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The effect of social and personal norms on stated preferences for multiple soil functions: evidence from Australia and Italy

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Although soil degradation has become a global phenomenon that might severely threaten the provision of a large range of ecosystem services, not much is known about the economic value of soil functions such as carbon sequestration and rainfall water infiltration. Knowing these values would be an important input into the recently developed concept of Soil Security. This paper aimed at closing this gap for a broad set of soil functions valued at the regional level in the Veneto region in Italy and New South Wales in Australia. The study not only elicits non-market values by a choice experiment but also investigates the impact of personal norm activation and social norms on stated preferences, by a hybrid choice model with multiple latent variables. As the survey was conducted in two countries, our study offers evidence of the external validity of both social norm effects and personal norm activation. The results reveal that respondents positively value the conservation of the soil functions and that both personal norm activation and social norm clearly affect stated preferences.

Key words: discrete choice experiment, hybrid choice model, norm activation, soil functions, taste heterogeneity.

1. Introduction

Soil degradation has become a global phenomenon (Koch et al., 2013). It can be defined as the decline in soil conditions that is caused by improper use or poor management and deteriorates soil functions and their capacity to provide economic goods and ecosystem services. Soil, which must be distinguished from 'land' as it is one of the core building blocks of land (Koch et al., 2013), contributes five principal functions within a landscape: nutrient cycling, water retention, biodiversity and habitat, storing, filtering, buffering and transforming compounds, and, finally, provision of physical stability and support. To respond to the problem of soil degradation, Soil Security as a sustainability science concept has been suggested to guide land

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management balancing ecosystem services, environmental, social, cultural and economic imperatives (Bennett et al., 2019; Koch et al., 2012; McBratney et al., 2014, 2019). Part of the Soil Security concept as an integrated framework is the identification of the economic value of the world soils (Bennett et al., 2019).

In contrast to the problems soil degradation can cause for societies, however, not much is known about the economic value of soil functions (Robinson et al., 2014) that are the basis for providing a broad range of ecosystem services (Greiner et al., 2017). This applies especially to the values not captured by markets (Bartkowski et al., 2020). Among the first empirical studies using stated preference methods were those presented by Colombo et al. (2005) and Colombo et al. (2006). While the former was concerned with the preferences over alternative policy designs to prevent soil erosion in southern Spain, Colombo et al. (2006) estimated the benefits of programs to mitigate the off-site impacts of soil erosion for a watershed in Andalusia, Spain. In another study from Spain, Almansa et al. (2012) determined the benefits of erosion control. Glenk and Colombo (2010, 2013) elicited, by a choice experiment, preferences for a soil carbon program in Scotland discussing, among other things, especially the implications for the development of climate change policies. Also engaged with the preferences for carbon farming, Kragt et al. (2016) report findings from a survey in Australia, employing choice experiments too. They find that Australians have a positive willingness to pay (WTP) for carbon storage in agricultural soils, but at the same time, preferences for reducing soil erosion (an intangible co-benefit of carbon farming) were not statistically significant in their models.

This paper adds to the above literature by presenting estimates of the benefits for certain soil functions elicited through an identical survey in New South Wales, Australia, and the Veneto region in Italy. The main objective of this study was to investigate how social and personal norms affect stated preferences captured by a choice experiment and willingness to pay to support policies aimed at preserving soil. Specifically, we contribute to the norm literature by researching processes of personal norm *activation* next to direct social norm effects. Our study sheds further light on construct validity of choice experiments because, as in other behavioural domains, it can be expected from theory that normative beliefs and processes of norm activation influence stated preferences. Compared with direct norm effects, norm activation involves a more complex decision-making process taking individuals' awareness of need and ascription of responsibility into account (Schwartz, 1977). This has so far been studied in stated preference analysis using the contingent valuation method (e.g. Blamey, 1998a,b; Liebe et al., 2011). In previous choice experiment studies, only the direct effects of norms on stated preferences were investigated (e.g. Börger & Hattam, 2017; Czajkowski et al., 2017). Thus, to the best of our knowledge, this is the first study that tests norm *activation* in a stated preference DCE context.

As we rely on a DCE embedded in a cross-sectional survey, we cannot test a *sequential* activation process from norm generation, by evaluation, to action, that is stated preferences. However, we can test important implications of norm activation, for example that the effect of a moral obligation to act in a certain way is moderated by the ascription of responsibility. In the case of stated preferences for a specific (attribute of a) non-marketed good such as environmental quality, the effect of a personal norm related to choosing this good should be stronger if individuals recognise that something has to be done concerning the good in question such as improving environmental quality. At the same time, it has to be considered that normative beliefs, similar to attitudes, are latent constructs, which cannot be directly observed.

While many approaches exist to measure social norms in incentivised laboratory and online experiments (e.g. Keuschnigg et al., 2016; Krupa & Weber, 2013) and field experiments (e.g. Baldassarri & Abascal, 2017; Winter & Zhang, 2018), they are less suitable in the context of our study. We are interested in norms related to a specific environmental good, which is not marketed. Therefore, as common in economic valuation studies on non-marketed goods, the provision of the good is hypothetical and it is difficult to create a situation with non-hypothetical decision-making. On the contrary, while it might be in principle possible to somehow measure a personal norm related to the provision of an environmental good by using, for example, dictator-game like situations, it is still difficult to incentivise concepts such as awareness of need and description of responsibility that are crucial parts of Schwartz's (1977) norm activation model. The same holds true for social norms related to the provision of an environmental good.

To test implications of norm activation in stated preferences, we use a hybrid choice model (HCM) with multiple latent variables and responses to survey questions as indicators. Generally, the objective of a HCM is to go beyond the random utility model (RUM) integrating a behavioural approach to further advance predictive choice models (Ben-Akiva et al., 2002). The model offers a framework for incorporating norms and attitudes as latent variables into the econometric model (Bartczak et al., 2016). Applying this framework also implies that two concerns can be targeted that accompany the incorporation of factors such as attitudes or norms into regressions models. These are, first, problems with endogeneity, and, secondly, errors inherently linked to the measurement of latent constructs. In the context of the present application, the HCM allows to test whether, in addition to social norm effects, effects of personal norms are moderated by norm activation determinants such as awareness of need and of responsibility. Our survey design also enables us to investigate the external validity of norm effects. As we carried out the survey in two separate countries, Australia and Italy, we can compare the social norm and personal norm activation effects for the same choice experiment in two different contexts.

The paper is organised as follows: we introduce personal and social norms as concepts originated from sociology and social psychology and present a conceptual norm activation model for analysing the link between both norms and stated preferences (Section 2). Next, we present the design of the empirical study, that is the choice experiment tasks and the questionnaire (Section 3). In Sections 4 and 5, we introduce the econometric approach and present our results, respectively. Section 6 provides a summary and discussion of our findings.

2. Social norms, personal norms and stated preferences

2.1 Defining social and personal norms

In sociology and social psychology, social and personal norms are key concepts in the study of behaviour (Hechter & Opp, 2001; Schwartz, 1977) or behavioural intentions (Ajzen, 1991). Most researchers agree that norms are behavioural expectations and prescriptions, which are supported by positive or negative sanctions (Hechter & Opp, 2001). In case of a *social norm,* these sanctions are exerted by a third party. This is also called injunctive norms, referring to what is (typically) approved in a social group or society (Cialdini et al., 1990, 1991; White et al., 2009). In empirical applications using surveys, researchers mostly apply a measure of subjectively perceived social norms 'by asking respondents to rate the extent to which important others would approve or disapprove of their performing a given behaviour' (Ajzen, 1991, 195).

