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Maria Carmela Aprile*, Damiano Fiorillo*

* Parthenope University of Naples

Via Generale Parisi, 13 - 80132 –
Napoli (Italy) Tel. (+39) 081 547 42 36
Fax (+39) 081 547 42 50
URL: http://www.crisei.uniparthenope.it/DiscussionPapers.asp

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Abstract

Water conservation represents one important pro-environmental behavior for a sustainable environment. This paper investigates the link between water conservation behavior and general environmental concerns using a large dataset as the1998 wave of Multipurpose Household Survey conducted annually by the Italian Central Statistical Office. Univariate probit models show that *pollution* and *resource exhaustion* are positively related to individual water conservation behavior while *alteration of environmental heritage* exhibits a negative relationship with water saving behavior. These findings are robust to the inclusion of environment knowledge and social capital variables. The robustness analysis also indicates that television and radio, participation to environmental initiatives, money for environmental protection and churchgoing are significant determinants of water conservation behavior.

*JEL classification***:** Q25, Q50, C21, C25, Z00
*Keywords***:** Water conservation, environmental concerns, socio and economic characteristics, environmental knowledge, social capital, Italy

1. Introduction

Water has been identified as one of the most important natural resources and somewhat different from the rest, because it is viewed as a key to prosperity and wealth (Arbués et al. 2003). Water depletion and contamination are among the main environmental problems faced worldwide in the 21st century and water conservation represents important pro-environmental behavior for a sustainable way of life on the planet (Corral-Verdugo et al. 2003). Water is generally abundant within the European region, but it is also unevenly distributed both in time and space, with large areas experiencing levels of water scarcity and drought (EEA 2012). Moreover, the current state of Europe's water resources is perceived to be under increasing pressure from a range of external drivers, which contribute to reduce water availability and increase pollution, thereby affecting water quality. Socio-economic factors such as population growth, increased consumption, and land use enhance the imbalance between water demand and water availability. As a result of this increasing imbalance, water resources are expected to diminish in Europe (Metzger et al. 2006). Climate change also has a huge impact on water scarcity (Weiβ and Alcamo 2011). Many regions in southern and eastern Europe, as well as some in western Europe, are already experiencing severe drought during the summer. However, projections indicate a deterioration and also a northward extension of the problem in future. Because the most significant causes of the water problem arise from human behavior, the search for determinants of water conservation behavior is one of the main objectives of environmental sciences (Corral-Verdugo et al. 2008) which has attracted research attention across numerous disciplines, including psychology, sociology, political science and economics. A number of studies have suggested that water consumption behavior is mainly predicted by price, socio-demographic features, psychological factors and environmental knowledge. One key result of this research is that environmental concerns are correlated with water conservation behavior when concerns and behaviors are assessed at a corresponding level of specificity.

In this paper we consider environmental concerns as non-monetary incentives in order to investigate the relationship between water conservation behavior and general environmental concerns using a large survey that provides information about environmental concerns and behaviors in a Mediterranean country: Italy. To the best of our knowledge, the empirical assessment of the relationship between general environmental concerns and water conservation behavior has never been performed in Italy.

Our study contributes to the literature in several ways. First, we perform an econometric analysis of the relationship between general environmental concerns and water conservation behavior, when concerns and behavior are not assessed at the same corresponding level of specificity controlling for

socio-economic characteristics. Secondly, in line with the psychological environmental literature we consider two types of general environmental concerns, egoistic and altruistic, and set up economic empirical hypotheses linking general environmental concerns with water saving behavior. Finally, we also take into account the source of information about environment problems and social capital to perform robustness analysis. Indeed, environmental knowledge and social capital may have simultaneous effects on general environmental concerns and water conservation behavior (Vicente-Molina et al. 2013; Owen and Videras 2007).

In the empirical analysis we use a dataset of approximately 41,000 individuals from the Multipurpose Household Survey (MHS) conducted annually by the Italian Central Statistics Office (ISTAT). We consider the year 1998 for an important reason: in this year there was no promotional campaign to inform the population about the importance of environmental issues. Thus people's sensibility to environmental problems was exclusively influenced by their own way of being.

In the ISTAT dataset respondents are asked about the frequency with which they save water at home. Our dependent variable *water conservation behavior* is a dummy variable equal to 1 for individuals who always save water, 0 otherwise. The key independent variables are general environmental concerns. We identify four variables that measure general environmental concerns: (EC1) *pollution* (noise, air, soil, water, electromagnetic); (EC2) *climate change* (greenhouse effect, climate change); (EC3) *resource exhaustion* (destruction of forests, depletion of natural resources); (EC4) *alteration of environmental heritage* (species extinction, destruction of the landscape).

Using univariate probit models we show that *pollution* and *resource exhaustion* are positively related to individual water conservation behavior while *alteration of environmental heritage* exhibits a negative relationship with water saving behavior. The former result may indicate that when an individual perceives general environmental issues as a threat to his/her own welfare as well as the welfare of the group which he/she is part of, the individual will save water at home. The latter finding may point out that when an individual perceives that general environmental issues are a threat to his/her group's welfare but thinks that for the others this is not so, then the individual will not save water. These findings are robust to the inclusion of the source of information about environment problems and social capital variables. Robustness investigation shows that specific sources such as television and radio, participation in environmental initiatives, supporting environmental protection with money and churchgoing are also significant determinants of water conservation behavior.

The paper is organized as follows. Section 2 contains a review of the related literature while Section 3 presents the empirical hypothesis. Section 4 describes the data and presents the empirical strategy. Sections 5 and 6 illustrate and discuss the econometric results.

2. Literature review

A large body of economic and social research has investigated the factors influencing water use behavior. Previous research has focused on specific areas of interest in attempting to define the determinants of water saving behavior. These areas are: i) water price; ii) socio-demographic features; iii) belief, attitude and concern; iv) environmental knowledge.

