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Willing or complying? The delicate interplay between voluntary and mandatory interventions to promote farmers' environmental behavior☆

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ABSTRACT

Agri-environmental policies generally build around two complementary approaches: mandatory requirements and (compensated) voluntary measures. One of the challenges of the future EU Common Agricultural Policy is precisely to find the right balance between these two types of interventions. We conducted an experiment with farmers in three EU Member States to assess the impact of (1) increasing mandatory contributions to the environment, and of (2) decreasing unconditional income support. We also assess the effect of two key behavioural factors: environmental concern and trait reactance. Results show that both interventions reduce voluntary contributions to the environment, but the reduction is higher when mandatory contributions increase than when income decreases.. However, when mandatory contribution increases substantially, this more than offsets the reduction of voluntary contributions, leading to higher total contributions.

1. Introduction

Agriculture has significant negative impacts on ecosystem multifunctionality, including climate mitigation, soil and water quality, and biodiversity preservation (Diaz et al. 2019; Clark et al. 2020; Wittwer et al. 2021). In contrast, organic and conservation farm management, including no-till systems, precision farming, integrated pest management, and cover crops, can reduce these externalities, and therefore directly contribute to various United Nations Sustainable Development Goals (Ladha et al. 2020).

Policymakers have different types of interventions at their disposal to encourage farmers to adopt more sustainable practices against this backdrop (Piñeiro et al. 2020). These interventions can be either mandatory or voluntary. Mandatory interventions generally consist of regulatory measures that impose certain practices on farmers. Voluntary interventions, instead, leave freedom to farmers and may incentivise them, for instance, through compensation for the cost incurred and/or income foregone to voluntarily adopt sustainable practices, through technical support, technological transfer or certification of food produced with environmentally friendly farming practices.

The EU's interventions to improve agriculture's environmental performance also revolve around these two approaches. Mandatory

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adoption interventions are referred to as "cross compliance". It includes statutory and mandatory requirements and EU standards of good agricultural and environmental condition (GAEC) of land (called 'conditionality'). The former include EU rules on public, animal and plant health, animal welfare, and the environment, which farmers have to meet irrespective of being Common Agricultural Policy (CAP) beneficiaries or not, while the latter must be met by farmers if they want to receive direct payments from the CAP.[1] Voluntary adoption interventions started with the creation of agri-environmental schemes (AES) in the early 1990 s, then renamed agri-environment-climate measures (AECMs).

The current CAP (European Union, 2021), which will be implemented from 2023 to 2027, also relies on a mix of mandatory and voluntary measures, progressively integrated to support environmental performance under a revised "green architecture". On the mandatory component, requirements to receive CAP payments are increased under an "enhanced conditionality". This "enhanced conditionality" incorporates the "greening" practices which during the period 2014–2022 conditioned 30% of the income-support payments, with the possibility to opt-out.[2] On the voluntary component, a new voluntary instrument is introduced, eco-schemes (ECS). Eco-schemes are mandatory for EU Member States (MS), who are obliged to include them in their policy implementation and allocate at least 25% of the CAP budget to them, but voluntary for farmers (see Runge et al., 2022 for an overview of these schemes in 15 MS). Farmers can decide to enrol into ECS on a yearly basis and receive a payment for the implementation of environmentally friendly agricultural management practices. Importantly, ECS will be financed from the direct income-support budget, which ties payments to farmers to the mandatory adoption of environmentally friendly practices. This means that shifting the budget away from 'complying' will entail a loss of income for farmers if they are not willing to adopt eco-schemes. This additional budget would be available to other farmers which could increase their environmental performance by adopting ECS.

The relative relevance of mandatory vs. voluntary agri-environmental policy instruments has been a hot debate, for both the last two CAP reforms (Czekaj et al. 2013; Singh et al. 2014). It is not clear how farmers will react to a CAP that increases their mandatory contribution to the environment and decreases their income from direct payments. Nor where is the balance in the mix of mandatory measures and voluntary schemes to reap the best environmental benefits. The articulation of both types of measures, in terms of potential synergies or 'cannibalism', seems even more of a question mark.

