



# Pro-social behaviours, waste concern and recycling behaviour in Italy at the end of the 1990s

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## Abstract

This paper examines both theoretically and empirically the link between pro-social behaviours, individual attitudes regarding waste prevention and disposal, and individual recycling behaviour in Italy at the end of the 1990s, in a period in which policy makers started to make the population aware of the importance of waste prevention, disposal and recycling. In the theoretical framework, following Czajkowski et al. (Environ Resour Econ 66:647–670, 2017), we develop a utility function that represents the individual level of satisfaction, which is influenced by certain aspects related to environmental quality. In the empirical analysis, using the 1998 wave of the multipurpose household survey (MHS) conducted by the Italian Central Statistical Office and probit models, we show a positive relationship between pro-social behaviours, waste concern and recycling behaviour that is robust to the inclusion of social capital variables.

**Keywords** Pro-social behaviours · Waste concern · Recycling behaviour · Social capital · Multipurpose household survey · Italy

## 1 Introduction

The economic literature increasingly recognizes that individuals are not only solely concerned with monetary rewards/punishments, but also with non-monetary aspects, such as the various behavioural norms (warm-glow, altruism, social,

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personal) that may be used to induce desirable actions (Van den Bergh 2008; Abbott et al. 2013; Alpízar and Gsottbauer 2015). People's attitudes and behaviours vis-à-vis environmental protection have become a fertile area in which to examine the importance of non-monetary incentives. In this field, for example, Halvorsen (2008), Hage et al. (2009) and Abbott et al. (2013) have shown that moral and social norms influence pro-environmental behaviours, while Brekke et al. (2003, 2010) and Czajkowski et al. (2017) have found that self-image is central to recycling behaviour. Owen and Videras (2006, 2007) and Videras et al. (2012), moreover, have explained that individuals who are more willing to behave according to civic and cultural norms and have more social ties are also more willing to protect the natural environment.

In this paper, by pro-social behaviours, we mean the highest level of social cooperation that limits free-riding behaviour. Among the main environmental problems, we consider waste prevention, disposal and recycling, as the European Commission published several waste-related directives intended to reduce waste generation and increase waste recycling (Nicolli and Mazzanti 2011; Cecere et al. 2014). Our contribution to the literature lies mainly in the empirical analysis of the relationship between pro-social behaviours, the individual's attitude regarding waste prevention and disposal and the individual's recycling behaviour in Italy at the end of the 1990s, in a period which ushered in national environmental policy to make the Italian population aware of the importance of waste prevention, disposal and recycling (the so-called Decreto Ronchi, Legislative Decree 22/1997). Prior to this period, individual awareness of and behaviours related to environmental waste problems were conditioned primarily by individual culture and lifestyles. Starting from this legislative provision, gradually, the garbage collection system and the garbage pricing have been changed and consequentially, the individual behaviours have been influenced also from these changes.

In specific terms, after a slight change of theoretical framework described in Czajkowski et al. (2017), we perform the first empirical assessment of the relationship between pro-social behaviours, waste concern and recycling behaviour for Italy considering the year 1998, because at the end of the 1990s, national environmental policy in Italy neither provided monetary incentives nor obliged its inhabitants to adopt pro-environment behaviours. Thus, it can be stated that attitudes to waste prevention and disposal and recycling behaviour were mainly influenced by non-monetary incentives.

These contributions also represent the added value of our paper to the literature. In other words, previous studies on the relationship between non-monetary incentives and recycling attitude and behaviour did not analyse the relationship between pro-environmental behaviours, waste concern and recycling behaviour; did not consider Italy in the investigation sample and did not include a scenario in which national environmental policy did not influence individual's attitude regarding waste prevention and disposal and the individual's recycling behaviour.

The paper is organized as follows: Sect. 2 offers a brief review of the related literature, while Sect. 3 presents a small change of the model contained in Czajkowski et al. (2017). Section 4 describes the data and presents the empirical strategy. Section 5 illustrates the results, while the final section concludes.

## 2 Related literature

The importance of monetary and non-monetary factors in pro-environmental behaviour in general and in waste recycling, in particular, has been widely investigated. For the purposes of this paper, we review studies that are relevant to our theoretical and empirical analysis.

First, several US studies find that differentiated tariffs and recycling programmes contribute to increase in solid waste recycling (Fullerton and Kinnaman 1996; Callan and Thomas 1997; Jenkins et al. 2003; Huang et al. 2011). Other studies show the same results for European countries (Dijkgraaf and Gradus 2004, 2009; Kipperber 2007; Bucciol et al. 2015).

Second, other contributions from the economic literature focus on warm-glow theory.<sup>1</sup> Nyborg et al. (2006) construct a model in which individuals are motivated by a concern for warm-glow, which depends on the total benefit a “green” good yields to the population and on the perception of what share of the population chooses to consume the “green” option. Hence, the individual’s intrinsic incentive to be pro-social increases as the share of the population acting in that way increases. Brekke et al. (2003) identify warm-glow with a positive self-image, a relationship that depends on the degree to which individuals believe that their behaviour is socially responsible. The individual’s self-image of being socially responsible is determined by a comparison of that individual’s actual behaviour with an endogenously determined morally ideal behaviour. Brekke et al. (2010) consider the role of what they refer to as duty orientation. A duty-oriented individual prefers a self-image of being a socially responsible person. Duty orientation can be regarded as an extension of the standard impure altruism model (Andreoni 1990): like the impure altruist, a duty-oriented individual receives a warm-glow, which increases with the size of his or her contribution. Using data from Statistics Norway, empirical results show that duty orientation is central to recycling behaviour. Czajkowski et al. (2017), investigating the determinants of individuals’ stated preferences for household recycling, construct a model in which economic factors, personal moral sentiments and social pressure can all contribute to an individual’s decision on how much they recycle. Using Polish data, the main result is that the willingness to pay for higher levels of household recycling is primarily linked to a moral motivation, associated with the belief that sorting at home is more thorough than sorting at a central facility.

Third, many studies consider social influences and social capital<sup>2</sup> (Pretty 2003; Thomas and Sharp 2013). Hornik et al. (1995), Schultz et al. (1995) and Thøgersen

<sup>1</sup> The points of reference for warm-glow are Deci (1971) in the psychology literature and Andreoni (1990) from the economics literature. According to Deci (1971), warm-glow means that an individual is motivated to perform an activity when he/she receives no apparent reward except the activity itself. In the model of Andreoni (1990), warm-glow means that the individual’s utility is not just a function of the consumption of the private and public goods but also of the individual’s contribution to the public good itself. This is commonly referred to as the “warm-glow” effect and describes a form of impure altruism (Daube and Ulph 2016).

<sup>2</sup> Social capital is usually referred to as “features of social organization such as networks, norms and social trust that facilitate coordination and cooperation for mutual benefit” (Putnam 1995, 65).

(1996), in reviews of prior empirical psychological studies on recycling behaviour, show that an important predictor is social influence of friends, family members and neighbours. In the economic field, using data on Scotland, Collins et al. (2006) show that social capital, measured by charitable work, is positively associated with waste recycling. Torgler and García-Valinas (2007) empirically investigate the determinants of an individual's attitudes toward preventing environmental damage in Spain, showing that social capital, such as trust and membership in voluntary environmental organizations, has a strong impact on an individual's preferences to prevent environmental damage. Owen and Videras (2006), using data from the World Values Survey, find that individuals who are more willing to behave according to civic norms are also more willing to protect the public good of the natural environment. Owen and Videras (2007) and Videras et al. (2012), using OECD and US datasets, respectively, extend the results of Owen and Videras (2006) to church groups (and churchgoing) and social ties. Finally, using Italian data, Fiorillo (2013) reports that membership of non-profit associations and church attendance are correlated with recycling behaviour. Crociata et al. (2015) extend the association to cultural participation, while Agovino et al. (2016) also include environmental associations and voluntary activities.

