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## Household Waste Recycling: National Survey Evidence from Italy

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**Abstract**

The paper analyses the determinants of household recycling in Italy with particular emphasis on social behaviour. The econometric analysis is based on two waves - 1998 and 2000 - of the Multipurpose Household Survey conducted annually by the Italian Central Statistics Office. In Italy household recycling was substantially voluntary in the years from 1998 to 2000 with no monetary incentives or pecuniary sanctions. Five different materials are investigated: paper, glass, plastic, aluminium and food waste. The results of the probit regressions suggest that membership in organizations, church attendance, the habit of talking politics and reading newspapers are significantly correlated with household recycling behaviour, while gender, age and household income playing the biggest role. Our findings also show that the presence of recycling bins for waste improves household recycling behaviour for all materials whereas difficulty to reach recycling bins adversely affects household recycling outcomes. Household judgments on waste disposal charges have no effect on the recycling effort. As expected, residency in Southern Italy is associated with the lowest probability of recycling all materials.

**Keywords:** household recycling, social behaviour, social capital, recycling bins, flat fee
**JEL Classification:** C35, Q53, Z1

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## 1. Introduction

The need to recycle used materials has become a pressing environmental issue over the last 30 years. Waste recycling has several positive effects in the pursuit of sustainable development. It reduces demand for virgin raw materials. There are fewer environmental impacts from material extraction, processing and transportation. Products made from recyclates rather than virgin materials generally consume less energy in manufacturing. Furthermore, less waste material going to landfill means a reduction in environmental and economic costs as well as in health and environmental risks associated with landfilling (Martin et al. 2006; van den Bergh 2008).

The increasing concern regarding waste recycling is evidenced in European Union (EU) environment policies whose primary objectives are to reduce waste production, promote waste collection and recovery as well as cut down waste materials sent to landfill. In Italy waste recycling was introduced by Legislative Decree 22/1997 (*Decreto Ronchi*). Since 1998, Italy has experienced an increase in separate waste collection, with the rate reaching 27.5% in 2007, up from 13% in 1999. Despite this trend, however, Italy continues to produce vast amounts of waste and send large amounts of recyclable materials to landfills, as may be seen in Table 1. In 1999 Italy produced 28.4 million tons (Mt) of urban waste of which 21.8 Mt were sent to landfill. In 2007, total waste production was 32.5 Mt with 17 Mt disposed of in landfill.

Indeed, if we consider the main EU member states (Table 1), we observe that apart from Germany, these countries have difficulty stabilizing (reducing) the production of waste and landfill is still the main form of waste management used. Nevertheless, Italy's waste management performance is being constantly monitored and evaluated because, until recently, some areas in southern Italy had experienced waste management crises, mainly due to the absence of serious alternatives to landfill sites and very low separate collection rates.

A clear picture of the current situation in Italy, as well as the relative trend, is shown in Table 2 representing the differences in the separate waste collection rate across macro regions. The average figure for the country is still dominated by low separate waste collection, significantly lower than those established by the policy makers (to recycle 35% of waste by 2006 and 40% by 2007)[1]. What is more, there is high geographical heterogeneity, with northern Italy rapidly evolving towards high levels of recycling (42% in 2007) and southern

[1] See D. Lgs 156/2006 and Law 292/2006.

| | Total waste production (million tons) | | Landfill (million tons) | |
|---|---|---|---|---|
| | 1999 | 2007 | 1999 | 2007 |
| Germany | 52.3 | 46.4 | 14.7 | 0.3 |
| UK | 33.4 | 34.8 | 27.5 | 19.7 |
| France | 30.6 | 34.3 | 13.5 | 11.7 |
| Italy | 28.4 | 32.5 | 21.8 | 16.9 |
| Spain | 24.5 | 26.2 | 13.1 | 15.1 |

Table 1 Total waste production and landfill in some EU countries

Source: APAT-ONR, rapporto rifiuti

| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| Italy (average) | 13.1 | 14.4 | 17.4 | 19.2 | 21.5 | 22.7 | 24.3 | 25.8 | 27.5 |
| North | 23.1 | 24.4 | 28.6 | 30.6 | 33.5 | 35.5 | 38.1 | 39.9 | 42.4 |
| Centre | 9.0 | 11.4 | 12.8 | 14.6 | 17.1 | 18.3 | 19.4 | 20.0 | 20.8 |
| South | 2.0 | 2.4 | 4.7 | 6.3 | 7.7 | 8.1 | 8.7 | 10.2 | 11.6 |

Table 2. Separate collection (% of waste total production).

Source: APAT-ONR, rapporto rifiuti

Italy dramatically mired in low separate collection (11.6% in 2007)[2].

The aim of this paper is to investigate the determinants of household recycling in Italy using household survey data for the years 1998 and 2000. Specifically, the paper contributes to the household waste recycling literature by analysing the role of non-economic factors in the household's decision to sort and recycle domestic waste. Hence the paper contributes to the literature by carrying out the first assessment of the socio-economic determinants of household recycling in Italy from an economic perspective.

For our purposes, the years from 1998 to 2000 are of great interest because Italian households used to drop off their mixed waste in recycling bins - for paper, glass, food waste, etc.., - placed along the streets and in public locations, and they paid a flat rate according to parameters such

[2] In Italy, until 1996 the main aim of environmental policy was waste disposal using taxation as a policy instrument to combat waste problems (see DPR 915/1982 and Law 475/1988). In 1997, Legislative Decree 22/1997, called *Decreto Ronchi* (DR), to improve waste management changed the aim of environmental policy, indicating as the main targets the reduction of waste materials sent to landfill and the increase in reuse, recovery and recycling. These targets included: recycling 15% of waste by 1999; 25% by 2001 and 35% by 2003. The Legislative Decree 156/2006 increased these targets to 35% of waste by 2007 and 40% by 2008. Furthermore, the DR replaced taxes with tariffs as policy instruments to cover costs related to waste management.

as house size. Thus even if household recycling was mandatory, it was in practice voluntary with no monetary incentives or effective monetary sanctions.

The study uses the Multipurpose Household Survey (hereafter indicated as MHS) conducted annually by the Italian Central Statistical Office. This large dataset is one of the best available for studying household recycling in a cross-section framework as it investigates a wide range of socio-economic behaviour by means of face-to-face interviews on a sample of 20,000 households, roughly corresponding to 60,000 individuals. However, the MHS does not collect information on household income. In order to overcome this limit, data from the MHS were merged with the Bank of Italy's Survey on Household Income and Wealth (hereafter indicated as SHIW) for two waves (1998 and 2000), using a statistical matching method. The SHIW covers 8,000 households composed of approximately 20,000 individuals. Through the statistical matching procedure, I impute the household income of an individual from the SHIW to a similar individual from the MHS in a pooled cross section sample consisting of two waves (1998 and 2000) of the MHS. The final dataset contains 47643 observations.

In the empirical analysis, the dependent variable is the recycling behaviour on five different materials: paper, glass, plastic, aluminium and food waste. Household recycling behaviour is measured through the question "Does the family usually do separate waste collection and place materials in assigned recycling bins?" where possible responses are: *yes always*, *yes sometimes*, *never*. Responses are re-coded into a binary variable equal to 1 in cases of *yes always* and 0 otherwise. As the independent variable, the paper uses: i) the policy information available in the data set as the judgment of the household on the waste disposal fee and on the presence of recycling bins for waste; ii) a rich set of social behavioural variables, such as membership of organizations, church attendance, meetings with friends and relatives, political interest and the frequency in reading the newspaper, watching television and listening to the radio; iii) many individual and socio-economic characteristics as control variables including household income.