Beyond the EU context, this policy question is also relevant wherever there is a choice between voluntary or compulsory schemes for the promotion of sustainable agriculture. For instance, up until the 1990 s, the US primarily focused on voluntary approaches to changing farmers' practices related to soil conservation and water quality protection, before increasingly relying on regulation (Bosch et al. 1993). Despite an increase in mandatory requirements, most interventions to address agri-environmental challenges in the EU, the US and Canada still take the form of voluntary incentive-based programs (Baylis et al. 2022).

The objective of this paper is to provide insights into the interplay between voluntary and mandatory agri-environmental interventions, in the context of the EU CAP reform. In this analysis, we also consider the impact of the change from income-support payments, conditioned on the mandatory adoption of environmentally friendly practices, to funding voluntary agri-environmental interventions. More specifically, we assess how the variation of mandatory contributions to the environment and variation of income affect farmers' contributions to the environment. Ultimately, our goal is to improve the understanding of the balance between voluntary and mandatory policy measures for the adoption of environmentally friendly farming practices. We also assess whether the behavioural responses to these policy interventions are contingent upon farmers' environmental concern and trait reactance, two 'dispositional' behavioural factors (following the classification of Dessart et al., 2019) which are internal and relatively stable to each individual.

To reach these objectives, we implemented a pre-registered[3] contextualized dictator game, in which farmers had to split their income between themselves and the environment. Contributions to the environment could be either mandatory without compensation (similar to conditionality in the CAP) or voluntary with compensation (similar to eco-schemes). We manipulated the intervention type (variation in mandatory contribution or variation in net income) between subjects and the intensity of intervention within subjects. Our approach is a framed field experiment,[4] a category to which Palm-Forster et al. (2019) refer as having potential for revealing causal interpretation of behavioural incentives for agri-environmental programs.

Our paper contributes to the burgeoning literature on the appropriateness of mandatory and voluntary agri-environmental policies (Thomas et al. 2019). To the best of our knowledge, there is very scant literature on the effect of increasing mandatory requirements on voluntary adoption of green farming practices. Missing evidence on an optimal blend of voluntary and mandatory instruments may lead to the observed political reluctance to impose direct regulations (Ruhl, 2000; Coppess, 2018). Although we focus on the adoption of environmentally friendly practices, our paper also contributes to the larger literature on dictator games (Engel, 2011) and on spill-over effects (d'Adda et al. 2017). It also adds to this discussion the potential impact of behavioural factors (environmental concern and reactance) on the optimal mix of mandatory and voluntary measures. Furthermore, we contribute to the scant literature that uses framed field experiments with farmers. For nearly a decade agricultural economists have signalled the promise of experimental methods to inform and evaluate agricultural policies related to the environment and to understand the role of behavioural drivers in their impact (Colen et al. 2016; Thoyer and Préget, 2019; Palm-Forster et al. 2019). However, framed field experiments are very infrequently applied (Lefebvre et al. 2021) even when they are well suited to identify causal relationships between interventions and outcomes (Palm-Forster and Messer, 2021) and therefore especially valuable for environmental policy evaluation (Bouma, 2021). Finally, this paper contributes to the recent literature that supports the implementation of the new green architecture of the CAP, in particular when it comes to its articulation between mandatory and voluntary measures (Bertoni et al. 2020; Hasler et al. 2022; Galli et al. 2020; Khafagy & Vigani, 2022).

The rest of this paper is structured as follows. We first present the literature, followed by a description of the experimental methods used and the econometric approach to analyse the data. We then present the results of the analysis followed by a discussion of their relevance both in terms of agricultural policy and the role of behavioural science in improving their effectiveness. Finally, we draw the main conclusions that can be derived from our analysis.

[1] Technically speaking, meeting the second element of cross-compliance is voluntary (Piñeiro et al. 2020). Farmers can opt out of CAP income-support payments and hence avoid having to comply with the requirements. However, evidence shows that the number of farmers who are eligible to forego the CAP income-support payments is extremely low, and that farmers tend to consider cross-compliance as mandatory (Dessart, 2019).

[2] Here also, although compliance with greening is voluntary, in practical terms, farmers perceive it as mandatory as most of them do not want to lose the associated income-support payments (Gaymard et al. 2020).

[3] https://aspredicted.org/ui4s6.pdf.

[4] See Harrison and List (2004), Charness et al. (2013), Higgins et al. (2017), for definitions of types of experiments.