Finally, many papers have shown that demographic and socio-economic variables also matter, such as age, education and income (Berglund 2006; Sidique et al. 2010; Czajkowski et al. 2014). Although several studies support the positive relationship between age and environmental attitude and recycling (Hage et al. 2009, Tabernero et al. 2015), other research points out a negative association (Czajkowski et al. 2014). Several papers find a positive association between education, waste attitudes and recycling behaviour (Hong et al. 1993; Tadesse 2009; Arbués and Villanúa 2016). More highly educated individuals possess greater environmental knowledge, skills and responsibility, which translate into pro-environmental attitude and behaviour (Vicente-Molina et al. 2013). Finally, high-income individuals are more likely to state their concern regarding environmental quality and are also more likely to recycle, as widely reported (Callan and Thomas 1997; Berglund and Söderholm 2003; Hage et al. 2009; Czajkowski et al. 2017).

Summing up the literature discussed above, pro-environmental attitudes toward waste prevention and disposal and recycling behaviour are related to the costs of waste collection, individuals' demographic and socio-economic characteristics, social capital and self-image. The latter is the basis of our theoretical model, the former are our control variables in the empirical analysis.

### 3 Theoretical framework

The theoretical analysis is related to the relationship between pro-social behaviours, environmental attitudes and recycling. We investigate from a theoretical standpoint three fundamental aspects which are strictly connected: the pro-social behaviours of individuals  $S$ , their environmental sensitivity  $R$  and the level of recycling activity  $W$ . Such behaviour, attitude and action are not conflicting, as will be clearly confirmed by our empirical analysis. We want just to show how using the following theoretical

structure there is a concrete possibility to point out a relationship between the will to contribute of the agents to the quality of the environment and the level of the environmental quality in the society.

Following Czajkowski et al. (2017), we develop a utility function that represents the individual level of satisfaction, which is influenced by certain aspects related to environmental quality  $G$ . The utility function is a quasi-concave and increasing function:

$$U = u(c, G) + S + R + W. \quad (1)$$

The agent maximizes the utility function subject to the following budget constraint:

$$I = c + pg, \quad (2)$$

where  $g$  is the individual contribution to public good  $G$ , namely environmental quality, and is always positive or equal to 0, the variable  $c$  is the individual private consumption that represents the amount of private goods consumption and leisure in monetary terms, and the price of consumption  $p$  is normalized to 1. Consequently, we consider  $g$  as the individual's contribution to the public good  $G$  allocated through use of his/her time and money, and  $p$  is an implicit price of contribution to the environmental quality  $G$  in terms of loss of consumption. Finally,  $I$  represents the income of the agent and incorporates all possible resources including the time available as considered in Becker (1965). The budget constraint is identical to that in Czajkowski et al. (2017). Since the contribution  $g$  of each individual of a large society is too small with respect to the total level of  $G$ ,  $G$  is considered as exogenously fixed. In contrast, we consider a utility function of a representative agent introducing some changes with respect to Czajkowski et al. (2017). We do not change the form of the utility function, but we examine the impact of different variables on the utility of an agent who wants to contribute to the public good by considering different aspects that can influence the level of his/her contribution. In particular, the agent can decide to contribute adopting pro-social behaviours  $S$  this means respecting the environment and consequentially, all the other members of society.

Thus, we can write the following expression:

$$S = -s(g - g^*)^2,$$

where  $s$  is a positive constant and  $g^*$  denotes the moral ideal effort of pro-social behaviour for the agent, and is equal to or greater than 0 as in Brekke et al. (2003, 2010) and Nyborg (2011).<sup>3</sup> Thus, any divergence from  $g^*$  determines results for the agent in a loss of utility, because of his/her non-ideal contribution to the environment compared with all other members of society. He/she considers protection of the environment a pro-social behaviour, believing that any effort exceeding his/her ideal effort could entail the loss of all possible resources, including time available.

<sup>3</sup> Unlike the contributions in question, we do not formalize self-image but introduce into the theoretical model other aspects that influence environmental quality.

To formalize the effort level of the agent who considers environmental protection a priority, we introduce the variable  $R$ , which is defined in the following expressions as:

$$R = -r(g - g^{**})^2,$$

where  $r$  is a positive constant and the variable  $R$  represents the level of the environmental sensitivity of the agent; here, we include the variable  $g^{**}$ , which represents the exogenous, ideal and optimal effort level devoted by the agent with different degrees of awareness with respect to ecological issues. As in the previous expression, any deviation from  $g^{**}$  implies for the agent a decrease in utility due to the lack of effort applied to understand how to improve quality of the environment.

Finally, we define the level of effort for the agent who effectively carries out the recycling activity  $W$ . In this case, we consider the ideal optimal effort devoted to recycling activity as  $g^{***}$ . We describe this aspect using the following expression:

$$W = -w(g - g^{***})^2,$$

where parameter  $w$  is a positive constant. The agent tries to devote as many resources as possible to reduce the gap between his/her contribution  $g$  and his/her ideal contribution  $g^{***}$  not to reduce his/her utility strictly related to the quality of the environment.

Thus, the agent maximizes Eq. (1) given the budget constraint (2) with respect to  $g$  to decide how much to contribute to public good  $G$  as follows:

$$g = \frac{sg^* + rg^{**} + wg^{***} - pu'(c)/2}{s + w + r}. \quad (3)$$

Equation (3) reveals important information: the optimal effort of the agents depends fundamentally on the level of the ideal effort. Thus, each agent in society maximizes his/her utility following an ideal level of pro-social behaviour, sensitivity towards environmental problems and recycling. Since all of these components are linked additively, the agents shift their efforts toward their respective ideal level of effort. Albeit differing in the ideal level of effort, they tend to maximize their utility by considering their own ideal level of effort. Each category of agents rationally decides to reach optimal values to maximize (2). Since all the agents in society maximize their utility, all of these decision variables move in the same direction. There is no incentive to partially increase one or two types of effort given the ideal level of effort that they wish to attain.

Let us analyze the value of contribution  $g$  which maximizes the agent's utility. The individual optimal contribution depends on the distance between  $g$  and, respectively, once each  $g^*$ ,  $g^{**}$ ,  $g^{***}$ , and also on the suitability of his/her preferences to develop activities and behaviours able to improve environmental quality depending on the constants  $w$ ,  $r$ ,  $s$ . The suitability of preferences and constants influences positively the level of the agent's contribution, although the marginal utility of consumption  $u'(c)$  times  $p$  results in a reduction of it. If the numerator of Eq. (3) is negative, the agent will prefer not to contribute at all and Eq. (3) will not hold. It is realistic to believe that there is a strictly positive relationship among  $g^*$ ,  $g^{**}$  and  $g^{***}$ . From Eq. (3), the optimal value of  $g$  is positively influenced by pro-social behaviour,

sensitivity to the environment and recycling. Therefore,  $g$  increases by  $\frac{s}{s+r+w}$ ,  $\frac{r}{s+r+w}$ ,  $\frac{w}{s+r+w}$  if  $*$ ,  $**$  and  $***$ , respectively, increase marginally with all other variables fixed.<sup>4</sup> To be more precise, the preferences of the individual are positively affected by the exogenous fixed parameters and variables  $s$ ,  $r$ ,  $w$ ,  $*$ ,  $**$ ,  $***$  and the optimal contribution will be increasing if the utility of the agent deriving from  $S$ ,  $R$ ,  $W$  is greater than the private consumption benefit. Given that this theoretical framework is a minor extension of Czajkowski et al. (2017), we underline that there is not direct link with the following empirical analysis but our aim is right to show and confirm a clear positive relationship between pro-social behaviour which demonstrate the existence of an high propensity to respect the environment in the society and the high quality of it.

