“Bad rebounds” and the Environment: Bottled water and plastic collection behavior using cross-sectional Italian data

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Abstract

The multidimensional nature of environmental problems is increasingly recognized, as different relevant behaviors may be mutually reinforcing or in a trade-off relationship. This is particularly relevant when the use of resources is tightly linked to their packaging, as in the case of bottled water consumption.

This paper aims at using Italian data to assess whether plastic related separated collection and bottled water consumption are complements or substitutes in consumers’ behaviors. Using Cross-sectional Italian data, we provide evidence of a challenging “rebound” effect: individuals more engaged in recycling are also those producing more plastic waste related to bottled water consumption. This has important consequences for policy analysis, since the rebound effect appears to be related to the availability of waste infrastructures: better infrastructure, namely door to door collection, inflate the consumption of (plastic packaged) bottled water. We also provide robustness analysis for our results, specifically addressing the role of endogeneity issues.

Keywords: bottled water, environmental concern; recycling waste; rebound effect;

JEL Classification: C21; Q25; Q53

1. Introduction

The principles of the circular economy are in antithesis with the traditional linear economic model, based instead on the typical "extract, produce, use and throw" scheme, which depends on the availability of large quantities of easily available and cheap materials and energy.

The circular economy is a model of production and consumption that extends the life cycle of the products, helping to reduce waste to a minimum. Once the product has finished its function, the materials it is made of are reintroduced, where possible through recycling[1] . Recycling waste is fundamental to the Circular Economy, with particular emphasis on plastic waste due to its well-documented environmental impact[2]. The strong emphasis on recycling can, however, generate unexpected by-side effects. This is the case when a model of consumption, largely based on cheap and recyclable items, is claimed to be compliant with the circular economy 3R model (Reduce, Reuse, Recycle): a limited compliance with the first of the 3R paradigm, i.e. Reduce, is traded with a large compliance with the latter one, i.e. Recycle. This is the case, for instance, of fast fashion, and here

[1] https://www.europarl.europa.eu/topics/en/article/20151201STO05603/circular-economy-definition-importance-and-benefits

[2] See, among others, https://www.unep.org/plastic-pollution and https://www.eea.europa.eu/en/topics/in-depth/plastics

we claim this can also be the case for bottled water consumption. The widespread consumption of bottled water is a crucial issue for the circular economy transition. Consumption of bottled water results in a corresponding high volume of plastic waste and widespread environmental impacts (Amicarelli et al., 2024; Garfí et al., 2016). Switching from bottled to tap water consumption may generate important environmental benefits in terms of reduction of CO2 emissions from production, as well as of use of raw materials. A corresponding significant effort should therefore being devoted towards a change in water consumption habits, from bottled water to tap water (e.g. Tosun et al., 2020).[3] A circular transition in relation to water consumption involves, as a result, a complex set of changes in consumers demand and in water utilities' management and production processes, to allow a departure from an increasing trend in bottled water consumption and plastic production/recycling towards a model of reduced plastic waste and increased tap water consumption . The aim of this paper is to delve into the potential trade-offs embedded in this multidimensional effort as, to our knowledge, a research effort in this direction is lacking.

A substantial body of ecological literature has examined strategies to mitigate the environmental impact of bottled water consumption patterns, focusing on pollution and waste reduction. For example, Orset et al. (2017) analyzed various policy approaches, ranging from informational campaigns on plastic types and their environmental consequences to recycling policies that promote the use of recyclable plastic bottles. Among the supply side policies, producer responsibility regulations based on the Extended Producer Responsibility (EPR) principle have been implemented to minimize waste and environmental pollution. This literature is coupled with an increasing attention to the behavioral drivers of tap and water consumption and the impact of the results on the design of policies (Garfí et al., 2025; Dorigoni and Bonini, 2023), but to the best of our knowledge possible trade-offs across different relevant behaviors is not yet addressed in the received literature.

Existing contributions providing possible hints on the existence of trade-offs include Castro et al. (2022), who suggest that a recycling approach for plastic packaging may lead to a rapid increase in landfill waste, as a substantial quantity of secondary materials is required to replace virgin materials while maintaining equivalent properties. Socially undesirable behavioral responses may be also the result of consumers' misconception that recycling can offset the negative impacts associated with bottled water (e.g. Qian, 2018), or of consumers' misperception of tap water quality (e.g. Beaumais and Crastes dit Sourd, 2024). These biases may result in potential complementarities or trade-offs in driving water and plastic consumption and waste generation, along the lines highlighted, among

[3] The identified benefits from tap water consumption abstract from other benefits that may arise due to the value of groundwater resources scarcity (Castellucci and D'Amato, 2006; Moncur and Pollock, 2018) which does not seem to heavily affect retail bottled water price (e.g. Carlucci et al., 2016), also due to the trade-offs between pricing and access to water resources (e.g. Benöhr, ,2023).

others, by D’Amato et al. (2016) in relation to solid waste. In particular, if consumers see recycling efforts and bottled water consumption as substitutes, so that a stronger effort in one direction “justifies” a weaker attitude towards the other, then we may observe unexpected behavioral responses to changes in policies and incentives. We argue, for example, that the production of plastic waste could paradoxically increase with the availability of recycling facilities, an unintended consequence that we refer to as a *rebound effect* in plastic waste production, borrowing from the energy economics literature (Gillingham et al., 2016).

In consumer behavior, the relationship between separated collection of plastic waste and plastic waste generation related to bottled water consumption rests on the more general literature on sustainable individual behaviours and their drivers.

Indeed, on one hand effective social information programs can significantly influence consumer behaviours toward reducing bottled water usage (Peter and Honea, 2012), for example through “emotional” engagement using social messages that can drive desirable behavioral changes. As a result, we can observe consumers that are already aware of environmental impacts and that are engaged in recycling practices to be more engaged in sustainability-related initiatives, including reducing bottled water consumption. If individuals perceive themselves as environmentally responsible due to their recycling efforts, they may be encouraged to abstain from single-use plastic items like water bottles, and this may go in the direction of making the different environmental behaviours as complements and, therefore, mutually reinforcing (Bruchmann et al., 2021).

Standard economic incentives also play a role in affecting consumers’ choices between bottled and tap water. De Marchi et al. (2020) show, for example, how the willingness to pay of consumers for bottled water changes with the packaging material. In general, consumers’ choices frequently hinge on perceptions of cost, availability, and accessibility. As a result, consumers may react to perceived benefits associated with choosing tap water over bottled water due to monetary and time savings (Zvěřinová et al., 2024). Improving infrastructures and promoting tap water as a convenient and desirable alternative to bottled water may also play a role in reducing plastics waste, potentially enacting complementarity and leading to a reduction in single-use plastic bottles and related waste.

The possible complementarity across separated plastic collection and bottled water consumption is also backed up by evidence showing that when consumers believe they are contributing to sustainable practices through recycling, their intentions to reduce bottled water consumption tend to improve (Viscusi et al., 2014). Educational programs highlighting the ease and efficiency of both behaviours may reinforce this complementary relationship.