2. Literature review

In the following paragraphs, we review the literature regarding each of the research questions we tackle in the paper. As stated in our pre-registration, the literature seems inconclusive with regard to them, and therefore did not pre-register directional hypotheses.

2.1. Mandatory vs. Voluntary contribution to the environment

The debate regarding the effectiveness of mandatory versus voluntary policy interventions transcends the particular case of agriculture, and has been addressed in the framework of general environmental protection (Segerson and Miceli, 1998; Khanna, 2001). From a policy perspective, mandatory interventions, given proper monitoring and sanctions, deliver more certain environmental benefits than voluntary measures, which by definition depend on farmers' willingness to enrol in these schemes (Piñeiro et al. 2020). Voluntary solutions can be suboptimal by raising the issue of self-selection, low rates of adoption (Brown et al. 2021), and non-enforceable mechanisms of paying farmers to do what is right. However, there is evidence suggesting that farmers prefer voluntary over mandatory measures (Dessart, 2019), especially if compulsory instruments, such as legal regulations, are too complex or inflexible (Schirmer et al. 2012; Gaymard et al. 2020). From an economic perspective, mandatory compliance with more stringent environmental regulations, if applied unilaterally or not compensated for, can hamper the competitiveness of agriculture and may also lead to dissatisfaction and protest on the side of the farmers. Importantly, voluntary instruments may reinforce farmers' intrinsic motivation to protect the environment through education, more so than compulsory instruments (Bosch et al. 1993).[5] Rules of law have the potential of either being internalized as norms (Nyborg et al. 2016, Nyborg 2018), or crowding out the initial intrinsic motivation of farmers actively protecting the environment under a system of unconditional subsidies.

2.2. Variation of mandatory contribution

Will more stringent environmental regulations lead farmers to more, or less voluntary contributions to the environment? Conversely, would environmental deregulation lowering farmers' mandatory adoption of sustainable practices encourage them to contribute more to the environment on a voluntary basis? Two streams of literature offer contradictory replies to these questions.

On the one hand, one strand of literature suggests that higher mandatory contributions to the environment should lead farmers to make higher voluntary contributions, both in relative and in absolute terms. The rationales for this potential effect are fourfold. First, in the spirit of cognitive dissonance theory (Festinger, 1957), farmers may be motivated to act consistently between their mandatory contribution and their voluntary contribution. Second, if farmers need to invest time and resources to comply with more stringent environmental regulations, this might create a positive spillover effect in favour of more voluntary adoption if this initial investment is seen as a sunk cost (Arkes & Blumer, 1985) or leads to synergies. In the case of adoption of reduced or no-tillage this seems to be the case, as adopters of such a practice are more likely to implement conservation crop rotations and cover crops (Claasen et al. 2018). Third, the foot-in-the-door effect (Freedman and Fraser, 1966) suggests that farmers would accept further contributing to the environment if they initially accepted doing so for a relatively small amount. There is a caveat in the relevance of these three theories for our research question: they – sometimes implicitly – suppose that the 'first' contribution is voluntary. Perhaps more relevant is the fourth theoretical framework building on the idea that mandatory contributions signal appropriate behaviour (Keser et al. 2017). Accordingly, obligations may create an anchor for injunctive norms (Engelmann et al. 2017), which individuals subsequently internalize (Cooter, 1998). Scholars frequently apply this theory to explain the power of non-binding defaults (e.g. Everett et al. 2015; Hansen et al. 2021). Evidence from public good games shows that minimum mandatory contributions increase average group contributions (Keser et al. 2017). In an experiment conducted among the general population, Bruns & Perino, (2021) find that setting a mandatory contribution to a climate mitigation fund does increase total contribution. An experiment with farmers also provided support for this theory: a minimum mandatory contribution to environmental public good (vs. no minimum mandatory contribution) led to higher contributions once this policy was discontinued (Kaczan et al. 2019).

