encountered too many zero WTP responses [22–24,26]. For example, Lim and Yoo [22], Kim et al. [23], Kim et al. [24], and Kim and Yoo [26] reported that the proportion of zero WTP responses was 56.5%, 46.5%, 61.7%, and 63.6%, respectively. The zero WTP response rate in this study is fairly small compared with the preceding studies. Therefore, it can be judged that the public is giving considerable value to the reduction.

Second, according to microeconomics, WTP means the economic benefits that arise from the reduction. The study evaluated the economic benefits that ensue from a 33% reduction in SMD by 2023 through an expansion of its collection and found that the population’s total WTP was KRW 110.30 billion (USD 99.75 million).

Third, the economic benefits can be compared with the costs caused by the reduction. In this regard, a cost-benefit analysis of the reduction indicated that the reduction is socially beneficial and, therefore, the investment on the reduction can be economically justified. This is because the net present value was larger than zero. Moreover, the benefit/cost ratio was greater than one. Thus, the reduction of SMD should be stably and continuously performed.

As addressed above, the CV approach has some limitations due to using a survey of respondents. For example, in a hypothetical market created with CV, payments of a certain amount are not actually made but are made hypothetically. Therefore, it would be useful to conduct a test for the respondents’ sincerity that adopts some statistical methods. One method is to include questions which gather ordinal data on a Likert-type scale in the CV questionnaire and then to compute a Cronbach’s alpha to test for internal consistency. Unfortunately, this study did not contain the questions in the CV questionnaire. This point needs to be appropriately handled in future CV studies.

To the best of the authors’ knowledge, there have not been many cases studies that applied CV to reducing marine debris, specifically SMD. Thus, one purpose of this study was to add a case study of South Korea to the literature. In particular, the implications of this study are all the more useful because there have been no related studies for the country. Nevertheless, this study needs to be improved in several respects to ensure that it is distinct from previous studies. First, if more observations are obtained through additional budgeting, the respondents can be segmented and the analysis could be made according to various criteria, such as geolocation of the respondent, whether the respondent had knowledge of campaigns around the issue prior to the survey, and relevance of the local issue, so as to obtain differentiated implications for each segmented group. Second, because the presented results are preliminary or partial, they can be supplemented by including enterprises in the survey. Since households consume products produced by businesses, there is a view that businesses are the ultimate polluting sources of the seas and oceans. Therefore, a follow-up study can be carried out by including enterprises as interviewees and using taxes paid by entrepreneurs and companies as the payment vehicle. In addition, future research should be conducted on companies that can respond to the polluters pay principle. Only then will this be helpful in establishing a more detailed policy on SMD.

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Appendix A. Main Part of the Survey Questionnaire

Part 1. Questions about Socio-Economic Characteristics

The interviewees were asked to respond to their socio-economic characteristics, such as the gender of the individual, the number of family members, the level of education, and the monthly income per household (before tax deduction). Questions about the number of family and income were open-ended questions, while the question about the level of education was as follows:

Table A1. Please check with √ your education level in years.

| Education Level | Uneducated | Elementary School | Middle School | High School | University | Graduate School |
|-----------------|------------|-------------------|---------------|------------|------------|-----------------|
| Education level in years | 0 | 1, 2, 3, 4, 5, 6 | 7, 8, 9 | 10, 11, 12 | 13, 14, 15, 16 | 17, 18, 19, 20 |

Part 2. Questions about Willingness to Pay for Reducing the Submerged Marine Debris (SMD) in South Korea

Type A. Q1. Is your household willing to pay additional income tax of 1000 Korean won (lower bid amount) annually for the next 10 years for reducing SMD in South Korea, supposing that the protection is certain to succeed?

a. Yes—go to Type A. Q2.
b. No—go to Q3.

c. Type A. Q2. Is your household willing to pay additional income tax of about 3000 Korean won (upper bid amount) annually for the next 10 years for reducing SMD in South Korea, supposing that the protection is certain to succeed?

a. Yes—finish this survey.
b. No—finish this survey.

