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The use of contingent valuation in assessing marine and coastal ecosystems' water quality: A review

By

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Abstract

Marine and coastal ecosystems are of high importance owing to the mankind dependence on the goods and services provided. As water quality is one perspective of healthy marine and coastal ecosystems, the aim of this study is to review as more as possible surveys conducted worldwide and in Greece. Due to the lack of an official market to valuate non-marketed goods and services, contingent valuation is applied intensively in order to provide the policy makers and the society generally with the specific values derived by a developed hypothetical market. In addition, this study reviews the crucial but debatable notion of value, the theoretical framework in accordance with the existing statistical models to estimate the welfare measures and the numerous disadvantages that have to be taken into account in order to implement a reliable contingent valuation survey.

Keywords: Contingent valuation; willingness to pay; willingness to accept; marine and coastal ecosystems.

JEL codes: Q51; Q57; Q25; Q28; C80; D12.

1. Introduction

Marine and coastal ecosystems play an important role in the balance of the environment as they interrelate and interact dynamically. The coverage of water amounts to more than 70% and the remainder consists of land area (Burke *et al*., 2001; UNEP, 2006). The total length of the world coastline extends over 350,000-1,000,000 km and circa 84% of the countries of the world that have a coastline within its extent display a variety of geomorphological types and ecosystems (Martinez, *et al*., 2007). Moreover, it is indicative the fact that human population lives within 100 km of the coast (Cohen *et al*., 1997; Gommes *et al*., 1998; Burke *et al*., 2001).

Mankind is strongly dependent on marine and coastal ecosystems and it is attracted by the environmental goods and services that are plentiful in these types of ecosystems and that influence their choice to live permanently for leisure, recreation, and tourism or even for commercial reasons (Martinez, *et al*., 2007). People's well being, basic needs and economy rely upon the exploitation of the most benefits provided by the ecosystems. According to the Millennium Ecosystem Assessment which is an international initiative that started in 2001, ecosystem services can be further divided into four categories. Particularly, the category of *provisioning services* like food and water, the category of *regulating services* such as the regulation of climate, wastes and water quality, the *cultural services* like recreational activities and *aesthetic and supporting services* referring to the wide range of habitats that serve in life cycle, productivity and commerce.

On the other hand, humans pose a serious threat to those ecosystems resulting in degradation. The biodiversity loss, the poor water quality and the sea level rise provoked by anthropogenic pressures are some of the challenges that marine and coastal ecosystems has to encounter without profoundly depicting the integrated imagine of the disaster (Halpern, 2007, 2008). Salm *et al*. (2000) reported that the environmental degradation of marine and coastal ecosystems is multifaceted in term of the various human constructions which aim to contribute to increasing profits but in essence replace the natural environment with harbors, industries, dams and settlements.

Lack of knowledge concerning the goods and services that ecosystems provide may lead to inefficient policy to manage the adverse consequences of the mankind activity. To date, direct markets attained to capture the value of some fundamental for the survival goods but failed to capture others such as recreational, cultural or aesthetic services named as non-market values (Pendleton, *et al.,* 2007). A rising area of study is how to value the non-marketed goods and services provided by natural ecosystems. We have to understand though the important notion of value from the ecological and economic perspective.

There is a serious debate between the two separate frameworks of ecology and economy. Both are characterized by complexity of the dynamic processes. As regards the economic perspective, the environmental ecosystem functions are evaluated concerning their importance for human welfare. According to the ecologists, human welfare notion is very restricted as the economic system evolves within the dynamics of a larger system, the environmental. So, it is obvious for the ecologists that the economic value of ecosystem is not representative of the real value, as the assessment of ecosystems depends on the hypothesis of the stability and the inaction of the environmental functions (Limburg *et al*., 2002).

The necessity of the collaboration of the two different frameworks to determine the value of nature has been an issue of a long-term debate of the scientists. Winter and Lockwood (2005) developed a model in order to incorporate different value types such as intrinsic and instrumental to estimate the impact on the future preferences for the natural environment.

Due to market imperfections or missing markets mainly for non-use values it is very important to conduct valuation studies. Economists with the aim to estimate monetary values of environmental goods and services, employ methods such as the direct market valuation, the revealed preference methods and methods of the stated preference. In our study we will review the existing academic work concerning the non-tradable goods and services of marine and coastal ecosystems with an emphasis to water quality. The review includes the contingent valuation approach which is a category of the stated preference methods used to estimate the total benefits including both the use and non-use values (Eom & Larson, 2006).

The methods of the stated preferences are extensively used in the economic environment over the past two decades (Carson, 2000). One of the key features of the methods is that they are applied in the valuation of non-use values. The basic assumption of these methods is that they rely primarily on research through questionnaires in which preferences are elicited by the participants in the research. The questions are ranked in a manner so as to reveal directly and indirectly the monetary value of the resource under consideration. Direct questions have the form of "How much are you willing to pay?" Or "Are you willing to pay an amount X?". At the same time, to elicit respondents' preferences according to the indirect approach includes options with different features that participants are asked to choose (Pearce, 2002). In fact, the absence of a formal market is substituted by a hypothetical where values are estimated through the willingness to pay or to accept of the 'consumers'. Two types of stated preference methods are the contingent valuation method and the choice modelling.

Furthermore, it is important to comment on issues of the economic theory that constitute the basis for the formulation of the explicit goals of the non-market valuation. Environmental economics inspired by the standard neoclassical price theory have developed the theoretical framework of non-market valuation. The fundamental principle of neoclassical economic theory is the individuals' preferences' for goods and the element of preference ordering. Willingness to pay or to accept (WTP/WTA) welfare measures can be derived from a statistical model that it is based on different perspectives such as parametric, non-parametric and semi-nonparametric.

Although the approach of contingent valuation is dominant in environmental valuation there are controversies concerning various problems that have to be dealt with such as the information effect, strategic behaviour, elicitation format, embedding effect, and hypothetical bias and protest responses. Taking into account the problems of the contingent valuation approach is critical in the conduction of an efficient estimation of the welfare measures stated by the participants in a survey.

The paper is organized as follows. Section 2 discusses the notion of environmental value that is being a debatable issue between economists and ecologists. Section 3 presents a literature review including non-market valuation of water quality in marine and coastal ecosystems. Section 4 describes important components of the economic theory which is the basis for the calculation of the welfare estimates. Furthermore, section 5 provides a critique as regards to different problems of contingent valuation approach and while the last section concludes the paper.

2. The notion of value: The debate between economists and ecologists

According to Costanza (2000), the term of value is used to denote the contribution of an item to achieve an objective or a goal. However, the term of value differs substantially in the framework of different disciplines such as Economics and Ecology. It is of crucial importance to shed light into different attempts and theories to interpret the 'value' (Goulder *et al.*, 1997). 'Economism Theory' and 'Intrinsic Value Theory' compete with each other as two polar opposite theories concerning the interpretation of value from the side of economists and ecologists (Norton, 2000).

There is the anthropocentric approach that usually economists tend to support. In accordance with this approach the value of a specific good and service is based on the ability to contribute to human well-being/utility directly and indirectly (Bockstael, 2000; Farber *et al.*, 2002; Goulder & Kennedy, 2010). Instrumental values that are basically anthropocentric can be further categorized in use or non-use values. This distinction depends on whether or not they are traded in formal markets. Use values include the benefits derived from the environment directly and indirectly. For example, direct use values of marine and coastal ecosystems include the extractive (food, fish, wood, medicines, etc.) and non-extractive (aesthetic, recreational, tourism, etc.) uses tradable in formal markets.