Water price

Price and economic incentives relate to the extent to which individuals believe price is a significant variable in reducing water conservation (Syme et al. 2000; Gilg and Barr 2006). Although price influences water demand, most research has found water demand rather price inelastic (Barrett 2004; Hoffman 2006; Clark and Finley 2007; Worthington and Hoffman 2008; Schleich and Hillenbrand 2009). This is because water has no substitutes for basic uses and water bills represent a small proportion of income (Arbuès et al. 2003).

Socio-demographic features

Socio-demographic characteristics examined include both individual characteristics, such as age, education, income, household composition and tenancy (Hamilton 1983; Berk et al. 1993; De Oliver 1999; Loh and Coghlan 2003; Campbell et al. 2004; Gilg et al. 2005; Willis et al. 2013); and property characteristics, such as house size and house age (Cavanagh et al. 2002; Olmstead et al. 2003; Syme et al. 2004).

With specific reference to individual characteristics, most studies that have examined age as a determinant of water conservation have found that older people are more likely to be water conservers (Gregory and Di Leo 2003; Gilg and Barr 2006; Clark and Finley 2007). Gregory and Di Leo (2003), who investigated water conservation behavior as a function associated with different experiences of generations, suggest that age may be positively related to water conservation while Gilg and Barr (2006) who analyzed the individual characteristics of different types of water savers pointed out that the most committed to water saving in the home were people with the highest age. Similar results are reported by Clark and Finley (2007). Inconsistencies emerge from the research investigating the impact of education on water conservation behavior. Some researchers report a positive relationship between education and water conservation (De Oliver 1999; Gilg and Barr 2006; Lam 2006). Thus, people who are more committed to water conservation are also more highly educated. Conversely, other researchers show an inverse relationship. In particular, they found that it is less educated individuals that show both more water conservation behavior and higher water conservation intentions (Gregory and Di Leo 2003; Clark and Finley 2007). Results from studies that examine income as a determinant of water conservation behavior are more

consistent. Research generally shows that individuals with higher income levels consume more water (Arbuès and Villanua 2006; Russell and Fielding 2010; Willis et al. 2013). Past research has also identified household size as a relevant variable influencing water consumption behavior. Makki et al. (2013) who explore the predominant determinants of water consumption show that the number of children and teenagers in a household is the most important characteristic influencing the increased water consumption. These findings are consistent with those of Randolph and Troy (2008) who found that households with children are the biggest users of water. Gregory and Di Leo (2003) have demonstrated a positive relationship between the number of residents and water use. More residents in a household explained a higher proportion of water consumption. Moreover, Gilg and Barr (2006) found that committed environmentalists who tended to have smaller households were more likely to engage water conservation behavior. However, Willis et al. (2013) demonstrated the opposite results. Their study indicates that there is a general decrease in water consumption per capita as family size increases. It was found that the kind of houses people live in and whether they are homeowners are additional factors that may influence water conservation behavior. Studies have found that individuals who live in detached houses report higher saving behavior (Gilg and Barr 2006; Clark and Finley 2007). Randolph and Troy (2008) showed that home owners are likely to have a direct control over their homes and are in a better position to undertake refitting through the installation of new appliances that can assist in lowering overall water use. In contrast, residential tenants have less control over practical conservation methods and do not know how much water they use as their water consumption is usually paid as part of the service charge payment. These findings suggest that homeowners are more likely to engage in more efficient behaviors, compared to tenants.

Belief, attitude and concern

Belief, attitude and concern have been perceived as predictors of water conservation behaviors. Within the (environmental) psychological literature, belief is conceptualized as a person's worldview which reflects beliefs about the relationship of people with the natural world (Scott and Willits 1994; Schultz et al. 2004; Russell and Fielding 2010). Attitude is determined by strengths of beliefs about consequences of behaviors and evaluations of such consequences (Ajzen 1989, 1991; Ajzen and Fishbein 2000). Environmental concern is treated as an attitude toward facts, one's own behavior, or others' behavior with consequences for the environment (Weigel 1983; Takala 1991; Bamberg 2003). Environmental concern may refer to either a specific attitude directly determining behaviors, or more broadly to a general attitude or value orientation (Stern 1992; Stern et al. 1993, 1995; Fransson and Garling 1999; Schultz 2000, 2001; Russell and Fielding 2010). These studies identify three different general attitudes:

(i) in the first case, environmental concern represents a new way of thinking called the New Environmental Paradigm (NEP). The NEP seeks to measure people's general environmental beliefs and their ecological worldview on a survey scale. The scale measures beliefs about the limits of nature and resources, human impacts on the balance of nature, humans' right to dominate over nature and the potential for ecological catastrophe. The works of Corral-Verdugo et al. (2003) and Corral-Verdugo et al. (2008) used the NEP survey scale to investigate the relationship between general environmental beliefs and water conservation behavior. In the first study general environmental beliefs were not found to be predictors of water consumption behavior while, in the second study, general environmental beliefs were shown to be drivers of water saving. Also Willis et al. (2011) used a survey scale on environmental issues showing, through cluster analysis, a positive link between general environmental attitudes and water conservation behavior.

(ii) In a second value orientation, environmental concern is tied to altruism: people care about environmental quality because they belief that a degraded environment poses a threat to people's health. Hence, it is the threat to wellbeing of people that is of central concern. In other words, a person judges environmental problems on the basis of the costs or benefits for other people, be they individuals, a neighborhood, a social network, a country or all humanity (Black et al. 1985; Hopper and Nielsen 1991; Schultz 2000). Stern et al. (1993) show that a person with an altruistic environmental concern has a higher pro-environmental behavior.

(iii) According to a third value orientation, environmental concern expresses self-interest: it is the perceived personal threats caused by environmental deterioration which is the important factor in underlying environmentally responsible behavior. Hence, self-interest may predispose a person to protect aspects of the environmental that affect him/her personally or to oppose protection of the environment if the personal costs are perceived as high (Stern and Dietz 1994). However, Stern et al. (1993, 1995) found a positive relationship between self-interested environmental concern and pro-environmental behavior.