The results of probit regressions suggest that membership in organizations, church attendance, the habit of talking politics and newspapers are significantly correlated with household recycling behaviour, while gender, age and household income play the largest role. Our findings also show that recycling bins for waste raise household recycling levels of all materials whereas recycling bins that are poorly accessible affect household recycling outcomes adversely. Households' judgment on waste disposal charges have no effect on recycling effort. As expected, living in the regions of Southern Italy is associated with the lowest probability of recycling all materials.

The paper is related to another strand of literature. It contributes to the literature on social capital (for an exhaustive survey see Durlauf and Fafchamps 2005). Membership in organizations and meetings with friends are forms of social capital in the Putnam sense (1993).

The paper is organized as follows. Section 2 contains a short review of the literature on the main determinants of household recycling behaviour. Section 3 describes the data and presents descriptive analysis. Section 4 illustrates the main results from the econometric analysis. The last section concludes.

## 2. Factors that affect household recycling: a review

The main focus in the empirical literature on household recycling has been how various recycling programmes and differentiated tariffs affect household recycling behaviour (Halvorsen 2008). Early studies found that household income and household size are the most important factors affecting per capita or household quantities of solid waste (Richardson and Haylicek 1978). Research also indicated that refuse disposal service conditions (i.e. service frequency and collection site) and service charges affect household solid waste generation: curbside programmes reduce waste generation while flat fee systems induce households to generate larger amounts of waste (Wertz 1976). Hong et al. (1993) examine the role of price incentives and other socio-economic factors in household recycling for the city of Portland in Oregon, (USA). They show that increases in disposal fees encourage recycling, although demand for solid waste collection services is not reduced substantially. Furthermore, household participation regarding curbside recycling increases as the educational level rises while it decreases as the value of time increases. Fullerton and Kinnaman (1996) examine the consequences for household decisions of the implementation of volume-based pricing programmes that require households to pay for each bag or can of garbage. Individual household data for Charlottesville in Virginia (USA) are employed to estimate the effect of such a programme on the weight of garbage, the number of containers, the weight per can and the amount of recycling. Findings show that in response to pricing households sometimes reduce the volume (number of bags) but not the weight. Linderhof et al. (2001) analyze the effects of weight-based pricing in the collection of household waste for households in a Dutch municipality (Oostzaan). They estimate short-run and long-run price effects for the amounts of both compostable and non-recyclable household waste and find considerable effects of prices. Jenkins et al. (2003) study the impact of two popular waste programmes (curbside and volume-based pricing) on the rate of recycling of several materials: glass bottles, plastic bottles, aluminium, newspaper and yard waste. They use

a household-level data set representing middle and upper-middle income groups of 20 metropolitan statistical areas across the USA. The main findings are as follows. Access to curbside recycling as well as drop-off recycling turns out to have a significant positive effect on the percentage recycled of all five materials, but the effect of a curbside programme on recycling effort is greater than the effect of a drop-off programme. The length of the recycling programme's life also has a significant positive effect on two materials. Mandatory (as opposed to voluntary) recycling programmes have an insignificant effect, for all materials considered. The level of unit price is statistically insignificant, as in Rechovsky and Stone (1994) and Fullerton and Kinnaman (1996). It is suggested by the authors that this can be explained by the fact that households might respond to pricing by shifting to goods that make recycling easier. Finally, as regards socio-economic factors, age and education level have a significant positive effect on, respectively, four and three materials.

Ferrara and Missios (2005) employ data from households in communities across Ontario, Canada to estimate the relationships between several commonly recycled materials (newsprint, glass, plastic, aluminium cans, tin cans, cardboard and toxic chemicals) and individual household characteristics, recycling programme attributes and garbage collection financing methods. They find that user fees on garbage collection have significant impact on recycling levels for all materials except toxic chemicals. Kipperberg (2007) investigates the determinants of recycling behaviour in Norway on five materials: paper, glass, metals, plastic and food waste. The analysis focused on the role of user fees on waste disposal, on the provision of convenient recycling options (curbside and drop-off programmes) and on socio-economic and demographic factors. The author shows that user fees on waste disposal have a significant positive effect on recycling intensities as well as curbside recycling programmes. The drop-off programme presents the expected sign but is statistically significant only in glass recycling intensity. Regarding demographic variables, age and population have, respectively, a significant positive and negative effect on household recycling behaviour for three materials.

Some empirical studies have examined social and psychological motivations for household waste recycling efforts. Vining and Ebreo (1990) using data on Champaign and Urbana in Illinois (USA) show that among the factors that discriminate recyclers from non-recyclers are knowledge and intrinsic motives, such as altruism and environmental concerns. Using experimental data, Hopper and McCarl Nielsen (1991) find that recycling behaviour is influenced by social and personal norms. Derksen and Gartrell (1993) with data on the province of Alberta (Canada) find that individual attitudes towards the environment affect recycling behaviour only in communities with easy access to a structured recycling programme. Hornik et

al. (1995) and Schultz et al. (1995), in reviewing prior empirical (psychological) studies on recycling behaviour, show that the important predictors are knowledge, attitudes and commitment to recycling as well as social influence (of friends, family members and neighbours). Schultz et al. (1995) also show that in prior empirical psychological studies on recycling behaviour, the most often reported demographic characteristics are gender, age, education and income. Overall, the results of these studies indicate an ambiguous relationship with recycling for age and education, a positive association for income and no significant correlation for gender.

Halvorsen (2008) models how social and moral norms and the opportunity cost of time affect household recycling efforts. He uses data from Norway on six materials: paper and cardboard, drink cartons, plastic, metal, glass and organic waste. Empirical findings evidence that indicators of warm-glow, social and moral norms increase household recycling activities. Furthermore, the estimated opportunity cost of time has a significant effect on the recycling effort while household (gross) income has a significant positive effect on recycling. Hage et al. (2009) analyze the determinants of recycling efforts in Swedish households focusing on the case of packaging waste (i.e. paper, glass, plastic and metal). They build a theoretical framework that integrates norm-motivated behaviour into a sample economic model of household choice. The results indicate that moral motives explain household recycling rates while social norms are not statistically significant. Moreover, recycling effort was found to increase with age.

Social capital has also been underlined as a significant parameter influencing household environmental behaviour (Pretty and Ward 2001; Pretty 2003). Van Ha et al. (2006) employ a parametric deterministic input distance function for computing the relative shadow prices of social capital for household-level paper-recycling units in Vietnam. They show that social capital – associational activity, social relations, trust and norms of reciprocity – has positive effects on the production efficiency of paper-recycling units. Torgler and García-Valiňas (2007) investigate empirically the determinants of individuals' attitudes towards preventing environmental damage in Spain, showing that social capital, such as trust and membership in voluntary environmental organizations, has a strong impact on individuals' preferences to prevent environmental damage. Using data on Taiwan, Tsai (2008) estimates the impact of social capital on the regional recycling rate. He provides evidence that regional social capital – volunteers in associations and the number of social organizations – is highly correlated with a region's recycling rate.

## 3. Sample description and empirical strategy

The data set used in the present study is drawn from the MHS, a cross-sectional survey administered annually by ISTAT. The new MSH series was initiated in 1993. Every year a representative sample of 20,000 Italian households (roughly corresponding to 60,000 individuals) is surveyed on key aspects of daily life and behaviour. Though the MSH is annual, it is not panel data. Among information provided, there are data on social behaviour, on a wide range of household recycling behaviour as well as socio-demographic characteristics.