On the other hand, non-use values can be classified to bequest, existence and option values (Turner *et al.*, 2000; Winter, 2007). Bequest value relates to an altruistic motive as far as intergenerational equity (Cicchetti & Wilde, 1992; Loomis, 1988). Existence value is associated with the satisfaction derived, relying on the knowledge that a natural resource or environmental good exists (Kruttilla, 1967; Cicchetti & Wilde, 1992). Furthermore, the option value refers to the benefit derived from the knowledge that a resource can be utilized in the future (Cicchetti & Wilde, 1992; Kruttilla, 1967; Arrow & Fisher, 1974; Winter, 2007; Turner *et al.*, 2000).

However, there is a strongly associated notion which is often mentioned in the literature with the option value that is quasi-option value. As supported by Arrow & Fisher (1974) and Henry (1974a, b) quasi-option value refers to an extra degree of uncertainty for the preservation of the natural resources used by the future generations. Finally, the separate segments of the instrumental value can be combined to form the total economic value of natural resources.

On the other hand, the interpretation of value can be different according to the biocentric approach in the sense that, in contrast to the anthropocentric approach, natural resources values can be estimated without any reference to human's needs satisfaction (Farber *et al.*, 2002; Norton, 2000; Winter, 2007; Goulder & Kennedy, 2010). As stated by O'Neill (1992), intrinsic value has an opposite meaning with the instrumental value. Specifically the intrinsic value of an object or action can be assessed by the contribution to the preservation of the health and coherence of ecosystems and species by themselves (Farber *et al.,* 2002).

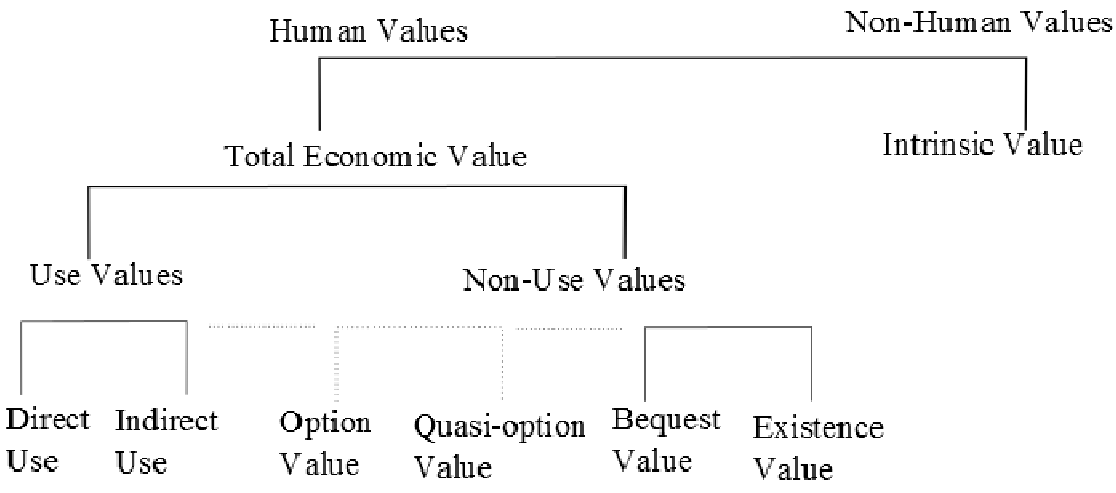
In line with Vilkka (1997) statement, nature has intrinsic value regardless of human well-being. Even though in biocentric approach it is better to avoid using the notion of value as in the nature does not exist a value system, or a goal to be achieved, sometimes ecologists use the concept of value in a common way as economists. For example, some of basic concepts in biology are the evolution and co-evolution. As to the evolution by natural selection, one of the basic principles of biology, there is not an evident goal to be achieved; however there is still the goal of the 'survival'. Moreover, as regards to the importance of co-evolution or the interrelation of ecosystems, one can state that there is the implied contribution to human survival (Farber *et al*., 2002).

The continuation of the debate between ecologists and ecomomists is based on the complementarity or substitutability. As the nature includes both instrumental and intrinsic value as stated by Halkos and Matsiori (2011), we may refer to these different approaches as complementary parts that aim to interpret an integral system. Costanza (2006) is one of the authors that support the concept of the complementarity of the two rationales. One of the most important challenges in the valuation of different ecosystems is to combine the different perceptions of value from the side of ecologists and economists (De Groot *et al*., 2002; Pearce *et al*., 2006). Hence, the combination of the two perspectives is crucial for the global conservation and sustainability (Millennium Ecosystem Assessment, 2005).

Generally, marine and coastal ecosystems provide the basics for the survival such as food provision, employment via fishing sector, other marketable goods such as genetic, medical or ornamental, quality in our life via tourism and recreation and many times security from natural disasters (UNEP, 2006). In order to valuate marine and coastal ecosystems it is necessary to specify a goal or objective as for example the maintenance of quality of bathing water in the coast under discussion.

Next, it is necessary to identify the contributions of the different components and functions of the ecosystem and finally to identify a management plan in order to set the operational objectives to achieve the specified goal (Katsanevakis *et al*., 2011). It is of major importance though, the decoding of the total economic value of marine and coastal ecosystem which is the sum of use and non-use values as it is depicted in Figure 1, in order to shed light into maximization of the social welfare.

Figure 1: The distinction between the human and non–human values



Source: Modified from Bateman *et al.* (2003).

3. Non-market valuation of marine and coastal ecosystems: A literature review of contingent valuation applications

The approach of contingent valuation is applied when there is no real market. Thus, by creating a hypothetical market, it is possible to valuate the non-tradable goods or services. The formal markets cannot generate prices for public goods due to their non-excludability and non-rivalry nature. As a result, we cannot depict the value of non- tradable goods and simultaneously the individuals' preferences. As it is claimed by Ciriacy-Wantrup (1947), who was the first to propose the approach of contingent valuation, individuals are encouraged to express via interviews the magnitude of the satisfaction by using the goods under estimation (Hanemann, 1994). In other words, participants in the survey are prompted to express their maximum WTP for an improvement or alternatively their minimum willingness to accept a compensation for the loss of an environmental good or service. Nevertheless, it is difficult for people to state the value of trade-offs due to not being familiar with the hypothetical market and the lack of information.