A *personal norm* means that individuals sanction themselves if they do (positive sanctions such as self-approval) or do not comply (negative sanctions such as bad consciousness) with a norm. Personal norms are also often called moral norms or internalised norms. Similar to social norms, in survey research personal norms are often measured by asking respondents to what extent they perceive performing a given behaviour as a moral obligation (e.g. Liebe et al., 2011).

While a direct effect of personal norms on corresponding behaviour can be expected, Schwartz's (1977) *norm activation model* supposes that a personal norm leading to moral obligations regarding a specific action such as contributing to a public environmental good is only activated and transformed into behaviour if certain conditions are fulfilled (see Figure 1 in Section 2.3). Schwartz suggests a cognitive and sequential decision model that covers the entire process from norm activation to action, which is quite complex and difficult to test. Although different specifications of the model can be found in the literature, also regarding willingness to pay for environmental goods (Blamey, 1998a, 1998b; Guagnano, 2001; Guagnano, Dietz, & Stern, 1994), many specifications include the awareness of need, the awareness of responsibility and the awareness of consequences as determinants of norm activation. Awareness of need refers to the precondition that

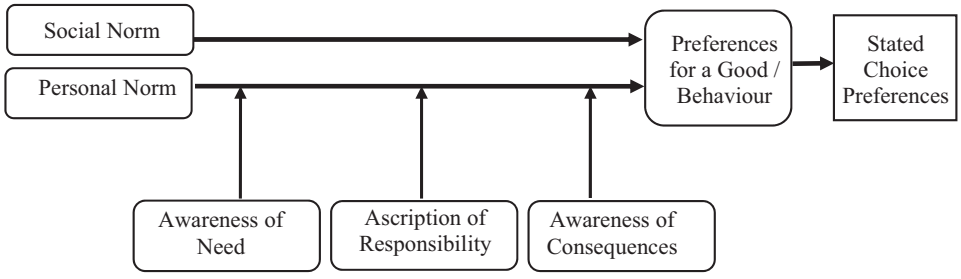

FIGURE 1 Relationship between Social Norms, Personal Norms and Stated Preferences.

individuals must recognise that something has to be done concerning the object in question (e.g. soil conservation). Awareness of responsibility means that individuals must recognise that they are responsible for doing something. Awareness of consequences refers to beliefs that an individual's behaviour has effects on the object in question. Given the awareness of need, awareness of responsibility and awareness of consequences, a perceived moral obligation can result in specific behaviour. These determinants can be seen as moderators of the effect of a perceived moral obligation on behaviour (e.g. Liebe et al., 2011); yet, they can also be seen as antecedents of activating a norm, especially if personal norms such as moral obligations are 'constructed' in a specific situation.

2.2 Previous findings on social and personal norm effects

With regard to contributions to environmental public goods, the topic of our empirical application, there are many studies indicating the relevance of social and personal norms for environmental behaviour in general (see, e.g., Bamberg & Möser, 2007; Steg & Vlek, 2009, for overviews) and willingness to pay for environmental amenities based on contingent valuation in particular (see Ajzen et al., 1996; Liebe et al., 2011; Meyerhoff, 2006; Moisseinen, 1999; Pouta & Rekola, 2001, for example). However, only a few studies consider social and personal norms in environmental stated choice experiment surveys. Previous research experimentally varied the information on social norms, for example, descriptive social norms, and studied the effect of this norm information on stated preferences and willingness to pay. Czajkowski et al. (2019) conducted a DCE on preferences for household waste collection in Poland with a specific focus on willingness to pay for more recycling. Respondents were assigned respondents to different information treatments regarding a descriptive social norm on the share in a specific population who recycle. The authors generally found that respondents' WTP for recycling increased after being provided with social norm information, and that the magnitude of the increased WTP varied across information treatments. Further examples of this experimental approach include the study by Araghi et al. (2014) who examined individuals' willingness to offset flight-related

carbon emissions. The results of this study suggest that the utility generated by carbon offsetting increases when the collective participation rate is high, thus suggesting a positive effect of social norms on sensitivity to this issue.

Another approach to study norm effects in stated choice experiment research uses survey items on norms and corresponding beliefs and includes these variables in choice models as observed variables to explain preference heterogeneity. This is often achieved by using interaction effects between the norm variables and choice experiment attributes, or by including norm variables in the membership function in latent class choice models. For example, Ndebele (2020) employs a discrete choice experiment to examine stated preferences for green electricity in New Zealand and includes, based on Schwartz's (1977) norm activation model, variables on personal norms to explain preference heterogeneity. The norm variables are included as interaction terms with attributes in the choice model. They significantly affect attribute effects in the choice model and willingness-to-pay values. Other studies examine preferences for certified animal-friendly products (Nocella et al., 2012), Fair Trade coffee (Andorfer & Liebe, 2013) and preferences for conservation benefits of marine protected areas (Börger & Hattam, 2017).

Only a few studies have applied a latent variable approach to investigate the effect of norms in the context of stated choice behaviour. Czajkowski et al. (2017) combine a stated choice experiment on household waste collection with responses to survey items on related social norms, personal norms and economic benefits/private costs. Based on a hybrid choice model, they identify three latent variables (social pressure, moral motivation and private costs/effort), by using as indicators respondents' answers to ten attitudinal statements corresponding to different motives for recycling. Their results suggest how moral motivation is a stronger determinant of the choice to sort waste than the other two traits. Hoyos et al. (2015), in a study aimed at investigating preferences for natural areas management, focused specifically on the analysis of the effect of awareness of consequences, rather than fully accounting for the personal norm activation process. The authors estimated a hybrid model with two latent variables, one capturing beliefs supporting environmental action, and the other beliefs supporting environmental inaction. The indicators for the estimation of the latent variables were obtained from psychometric scales. By using a latent class approach, the authors found pro-action citizens to have a stronger preference towards management plans aimed at increasing the level of environmental quality attributes, compared with pro-inaction ones.

2.3 A model of social and personal norm effects on stated preferences

Similar to the treatment of attitudes (McFadden, 1986), in the present study we conceptualise social and personal norms as injunctive norms and latent constructs, which cannot be directly observed by researchers. The latent

construct perspective is justified as we rely on injunctive subjective social and personal norms, and hence, the underlying 'true' psychic states cannot be observed. Therefore, the survey responses to social and personal norm questions must be understood as indicators of these psychic states, which are related to stated preferences for a specific good/behaviour. As we employ DCEs, we examine stated choice behaviour as the behavioural outcome. This basic reasoning on the relationship between social norms and personal norms and stated choice preferences is depicted in Figure 1.

The social norm, that is the belief of the extent to which important reference persons or groups would be in favour of an individual's choice behaviour, is expected to have a direct effect on stated choice preferences. Also, the personal norm, that is the perceived moral obligation that an individual ought to perform a specific behaviour, is expected to have a direct effect. In a more complex norm activation model (e.g. Blamey, 1998a,b), we expect that the personal norm effect is moderated by the perceived awareness of need to perform a specific behaviour, an individual's ascription of responsibility to perform the behaviour and the awareness of consequences of a specific behavioural choice.

In the following, we test implications of this norm activation model in the context of stated preferences for a public environmental good, namely soil conservation.