Environmental knowledge

Most studies view environmental knowledge as antecedence of environmental concerns (Bamberg 2003). In particular, it has been found that the level of environmental knowledge could be crucial in turning individuals' behavior toward sustainability (Adomssent 2013; Bradley et al. 1999; Szerényi et al. 2009). People who have greater knowledge of environmental problems and their causes will become more motivated to act toward the environment in more responsible ways (Barber et al. 2009). Conversely, lack of knowledge or the holding of contradictory information might limit pro-environmental behavior (Vicente-Molina et al. 2013). However, as reported in Vicente-Molina et al. (2013), although the theoretical literature states that knowledge might play a significant role in pro-

environmental behavior, the empirical evidence is not clear. Some studies find no close relationship between environmental knowledge and pro-environmental behavior (Bartiaux 2008; Laroche et al. 2001; Maloney and Ward 1973). Others show that a deeper knowledge of environmental issues increases the likelihood of people taking action to protect the environment (Kaiser and Fuhrer 2003; Kollmuss and Agyeman 2002; Mobley et al. 2010). Specifically, according to Stern (1992), when individuals who are more actively engaged in environmental issues are compared to less actively engaged individuals, the factor which most clearly differentiates between the groups is knowledge about the specific problem and how to act in order to most effectively deal with it. Grob (1995) finds that the more people know about environmental problems, the more appropriately they will behave. This hypothesis is supported by Kaiser et al. (1999) who suggest that environmental knowledge has predictive power in terms of pro-environmental behavior. In a specific study on water conservation, Clark and Finley (2007) sought to identify the relationship between specific knowledge of environmental problems and water conservation behavior, finding that individuals who reported greater awareness of environmental problems also reported greater conservation actions.

It is worth pointing out that general knowledge about environmental issues is often acquired through the education system (García – Valiñas et al. 2010). The literature agrees in describing such a source of environmental knowledge as formal education. In particular, some studies suggest that formal education aims to raise concern for the environment and provide individuals with the knowledge and skills required to tackle environmental problems and prevent new ones (Oğuz et al. 2010). However, the literature on environmental knowledge also recognizes the importance of informal education channels such as media (watching television or reading magazines), the Internet or social interactions in influencing people's environmental behavior. Through these channels people can learn more about environmental problems and increase their environmental responsibility (Chan 1998; Thamwipat et al. 2012; Adomssent 2013). It was found that the media generate social norms in individuals, which influence pro-environmental behavior through attitudes and behavioral intentions (Bamberg and Moser 2007). The role of both formal and informal education is analyzed by Vicente-Molina et al. (2013) who investigate the influence of environmental knowledge on pro-environmental behavior among university students from countries with different levels of economic development. Research findings suggest that while knowledge from the formal education system influences environmental behavior, attitude and informal education are not relevant variables.

3. The present study

The starting point of the present paper is the approach of Stern and colleagues regarding egoistic and altruistic general environmental concerns. We try to apply this approach in economic terms with the aim of building empirical hypotheses with which to study the relationship between general environmental concerns and water conservation behavior in Italy.

We consider two types of environmental concerns: egoistic and altruistic. Individuals with egoistic environmental concerns take care of their own welfare. In the absence of economic incentives (penalties) they are not prone to adopt water conservation behavior. However, such people may become water conservation individuals if general environmental problems are perceived to affect their own welfare by increasing the personal costs of environmental degradation. In this context, individuals would reduce water consumption with the aim of internalizing future personal costs. In other words, if individuals with egoistic environmental concerns perceive general environmental issues as a threat to their own welfare through an increasing in personal costs, they would internalize such costs by engaging with water conservation behavior. Based on this argument, we pose the first empirical hypothesis:

H1: We would expect a positive correlation between egoistic environmental concerns and water conservation behavior if general environmental issues are perceived as a threat to own welfare.

Individuals with altruistic environmental concerns take care of the welfare of others. In the absence of economic incentives they save water because, for these people, the group's benefits linked to water conservation are higher than personal costs. According to this model, altruistic environmental concerns are positively correlated with water conservation behavior. Hence, we set up the second empirical hypothesis:

H2: We would expect a positive correlation between altruistic environmental concerns and water conservation behavior if general environmental issues are perceived as a threat to the group's welfare.

However, individuals with altruistic environmental concerns may not save water if they perceive that group's members will behave as free riders, i.e. they will not engage water conservation behavior. In this case, there would be a negative correlation between altruistic environmental concerns and water conservation behavior. Therefore, we advance the third empirical hypothesis.

H3: We would expect a negative correlation between altruistic environmental concerns and water conservation behavior if individuals perceive that group's members will behave as free riders.

4. Data and empirical method

The empirical analysis uses the 1998 wave of the Multipurpose Household Survey (MHS) conducted annually by the Italian Central Statistics Office. This large dataset is one of the best available for studying pro-environmental behaviour in a cross-section framework as it investigates a wide range of behaviours by means of face-to-face interviews on a sample of about 20,000 households corresponding to about 60,000 individuals. The 1998 wave is a unique dataset because it includes 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 about 41,000 observations. Table 1 shows definitions of the variables used in the econometric analysis with weighted summary statistics.

Water conservation behavior

The 1998 wave of the MHS includes a section devoted to environmental issues. This section is used to identify the measure of pro-environmental behavior, i.e. water conservation behavior. The dependent variable *water conservation behavior* (WCB) is measured by the question "How often are you careful in not wasting water at home?" where possible responses are: yes always, yes sometimes, never. Responses are re-coded into a binary variable which is equal to 1 in cases of "yes always" and 0 otherwise. As we can see in Table 1, more than half of the respondents in our sample adopt water conservation behavior at home.