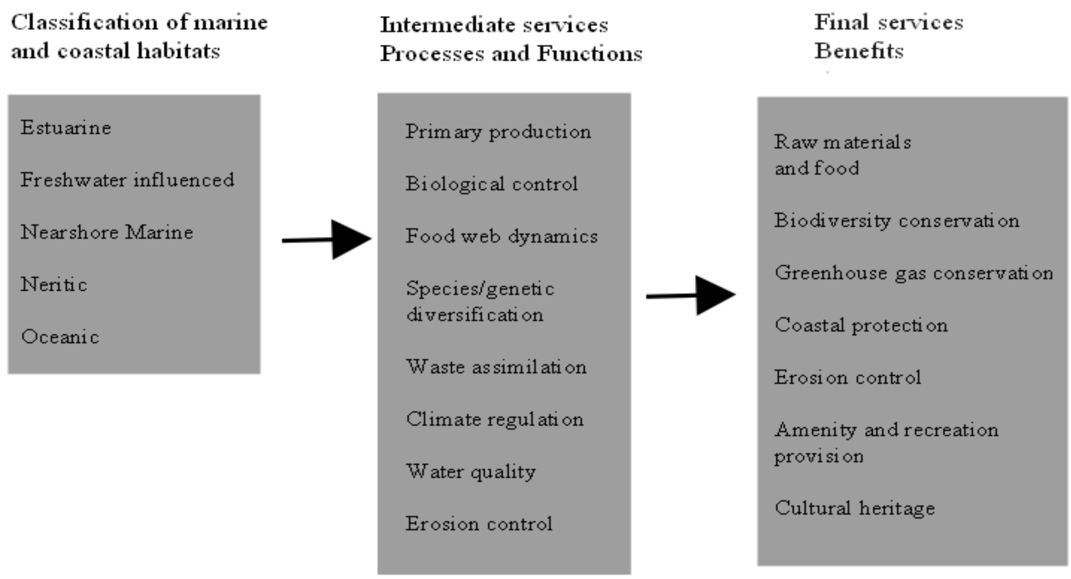
The contingent valuation approach has been expanded in many areas of economics such as health economics (O'Brien & Gafni, 1996; Ryan, 2004; Smith, 2003; Diener *et al.*, 1998; Borghi & Jan, 2008; O'Shea *et al.*, 2008; Ryan & Watson, 2008), cultural economics (Lockwood *et al.,* 1996; Noonan, 2002; Kim *et al.,* 2007 Báez, 2009; Herrero *et al.,* 2011), transportation (Md Nor *et al.,* 2003), marketing (Louviere & Woodworth, 1983) and in the field of environmental economics (Hanemann, 1994; Boxal *et al.,* 1996; Adamowicz *et al*., 1998; Hanley *et al*., 1998; Christie & Azevedo, 2002; Alias *et al.*, 2008; Skourtos *et al.,* 2005; Remoundou *et al*., 2009; Halkos & Jones, 2012).

Valuing marine and coastal ecosystems is among the most demanding issues in Environmental Economics. The estimation of the value of marine and coastal ecosystems is based on an instrumental viewpoint, whereby the value is considered as the interaction between the individuals and the flows of ecosystem goods and services. Additionally, the anthropocentric perspective of marine and coastal ecosystems implies the utility derived from human beings and the total impact in human welfare (Nunes & van den Bergh, 2001; Nunes *et al*., 2009).

Fisher *et al*. (2009) claim that ecosystem goods and services are interrelated in terms of providing ecosystem benefits for humans. Figure 2 describes the interconnection of marine and coastal habitats the physical environment of which can be categorized into five different regimes such as the estuarine, the freshwater influenced, the near shore, the neritic and the oceanic. The changes and the alterations of different functions and processes of ecosystems result in changes to human welfare providing them with the beneficial final marine and coastal services (Luisetti *et al*., 2010). It is necessary that these changes are being taken into account by the marine and coastal policy stakeholders. Some of the benefits or the final services derived by intermediate services are the raw material and food, the biodiversity conservation, the greenhouse gas conservation, the coastal protection, the erosion control, the provision of amenity and recreation and the cultural heritage.

Numerous contingent valuation surveys have been conducted worldwide, including Greece, which try to estimate the final benefits derived from the integrated processes and functions of marine and coastal ecosystems such as water quality regulation. Water quality and aquatic life are affected directly by pressures provoked by mankind development in coastal and marine areas and indirectly by the lack of water quality management and implementation of policies.

Figure 2: The interrelation of marine and coastal habitats with the intermediate and final services.



Source: Modified from Madden *et al*. (2005), Luisetti *et al*. (2010), Fletcher *et al*. (2011) and Barbier *et al*. (2010).

Bockstael *et al*. (1989) carried out a research in Chesapeake Bay, the largest estuarine in USA which lies off the Atlantic Ocean, to estimate the participants' WTP concerning the changes in water quality improvements. In the survey, a hypothetical improvement in water quality from a current condition is considered and the data sets generated from three recreational activities such as beach use, boating and fishing have been analyzed using a Tobit model. Some years later in the same estuarine, Lipton (2003) utilized the contingent valuation approach, asking boaters to rank their perception of water quality. Factors seemed to influence the WTP, was the condition whether or not the boat was trailed or kept in the water and whether the vessel was a sail or powerboat. A Tobit model was applied to examine the WTP values; however, no demographic characteristics were included in the survey.

Hayes *et al*. (1992) examined the benefits of water quality improvement for residents in the Upper Narragansett Bay of Rhode Island in eastern USA. The variables under valuation are associated with the recreational activities, the general attitude towards water quality and the scenarios of water quality changes such as improvements that allow swimming and accessibility to the shell-fishing areas. Moreover, the analysis included questions about the distance from the estuary, the length of their residency, the year they settled in the area and general socioeconomic and demographic characteristics. The collected data as regards to the willingness to contribute to the improvement of the water quality of the estuary was examined using Logit model formulations.

As regards to contingent valuation surveys in Europe, Georgiou *et al*. (1998) by implementing regression models to analyse the derived data from the survey, estimated the value of eliminating the potential risks of illness caused by the quality of bathing water in two east coastal resorts such as Great Yarmouth and Lowestoft of the UK. Furthermore, they investigated the importance of inclusion of different factors such as the individual's acceptability to risk and health attitudes, except from the inclusion of traditional factors such as income, education etc. In the same territory, Georgiou *et al*. (2000) in order to enhance the previous results examined the WTP for the improvement of the quality of bathing water towards the risks of illness, to provide policy makers with information about the preferences in terms of traditional socioeconomic variables, attitudes towards risk, trust and accountability of institutions and regulatory processes.

On the South-Western Scottish coastline, Hanley & Kriström (2002) conducted a contingent valuation approach utilizing the Kaplan-Meier survival curve to obtain a non-parametric estimate of the distribution function, concerning the replies of the participants to valuation questions. The WTP estimation has been explored by a modified Turnbull algorithm and for the additional examination of the data; a Tobit model was also applied. As the major bathing beaches along south-western Scottish coastline failed to meet the guideline standards of the Bathing Waters Directive,

Hanley *et al*. (2003) conducted another survey combining revealed preference with stated preference data to value coastal water quality improvements. Specifically, the utilization of revealed preference and contingent behavior models simultaneously, result in eliminating the hypothetical bias which is a common problem related to contingent valuation approach. There are also other studies referring to water quality improvement that utilize contingent behaviour data (Nahman & Rigby, 2008; Barry *et al*., 2011).

In the estuarine system of Randers Fjord in Denmark, Atkins *et al*. (2007) carried out a study implementing the contingent valuation approach to examine public preferences for water quality improvements and specifically the reduced eutrofication. First the decision tree analysis has been applied to investigate the relationship between the respondent's decision and a number of variables such as the annual income, the distance of their residence from the Fjord. Next, willingness to pay bids was investigated via the decision tree analysis in order to reveal the complexity of respondents' preferences.

Goffe *et al*. (1995) tried to evaluate individuals' preferences towards water quality in the French Harbor of Brest. The corresponding WTP estimates for water health and preservation of the ecosystem against eutrofication has been examined by the application of Tobit model formulations.

In Guadiana Estuary between Portugal and Spain, Guimarães *et al*. (2011) report the first application of the contingent valuation approach to evaluate the public preferences as regards to the improvement of water quality. The survey employed socioeconomic variables, variables concerning the performance of leisure such as diving, sailing etc., or the performance of professional activity such as restaurants, hotels etc., the perception of water quality and environmental awareness variables. As far as the econometric methods are concerned, the voting behaviour was analyzed by the Logit model and bid decision by using Generalized Additive Models (GAM).

In the same estuary, Ramazo-Hernandez & Saz-Salazar (2012) investigating the respondent's preferences concerning the water quality improvements according to Water Framework Directive (WFD), utilized parametric and non-parametric approaches. Initially, a Logit model has been applied which was followed by a Spike model to deal with zero bids and secondly the Kriström's non parametric approach employed in order to find a robust estimate of mean WTP equal to €33 per family yearly. This estimate aggregated by the number of households residing in the Guadiana river basin (GRB) yielding a social benefit of improving water quality equal to €39 million per year. About half of the respondents (258 of the 505 respondents) stated that they were unwilling to pay extra money in their water bills to attain the water quality targets set by the WFD.