3. Survey design

3.1 Choice experiment

The DCE was concerned with preferences for soil conservation. The identification of the attributes and related levels was achieved after an in-depth discussion with Australian and Italian soil scientists, as the aim was to define a set of realistic but meaningful soil functions underpinning ecosystem services. Being aware that the majority of people are probably not familiar with the concept of environmental services generated by soil, in addition to a careful literature review, we conducted face-to-face pilot interviews. To enable informed choices, an extended and detailed description of each attribute, along with examples of environmental service/soil function improvement as a consequence of specific practices, was provided to respondents prior to the sequence of choice tasks. Respondents were also informed about the benefits of improving the current levels of each soil function. For example, for nitrogen in groundwater, the attribute description stated that reducing its level would provide both ecological (such as reduction of algae bloom) and human health benefits. Concerning the latter, respondents were specifically informed that concentrations above 10 mg/L in drinking water can lead to fatal health issues (hypoxia and anoxia) for infants. The description also stated that the lowest is nitrogen concentration, the lowest are the ecological and health risks. Table 1 reports attributes and

TABLE 1 Attributes and attribute levels in Italy (Veneto region) and NSW (Australia)

Attributes	Levels in New South Wales	Levels in Veneto Region
Soil carbon sequestration	0.20 t/ha/year (0.1% of total CO_2)	0.20 t/ha/year (0.4% of total CO_2)
	0.60 t/ha/year (0.3% of total CO_2)	0.80 t/ha/year (1.6% of total CO_2)
	1.20 t/ha/year (0.6% of total CO_2)	1.40 t/ha/year (2.7% of total CO_2)
	1.85% t/ha/year (0.9% of total CO_2)	2.00% t/ha/year (3.9% of total CO_2)
Earthworm density	25 individuals/m^2 (no increase)	15 individuals/m^2 (no increase)
	50 individuals/m^2 (200% increase)	25 individuals/m^2 (167% increase)
	75 individuals/m^2 (300% increase)	40 individuals/m^2 (267% increase)
	100 individuals/m^2 (400% increase)	60 individuals/m^2 (400% increase)
Rainfall water infiltration	23% of rainfall (no increase)	23% of rainfall (no increase)
	28% of rainfall (+5%)	28% of rainfall (+5%)
	34% of rainfall (+11%)	34% of rainfall (+11%)
	40% of rainfall (+17%)	40% of rainfall (+17%)
Salinity in groundwater	2000 μS/cm (no reduction)	
	1400 μS/cm (30% reduction)	
	800 μS/cm (60% reduction)	
	500 μS/cm (75% reduction)	
Nitrogen in groundwater		11.9 mg/L (no reduction)
		8.3 mg/L (30% reduction)
		4.8 mg/L (60% reduction)
		1.8 mg/L (75% reduction)
Household tax (A$)	10 A$	5 €
	20 A$	10 €
	50 A$	25 €
	100 A$	50 €
	210 A$	100 €
	375 A$	180 €

corresponding levels for Australia and Italy. The attributes are the same in both countries, except one, due to structural and morphological soil characteristics of the land. Thus, salinity in groundwater was used in the Australian survey and nitrogen in groundwater was used in the Italian survey, while soil carbon sequestration, earthworm density, rainfall water infiltration and a household tax were used in both countries. The attributes were defined on the base of the cascading framework developed by Haines-Young and Potschin (2010), which describes the flow of benefits from ecosystems to humankind through ecosystem services.

Attributes included in the DCE are (see details in Table 1) as follows: *i) soil carbon sequestration,* that is the soil capacity to capture and store atmospheric CO_2. Increasing soil carbon sequestration has two major benefits: a) it helps to mitigate climate change and b) it improves soil health and fertility; *ii) earthworm density,* which refers to the number of earthworms living in the

soil. Earthworms influence soil ecosystems by modifying physical, chemical and biological properties of soil; *iii) rainfall water infiltration* is the capacity to absorb water at the land surface, and either store it for use by plants or slowly release it to groundwater; *iv) nitrogen in groundwater* is a major issue in the Veneto region (Italy), whereas it is not in Australia; nitrogen pollution in water bodies and groundwater can cause environmental and health problems; and *iv) salinity in groundwater* is a major issue in New South Wales (Australia), and not in the Veneto Region; salinity is the quantity of salt dissolved in groundwater. Overall, all the above issues can be partly solved with the adoption of specific agricultural practices that have been explained in detail to respondents.

Ultimately, the payment vehicle is a household tax (for the next 5 years), which describes how much it would cost the household to implement policies aimed at increasing the level of environmental services. The tax would be used to financially support the implementation of land management plans and practices to increase environmental services at state level.

A D-efficient experimental design was developed for the two surveys using Bayesian priors from a uniform distribution to indicate expected signs of the parameters. As prior values, we used positive numbers close to zero for the non-monetary attributes, increasing slightly for each attribute level, and negative numbers close to zero for the cost attribute. Using dummy coding, the design accounted for potential nonlinear relationships between changes in the attribute levels and utility. For the cost attribute, a linear relationship was assumed. In both surveys, three split samples – each with 500 respondents – were used. The difference among the splits is the number of choice sets the design comprises (24/48/156 sets). In both surveys, all respondents faced 12 choice sets with three alternatives: two designed and a status quo alternative. The order of appearance was randomised. Figure 2 shows an example of a choice task used in New South Wales, Australia.

3.2 Questionnaire, variables and sampling

The questionnaire consists of four parts: the first part explores citizens' overall knowledge towards environmental issues and the importance they place on environmental aspects. Another battery of statements focuses on soil

Attribute	Alternative 1	Alternative 2	Status quo
Carbon sequestration (t/ha/year)	0.2 (0.1% of total CO_2)	1.2 (0.6% of total CO_2)	
Earthworm density (individuals/m^2)	25 (no increase)	50 (200% increase)	
Rainfall water infiltration (%)	40 (+17%)	23 (no increase)	None
Salinity in groundwater (mg/l)	800 µS/cm (30% reduction)	2000 µS/cm (no reduction)	
Household tax (A$)	10	20	
I choose	◯	◯	◯

FIGURE 2 Example of a choice set.

degradation in order to investigate more specifically how to tackle this issue at national and at local (case study) level. Respondents were then requested to state how well they feel informed about the different environmental problems. In the second part of the questionnaire, the several services provided by soil were introduced and the attributes used in the DCE were presented. To explore determinants of respondents' choices, we additionally asked in part three of the questionnaire to respond to social norm items and to items employed to operationalise the norm activation model by Schwartz (1977). Finally, the fourth part of the questionnaire collects socio-economic information.

The 15 items used to measure norms and the components of the norm activation model are reported in Table 2. Respondents were asked to indicate how much they agree with the statements, on a scale from 1 to 5 (1 = I do not agree at all, 5 = I completely agree). Also, the order of presentation of these items was randomised in both surveys.

TABLE 2 Items used to capture latent concepts of norm activation model

Awareness of need
- Compared with other environmental issues of New South Wales, soil conservation is not a high priority.
- The current soil condition in New South Wales region is sufficient.
- There is no need to increase measures to protect soil in New South Wales.

Awareness of consequences
- I am aware of the consequences decreasing soil quality will have on future farming in New South Wales.

Ascription of responsibility
- I feel jointly responsible for conservation of our soils.
- I feel jointly responsible for the negative consequences of soil degradation in New South Wales.
- I believe that every citizen of New South Wales is partly responsible for the conservation of our soils.
- I feel joint responsibility for the financial support of soil protection measures in New South Wales

Personal norm
- I feel a moral obligation to financially support conservation of our soils no matter what other people do.
- Seen from my values, the right thing to do is to support soil conservation in our state.
- It would be against my moral principles not to protect soils for the future in our state.
- People like me should do everything they can to decrease degradation of our soils.