On the other hand, moral licensing (Merritt et al. 2010) suggests that farmers, having done a mandatory deed for the environment, will feel entitled to behave in a less environmentally friendly way. This phenomenon has been observed in a number of areas (see Blanken et al. 2015 for a *meta*-analysis). For example, people who previously undertake ethical behaviours end up offering less money to other participants (Cornelissen et al. 2013), and even taking more money away from a public fund for themselves (Clot et al. 2018). When the environmental damage of one's actions is lower, people feel morally entitled to make less effort to mitigate this damage (Dorner, 2019). Whether or not the moral licensing effect occurs when the good deed is mandatory is subject to debate (Engelmann et al. 2017). Applied to farmers' behaviour, it could be that, when obliged to adopt more environmentally friendly farming practices, farmers may feel entitled to do less for the environment on a voluntary basis. Similarly, increasing mandatory contributions can raise distrust (Falk and Kosfeld, 2006) and reactance (Brehm & Brehm, 1981; Contzen et al. 2021), a feeling of being threatened in terms of freedom to choose, which may result in a defensive reaction, such as lower voluntary contributions. In a famous experiment, Falk and Kosfeld (2006) found that agents produce less when principals set a minimum level of productivity, thereby illustrating the 'hidden costs of control'.

2.3. Variation of income

The second effect that this study investigates is the variation of income, due to a budget shift from conditioned income-support direct payments to a new voluntary scheme called eco-schemes. The most relevant behavioural literature with respect to this question uses dictator games (Kahneman et al. 1986). In absolute terms, when endowments in dictator games are lower, donations are lower. For instance, when dictators receive USD 100, they give on average USD 25; but, when they receive USD 10, they give on average USD 3.3 (Carpenter et al. 2005). Since the range of permissible donations is very different, this difference in absolute terms is straightforward. In relative terms, the pattern is less intuitive. In the abovementioned study, dictators who receive USD 100 give on average 25 % of their endowment, whereas those who receive USD 10 give on average 33 % of their endowment to the other participant. Recent *meta*-analyses show that, when dictators receive a lower endowment, they tend to donate a slightly larger proportion of their endowment (Engel, 2011; Larney et al. 2019). Applied to the reduction in farmers' income, this would suggest that lower income would lead to higher relative voluntary contributions to the environment. However, unlike in these dictator games, farmers participating in voluntary schemes would receive compensation in return. Several studies have also looked at dictators' behaviour when donations are subsidized (see Eckel & Grossman, 2003 for an application, and Andreoni & Miller (2002) for a theoretical framework).

[5] This holds if the voluntary instruments do not include economic incentives. If economic incentives are used to promote the voluntary instruments evidence of crowding out, and to a lesser extent also crowding in, has been found (Rode et al. 2015).

2.4. Environmental concern

Environmental concern consists in the negative affect associated with environmental problems (Schultz et al. 2005). Scholars have consistently found that environmental concern is one of the drivers of farmers' adoption of sustainable practices (see Dessart et al. 2019 for a review). For instance, environmental concern positively correlates with the likelihood of adopting organic dry stock farming in Ireland (Läpple & Kelley, 2015). One potential explanation for this effect is that environmental concern increases farmers' intrinsic motivation to protect the environment and their personal norm to act (Bouman et al. 2021). Intrinsic motivation is the desire to perform an activity, such as contributing to a public good, when one receives no apparent reward except the activity itself (Frey & Jegen, 2001). Given all the elements above, one could expect farmers with high (vs. low) environmental concern to contribute more (vs. low) to the environment, but also to be less affected by variations in their mandatory contribution and variation in their income.

However, there is also increasing evidence that environmental concern is not a sufficient condition to lead to pro-environmental behaviour. Habit and contextual (e.g. economic) constraints can sometimes stop individuals who care about the environment from contributing to the environment (Steg & Vlek, 2009). Scholars have reported contradictions between environmental concern and the financial dimension in farmers' discourses (Gaymard et al. 2020).

2.5. Trait reactance

Psychological reactance is an emotional, cognitive or behavioural response occurring when an individual feels her freedom is threatened (Brehm & Brehm, 1981). Trait reactance is the "consistent tendency to perceive and react to situations as if one's freedoms were being threatened" (Kelly & Nauta, 1997). Individuals with high trait reactance are particularly likely to experience anger when external factors, such as obligation or persuasion attempts, affect their situation, and to react in an effort to restore their freedom (see Steindl et al. 2015 for a review). Reactance has been studied in the context of mandatory vs. voluntary policies (e.g. Contzen et al. 2021), and in the context of agri-environmental policies (Thomas et al. 2019). One could reasonably expect that farmers who have high trait reactance would be particularly affected by a decrease in their income due to any external factor, whether an increase in their mandatory contribution to the environment, or a decrease in their CAP direct payment. Indeed, both variations are the result of a policy intervention, which by definition is external. The obligation to contribute more to the environment, and the unilateral decision leading to receiving less CAP direct payments could both constitute a threat, which farmers with high reactance would be particularly prone to react to, by decreasing their voluntary contribution.