Table 1. Weighted descriptive statistics

Variable	Description	Mean	Std. Dev.
Dependent variables			
Water conservation	=1 if the respondent always saves water at home	0.54	0.50
Key independent variables: environmental concerns			
EC1. Pollution	0-5 scale: air, soil, water, electromagnetic, noise	1.38	0.98
EC2. Climate change	0-2 scale: greenhouse effect, climate change	0.96	0.71
EC3: Resource exhaustion	0-2 scale: depletion of natural resources, destruction of forests	0.42	0.58
EC4. Alteration of env. heritage	0-2 scale: extinction of species, destruction of the landscape	0.33	0.53
Source of information about the environment problems			
Tv and radio	= 1 if respondent follows programs on environmental issues on TV and the radio	0.35	0.47
Magazines and books	= 1 if respondent reads news on environmental issues in newspapers, magazines and books	0.26	0.44
Conferences	= 1 if respondent attends environmental conferences	0.02	0.15
Member	=1 if respondent is a member of environmental associations	0.01	0.11
Initiatives	=1 if respondent takes part in initiatives of environmental associations	0.01	0.11
Money	=1 if respondent gives money for environmental protection	0.01	0.10
Demographic and socio-economic characteristics			
Judgment on water rates	= 1 if the respondent values water rates high	0.45	0.50
Female	= 1 if female. Reference group: male	0.51	0.50
Married	= 1 if married. Reference group: single	0.59	0.49
Divorced	= 1 if separated/divorced	0.03	0.17
Widowed	= 1 if widowed	0.06	0.23
Age31-40	= 1 if age between 31 and 40. Reference group: age 16-30	0.18	0.38
Age41-50	= 1 if age between 41 and 50	0.17	0.38
Age51-60	= 1 if age between 51 and 60	0.15	0.36
Age61-70	= 1 if age between 61 and 70	0.13	0.34
Age71-80	= 1 if age between 71 and 80	0.08	0.27
Household size	Number of people who live in family	3.36	1.27
Children0_5	1 = if children aged between 0 and 5 years. Reference group: no children	0.13	0.40
Children6_12	1 = if children aged between 6 and 12 years	0.18	0.46
Children13_17	1 = if children aged between 13 and 17 years	0.24	0.51
Low education	= 1 if no education, completed elementary school and completed junior high school**.** Reference group: high school (diploma)	0.61	0.49
Bachelor's degree	= 1 if university degree and/or doctorate	0.07	0.26
Household income (ln)	Natural logarithm of household income	10.71	0.45
Good health	= 1 if self-perceived health is good	0.76	0.43
Homeowner	= 1 if homeowner	0.72	0.45
No. of rooms	Number of rooms between 1 and 15	4.53	1.63
Entrepreneur	= 1 if entrepreneur	0.05	0.22
Employed	= 1 if employed	0.43	0.49
Unemployed	= 1 if unemployed. Reference group: other status	0.07	0.26
Retired	= 1 if retired	0.19	0.39
Size of municipality			
Metropolis	= 1 if metropolitan area. Reference group: <2,000 inhabitants	0.22	0.42
Neighboring 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
2,000-10,000	= 1 if between 2,000 and 10,000 inhabitants	0.24	0.43
Social capital			
Volunteering membership	= 1 if passive and/or active participation in voluntary associations	0.10	0.30
Church attendance	= 1 if church attendance one or more a week	0.34	0.47

Table 2. Weighted correlation matrix between water conservation behavior and environmental concerns

	EC1	EC2	EC3	EC4
WCB	0.012**	0.004	0.007	-0.028**

Note:

** denotes that the coefficient is statistically different from zero at 5 percent.

General environmental concerns

A series of major environmental issues in the 1998 wave of the MHS captures individual concerns on the quality of the environment. The answers to the multiple choice question "What are the worrying environmental problems?" are used as proxies for general environmental concerns. Respondents could choose five answers among the following: (i) greenhouse effect; (ii) species extinction; (iii) climate change; (iv) noise; (v) air pollution; (vi) soil pollution; (vii) water pollution; (viii) destruction of forests; (ix) electromagnetic pollution; (x) destruction of landscape; (xi) depletion of natural resources.

We consider environmental concerns linked to four specific issues. We add 1 to the environmental concern variable when the respondent states that he/she agrees with the related environmental issue. The four general environmental concerns variables are:

EC1. *Pollution* (noise; air, soil, water, electromagnetic);

EC2. *Climate change* (greenhouse effect, climate change);

EC3. *Resource exhaustion* (destruction of forests, depletion of natural resources);

EC4. *Alteration of environmental heritage* (species extinction, destruction of the landscape).

With reference to concern on pollution, we focus on the types of environmental pollution with the hugest effects on human health and the alteration of biodiversity (Kampa and Castenas, 2008; Passcher-Vermeer and Passcher, 2000; Ising and Kruppa, 2004; Vörösmarty et al., 2010; Oliver, 1997; Balmori, 2009). People's awareness about the direct effects of pollution on their health and the environmental setting in which they live led us to interpret people's concern with pollution as an egoistic environmental concern.

As regards the environmental concern labeled as climate change, we consider both climate change and the greenhouse effect. Past studies have found that the majority of people in industrialized countries are increasingly aware of and concerned about climate change and the greenhouse effect (Leiserowitz, 2007; Tobler et al., 2012), which are expected to bring about major change in freshwater availability, the productive capacity of soils, and patterns of human settlement (Raleigh, Urdal, 2007). Uncertainty around future risk scenarios increases people's concern that future generations will not be able to make use of the stock of natural resources, which ensures well-being for the present. Moreover, it was also demonstrated that people's perception of climate change

influences their level of concern, which affects their motivation to act (Swim et al., 2009). In line with this assumption, some studies indicate that concern about climate change increases consumers' willingness to modify their behaviors (Semenza et al., 2008). Consistent with these assumptions, we assume people's concern on climate change as an altruistic environmental concern.

Among environmental concerns, we view resource exhaustion as a specific concern influenced by the assumption that resource depletion may threaten the welfare of future generations. Indeed, several scholars contend that the earth cannot for long continue to support current and anticipated levels of demand for both exhaustible and renewable resources (Tilton, 1996). In line with people's perception that natural resources depletion represents a dangerous threat to the welfare of future generations, we interpret people's concern on resource exhaustion as an altruistic environmental concern.