Social norm
- My friends and relatives would be in favour of me contributing to increase soil conservation measures in our state.
- Most people who are important to me think I should financially support conservation of our soils.
- People whose opinions I value would prefer that I support conservation of our soils.

The survey was conducted online in Italy (the Veneto region) and Australia (the New South Wales) in 2019. Overall, 1,581 (Australia) and 1,548 (Italy) complete interviews were realised. Table 3 reports the descriptive statistics for the two samples. Age shows a similar distribution within the two samples, with a mean of 46.10 years (Italy) and 45.41 years (Australia). Gender is evenly balanced in both data sets. Regarding education, most of the Italian sample is characterised by a secondary school level (65.10%), while most of the Australian respondents are graduates (56.05%). Overall, the samples are representative in terms of gender, while younger individuals and graduated ones are over-represented.

4. Econometric approach

The point of departure of modelling norm (activation) effects is the hybrid choice modelling (HCM) framework (Ben-Akiva et al., 2002; Bolduc et al., 2005; McFadden, 1986). Within this framework, we treat the stated scores in the norm-related questions as dependent rather than exogenous explanatory variables. Specifically, personal and social norms, awareness of need/consequences and ascription of responsibility affecting individual n are treated as latent variables, LV_{Pn}, LV_{Sn}, LV_{ACn} and LV_{ARn}, and the scores on related scales are used as indicators. Latent variable LV_{ACn} incorporates both awareness of need and awareness of consequences, as we found such specification to perform better than one with two separate latent variables for each characteristic. As such, we used as indicators for this latent variable the attitudinal questions related to both traits (i.e. the first four statements reported in Table 2). For the sake of brevity, in what follows we refer to this only as awareness of need. The hybrid model adopted in our study is

TABLE 3 Descriptive statistics for the two samples

	Italy		Australia	
	Sample	Population*	Sample	Population†
Age (%)				
18–20	4.6	3.4	4.3	
21–39	28.5	24.5	33.1	
40–59	44.7	36.4	39.6	
60 or more	22.2	35.2	23.0	
Mean (years)	46.1	44.8	45.4	37.9
Gender (%)				
Male	50.4	48.2	49.8	49.3
Female	49.6	51.8	50.2	50.7
Education (%)				
Primary school	0.7	37.5	0.8	27.0
Secondary school	65.1	42.4	34.7	20.5
Graduate or post-graduate	34.0	20.1	64.1	22.0

*https://dati.istat.it/.
†https://quickstats.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/036.

composed of: i) structural equations in which latent variables are function of socio-demographic characteristics; ii) a set of measurement equations in which the latent variables explain the scores on the norm-related scales; and iii) the choice component that estimates probability of choosing an alternative as a function of both its attributes and the latent variables.

By using LV_n as a general notation for all latent variables, the structural equation is expressed as:

$$LV_n = \gamma_1 Z_{1n} + \ldots + \gamma_{1m} Z_{mn} + \omega_n \tag{1}$$

where $Z_{1n}, \ldots, Z_{mn}$ are socio-demographic characteristics of individual n, and ω_n is an error term assumed to follow a normal distribution with zero mean and standard deviation σ_ω.

The measurement equations use the scores on the norm-related scales as indicators for LV_n. For a discrete indicator I_L with levels $i_1, i_2, \ldots, i_k$ such that $i_1 < i_2 < \ldots < i_k$, the measurement equations are modelled as ordered logit models, where $\tau_1, \tau_2, \ldots, \tau_{k-1}$ are thresholds to be estimated:

$$I_g = \left\{ \begin{array}{lll} 1 & if & -\infty < LV_n \leq \tau_1 \\ 2 & if & \tau_1 < LV_n \leq \tau_2 \\ 3 & if & \tau_2 < LV_n \leq \tau_3 \\ 4 & if & \tau_3 < LV_n \leq \tau_4 \\ 5 & if & \tau_4 < LV_n \leq \infty \end{array} \right\} \tag{2}$$

The probabilities associated with the observed outcomes are estimated by:

$$P(I_L = l | LV_n) = \frac{\exp(\tau_k - \lambda_L LV_n)}{1 + \exp(\tau_k - \lambda_L LV_n)} - \frac{\exp(\tau_{k-1} - \lambda_L LV_n)}{1 + \exp(\tau_{k-1} - \lambda_L LV_n)}, \; l = 1, \ldots, 5 \tag{3}$$

where it is implicit that $\tau_5 = +\infty$ and coefficients λ_L measure the effect of the latent variables on score probabilities.

The choice component is based on the random utility theory (Luce, 1959; McFadden, 1974). An individual n facing a set of J mutually exclusive alternatives has utility U_i for alternative i defined as a function of attributes X_{ki}, so that:

$$U_{ni} = \beta_n x_i + \epsilon_{ni} \tag{4}$$

where ϵ_{ni} is the unobserved error assumed to be i.i.d. extreme value type I. In order to account for preference heterogeneity towards the improvement in soil function, we adopt a mixed logit model (with panel specification) as choice component. As such, coefficients β_n have mean μ and standard deviation σ to be estimated. Error components were not included in the specification, given the already large number of parameters of our model.

The effect of personal and social norms on sensitivity to soil function improvements is measured by interaction terms between the two latent variables (LV_{Pn} and LV_{Sn}) and attribute coefficients. To account for the moderation effect of awareness of need and ascription of responsibility, the effect of the interaction terms between personal norms and attribute coefficients is weighted by functions of the latent variables LV_{ACn} and LV_{ARn}. These functions (f and h) scale the impact of interaction terms on sensitivity to each attribute x by a logistic transform of LV_{ACn} and LV_{ARn}:

$$f(LV_{ACn}) = \frac{1}{1 + \exp(-\lambda_x LV_{ACn})} \tag{5}$$

$$h(LV_{ARn}) = \frac{1}{1 + \exp(-\emptyset_x LV_{ARn})} \tag{6}$$

The utility function is then expressed as:

$$U_{ni} = (\beta_n + f(LV_{ACn})h(LV_{ARn})\varphi_P LV_{Pn} + \varphi_s LV_{Sn})x_i + \epsilon_{ni} \tag{7}$$

According to this specification, the closer f and h functions are to 1, the fuller is the effect of personal norms on sensitivity to soil functions.

Finally, the probability of respondent n choosing alternative i in choice occasion t is expressed as:

$$P(i)_{nit} = \prod_{t=1}^{Ti} \frac{\exp((\beta_n + f(LV_{ACn}) + h(LV_{ARn})\varphi_P LV_{Pn} + \varphi_s LV_{Sn})x_{it})}{\sum_{j=1}^{J} \exp\left((\beta_n + f(LV_{ACn})h(LV_{ARn})\varphi_P LV_{Pn} + \varphi_s LV_{Sn})x_{jt}\right)} \tag{8}$$

The model is estimated by maximum simulated likelihood, which involves the maximisation of the joint likelihood of the observed sequence of choices (Eqn 8) and stated scores to norm-related questions (Eqn 3). In both data sets, we included in the utility function an alternative specific constant (ASC) capturing preferences towards the *status quo* option. All model components were estimated simultaneously by using the R package Apollo (Hess & Palma, 2019), and 20,000 Sobol draws were used for simulation. We assumed coefficients for non-monetary attributes to follow a normal distribution, while that for tax follows a log-normal one.