In Greece, although the literature on the valuation of indirect values is limited, there have been some surveys aiming at the determination of the role of environmental valuation methodologies and derived information for policy makers. Kountouri *et al*. (2009) explore the value of building a wind farm using the contingent valuation. Moreover, Birol *et al.* (2006) studied the value of efficient water resources management policies with economic valuation such as cost-benefit analysis, the hedonic pricing method, the travel cost method, the choice experiment and the contingent valuation method. For the valuation of water quality, Birol *et al*. (2007) investigated the WTP of farmers for the adoption of an effective management of wastewater in the aquifer of Akrotiri in Cyprus.

As far as it concerns the surveys of the water quality of Greek marine and coastal areas, the literature is limited too (Kontogianni *et al*., 2003; Jones *et al*., 2008; Organtzi *et al.*, 2009; Halkos and Matsiori, 2011). Kontogianni *et al.* (2003) attempted to examine the impact of the quality of Thermaikos Gulf in Thessaloniki on the preferences of the residents. Respondents were asked to state their maximum willingness to contribute to the Gulf's restoration. The incorporated variables in the survey are related to the knowledge about the location of the discharged municipal wastes, the recreational activities such as fishing, swimming, walking in the coastline, sailing, the intended behaviour of respondents if the water quality improves and the motives contributing for such an improvement. Other variables included are related to economic valuation questions and socioeconomic characteristics. A logistic regression has been utilized in order to examine the payment principle, the attitude towards the intervention, the WTP estimates and selected motivations for improving the quality of the Gulf.

In the Northeast side of the Aegean Sea, where Mytilene is located, Jones *et al*. (2008) applied a contingent valuation survey in order to elicit respondents' WTP for the improvement of the coastal water quality resulting from the construction of a

Sewage Treatment Plant. Respondents were provided with questions as regards the most important problems in the area under consideration, the pollution factors, the attitude towards the construction of the plant and their preferences. Economic valuation section included the reasons to contribute to the improvement or not. Different econometric models have been applied in order to examine and compare the results of the survey, namely a multiple regression model, an exponential and a multiplicative model. Finally, a Tobit model has been utilized with the purpose of dealing with the zero WTP values.

In order to evaluate the environmental benefits derived from the construction of a wastewater treatment plant, Organtzi *et al.* (2009) administered a survey of the coast of Toroneos Gulf at the eastern side of the Cassandra peninsula in Greece. The questionnaire of the double bounded dichotomous choice contingent valuation approach included three groups of participants such as the permanent residents, the owners of a private holiday house and the campers who visit the seaside village of Kriopigi frequently. The variable inter alia of the demographic and socioeconomic characteristics were estimated using maximum likelihood.

Halkos & Matsiori (2012a, b) applied a contingent valuation survey in order to estimate the economic benefits derived from improved coastal quality of beaches along the Pagasitikos Gulf in central Greece. The objective of the survey is to investigate how the determinant factors of the coastal protection, the coastal development and coastal management affect the participants' in the survey WTP for the coastal zone quality improvement and the awarded beaches with a blue flag. The effect of the variables included, were analyzed via the implementation of OLS and Logit formulation resulting in the conclusion that a great number of respondents were willing to pay for improvements in coastal zones quality.

Table 1: CVM Studies in marine and coastal ecosystems' water quality.

Author (year)	**Goods/Services estimated**	**Country**	**Sample size/ Elicitation Format**	**Econometric Approach**	**WTP/WTA**
Bockstael *et a1*. (1989)	Water quality improvement	Chesapeake Bay in USA	496 in person interviews	Tobit model	Average WTP of $ (1000) 67,582
Goffe *et al*. (1995)	(1) Improved water health, (2) Preservation of the ecosystem against eutrophication	French Harbor of Brest	607 direct interviews	Tobit model	Mean WTP of FF 218 for health and FF 173 for ecosystem
Georgiou *et al*. (1998)	Bathing water quality	UK	400 in person interviews	Box-Cox procedure with semi-long form	Mean WTP of £12,64 per household
Georgiou *et al*. (2000)	Bathing water quality	UK	626 in person interviews	Multivariate statistical analysis	Mean WTP of £35.73 per household
Lipton (2003)	Water quality	Chesapeake Bay USA	Mail survey of 2510 sample units	Tobit model	Mean WTP for poor water quality rating: $103; Fair water quality rating: $ 124; Good: $ 70; Very good: $51;Excellent: $ 38
Atkins *et al*. (2007)	Water quality improvements (reduced eutrofication)	Randers Fjord in Denmark	Mail survey of 207 respondents	Decision tree and regression analysis	Mean willingness-to-pay (in terms of a local tax) of DKK 57 (€7,64)per person, per month over a ten year period.
Guimarães *et al*. (2011)	Improvement of water quality	Guadiana Estuary between Portugal and Spain	67 face to face interviews in the pilot survey and 300 face to face interviews in the final survey	Two step model: (1) voting behaviour examined by logit (2) bid decision examined by Generalized Additive Models (GAM)	Mean WTP of € 47 per person per year over a five year period.

Ramajo-Hernandez and Saz-Salazar (2012)	Water quality improvements	Guadiana Estuary between Portugal and Spain	505 personal interviews	Logit, Spike models and Kriström's non-parametric approach	Mean WTP of € 33 per family, per year.
Contingent Valuation Studies in Greece: Water quality in marine and coastal ecosystems					
Kontogianni *et al.* (2003)	Impact of water quality	Thermaikos Gulf in Thessaloniki	480 face to face interviews	Logit to examine the payment principle, the WTP estimates attitude towards intervention, and selected motivations for improving quality	Mean WTP of 5189 drachmas per four monthly water rates bill
Jones et al. (2008)	Coastal water quality and the benefits derived from operation of the Sewage Treatment Plant (STP)	In the Northeast side of the Aegean Sea in Mytilene	140 personal interviews	Regression analysis for WTP estimated and Tobit model to deal with protest responses	Mean WTP € 16.84 per respondent every 4 months over a period of 4 years
Organtzi *et al*. (2009)	Environmental benefit for the construction of wastewater treatment	Coast of Toroneos Gulf at the eastern side of the Cassandra Peninsula	246 personal interviews	Maximum likelihood from the double bounded dichotomous choice model (Hanemann, et al., 1991). Confidence intervals are constructed via coefficients from the Weibull function	Mean WTP of € 56.40 per respondent
Halkos and Matsiori (2012a)	Improvement quality (environment, water as well as recreation activities)	Pagasitikos Gulf in Volos city	300 face to face interviews	OLS and Logit model formulation	6.33% and 2.33% were willing to pay at the lowest price of 5€ and at the highest price bid of 50€ respectively.

4. The economic foundations of contingent valuation

4.1 Welfare measures

Economic theory represents the basis for the formulation of the explicit goals of the non-market valuation. The standard neoclassical price theory is distinct from the non-market valuation, but it contributes to the development of the theoretical framework of this non-market assessment. The fundamental principle of neoclassical economic theory is the individuals' preferences' concerning goods and the element of preference ordering.