c. Type B. Q1. Is your household willing to pay additional income tax of about 3000 Korean won (upper bid amount) annually for the next 10 years for reducing SMD in South Korea, supposing that the protection is certain to succeed?

a. Yes—finish this survey.
b. No—go to Type B. Q2.

c. Type B. Q2. Is your household willing to pay additional income tax of about 1000 Korean won (lower bid amount) annually for the next 10 years for reducing SMD in South Korea, supposing that the protection is certain to succeed?

a. Yes—finish this survey.
b. No—go to Q3.

c. Q3. Then, is your household not willing to pay anything for reducing SMD in South Korea?

a. Yes, our household is willing to pay something less than 1000 Korean won.
b. No, our household is not willing to pay anything. In other words, our household’s willingness to pay is zero.

References

1. Zambrano-Monserrate, M.A.; Ruano, M.A. Estimating the damage cost of plastic waste in Galapagos Islands: A contingent valuation approach. Mar. Policy 2020, 117, 103933. [CrossRef]
2. Sheavly, S.B.; Register, K.M. Marine Debris & Plastics: Environmental Concerns, Sources, Impacts and Solutions. J. Polym. Environ. 2007, 15, 301–305.
3. Chen, C.L. Regulation and management of marine litter. In *A Marine Anthropogenic Litter*; Bergmann, M., Gutow, L., Klages, M., Eds.; Springer: Dordrecht, The Netherlands, 2015; pp. 395–428.

4. United Nations Environment Programme. *Marine Plastic Debris and Microplastics Global Lessons and Research to Inspire Action and Guide Policy Change*; United Nations Environment Programme: Nairobi, Kenya, 2016. (In English)

5. Ellen MacArthur Foundation. The New Plastics Economy: Rethinking the Future of Plastics & Catalysing Action. 2017. Available online: [http://www.ellennmacarthurfoundation.org/publications](http://www.ellennmacarthurfoundation.org/publications) (accessed on 4 June 2020).

6. National Oceanic and Atmospheric Administration. What is Marine Debris? 2018. Available online: [https://oceanservice.noaa.gov/facts/marinedebris.html](https://oceanservice.noaa.gov/facts/marinedebris.html) (accessed on 4 June 2020).

7. Olivelli, A.; Hardesty, D.; Wilcox, C. Coastal margins and backshores represent a major sink for marine debris: Insights from a continental-scale analysis. *Environ. Res. Lett.* 2020, in press. Available online: [https://doi.org/10.1088/1748-9326/ab7836](https://doi.org/10.1088/1748-9326/ab7836) (accessed on 4 June 2020). [CrossRef]

8. McIlgorm, A.; Campbell, H.F.; Rule, M.J. The economic cost and control of marine debris damage in the Asia-Pacific Region. *Ocean Coast. Manag.* 2011, 54, 643–651. [CrossRef]

9. United Nations. The Sustainable Development Goals Report. 2017. Available online: [https://unstats.un.org/sdgs/report/2017/](https://unstats.un.org/sdgs/report/2017/) (accessed on 4 June 2020).

10. Chiba, S.; Saito, H.; Fletcher, R.; Yogi, T.; Kayo, M.; Miyagi, S.; Ogido, M.; Fujikura, K. Human footprint in the abyss: 30 year records of deep-sea plastic debris. *Mar. Policy* 2018, 96, 204–212. [CrossRef]

11. Jang, Y.C.; Lee, J.M.; Hong, S.W.; Mok, J.Y.; Kim, K.S.; Lee, Y.J.; Choi, H.W.; Kang, H.M.; Lee, S.H. Estimation of the annual flow and stock of marine debris in South Korea for management purposes. *Mar. Pollut. Bull.* 2014, 86, 505–511. [CrossRef]

12. Cho, D.O. Challenges to marine debris management in Korea. *Coast. Manag.* 2005, 33, 389–409. [CrossRef]

13. Hong, S.W.; Lee, J.M.; Jang, Y.C.; Kim, Y.J.; Kim, H.J.; Han, D.; Hong, S.H.; Kang, D.; Shim, W.J. Impacts of marine debris on wild animals in the coastal area of Korea. *Mar. Pollut. Bull.* 2013, 66, 117–124. [CrossRef]