However, the MSH does not collect information on household income. To fill this gap, the ISTAT MSH was combined with the SHIW carried out by the Bank of Italy. The SHIW covers 8,000 households (20,000 individuals) and contains detailed information on income and wealth of family members as well as socio-demographic characteristics of the household. Both samples are representative of the Italian population at national and regional level. Basically, through the statistical matching procedure, I impute the household income of an individual from the SHIW to a similar individual from the MHS in a pooled cross section sample composed by two waves (1998 and 2000) of the MHS[3]. The unit of analysis is the household head. The final dataset contains 47643 observations. Table 3 shows definitions and measurement of variables used in the econometric analysis. Weighted summary statistics are reported in Table 4.

The dependent variable is household recycling behaviour on five different materials: paper, glass, plastic, aluminium and food waste. Household recycling behaviour is measured through the question "Has the family the habit to do waste collection and to place them in assigned recycling bins?" 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 4, glass and paper are the materials subject to most recycling in the Italian sample, whereas recycling behaviour for plastic, food and aluminium is significantly lower in Italy.

The availability of an effective recycling infrastructure that enables households to recycle their waste as well as waste disposal fees are clearly crucial parts of any recycling programme

[3] For detailed information about how the statistical matching was performed, see Fiorillo (2009).

Table 3. Detailed description of variables

| Variable | Description |
|---|---|
| *Dependent variables* | |
| Paper recycling | Family accustomed to doing paper recycling, 1= yes always |
| Glass recycling | Family accustomed to doing glass recycling, 1= yes always |
| Aluminium recycling | Family accustomed to doing aluminium recycling, 1= yes always |
| Plastic recycling | Family accustomed to doing plastic recycling, 1= yes always |
| Food waste recycling | Family accustomed to doing food recycling, 1= yes always |
| *Independent variables* | |
| *Policy variable* | |
| Judgment on waste disposal fee | Household judgment on the waste disposal service charge, 1=high |
| Recycling bin for paper | Presence in the area where the household lives of paper recycling bins, 1= yes |
| Recycling bin for glass | Presence in the area where the household lives of glass recycling bins, 1= yes |
| Recycling bin for aluminium | Presence in the area where the household lives of aluminium recycling bins, 1=yes |
| Recycling bin for plastic | Presence in the area where the household lives of plastic recycling bins, 1= yes |
| Recycling bin for food waste | Presence in the area where the household lives of food waste recycling bins, 1= yes |
| Recycling bin for paper_dtr | Presence in the area where the household lives of paper recycling bins, 1= yes but difficult to reach |
| Recycling bin for glass _dtr | Presence in the area where the household lives of glass recycling bins, 1= yes but difficult to reach |
| Recycling bin for aluminium_dtr | Presence in the area where the household lives of aluminium recycling bins, 1= yes but difficult to reach |
| Recycling bin for plastic_dtr | Presence in the area where the household lives of plastic recycling bins, 1= yes but difficult to reach |
| Recycling bin for food waste_dtr | Presence in the area where the household lives of food waste recycling bins, 1= yes but difficult to reach |
| *Pro-environmental behaviour* | |
| Environmental problems | Environmental problems are the main problem of the nation, 1=yes |
| *Social behaviour variables* | |
| Passive membership | Participation in meetings of formal organizations, 1 = voluntary service, ecological, cultural, political party and unions |
| Active membership | Unpaid activity for formal organizations, 1 = voluntary service, other, political party and unions |
| Meeting friends | Meeting with friends, 1= every day or more than once a week |
| Visiting relatives | Meeting with relatives, 1= everyday or more than once a week |
| Church attendance | Whether the respondent goes to church once or more a week, 1 = yes |
| Talk politics | Talks politics, 1 = every day or more than once a week |
| Listen to politics | Whether the respondent listens to political debates, 1 = yes |
| Newspapers | Whether the respondent reads newspapers every day; 1 = yes |
| Television | Whether the respondent watches television every day; 1 = yes |
| Radio | Whether the respondent listens to the radio every day; 1 = yes |
| *Demographic and socio-economic characteristics* | |
| Male | Gender of the respondent, 1= male**. Reference group: female** |
| Married | Marital status of the respondent, 1= married. **Reference group: single** |
| Divorced | Marital status of the respondent, 1 = divorced |
| Widowed | Marital status of the respondent , 1 = widowed |
| Age31-40 | Age of the respondent, 1 = age between 31 and 40. **Reference group: age16-30** |
| Age41-50 | Age of the respondent, 1 = age between 41 and 50 |

| | |
|---|---|
| Age51-60 | Age of the respondent, 1 = age between 51 and 60 |
| Age61-70 | Age of the respondent, 1 = age between 61 and 70 |
| Age71-80 | Age of the respondent, 1 = age between 71 and 80 |
| Household size | Number of people who live in family |
| Children0_5 | Age of children, 1 = children aged between 0 and 5 years. **Reference group: no children** |
| Children6_12 | Age of children, 1 = children aged between 6 and 12 years |
| Children13_17 | Age of children, 1 = children aged between 13 and 17 years |
| Low education | Education of the respondent, 1 = no education, completed elementary school (5 years) and completed junior high school (8 years) |
| High school (diploma) | Education of the respondent, 1 = completed high school (13 years). **Reference group** |
| Bachelor's degree | Education of the respondent, 1 = university degree and/or doctorate (18 years and more) |
| Household income (ln) | Natural logarithm of imputed household income (sum of labour income, capital income and pensions) |
| Poor health | Dummy, 1 if the respondent assesses his/her state of perceived health as poor; 0 otherwise. **Reference group: fair health,** |
| Good health | Dummy, 1 if the respondent assesses his/her state of perceived health as good; 0 otherwise |
| Unemployed | Employment status of the respondent, 1 = unemployed. **Reference group: employed** |
| Entrepreneur | Employment status of the respondent, 1 = entrepreneur |
| Self-employed | Employment status of the respondent, 1= self-employed |
| Retired | Employment status of the respondent, 1 = retired |
| Homeowner | Whether the respondent owns his/her home outright, yes = 1 |
| Council house | Whether the respondent lives in a council house, yes = 1 |
| Rooms | Number of rooms, 1 = between 1 and 5 rooms |
| *Perception of community problems* | |
| Micro-criminality | Whether the respondent has been pickpocketed, yes = 1 |
| No parking problems | Whether the respondent states that there is no difficulty parking in the area where he/she lives, yes = 1 |
| No traffic problems | Whether the respondent states that there is no traffic in the area where he/she lives, yes =1 |
| No pollution | Whether the respondent states that there is no pollution in the area where he/she lives, yes =1 |
| No dirtiness problems | Whether the respondent states that there is no filth in the area where he/she lives, yes =1 |
| Family problems to reach bins | Whether the respondent states that his\her family has problems reaching recycling bins, 1= yes |
| *Size of municipality* | |
| Metropolis | Whether the respondent states that he/she lives in a metropolitan area, yes=1. **Reference group: <2000** |
| Neighbouring metropolis | Whether the respondent states that he/she lives in a municipality close to a metropolitan area, yes=1 |
| >50,000 | Whether the respondent states that he/she lives in a municipality with more than 50,000 inhabitants, yes=1 |
| 10,000-50,000 | Whether the respondent states that he/she lives in a municipality with 10,000-50,000 inhabitants, yes=1 |
| 2,000-10,000 | Whether the respondent states that he/she lives in a municipality with 2,000-10,000 inhabitants, yes=1 |

(Martin et al. 2006). In the data set, the policy information available for the econometric analysis is the judgment of the household head on the waste disposal fee and on the presence of recycling bins for waste (Table 3).