Preference ordering can be represented by a utility function, which is defined over goods, in our case the non-marketed ones. Market commodities can be expressed via the vector $X[x_1, x_2, x_3,..., x_n]$ which is defined by the individuals and non-marketed commodities via the vector $Q[q_1, q_2, q_3,..., q_k]$ which is defined exogenously. The individuals' utility function $U(X,Q)$ corresponds to a single number (X,Q). The utility function represents the individuals' preferences for a commodity A versus B if $U(X_A,Q_A) > U(X_B,Q_B)$. Another crucial element for the analysis is the money available to be spent on acquiring the desired items in the formal market depending on the system of the prices $P(p_1, p_2,...., p_n)$.

The basic choice problem is the maximization of individuals' utility under the assumption of the available income I and the fixed levels of the non market commodities.

$$\max_X U(X,Q)$$
$$\text{subject to } \; P * X \leq I \quad Q \equiv Q_0 \qquad (1)$$

Each market commodity has an optimal demand that can be expressed as $X' \equiv X(P,Q,I)$. Substituting the Marshallian demand[1] in the utility function we obtain the indirect utility which is a function of prices and income.

$$\begin{aligned} &V(P,Q,I) \equiv \max_X U(X,Q) \\ &\textit{subject to } \; P * X \leq I \end{aligned} \quad . \qquad (2)$$

However, the individual's optimization problem can be expressed in the form of a utility maximization problem for a given constraint or as an expenditure minimization problem.

The minimum expenditure function $m(P,Q,U)$ can be characterized by the duality to the indirect utility function and can be expressed by the problem:

$$\begin{aligned} &m(P,Q,U) \equiv \min_X (P * X) \\ &\textit{subject to } \; U(X,Q) \geq U \end{aligned} \qquad (3)$$

When the direct and the indirect utility function are increasing and quasi-concave in Q, the minimum expenditure function is decreasing and convex in Q.

The aforementioned functions of indirect utility and minimum expenditure serve as a theoretical framework for the welfare estimation. Stated preference methods and the contingent valuation method specifically, can be considered as the estimation of the changes of the indirect utility and the expenditure function from the Q_0 situation to Q_1. Interpreting the changes as individuals' utility we have two states such as $V_0 \equiv V(P,Q_0,I)$ and $V_1 \equiv V(P,Q_1,I)$. In order to estimate the change in terms of monetary values we use the two Hicksian measures of the compensating variation $CV \equiv CV(Q_0,Q_1,P,I)$ and the equivalent variation $EV \equiv EV(Q_0,Q_1,P,I)$. Compensating variation expresses the amount an individual has to deduct in order to

[1] The negative of the ratio of the derivatives of the indirect utility function produces the Marshalian curve (Haab *et al.*, 2002 pp. 6)

leave a person just as well off as in the initial situation after the change in income and prices. Adversely, equivalent variation expresses the amount of income paid in order to leave a person just as well off as the terminal situation (Haab *et al*., 2002).

Another way to describe welfare measures is via the WTP and WTA measures. WTP is the maximum amount an individual contributes for an improvement of natural service or good as for example the water quality in marine ecosystems.

The relationship between *CV*, *EV*, *WTP* and *WTA* are described by the following equations:

$$WTP(Q_0, Q_1, P, I) \equiv CV(Q_0, Q_1, P, I) \quad \textit{if utility increase} \tag{4}$$

$$WTP(Q_0, Q_1, P, I) \equiv -EV(Q_0, Q_1, P, I) \quad \textit{if utility decrease} \tag{5}$$

$$WTA(Q_0, Q_1, P, I) \equiv EV(Q_0, Q_1, P, I) \quad \textit{if utility increase} \tag{6}$$

$$WTA(Q_0, Q_1, P, I) \equiv -CV(Q_0, Q_1, P, I) \quad \textit{if utility decrease} \tag{7}$$

The compensating and equivalent variation is also expressed by the expenditure function:

$$CV = m(P, Q_0, U_0) - m(P, Q_1, U_0) \tag{8}$$

$$EV = m(P, Q_0, U_1) - m(P, Q_1, U_1) \tag{9}$$

We can illustrate these concepts using the Box-Cox indirect utility function:

$$V_Q = a_Q + b_Q[(I^{\lambda} - 1)/\lambda] \quad if \quad Q = 0{,}1 \quad a_1 \geq a_0 \quad b_1 \geq b_0 \tag{10}$$

This indirect utility function can be considered as a structure of a Constant Elasticity of Substitution utility function.

The compensating variation in terms of a Box-Cox indirect utility function can be written as:

$$CV = \{[(b_0 I^{\lambda})/b_1] - [(\lambda a_1 - \lambda a_0)/b_1] - [(b_1 - b_0)/b_1]\} \tag{11}$$

These concepts imply the following relations:

$$\begin{aligned} \lambda > 1 &\Rightarrow \text{income elasticity of WTP} < 0 \\ \lambda = 1 &\Rightarrow \text{income elasticity of WTP} = 0 \\ \lambda < 1 &\Rightarrow \text{income elasticity of WTP} > 0 \end{aligned} \tag{11a}$$

Willingness to pay (WTP) and willingness to accept (WTA) estimates considerably differ due to the income elasticity of the price of the environmental good or service under valuation implying that income elasticity depends upon the variation of Q (Carson & Hanemann, 2005; Flores and Carson, 1997).

4.2 Statistical and econometric issues in estimating WTP and WTA

The necessity of the WTP and WTA derives from the non-observable units of utility alterations since the welfare measures are monotone transformations of the utility function. Under the framework of the deterministic model of WTP/WTA for the environmental alteration we have to incorporate random units in order to combine the economic with the stochastic model. The first step is to estimate the WTP/WTA distribution and the second is to trace the probability distribution given the assumption of the utility maximization of the participants in the survey of the contingent valuation (Carson and Hanemann, 2005). For convenience we will use only the WTP measure to illustrate the modeling structure.

With the aim to obtain the distribution, WTP can be expressed by a linear regression. The expected value of the compensating surplus $E(CV) = \mu_{\mathrm{WTP}}$ equates with the mean of WTP and a random term e which is normally distributed. That is:

$$WTP = \mu_{\mathrm{WTP}} + e \tag{12}$$

Alternatively the above equation can be expressed by the logarithm of WTP as:

$$\ln WTP = \mu_{\mathrm{WTP}} + e \tag{13}$$

Analyzing the WTP further, the individual' WTP function can be explained by the following form:

$$WTP_i = a_0 + a_1 Z_i + e_i \quad (14)$$

Where α_0 and α_1 represent the constant and the variance coefficient respectively; Z_i represents the vector of variance which includes individuals' socioeconomic variables; and e_i is a random term (with zero mean and variance σ^2) referring both to individuals' WTP random term and the additional error caused by the inefficient specification of the model from the researcher (Wang *et al.*, 2004).

The cumulative distribution function can be normal, logistic or Weibull and can be denoted as:

$$F(x) \equiv \Pr(X \leq x) \equiv \sum_{k \leq x} \Pr(X = k) \quad (15)$$

This expression represents the probability that a discrete random variable X can take values equal or smaller than a definite value of x. If we assume that the random variable is the compensating surplus the above equation can be transformed as:

$$F(x) \equiv \Pr(CV \leq x) \equiv \sum_{k \leq x} \Pr(CV = k) \quad (16)$$

The structure of the cumulative distribution function (cdf) is related to the type of the survey question. The respondent states the preferred value autonomously when is asked a question in an open-ended format. The probability of attaining the response as to the value, take the following form:

$$\Pr(CV = B) \equiv f(B) \quad (17)$$

Where $f(B)$, represents the probability density function.