5. Results

5.1 Personal and social norms

This section reports the descriptive statistics for the norm-related items we used as indicators for the hybrid models. Table 4 reports the moments of the

TABLE 4 Descriptive statistics for norm-related questions

	Italy		Australia		|t|
	Mean	SD	Mean	SD	
Personal norms					
I feel a moral obligation to financially support conservation of our soils no matter what other people do.	3.44	1.15	3.33	1.23	2.55
Seen from my values, the right thing to do is to support soil conservation in our state.	3.94	0.98	3.58	1.16	9.32
It would be against my moral principles not to protect soils for the future in our state.	3.97	1.02	3.63	1.13	8.83
People like me should do everything they can to decrease degradation of our soils.	3.99	0.97	3.58	1.16	10.59
Social norms					
My friends and relatives would be in favour of me contributing to increase soil conservation in our state.	3.41	1.06	2.50	1.13	22.64
Most people who are important to me think I should financially support conservation of our soils.	3.06	1.15	2.70	1.19	8.60
People whose opinions I value would prefer that I support conservation of our soils.	3.22	1.11	2.65	1.21	13.59
Awareness of need					
Compared to other environmental issues of our state, soil conservation is not a high priority.	2.61	1.21	3.17	1.17	44.61
The current soil condition in our state is sufficient.	2.63	1.07	2.96	1.17	28.25
There is no need to increase measures to protect soil in our state.	2.13	1.20	2.69	1.35	41.53
Awareness of consequences					
I am aware of the consequences decreasing soil quality will have on future farming in our state.	3.63	1.02	3.57	1.12	5.23
Ascription of responsibility					
I feel jointly responsible for conservation of our soils.	3.55	1.07	3.37	1.18	15.47
I feel jointly responsible for the negative consequences of soil degradation in our state.	3.24	1.16	3.21	1.22	2.17
I believe that every citizen of our state is partly responsible for the conservation of our soils.	3.98	1.03	3.56	1.16	35.99
I feel joint responsibility for the financial support of soil protection measures in our state.	3.36	1.07	3.29	1.22	5.96

distributions for each item, along with the results of the t-tests adopted to test for significance in differences between the means of each statement in the two countries.

The first interesting observation about the distribution of the scores is how the mean values are systematically larger in Italy for both norms. Specifically, starting from personal norms, the values are 3.33 vs 3.44 for the first statement ('I feel a moral obligation to financially support conservation of our soils no matter what other people do'), 3.58 vs 3.94 for the second ('Seen from my values, the right thing to do is to support soil conservation in our state'), 3.63 vs 3.97 for the third ('It would be against my moral principles not to protect soils for the future in our state') and 3.58 vs 3.99 for the fourth ('People like me should do everything they can to decrease degradation of our soils').

Statements related to a social norm, in all cases, show lower average scores than those related to personal norms. In Australia, in particular, the mean values are lower than 3 for all statements. For Italy, the statement with the highest mean score is the first ('My friends and relatives would be in favor of me contributing to increase soil conservation measures in our state') with a value of 3.41, while for Australia, it is the second ('Most people who are important to me think I should financially support conservation of our soils') with a mean of 2.70.

Italian citizens also seem – on average – to be more aware of the need for soil conservation. Specifically, they score lower (2.61 vs 3.17) on the statements 'Compared to other environmental issues of our state, soil conservation is not a high priority' (i.e. they are more prone to think that soil conservation is a priority) and 'There is no need to increase measures to protect soil in our state'. For the latter statement, however, the average score is below 3 in both cases (2.13 in Italy and 2.69 in Australia), which suggests that citizens in both countries generally think that more should be done for soil conservation. This is consistent with the average score for the item 'The current soil condition in our state is sufficient', which is lower than 3 in both countries (2.63 in Italy and 2.96 in Australia). As it concerns awareness of consequences, the average scores are again higher in Italy (3.63 vs 3.57 for the statement 'I am aware of the consequences decreasing soil quality will have on future farming in our state').

Finally, citizens in both countries seem to generally feel responsible for soil conservation, with an average score higher than 3 for all the related statements. The average scores, as in all previous cases, are higher in Italy. Citizens in both countries seem to particularly agree with the statement 'I believe that every citizen of our state is partly responsible for the conservation of our soils' (average score = 3.98 in Italy and 3.56 in Australia), while the item associated with the lowest average score is 'I feel jointly responsible for the negative consequences of soil degradation in our state' in both countries (3.24 in Italy and 3.21 in Australia).

5.2 Hybrid model results

The impact of the latent variable – captured by λ coefficients – is statistically significant at 95% level for all the indicators in both data sets (Table 5). As it concerns personal and social norms, the sign of λ is positive in all cases, which suggests that the two latent variables capture both a strong sense of personal and social norms. Indeed, individuals strongly affected by personal and social norms are expected to state high scores in all norm-related questions included in the survey. For the awareness latent variable, λ is negative for indicators 1, 2 and 3 and positive for the fourth one. Indicators 1, 2 and 3 refer respectively to the statements 'Compared to other environmental issues of our state, soil conservation is not a high priority', 'The current soil condition in our state is sufficient' and 'There is no need to increase measures to protect soil in our

state', for which a low score indicates a high awareness of need. The fourth indicator, instead, implies a high awareness of consequences when scores are high. Overall, the signs of the λ coefficients suggest that the awareness latent variable captures the propensity to have a strong sense of this trait. Finally, the sign of λ is statistically significant and positive for all indicators in the measurement equations for the ascription of responsibility latent variable. As for the case of norms, a high score on all questions related to this trait implies a strong perception. As such, we can infer that this latent variable captures a strong sense of responsibility towards soil protection. Moving to the structural equations (Table 6), the γ coefficients measure the effect of socio-demographics on the four latent variables and provide some interesting information on the profile of individuals who are more likely to have a strong sense of each trait. Starting from personal norms, the estimates suggest that in both countries younger, wealthier and higher-educated individuals are more likely to have a strong sense of this trait. With respect to gender, the results are different across countries: in Italy, men seem to have a stronger perception of personal norms, while the opposite is true in Australia. Moving to social norms, for both age and education results are consistent across the two countries: older individuals seem more affected by social norms, and the same goes with those with higher education. Gender and income, instead, do not have a significant effect. Moving to awareness, in Australia only education seems to have a significant effect on perception of this trait. Specifically, individuals with a degree seem to have a stronger sense of this trait. In Italy, instead, it seems that men with a degree and high income are more likely to have a strong awareness. In both countries, income and education have a positive effect on sense of responsibility. Age, instead, has a different effect: in Italy, younger individuals are more likely to feel responsible for soil conservation, while the opposite is true in Australia. Gender has a significant effect only in Italy, specifically positive for men.

The estimates of the main effects of the choice component are consistent across the two data sets and overall suggest how citizens of both countries are interested in the improvement of all soil function included in the study (Table 7). All β coefficients are statistically significant at 95% level, and the signs are aligned with the expectations: citizens are interested in increasing the level of carbon sequestration, earthworm density and rainfall infiltration (positive sign) and in decreasing nitrates in groundwater for Italy and salinity for Australia (negative sign). As expected, the tax has a negative sign, in accordance with economic theory. Finally, in both countries the status quo is associated with a negative coefficient, thus implying that citizens are interested in an improvement in current soil function provisioning. The standard deviation parameters σ are all statistically significant as well suggesting substantial unobserved preference heterogeneity towards soil function improvements in both countries.