On the other hand, we may also observe substitutability, driven by consumers preferences and opportunity costs. Substitutability between the two behaviours can arise when consumers perceive their eco-friendly choices through participation in recycling initiatives as “enough” in the reduction of plastic waste, rather than directly reducing single-use items, so that some individuals may feel justified in consuming bottled water due to their recycling efforts (Ballantine et al., 2019). This is a potential source for a trade-off across separated plastic collection and bottled water consumption reduction. This phenomenon occurs when the increased efficiency of waste management leads to behavioral shifts that ultimately counteract environmental benefits, e.g. when only “broad” environmental behaviors matter and then providing effort in one environmental dimension is perceived as enough; this may especially happen when consumers perceive behaviors as similar, along the lines of Margetts and Kashima (2017). In the case of plastic recycling, consumers may perceive a reduced environmental cost associated with plastic use, and this may justify less attention towards bottled water use.

With this framework in mind, while previous studies have explored various determinants of bottled water consumption (Geerts et al., 2020; De Simone et al., 2024), we aim to first focus on a more in-depth analysis of environmental concerns and consumer awareness in shaping purchasing decisions within the framework of the

effect. These aspects have received limited attention in the literature, yet we argue that they hold significant potential, as they influence psychological constructs—such as attitudes—that ultimately shape consumers' decisions to purchase bottled water.

Second, we investigate the evidence of a rebound effect between bottled water consumption and separated collection, using an innovative approach, involving individual drivers and environmental concerns, to understanding if and how plastic recycling practices modify consumer choices, reducing or amplifying the rebound effect. We believe that it is essential for policy makers to understand the rebound effect linked to plastic recycling and bottled water consumption, to avoid ineffective or counterproductive policies, and to orient environmental strategies towards a more preventive and sustainable approach.

Our work unveils as follows. First, we borrow from the literature on the theoretical drivers of environmental behaviors and using a simple model based on a representative rational consumer, we show how different environmental behaviors may interact in the utility function, being in a complementarity or trade-off relationship, and we investigate how the linkage is affected by policy-related incentives, which in our setting take the form of waste related infrastructures.

Then, using a comprehensive dataset on Italian households, we assess how the availability of separated collection infrastructures impacts on bottled water consumption: controlling for potential endogeneity issues, we show that indeed better infrastructures lead at the same time to a larger separated collection likelihood but, at the same time, imply a larger bottled water consumption, though the effect is quantitatively not very large. This indeed suggests the possibility of a rebound effect that is relevant for the circular economy transition in the context of water consumption choices. Italy is a compelling case study, being among the largest bottled water consumers in the world[4].

The paper starts, in section 2, with a conceptual microeconomic framework to identify the possible sources of a rebound effect. Section 3 describes data and the adopted methodology, while section 4 presents the main results. Section 5 provides robustness checks, also in relation to potential endogeneity biases. Finally, section 6 concludes.

2. Theoretical framework

We model individual behaviors that are relevant to the environment in a stylized setting where consumption decisions are taken according to individual welfare (which is affected, among other things, by environmental valued) and incentives (e.g. relative prices and policies). We do so by referring to the literature on the drivers of environmental behaviors, including, among others, Brekke et al. (2003), Andreoni (1990) and, closer to our modelling strategy, D'Amato et al. (2016). More specifically, our analysis relates to the possible complementarity or substitutability across different environmental behaviors to justify the possibility that different behaviors either encourage or discourage each other.

We develop a simple utility maximization model featuring a representative agent with the following utility function, which satisfies standard concavity assumptions:

$$U = u(b, r) + x \tag{1}$$

where

- b stands for plastic-packaged (PP henceforth) bottled water consumption. We assume that the marginal utility of plastic bottle consumption is positive, but may be lowered by awareness of environmental concerns in relation to the production of plastic waste, as well as by a stronger awareness of the quality of tap water; we are implicitly assuming that bottled water is plastic packaged, which is consistent with empirical evidence;

[4] Packaged water consumption in Italy grew, between 2010 and 2023, from 187 to 248 liters per capita (source: https://www.statista.com/statistics/620252/packaged-water-consumption-in-italy-per-capita/ - accessed 26/06/25). Data suggest that in 2022 Italy was the biggest consumer of bottled water in Europe, and the second largest consumer worldwide (source: https://www.euronews.com/green/2024/07/27/italy-germany-portugal-which-european-countries-consume-the-most-bottled-water/ - accessed 26/06/25). Though comparability of data may be an issue, this suggests that Italy is indeed worth attention in relation to plastic waste generation and management.

- r stands for plastics recycling, i.e. time and resources allocated to a proper separation of plastic waste);
- x stands for other (private) goods, including "pure" leisure time.

Total water consumption level is set as exogenous, as it is reasonable, so that the variable b can be seen as the share of PP bottled water over total water consumption, or as the probability of consuming PP bottled water.

We also define a budget constraint, accounting for the price of bottled water (label it as p_b) and other consumption goods (normalized to *1*) and for the opportunity cost of environmental efforts in improving separated collection (label it as p_r). The latter opportunity cost is assumed to decrease with the quality of waste related infrastructures (e.g. with the availability of door to door collection facilities). This makes the model close to D'Amato et al. (2016).

The corresponding (standard) budget constraint can be rewritten as:

$$p_b b + p_r r + x = R \tag{2}$$

Where R is the exogenous representative consumer's income. Using the budget constraint we can rewrite the utility function as follows:

$$U = u(b, r) + R - p_b b - p_r r$$

The first order conditions for an interior solution, (under standard second order assumptions), are:

$$u_b(.) = p_b \tag{3}$$

$$u_r(.) = p_r \tag{4}$$

Under standard assumptions, from (3) and (4) we get our first, straightforward testable hypotheses:

Result 1. *Stronger preferences towards the environment, increasing the marginal utility of separated collection and decreasing the marginal utility of PP bottled water consumption, imply that more effort is done in separated collection and less PP bottled water is consumed.*

Result 2. *Stronger preferences towards the tap water, decreasing the marginal utility of of bottled water consumption, imply that less bottled water is consumed.*

Totally differentiating (3) and (4), and under standard second order conditions[5], we get the following comparative statics results:

$$\frac{dr}{dp_r} = \frac{u_{bb}}{|H|} < 0 \text{ and } \frac{db}{dp_b} = \frac{u_{rr}}{|H|} < 0,$$

so that, as it is reasonable, the recycling effort decreases with the related opportunity cost, while the amount of bottled water consumption decreases with the related price. The central part of our result is, however, the following:

Result 3. *Given the price of bottled water, the likelihood/amount of bottled water consumption can increase or decrease with the opportunity cost of separated collection, depending on whether the latter and the former are complements or substitutes in the utility function.*