Empirically, we just focus on the relationship between pro-social behaviour, awareness of environmental quality and recycling to show what kind of link exists among these components. The measures considered in the empirical investigation incorporate the cost related to waste concern, recycling behaviour and pro-social behaviour. Thus, the main purpose of the analysis is to show how they behave in our dataset with respect to the improvement in environmental quality. While the theoretical model explains how to determine the optimal contribution, our empirical analysis points out how the variables and parameters interact in relation to a questionnaire with a section on environmental issues.

## 4 Empirical hypotheses, data and strategy

In the model, we determine the expression of the optimal contribution for the agent. All the components are considered to influence the contribution and utility function positively, mainly reducing the difference between the agent's efforts and the ideal level of contribution for each component. Reasonably, the agent behaves rationally, increasing all his/her efforts in the same direction as it is not realistic to improve the contribution towards  $*$ , while reducing the others towards  $**$  and  $***$  and vice versa.

We believe that there would be a positive link between pro-social behaviours and the level of sensitivity toward environmental problems and between pro-social behaviours and recycling as well as between the level of sensitivity toward environmental problems and recycling. Hence, our empirical hypotheses are as follows:

- The measure of pro-social behaviours is positively correlated with the measure of waste concern;
- The measure of pro-social behaviours is positively associated with the measure of recycling behaviour;
- The measure of waste concern is positively related with the measure of recycling behaviour.

<sup>4</sup> <sup>4</sup> We differentiate Eq. (3.3) in order to obtain the marginal increase for each ideal contribution.

Our empirical analysis uses the 1998 wave of the Multipurpose Household Survey (MHS) conducted annually by the Italian Central Statistics Office (ISTAT 1998). This large dataset is one of the best available for studying pro-environmental attitudes and behaviour in a cross-sectional framework, as it investigates a wide range of behaviours through face-to-face interviews using a sample of approximately 20,000 households, roughly corresponding to 60,000 individuals. The 1998 wave is an invaluable dataset, because there is a section on environmental issues not available in the other waves. The unit of analysis is the individual. The final dataset used in the empirical analysis contains 36,394 observations. Table 1 reports the definitions of the variables used in the econometric analysis with weighted summary statistics.

#### 4.1 Measures of waste concern, recycling behaviour and pro-social behaviours

The 1998 wave of the MHS includes a section devoted to environmental issues. This section is used for identifying measures of pro-environmental attitudes and behaviour and pro-social behaviours. Among the main environmental problems, we consider waste prevention and disposal, as waste reduction is at the top of the waste hierarchy (I et al. 1997; Pearce 2004; Kinnaman et al. 2014). The European Commission has issued several waste directives with the aim of reducing waste generation and increasing waste recycling (Nicolli and Mazzanti 2011; Cecere et al. 2014). We consider the individual's concern regarding waste prevention and disposal as a measure of waste concern. The first key variable is Waste Concern, a dummy variable equal to one if the respondent claims "waste prevention and disposal" is "the most worrying environmental problem". The second key variable is Recycling Behaviour, a binary variable equal to one if the individual recycles at least one of five different materials: paper, glass, plastic, aluminum and food waste. Recycling behaviour is a behavioural action, as it demonstrates actual willingness to incur a cost to protect the environment 5. The third key variable is Pro-Social behaviours, measured on a scale from 0 to 3, with 3 indicating the highest level of civic cooperation that limits free-riding behaviour. A series of environmental questions in the 1998 wave of the MHS captures individual behaviours vis-à-vis social cooperation. We examine three behaviours, and we add one to pro-social behaviours each time the respondent states that he/she never engaged in the following behaviours: (a) "throw paper in the street"; (b) "double park"; and (c) "engage in noisy driving behaviours". Table 1 shows that, while less than half of the respondents in our sample express concern regarding waste prevention and disposal (Waste Concern), the proportion of respondents who recycle (Recycling Behaviour) is greater at 65%. In addition, the sample average of the index of pro-social behaviours is 1.77, and the standard deviation is 0.85.



**Table 1** Weighted descriptive statistics

| Variable  | Description   | Mean | Standard deviation |
|---|---|------|--------------------|
| <b>Key variables</b>                                  |   |      |                    |
| Waste concern   | = 1 if the respondent claims that waste protection and disposal is the most worrying environmental problem                | 0.41 | 0.49               |
| Recycling behaviour                                   | = 1 if the respondent recycles at least one of five different materials: paper, glass, plastic, aluminum and food waste   | 0.65 | 0.48               |
| Pro-social behaviours                                 | 0–3 scale of civic behaviours*  | 1.77 | 0.85               |
| <b>Control variables</b>                              |   |      |                    |
| <b>Supply side variables</b>                          |   |      |                    |
| Waste disposal fee judgment                           | = 1 if high   | 0.68 | 0.47               |
| Recycling bins easy to reach                          | = 1 if recycling bins easy to reach in the area where the respondent lives  | 0.65 | 0.48               |
| Recycling bins difficult to reach                     | = 1 if recycling bins difficult to reach in the area where the respondent lives   | 0.25 | 0.43               |
| <b>Demographic and socio-economic characteristics</b> |   |      |                    |
| Female  | = 1 if female. Reference group: male  | 0.50 | 0.50               |
| Married   | = 1 if married. Reference group: single   | 0.60 | 0.49               |
| Divorced  | = 1 if divorced   | 0.03 | 0.17               |
| Widowed   | = 1 if widowed  | 0.05 | 0.22               |
| Age 31–40   | = 1 if age between 31 and 40. Reference group: age 16–30  | 0.18 | 0.39               |
| Age 41–50   | = 1 if age between 41 and 50  | 0.17 | 0.38               |
| Age 51–60   | = 1 if age between 51 and 60  | 0.15 | 0.36               |
| Age 61–70   | = 1 if age between 61 and 70  | 0.12 | 0.33               |
| Age 71–80   | = 1 if age between 71 and 80  | 0.07 | 0.26               |
| Household size  | Number of people who live in family   | 3.37 | 1.25               |
| Low education   | = 1 if no education, completed elementary school and completed junior high school. Reference group: high school (diploma) | 0.59 | 0.49               |
| Bachelor's degree                                     | = 1 if university degree and/or doctorate   | 0.08 | 0.27               |