Moving to the effect of the latent variables related to personal and social norms on sensitivity to soil function improvements (Table 8), we see that

TABLE 5 Results of the measurement equations

Variables	Personal norms				Social norms				Awareness of need				Ascription of responsibility			
	Italy		Australia		Italy		Australia		Italy		Australia		Italy		Australia	
	Coefficient	|t|	Coefficient	|t|	Coefficient	|t|	Coefficient	|t|	Coefficient	|t|	Coefficient	|t|	Coefficient	|t|	Coefficient	|t|
LV effect on indicators																
λ_1	2.24**	2.33	2.45**	2.66	1.09***	2.76	1.33***	3.21	−0.13***	3.71	−0.59**	2.22	2.12**	2.38	1.69*	3.33
λ_2	2.66**	2.22	3.19**	2.55	1.21***	4.77	1.43**	2.44	−0.19***	4.44	−0.41**	2.06	2.21***	3.19	1.92*	2.12
λ_3	2.78***	3.99	3.11**	2.61	1.08**	2.12	1.61***	2.94	−0.18***	5.42	−0.33**	2.09	1.98**	2.46	2.02**	2.88
λ_4	2.23***	3.55	3.09**	2.55					0.15***	3.22	0.47**	2.12	1.88**	2.55	2.41**	2.59
Threshold parameters																
$\tau_{1,1}$	−3.71***	4.22	−2.48***	11.56	−3.90***	3.61	−3.78***	11.77	−0.65***	4.69	−3.01***	3.99	−4.22***	4.65	−2.67**	4.09
$\tau_{1,2}$	−2.22***	3.93	−1.26***	5.77	−2.20***	5.54	−1.25***	5.87	0.56***	3.55	−1.71***	3.23	−2.34**	2.41	−1.41***	4.42
$\tau_{1,3}$	0.13***	3.23	0.98***	4.68	0.23***	5.55	1.68***	5.01	1.77***	3.49	0.04***	3.18	0.55**	2.66	0.66***	4.04
$\tau_{1,4}$	2.12***	4.39	2.21***	12.29	2.66***	4.99	3.53***	12.12	2.99***	4.87	1.65***	4.34	2.67***	3.22	2.57***	4.65
$\tau_{2,1}$	−6.19***	4.28	−4.34***	12.22	−3.01**	2.39	−5.66***	12.11	−1.35***	2.83	−4.81**	2.51	−3.19***	3.31	−3.56***	3.12
$\tau_{2,2}$	−4.22**	2.34	−2.25***	7.47	−1.32**	2.46	−2.41***	7.88	0.86***	2.73	−3.34**	2.56	−1.25***	5.32	−1.79**	2.54
$\tau_{2,3}$	−1.26***	5.55	0.58**	2.11	1.19***	2.77	1.88***	2.52	2.16***	3.99	−0.96***	3.56	1.11***	4.27	0.69***	4.15
$\tau_{2,4}$	1.23***	3.25	3.41***	10.67	3.51***	5.76	4.26***	10.98	3.54**	2.52	0.92**	2.18	3.29***	3.06	2.56***	3.72
$\tau_{3,1}$	−5.72***	4.44	−4.15***	12.45	−3.47***	3.18	−4.38***	13.43	−3.66***	2.94	−4.44**	2.66	−4.32***	2.71	−4.34***	3.49
$\tau_{3,2}$	−4.21***	3.34	−2.59***	8.98	−2.11***	5.39	−1.83***	9.17	−2.59***	4.21	−3.21***	3.59	−2.62***	3.73	−2.63***	4.44
$\tau_{3,3}$	−1.59***	5.23	0.45	1.61	0.88**	2.25	1.77**	1.99	−0.91***	5.11	−1.17***	4.61	−0.65***	4.80	−0.56***	4.31
$\tau_{3,4}$	1.21***	2.99	3.09***	9.96	3.35***	2.73	3.51***	10.41	0.63***	4.69	0.79***	4.19	1.18***	5.40	1.69***	3.41
$\tau_{4,1}$	−5.88***	2.12	−3.67***	12.55	–	–	–	–	−0.18***	3.68	−4.49***	3.25	−3.22***	4.33	−2.97***	2.79
$\tau_{4,2}$	−4.23***	3.13	−2.28***	8.99	–	–	–	–	1.34**	2.66	−3.21**	2.54	−1.55***	2.99	−1.40***	2.88
$\tau_{4,3}$	−1.34***	4.88	0.66**	2.56	–	–	–	–	2.31***	5.21	−1.14***	4.65	0.78***	5.11	0.38***	4.99
$\tau_{4,4}$	1.12***	3.39	2.97***	10.56	–	–	–	–	3.26***	4.02	0.82***	3.66	2.89**	2.54	2.24***	3.75

Significance levels: 99% = ***; 95% = **; 90% = *.

TABLE 6 Results of the structural equations

	Personal norms				Social norms				Awareness of need				Ascription of responsibility			
	Italy		Australia		Italy		Australia		Italy		Australia		Italy		Australia	
	Coefficient	|t|	Coefficient	|t|	Coefficient	|t|	Coefficient	|t|	Coefficient	|t|	Coefficient	|t|	Coefficient	|t|	Coefficient	|t|
γ_{age}	−0.008**	2.41	−0.003***	2.86	0.023***	3.81	0.108***	3.44	0.214	1.39	0.223	1.19	−0.012***	4.87	0.234	1.17
γ_{man}	0.096**	2.28	−0.045**	2.45	−0.342	1.47	0.053	0.94	0.155**	2.65	−0.111	0.19	0.067**	2.15	0.960	0.99
γ_{degree}	0.055***	5.51	0.289***	5.87	0.188***	3.22	0.211***	5.68	0.344**	2.66	0.221**	2.25	0.019**	2.44	0.511**	2.37
γ_{income}	0.054**	2.67	0.145***	2.88	0.165	0.42	0.212	0.98	0.231***	2.87	0.353	1.43	0.023**	2.21	0.225***	3.21

Significance levels: 99% = ***; 95% = **; 90% = *.

TABLE 7 Results of the choice component – main effects

	Italy		Australia	
	Coefficient	|t|	Coefficient	|t|
Mean coefficients				
μ_{carbon}	0.722***	2.88	0.152**	2.34
$\mu_{earthworm}$	0.064***	5.46	0.031***	3.66
$\mu_{rainfall}$	0.879***	3.12	0.876***	6.55
$\mu_{nitrate}$	−0.544**	2.50		
$\mu_{salinity}$			−0.308***	8.19
μ_{tax}	−2.489***	4.49	−1.309***	10.23
μ_{sq}	−2.219***	2.89	−0.581***	12.49
Standard deviations				
σ_{carbon}	0.051***	3.38	0.134***	4.43
$\sigma_{earthworm}$	0.055**	2.56	0.025***	5.77
$\sigma_{rainfall}$	0.356***	4.68	0.647***	9.28
$\sigma_{nitrate/salinity}$	0.225***	4.15	0.134***	6.68
σ_{tax}	1.171***	3.98	0.528**	2.32

Significance levels: 99% = ***; 95% = **; and 90% = *.

most interaction term coefficients are statistically significant. This supports our hypothesis that personal and social norms affect preferences towards soil conservation. By looking more in detail at the estimates for personal norms, in both countries individuals with a strong perception of personal norms seem to be more sensitive to the increase in carbon sequestration, earthworm density and rainfall infiltration and to the improvement in groundwater quality. Such results are consistent with the theory and corroborate the importance of accounting for social and personal norms when investigating preferences towards environmental services, such as soil protection. For the payment vehicle, instead, results are different in the two countries: in Italy, it seems that people with strong personal norms are less sensitive to the tax, while the opposite is true in Australia. Results are very similar for social norms: in both countries, individuals strongly affected by social norms are more sensitive to the improvement in all soil function. The only exceptions are carbon sequestration (no significant effect of social norms in Australia) and rainfall infiltration (no significant effect in Italy).