Lastly, we consider people's concern on the alteration of environmental heritage. We use the expression 'environmental heritage' to indicate the complexity of elements that form the natural capital. The natural capital performs two kinds of functions. The first is directly relevant to the production process. The other, which is defined as the environmental one, comprises basic life-support functions that are guaranteed by the conservation of biological and genetic diversity, such as wild plants and animals. Moreover, environmental functions contribute to human welfare through amenity services, such as the beauty of wilderness and landscape (Pearce and Turner, 1990). Both life-support functions and amenity services are produced directly by natural capital independently of human activity, but human activity can have an (often negative) effect on these functions (Ekins et al., 2003). Based on these assumptions of the economic theory, we focus on extinction of natural species and destruction of landscape perceived by people as negative effects produced by human activity on the environmental heritage at the expense of both present and future generations. Thus, we read people's concern on the alteration of environmental heritage as an altruistic concern.

The sample average as well as the standard deviation of the variables are reported in Table 1. Means of these scales indicate that the highest levels of concern are for pollution (mean = 1.38) and climate change (mean = 0.98), followed by resource exhaustion (mean = 0.42). The lowest level is for alteration of environmental heritage (mean = 0.33).

It is important to point out that in line with the environmental literature in our study environmental concerns and pro-environmental behavior are not assessed at the same level of specificity, i.e. in our dataset we have general environmental concerns and not specific water environmental concerns. Although WCB and EC are not assessed at the same level of specificity, as pointed out by some descriptive studies (see Corral-Verdugo et al. 2003), our descriptive results show statistically significant correlations among WCB, EC1 and EC4 (Table 2).

Demographic and socio-economic characteristics

In order to consider factors, which might influence both water conservation behavior and environmental concerns we focus on some demographic and socio-economic characteristics. Specifically, we concentrate on the following features: (i) assessment of respondents on water rates as a proxy of water price; (ii) gender (*female* and *male* as the reference category); (iii) marital status including categories for *married*, *divorced* and *widowed* against a base category of being single; (iv) age (*31-40*, *41-50*, *51-60*, *61-70*, *71-80*, with *age16-30* used as reference group); (v) the number of individuals living in the household (*household size*); (vi) age of children (*Children0_5*, *Children6_12*, *Children13_17*); (vii) level of education (*low education*, *bachelor's degree*, with *high school* being the reference category); (viii) household income (h*ousehold income (ln)*); (ix) self-reported good health (*good health*); (x) tenure status (*homeowner*); (xi) number of rooms; (xii) employment status (*unemployed*, *entrepreneur*, *employed*, *retired* with other status utilized as reference category). The average respondent in the sample is married, poorly educated (elementary school and/or junior high school completed), is in good health and a homeowner.

Moreover, we also consider the size of the municipality (*metropolis*, *neighboring metropolis*, *>50,000*, *10,000-50,000*, *2,000-10,000* with *<2,000* 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.

Source of information about environmental problems

Environmental knowledge is measured by the question "How do you keep informed about environmental issues?". Specifically, we consider the following sources: TV and radio; magazines and books; attending conferences; membership of environmental associations; involvement in environmental initiatives; supporting environmental protection with money. On the basis of respondents' answers, we build binary variables (= 1 if the answer is yes, 0 otherwise).

Table 1 shows that 35% of the respondents are informed on environmental issues by television and radio programs, while 25% of the interviewees usually read information in newspapers, magazines and books. Only a minority of respondents (1%) use, as sources of information on environmental issues, their *membership of environmental associations, involving in environmental initiatives, and supporting environmental protection with money*.

Social capital

Social capital has also been underlined as a significant factor influencing pro-environmental behavior (Torgler and García-Valiňas 2007; Owen and Videras 2007, 2012; Fiorillo 2013). Torgler and García-Valiňas (2007) study the determinants of individuals' attitudes toward preventing

environmental damage in Spain, finding that trust and membership in voluntary environmental organizations have a strong impact on individuals' preferences to avoid environmental damage. Owen and Videras (2007) using OECD data show that individuals who are more willing to behave according to moral norms are also more willing to protect the public good of the natural environment while Videras et al. (2012), with US datasets, extend Owen and Videras' (2007) findings to social ties.

We build a variable according to membership in associations. *Volunteering membership* is a binary variable equal to one if the individual is a passive member (the individual participates in association meetings) and/or an active member (the individual does unpaid work) in volunteering associations. On average, about 10% of the respondents participate in voluntary associations. Moreover, we also take account of a *church attendance* variable measured through a dummy variable which is equal to one it the respondent goes to a church or another place of worship one or more times a week. According to Owen and Videras (2007), religious traditions include world views, ethical precepts and spiritual elements that shape perceptions about the natural environment and can act as guiding principles regarding how our acts and choices affect nature. The sample mean of this variable is 0.34.

Empirical model

The empirical model of water conservation behavior can be represented through the following estimation equation:

$$WCB_i^* = \alpha + EC_i'\beta + \lambda Y_i + Z_i'\delta + \varepsilon_i \quad (1)$$

where WCB^* is the water conservation behavior of the respondent i; EC are the environmental concerns variables defined at the individual level; Y is annual household income; the Z matrix consists of the other variables that are known to influence water conservation behavior and ε is a random-error term.

We do not observe the "latent" variable WCB^* in the data. Rather, we observe WCB as a binary choice which takes value 1 if the respondent always saves water at home. Thus, the structure of (1) makes it suitable for estimation as a probit model:

$$\Pr(WCB_i = 1) = \Phi(\alpha - EC_i'\beta - \lambda Y_i - Z_i'\delta) \quad (2)$$

where $\Phi(\cdot)$ is the cumulative distribution function of a normal standard.

5. Econometric results

The findings of econometric analysis are divided into three sections. In the first section, the basic relationship between water conservation behavior and environmental concerns are considered. In the second, the socio-economic determinants of water saving behavior are examined. In the last section, a robustness analysis is performed with factors linked to pro-environmental behaviors, such as the source of information about environmental issues and social capital.

5.1. Environmental concerns

In Table 2, Columns (I) – (V) present the probit estimations of Eq. (2), marginal effects and standard errors (in brackets) are corrected for heteroskedasticity, using as a dependent variable water conservation behavior, as key independent variables general environmental concerns and as control variables all socio-economic characteristics variables.