Table 1 (continued)

| Variable                         | Description   | Mean  | Standard deviation |
|----------------------------------|---|-------|--------------------|
| Household income (ln)            | Natural logarithm of household income                             | 10.72 | 0.44               |
| Good health                      | = 1 if self-perceived health is good                              | 0.76  | 0.42               |
| Unemployed                       | = 1 if unemployed. Reference group: other status                  | 0.07  | 0.25               |
| Entrepreneur                     | = 1 if entrepreneur   | 0.05  | 0.22               |
| Employed                         | = 1 if employed   | 0.45  | 0.50               |
| Retired                          | = 1 if retired  | 0.18  | 0.39               |
| Homeowner                        | = 1 if homeowner  | 0.72  | 0.45               |
| Newspapers                       | = 1 if newspapers every day                                       | 0.24  | 0.43               |
| Perception of community problems |   |       |                    |
| Micro-criminality                | = 1 if pickpocketed   | 0.03  | 0.18               |
| No parking problems              | = 1 if no difficulty parking                                      | 0.35  | 0.48               |
| No traffic problems              | = 1 if no traffic problems  | 0.20  | 0.40               |
| No pollution                     | = 1 if no pollution   | 0.24  | 0.43               |
| No dirtiness problems            | = 1 if no filth   | 0.23  | 0.42               |
| Size of municipality             |   |       |                    |
| Metropolis                       | = 1 if metropolitan area. Reference group: < 2000 inhabitants     | 0.22  | 0.42               |
| Neighbouring metropolis          | = 1 if close to metropolitan area                                 | 0.08  | 0.27               |
| > 50,000                         | = 1 if more than 50,000 inhabitants                               | 0.15  | 0.36               |
| 10,000–50,000                    | = 1 if between 10,000 and 50,000 inhabitants                      | 0.22  | 0.41               |
| 2000–10,000                      | = 1 if between 2000 and 10,000 inhabitants                        | 0.25  | 0.43               |
| Social capital variables         |   |       |                    |
| Union membership                 | = 1 if passive and active participation in trade unions           | 0.09  | 0.29               |
| Volunteering membership          | = 1 if passive and active participation in voluntary associations | 0.11  | 0.31               |

Table 1 (continued)

| Variable                 | Description  | Mean | Standard deviation |
|--------------------------|--|------|--------------------|
| Political membership     | = 1 if passive and active participation in political party | 0.04 | 0.21               |
| Church attendance        | = 1 if church attendance one or more a week                | 0.33 | 0.47               |
| Environmental membership | = 1 if passive participation in environmental associations | 0.02 | 0.13               |

\*If respondent states that he/she never engaged in the following behaviours: (a) “throw paper in the street”; (b) “double park”; and (c) “engage in noisy driving behaviors.”

#### 4.1.1 Supply side variables

The supply side information available in the MHS regards the judgment of the respondent on the waste disposal fee and the presence of recycling bins for waste placed along the street. These variables measure the costs of waste collection. MHS asks respondents how they judge the cost for waste disposal services, with answers including (1) high, (2) fair, (3) low. We create a dummy variable labelled “waste disposal fee judgement” if the respondent judges the cost of the waste disposal service to be high. Table 1 shows that 68% of respondents judge the cost of waste disposal to be high. With regard to recycling bins for waste, the MSH asks respondents the question: “Are there recycling bins for separate waste collection in the area where you live?” The answers are: (1) yes and easy to reach; (2) yes but difficult to reach; (3) no; (4) do not know. We use responses (1) and (2) to build two dummy variables for recycling bins labelled “recycling bins easy to reach” and “recycling bins difficult to reach”. In the sample, respectively, 65% of Italian individuals report that there are recycling bins for waste, while 25% of respondents claim that they are difficult to reach.

#### 4.1.2 Demographic and socio-economic characteristics

To account for factors that might influence waste attitudes, recycling behaviour and pro-social behaviours, we control for numerous demographic and socio-economic characteristics.

We control for gender (Female), with male as the reference category, and for marital status, by including categories for married, divorced and widowed against a base category of being single. We consider age (Age 31–40, Age 41–50, Age 51–60, Age 61–70, Age 71–80, with Age 16–30 used as the reference group), the number of individuals living in the household (Household size), two variables representing the level of education attained (Low education and Bachelor’s degree, with High school being the reference category). We further control for the natural logarithm of household income (Household income ( $\ln$ )), self-reported good health (Good health), employment status (Unemployed, Entrepreneur, Employed, Retired with other status employed as the reference category), tenure status (Homeowner) and the habit of reading newspapers (Newspapers). The average respondent in the sample is married, has low education (elementary school and/or junior high school completed), is in good health and is a homeowner. We also control for the quality of the surrounding environment where the respondent lives. These variables are designed to measure the respondent’s beliefs regarding potential environmental problems related to the area where he/she lives. These indicators of subjective perception are public safety where the household lives (Micro-criminality) and a number of other issues such as parking (No parking problems), traffic (No traffic problems), pollution (No pollution) and dirtiness (No dirtiness problem). Moreover, we also control for the size of municipality (Metropolis, Neighbouring metropolis, More than 50,000, 10,000–50,000, and 2000–10,000, with fewer than 2000 inhabitants being the reference category). Regional fixed effects are also included to account for the high

regional heterogeneity in economic development and environmental quality existing in Italy.

#### 4.1.3 Social capital variables

To check the robustness of the relationship between waste concern, recycling behaviour and pro-social behaviours, we also control for social capital variables. We construct three variables reflecting passive and active membership of associations. Union membership, volunteering membership and political membership are dummy variables equal to one if the individual is a passive member (the individual participated in meetings of an association) and/or an active member (the individual did unpaid work for an association), in trade unions, volunteering associations and political parties. On average, approximately 10% of the respondents participate in trade unions and voluntary associations, while the participation rate in political parties is only 4%. Moreover, we also include Church attendance, a binary variable that is equal to one if the respondent attends a church or another place of worship one or more times per week. Religious traditions include worldviews, ethical precepts and spiritual elements that shape perceptions of the natural environment and can act as guiding principles regarding how individuals act and how their choices affect nature (Owen and Videras 2007). The sample mean of this variable is 0.33. Finally, individuals who participate in activities promoted by environmental organizations may be more likely to learn about the value of preserving the natural environment (Owen and Videras 2006). Hence, we also include the variable environmental membership, which equals one if the individual reports participation in environmental associations. The sample mean of this variable is only 0.02.

#### 4.2 Empirical strategy

We empirically model the relationship between pro-social behaviours, waste attitudes and recycling behaviour using the following sets of models. First, we estimate the relationship between Waste Concern and Pro-Social behaviours controlling for supply side, demographic and socio-economic characteristics and regional dummy variables:

$$\Pr(\text{Waste}_i = 1) = \Psi(\alpha_0 + \alpha_1 S_i + \alpha_2 SS_i + \alpha_3 D_i + \alpha_4 T_i). \quad (4)$$

Then, we estimate the relationship between recycling behaviour, pro-social behaviours and waste concern controlling for the same independent variables:

$$\Pr(\text{Recycle}_i = 1) = \Psi(\beta_0 + \alpha\beta_1 S_i + \beta_2 \text{Waste}_i + \beta_3 SS_i + \beta_4 D_i + \beta_5 T_i), \quad (5)$$

where  $S$  is our measure of pro-social behaviours;  $SS$  is a matrix containing the waste disposal fee and recycling bin variables;  $D$  is a matrix containing gender, marital status, age, education, household size and income, self-reported good health, employment status, tenure status, the habit of reading newspapers, the quality of the surrounding environment and the size of the municipality where the respondent lives.  $T$  is the vector of regional dummies;  $\Psi(\cdot)$  is the cumulative distribution function of a normal standard.

To check the robustness of our estimates, we expand Eqs. (4) and (5) to include individual social capital variables:

$$\Pr(\text{Waste}_i = 1) = \Psi(\alpha_0 + \alpha_1 S_i + \alpha_2 SS_i + \alpha_3 D_i + \alpha_4 T_i + \alpha_5 SC_i), \quad (6)$$

$$\Pr(\text{Recycle}_i = 1) = \Psi(\beta_0 + \alpha\beta_1 S_i + \beta_2 \text{Waste}_i + \beta_3 SS_i + \beta_4 D_i + \beta_5 T_i + \beta_6 SC_i), \quad (7)$$

where  $SC$  is a matrix containing social capital variables, i.e., participation in trade unions, volunteering and environmental associations, political parties and churchgoing.