The MSH asked individuals how they judge the cost for waste disposal services. The answers were; i) high; ii) fair; iii) low. I create a dummy "judgment on waste disposal fee", assuming the value 1 if the household head judges the cost of the waste disposal service as high. In the Italian sample (Table 4), 67 percent of respondents judge the cost of waste disposal to be high.

As regards recycling bins for waste, the MSH asked respondents the question "Are there recycling bins for waste separate collection in the area where the household lives?" The answers were; 1) yes and easy to reach; 2) yes but difficult to reach; 3) no; 4) I do not know. I used responses (1) and (2) and created a dummy variable for recycling bins for each of the five materials (Table 3).

Recycling bins appear common in Italy: according to 71 percent of Italian household heads there are recycling bins for glass in the area where they live; 63 percent state there are facilities for paper recycling and 52 % for plastic. Only 43 and 41 % of household heads stated there were recycling bins for aluminium and food waste, respectively. By contrast, a small percentage of the Italian sample found it difficult to reach recycling bins for separate waste collection.

With respect to pro-environmental behaviour, i.e., whether according to Italian households environmental problems are the main problem in Italy, only 17% of respondents agree with this statement.

Social behaviour is measured through the following set of variables (Table 3):

- Membership in organizations, distinguished between passive membership (if the individual participated in meetings of an organization in the 12 months prior to the interview) and active membership (if the individual did unpaid work for an organization in the 12 months prior to the interview). The organizations I allowed for are voluntary, charitable, ecological and cultural associations, political parties and trade unions.
- The frequency of meetings with friends, coded as 1 if the interviewee meets friends every day or at least twice a week.
- The frequency of meetings with relatives, coded as above.
- Church attendance as measured through a binary variable which is equal to 1 if the interviewee goes to a church or other place of worship one or more times a week.

Table 4. Weighted descriptive statistics

| Variable | Mean | Standard deviation | Minimum | Maximum | Observations |
|---|---|---|---|---|---|
| Paper recycling | 0.50 | 0.50 | 0 | 1 | 46936 |
| Glass recycling | 0.55 | 0.50 | 0 | 1 | 47000 |
| Aluminium recycling | 0.31 | 0.16 | 0 | 1 | 46540 |
| Plastic recycling | 0.44 | 0.50 | 0 | 1 | 46741 |
| Food waste recycling | 0.40 | 0.49 | 0 | 1 | 46333 |
| Judgment on waste disposal fee | 0.67 | 0.47 | 0 | 1 | 47201 |
| Recycling bin for paper | 0.63 | 0.48 | 0 | 1 | 47051 |
| Recycling bin for glass | 0.71 | 0.45 | 0 | 1 | 47106 |
| Recycling bin for aluminium | 0.41 | 0.49 | 0 | 1 | 46830 |
| Recycling bin for plastic | 0.52 | 0.50 | 0 | 1 | 46896 |
| Recycling bin for food waste | 0.43 | 0.49 | 0 | 1 | 46703 |
| Recycling bin for paper_dtr | 0.14 | 0.35 | 0 | 1 | 47051 |
| Recycling bin for glass_dtr | 0.17 | 0.37 | 0 | 1 | 47106 |
| Recycling bin for aluminium_dtr | 0.12 | 0.32 | 0 | 1 | 46830 |
| Recycling bin for plastic_dtr | 0.13 | 0.33 | 0 | 1 | 46896 |
| Recycling bin for food waste_dtr | 0.06 | 0.25 | 0 | 1 | 46703 |
| Environmental problems | 0.17 | 0.37 | 0 | 1 | 47643 |
| Passive membership | 0.25 | 0.43 | 0 | 1 | 46487 |
| Active membership | 0.14 | 0.34 | 0 | 1 | 46341 |
| Meeting friends | 0.67 | 0.47 | 0. | 1 | 47297 |
| Visiting relatives | 0.30 | 0.46 | 0 | 1 | 47643 |
| Church attendance | 0.33 | 0.47 | 0 | 1 | 46632 |
| Talk politics | 0.43 | 0.49 | 0 | 1 | 46708 |
| Listen to politics | 0.23 | 0.42 | 0 | 1 | 46035 |
| Newspapers | 0.29 | 0.45 | 0 | 1 | 46738 |
| Television | 0.88 | 0.33 | 0 | 1 | 46479 |
| Radio | 0.39 | 0.49 | 0 | 1 | 46479 |
| Female | 0.24 | 0.42 | 0 | 1 | 47643 |
| Married | 0.67 | 0.47 | 0 | 1 | 47643 |
| Divorced | 0.07 | 0.25 | 0 | 1 | 47643 |
| Widowed | 0.15 | 0.35 | 0 | 1 | 47643 |
| Age31-40 | 0.19 | 0.39 | 0 | 1 | 47643 |
| Age41-50 | 0.20 | 0.40 | 0 | 1 | 47643 |

| | | | | | |
|---|---|---|---|---|---|
| Age51-60 | 0.19 | 0.40 | 0 | 1 | 47643 |
| Age61-70 | 0.20 | 0.40 | 0 | 1 | 47643 |
| Age71-80 | 0.16 | 0.37 | 0 | 1 | 47643 |
| Household size | 2.73 | 1.29 | 0 | 12 | 47643 |
| Children0_5 | 0.15 | 0.42 | 0 | 1 | 47643 |
| Children6_12 | 0.19 | 0.47 | 0 | 1 | 47643 |
| Children13_17 | 0.15 | 0.41 | 0 | 1 | 47643 |
| Low education | 0.62 | 0.48 | 0 | 1 | 47643 |
| Bachelor's degree | 0.08 | 0.28 | 0 | 1 | 47643 |
| Household income (ln) | 10.67 | 0.46 | 8.69 | 12.22 | 47643 |
| Bad health | 0.09 | 0.29 | 0 | 1 | 46942 |
| Good health | 0.71 | 0.45 | 0 | 1 | 46942 |
| Unemployed | 0.03 | 0.16 | 0 | 1 | 47643 |
| Entrepreneur | 0.07 | 0.25 | 0 | 1 | 47643 |
| Self-employed | 0.09 | 0.29 | 0 | 1 | 47643 |
| Retired | 0.33 | 0.47 | 0 | 1 | 47643 |
| Homeowner | 0.69 | 0.46 | 0 | 1 | 47643 |
| Council house | 0.62 | 0.48 | 0 | 1 | 46958 |
| Rooms | 3.15 | 1.75 | 1 | 5 | 47058 |
| Micro-criminality | 0.03 | 0.17 | 0 | 1 | 47474 |
| No parking problems | 0.36 | 0.48 | 0 | 1 | 47228 |
| No traffic problems | 0.21 | 0.41 | 0 | 1 | 47181 |
| No pollution | 0.26 | 0.44 | 0 | 1 | 47181 |
| No dirtiness problems | 0.26 | 0.44 | 0 | 1 | 47249 |
| Family problems to reach bins | 0.05 | 0.22 | 0 | 1 | 46915 |
| Metropolis | 0.24 | 0.43 | 0 | 1 | 47643 |
| Neighbouring metropolis | 0.08 | 0.27 | 0 | 1 | 47643 |
| >50,000 | 0.16 | 0.36 | 0 | 1 | 47643 |
| 10,000-50,000 | 0.21 | 0.41 | 0 | 1 | 47643 |
| 2,000-10,000 | 0.24 | 0.43 | 0 | 1 | 47643 |

- The habit of talking politics, coded as 1 if the interviewee speaks about politics every day or more than once a week.

- The habit of listening to political debates as measured through a binary variable which is equal to 1 if the interviewee listens to political debates.

- Newspapers as measured through a binary variable which is equal to 1 if the interviewee reads newspapers every day.