Let us discuss first the basic results on general environmental concerns variables. Through columns (I) – (V) we observe that all such variables, i.e. *pollution*, *climate change*, *resource exhaustion* and *alteration of environmental heritage*, are statistically significant at the 1 percent level but with a different sign. A greater concern for pollution, climate change and resource exhaustion is related to a higher likelihood that the respondent saves water at home. A greater concern for alteration of environmental heritage is linked to a higher probability of the individual's water conservation behavior diminishing.

Table 2. Probit results: marginal effects of the basic determinants of water conservation behavior

	I	II	III	IV	V
EC1. Pollution	0.008(0.002)***				0.009(0.003)***
EC2. Climate change		0.010(0.003)***			0.011(0.003)***
EC3. Resource exhaustion			0.016(0.004)***		0.018(0.004)***
EC4. Alteration of env. heritage				-0.016(0.005)***	-0.015(0.005)***
Judgment on water rates	0.031(0.005)***	0.031(0.005)***	0.031(0.005)***	0.031(0.005)***	0.031(0.005)***
Female	0.011(0.005)**	0.011(0.005)**	0.011(0.005)**	0.011(0.005)**	0.011(0.005)**
Married	-0.033(0.009)***	-0.033(0.009)***	-0.033(0.009)***	-0.032(0.009)***	-0.034(0.009)***
Divorced	-0.071(0.015)***	-0.071(0.015)***	-0.071(0.015)***	-0.071(0.015)***	-0.071(0.015)***
Widowed	-0.070(0.014)***	-0.070(0.014)***	-0.070(0.014)***	-0.070(0.014)***	-0.070(0.014)***
Age31-40	0.037(0.009)***	0.037(0.009)***	0.037(0.009)***	0.037(0.009)***	0.038(0.009)***
Age41-50	0.057(0.010)***	0.057(0.010)***	0.057(0.010)***	0.056(0.010)***	0.058(0.010)***
Age51-60	0.075(0.011)***	0.076(0.011)***	0.076(0.011)***	0.075(0.011)***	0.077(0.011)***
Age61-70	0.126(0.012)***	0.127(0.012)***	0.127(0.012)***	0.125(0.012)***	0.128(0.012)***
Age71-80	0.155(0.014)***	0.156(0.014)***	0.157(0.014)***	0.153(0.014)***	0.159(0.014)***
Household size	-0.027(0.003)***	-0.027(0.003)***	-0.027(0.003)***	-0.027(0.003)***	-0.027(0.003)***
Children0_5	0.042(0.008)***	0.042(0.008)***	0.042(0.008)***	0.041(0.008)***	0.041(0.008)***
Children6_12	0.043(0.006)***	0.043(0.006)***	0.043(0.006)***	0.043(0.006)***	0.043(0.006)***
Children13_17	-0.031(0.006)***	-0.031(0.006)***	-0.031(0.006)***	-0.031(0.006)***	-0.032(0.006)***
Low education	0.015(0.006)**	0.015(0.006)**	0.015(0.006)**	0.014(0.006)**	0.016(0.006)**
Bachelor's degree	0.013(0.010)	0.014(0.010)	0.014(0.010)	0.014(0.010)	0.014(0.010)
Household income (ln)	-0.023(0.010)**	-0.023(0.010)**	-0.024(0.010)**	-0.022(0.010)**	-0.025(0.010)***
Good health	-0.016(0.006)**	-0.016(0.006)**	-0.016(0.006)**	-0.015(0.006)**	-0.016(0.006)***
Homeowner	0.026(0.007)***	0.026(0.007)***	0.026(0.007)***	0.026(0.007)***	0.026(0.007)***
No. of rooms	-0.004(0.002)**	-0.004(0.002)**	-0.004(0.002)**	-0.004(0.002)**	-0.004(0.002)**
Entrepreneur	-0.036(0.012)***	-0.036(0.012)***	-0.037(0.012)***	-0.036(0.012)***	-0.036(0.012)***
Employed	-0.010(0.007)	-0.011(0.007)	-0.010(0.007)	-0.011(0.007)	-0.010(0.007)
Unemployed	0.026(0.010)**	0.026(0.010)**	0.027(0.010)**	0.026(0.010)**	0.026(0.010)**
Retired	0.020(0.009)**	0.020(0.009)**	0.020(0.009)**	0.020(0.009)**	0.019(0.009)**
Metropolis	0.013(0.010)	0.014(0.010)	0.013(0.010)	0.013(0.010)	0.013(0.010)
Neighboring metropolis	-0.000(0.013)	0.000(0.013)	-0.000(0.013)	-0.000(0.013)	-0.000(0.013)
>50,000	0.008(0.011)	0.009(0.011)	0.008(0.011)	0.008(0.011)	0.008(0.011)
10,000-50,000	0.014(0.010)	0.014(0.010)	0.014(0.010)	0.014(0.010)	0.014(0.010)
2,000-10,000	0.015(0.010)	0.015(0.010)	0.014(0.010)	0.014(0.010)	0.015(0.010)
Regional dummies	Yes	Yes	Yes	Yes	Yes
No. of observations	40,321	40,321	40321	40321	40321
Pseudo R-squared	0.022	0.022	0.022	0.022	0.023
Log-likelihood	-27,153.98	-27,154.27	-27,151.89-	-27,152.62	27,136.00

Notes: The dependent variable *water conservation behavior* takes value 1 if the respondent always saves water at home. The models are estimated with standard probit. Regressors' legend: see Table 1. Regional dummies are omitted from the Table for reasons of space. The standard errors are corrected for heteroskedasticity. The symbols ***, **, * denote that the coefficient is statistically different from zero at 1, 5 and 10 %, respectively.

Since we have interpreted *pollution* as an egoistic environmental concern and respectively *climate change*, *resource exhaustion* and *alteration of environmental heritage* as altruistic environmental concerns (Section 4), the findings on EC1-EC4 seem to fit the empirical hypothesis H1, H2, and H3 of Section 3. The results on *pollution* may indicate that when the respondent perceives general environmental issues as a threat to his/her own welfare, the individual will save water at home. Moreover, *climate change* and *resource exhaustion* may point out that if the respondent perceives general environmental issues as a threat to the welfare of the group he/she takes part in, he/she will save water at home, too. Instead, if the individual perceives general environmental issues as a threat to the group's welfare he/she takes part in but thinks that for the others this is not so, then he/she will behave as a free rider and will not save water. This seems the case of the finding about *alteration of environmental heritage,* which fits hypothesis H3 of Section 3.