On the report of Hanemann (1984), in case of the closed-ended single-bound format the respondent is asked to choose to pay a value B or not for the change of the status quo situation Q_0 to an alternative Q_1. If the answer is 'yes', this implies the relation $CV \geq B$. The probability for attaining a positive answer is symbolized as:

$$\Pr(CV \geq B) \equiv 1 - F(B) \tag{18}$$

In the event of a negative response, this means that the compensating variation is less than the proposed value. That is:

$$\Pr(CV \leq B) \equiv F(B) \tag{19}$$

Moreover, the closed-ended, double-bounded format includes two valuation questions regarding two proposed bids, B_{Higher}, B_{Lower} with the basic assumption that the second preferred value depends on the first one. Specifically, if the answer in the first question is positive then the second value is greater than the first. Adversely, if the first answer is negative then the second bid is smaller than the initial (Hanemann *et al.*, 1991). The different response combinations 'yes'/'yes', 'no'/'no', 'yes'/'no', 'no'/'yes', can be expressed in the form of response probabilities as:

$$\Pr(yes/yes) = \Pr(CV \geq B_{Higher}) = 1 - F(B_{Higher}) \tag{20}$$

$$\Pr(yes/no) = \Pr(B_{Higher} \geq CV \geq B) = F(B_{Higher}) - F(B) \tag{21}$$

$$\Pr(no/yes) = \Pr(B \ \geq CV \geq B_{Lower}) = F(B \ ) - F(B_{Lower}) \tag{22}$$

$$\Pr(no/no) = \Pr(B_{Lower} \geq CV) = F(B_{Lowet}) \tag{23}$$

Another way to obtain the distribution of WTP, is by applying the random utility maximization approach (RUM) (Hanemann, 1984; Mitchell *et al.*, 1989; McFadden, 1974; Ben-Akiva *et al.*, 1985). In the framework of (RUM), the direct utility $U_{ij}(.)$ is equal to the indirect $V_{ij}(.)$ and the random term e_{ij}.

$$U_i(I_j, Z_j, Q; e_{ij}) = V_i(I_j, Q, Z_j) + e_{ij} \tag{24}$$

Where $i = 0,1$ describing the different states as 0 for the initial situation or status quo and 1 for the final state; I_j represents the income of the individual; Z_j the household characteristics of the individual j, Q_i the change of the environmental good or amenity and e_{ij} the random term. The basic assumption of RUM model is that the respondent can answer with certainty about the contribution for an environmental change, however, the researcher treats the individual's preferences as random (Carson & Hanemann, 2005; Haab *et al*., 2002; Giraud *et al*., 2001; Cooper *et al*., 2002).

The corresponding response probability function of the RUM model can be expressed as:

$$\Pr(yes_j) = \Pr(V_1 \geq V_0) = 1 - F(B) \qquad (25)$$

Where $V_1 = (Q_1, Z_j, I_j - B,\ e_{1j})$ and $V_0 = (Q_0, Z_j, I_j,\ e_{0j})$ denote the indirect utilities of the item under estimation at the initial 0 and final 1 situation.

The aforesaid response probability function constitutes the starting point for the parametric and non-parametric analysis. Initially, we can illustrate some of the different parametric approaches depending on the basic form of random utility function. It is well acknowledged that the utility in RUM specifications is characterized by the sum of a deterministic and a random term which is expressed by the equation $e_{ij} = e_{1j} - e_{0j}$. Further, the random terms are independently and identically distributed (IID) with zero mean.

When we take for granted the linearity with respect to income, we assume constant marginal utility across the individuals. In this case, the random utility function takes the form:

$$V_{ij}(I_j) = a_i Z_j + b_i I_j \qquad (26)$$

The above equation can be transformed into the following forms of the initial state 0 and the final 1:

$$V_{0j}(I_j) = a_0 Z_j + b_0 I_j \tag{27}$$

$$V_{1j}(I_j - B) = a_1 Z_j + b_1 (I_j - B) \tag{28}$$

The term B represents the bid amount offered to the respondents for the implemented measure corresponding to the environmental change.

The difference between the indirect utilities given that $a = a_1 - a_0$ and $b_1 = b_0$ is given as:

$$\begin{aligned} V_{1j}(I_j - B) - V_{0j}(I_j) &= (a_1 - a_0) Z_j + b_1 (I_j - B) - b_0 I_j = \\ &= a Z_j + bB \end{aligned} \tag{29}$$

Having specified the deterministic component of the random utility model with linear income we can also identify the structure of the response probability function, as:

$$\Pr(yes) = \Pr(aZ_j - bB + e_{ij} > 0) = \Pr(e_{ij} < aZ_j - bB) \tag{30}$$

The corresponding standard normal probability can be designed as:

$$\Pr(yes) = \Pr(e_{ij} < aZ_j - bB) = \phi\left[\left(aZ_j / \sigma\right) - \left(bB / \sigma\right)\right] \tag{31}$$

Where ϕ, denotes the cumulative distribution response probability function of the standardized errors.

If the random term is characterized by the symmetric logistic distribution $e \sim \left(0, \frac{\pi^2 \sigma}{3}\right)$, we can design the Logit model as:

$$\Pr(yes) = \Pr[(1 + \exp(-(aZ_j / \sigma - bB / \sigma))]^{-1} \tag{32}$$

If the random component is standard logistic distributed $e \sim \left(0, \frac{\pi^2}{3}\right)$, the Probit model can be estimated as:

$$\Pr(yes) = \phi[(aZ_j / \sigma) - (bB / \sigma)] \tag{33}$$

Another parametric approach of the RUM is the log-linear form as regards the income. The basic assumption is that the marginal utility $\frac{\partial V_{ij}}{\partial I_j} = \frac{b}{I_j}$ is not constant across the individuals but adversely is decreasing given $b > 0$. The response probability expression with normal distributed errors can be recognized as:

$$\Pr(yes) = \Pr\left[\left(\frac{aZ_j}{\sigma} + \frac{b\ln[(\frac{I_j - B}{I_j})]}{\sigma}\right) > -e_{ij}\right] \tag{34}$$

The corresponding standard normal cumulative response probability form can be calculated as:

$$\Pr(yes) = \phi\left(\frac{aZ_j}{\sigma} + \frac{b\ln[(\frac{I_j - B}{I_j})]}{\sigma}\right) \tag{35}$$

The Box-Cox version of random utility model can be represented by the following equation:

$$V_{ij} = a_i Z_j + bI_{ij}^{\lambda} + e_{ij} \tag{36}$$

where $I^{\lambda} = I^{\lambda} - 1 / \lambda$. The random utility function can take different forms as far as the term λ takes different values:

$$\begin{aligned} &\lambda = 1 \Rightarrow I^{\lambda} = I - 1 \\ &\lambda = 0 \Rightarrow I^{\lambda} = \ln I \\ &\lambda = -1 \Rightarrow I^{\lambda} = bI^{\lambda - 1} \\ &\lambda = 2 \Rightarrow I^{\lambda} = I^2 - 1 / 2 \end{aligned} \tag{37}$$

The response probability functions when the transformation term is constant $\lambda = 1 \Rightarrow I^{\lambda} = I - 1$ is given by:

$$\Pr(yes) = \Pr\left[aZ_j + b\left[\frac{(I_j - B)^{\lambda} - I_j^{\lambda}}{\lambda}\right] > -e_{ij}\right] \quad (38)$$

The corresponding cumulative form can be expressed as:

$$\Pr(yes) = \phi\left[\frac{aZ_j + b\left[\frac{(I_j - B)^{\lambda} - I_j^{\lambda}}{\lambda}\right]}{\sigma}\right] \quad (39)$$

The following equation represents the response probability distribution function that belongs to the family of parametric approaches with the difference that utilizes an asymmetric distribution to some extent such as the Weibull distribution.

$$\Pr(yes) = \exp(-\exp(aZ_j + bB)) \quad (40)$$

The confidence intervals are produced via the coefficients from the Weibull function (Krinsky & Robb, 1986; Park *et al.*, 1991).