## 5 Results

Table 2 presents the probit estimations of Eqs. (4) and (5). The first column shows marginal effects, while the second presents the standard errors, which are corrected for heteroskedasticity. We start with findings regarding the demographic and socio-economic characteristics and regional dummies. The key demographic and socio-economic determinants of waste concern and recycling behaviour are age 71–80 dummy, education and household income. These results are in line with previous investigations indicated in Sect. 2.

The marginal effect for the age cohort between 71 and 80 years of age exhibits a negative sign and is statistically significant at the 1% level. Hence, being an older person decreases the probability of exhibiting waste concern and recycling behaviour by approximately 6% and 8%, respectively. Low education enters the waste and recycling equations with a negative and statistically significant (1%) marginal effect. This means that an individual who has completed elementary school and/or junior high school has lower waste concern and recycling behaviour than an individual with a high school diploma. Moreover, university graduates also have a higher probability of exhibiting waste concern and recycling behaviour than do high school leavers (significant at least at the 5% level). Thus, the results suggest that individuals with more education are more likely to state their support for environmental quality than those with low levels of education. Household income has a significant and positive correlation with waste concern and recycling behaviour (significant at the 1% level). Thus, having higher income raises the probability of exhibiting waste concern and recycling behaviour by, respectively, approximately 6% and 9%.

Other controls also matter for both waste concern and recycling behaviour. An individual who reports that there are no parking problems in the area where he/she lives exhibits a higher likelihood of waste concern and recycling behaviour (significantly at the 10% and 1%, respectively). In addition, an individual who states that there are no traffic problems in the area where he/she lives has a lower probability both of being concerned about waste prevention and disposal and engaging in recycling behaviour (significant at the 5% and 10% levels, respectively).

**Table 2** Probit results: marginal effects of waste and recycle

| Variable                          | Waste       |           | Recycle     |           |
|-----------------------------------|-------------|-----------|-------------|-----------|
|                                   | dF/dx       | Std. err. | dF/dx       | Std. err. |
| Pro-social behaviours             | 0.014***    | 0.003     | 0.028***    | 0.003     |
| Waste concern                     |             |           | 0.044***    | 0.006     |
| Waste disposal fee judgment       |             |           | 0.004       | 0.006     |
| Recycling bins easy to reach      |             |           | 0.343***    | 0.006     |
| Recycling bins difficult to reach |             |           | 0.079***    | 0.007     |
| Female                            | − 0.012**   | 0.006     | 0.011*      | 0.006     |
| Married                           | 0.020**     | 0.008     | − 0.011     | 0.009     |
| Divorced                          | 0.011       | 0.016     | − 0.049***  | 0.019     |
| Widowed                           | − 0.001     | 0.015     | − 0.020     | 0.016     |
| Age 31–40                         | 0.002       | 0.010     | − 0.003     | 0.011     |
| Age 41–50                         | − 0.012     | 0.010     | 0.004       | 0.012     |
| Age 51–60                         | − 0.018     | 0.011     | 0.023*      | 0.012     |
| Age 61–70                         | − 0.019     | 0.013     | − 0.004     | 0.015     |
| Age 71–80                         | − 0.062***  | 0.015     | − 0.080***  | 0.018     |
| Household size                    | − 0.002     | 0.003     | − 0.004     | 0.003     |
| Low education                     | − 0.029***  | 0.007     | − 0.031***  | 0.007     |
| Bachelor's degree                 | 0.034***    | 0.010     | 0.028**     | 0.011     |
| Household income (ln)             | 0.063***    | 0.010     | 0.087***    | 0.011     |
| Good health                       | 0.008       | 0.006     | 0.007       | 0.007     |
| Unemployed                        | − 0.020*    | 0.011     | − 0.061***  | 0.012     |
| Entrepreneur                      | 0.018       | 0.012     | − 0.013     | 0.014     |
| Employed                          | − 0.007     | 0.007     | − 0.029***  | 0.008     |
| Retired                           | 0.011       | 0.010     | 0.031***    | 0.011     |
| Homeowner                         | 0.004       | 0.007     | 0.007       | 0.007     |
| Newspapers                        | − 0.010     | 0.006     | 0.021***    | 0.007     |
| Micro-criminality                 | − 0.022     | 0.014     | 0.031*      | 0.016     |
| No parking problems               | 0.012*      | 0.007     | 0.039***    | 0.007     |
| No traffic problems               | − 0.019**   | 0.008     | − 0.017*    | 0.010     |
| No pollution                      | 0.033***    | 0.008     | 0.008       | 0.009     |
| No dirtiness problems             | − 0.014*    | 0.007     | 0.020**     | 0.008     |
| Metropolis                        | 0.018       | 0.011     | − 0.017     | 0.012     |
| Neighbouring metropolis           | 0.029**     | 0.013     | − 0.026*    | 0.015     |
| > 50,000                          | 0.016       | 0.012     | − 0.021*    | 0.013     |
| 10,000–50,000                     | 0.017       | 0.011     | − 0.016     | 0.012     |
| 2000–10,000                       | 0.011       | 0.011     | − 0.018     | 0.012     |
| Regional dummies                  | Yes         |           | Yes         |           |
| No. of observations               | 35,426      |           | 35,994      |           |
| Pseudo <i>R</i> -squared          | 0.0158      |           | 0.2583      |           |
| Log-likelihood                    | − 23,231.29 |           | − 17,334.69 |           |

The dependent variables waste and recycle take value 1, respectively, if a) individual claims that waste protection and disposal is the most worrying environmental problem and b) individual recycles at least one of four different materials: paper, glass, plastic and aluminum. The model is estimated with a standard probit. Regressors' legend: see Table 1. Regional dummies are omitted for reasons of space. The

**Table 2** (continued)

standard errors are corrected for heteroskedasticity. The symbols \*\*\*, \*\*, \* denote that the coefficient is statistically different from 0 to 1, 5 and 10%, respectively

A number of other demographic and socio-economic characteristics have a differential relationship with waste attitudes and recycling behaviour. Being female decreases the probability of waste concern, while it increases the likelihood of recycling behaviour. If an individual perceives the area where he/she lives as not being polluted, this belief encourages his/her concern regarding waste prevention and disposal. As regards recycling behaviour, recycling bins for waste have a positive and significant relationship with recycling behaviour (significant at 1%). The unemployed and employed individuals recycle less, while the retired recycle more (all significant at the 1% level). Moreover, an individual who reads newspapers every day is also more likely to recycle (significant at the 1% level).

The covariates also include regional dummies. Individuals living in Southern Italy are less likely to report pro-environmental attitudes and behaviour. In particular, individuals in Sicily have the lowest probability of reporting being concerned about waste prevention and disposal, while individuals in Campania have the lowest probability of recycling. As we control for a full set of individual-level demographic, social and economic variables, a plausible explanation for such findings should be sought in regional economic and institutional factors, comprising economic growth and environmental policy.

Looking at key variables, the probit estimates of Eqs. (4) and (5) with demographic and socio-economic characteristics and regional dummies (Table 2) show evidence for the expected positive relationship between pro-social behaviours, waste attitudes and recycling behaviour. First, the marginal effect of pro-social behaviours in the equation of waste concern is positive and statistically significant at the 1% level. The Pro-social behaviour variables positively correlated with a higher probability of declaring waste attitudes by 1.4%. Second, the marginal effect of pro-social behaviours in the equation of recycling behaviour is positive and statistically significant at the 1% level. The pro-social behaviour index is positively related with a 2.8% higher likelihood of declaring recycling behaviour. Third, the marginal effect of waste concern in the equation of recycling behaviour is positive and statistically significant at the 1% level. The waste concern variable is positively associated with a 4.4% higher probability of declaring recycling behaviour.