3. Experimental design and data

3.1. Token allocation task

We implement a framed field experiment resembling a dictator game to test the effects of increasing mandatory contributions and decreasing net income on contributions to the environment. We provide only an overview of the main characteristics of the experiment but the interested reader can access additional details in the full report by Dessart et al. (2021). The Institutional Review Board of the German Association for Experimental Economic Research granted expedite ethical approval before fieldwork was carried out (certificate number WGjq7WN8).

In the experiment, farmers were presented with a decision task involving splitting an initial income between themselves and the environment. The instructions and the decision task implemented can be found in the supplementary material (SM1). Farmers started with an endowed income, framed in terms of experimental tokens representing their initial net (farm) income, which they were told included profits from selling crops or livestock products and direct income-support payments from the CAP. The contribution to the environment was described as representing the (short-term) reduction of profits that farmers incur when they adopt more environmentally friendly farming practices, which is often the case in real life (Banerjee et al. 2014). Other pieces of research with farmers (Kaczan et al. 2019; Kits et al. 2014) used a similar setting to assess their willingness to adopt environmentally friendly practices.

Farmers were informed that there were two types of contributions to the environment: mandatory and voluntary. Mandatory contributions were described as amounts that farmers had to give to the environment and for which no compensation was received, thus, even when not explicitly mentioned, resembling the functioning of conditionality tied to CAP income-support direct payments. Farmers' main task was to decide how many tokens they would voluntarily contribute to the environment. Farmers were informed that, for each token allocated to the environment as voluntary contributions, they would receive some tokens as compensation. The compensation level was fixed at 90% of the number of tokens that they voluntarily gave to the environment. This compensation level was chosen to reflect how compensation for voluntary measures under the CAP is implemented, where opportunity costs are taken into account, but administrative and behavioural change costs not. We informed farmers that their decision would only be binding for one year, in an effort to make this decision resemble the functioning of ECS in the new CAP.

3.2. Experimental design

Our experimental design had two factors: framing of variation and intensity of variation. The first factor had two levels (variation in mandatory contributions vs. variation in initial net income) and the second one three (0, +/-35, +/- 85) leading to six experimental treatments. Farmers were randomly[6] assigned to one of the two framings (between subjects).

While we decided to call the first factor framing, one may also call it 'source of variation' or 'type of intervention' in the spirit of a more conceptual framing linked to the policy question at hand (cf. Alekseev et al., 2017). This is particularly relevant as the change in framing could be confounded with changes in the contributions to the environment. In the income framing, variations are not directly related to changes in contribution to the environment,[7] while in the mandatory framing, increases or decreases are associated with equivalent changes in

[6] Based on balance tests we observe that the randomization delivered fully comparable samples with one exception. Significant differences were found for the AECM variable. However, joint orthogonality was achieved. The lack of full equivalence between sub-samples could bias our results in particular if there was large interaction between the between-subjects factor and the AECM variable, for which unbalance was observed. This is not the case (results not reported). Moreover, using only data for Spain and Poland, we find no differences between the AECM variable. The analysis reported in the paper using only these two countries yields the same conclusions (not reported).

[7] One could argue that indirectly, as the reduced income is made available as support for ECS, the decisions of farmers to adopt ECS with that budget could also increase the contributions to the environment. However, we cannot test what farmers expected from others in that setting. We can just observe their reactions. Moreover, to simplify the experiment experiment farmers were not informed about the destination of the budget available due to reduced direct payments.

Table 1
Experimental design and levels.