The proper formulation of the response probability function aids to the estimation of the welfare measures expressed by the central tendencies such as mean and median of the WTP. The employment of the central tendencies depends on the specific criteria applied by the decision maker (Bateman *et al.*, 2002).

The majority of the researchers in the field of modelling the non-market values through the contingent valuation approach employ parametric models, such as the Probit and Logit, especially to investigate data derived from the discrete choice models. The distribution of the Logit and Probit model serves as a means of estimating the mean WTP. Nevertheless, the response probability function can either be parametric or non-parametric. The parametric approaches use the response probability function as a known function, while the distribution of the WTP depends on a vector that constitutes a finite number of unknown parameters (An, 1996).

Modelling the WTP distribution via parametric approaches results in efficient estimators, in appropriate behaviour description, or in the derivation of precise estimates of central tendencies, although, there are serious disadvantages such as the biased and inconsistent estimates due to the strong interconnection to distributional and functional assumptions (Creel & Loomis, 1997; Osorio & Mittelhammer, 2012; Crooker & Herriges, 2004).

The underlying problems of parametric methods have led to the non-parametric approaches. One of the main purposes of the non parametric estimators is the investigation of the distribution of the response probability or survivor function. The distribution's shape of the survivor function is tracted out by a discrete set of points (Carson & Hanemann, 2005). There have been introduced pioneering methods, in order to tract out the discrete set of points, that the mean WTP is independent to a given distribution of the model implemented such as Logit or Probit (Creel & Loomis, 1997; Kriström, 1990; Turnbull, 1976; Giraud *et al*., 2001).

One of the ways to connect the discrete set of points that depicts the shape of the survivor function is the Turnbull distribution-free estimator. The estimator, accomplish to provide a lower bound of the mean WTP given that $\phi_n \le \phi_{n+1}\, if\, B_n \le B_{n+1}$ where ϕ denotes the cumulative density function (cdf) and n the number of bid values (B) offered (Crooker & Herriges, 2004). In this way we have:

$$E(WTP)_{LB} = \sum_{n=1}^{N} B_n(\phi_{n+1} - \phi_n) \le E(WTP) \qquad (41)$$

The application of the linear interpolation, is another easy trial to develop the exact shape of the distribution of the response probability function according to Kriström (1990), which results in a piecewise linear cdf under the assumption that the probability of the Bids offered are uniformly distributed. The upper bound of the WTP expected value given $\phi_0 = 1 \, and \, \phi_{n+1} = 0$ is expressed as:

$$E(WTP)_{UB} = \sum_{n=1}^{N} (B_n + B_{n+1})(\phi_n - \phi_{n+1}) \tag{42}$$

Smoothing assumptions concerning the distribution leads to a more consistent description of the shape of the survivor function distribution. What is more, semi-nonparametric estimators allow the inclusion of descriptive variables apart from the bid price (An, 1996; Araña & Leon, 2005).

After the Chen & Randall (1997) estimator, the compensating variance function is separated into a nonstochastic WTP function such as the exponential form and a random term, so that *CV=non-stochastic(WTP)-e*. Using the Gallant Fourier Flexible Form to model the nonstochastic component, implies a monotonic transformation of the error term. One of the advantages of Chen and Randall's estimator is that it allows the implementation of the standard maximum likelihood procedure (Creel & Loomis, 1997; Crooker & Herriges, 2004).

Creel & Loomis (1997) estimator is almost similar to the aforementioned although, it differs in terms of the utilization of the utility difference as in equation (29) and the necessity of the estimation of only one series.

There are also plenty of surveys that introduce semi- nonparametric approaches including smoothness assumption (An, 2000; Horowitz, 1992; Cooper *et al*., 2002; Khan *et al*., 2012; Belluzzo, 2004; Huang *et al*., 2008; Rothe, 2009; Fezzi & Ferini, 2012), but have not so far being applied thoroughly in empirical research either because of the required knowledge in the field or the difficulty in reference with the definition of the particular smoothing assumptions. In the recent literature, as to valuation of marine and coastal goods and services, Landry & Liu (2009) utilize a semi parametric approach in order to estimate revealed and stated preference recreation demand models concerning the beach in North Carolina.

This approach is an alternative versus the parametric approach in terms of misspecification relating to the unobserved heterogeneity. Madani *et al.* (2012) applied a semi non-parametric distribution free estimator to analyze the data collected from the contingent valuation approach respecting the value of coral reef within Kish Island. Yet, non-parametric estimators in marine and coastal empirical research are extensively used compared to semi non-parametric estimators (Edwards, 2009; Van Biervliet & Nunes, 2006; Petrolia & Kim, 2009; Casiwan-Launio *et al.*, 2011; Jørgensen *et al.,* 2012).

5. A critical consideration of contingent valuation method

Although contingent valuation is dominant among environmental methodologies, there are controversies related to the validity and reliability of the estimates. The validity of the results refers to the consistency and the reproducibility of results (Kealy *et al.*, 1990). The validity can be divided into content, structure and criteria validity. *Content validity* refers to the quality of the tools used, such as the questions involved in the survey. As noted by Bateman *et al.* (2002) the important issues as regards to the content validity is whether the appropriate questions is utilized in order to elicit the stated preferences of the participants or the participant has answered in the offered question. Evidently, if it is asked the wrong question, this leads to invalid estimation.

The *structure validity* refers to the ability of the theoretical structure of the hypothetical market to estimate the real economic value which is stated by the respondents (Freeman, 1993). The structure validity can be further divided into two categories. The first category relates to the *convergent validity*, in which the estimates are compared with others to assess the degree of convergence as envisaged by the theory. The second category refers to the *theoretical validity* in which the results are examined in the context of their consistency with the rules of economic theory. The theoretical validity involves the estimation of the WTP and the examination of the relationship between the estimates and standard economic variables such as income (Mitchell & Carson, 1989).

The *criterion validity* is relevant to the comparison of a measure with another which is considered that is the most consistent within the theoretical structure. For example, the validity of the questions to assess the Hicksian surplus can be estimated by comparing the results with a hypothetical structure of questions considered to be the most associated to the theoretical structure of the method used (Bateman *et al*., 2002).

Another considerable issue is the reliability which relates to the structure and the internal consistency of the contingent valuation approach. Hanley (1997) proposed two ways to estimate the reliability of the survey results. Initially, it is necessary to test the convergent validity and secondly to carry out the test-retest method applied by Loomis (1990), where the same questions were repeated to the same respondents in order to assure the consistency of their responds. On the report of Whitehead *et al*., (1995) another application constitutes of two similar questions in different formats so as to check the positive correlations between the measures.

Apart from the reliability the elicitation effect is a controversial issue too. The value of an environmental amenity is elicited via different elicitation formats such as open ended questions, bidding games, payment cards, single –bounded dichotomous choice questions and multiple-bound dichotomous choice questions (Chien *et al*., 2005), whereas the most common formats include 'response effects'. Starting point bias is a difficulty in terms of a problematic initial bid that has to encounter the utilization of the bidding game format, the single bounded dichotomous choice format and the double-bound dichotomous choice format (Venkatachalam, 2004). The difficulty with the starting point bias refers probably to the lack of the researcher's experience or the respondents' familiarity to commodities under examination, or the respondents' impatience concerning the bidding process (Silberman & Klock, 1989).

