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Contingent valuation method applied to waste management

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ABSTRACT

This study focus on the application of the contingent valuation method to the municipal packaging waste selective collection. The Dichotomous Choice Single Bounded was the elicitation method chosen where a monthly payment, from a set of seven monthly payments, was proposed. In order to assess the willingness to pay (WTP) for the service, a survey was administered to a sample of 1186 individuals. Respondents were questioned about their current recycling and socio-demographic characteristics and if they were willing to pay the amount proposed for a more sustainable selective waste collection service. The high number of "Protest answers" led to two different sample analysis. The Turnbull estimator was used to estimate the mean WTP and the values obtained range between 1.56 and 2.84 euros. Regarding the logit models, the mean WTP values were −1.35 and 3.16 euros, depending on whether or not protest answers were included. The results were consistent with a WTP of 2.54 euros obtained in a Pre-Study conducted to a sample of 162 individuals where the elicitation method of payment card was used.

1. Introduction

In the last decades the economic development led to in new consumption habits that resulted in a significant increase of waste production. In Portugal, as in several countries across Europe, waste management has evolved and, as a consequence, recycling activities have increased (Da Cruz et al., 2014a).

The Directive 94/62/EC of 20 December set targets for recovery and recycling for Member States, while leaving the choice of actual policies and models of management for packaging waste to be taken by each Member State. In 1994, the Directive 94/62/CE on Packaging and Packaging Waste (PPW) was adopted and three main targets were set:

- Recover 50% of packaging waste (with maximum 65%);
- Recycle 25% of packaging waste (with maximum 45%); and
- Recycle at least 15% by weight of each individual packaging material.

Municipal Solid Waste (MSW) services encompass several management operations, such as refuse and selective collection, sorting, mechanical treatment, composting, incineration and/or landfilling. Packaging waste is usually selectively collected by different material flows (glass, paper/cardboard and plastic/metal/other packaging) and by one of the two main collection types, "kerbside system" (door-to-door) or "bring system".

In Portugal, packaging waste management is carried out by 12 multimunicipal and 11 intermunicipal companies (Simões et al., 2010). The activities carried out by these companies comprise mainly selective collection and sorting operations. Packaging waste is usually selectively collected by three different material flows (glass, paper/cardboard and plastic/metal/other packaging) and by one of the two main collection types: "curbside system" (door-to-door) or "bring system" (using drop-off containers). The undifferentiated waste flow is collected, in general, on a daily basis and the waste is collected through 1000 l containers placed on the street. These containers are shared by the householders.

According to the Portuguese law, the municipalities are responsible for the management of the municipal waste (Marques and Simões, 2008). However, regarding the packaging waste, the packaging industry is responsible for supporting the costs of the recycling operations through a company, a compliance scheme, in Portugal is called Sociedade Ponto Verde (SPV). The collection and recovery of packaging waste is established through contracts between municipalities or multimunicipal or intermunicipal systems that have the concession for the selective collection and sorting of packaging waste and SPV.

Currently, in Portugal, the recycling of the packaging waste is performed on a voluntary basis because there is no economic incentive to recycle. The municipal waste fees in Portugal are charged through the water bill, because it is assumed that the amount of waste produced is proportional to the water consumption. Moreover, it varies significantly according to the municipality.

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However, the costs of selective collection and sorting are, in part, supported by the municipalities. Detailed information on the Portuguese cost structure of the packaging waste system is described in Da Cruz et al. (2012).

In other countries the costs of the selective collection are supported by the citizens (Da Cruz et al., 2014b). They are either directly supported by the use of the service (e.g. the US) or indirectly, for example, by the cost of the special bags that are used to collect the packaging waste (Belgium). In Portugal, there is no economic incentive to sort the packaging waste. Without any incentive, Portugal has managed to increase the amount of packaging waste recycled in the last decade and fulfil the PPW Directive targets. Nevertheless, previous studies concluded that householders are willing to pay for the selective waste collection for environmental proposes or to reduce the waste management fees of the non-recyclable fraction. The aim of this paper was to find how much Portuguese householders value this service, i.e., how much they are willing to pay. The study of willingness to pay (WTP) on waste recycling is relatively new in the literature and, therefore, this research provides a good contribution in this scope. Moreover, the results of this study can be useful for municipalities that are willing to introduce a new waste management charging mechanism based on the waste produced, which in Portugal would be fairer to the householders and would contribute for a more economic and environmental sustainable system.

After this introduction, the paper is organized as follows: the background and the econometric models applied are described followed by the pre-test description and the survey design. The results obtained are presented and discussed and finally the conclusions complete this paper.

2. Background

The contingent valuation method (CVM) is a method of economic valuation of natural resources using stated-preference techniques. CVM is widely used in welfare economics based on the neoclassical concept of economic value and of individual utility maximization.