The moderation effect of both awareness of need and ascription of responsibility is statistically significant for every soil function, with the exception of rainfall infiltration in both countries. To represent more clearly the moderation effect of these traits, Tables 9 and 10 report the average values of the logistic functions f and h at varying perception levels. To retrieve such values, we computed LV values for each individual by combining estimated coefficients from structural equations with their socio-demographic characteristics[1] and retrieved the distribution of LVs values across sample.

[1] Taking social norms in Australia as an example (significant coefficients: 0.108 for age and 0.211 for being graduated), the LV value for a 45-year-old graduated individual is computed as 0.108*45 + 0.211*1 = 5.071.

TABLE 8 Results of the choice component – interaction and moderation terms

	Italy		Australia	
	Coefficient	|t|	Coefficient	|t|
Interaction terms with personal norm latent variable				
$\phi_{P,carbon}$	0.615***	4.39	0.123**	2.59
$\phi_{P,earthworm}$	0.299***	4.69	0.277**	2.66
$\phi_{P,rainfall}$	0.348***	4.62	1.205***	4.08
$\phi_{P,nitrate}$	−0.124***	5.12		
$\phi_{Psalinity}$			−0.206***	4.34
$\phi_{P,tax}$	0.350***	3.33	−0.120***	3.22
Interaction terms with social norm latent variable				
$\phi_{S,carbon}$	0.123***	3.17	0.055	1.08
$\phi_{S,earthworm}$	0.066***	3.88	0.109**	1.98
$\phi_{S,rainfall}$	0.049	0.65	0.125***	4.42
$\phi_{S,nitrate}$	−0.038**	2.15		
$\phi_{S,salinity}$			−0.231***	4.96
$\phi_{S,tax}$	0.177***	3.88	−0.028***	7.57
Awareness of need moderation effect				
$\lambda_{AC,carbon}$	1.909***	4.85	1.158**	2.04
$\lambda_{AC,earthworm}$	2.955***	5.51	2.400**	2.35
$\lambda_{AC,rainfall}$	2.966	0.76	0.587	1.05
$\lambda_{AC,nitrate}$	0.577***	4.68		
$\lambda_{AC,salinity}$			2.088**	2.10
$\lambda_{AC,tax}$	2.099***	3.99	1.112**	2.66
Ascription of responsibility moderation effect				
$\phi_{AR,carbon}$	3.506***	4.10	3.155**	2.12
$\phi_{AR,earthworm}$	7.104***	2.87	4.296**	2.48
$\phi_{AR,rainfall}$	1.602	1.21	1.057	1.44
$\phi_{AR,nitrate}$	5.007***	3.66		
$\phi_{AR,salinity}$			3.664**	2.68
$\phi_{AR,tax}$	3.188**	2.19	1.025**	2.22

Significance levels: 99% = ***; 95% = **; and 90% = *.

Then, we defined three degrees of personal and social norm perception: i) low (one standard deviation below mean LV value); intermediate (mean LV value); high (one standard deviation above mean LV value). Value for rainfall infiltration is omitted from the tables, as we found no significant effect of the two traits on such attributes. By looking at the tables, it can be firstly noticed that at intermediate and high perception, the values are higher for ascription of responsibility than for awareness of need for all attributes and in both countries. This suggests that having a strong sense of responsibility towards soil conservation has a stronger effect on the degree to which personal norms affect sensitivity to soil functions than having a high awareness of need of soil degradation.

It can be also noticed how high perception often results in values of the logistic functions, which are very close to 1. Examples are a high sense of responsibility in the case of earthworm density (0.979 in both countries), carbon sequestration (0.968 in Australia and 0.964 in Italy) and nitrates in groundwater (0.968). For awareness of need, the highest values are found for

TABLE 9 Moderation effect of awareness of need

Perception	Italy			Australia		
	Low	Intermediate	High	Low	Intermediate	High
Carbon sequestration	0.335	0.644	0.867	0.437	0.629	0.788
Earthworm density	0.257	0.715	0.948	0.372	0.749	0.938
Nitrates in groundwater	0.448	0.545	0.638	–	–	–
Salinity in groundwater	–	–	–	0.388	0.722	0.914
Tax	0.320	0.658	0.887	0.439	0.624	0.779

TABLE 10 Moderation effect of ascription of responsibility

Perception	Italy			Australia		
	Low	Intermediate	High	Low	Intermediate	High
Carbon sequestration	0.301	0.773	0.964	0.424	0.825	0.968
Earthworm density	0.273	0.806	0.979	0.415	0.851	0.979
Nitrates in groundwater	0.294	0.782	0.969	–	–	–
Salinity in groundwater	–	–	–	0.417	0.845	0.977
Tax	0.318	0.753	0.952	0.475	0.623	0.752

earthworm density (0.948 in Italy and 0.938). At low perception, instead, the values are much lower, between 0.250 and 0.500 in all cases. Such results suggest that having a strong sense of ascription of responsibility and awareness of need results in a much stronger 'activation effect' than having a low perception of such traits.

5.3 Welfare measures

For each soil function, WTP estimates are reported at whole sample level and at different degrees of norm perception (low, intermediate and high), identified as described in the previous section for awareness of need and ascription of responsibility levels (Table 11).

To obtain the WTP values, we used a simulation approach. Specifically, we randomly draw 10,000 values, $R = r_1, r_2, \ldots r_{10000}$, from the distribution of the attributes' coefficients (e.g. for carbon sequestration in Italy, a normal distribution with mean 0.722 and standard deviation 0.051; see Table 7). Then, we computed the WTP ratio for each draw (e.g. for the first draw, $WTP_{1,carbon} = r_{1,carbon}/-r_{1,\mathrm{cost}}$). Finally, we averaged the WTP values over the 10,000 draws.

To describe the effect of social and personal norms on welfare measures, we first estimated a 'baseline' value, which captures WTP values for individuals with intermediate perception of both norms. Then, we focused specifically on each norm and estimated values for individuals with low and high norm perception, assuming that perception of the other norm is at intermediate

TABLE 11 Marginal willingness-to-pay estimates

	Carbon sequestration				Earthworm density				Rainfall infiltration				Salinity/nitrate in groundwater			
	Australia		Italy		Australia		Italy		Australia		Italy		Australia		Italy	
	Value ($)	Δ%	Value (€)	Δ%	Value ($)	Δ%	Value (€)	Δ%	Value ($)	Δ%	Value (€)	Δ%	Value ($)	Δ%	Value (€)	Δ%
Whole sample	13.691		14.891		0.476		0.581		1.871		1.360		−0.031		−12.879	
Baseline	13.762		14.361		0.489		0.512		1.983		1.245		−0.039		−13.189	
Personal norms																
Low perception	10.753	−21.9	12.782	−11.01	0.366	−25.15	0.389	−20.45	1.689	−14.83	1.081	−13.17	−0.034	−12.82	−12.167	−7.75
High perception	16.642	+20.9	17.291	+20.42	0.654	33.74	0.616	+25.97	2.182	+10.04	1.408	+13.09	−0.048	+23.08	−15.458	+17.20
Social norms																
Low perception	–	–	13.123	−8.64	0.402	−17.79	0.354	−27.61	1.605	−19.06	–	–	−0.029	−25.64	−11.378	−13.73
High perception	–	–	16.783	+16.85	0.606	23.93	0.632	+29.24	2.203	+11.09	–	–	−0.050	+30.56	−16.455	+24.76
Personal + social norms																
Low perception	–	–	12.062	−16.02	0.301	−38.45	0.296	−39.47	1.514	−23.65	–	–	−0.026	−33.33	−10.883	−17.48
High perception	–	–	18.850	+31.27	0.704	43.97	0.712	+45.60	2.305	+16.24	–	–	−0.058	+48.72	−17.897	+35.70

level. Finally, we estimated WTP values for low and high perception of both norms. For each estimated value, we also report the percentage variation compared with the baseline one (Δ%). In all cases, WTP values are estimated assuming an intermediate perception of both awareness of need and ascription of responsibility.