Proof. The result in hypothesis 3 is easily shown from comparative statics results. Indeed, totally differentiating (3) and (4) and solving for $\frac{db}{dp_r}$ we get

$$\frac{db}{dp_r} = -\frac{u_{rb}}{|H|}$$

where, again $|H| = u_{rr}(.)u_{bb}(.) - u_{rb}^2(.) > 0$, while $u_{rb}(.)$ is the cross derivative of the utility function across the two kinds of "good/effort", namely consuming bottled water and performing separated collection. Therefore, the sign of $\frac{db}{dp_r}$ is the opposite of the sign of $u_{rb}(.)$. ■

Result 3 is the potential theoretical underpinning for a *rebound effect* in our setting. More specifically, such an effect can indeed take place when $\frac{db}{dp_r} < 0$, i.e. if the marginal utility of bottled water consumption increases with the effort in separating plastic waste, i.e. a larger effort in separated collection implies a larger marginal utility from bottled water consumption. In such a case, a decline in the opportunity cost of separated collection (for example due to the availability of door-to-door collection facilities) may bring an increase in bottled water consumption (a decrease in the corresponding effort of reducing the production of plastic waste) and vice versa. As already outlined in the introduction, this forces potentially leading to a "circular" *rebound* may be justified on the basis

[5] These conditions would amount to assuming that i.e. $u_{rr}(.) < 0$ and $|H| = u_{rr}(.)u_{bb}(.) - u_{rb}^2(.) > 0$.

of individuals' perception in terms of similarity across environmental efforts, so that separating waste implies a lower sense of "guilt" from consuming more PP bottled water. Indeed, this is a possible justification for the substitutability across the two environmental efforts under scrutiny.

3. Data, variables and methodology

To empirically assess our theoretical intuition, we use a dataset obtained from the Multipurpose Household Survey (MHS), a cross-sectional qualitative survey conducted annually by ISTAT and representative of the Italian population. Starting from 1993, every year approximately 20,000 households and 50,000 individuals are surveyed on several aspects of daily life. The dataset provides information on socio-demographic characteristics of the respondent and/or the related households and on environmental-specific issues such as concern, satisfaction and use of natural resources including the consumption of mineral water (bottled) and tap water.

We considered a four-year time span (2017-2020) and pooled each survey into a unique final dataset. We use quantitative techniques to understand whether the consumption of bottled water may depend on the level of perceived environmental concern of consumers, and if it is affected by the efficiency and quality of water service supply. Then, we assess the evidence of a rebound effect between bottled water consumption and plastic recycling behaviors. Lastly, we control for several socio-demographic variables, as well as for regional and time fixed effects.

Table 1 shows definitions and measurement of variables used in the econometric analysis. The Appendix reports the correlation matrix and summary statistics.

As to our dependent variable, we do not have a precise measure of PP bottled water consumption, since in the Istat survey we can only get information about the consumption of bottled water. However, plastic packaging is prominent in the production of water containers. For example, PET bottles are widely used in the soft drink sector (Tsironi et al., 2022). Moreover, as the data provided by Legambiente (2018) show, the largest part of bottled mineral water is plastic packaged. Therefore, we deem our dependent variable, a dummy that equals 1 if the respondent announces he/she is consuming bottled water, as a quite good proxy of the investigated behavior sketched in equation 1, i.e. plastic bottled water consumption. We use, as our main driver, the habit of separated plastic collection through door-to-door facilities. In addition, to be able to separate the impact of infrastructures availability from that measuring the presence of waste separation efforts, we also use a dummy only accounting for the availability of door-to-door collection.

We also test for the role of different dimensions of environmental awareness and concern, and control for water quality and for other socio-demographic characteristics. From descriptive statistics, presented in Table A1, nearly 50% say they collect plastic containers through door-to-door collection, while this percentage rises to 52% if we also include those who declare they do it sometimes. Approximately 67% of respondents declare to live in an area served/involved by door-to-door waste collection.

In relation to environmental concerns, the highest levels of concern are for Climate risk (mean = 0.569) and Pollution (mean = 0.475); then, Resource exhaustion (mean = 0.312).

Almost 75% of respondents declare to be satisfied or very satisfied about perceived tap water quality, while only 10% declare irregularities in water service and 98% perceive its cost as high or, at least, adequate. On average, about 16% of the respondents has a high level of trust in local institutions.

Nearly 76% of the respondents own their own home, while nearly 45% of the respondents have a highly paid job position (manager, self-employed as entrepreneur, freelancer, managerial staff, cadres or employee).

Given the binary nature of our dependent variables, we estimate the following probit model:

$$\Pr(Y_i = 1|X) = \Phi(X, \rho)$$

where Y_i is a dummy variable that takes value 1 if respondent i consumes bottled water and 0 otherwise, X is a set of explanatory variables and ρ a set of control variables, as detailed above and in Table 1, while Φ is the cumulative distribution function of the standard normal distribution.

We will then detail robustness checks in section 5.

Table 1. Variables Description

Variables	Description
Dependent variable	
Bottled water	Dummy=1, if the respondent drinks bottled water; =0, if not
Independent variables	
Rebound variables	
Plastic Always	Dummy =1, if the respondent always has the habit of collecting plastic containers separately using door-to-door collection, =0, otherwise
Plastic Always and Sometimes	Dummy =1, if the respondent always or sometimes has the habit of collecting plastic containers separately using door-to-door collection, =0, otherwise
Door-To-Door Presence	Dummy = 1, if the area in which the respondent lives is served/involved by door-to-door waste collection.
Environmental concern	
Pollution	Dummy=1, if the respondent is mostly worried for pollution in sea and rivers, or soil.
Resource exhaustion	Dummy=1, if the respondent is mostly worried for destruction of forests and loss of biodiversity.
Climate risk	

	Dummy=1, if the respondent is mostly worried for climate change or hydrogeological instability (e.g., earthquakes, floods, etc.).
Water service (judgment)	
Quality	Dummy =1, if tap water quality is perceived as high; =0, otherwise
Irregular water supply	Dummy =1, if interruptions in the water supply service occur; =0, not
Cost	Dummy =1 if water cost is perceived as high or adequate; = 0, otherwise
Trust	Dummy= 1 if trust in local institutions is high, =0, otherwise.
Socio-economic profile	
Owner	Dummy =1, if the respondent is homeowner; =0, otherwise
Job position	Dummy =1, if respondent is manager, self-employed as entrepreneur, freelancer, managerial staff, cadres or employee; =0, otherwise
Control variables	
Gender	Dummy =1, if respondent is female; =0, if male
Age	Dummy=1, if 18-39 years; =0, otherwise
Household size	Number of people living in family
Educational level	Dummy =1, if respondent is high school graduated, degreed or post-degreed; =0, otherwise
Employment status	Dummy =1, if the respondent is employed; =0, otherwise
Health	Dummy =1 if respondent is satisfied or very satisfied on health status in the last 12 months; =0 if bit or not satisfied
Instruments	
Paper	Dummy =1, if the respondent always has the habit of collecting paper and cardboard separately using door-to-door collection, =0, otherwise
Medicines	Dummy =1, if the respondent always has the habit of collecting medicines separately using door-to-door collection, =0, otherwise
Dummy region	Regional control
Dummy year	Year control

4. Results

The results from the three probit specifications presented in Table 2 provide consistent insights into the determinants of bottled water consumption, i.e our proxy for water related plastic waste production, where the marginal effects (dy/dx – ME from now on) represent the change in the probability of consuming bottled water associated with a one-unit change in each independent variable.