- Television as measured through a binary variable which is equal to 1 if the interviewee watches television every day.

- Radio as measured through a binary variable which is equal to 1 if the interviewee listens to the radio every day.

Table 4 shows that 67% and 30% of Italian households meet, respectively, friends and relatives one or more times per week; 25% of the respondents are members of organizations while 14% of the interviewees supply unpaid labour for organizations. With regard to politics, respectively, 43% and 23% of respondents have the habit of talking politics and the habit of listening to political debates, whereas 35% of the sample attend churches or other places of worship one or more times per week. As regards the mass media (newspapers, television, radio), 88% of the respondents indicated that they watch television every day a week. Radio is a distant second, with 39%. The least common source of information is newsprint, with 29% of interviewees reporting they read newspapers every day.

I controlled for many demographic and socio-economic characteristics such as gender, marital status, age, family size, presence and age of children, education, imputed household income (sum of labour income, capital income and pensions), self-reported health, employment status, homeownership, the home's characteristics (whether it is "council") and number of rooms. The quality of the surrounding environment is assessed through indicators of subjective perception of its safety and by a number of other issues such as traffic and parking problems, pollution, dirtiness and household problems to reach recycling bins. Finally, I also control for the size of municipality.

Regarding individual characteristics, Table 4 shows that almost half of the respondents are female and married, while 62% of the respondents have low education (completed elementary school and/or completed junior high school). The largest groups of individuals (20%) are aged between 41 and 50 and between 61 and 70. Half of the sample comprises respondents with children aged between 0 and 17. Interestingly, 71% of interviewees stated they were in good health, 69% are homeowners and 62% live in a council house.

The empirical model of household recycling behaviour can be represented through the following estimation equation:

$$HR_{it}^{*} = \alpha + PV_{it}^{'}\varphi + SB_{it}^{'}\beta + \lambda Y_{it} + Z_{it}^{'}\delta + \varepsilon_{it} \quad (1)$$

where $HR^{*}$ is the recycling behaviour of the household head $i$ at time $t$; $PV$ are the policy variables defined at the level of the household head; $SB$ are the social behaviour variables defined at the level of the household head; $Y$ is the annual household income; the $Z$ matrix consists of the other variables that are known to influence household recycling behaviour and $\varepsilon$ is a random-error term.

I do not observe the "latent" variable $HR_{it}^{*}$ in the data. Rather, I observe $HR_{it}$ as a binary choice which takes value 1 if the household head always recycles. Thus, the structure of (1) makes it suitable for estimation as a probit model:

$$\Pr(HR_{it} = 1) = \Phi(\alpha - PV_{it}^{'}\varphi - SB_{it}^{'}\beta - \lambda Y_{it} - Z_{it}^{'}\delta) \quad (2)$$

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

## 4. Econometric results

In this section, I analyse the impact of policy variables, pro-environmental behaviour as well as social behaviour and individual features upon household waste recycling behaviour. Section 4.1 shows results for baseline models.

### *4.1 Baseline findings*

In Table 5, Columns (I) – (V) present the probit estimations of Eq. (2), marginal effects and standard errors corrected for heteroskedasticity, using as a dependent variable the recycling behaviour of the household head on five different materials: paper, glass, plastic, aluminium and food waste. In addition to the variables discussed in Section 3, we include regional dummies to control for policy influences operating beyond the size of the municipality. In the next subsections, I discuss the results for the three groups of independent variables: judgment on waste disposal fee, recycling bins for waste and pro-environmental behaviour; social behaviour; demographic characteristics and regional dummies.

#### *4.1.1 Judgment on waste disposal fee, recycling bins and pro-environmental behaviour*

The results in Table 5 suggest that the opinion of the household head on the cost of the waste disposal service has no effect on waste recycling behaviour of all five materials. These findings seem to indicate that fees on waste disposal do not have an effect on the recycling effort. However, because the data do not provide information on waste disposal fee but only on the households' opinion on the cost of waste disposal services, the effect of a fee on recycling behaviour remains unclear.

The results reported in Table 5 show that for all materials, the recycling bins program has a positive and significant impact on waste recycling behaviour. The marginal effects reported in Table 5 show that the magnitude of the effect of recycling bins is quite similar across materials. Introducing a recycling bin for paper increases the probability of recycling by 24%; for glass and aluminium the marginal effect is, respectively, 27 and 28% while for plastic it is 31%. These results seem to suggest that the recycling bins program has a smaller impact on materials for which there were recycling options. For example, charity drives have traditionally focused on collecting newspapers. Adding a local recycling bins program is likely to have little impact on this type of recycling behaviour (Jenkins et al. 2003).

Introducing a recycling bin for food waste raises the recycling probability by 40%. This indicates that the presence of recycling bins has a greater effect on food waste than first appears (Jenkins et al. 2003).

As expected, if recycling bins are difficult to reach this has a negative and significant effect on recycling behaviour for all five materials. The magnitude of the marginal effect is quite similar across materials. However, food waste and plastic have the highest negative marginal effect. This comes as no surprise because, compared with newspapers and aluminium, food waste, plastic and glass have high transportation and storage costs. Hence, improving the proximity of recycling bins should reduce households' transportation and storage costs which could increase household recycling levels.

Unsurprisingly, having a pro-environmental behaviour leads to a higher recycling effort. The probability of always recycling rises from 2.3% (plastic and food waste), 2.6% (for paper and aluminium) to 2.9% (glass) .

Table 5. Probit results: marginal effects

| | I | II | III | IV | V |
|---|---|---|---|---|---|
| Variable | Paper | Glass | Plastic | Aluminium | Food waste |
| Judgment on waste disposal fee | -0.003 | -0.005 | -0.004 | -0.004 | -0.001 |
| | (0.006) | (0.006) | (0.006) | (0.005) | (0.005) |
| Recycling bin for paper | 0.243*** | | | | |
| | (0.006) | | | | |
| Recycling bin for glass | | 0.266*** | | | |
| | | (0.006) | | | |
| Recycling bin for plastic | | | 0.313*** | | |
| | | | (0.005) | | |
| Recycling bin for aluminium | | | | 0.279*** | |
| | | | | (0.005) | |
| Recycling bin for food waste | | | | | 0.396*** |
| | | | | | (0.005) |
| Recycling bin for paper_dtr | -0.170*** | | | | |
| | (0.007) | | | | |
| Recycling bin for glass_dtr | | -0.160*** | | | |
| | | (0.007) | | | |
| Recycling bin for aluminium_dtr | | | -0.174*** | | |
| | | | (0.007) | | |
| Recycling bin for plastic_dtr | | | | -0.133*** | |
| | | | | (0.005) | |
| Recycling bin for food waste_dtr | | | | | -0.180*** |
| | | | | | (0.007) |
| Environmental problems | 0.025*** | 0.028*** | 0.022*** | 0.026*** | 0.023*** |
| | (0.007) | (0.007) | (0.007) | (0.006) | (0.007) |
| Passive membership | 0.054*** | 0.057*** | 0.041*** | 0.029*** | 0.035*** |
| | (0.008) | (0.007) | (0.007) | (0.006) | (0.007) |
| Active membership | 0.053*** | 0.046*** | 0.050*** | 0.029*** | 0.017** |
| | (0.009) | (0.009) | (0.009) | (0.008) | (0.009) |
| Meeting friends | 0.010 | 0.025*** | 0.003 | 0.011** | 0.008 |
| | (0.006) | (0.006) | (0.006) | (0.005) | (0.005) |
| Visiting relatives | 0.004 | 0.008 | 0.010* | 0.006 | 0.010* |
| | (0.006) | (0.006) | (0.006) | (0.005) | (0.006) |
| Church attendance | 0.042*** | 0.044*** | 0.024*** | 0.026*** | 0.020*** |
| | (0.006) | (0.006) | (0.006) | (0.005) | (0.006) |
| Talking politics | 0.029*** | 0.020*** | 0.026*** | 0.017*** | 0.013** |
| | (0.006) | (0.006) | (0.006) | (0.005) | (0.006) |
| Listening to politics | 0.013* | 0.020*** | 0.008 | 0.007 | 0.015** |
| | (0.006) | (0.006) | (0.006) | (0.005) | (0.006) |
| Newspapers | 0.047*** | 0.026*** | 0.026*** | 0.021*** | 0.011** |
| | (0.006) | (0.006) | (0.006) | (0.005) | (0.006) |
| Television | 0.015* | 0.022** | 0.020** | 0.006 | 0.005 |
| | (0.009) | (0.009) | (0.008) | (0.007) | (0.008) |
| Radio | 0.016*** | 0.015*** | 0.010* | 0.011** | 0.001 |
| | (0.006) | (0.006) | (0.005) | (0.004) | (0.005) |
| Female | 0.067*** | 0.068*** | 0.050*** | 0.026*** | 0.034*** |
| | (0.010) | (0.010) | (0.009) | (0.008) | (0.009) |
| Married | 0.051*** | 0.063*** | 0.053*** | 0.023** | 0.025** |