## 5.1 Robustness check

The observed association between pro-social behaviours, waste attitudes and recycling behaviour could conceal the effect of other factors that lead to individuals having a high willingness both to cooperate in the provision of public goods and to protect environmental quality. Thus, the first potential problem with the interpretation of our results is omitted variable bias. We address this problem by adding social capital variables.



**Table 3** Probit results: marginal effects of robustness analysis of waste

|                         | I                 | II                | III               | IV                | V                 | VI                |
|-------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Pro-social behaviours   | 0.014 (0.003)***  | 0.013 (0.003)***  | 0.014 (0.003)***  | 0.014 (0.003)***  | 0.014 (0.003)***  | 0.013 (0.003)***  |
| Union membership        | 0.044 (0.009)***  |                   |                   |                   |                   | 0.034 (0.010)***  |
| Volunteering membership |                   | 0.070 (0.009)***  | 0.036 (0.013)***  |                   |                   | 0.065 (0.009)***  |
| Political membership    |                   |                   |                   |                   |                   | 0.012 (0.014)     |
| Church attendance       |                   |                   |                   | 0.013 (0.06)**    |                   | 0.007 (0.006)     |
| Environmental member.   |                   |                   |                   |                   | 0.041 (0.020)**   | -0.001 (0.021)    |
| Female                  | -0.010 (0.006)*   | -0.011 (0.006)*   | -0.010 (0.006)*   | -0.014 (0.006)**  | -0.011 (0.006)*   | -0.010 (0.006)*   |
| Married                 | 0.019 (0.008)**   | 0.021 (0.008)**   | 0.020 (0.008)**   | 0.019 (0.008)**   | 0.020 (0.008)**   | 0.020 (0.008)**   |
| Divorced                | 0.010 (0.016)     | 0.012 (0.016)     | 0.011 (0.016)     | 0.011 (0.016)     | 0.011 (0.016)     | 0.011 (0.016)     |
| Widowed                 | -0.002 (0.015)    | 0.000 (0.015)     | -0.001 (0.015)    | -0.002 (0.015)    | -0.000 (0.015)    | -0.001 (0.015)    |
| Age 31–40               | 0.001 (0.010)     | 0.002 (0.010)     | 0.002 (0.010)     | 0.001 (0.010)     | 0.002 (0.010)     | 0.001 (0.010)     |
| Age 41–50               | -0.015 (0.010)    | -0.013 (0.010)    | -0.012 (0.010)    | -0.013 (0.010)    | -0.012 (0.010)    | -0.016 (0.010)    |
| Age 51–60               | -0.019 (0.011)*   | -0.017 (0.011)    | -0.018 (0.011)    | -0.020 (0.011)    | -0.017 (0.011)    | -0.020 (0.011)*   |
| Age 61–70               | -0.019 (0.013)    | -0.017 (0.013)    | -0.019 (0.013)    | -0.023 (0.013)*   | -0.018 (0.013)    | -0.019 (0.013)    |
| Age 71–80               | -0.062 (0.015)*** | -0.056 (0.015)*** | -0.062 (0.015)*** | -0.065 (0.015)*** | -0.061 (0.015)*** | -0.060 (0.015)*** |
| Household size          | -0.002 (0.003)    | -0.001 (0.003)    | -0.002 (0.003)    | -0.002 (0.003)    | -0.001 (0.003)    | -0.002 (0.003)    |
| Low education           | -0.028 (0.007)*** | -0.026 (0.007)*** | -0.028 (0.007)*** | -0.029 (0.007)*** | -0.029 (0.007)*** | -0.025 (0.007)*** |
| Bachelor's degree       | 0.033 (0.010)***  | 0.032 (0.010)***  | 0.034 (0.010)***  | 0.033 (0.010)***  | 0.035 (0.010)***  | 0.033 (0.011)***  |
| Household income (ln)   | 0.063 (0.010)***  | 0.061 (0.010)***  | 0.063 (0.010)***  | 0.063 (0.010)***  | 0.063 (0.010)***  | 0.061 (0.010)***  |
| Good health             | 0.008 (0.006)     | 0.009 (0.006)     | 0.008 (0.006)     | 0.008 (0.006)     | 0.008 (0.007)     | 0.008 (0.006)     |
| Unemployed              | -0.020 (0.011)*   | -0.017 (0.011)    | -0.019 (0.011)*   | -0.018 (0.011)*   | -0.019 (0.011)*   | -0.017 (0.011)    |
| Entrepreneur            | 0.026 (0.012)**   | 0.020 (0.012)     | 0.017 (0.012)     | 0.018 (0.012)     | 0.019 (0.012)     | 0.023 (0.012)*    |
| Employed                | -0.012 (0.007)*   | -0.005 (0.007)    | -0.007 (0.007)    | -0.005 (0.007)    | -0.006 (0.007)    | -0.008 (0.007)    |
| Retired                 | 0.011 (0.010)     | 0.010 (0.010)     | 0.012 (0.010)     | 0.012 (0.010)     | 0.012 (0.010)     | 0.011 (0.010)     |
| Homeowner               | 0.004 (0.007)     | 0.004 (0.007)     | 0.004 (0.007)     | 0.003 (0.007)     | 0.003 (0.007)     | 0.003 (0.007)     |
| Newspapers              | -0.011 (0.006)*   | -0.012 (0.006)*   | -0.012 (0.006)*   | -0.010 (0.006)*   | -0.011 (0.006)*   | -0.013 (0.006)**  |

Table 3 (continued)

|                          | I                | II               | III              | IV               | V                | VI               |
|--------------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| Micro-criminality        | -0.023 (0.014)   | -0.023 (0.014)   | -0.022 (0.014)   | -0.022 (0.014)   | -0.022 (0.015)   | -0.023 (0.015)   |
| No parking problems      | 0.011 (0.007)    | 0.011 (0.007)*   | 0.011 (0.007)*   | 0.012 (0.007)*   | 0.012 (0.007)*   | 0.010 (0.007)    |
| No traffic problems      | -0.018 (0.008)** | -0.019 (0.008)** | -0.019 (0.008)** | -0.018 (0.008)** | -0.019 (0.008)** | -0.019 (0.008)** |
| No pollution             | 0.033 (0.008)*** | 0.033 (0.008)*** | 0.033 (0.008)*** | 0.032 (0.008)*** | 0.034 (0.008)*** | 0.033 (0.008)*** |
| No dirtiness problems    | -0.013 (0.007)*  | -0.013 (0.007)*  | -0.013 (0.007)*  | -0.014 (0.007)*  | -0.014 (0.007)*  | -0.013 (0.007)*  |
| Metropolis               | 0.018 (0.011)    | 0.019 (0.011)*   | 0.018 (0.011)    | 0.018 (0.011)    | 0.016 (0.011)    | 0.017 (0.011)    |
| Neighbouring metropolis  | 0.029 (0.013)**  | 0.030 (0.013)**  | 0.030 (0.013)**  | 0.029 (0.013)**  | 0.029 (0.013)**  | 0.030 (0.013)**  |
| > 50,000                 | 0.015 (0.012)    | 0.016 (0.012)    | 0.015 (0.012)    | 0.016 (0.012)    | 0.015 (0.012)    | 0.016 (0.012)    |
| 10,000–50,000            | 0.017 (0.011)    | 0.018 (0.011)    | 0.017 (0.011)    | 0.018 (0.011)    | 0.016 (0.011)    | 0.016 (0.011)    |
| 2000–10,000              | 0.010 (0.011)    | 0.011 (0.011)    | 0.010 (0.011)    | 0.011 (0.011)    | 0.010 (0.011)    | 0.011 (0.011)    |
| Regional dummies         | Yes              | Yes              | Yes              | Yes              | Yes              | Yes              |
| No. of observations      | 35,248           | 35,246           | 35,277           | 35,387           | 35,005           | 34,969           |
| Pseudo <i>R</i> -squared | 0.0164           | 0.0173           | 0.0161           | 0.0159           | 0.0161           | 0.0176           |
| Log-likelihood           | -23,098.05       | -23,076.86       | -23,123.37       | -23,201.22       | -22,940.28       | -22,878.71       |