All three variables of environmental concerns show significant negative marginal effects across all models, suggesting that higher environmental concerns, particularly regarding pollution of sea/rivers and soil and climatic risk are associated with a lower likelihood of consuming bottled water, i.e. they are associated with a reduction in the probability of producing plastic waste.

As to water service characteristics, the only significant effect across all the specifications is linked to *Quality*, whose marginal effects is around -0.022, indicating that an increase in perceived tap water quality is correlated with a reduction in the probability of bottled water consumption.

As to the socio-economic profile of the respondent, a higher-paying job position (*Job Position*) corresponds to a greater probability of consuming bottled water (ME = 0.007 and a significance level at 1%), while owning a home (*Owner*) does not significantly correlate with water consumption choices. The socio-demographic controls are all statistically significant at 1%.

Gender shows a negative and significant ME = -0.007, indicating that women may be less likely to engage in consumer behavior that would increase the use of plastic packaging, while the other control variables (Age, Household Size, Educational Level, Employment Status, Health) all feature a significant and positive correlation in all the three models, indicating that these factors are associated with an increase in the likelihood of consuming bottled water.

Being younger (*Age*) is associated with a larger bottled water consumption (ME = 0.025), likely reflecting generational differences in consumption patterns or risk perceptions. *Household size* and a higher level of Education (*Educational level*) feature small positive marginal effects (ME = 0.003 and ME = 0.005, respectively). *Employment status* is one of the strongest socioeconomic drivers, with a positive correlation with bottled water consumption and a ME = 0.027 and *Health* concerns also shows a positive significant effect (ME = 0.011) in shaping the probability of consuming bottled water consumption.

In Models II and III, we enrich our specification by including the variables *Plastic Always* and *Plastic Always and Sometimes*, to assess the possibility of a positive and statistically significant correlation implying that consumers that are engaging in more separated collection effort in the presence of door-to-door collection facilities are also more likely to consume bottled water.

The possibility of such unexpected (but reasonable) outcome is confirmed in columns 4 and 6 in Table 2. In other words, respondents who regularly separate waste using door-to-door collection are more likely to consume bottled water (ME = 0.008 and a significance level at 1%). This result may indeed indicate a *rebound effect*, that may be rationalized according to the received literature and to our theoretical framework: the perception of "doing the right thing" by participating in door-to-door collection reduces the sense of guilt related to plastic waste production, implying an increase in the marginal utility of bottled water consumption and leading to an increase in the latter. This evidence is also confirmed in Model III where we consider not only those who regularly use door-to-door collection, but also those who use it only sometimes, including both frequencies of the behavior in the variable *Plastic Always and Sometimes* (reported in the results tables as "*Plastic Alw. and Som.*" due to lack of space).

Although the marginal effects of the rebound variables are quite small in magnitude, corresponding to approximately a 0.08% increase in the probability of consuming bottled water, the hint of a counter-intuitive trade-off across environmental behaviors may be relevant for policy and for future research.

Table 2 - Results - Probit regression models

	Model I		Model II		Model III	
	Coefficients	dy/dx	Coefficients	dy/dx	Coefficients	dy/dx
	(1)	(2)	(3)	(4)	(5)	(6)
Independent variables						
Rebound variables						
Plastic Always			0.053(0.012)***	0.008(0.002)***		
Plastic Alw. and Som.					0.056(0.012)***	0.008(0.002)***
Environmental concerns						
Pollution	-0.021(0.011)*	-0.003(0.002)*	-0.022(0.011)**	-0.003(0.002)**	-0.022(0.011)**	-0.003(0.002)**
Resource	-0.042(0.011)***	-0.006(0.002)***	-0.040(0.012)***	-0.006(0.002)***	-0.040(0.012)***	-0.006(0.002)***
Climate	-0.031(0.012)***	-0.005(0.002)***	-0.032(0.012)***	-0.005(0.002)***	-0.032(0.012)***	-0.005(0.002)***
Water service (Judgment)						
Quality	-0.150(0.014)***	-0.023(0.002)***	-0.148(0.014)***	-0.023(0.002)***	-0.148(0.014)***	-0.022(0.002)***
Irregular water supply	0.028(0.021)	0.004(0.003)	0.025(0.021)	0.004(0.003)	0.025(0.021)	0.004(0.003)
Cost	-0.005(0.045)	-0.001(0.007)	-0.001(0.045)	-0.001(0.007)	-0.001(0.045)	-0.001(0.007)
Trust	0.007(0.015)	0.001(0.002)	0.005(0.015)	0.001(0.002)	0.005(0.015)	0.001(0.002)
Socio-economic profile						
Owner	0.002(0.013)	0.001(0.002)	-0.001(0.014)	-0.001(0.002)	-0.001(0.014)	-0.001(0.002)
Job position	0.043(0.013)***	0.007(0.002)***	0.046(0.013)***	0.007(0.002)***	0.046(0.013)***	0.007(0.002)***
Control variables						
Gender	-0.043(0.011)***	-0.007(0.002)***	-0.045(0.011)***	-0.007(0.002)***	-0.045(0.011)***	-0.007(0.002)***
Age	0.162(0.015)***	0.025(0.002)***	0.160(0.015)***	0.024(0.002)***	0.160(0.015)***	0.024(0.002)***
Household size	0.023(0.005)***	0.003(0.001)***	0.022(0.005)***	0.003(0.001)***	0.022(0.005)***	0.003(0.001)***
Educational level	0.036(0.013)***	0.005(0.002)***	0.036(0.013)***	0.006(0.002)***	0.037(0.013)***	0.006(0.002)***
Employment status	0.178(0.012)***	0.027(0.002)***	0.177(0.012)***	0.027(0.002)***	0.177(0.012)***	0.027(0.002)***
Health	0.074(0.014)***	0.011(0.002)***	0.075(0.014)***	0.011(0.002)***	0.075(0.014)***	0.011(0.002)***
Dummy region	YES	YES	YES	YES	YES	YES
Dummy year	YES	YES	YES	YES	YES	YES
Constant	1.478(0.056)***		1.455(0.057)***		1.453(0.057)***	
No. of observations	112,699	112,699	111,770	111,770	111,770	111,770
Log pseudolikelihood	-31855.573	-31855.573	-31624.233	-31624.233	-31623.266	-31623.266

Notes: The dependent variable bottled water consumption takes value 1 if the respondent drinks bottled water (at least a minimum amount). The models are estimated with standard probit.
*Regressors' description: see Table 1. Regional and yearly dummies are omitted from the Table for reasons of space. The symbols ***, **, * denote that the coefficient is statistically different from zero at 1, 5 and 10 %, respectively. Standard errors are in parentheses.*

5. Identifying the sources of the *rebound effect*

We further develop our analysis to be able to identify the potential driving forces of results reported in Table 2. In Tables 3a and 3b we first further validate the core results in terms of significance and explore interaction effects across recycling behaviors (*Plastic Always* and *Plastic Alw. and Som.* respectively) and environmental concern variables, aiming to separate the motivational component from the infrastructural/opportunity cost component, along the lines suggested by our theoretical analysis.