| | | | | | |
|---|---|---|---|---|---|
| | (0.011) | (0.011) | (0.011) | (0.009) | (0.010) |
| Divorced | -0.027** | -0.023* | -0.019 | -0.018* | -0.010 |
| | (0.013) | (0.013) | (0.013) | (0.010) | (0.012) |
| Widowed | 0.002 | -0.012 | -0.008 | -0.011 | -0.027** |
| | (0.013) | (0.012) | (0.012) | (0.010) | (0.011) |
| Age31-40 | 0.048*** | 0.043*** | 0.039*** | 0.036*** | 0.015 |
| | (0.014) | (0.014) | (0.014) | (0.012) | (0.013) |
| Age41-50 | 0.068*** | 0.049*** | 0.034** | 0.035*** | 0.020 |
| | (0.015) | (0.015) | (0.014) | (0.013) | (0.014) |
| Age51-60 | 0.085*** | 0.064*** | 0.052*** | 0.043*** | 0.031** |
| | (0.016) | (0.015) | (0.015) | (0.013) | (0.015) |
| Age61-70 | 0.080*** | 0.063*** | 0.050*** | 0.036** | 0.017 |
| | (0.017) | (0.017) | (0.017) | (0.015) | (0.016) |
| Age71-80 | 0.030 | 0.007 | 0.006 | 0.008 | 0.004 |
| | (0.019) | (0.018) | (0.018) | (0.015) | (0.017) |
| Household size | 0.003 | -0.001 | 0.003 | 0.000 | 0.005 |
| | (0.004) | (0.004) | (0.004) | (0.003) | (0.004) |
| Children0_5 | -0.023*** | -0.014 | -0.019** | -0.016** | -0.009 |
| | (0.008) | (0.008) | (0.008) | (0.007) | (0.008) |
| Children6_12 | -0.008 | -0.007 | -0.012* | -0.004 | -0.002 |
| | (0.007) | (0.007) | (0.007) | (0.006) | (0.006) |
| Children13_17 | -0.003 | 0.000 | 0.007 | 0.006 | 0.003 |
| | (0.008) | (0.008) | (0.008) | (0.006) | (0.007) |
| Low education | -0.045*** | -0.034*** | -0.040*** | -0.014** | -0.006 |
| | (0.009) | (0.008) | (0.008) | (0.007) | (0.008) |
| Bachelor’s degree | 0.027** | 0.018 | 0.007 | -0.003 | -0.001 |
| | (0.011) | (0.011) | (0.011) | (0.009) | (0.010) |
| Household income (ln) | 0.082*** | 0.065*** | 0.041*** | 0.035*** | 0.002 |
| | (0.014) | (0.013) | (0.013) | (0.011) | (0.013) |
| Poor health | -0.037*** | -0.038*** | -0.033*** | -0.019** | -0.014 |
| | (0.011) | (0.011) | (0.011) | (0.009) | (0.010) |
| Good health | 0.009 | -0.007 | -0.003 | -0.008 | -0.001 |
| | (0.007) | (0.007) | (0.007) | (0.006) | (0.007) |
| Unemployed | -0.011 | -0.024 | -0.021 | -0.007 | -0.047*** |
| | (0.018) | (0.017) | (0.017) | (0.015) | (0.015) |
| Entrepreneur | -0.020* | -0.021* | -0.015 | -0.011 | -0.007 |
| | (0.011) | (0.011) | (0.011) | (0.009) | (0.010) |
| Self-employed | -0.024** | -0.015 | -0.029*** | -0.020** | -0.009 |
| | (0.010) | (0.010) | (0.009) | (0.008) | (0.009) |
| Retired | 0.058*** | 0.054*** | 0.044*** | 0.033*** | 0.029*** |
| | (0.009) | (0.009) | (0.009) | (0.007) | (0.008) |
| Homeowner | -0.000 | 0.021*** | 0.007 | 0.004 | 0.024*** |
| | (0.008) | (0.008) | (0.007) | (0.006) | (0.007) |
| Civil house | 0.021*** | 0.017*** | 0.013** | 0.007 | -0.001 |
| | (0.006) | (0.006) | (0.005) | (0.005) | (0.005) |
| Rooms | 0.003** | 0.003** | 0.003** | 0.002* | 0.002 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Micro-criminality | 0.005 | -0.009 | 0.009 | -0.003 | -0.010 |
| | (0.017) | (0.017) | (0.016) | (0.013) | (0.015) |

| | | | | | |
|---|---|---|---|---|---|
| No parking problems | 0.016** | 0.045*** | 0.033*** | 0.022*** | 0.042*** |
| | (0.007) | (0.007) | (0.006) | (0.005) | (0.006) |
| No traffic problems | -0.005 | -0.003 | -0.007 | 0.008 | 0.003 |
| | (0.009) | (0.008) | (0.008) | (0.007) | (0.008) |
| No pollution | -0.030*** | -0.008 | -0.020*** | -0.020*** | -0.009 |
| | (0.008) | (0.008) | (0.008) | (0.006) | (0.007) |
| No dirtiness problems | 0.011* | 0.013** | 0.014** | 0.006 | 0.009 |
| | (0.007) | (0.006) | (0.006) | (0.005) | (0.006) |
| Family problems to reach bins | -0.032*** | -0.025* | -0.002 | -0.005 | 0.011 |
| | (0.013) | (0.013) | (0.012) | (0.010) | (0.012) |
| Metropolis | -0.007 | -0.020* | -0.018* | -0.018** | -0.004 |
| | (0.011) | (0.011) | (0.011) | (0.009) | (0.010) |
| Neighbouring metropolis | 0.005 | -0.025* | -0.003 | -0.007 | -0.002 |
| | (0.014) | (0.014) | (0.013) | (0.011) | (0.013) |
| >50,000 | -0.017 | -0.035*** | -0.030*** | -0.014 | -0.019 |
| | (0.012) | (0.012) | (0.011) | (0.009) | (0.011) |
| 10,000-50,000 | -0.008 | -0.024** | -0.019* | -0.006 | -0.004 |
| | (0.012) | (0.011) | (0.011) | (0.009) | (0.011) |
| 2,000-10,000 | -0.008 | -0.028** | -0.022** | -0.019** | -0.005 |
| | (0.011) | (0.011) | (0.011) | (0.009) | (0.010) |
| Regional dummies | Yes | Yes | Yes | Yes | Yes |
| Year dummies | Yes | Yes | Yes | Yes | Yes |
| No. of observations | 42094 | 42204 | 41851 | 41646 | 41400 |
| Pseudo R-squared | 0.26 | 0. 23 | 0.23 | 0.24 | 0.21 |
| Log-likelihood | -21545.84 | -22353.20 | -21762.57 | -18665.82 | -21405.61 |

Notes: The dependent variable *household recycling* takes value 1 if the household head always recycles. The model is estimated with a standard probit. Regressors' legend: see Table 3. Regional and year 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.