14. Choi, E.C.; Lee, J.S. The willingness to pay for removing the microplastics in the ocean—The case of Seoul metropolitan area, South Korea. *Mar. Policy* 2018, 93, 93–100. [CrossRef]

15. Dribek, A.; Voltaire, L. Contingent valuation analysis of willingness to pay for beach erosion control through the stabiplage technique: A study in Djerba (Tunisia). *Mar. Policy* 2017, 86, 17–23. [CrossRef]

16. Nieminen, E.; Ahtiainen, H.; Lagerkvist, C.J.; Oinonen, S. The economic benefits of achieving Good Environmental Status in the Finnish marine waters of the Baltic Sea. *Mar. Policy* 2019, 99, 181–189. [CrossRef]

17. Champ, P.A. Collecting nonmarket valuation data. In *A Primer on Nonmarket Valuation*, 2nd ed.; Champ, P.A., Boyle, K.J., Brown, T.C., Eds.; Springer: Dordrecht, The Netherlands, 2017.

18. Mitchell, R.C.; Carson, R.T. *Using Surveys to Value Public Goods: The Contingent Valuation Method*; Resources for the Future: Washington, DC, USA, 1989.

19. Korea Development Institute. *Guidelines for Preliminary Feasibility Study Using Contingent Valuation Method*; Korea Development Institute: Sejong, Korea, 2012. (In Korean)

20. Arrow, K.; Solow, R.; Portney, P.R.; Leamer, E.E.; Radner, R.; Schuman, H. Report of the NOAA panel on contingent valuation. *Fed. Regist.* 1993, 58, 4601–4614.

21. Cooper, J.C.; Hanemann, M.; Signorello, G. One-and-one-half bound dichotomous choice contingent valuation. *Rev. Econ. Stat.* 2002, 84, 742–750. [CrossRef]

22. Lim, S.Y.; Yoo, S.H. Will South Korean residential consumers accept the renewable heat incentive scheme? A stated preference approach. *Energies* 2019, 12, 1910. [CrossRef]

23. Kim, J.H.; Kim, H.J.; Yoo, S.H. Public value of enforcing the PM$_{2.5}$ concentration reduction policy in South Korean urban areas. *Sustainability* 2018, 10, 1144. [CrossRef]

24. Kim, H.J.; Lee, H.J.; Yoo, S.H. Public willingness to pay for endocrine disrupting chemicals-free labelling policy in Korea. *Appl. Econ.* 2019, 51, 131–140. [CrossRef]

25. Mahmoodi, A.; Ghashti, M.J.; Yavari, G.R.; Mehrara, M.; Yazdani, S. Estimating the recreational value of Rudkhan Castel Forest Park: Application of One and One-half Bound (OOHD) dichotomous choice contingent valuation. *Agric. Econ. Dev.* 2019, 33, 313–327.

26. Kim, J.H.; Yoo, S.H. South Koreans’ perspective on assisting the power supply to North Korea: Evidence from a contingent valuation. *Energy Policy* 2020, 139, 111336. [CrossRef]
27. Segerson, K. Valuing environmental goods and services: An economic perspective. In *A Primer on Nonmarket Valuation*, 2nd ed.; Champ, P.A., Boyle, K.J., Brown, T.C., Eds.; Springer: Dordrecht, The Netherlands, 2017.

28. Smith, V.K. Fifty years of contingent valuation. In *Handbook on Contingent Valuation*; Alberini, A., Kahn, J.R., Eds.; Edward Elgar: Cheltenham, UK, 2006.

29. Carson, R.T. *Contingent Valuation: A Comprehensive Bibliography and History*; Edward Elgar: Cheltenham, UK, 2011.

30. Loomis, J.; González-Cabán, A.; Champ, J. Estimating the robustness of contingent valuation estimates of WTP to survey mode and treatment of protest responses. In *The International Handbook on Non-Market Environmental Evaluation*; Bennett, J., Ed.; Edward Elgar: Cheltenham, UK, 2011.