In Table 3a, in Model Ia we extend the baseline model of Table 2 by including the interaction between *Plastic Always* and *Pollution*, in Model IIa by adding the interaction between *Plastic Always* and *Resource*, while in Model IIIa we consider the interaction between *Plastic Always* and *Climate.*

However, despite *Plastic Always* has positive and significative marginal effects in all the three specifications, all the interactions effects are non-significative. Very similar evidence is provided in Table 3b, where we reported extensions of the baseline models of Table 2, by including interaction effects between *Plastic Alw. and Som.* and environmental concern variables (Models 1b-3b).

Table 3a- Robustness check and interaction effects between Plastic Always and Environmental Concerns

	Model Ia		Model IIa		Model IIIa	
	Coefficients	dy/dx	Coefficients	dy/dx	Coefficients	dy/dx
	(1)	(2)	(3)	(4)	(5)	(6)
Independent variables						
Rebound variables						
Plastic Always	0.055(0.017)***	0.008(0.003)***	0.054(0.014)***	0.008(0.002)***	0.029(0.020)	0.004(0.003)
Environmental concerns						
Pollution	-0.021(0.015)	-0.003(0.002)	-0.022(0.011)**	-0.003(0.002)**	-0.022(0.011)**	-0.003(0.002)**
Resource	-0.040(0.012)***	-0.006(0.002)***	-0.038(0.016)**	-0.006(0.002)**	-0.040(0.012)***	-0.006(0.002)***
Climate	-0.032(0.012)***	-0.005(0.002)***	-0.032(0.012)***	-0.005(0.002)***	-0.048(0.016)***	-0.007(0.002)***
Interaction effects						
Plastic Always * Pollution	-0.003(0.022)	-0.001(0.003)				
Plastic Always * Resource			-0.003(0.023)	-0.001(0.003)		
Plastic Always * Climate					0.035(0.023)	0.005(0.004)
Water service (Judgment)						
Quality	-0.148(0.014)***	-0.023(0.002)***	-0.148(0.014)***	-0.023(0.002)***	-0.148(0.014)***	-0.023(0.002)***
Irregular water supply	0.025(0.021)	0.004(0.003)	0.025(0.021)	0.004(0.003)	0.025(0.021)	0.004(0.003)
Cost	-0.001(0.045)	-0.001(0.007)	-0.001(0.045)	-0.001(0.007)	-0.001(0.045)	-0.001(0.007)
Trust	0.005(0.015)	0.001(0.002)	0.005(0.015)	0.001(0.002)	0.005(0.015)	0.001(0.002)
Socio-economic profile						
Owner	-0.001(0.014)	-0.001(0.002)	-0.001(0.014)	-0.001(0.002)	-0.001(0.014)	-0.001(0.002)
Job position	0.046(0.013)***	0.007(0.002)***	0.046(0.013)***	0.007(0.002)***	0.046(0.013)***	0.007(0.002)***
Control variables						
Gender	-0.045(0.011)***	-0.007(0.002)***	-0.045(0.011)***	-0.007(0.002)***	-0.045(0.011)***	-0.007(0.002)***

Age	0.160(0.015)***	0.024(0.002)***	0.160(0.015)***	0.024(0.002)***	0.160(0.015)***	0.024(0.002)***
Household size	0.022(0.005)***	0.003(0.001)***	0.022(0.005)***	0.003(0.001)***	0.022(0.005)***	0.003(0.001)***
Educational level	0.036(0.013)***	0.006(0.002)***	0.036(0.013)***	0.006(0.002)***	0.036(0.013)***	0.006(0.002)***
Employment status	0.177(0.012)***	0.027(0.002)***	0.177(0.012)***	0.027(0.002)***	0.177(0.012)***	0.027(0.002)***
Health	0.075(0.014)***	0.011(0.002)***	0.075(0.014)***	0.011(0.002)***	0.075(0.014)***	0.011(0.002)***
Dummy region	YES	YES	YES	YES	YES	YES
Dummy year	YES	YES	YES	YES	YES	YES
Constant	1.454(0.057)***		1.454(0.057)***		1.466(0.057)***	
No. of observations	111,770	111,770	111,770	111,770	111,770	111,770
Log pseudolikelihood	-31624.224	-31624.224	-31624.225	-31624.225	-31623.087	-31623.087

Notes: The dependent variable bottled water consumption takes value 1 if the respondent drinks bottled water (at least a minimum amount). The models are estimated with standard probit.
*Regressors' description: see Table 1. Regional and yearly dummies are omitted from the Table for reasons of space. The symbols ***, **, * denote that the coefficient is statistically different from zero at 1, 5 and 10 %, respectively. Standard errors are in parentheses.*

Table 3b- Robustness check and interaction effects between Plastic Alw. and Som. and Environmental Concerns