See Table 2

**Table 4** Probit results: marginal effects of robustness analysis of recycling

|                              | I                 | II                | III               | IV                | V                 | VI                |
|------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Pro-social behaviours        | 0.028 (0.003)***  | 0.028 (0.003)***  | 0.028 (0.003)***  | 0.028 (0.003)***  | 0.028 (0.003)***  | 0.028 (0.003)***  |
| Waste concern                | 0.043 (0.006)***  | 0.042 (0.06)***   | 0.043 (0.006)***  | 0.044 (0.006)***  | 0.043 (0.006)***  | 0.041 (0.006)***  |
| Union membership             | 0.051 (0.010)***  |                   |                   |                   |                   | 0.047 (0.010)***  |
| Volunteering membership      |                   | 0.086 (0.009)***  |                   |                   |                   | 0.072 (0.010)***  |
| Political membership         |                   |                   | 0.027 (0.014)*    |                   |                   | −0.009 (0.016)    |
| Church attendance            |                   |                   |                   | 0.042 (0.006)***  |                   | 0.036 (0.006)***  |
| Environmental member.        |                   |                   |                   |                   | 0.128 (0.019)***  | 0.090 (0.022)***  |
| Waste disposal fee j.        | 0.004 (0.006)     | 0.004 (0.006)     | 0.005 (0.006)     | 0.005 (0.006)     | 0.004 (0.006)     | 0.004 (0.006)     |
| Recycling b. easy to r.      | 0.343 (0.006)***  | 0.342 (0.006)***  | 0.343 (0.006)***  | 0.343 (0.006)***  | 0.343 (0.006)***  | 0.343 (0.006)***  |
| Recycling b. difficult to r. | 0.080 (0.007)***  | 0.079 (0.007)***  | 0.079 (0.007)***  | 0.080 (0.007)***  | 0.008 (0.007)***  | 0.080 (0.007)***  |
| Female                       | 0.012 (0.006)*    | 0.011 (0.006)*    | 0.011 (0.006)*    | 0.003 (0.006)     | 0.011 (0.006)*    | 0.006 (0.008)     |
| Married                      | −0.012 (0.009)    | −0.010 (0.009)    | −0.011 (0.009)    | −0.012 (0.009)    | −0.011 (0.009)    | −0.010 (0.009)    |
| Divorced                     | −0.048 (0.018)*** | −0.046 (0.018)*** | −0.047 (0.018)*** | −0.044 (0.018)*** | −0.048 (0.018)*** | −0.043 (0.018)*** |
| Widowed                      | −0.022 (0.016)    | −0.020 (0.016)    | −0.021 (0.016)    | −0.021 (0.016)    | −0.021 (0.016)    | −0.021 (0.016)    |
| Age 31–40                    | −0.004 (0.011)    | −0.002 (0.011)    | −0.003 (0.011)    | −0.004 (0.011)    | −0.002 (0.011)    | −0.005 (0.011)    |
| Age 41–50                    | 0.002 (0.011)     | 0.004 (0.012)     | 0.004 (0.012)     | −0.001 (0.012)    | 0.005 (0.012)     | −0.001 (0.012)    |
| Age 51–60                    | 0.020 (0.012)     | 0.022 (0.012)*    | 0.022 (0.012)     | 0.017 (0.012)     | 0.024 (0.012)*    | 0.018 (0.012)     |
| Age 61–70                    | −0.006 (0.015)    | −0.003 (0.015)    | −0.005 (0.015)    | −0.013 (0.015)    | −0.002 (0.015)    | −0.009 (0.015)    |
| Age 71–80                    | −0.081 (0.018)*** | −0.074 (0.018)*** | −0.080 (0.018)*** | −0.090 (0.018)*** | −0.076 (0.018)*** | −0.081 (0.018)*** |
| Household size               | −0.004 (0.003)    | −0.004 (0.003)    | −0.004 (0.003)    | −0.004 (0.003)    | −0.003 (0.003)    | −0.003 (0.003)    |
| Low education                | −0.029 (0.007)*** | −0.027 (0.007)*** | −0.030 (0.007)*** | −0.030 (0.007)*** | −0.029 (0.007)*** | −0.025 (0.007)*** |
| Bachelor's degree            | 0.028 (0.011)**   | 0.027 (0.011)**   | 0.029 (0.011)***  | 0.028 (0.011)**   | 0.028 (0.012)**   | 0.026 (0.012)**   |
| Household income (ln)        | 0.086 (0.011)***  | 0.083 (0.011)***  | 0.086 (0.011)***  | 0.084 (0.011)***  | 0.084 (0.011)***  | 0.080 (0.011)***  |
| Good health                  | 0.007 (0.007)     | 0.008 (0.007)     | 0.007 (0.007)     | 0.008 (0.007)     | 0.008 (0.007)     | 0.009 (0.007)     |
| Unemployed                   | −0.062 (0.012)*** | −0.061 (0.012)*** | −0.062 (0.012)*** | −0.058 (0.012)*** | −0.060 (0.012)*** | −0.056 (0.012)*** |
| Entrepreneur                 | −0.006 (0.014)    | −0.013 (0.014)    | −0.013 (0.014)    | −0.012 (0.014)    | −0.011 (0.014)    | −0.004 (0.014)    |

Table 4 (continued)