### *4.1.2 Social behaviour*

In this Section I focus on the relationship between social behaviour and household recycling effort. In Table 5, Columns (I) – (V) show a positive correlation (statistically significant at 1%) between membership in organizations and the choice of the household head to always recycle all five materials. Membership in organizations is associated with a 5.7% higher probability of recycling glass, a 5.4% higher probability of recycling paper and a 4.1% higher probability for plastic. For food waste the marginal effect is 3.5% and for aluminium it is 2.9. These findings could well be explained by the fact that individuals who participate in (social) organizations have stronger preferences for (local) public goods. Furthermore, social organizations, such as social networks, are also responsible for the flow of information on environmental issues (Jones et al. 2010).

The impact of active membership (volunteer labour supply) in organizations is positive and statistically significant at 1% as well (except for food waste significantly at 5%). Active membership in organizations is correlated with a 5.3% higher probability of recycling paper, a 5.0% higher probability for plastic and a 4.6% higher probability for glass. For aluminium the marginal effect is 2.9% and for food waste it is 1.7.

This is likely to happen because there may well be channels of "warm-glow" and moral norms. The literature on volunteering suggests that among the reasons why individuals supply unpaid work there is the pleasure of giving, also referred to as "warm-glow" (Andreoni 1990, Fiorillo 2010, 2011). Hence, volunteers may recycle because they gain utility from contributing to a just cause (to protect the environment). Moreover, individuals who actively participate in organizations may develop and enforce moral norms that may positively affect his/her recycling behaviour (see Section 2).

The effect of meetings with friends on household recycling is positive and statistically significant for glass (1%) and aluminium (5%), whereas visiting relatives has a low positive impact (10%) only for plastic and food waste. Thus, meetings with friends and relatives do not seem important social determinants of recycling behaviour.

Church attendance has a positive and statistically significant effect at 1% on household recycling for all five materials. If the head of a family goes to a church or other place of worship one or more times a week, the probability that he/she always recycles increases by 4.4% in the case of glass, 4.2% in the case of paper, 2.6% for aluminium, 2.4% for plastic and 2.0% for food waste. Religious participation might enhance individual recycling behaviour in the following ways. First, religious associations can provide knowledge and information on household recycling programmes. Second, religious associations can promote moral norms which may positively influence recycling behaviour. Finally, church attendance can reduce individual opportunism and motivate individuals (households) to devote more effort to action to protect the environment, such as recycling.

Table 5 also shows that the habit of talking politics matters. Talking politics every day or several times a week leads to a higher probability of always recycling for all materials. The habit of talking politics is associated with a 2.9% higher probability of recycling paper, a 2.6% higher probability for plastic and 2.0% for glass. For aluminium the marginal effect is 1.7% and for food waste it is 1.3. Instead, the habit of listening to political debates presents a positive and significant association with household recycling only for glass (1%), food (5%) and paper (10%).

A feasible reason for these findings recalls the argument according to which politically interested people are well-informed and have a high level of current knowledge about what is going on in politics (Torgler and García-Valiňas 2007). Hence, politically interested people may be well informed about environmental issues and problems and may have greater willingness to participate in recycling programmes.

The relationship between the decision to recycle and mass media is also examined in Table 5. The relationship is analyzed for newspapers, television and radio. Individuals who read newspapers every day are more likely to always recycle all materials. The reading of newspapers is correlated with a 4.7% higher probability of recycling paper, 2.6% for glass and plastic, 2.1% for aluminium and 1.1% for recycling food waste. These results seem in line with previous research (Nixon and Saphores 2009).

Watching television every day is associated with a higher recycling probability for paper, glass and plastic, while individuals who listen to the radio every day are more likely to recycle all materials, except for food waste. Nevertheless, the magnitude of the marginal effects of the television and radio variables on recycling is lower than that of the newspaper variable. Newspapers, television and radio are potential information sources about recycling. Thus, the importance of newspapers compared with the other sources should not be surprising since they leave a visible record of usable information (Nixon and Saphores 2009).

*4.1.3 Demographic and socio-economic characteristics*

As seen in Section 2, the existing literature on household recycling focuses on the demographic characteristics of recyclers. The econometric analysis presented in Table 5 includes a number of demographic characteristics of the household head. The statistical significance and magnitude of the effects of these variables on recycling behaviour are quite similar across the five materials. Below, I discuss those variables that have a statistically significant effect.

Being female increases the likelihood to recycle for all materials (statistically significant at 1%). Being female is associated, respectively, with a 6.8, 6.7 and 5.0% higher probability of recycling glass, paper and plastic. For food waste the marginal effect is 3.4% and for aluminium it is 2.6. Thus *female* is one of the most significant and important quantitative coefficients in the specifications.

In Table 5 we observe a statistically non-linear relationship between age dummies and recycling behaviour for all materials, except for food waste. Non-linearity show a U-shaped relationship. Being in the age class between 51 and 60 increases the recycling probability by

8.5% for paper, 6.4% for glass, 5.2% for plastic, 4.3% for aluminium and 3.1% for food waste. Hence, also the marginal effect of the age 51-60 dummy can be seen as one of the most significant and important quantitative coefficients of all those used. The significant relationship among age dummies and recycling outcomes is in line with previous studies (Jenkins et al. 2003; Kipperberg 2009; Hage et al. 2009; Nixon and Saphores 2009).

*Low education* enters the recycling behaviour equations with a negative sign and is statistically significant (1%) in the regressions for paper, glass, plastic and aluminium. This means that a household head who has completed elementary school and/or junior high school recycles less than a household head with a high school (diploma). In the recycling behaviour for paper, it also results that university graduates have a higher probability of recycling than high school-leavers. These results suggest a positive correlation between education and recycling behaviour and are consistent with the findings of Hong et al. (1993) and Jenkins et al. (2003).

Household income has a significant and positive effect on recycling behaviour for all materials, except for food waste. This suggests that household recycling behaviour is a normal good. This result is in line with one strand of the literature (Richardson and Haylicek 1978; Schultz et al. 1995; Jenkins et al. 2003; Halvorsen 2008).

A number of other socio-economic variables also influence recycling behaviour. Being married raises the recycling probability for all materials, while being divorced decreases the recycling outcomes for paper, glass and aluminium. Finally, widowed status is associated negatively and significantly (5%) with recycling behaviour for food waste.

Recycling behaviour does not seem to depend on household characteristics. Household size is not statistically significant, nor is the presence of children aged between 6 and 17. Nevertheless, a household head with children under six has a lower probability of recycling paper, plastic and aluminium. These results appear to conflict with previous research which indicates that larger households are more likely to recycle (Ando and Gasselin 2005; Nixon and Saphores 2009).