31. Freeman, A.M., III; Herriges, J.A.; Kling, C.L. *The Measurement of Environmental and Resource Values: Theory and Methods*, 3rd ed.; RFF Press: New York, NY, USA, 2014.

32. Flores, N.E. A conceptual framework for nonmarket valuation. In *A Primer on Nonmarket Valuation*, 2nd ed.; Champ, P.A., Boyle, K.J., Brown, T.C., Eds.; Springer: Dordrecht, The Netherlands, 2017.

33. Bateman, I.J.; Carson, R.T.; Day, B.; Hanemann, M.; Hanley, N.; Hett, T.; Sugden, R. *Economic Valuation with Stated Preference Techniques: A Manual*; Edward Elgar: Cheltenham, UK, 2002.

34. Haab, T.; Lewis, L.; Whitehead, J. *State of the Art of Contingent Valuation*; Oxford Research Encyclopedia of Environmental Science; Oxford University Press: Oxford, UK, 2020.

35. Boyle, K.J. Contingent valuation in practice. In *A Primer on Nonmarket Valuation*, 2nd ed.; Champ, P.A., Boyle, K.J., Brown, T.C., Eds.; Springer: Dordrecht, The Netherlands, 2017.

36. Ahmed, S.U.; Gotoh, K. *Cost-Benefit Analysis of Environmental Goods by Applying the Contingent Valuation Method: Some Japanese Case Studies*; Springer: Tokyo, Japan, 2006.

37. Hoyos, D.; Mariel, P. Contingent valuation: Past, present and future. *Prague Econ. Pap.* **2010**, *4*, 329–343. [CrossRef]

38. Whitehead, J.C. A practitioner’s primer on the contingent valuation method. In *Handbook on Contingent Valuation*; Alberini, A., Kahn, J.R., Eds.; Edward Elgar: Cheltenham, UK, 2006.

39. Johnston, R.J.; Boyle, K.J.; Adamowicz, W.; Bennett, J.; Brouwer, R.; Cameron, T.A.; Hanemann, W.M.; Hanley, N.; Ryan, M.; Scarpa, R.; et al. Contemporary guidance for stated preference studies. *J. Assoc. Environ. Resour. Econ.* **2017**, *4*, 319–405. [CrossRef]

40. Kriström, B. Spike models in contingent valuation. *Am. J. Agric. Econ.* **1997**, *79*, 1013–1023. [CrossRef]

41. Habb, T.C.; McConnell, K.E. *Valuing Environmental and Natural Resources*; Edward Elgar: Cheltenham, UK, 2002.

42. Yoo, S.H.; Kwak, S.J. Using a spike model to deal with zero response data from double bounded dichotomous contingent valuation survey. *Appl. Econ. Lett.* **2002**, *9*, 929–932. [CrossRef]

43. Hanemann, W.M. Welfare evaluations in contingent valuation experiments with discrete responses. *Am. J. Agric. Econ.* **1984**, *66*, 332–341. [CrossRef]

44. Carson, R.T.; Hanemann, W.M. Contingent valuation. In *Handbook of Environmental Economics*; Maler, K.G., Vincent, J.R., Eds.; North-Holland: Amsterdam, The Netherlands, 2005; Volume 2, pp. 821–936.

45. Carson, R.T.; Hanemann, W.M.; Whittington, D. The existence value of a distinctive native American culture: Survival of the Hopi reservation. *Environ. Resour. Econ.* **2020**, *75*, 931–951. [CrossRef]

46. Krinsky, I.; Robb, A.L. On approximating the statistical properties of elasticities. *Rev. Econ. Stat.* **1986**, *68*, 715–719. [CrossRef]

47. Statistics Korea. Available online: [http://kosis.kr](http://kosis.kr) (accessed on 4 June 2020).

48. Korea Ministry of Oceans and Fisheries. *The Third Marine Debris Management Master Plan*. (2019–2023); Ministry of Oceans and Fisheries: Sejong, Korea, 2019. (In Korean)