|                          | I                 | II                | III               | IV                | V                 | VI                |
|--------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Employed                 | -0.036 (0.008)*** | -0.028 (0.008)*** | -0.030 (0.008)*** | -0.025 (0.008)*** | -0.028 (0.008)*** | -0.029 (0.008)*** |
| Retired                  | 0.031 (0.011)***  | 0.031 (0.011)***  | 0.032 (0.011)***  | 0.032 (0.011)***  | 0.031 (0.011)***  | 0.031 (0.011)***  |
| Homeowner                | 0.009 (0.008)     | 0.009 (0.008)     | 0.008 (0.008)     | 0.007 (0.008)     | 0.009 (0.008)     | 0.009 (0.008)     |
| Newspapers               | 0.020 (0.007)***  | 0.020 (0.007)***  | 0.020 (0.007)***  | 0.020 (0.007)***  | 0.022 (0.007)***  | 0.020 (0.007)***  |
| Micro-criminality        | 0.029 (0.016)*    | 0.027 (0.016)*    | 0.029 (0.016)*    | 0.031 (0.016)*    | 0.029 (0.016)*    | 0.028 (0.016)*    |
| No parking problems      | 0.039 (0.007)***  | 0.039 (0.007)***  | 0.039 (0.007)***  | 0.039 (0.007)***  | 0.040 (0.007)***  | 0.038 (0.007)***  |
| No traffic problems      | -0.016 (0.010)*   | -0.017 (0.010)*   | -0.017 (0.010)*   | -0.017 (0.010)*   | -0.017 (0.010)*   | -0.017 (0.010)*   |
| No pollution             | 0.008 (0.009)     | 0.008 (0.008)     | 0.008 (0.009)     | 0.007 (0.009)     | 0.009 (0.009)     | 0.008 (0.008)     |
| No dirtiness problems    | 0.020 (0.008)**   | 0.020 (0.008)**   | 0.019 (0.008)**   | 0.020 (0.008)**   | 0.018 (0.008)**   | 0.018 (0.008)**   |
| Metropolis               | -0.017 (0.012)    | -0.017 (0.012)    | -0.016 (0.012)    | -0.017 (0.012)    | -0.018 (0.012)    | -0.018 (0.012)    |
| Neighbouring metropolis  | -0.028 (0.015)*   | -0.027 (0.015)*   | -0.027 (0.015)*   | -0.026 (0.015)*   | -0.029 (0.015)**  | -0.029 (0.015)**  |
| >50,000                  | -0.023 (0.013)*   | -0.022 (0.013)*   | -0.021 (0.013)    | -0.021 (0.013)    | -0.022 (0.013)*   | -0.021 (0.013)*   |
| 10,000–50,000            | -0.017 (0.012)    | -0.017 (0.012)    | -0.016 (0.012)    | -0.016 (0.012)    | -0.018 (0.012)    | -0.018 (0.012)    |
| 2000–10,000              | -0.019 (0.012)    | -0.018 (0.012)    | -0.018 (0.012)    | -0.017 (0.012)    | -0.020 (0.012)    | -0.019 (0.012)    |
| Regional dummies         | Yes               | Yes               | Yes               | Yes               | Yes               | Yes               |
| No. of observations      | 34,822            | 34,819            | 34,849            | 34,956            | 34,583            | 34,548            |
| Pseudo <i>R</i> -squared | 0.2587            | 0.2599            | 0.2582            | 0.2595            | 0.2921            | 0.2618            |
| Log-likelihood           | -17,240.04        | -17,209.46        | -17,263.80        | -17,287.13        | -17,110.465       | -17,033.95        |

See Table 2

As described in Sect. 4.1.4, we consider variables intended to capture additional social/relational aspects of individual behaviour such as membership of various types of associations and churchgoing. Tables 3 and 4 present the results for the waste and recycling Eqs. (6) and (7). Standard errors corrected for heteroskedasticity are presented in brackets.

In the waste equations, we find that the marginal effect on pro-social behaviours remains unchanged when including the social participation variables (Table 3, columns I through VI).

We find evidence that union and volunteering membership are positive and significant predictors of reporting concern about waste prevention and disposal (both at the 1% level) (columns I and II), the marginal effects of which are robust to simultaneously including all social participation variables (column VI). Being a member (passive and/or active) of a trade union or a volunteering association is positively correlated with the likelihood of reporting waste concern, increasing the likelihood by 3.4% and 6.5%, respectively. When considered individually, political and environmental membership and church attendance are statistically significant at conventional levels or greater (columns III through V), but when considered simultaneously, their statistical significance disappears (column VI), showing that they are not robust predictors of an individual's concern regarding waste prevention and disposal. In particular, the result on participation in environmental groups suggests that environmental membership is not an indication of greater environmental concern. It should be pointed out that the marginal effects on the other covariates remain stable (with respect to the results reported in Table 2), with the exception of the habit of reading a newspaper every day. Adding control variables for social participation implies that newspaper readership is statistically significant at 5% with a negative sign (Table 3, column VI). This evidence indicates that the habit of reading a newspaper every day reduces the probability of reporting waste concern.

In the recycling equations, we also find that the marginal effect of pro-social behaviours and waste concern remains stable when including social participation variables (Table 4, Columns I–VI). We also find evidence that union and volunteering membership are positive and significant predictors of recycling (both at the 1% level) (columns I and II), the marginal effects of which are robust to simultaneously considering all social capital variables (column VI). Being a member of a trade union or a volunteering association is positively linked to the likelihood of recycling behaviour, increasing the likelihood by 4.7% and 7.4%, respectively. Moreover, when considered both individually and simultaneously with all other control variables, church attendance and environmental membership are robust predictors of recycling behaviour (column VI). Attending church one or more times per week and being a passive member of an environmental association is positively related to the probability of recycling, increasing the likelihood by 3.6% and 9%, respectively. This last result indicates that participation in environmental groups is an indication of higher pro-environmental behaviour. It is also worth noting that the marginal effects on the other covariates remain stable (with respect to the results reported in Table 2).

## 6 Conclusions

To extend the previous literature on the environmental habits of individuals in protecting the environment quality, this paper identified a reasonable and plausible connection among the concept of pro-social behaviours, waste concern and recycling behaviour. The purpose was to establish a credible link between the existence of non-monetary motivations and environmental protection, especially in cases such as recycling activity. From a theoretical point of view, there are three fundamental aspects strictly connected to each other: the pro-social behaviours of individuals, their environmental sensitivity and the level of recycling.

Analytically, we formalized our point of view by using an agent's utility function in which we introduced the variables additively. We thus modelled a situation in which these aspects are not conflicting. In the empirical analysis, our conceptual and analytical framework was applied to a representative sample of Italian individuals who express attitudes and behaviours regarding two main environmental issues: waste prevention, disposal, and recycling activities. We considered the year 1998 for a specific reason: until the Ronchi Legislative Decree entered into force in 1997 most of the population was unaware of the importance of waste prevention, disposal and recycling. Hence individual awareness of and behaviours related to environmental waste problems were mainly influenced by their own way of being. This unique social context gave us the possibility to detect individual behaviours without the environmental policies as we have observed in the following years until today.

Actually the garbage collection system and the garbage pricing have been changed. Before the Ronchi Legislative Decree, the inhabitants of the urban areas deliver waste in collective garbage bins located in the neighbourhood of their home and the easier way to throw away the rubbish was to not do any kind of recycling activities. Who decided to develop recycling activity was forced to store the different waste in his/her home and afterwards to carry all the separate materials to a collection point located in the city. In addition, there was no reward and sanctioning system that pushed the inhabitants to recycle. Starting from the approval of Ronchi Legislative Decree and of the other national and European measures, it has been introduced a door-to-door garbage collection. Indeed, it has been imposed to the inhabitants to place their different types of waste in separate and specific bins. Furthermore, it has been developed reward and sanctioning systems that have been stimulated the recycling activities. So, for that reasons, the end of 90s is a breaking point in the regulation of the rubbish deliver. Before this point, the behaviours related to environmental waste problems were conditioned primarily by individual culture and lifestyles, subsequently, other exogenous components have been pushed the people towards pro-environmental behaviours.

In an academic perspective, we found a positive relationship between pro-social behaviours, waste concern and recycling behaviour, robust to the inclusion of social capital variables that we showed related to an individual's concern regarding waste prevention and disposal and to an individual's recycling behaviour.

Our results appear to indicate that, in the Italian context, when environmental policy started, social policy to reduce social and economic inequalities could be successful to improve waste concern and recycling behaviour.

Furthermore, the policy makers implementing measures that stimulate the social inclusion and cohesion can improve the level of civilness and the pro-social behaviour. At same time, these policies can increase the attitudes and pro-environmental behaviours and the quality of the environment in a determined area.

Twenty years on from the Ronchi Legislative Decree of 1997, further studies would appear required to establish to what extent Italian's environmental policy has played a role in increasing individuals' pro-environmental attitudes and behaviours and in "crowding out" pro-social behaviours.

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