On 24 March 1989, when the Exxon Valdez oil spill occurred in Alaska, the State of Alaska sued the company for the loss of passive-use values. The CVM was debated in a symposium sponsored by the Exxon Corporation, which led to the creation of a government panel – established by the National Oceanic and Atmospheric Administration (NOAA) and chaired by two Nobel laureates in economics – to assess the scientific validity of the CVM. The NOAA panel concluded that "CVM studies can produce estimates reliable enough to be the starting point of a judicial process of damage assessment, including lost passive (non-use) values" (Arrow et al., 1993, p. 4610). The panel offered its approval of CVM subject to a set of best-practice guidelines that influenced the development of the methodology (Stavins, 2009). Nowadays, the CVM is a method widely used in academic research and in environmental valuation studies.

The so-called WTP is calculated based on responses to hypothetical scenarios collected through surveys or interviews. There are different approaches to investigate stated preference but this paper adopted the CMV method where respondents are asked to reveal their WTP a certain amount (often a binary yes/no question). Contingent valuation is frequently used for assessing monetary values on environmental services (Carson, 2000). This method is often adopted to obtain information on the goods and services as they are not available in the market. CVM may be used for assessing WTP for public goods and services. Krutilla (1967) highlighted the importance of the irreversibility in environmental decision making and discussed the possibility that non-use values constitute a main component of the total economic value of an environmental good. In his opinion, not including these values would give wrong signals to policymakers. According to the author, the only methodology available to achieve the economic value was through the CVM.

Bishop and Heberlein (1979) were the first to incorporate the dichotomous format in CVM surveys. The dichotomous format (also known as referendum or closed ended) gained considerable popularity since then. The methodology gained significant political acceptance in the United States (US) in the 1970s and in 1980s as it was considered an economic valuation tool by several federal institutions. Mitchell and Carson (1989) introduced the theoretical framework of the CVM, focusing on design issues, elicitation formats, potential biases, etc. The CVM was applied to waste recycling systems in Jakus et al. (1996) and Lake et al. (1996).

3. Econometric models

A CVM survey provides information concerning WTP distribution for a proposed change in an environmental good. The theoretical background of the method is composed by the structure of the utility function and econometric theory.

The cumulative distribution function of WTP, G_C, and the corresponding probability density function, g_C, depend on the survey design. In the case of an open-ended method the individuals are asked to state their maximum WTP directly, A, the probability that an individual's WTP is equal to A, is (Hoyos and Mariel, 2010):

$$Pr\{\text{WTP} = A\} = 1 - g_C(A) \tag{1}$$

In the closed-ended question format, the probability that their WTP is equal to or greater than the mount "A" proposed is:

$$Pr\{\text{WTP} \geq A\} = 1 - G_C(A) \tag{2}$$

WTP distribution can be calculated through two approaches. In the open-ended questions format linear regression is assumed with some covariates (Z_γ) and a normally distributed random term (ε), so that WTP is also normally distributed:

$$\text{WTP} = \mu\text{WTP} + \varepsilon = Z\gamma + \varepsilon \tag{3}$$

The other approach includes a random term in the utility function, the so-called random utility models (RUM) (Hanemann, 1984). In the RUM, the individual knows his utility function concerning the good or service under study and consequently his WTP. However, given that these preferences cannot be observed by the researcher, they can be classified as a random variable where the error term is directly in the utility function. Following the closed-ended single-bounded CVM question format, the probability that the respondent answers "yes" can be written as (Hoyos and Mariel, 2010):

$$Pr\{\text{response is } ''\text{yes}''\} = Pr\{WTP(p, q^0, q^1, y; \varepsilon) \geq A\} \tag{4}$$

$$Pr\{\text{response is } ''\text{yes}''\} = Pr\{v(p, q^1, y - A; \varepsilon) \geq v(p, q^0, y; \varepsilon)\} \equiv 1 - G_C(A) \tag{5}$$

where q^0, q^1—scalars for the good being valued at the initial (0) and final (1) situations; p—vector of the prices; y—individual's income; A—amount of money being proposed in the questionnaire.

$$Pr\{\text{response is } ''\text{yes}''\} = 1 - G_C(A) = 1 - G\left(\frac{A - \mu_{wtp}}{\sigma_{wtp}}\right) \tag{6}$$

In the first approach (parametric), the probability of a "yes" response is a known function of the bid amount (A). In the second approach (non-parametric), the bid levels are treated separately.

A closed-ended single-bounded approach will be applied. A bid, from a set of bids, will be proposed to the respondents who provide a "Yes" or "No" answer representing that they are willing to pay, at least, the amount proposed. Given the sample of individuals and the corresponding Yes/No responses, the logit model will be used, following Hanemann (1984), to obtain mean WTP estimates.