Perceived health and employment status matter. A household head who perceives their health status as poor is less likely to recycle all materials (except food waste). With regard to employment status, entrepreneurs recycle less paper and glass, the self-employed recycle less paper, plastic and aluminium, the unemployed recycle less food waste, while the retired recycle all five materials to a greater extent. Interestingly, being retired is correlated with 5.8% higher probability of recycling paper, a 5.4% higher probability for glass, 4.4% for plastic, 3.3% for aluminium and 2.9% for food waste. One explanation for these results could be that the retired have a lower opportunity cost of time.

Recycling studies frequently focus on whether a respondent owns or rents his/her home and on the home's characteristics. These issues are also examined here. Homeowners are more likely than tenants to recycle glass and food waste. This may indicate that homeowners are more attached to their community and/or are more concerned with the perceptions of their neighbours and recycle more as a result (Ferrara and Missios 2005).

Household heads who live in council house are more likely to recycle paper, glass and plastic. Living in a house with between one and five rooms increases the probability of recycling all materials (except food waste), although the magnitude of the marginal effects is low. A possible explanation for this result might be a lack of outdoor and indoor storage space.

Perception of community problems matters too. A household head who states that there is no difficulty parking in the area where he/she lives has a higher probability of recycling all five materials. Interestingly, no parking problem is associated with a 4.5% higher probability of recycling glass and a 4.2% higher probability of recycling food waste. Moreover, a household head who states that there is no dirtiness in the area where he/she lives has a higher probability of recycling paper, glass and plastic. Poor access to recycling bins decreases the probability of recycling paper by 3.2% and that of recycling glass by 2.5%.

The size of municipality enters the recycling behaviour regressions of glass and plastic negatively and significantly, indicating a non-linear relationship. Household heads living in a municipality with more than 50,000 inhabitants have the lowest recycling probability, followed by individuals living in municipalities with 2,000-10,000 inhabitants and by those living close to a metropolis, in the case of glass, and in a metropolis, in the case of plastic.

Table 5.1. Probit results. Regional marginal effects

| | I | II | III | IV | V |
|---|---|---|---|---|---|
| Variable | Paper | Glass | Plastic | Aluminium | Food waste |
| Piedmont+VdA | -0.325*** | -0.356*** | -0.295*** | -0.198*** | -0.222*** |
| | (0.009) | (0.011) | (0.007) | (0.004) | (0.008) |
| Trentino-AA | -0.132*** | -0.175*** | -0.246*** | -0.063*** | -0.176*** |
| | (0.017) | (0.018) | (0.010) | (0.010) | (0.010) |
| Veneto | -0.229*** | -0.266*** | -0.206*** | -0.092*** | -0.182*** |
| | (0.012) | (0.014) | (0.010) | (0.008) | (0.009) |
| Friuli-VG | -0.210*** | -0.268*** | -0.222*** | -0.154*** | -0.232*** |
| | (0.016) | (0.017) | (0.012) | (0.006) | (0.009) |
| Liguria | -0.360*** | -0.407*** | -0.340*** | -0.228*** | -0.278*** |
| | (0.009) | (0.010) | (0.006) | (0.003) | (0.006) |
| Emilia-R | -0.275*** | -0.325*** | -0.285*** | -0.184*** | -0.250*** |
| | (0.011) | (0.012) | (0.008) | (0.005) | (0.007) |
| Tuscany | -0.301*** | -0.358*** | -0.323*** | -0.186*** | -0.260*** |
| | (0.011) | (0.011) | (0.006) | (0.005) | (0.007) |
| Umbria | -0.430*** | -0.482*** | -0.372*** | -0.226*** | -0.323*** |
| | (0.006) | (0.007) | (0.004) | (0.003) | (0.004) |
| Marche | -0.386*** | -0.412*** | -0.324*** | -0.210*** | -0.256** |
| | (0.008) | (0.010) | (0.006) | (0.004) | (0.008) |
| Lazio | -0.415*** | -0.451*** | -0.365*** | -0.212*** | -0.265*** |
| | (0.007) | (0.009) | (0.005) | (0.004) | (0.007) |
| Abruzzi | -0.451*** | -0.485*** | -0.375*** | -0.225*** | -0.300*** |
| | (0.005) | (0.007) | (0.004) | (0.003) | (0.006) |
| Molise | -0.447*** | -0.498*** | -0.370*** | -0.224*** | -0.290*** |
| | (0.005) | (0.006) | (0.004) | (0.003) | (0.006) |
| Campania | - 0.506*** | -0.543*** | -0.395*** | -0.252*** | -0.350*** |
| | (0.004) | (0.005) | (0.004) | (0.003) | (0.004) |
| Puglia | -0.419*** | -0.488*** | -0.348*** | -0.233*** | -0.305*** |
| | (0.007) | (0.007) | (0.006) | (0.003) | (0.006) |
| Basilicata | -0.463*** | -0.522*** | -0.377*** | -0.227*** | -0.314*** |
| | (0.004) | (0.005) | (0.004) | (0.003) | (0.005) |
| Calabria | -0.485*** | -0.549*** | -0.397** | -0.243*** | -0.332*** |
| | (0.003) | (0.004) | (0.003) | (0.003) | (0.004) |
| Sicily | -0.490*** | -0.544*** | -0.390*** | -0.240*** | -0.305*** |
| | (0.005) | (0.005) | (0.004) | (0.003) | (0.006) |
| Sardinia | -0.474*** | -0.510*** | -0.400*** | -0.244*** | -0.329*** |
| | (0.004) | (0.006) | (0.003) | (0.003) | (0.004) |

Note : Lombardy is the reference region.

The regressors also include 18 regional dummies (Val d'Aosta is aggregated with Piedmont), with Lombardy as the reference region, whose marginal effects are shown in Table 5.1. Household heads living in Southern Italy are less likely to recycle all materials. In particular, individuals in Campania have the lowest probability of recycling all materials. Living in Campania is correlated with 51% lower probability of recycling paper, with a 54% lower probability for glass, a 40% lower probability for plastic, 25% for aluminium and 35% lower probability for food waste.

## 5. Concluding remarks

The paper investigated the determinants of household waste recycling behaviour in Italy on five different materials: paper, glass, plastic, aluminium and food waste. It used survey-based evidence from 47643 observations from the 1998 and 2000 Italian Multipurpose Household Survey conducted annually by the Italian Central Statistics Office. Its main aim was to explain the likelihood of household recycling behaviour in the absence of monetary incentives and sanctions, and focus on social behaviour. To my knowledge, this is the first empirical study to address such issues at the household level in Italy.

Econometric analysis showed a range of significant determinants of recycling behaviour. Recycling bins increase households' probability of always recycling all five materials. Further, difficulties reaching recycling bins in the area where the household head lives reduce recycling levels for all materials. The magnitude of the marginal effects is quite similar across the materials, with the largest impacts on food waste and plastic. These results suggest that the recycling bins programme has a smaller impact on materials for which there were recycling options such as newspapers. Furthermore, improving the proximity of recycling bins should reduce households' transportation and storage costs which could increase household recycling levels.

Social behaviour matters. Passive and active (unpaid labour supply) membership in (social) organizations have sizeable marginal effects in increasing the probability of always recycling all five materials. These findings indicate that social capital is an important factor in household recycling activities. Moreover, other social behaviour also constitutes major determinants of recycling: church attendance, reading newspapers and talking politics on a regular basis are also significantly positively associated with the probability of always recycling all five materials.

Individual characteristics matter too. Females always recycle more than males; married individuals always recycle more than singles. Household recycling behaviour is U-shaped in

relation to age, while higher household income produces a higher probability of always recycling. Moreover, I found that the poorly educated are less likely to recycle than an educated household head, and the retired are more likely to recycle than those in employment. Finally, the household head who lives in the regions of southern Italy is least likely to recycle.

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