The 'baseline' values show to what extent individuals in both countries are willing to pay for the improvement of all soil function at intermediate perception level. For example, for carbon sequestration, the value is \$13.8/t/ha/year in Australia and €14.5/t/ha/year in Italy.

Regarding the effect of personal norms on WTP values, it can be noticed how in all cases a low norm perception implies a lower WTP value compared with the baseline, while the opposite is true for high norm perception. This is particularly evident in the case of WTP value for earthworm density, which in Australia is around 25% lower compared to the baseline for individuals with low personal norm perception and 34% higher for individuals with high perception, and in Italy around 20% lower for low perception and 26% higher for high perception. The other soil functions, instead, seem to be affected to a lesser degree by personal norm perception in the Italian sample.

Social norms were not found to affect sensitivity to carbon sequestration in the Australian data set and rainfall infiltration in the Italian one. Consequently, we did not estimate WTP variation associated with social norm perception for these attributes. Social norms, instead, seem to strongly affect willingness to pay for decreasing salinity in Australia (31% higher for high perception and 26% lower for low perception) and to a lesser degree for earthworm density (+24% and −18% for high/low perception). In relation to the Italian sample, a stronger effect of social norms was found for earthworm density (+29% and −28% for high/low perception) and nitrates in groundwater (+25% and −14% for high/low perception).

Finally, we turn to the estimates that account for the effect of both norm perceptions. As expected, these WTP values are associated with the largest deviations from the baseline values. This is especially true for salinity in groundwater in Australia, which has a WTP value 48% higher than the baseline for high perception and 33% lower for low perceptions. In Italy, the largest effect is for earthworm's density (+45% and −40% for high/low perception) and is then rather similar for carbon sequestration and nitrates in groundwater (+31%/−16% for carbon and +36%/−17% for nitrates).

Overall, these estimates highlight the substantial impact of norm perception on willingness to financially support public measures aimed at soil preservation. They also highlight how such support is strongly heterogeneous across soil functions and between the two countries.

6. Discussion and conclusions

An extensive body of literature in sociology and social psychology suggests that personal and social norms affect individuals' choices and behaviour.

Importantly, the literature also highlights that personal norms do not always lead to corresponding behaviour and that processes of norm activation are at play. Despite such evidence, only few studies have incorporated norms and their activation in the analysis of stated choice behaviour.

In this paper, we try to fill this gap by investigating the effect of personal norm activation and social norms on individual choices over public goods, by a choice experiment approach. By using two data sets collected in Italy and Australia dealing with preferences towards soil functions/conservation, we demonstrate that norms play an important role in predicting whether and to which degree an individual is willing to pay to improve environmental quality. Given previous research in sociology and social psychology, we expected individuals with a high sense of personal and social norms to be more sensitive to improvements in soil functions. To test such norm effects, we estimated a hybrid choice model with latent variables capturing sense of personal and social norms. The latent variables were included in the utility function as interactions with coefficients measuring sensitivity towards changes in the attributes. The results support our hypothesis providing evidence on the effect of norms: respondents who feel a personal norm or perceive expectations of others regarding their behaviour reveal, on average, a different choice pattern. Specifically, we found that both personal and social norms positively affect sensitivity and WTP values for soil conservation policies. The effect on the welfare measures is substantial, resulting for some attributes in a twofold increase in WTP value for individuals with high norm perception compared to those with low perception. Importantly, these results are consistent across the two data sets, except for two attributes (rainfall infiltration in Italy and carbon sequestration in Australia). In these cases, we did not found significant sensitivities to social norms. Therefore, our inter-country approach indicates a high robustness of the effects of personal norms but it reveals some differences when it comes to the effect of the social norm.

The second contribution of this paper concerns the inclusion of personal norm activation in the analysis of choices. We tested implications of norm activation on preferences by incorporating in our hybrid model two latent variables related to awareness of need and ascription of responsibility. Such variables were used as scaling factors for interaction terms between personal norm latent variable and attribute coefficients. In accordance with the norm activation model (Schwartz, 1977), we expected a stronger effect of personal norms on preferences for individuals with high awareness of need and sense of responsibility. The results support such theoretical expectations: we found a substantially stronger effect of personal norm activation for individuals with high perception of both moderation traits. The results also indicate that ascription of responsibility has a stronger effect on norm activation than awareness of need. These findings are consistent across the two data sets and hence support the construct validity of our stated preference analysis. As we rely on cross-sectional data, however, we cannot test a *sequential* norm activation process. Also, we cannot rule out reverse causality (choice

behaviour influences norm perceptions) in our cross-sectional analysis (see Kroesen et al., 2017, for a discussion). This should be followed up in future research. Furthermore, hypothetical bias is a concern in economic valuation studies: research shows a positive correlation between stated and incentivised payments, but at the same time, there is usually an upward bias in hypothetical settings (Penn & Wu, 2018). This can affect the size of WTP values but does not necessarily mean that the association between norm-related factors and stated preferences is also affected. However, future research could examine whether methods to mitigate the hypothetical bias also influence norm-related effects in stated preference studies. Also, future studies can explore how tailored and incentivised approaches to measure normative expectations related to the provision of non-marketed goods and constructs of the norm activation model can be developed and implemented in survey research (see, e.g., Bicchieri, 2006, 2017, for a comprehensive and general theoretical and empirical account).

Concerning our empirical application, that is preferences towards soil functions, we found respondents to be willing to pay for increasing the level of carbon sequestration, earthworm density and rainfall infiltration and for decreasing the amount of nitrates in groundwater for Italy and salinity for Australia. Given that the WTP values for the improvement in the soil functions are positively affected by both personal and social norms, our results suggest that behavioural interventions that leverage such traits (e.g. communication campaigns, provisioning of information on others' behaviour) may be a tool to increase citizens willingness to contribute to public actions aimed at preserving soil condition. To what extent the above support soil management as considered necessary in the Soil Security concept remains an open question and could only be answered by conducting a cost–benefit analysis.

Finally, the application of the HCM has been debated in the literature (e.g. Chorus & Kroesen, 2014; Vij & Walker, 2016). Applying an HCM to account for the effect of social norms and personal norm activation on choices, our study provides support to the adoption of such a model. The advantage of using HCM is that it allows to explicitly represent the complexity of the norm activation process and how this affects stated preferences and their heterogeneity. Also, it considers that normative beliefs are latent constructs. It is therefore closer to theoretical models of norm activation than less complex modelling approaches. If, however, in contrast to disentangling preference heterogeneity and its determinants the prediction of choice behaviour is in the limelight, more parsimonious models such as a standard random parameter logit might be the better option (see Mariel & Meyerhoff, 2016). Yet, comparing model performance concerning the ability to predict choice behaviour was not the focus of this study. Our study demonstrates that norm effects and norm activation, combined with an HCM framework, can shed more light on stated preferences in DCEs and paves the way for further applications of our approach in future research.

Conflict of interest

The authors have no conflict of interest to declare.

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Data availability statement

Data are available on request from the authors.

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