5.2. Socio-economic characteristics

The marginal effects of all socio-economic features variables are reported in Table 2, Columns (I) – (V). We discuss those variables that have a statistically significant sign.

The respondent's opinion on water cost has a positive relationship with water saving behavior, significant at the 1 percent level. Although the data do not provide information on water fees but only on the individual's assessment about the cost of water consumption at home, this finding seems to point out that the higher the individual judges water rates to be, the greater the likelihood of him/her reducing water consumption.

The results on gender and marital status indicate that females are more water-saving than males, while the married, divorced and widowed save less water than single people. The marginal effect on *female* presents a positive sign and is statistically significant at the conventional level whereas the marginal effects on all marital status variables have a statistically significant negative sign at the 1 percent level. Previous research on gender found similar differences (Arcury and Johnson, 1987; Davidson and Frendenburg, 1995; Vicente-Molina et al., 2013).

A statistically significant linear relationship is observed between age dummies and water conservation (at the 1% level): older people are more likely to be water savers. These results are in line with previous studies (Gregory and Di Leo 2003; Gilg and Barr 2006; Clark and Finley 2007). The evidence in Table 2 shows that the likelihood of being a water saver decreases with family size and the presence of teenagers. The marginal effects on *household_size* and *children13_17* have a statistically significant negative sign (at the 1% level). These findings are consistent with one strand of the literature (Gregory and Di Leo 2003; Randolph and Troy 2008; Makki et al. 2013). On the other hand, having children aged between 0 and 12 raises the probability of being water savers: the

marginal effects on *children0_5* and *children6_12* present a statistically significant positive sign at the 1 percent level.

Regarding education, in line with some previous studies described in Section 2, *low education* shows a positive and significant correlation with water conservation (at the 1% level). Hence, we find that individuals who are more committed to water conservation are not those who are more highly educated. Household income has a significant and negative relationship with water saving. Individuals with higher income consume more water. This result is consistent with previous research reviewed in Section 2.

Water conservation behavior is also influenced by home ownership and number of rooms. Results in Table 2 show that homeowners are more likely to engage in water saving (significant at the 1% level). On the other hand, having a house with a large number of rooms raises the probability of consuming water (significant at a conventional level).

Perceived health and employment status are also significant determinants. An individual who perceives his/her health status as good is less likely to save water at home. With regard to employment status, being an entrepreneur is correlated with a higher probability of consuming water (significant at the 1% level) while being unemployed and retired is linked with a higher likelihood of saving water (significant at a conventional level).

5.3. Robustness analysis

A potential problem with the interpretation of the previous findings may be omitted variables bias, i.e. other factors might cause both a high propensity to save water and to increase their own concerns about environmental quality. Here, we regard this issue by adding further control variables. First of all, we take into account six sources of information about the environmental problems. As reviewed in Section 2, a greater knowledge of environmental problems increases the likelihood that individuals take action to protect the environment. Second, we consider two variables intended to capture additional relational aspects of individual behavior, namely membership of volunteering associations and churchgoing, which previous empirical investigations found to be correlated with pro-environmental behaviors (see Section 2). Table 3 reports the results for environmental knowledge variables (I), social capital variables (II) and all control variables (III).

Table 3. Probit results: marginal effects of robustness analysis with environmental knowledge variables (I), social capital variables (II) , environmental knowledge, social capital and all control variables (III)

	I	II	III
Pollution	0.006(0.003)**	0.009(0.003)***	0.006(0.003)**
Climate change	0.006(0.004)*	0.010(0.004)***	0.006(0.004)
Resources exhaustion	0.012(0.004)***	0.018(0.004)***	0.012(0.004)***
Alteration of env. heritage	-0.021(0.005)***	-0.015(0.005)***	-0.021(0.005)***
Tv and radio	0.054(0.007)***		0.053(0.007)***
Magazines and books	0.004(0.008)		0.005(0.008)
Conferences	0.008(0.017)		0.007(0.018)
Member	-0.018(0.025)		-0.018(0.025)
Initiatives	0.050(0.025)**		0.052(0.025)**
Money	0.065(0.024)***		0.064(0.024)***
Volunteering member.		0.003(0.009)	-0.003(0.009)
Church attendance		0.040(0.006)***	0.040(0.006)***
Judgment on water fees	0.032(0.005)***	0.030(0.005)***	0.031(0.005)***
Female	0.011(0.005)**	0.005(0.006)	0.005(0.006)
Married	-0.035(0.009)***	-0.035(0.009)***	-0.036(0.009)***
Divorced	-0.071(0.015)***	-0.068(0.015)***	-0.068(0.015)***
Widowed	-0.073(0.014)***	-0.073(0.014)***	-0.075(0.014)***
Age31-40	0.037(0.009)***	0.038(0.009)***	0.038(0.009)***
Age41-50	0.056(0.010)***	0.056(0.010)***	0.054(0.010)***
Age51-60	0.076(0.011)***	0.073(0.011)***	0.073(0.011)***
Age61-70	0.130(0.012)***	0.123(0.013)***	0.125(0.013)***
Age71-80	0.165(0.014)***	0.155(0.014)***	0.160(0.014)***
Household size	-0.024(0.003)***	-0.025(0.003)***	-0.023(0.003)***
Children0_5	0.040(0.008)***	0.042(0.008)***	0.041(0.008)***
Children6_12	0.041(0.006)***	0.040(0.006)***	0.038(0.006)***
Children13_17	-0.033(0.006)***	-0.034(0.006)***	-0.035(0.006)***
Low education	0.021(0.006)***	0.016(0.006)**	0.021(0.006)***
Bachelor's degree	0.009(0.010)	0.013(0.010)	0.007(0.010)
Household income (ln)	-0.035(0.010)***	-0.027(0.010)***	-0.037(0.010)***
Good health	-0.018(0.006)***	-0.015(0.006)**	-0.016(0.006)***
Homeowner	0.028(0.007)***	0.025(0.007)***	0.027(0.007)***
Number rooms	-0.004(0.002)**	-0.005(0.002)***	-0.005(0.002)***
Entrepreneur	-0.035(0.012)***	-0.034(0.012)***	-0.033(0.012)***
Employed	-0.007(0.007)	-0.007(0.007)	-0.004(0.007)
Unemployed	0.028(0.010)***	0.029(0.010)***	0.031(0.010)***
Retired	0.019(0.009)**	0.019(0.009)**	0.019(0.009)**
Metropolis	0.013(0.010)	0.011(0.011)	0.010(0.011)
Neighboring metropolis	-0.001(0.013)	-0.002(0.013)	-0.002(0.013)
>50,000	0.007(0.011)	0.006(0.011)	0.005(0.011)
10,000-50,000	0.013(0.010)	0.011(0.011)	0.010(0.011)
2,000-10,000	0.014(0.010)	0.013(0.010)	0.013(0.010)
Regional dummies	Yes	Yes	Yes
No. of observations	40,321	39,859	39,859
Pseudo R-squared	0.025	0.024	0.026
Log-likelihood	-27,073.31	-26,800.66	-26,739.76