Efforts to face the problem relate to particular design of the questionnaire. Using a payment card is a solution; however, this may lead to anchoring in which the design of a numerical bid can result in an alteration of the response. Besides, explicit models can be generated to reduce the negative effects. Aprahamian *et al*. (2007) proposed a model with an open-ended follow-up question and an anchoring random parameter. Chien *et al.* (2005) includes the 'yea says bias' in the model which refers to the biased responses of participants regardless the content of the question. The 'yea saying' problem is frequently related to 'fat right tail problem' where the cumulative density functions are disproportionately large leading to large mean estimates of WTP (Ready & Hu, 1995).

The information as regard with the good or service to be estimated is crucial to the estimates of the mean WTP/WTA. According to Bergsrtom *et al*. (1990) the type of information may affect seriously the results either in a positive or in a negative way. The required information includes the quality of the environmental amenity, the budget constraints, the relative expenditures, or the knowledge about other substitutes (Bergstrom *et al*., 1989; Blomquist & Whitehead, 1998).

Embedding effect is another problem among a great list. As claimed by Kahneman & Knetsch (1992) there is a tendency to overrate a good if it is estimated on its own rather than if it is part of a more inclusive agenda. The embedding effect has been interpreted in terms of part-whole bias, disaggregation bias and sub-additivity, scope and order effects. Hanemman (1994) redefined the concept of the embedding effect proposing the further classification in the sequencing or question order effect which is related to the order of questions, the scope effect which is related to the valuation of equally different sizes of a presented good under estimation and the sub-additivity effect which is referred to as the 'adding up' problem (Dupont, 2003).

There is a debate concerning the existence of scope effect, however, the empirical research that considers this problem is very limited (Venckatachalam, 2004). As suggested by Mitchell & Carson (1989), the embedding effect can be minimized by the better interpretation of the presented commodity to respondents via all different types of media including optical.

Strategic behaviour is a common problem that characterizes the contingent valuation approach and especially the open-ended question format. The respondents can be classified as regards to their attitude to act strategically and not reveal their real intention to pay for the change of the environmental amenity. Specifically, free riders are those that underestimate the good under consideration given that there are always others willing to contribute for the change. The second category of the strategic behaviour refers to the overpledging in terms of overstating the WTP given that an external source will provide the financial support for the provision of the good or service under estimation (Mitchell & Carson, 1989).

Additionally, strategic behaviour can be revealed by the continuous same response during the survey which leads to flattened WTP distribution (Carson & Hanemann, 2005). Although, Samuelson (1954), has commented upon the design of the contingent valuation approach that communicate the problem of strategic behaviour, for some other researchers, strategic behavior does not constitute a crucial problem (Cummings *et al*., 1986; Mitchell & Carson, 1989; Griffin *et al*., 1995; Schulze *et al*., 1981). Whittington *et al.* (1992) utilizing a multivariate analysis examined the impact of the existence of time to think and revise the WTP responses in order to investigate the existence strategic bias. Deshazo (2002) developed a head-to-head test to explore the strategic bias, the yea-saying and the anchoring problem concluding that it is more efficient using the iterative bid design in order to minimize the problems.

In addition, researches have to take into account the true zero bids and protest responses. In the majority of the contingent valuation studies there are participants that are not willing to contribute for an environmental improvement of a public good either because they cannot afford to or they consider unfair the payment vehicle, or they adopt a free riding behavior or they do not possess the sufficient information (Jørgensen *et al*., 1999; Strazzera *et al*., 2003). One of the solutions to the specific problem is the exclusion of the protest zero bids of the sample if the respondents state that they are sincerely indifferent to the good under estimation, whereas this can lead to another problem named 'sample selection bias' in terms of flatness of the likelihood function.

Alternative solution is the utilization of Tobit model (Tobin, 1958), the use of the sample selection models such as Heckman (Heckman, 1979), or the use of the double hurdle models (Cho *et al*., 2008). Recently, Halkos & Jones (2012), with the purpose of determining the effect of social factors on the individuals' state concerning the contribution for an improvement of environmental protection of biodiversity, utilized the Heckman sample selection model and the double hurdle model in order to tackle the problem of the refusals to pay and the protesters to respond. In the same line, Halkos & Matsiori (2012a), examining the current and potential economic value of an artificial lake, applied the double hurdle model in comparison with Tobit model to deal with zero responses, while Tobit model fail to take into account the sources of the zero responses.

The hypothetical scenarios of payment and provision of the good or service that is the basic feature of contingent valuation survey, can lead to a divergence of respondent's statement and thus to a hypothetical bias. As stated by Ajzen (2004) the reason for the existence of the hypothetical bias is the different intentions of respondents in a hypothetical or in a real frame of reference. Empirical results in the literature show a higher WTP in a hypothetical context rather than in an actual (Cummings *et al*., 1995; Brown *et al*., 1996; Kealy *et al.*, 1990; List & Gallet, 2001; Harrison, 2006).

One of the approaches to deal with the hypothetical bias has been proposed by Cummings & Taylor (1999). 'Cheap talk approach' includes an integrated discussion with the respondent concerning the hypothetical bias problem. Another approach proposed is the 'certainty approach' which depends on the respondent's certainty to contribute to the change of the amenity (Murphy *et al*., 2005; Champ & Bishop, 2001; Poe *et al*., 2002; Vossler *et al*., 2003; Blumenschein *et al*., 2008).

6. A summary of the main points

Humans' well being, basic needs and economy rely upon the exploitation of the most benefits provided by the ecosystems. However, the economic activity results to damages to the biodiversity, the water quality and the sea level rise. Hence, to manage the adverse consequences it is important to develop the knowledge concerning the valuable goods and services that various ecosystems provide.

Although contingent valuation is considered as one of the most promising methods there are various limitations that have to be addressed carefully, either by the inclusion of an appropriate question format, or by conducting the analysis of the data with a proper econometric method parametric, non-parametric or semi non-parametric.

The parametric approaches treat the response probability function as a known function, while the distribution of the WTP depends on a vector that constitutes a finite number of unknown parameters. Moreover, estimators such as the non-parametric Turnbull and Kriström's, have been applied in the literature. The semi non-parametric estimators which include smoothing assumptions concerning the distribution lead to a more consistent depiction of the shape of the survivor function distribution as they allow the inclusion of descriptive variables apart from the bid price. Although there are also plenty of surveys that introduce semi non-parametric approaches, there have not been applied thoroughly in empirical research or in the field of marine and coastal goods and services.

To criticize the approach of contingent valuation a number of issues were presented such as the validity and reliability of the estimates. The validity of the results refers to the consistency and reproducibility of results and the reliability relates to the structure and the internal consistency of the contingent valuation approach. Another consideration is the elicitation effect that is related to the estimation of the value of an environmental amenity via different elicitation formats. Starting point bias is an included disadvantage in terms of a problematic initial bid.

Furthermore, given that the contingent valuation is designed in harmony with hypothetical scenarios of payment and provision of the good or service, the respondents alter their statements. Another common problem is the limited available information of the respondents and its crucial role to the estimates of the mean WTP/WTA. Concerning the voting behaviour, the respondents can be classified as free riders who underestimate the WTP, those who overstate the WTP given external financial support and as protesters that do not agree to contribute for an environmental improvement of the good or service under estimation.

To date the literature of the contingent valuation studies in the field of marine and coastal ecosystem is consistently increasing. The challenge is to succeed the elicitation of an appropriate number of response units in order to estimate the welfare measures dealing at the same time with the majority of included bias in the research. Besides of reviewing the available studies concerning the water quality of marine and coastal systems, the scope of the present paper is to provide a linkage between the important notions of value, the economic theory which is based the contingent valuation approach in accordance with the statistical models to derive the welfare measures and included disadvantages of the method.

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