	Model Ib		Model IIb		Model IIIb	
	Coefficients	dy/dx	Coefficients	dy/dx	Coefficients	dy/dx
	(1)	(2)	(3)	(4)	(5)	(6)
Independent variables						
Rebound variables						
Plastic Alw. and Som.	0.062(0.017)***	0.009(0.003)***	0.054(0.014)***	0.008(0.002)***	0.033(0.020)*	0.005(0.003)*
Environmental concerns						
Pollution	-0.017(0.015)	-0.003(0.002)	-0.022(0.011)**	-0.003(0.002)**	-0.022(0.011)**	-0.003(0.002)**
Resource	-0.040(0.012)***	-0.006(0.002)***	-0.042(0.016)***	-0.006(0.002)***	-0.040(0.012)***	-0.006(0.002)***
Climate	-0.032(0.012)***	-0.005(0.002)***	-0.032(0.012)***	-0.005(0.002)***	-0.048(0.016)***	-0.007(0.002)***
Interaction effects						
Plastic Alw. and Som.* Pollution	-0.011(0.022)	-0.002(0.003)				
Plastic Alw. and Som.* Resource			0.005(0.023)	0.001(0.003)		
Plastic Alw. and Som.* Climate					0.034(0.023)	0.005(0.004)
Water service (Judgment)						
Quality	-0.148(0.014)***	-0.023(0.002)***	-0.148(0.014)***	-0.023(0.002)***	-0.148(0.014)***	-0.023(0.002)***
Irregular water supply	0.025(0.021)	0.004(0.003)	0.025(0.021)	0.004(0.003)	0.025(0.021)	0.004(0.003)
Cost	-0.001(0.045)	-0.001(0.007)	-0.001(0.045)	-0.001(0.007)	-0.001(0.045)	-0.001(0.007)
Trust	0.005(0.015)	0.001(0.002)	0.005(0.015)	0.001(0.002)	0.005(0.015)	0.001(0.002)
Socio-economic profile						
Owner	-0.001(0.014)	-0.001(0.002)	-0.001(0.014)	-0.001(0.002)	-0.001(0.014)	-0.001(0.002)
Job position	0.046(0.013)***	0.007(0.002)***	0.046(0.013)***	0.007(0.002)***	0.046(0.013)***	0.007(0.002)***
Control variables						
Gender	-0.045(0.011)***	-0.007(0.002)***	-0.045(0.011)***	-0.007(0.002)***	-0.045(0.011)***	-0.007(0.002)***
Age	0.160(0.015)***	0.024(0.002)***	0.160(0.015)***	0.024(0.002)***	0.160(0.015)***	0.024(0.002)***
Household size	0.022(0.005)***	0.003(0.001)***	0.022(0.005)***	0.003(0.001)***	0.022(0.005)***	0.003(0.001)***
Educational level	0.037(0.013)***	0.006(0.002)***	0.037(0.013)***	0.006(0.002)***	0.037(0.013)***	0.006(0.002)***

Employment status	0.177(0.012)***	0.027(0.002)***	0.177(0.012)***	0.027(0.002)***	0.177(0.012)***	0.027(0.002)***
Health	0.075(0.014)***	0.011(0.002)***	0.075(0.014)***	0.011(0.002)***	0.075(0.014)***	0.011(0.002)***
Dummy region	YES	YES	YES	YES	YES	YES
Dummy year	YES	YES	YES	YES	YES	YES
Constant	1.451(0.057)***		1.454(0.057)***		1.464(0.057)***	
No. of observations	111,770	111,770	111,770	111,770	111,770	111,770
Log pseudolikelihood	-31623.148	-31623.148	-31623.243	-31623.243	-31622.199	-31622.199

Notes: The dependent variable bottled water consumption takes value 1 if the respondent drinks bottled water (at least a minimum amount). The models are estimated with standard probit.
*Regressors' description: see Table 1. Regional and yearly dummies are omitted from the Table for reasons of space. The symbols ***, **, * denote that the coefficient is statistically different from zero at 1, 5 and 10 %, respectively. Standard errors are in parentheses.*

By performing the interaction effects in Tables 3a and 3b and not obtaining significant marginal effects for them, it is evident that environmental concerns influence the consumption of bottled water, regardless of whether the respondent collects separately plastic waste or not, so that we can conclude that the channel linked to environmental concerns is separated from that stemming from separated waste collection behavior. As a matter of fact, the presence of environmental concerns has an impact on bottled water consumption, but does not affect the impact that separate collection of plastic has on the dependent variable. This is a hint that separate collection is mainly driven by the opportunity cost of plastic collection, i.e., the availability of infrastructures, rather than by environmental sensitivity. To rigorously identify the sources of the *rebound* effect we need to rigorously identify whether plastic separation is related to the opportunity cost for respondents in collecting separately plastic waste. To this end, in Table 3c we further extend the baseline model from Table 2, adding in Model Ic the variable *Door-to-Door Presence,* a dummy that only indicates whether the area in which the respondent lives is served by door-to-door waste collection.

This last specification is further extended in Models IIc and IIIc, where we add alternatively the variables *Plastic Always* and *Plastic Alw. and Som.*, respectively.

Being exposed to door-to-door collection service is correlated in a statistically significant way with the probability of consuming bottled water (and, therefore, of generating more plastic waste from packaging). The marginal effect is constant and positive (ranging from 1.3% to 1.4%) in all specifications shown in Table 3c.

This marginal effect is much larger than the marginal effects of environmental concerns, i.e. opportunity cost seem to feature a much stronger marginal effect than individual perceptions of environmental concerns, indicating that these last ones are weaker in potentially driving a reduction in bottled water consumption as compared to availability of door-to-door collection services.

Further, models IIc and IIIc, where the variables *Plastic Always* and *Plastic Alw. and Som.* are also included, we see that they are not significant, while Door-to-Door Presence maintains its positive and significant marginal effect. This allows to further disentangle the "infrastructural" effect from any motivation for separation and/or environmental concern.

Paradoxically, even though improving infrastructures and providing door-to-door services causes a lower opportunity cost of separated plastic collection, this may be at least partially compensated by our identified *rebound effect* which, at least according to the literature and to our theoretical analysis, may be triggered by a sort of over-justification effect in individuals and, more generally, a trade-off relationship between bottled water consumption and separated collection.

Table 3c – Robustness check; inclusion of the variable Door-to-Door Presence

	Model Ic		Model IIc		Model IIIc	
	Coefficients	dy/dx	Coefficients	dy/dx	Coefficients	dy/dx
	(1)	(2)	(3)	(4)	(5)	(6)
Independent variables						
Rebound variables						
Door-To-Door Presence	0.086(0.012)***	0.013 (0.002)***	0.089(0.016)***	0.014(0.002)***	0.089(0.017)***	0.014(0.003)***
Plastic Always			-0.005(0.016)	-0.001(0.002)		
Plastic Alw. and Som.					-0.005(0.017)	-0.001(0.003)
Environmental concerns						
Pollution	-0.022(0.011)**	-0.003(0.002)**	-0.022(0.011)**	-0.003(0.002)**	-0.022(0.011)**	-0.003(0.002)**
Resource	-0.042(0.011)***	-0.006(0.002)***	-0.040(0.012)***	-0.006(0.002)***	-0.040(0.012)***	-0.006(0.002)***
Climate	-0.031(0.012)***	-0.005(0.002)***	-0.031(0.012)***	-0.005(0.002)***	-0.031(0.012)***	-0.005(0.002)***
Water service (Judgment)						
Quality	-0.149(0.014)***	-0.023(0.002)***	-0.147(0.014)***	-0.022(0.002)***	-0.147(0.014)***	-0.022(0.002)***
Irregular water supply	0.024(0.021)	0.004(0.003)	0.023(0.021)	0.004(0.003)	0.023(0.021)	0.004(0.003)
Cost	-0.005(0.045)	-0.001(0.007)	0.001(0.045)	0.001(0.007)	0.001(0.045)	0.001(0.007)
Trust	0.003(0.015)	0.001(0.002)	0.003(0.015)	0.001(0.002)	0.003(0.015)	0.001(0.002)
Socio-economic profile						
Owner	-0.003(0.013)	-0.001(0.002)	-0.003(0.014)	-0.001(0.002)	-0.003(0.014)	-0.001(0.002)
Job position	0.046(0.013)***	0.007(0.002)***	0.046(0.013)***	0.007(0.002)***	0.046(0.013)***	0.007(0.002)***
Control variables						
Gender	-0.044(0.011)***	-0.007(0.002)***	-0.045(0.011)***	-0.007(0.002)***	-0.045(0.011)***	-0.007(0.002)***
Age	0.160(0.015)***	0.024(0.002)***	0.158(0.015)***	0.024(0.002)***	0.158(0.015)***	0.024(0.002)***
Household size	0.021(0.005)***	0.003(0.001)***	0.022(0.005)***	0.003(0.001)***	0.022(0.005)***	0.003(0.001)***
Educational level	0.039(0.013)***	0.006(0.002)***	0.038(0.013)***	0.006(0.002)***	0.038(0.013)***	0.006(0.002)***
Employment status	0.178(0.012)***	0.027(0.002)***	0.177(0.012)***	0.027(0.002)***	0.177(0.012)***	0.027(0.002)***
Health	0.073(0.014)***	0.011(0.002)***	0.074(0.014)***	0.011(0.002)***	0.074(0.014)***	0.011(0.002)***
Dummy region	YES	YES	YES	YES	YES	YES
Dummy year	YES	YES	YES	YES	YES	YES
Constant	1.431(0.057)***		1.425(0.057)***		1.425(0.057)***	