Notes: see Table 2.

According to previous studies, environmental knowledge is an antecedent of environmental concerns. Adding environmental knowledge variables to equation (1) changes the size and significance of environmental concerns variables. Column (I) shows that the marginal effects on *pollution* and *climate change* decrease and lose significance, being statistically significant, respectively, at 5 and 10 percent. Moreover, also the marginal effect on *resource exhaustion* decreases while remaining significant at the 1 percent level. Finally, the marginal effect on *alteration of environmental heritage* rises and continues to be significant at the 1 percent level. Regarding the environmental knowledge variables, results in Column (I) show a high statistical correlation among *tv and radio*, *initiatives, money* and water conservation behavior. Indeed, reading magazines and books, attending environmental conferences and being a member of environmental associations are not important for water conservation. The former findings are in line with one strand of the literature which found a relationship between environmental knowledge and pro-environmental behavior (see Section 2).

Putting social capital variables into equation (1) does not modify the size or significance of environmental concerns variables (see Table 2). Moreover, *church attendance* is positively correlated with water conservation behavior as previous studies on churchgoing and pro-environmental behavior have found (see Section 4). Additionally, *church attendance* changes size and significance of the female variable. Indeed, the marginal effect on *female* is no more statistically significant, indicating that the correlation between *female* and water conservation is mediated by churchgoing.

Column (III) shows the findings with all covariates. The results on environmental knowledge and social capital variables are close to those reported in previous columns while the evidence on environmental concerns variables are similar to those of Column (I) with the exception of *climate change* which is no longer statistically significant. These results point out that the media, active participation in environmental events, social ties and religious norms are related both to pro-environmental behavior and environmental concerns. In other words, greater knowledge of environmental problems, social relationships and moral norms impact on beliefs and behavior driving people to take action to protect the environment.

6. Discussion

The present study investigates the relationship between four different kinds of general environmental concerns – *pollution, climate change, resource exhaustion, alteration of environmental heritage* - and water conservation behavior using the 1998 Multipurpose Household Survey (MHS) conducted annually by Italian Centre Statistics Office. The paper is an empirical

contribution to the debate regarding the link between environmental concern and water saving when concerns and behaviors are not assessed at the same level of specificity (Corral-Verdugo et al. 2003). In so doing, the study focuses for the first time on the relationship between general environmental concerns and water conservation behavior in Italy.

In line with previous findings (Stern et al. 1993; 1995; Corral-Verdugo et al. 2008), the study shows that general environmental concerns are found associated with the probability of saving water at home. Thus, individuals with higher concerns regarding pollution and resource exhaustion have, respectively, a 0.6 and 1.2 percent higher probability of saving water. Instead, people with higher concerns on the alteration of environmental heritage present a 2.1 percent higher probability of being water consumers. These results seem to confirm our empirical hypothesis according to which individuals who perceive general environmental issues as a threat to their own welfare as well as the group's welfare to which they belong, will be water savers (H1 and H2). On the other hand, when individuals perceive that other group members will be water consumers, they will be water consumers too (H3).

Interesting findings regard environmental knowledge and social capital variables. When the models are fitted with these further control variables, environmental concerns variables change size and significance with the climate change variable no longer significant. Hence, greater knowledge of environmental problems, social ties and religious norm are found related both to the water conservation behavior and general environmental concerns. Thus, following programs on environmental issues on television and on the radio is associated with a 5.3 % higher probability of adopting water conservation behavior. Moreover, being active in environmental protection, taking part in initiatives and giving money, is related to a higher likelihood of being a water saver (5.2 and 6.4 percent, respectively). Furthermore, churchgoing is linked with a 4.0 percent higher probability of saving water. Evidence about the link between environmental knowledge, social capital and environmental concerns would suggest the need of initiatives by policy makers through environmental campaigns aimed at steering people's general environmental concerns toward pro-environmental behavior.

The paper also finds various significant relationships at the individual level. Evaluating water fees as high, being female, older, poorly educated, a homeowner, unemployed, retired and having children is associated with a higher probability of being a water saver. The features with the greatest marginal effect are age dummy variables. Thus individuals over 70 years have a 12.5 % higher probability of saving water at home. On the contrary, being married, divorced, widowed, an entrepreneur and having a large family with the presence of teenagers, higher (household) income and a big house are related with a higher likelihood of being a water consumer. Here, the

characteristics with the highest marginal effect are marital status variables. Being widowed increases the likelihood of consuming water by 6.8 percent. These results are consistent with previous research, confirming that individual characteristics are able to affect water conservation behavior.

Future research to examine the interaction among water conservation, environmental concerns and environmental knowledge would be desirable, taking account that the environmental context may be endogenously determined.

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