No. of observations	112,581	112,581	111,678	111,678	111,678	111,678
Log pseudolikelihood	-31804.437	-31804.437	-31585.639	-31585.639	-31585.639	-31585.639

Notes: The dependent variable bottled water consumption takes value 1 if the respondent drinks bottled water (at least a minimum amount). The models are estimated with standard probit.
*Regressors' description: see Table 1. Regional and yearly dummies are omitted from the Table for reasons of space. The symbols ***, **, * denote that the coefficient is statistically different from zero at 1, 5 and 10 %, respectively. Standard errors are in parentheses.*

Finally, an endogeneity problem may arise due to the potential reverse causality issue between plastic recycling behaviors and the dependent variable, i.e. it is possible that the consumption of bottled water influences the propensity to use the "door-to-door" services for plastic containers.

An individual who consumes bottled water may, in other words, feel more obliged to dispose of plastic waste correctly, using the door-to-door service. Therefore, the latter can be a consequence, rather that the cause, of the consumption of bottled water (production of plastic waste).

To address this problem and avoid biased and inconsistent estimates, we use a Two Stage Least Squares (TSLS) approach, implementing as instruments the variables *Paper* and *Medicines* (see Section 2, Table 1 for Variables description) which are related to paper and medicines waste separation under door-to-door collection.

We assume that instruments could be linked to the potentially endogenous independent variable, i.e. collecting plastic containers separately using door-to-door collection, and that they are not correlated with the production of plastic waste.

In doing this, in Table 4 in the first three columns we provide the results of TSLS estimates (having regard to Modell II of Table 2), showing both stages and the marginal effects, while in columns 4-5 we provide an OLS estimation, including also *Paper* and *Medicines* dummies.

Wald test of exogeneity, strongly rejecting the null hypothesis, indicates that there is very strong evidence of endogeneity of *Plastic Always* variable, highlighting the impossibility of using an OLS approach, so that one or more instrumental variables are necessary to obtain consistent estimates.

The first stage of TSLS model, with Plastic Always as dependent variable, shows a significance level of 1% for both instruments, indicating their relevant validity.

This evidence is also supported by the high F-statistic value and p-value < 0.01, which confirm that the instruments are strong and adequate to address the endogeneity problem, and the estimate should be reliable.

The under-identification test (Kleibergen-Paap LM test) shows that the model is correctly identified ($p < 0.01$), while for Weak identification test (Stock-Yogo and Kleibergen-Paap rk Wald F statistic), the values obtained exceed the critical thresholds of 10%, indicating that the problem of weak instruments is not present. Moreover, the Hansen test, not rejecting the null hypothesis, confirms the credibility of the 2SLS model, as well as the validity of the instruments used.

In other words, the instruments are valid as they are not correlated with the error term and are, therefore, exogenous.

Table 4 shows that our results are robust to the IV approach adopted. Even more so as the marginal effects slightly increase (i.e. those who perform separated collection of plastics in a door-to-door setting are 1.6% more likely to consume bottled water). Our main result is therefore confirmed, and a causal relation from separated plastic collection to bottled water consumption can be derived.

Table 4 – Endogeneity-corrected estimates[6]

	Model II (TSLS)			Model II (OLS)	
	First Stage	Second Stage	dy/dx	Coefficients	dy/dx
	(1)	(2)	(3)	(5)	(6)
Independent variables					
Rebound variables					
Plastic Always		0.100(0.015)***	0.016(0.002)***	-0.003(0.003)	-0.003(0.003)
Environmental concerns					
Pollution	0.006(0.002)***	-0.022(0.011)**	-0.003(0.002)**	-0.003(0.002)**	-0.003(0.002)**
Resource	0.002(0.002)	-0.042(0.012)***	-0.006(0.002)***	-0.006(0.002)***	-0.006(0.002)***
Climate	0.008(0.002)***	-0.033(0.012)***	-0.006(0.002)***	-0.005(0.002)***	-0.005(0.002)***
Water service (Judgment)					
Quality	-0.007(0.002)***	-0.147(0.014)***	-0.021(0.002)***	-0.021(0.002)***	-0.021(0.002)***
Irregular water supply	0.011(0.003)***	0.026(0.021)	0.004(0.003)	0.004(0.003)	0.004(0.003)
Cost	-0.004(0.008)	-0.006(0.045)	-0.001(0.007)	-0.001(0.007)	-0.001(0.007)
Trust	0.009(0.003)***	0.003(0.015)	0.001(0.002)	0.001(0.002)	0.001(0.002)
Socio-economic profile					
Owner	0.006(0.002)***	-0.005(0.014)	-0.001(0.002)	-0.001(0.002)	-0.001(0.002)
Job position	-0.017(0.002)***	0.048(0.013)***	0.007(0.002)***	0.007(0.002)***	0.007(0.002)***
Control variables					
Gender	-0.001(0.002)	-0.047(0.011)***	-0.008(0.002)***	-0.008(0.002)***	-0.008(0.002)***
Age	0.009(0.002)***	0.161(0.015)***	0.021(0.002)***	0.022(0.002)***	0.022(0.002)***
Household size	0.003(0.001)***	0.022(0.005)***	0.004(0.001)***	0.004(0.001)***	0.004(0.001)***
Educational level	-0.013(0.002)***	0.038(0.014)***	0.007(0.002)***	0.007(0.002)***	0.007(0.002)***
Employment status	0.007(0.002)***	0.179(0.012)***	0.027(0.002)***	0.027(0.002)***	0.027(0.002)***
Health	-0.004(0.002)	0.074(0.014)***	0.012(0.002)***	0.012(0.002)***	0.012(0.002)***
Instruments					
Paper	0.732(0.002)***			0.014(0.003)***	0.014(0.003)***
Medicines	0.189(0.002)***			-0.001(0.003)	-0.001(0.003)
Dummy region	YES	YES	YES	YES	YES
Dummy year	YES	YES	YES	YES	YES

[6] Results and diagnostics for endogeneity are confirmed including also the frequence "sometimes" within plastic recycling behavior variable (using *Plastic Always and Sometimes*, instead of *Plastic Always*) and in the instruments.

Constant	-0.022(0.010)**	1.442(0.057)***		0.914(0.008)***	
No. of observations	110,115	110,115	110,115	110,115	110,115
Wald test of exogeneity	chi2(1) = 23.91 Prob > chi2 = 0.0000				
First-stage F-statistic	F(2, 110075) = 1.3e+05 Prob > F = 0.0000				
Underidentification test	Kleibergen-Paap rk LM statistic Chi-sq(2)=48080.60 P-val=0.0000				
Weak Identification test	Cragg-Donald Wald F statistic = 72585.14 Kleibergen-Paap rk Wald F statistic = 1.3e+05 Stock-Yogo weak ID test critical values: 10% maximal IV size = 19.93				
Hansen (overidentification test of all instruments) J statistic	J = 1.218 (0.270)				

Notes: For Model I (columns 1-3), first stage is reported in the first column, Second stage in column 2, while Column 3 contains marginal effects.
Columns 4-5 include Model II (OLS estimate), Instrumented variable: Plastic Always.
*Instruments: Paper and Medicine. The symbols ***, **, * denote that the coefficients are significantly different from zero at 1, 5 and 10%, respectively. Standard errors are in parentheses.*

6. Concluding remarks

This work aimed at investigating the behavioral linkages between consumers choices that are relevant for the circular economy transition, namely bottled water consumption and separated plastics collection. To this end, we used Italian household level data for the period 2017-2020 to test the conclusions of a simplified microeconomic model, allowing us to provide, together with the received literature, possible forces behind complementarity or trade-offs in the decision making process under scrutiny.

We show that environmental concerns play a role in driving bottled water consumption, in the expected direction. Also, through different specifications, we show the existence of a *rebound effect***:** consumers who engage in separated plastic collection in the presence of door-to-door facilities are also more likely of consuming bottled water. Also, by controlling for potential endogeneity, we establish a causal relationship, such that separated collection implies an increase in the likelihood of bottled water consumption, which can be explained on the basis of an over-justification effect: consumers who are performing separated collection may feel that they are contributing to the circular economy paradigm through recycling, then they are “allowed” to consume more bottled water and to generate more plastics waste. This impact seems to be mostly driven by the presence of door-to-door infrastructures, providing policy relevance to our results, by suggesting possible crowding out effects that may harm the real life effectiveness of circular economy policies.

Our paper deals with a (to our knowledge) not yet fully investigated issue. On the other hand, it has to be seen as a first step: more detailed data on individual’s behaviors, together with cleaner information on separated collection choices and infrastructure availability, could contribute to a clearer identification of the potential *rebound effects* in circularity policy, that are however robustly suggested by our analysis.

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Appendix

Table A1 – Descriptive statistics

Variables	Observations	Mean	Std.dev.	Min	Max
Bottled Water	163,937	0.910	0.286	0	1
Plastic Always	179,988	0.495	0.500	0	1
Plastic Alw. and Som.	179,988	0.517	0.500	0	1
Door-To-Door Presence	181,433	0.674	0.469	0	1
Pollution	181,943	0.475	0.499	0	1
Resource exhaustion	181,943	0.312	0.463	0	1
Climate risk	181,943	0.569	0.495	0	1
Quality	174,628	0.745	0.436	0	1
Irregular water supply	181,147	0.102	0.303	0	1
Cost	173,060	0.981	0.135	0	1
Trust	156,680	0.161	0.367	0	1
Owner	181,288	0.759	0.428	0	1
Job position	125,956	0.445	0.497	0	1
Gender	181,943	0.518	0.500	0	1
Age	153,281	0.261	0.439	0	1
Household size	181,943	3.000	1.335	1	11
Educational level	173,674	0.479	0.500	0	1
Employment status	158,513	0.428	0.495	0	1
Health	157,894	0.815	0.388	0	1
Paper	179,573	0.599	0.490	0	1
Medicines	178,968	0.078	0.269	0	1

Table A2 – Correlation matrix

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Bottled Water	**1**																		
2. Pollution	-0.001	**1**																	
3. Resource Exhaustion	-0.003	-0.001	**1**																
4. Climate Risk	-0.003	-0.031	-0.022	**1**															
5. Quality	-0.044	-0.025	0.012	0.003	**1**														
6. Irregular water supply	0.010	0.008	-0.015	-0.007	-0.248	**1**													
7. Cost	-0.003	0.004	-0.012	0.002	-0.008	-0.010	**1**												
8. Trust	-0.005	-0.012	0.008	0.013	0.083	-0.047	-0.013	**1**											
9. Owner	0.000	0.027	-0.022	0.033	0.013	-0.006	0.007	0.010	**1**										
10. Job position	0.021	0.047	0.014	0.050	0.009	-0.028	-0.009	-0.009	0.123	**1**									
11. Gender	-0.016	-0.002	0.004	0.020	0.004	-0.020	0.003	-0.008	-0.007	0.056	**1**								
12. Age	0.046	0.004	0.068	-0.019	-0.022	0.012	-0.014	-0.044	-0.120	-0.029	-0.012	**1**							
13. Household size	0.032	0.027	0.007	-0.003	-0.040	0.032	0.015	-0.028	0.037	-0.014	-0.055	0.191	**1**						
14. Educational level	0.039	0.060	0.059	0.048	-0.003	-0.027	-0.005	-0.034	0.066	0.468	0.044	0.244	0.111	**1**					
15. Employment status	0.067	0.038	0.045	0.010	-0.008	-0.009	-0.007	-0.032	-0.045	0.174	-0.109	0.221	0.220	0.331	**1**				
16. Health	0.031	0.027	0.029	0.015	0.059	-0.043	-0.004	0.032	0.007	0.091	-0.047	0.152	0.113	0.177	0.230	**1**			
17. Door-To-Door Presence	0.034	0.017	-0.002	-0.003	-0.028	0.046	0.001	0.040	0.044	-0.056	-0.011	0.008	0.046	-0.042	-0.003	0.002	**1**		
18. Plastic Always	0.017	0.022	0.023	0.027	0.026	-0.058	0.009	0.029	0.035	0.037	0.025	-0.013	-0.004	0.048	0.011	0.020	0.192	**1**	
19. Plastic Alw. And Som.	0.032	0.022	-0.010	0.003	-0.057	0.075	0.005	0.014	0.037	-0.071	-0.016	0.009	0.047	-0.056	-0.011	-0.013	0.713	0.206	**1**