			Within-subject factor (intensity of variation)		
			0	**+/-35**	**+/-85**
Between subject factor (framing of variation)	Variation on **mandatory contribution** to the environment - MAND	*Initial net income*	300	300	300
		Mandatory contribution	**5**	**40**	**90**
		Gap from level 1	–	+35	+85
		Income available for voluntary allocation	295	260	210
		Treatment label	MAND_0	MAND_35	MAND_85
	Variation of **initial net income** - INC	**Initial net income**	**300**	**265**	**215**
		Mandatory contribution	5	5	5
		Gap from level 1	–	−35	−85
		Income available for voluntary allocation	295	260	210
		Treatment label	INC_0	INC_35	INC_85

Levels of the within-subject factor were presented randomly to farmers.
Source: own elaboration.

environmental provision. Therefore, the impact of the change in framing could be potentially confounded with the impact on the change of environmental provision.[8] However, we believe that this limitation is necessary to have a simplified representation for participating farmers of the alternative policies we want to test as described below.

Farmers were informed up-front that they would have to make a token allocation decision three consecutive times, and that their mandatory contribution or their initial net income would vary across the three situations. The order of presenting the three levels of the intensity of variation was randomized between participants, hence ensuring the possibility of comparing all six treatments for the first decision between subjects. The variation in the mandatory contributions would mimic the fact that, under the new CAP, beneficiaries will have their income-support payments linked to a stronger set of mandatory requirements. Variation in initial income was phrased as a variation in the direct income-support payments farmers receive from the CAP. This variation mimicked the fact that part of the (conditioned on the adoption of green practices) income-support direct payments budget would have to be shifted away in order to finance the (voluntary) eco-schemes, however this was not communicated to the participants. The absolute intensity of variation between the levels within each within-subject factor were set identical in both types of framing of variation. The lowest level was set to reflect the current cost of mandatory measures under greening according to ECA (2017). The intermediate level corresponded approximately to the reduction in direct payments needed to assure a 35% budget reallocation from direct payments for ECS, as for the EU as a whole direct payments represent 30% of their income (European Commission, 2020). However, this was not communicated in the questionnaire. The highest level was set to ensure contrast between experimental conditions. The design of the experiment is presented in Table 1.

3.3. Incentives

To avoid hypothetical and social desirability bias, choices were incentivized. To minimize administrative burden, we decided to pay only a subsample of farmers, as overall paying for only a subset of periods or individuals has been shown to be at least as effective as the "pay all'' approach (Charness et al. 2016). Prior to making their decisions, farmers were told that one in twenty farmers would be randomly selected to receive a payment. For those selected, only one of their three decisions would be randomly selected as binding to enhance independence of the decisions. The tokens that resulted for the farmer to keep were paid using an on-line voucher to use in a major online retailer. The tokens allocated to the environment were transferred to the environmental programme 'A Tree for You'[9] managed by a French NGO to plant trees. Farmers were also informed about the conversion rates of experimental tokens to local currency.[10]

3.4. Quality measures

Before making the three decisions, participants saw a three-minute instruction video detailing the features of the experiment. Then participants had the opportunity to watch the video again or see the same explanations in writing (see supplementary material SM2), should they have encountered technical problems or difficulty in understanding. Following these instructions, farmers were asked four questions to control for understanding of the task (see supplementary material SM3). If the answer they provided was not correct, a pop-up screen would repeat the correct answer. For three of these four questions, we obtained more than 85 % correct replies. The three questions with mostly correct answers focused on what the contributions to the environment represented in terms of farm management; the way the token allocation would be translated into actual payments; and compensation level they would receive for voluntary contributions to the environment. On the other hand, only one in two respondents provided a correct response to the fourth question, which was related to the random selection of one of the three decisions for the implementation of the real incentives (see above).

The experiment was piloted both face-to-face (five farmers per country) and on-line (10 farmers per country). A revised experimental design was developed following the feedback obtained which was subsequently piloted with 14 farmers in Spain. The second pilot showed that participants understood the general logic of the experiment and was therefore rolled out to the full sample.

3.5. Behavioural variables

The experiment was preceded and followed by a small questionnaire to characterize respondents. Two variables of that questionnaire are of specific interest for the paper: environmental concern and trait

[8] Typically, framing effects are experimentally studied by presenting options with either positive or negative connotations, such as loss or gain frames (Plous, 1993). A common framing in dictator games is to compare giving vs. taking versions of the game, which typically lead to different results due to the impact of social norms (Krupka and Weber, 2013).

[9] https://www.atreeforyou.org/en/home/.

[10] Conversion rates were based on monthly comparative price levels (OECD, 2020) rounding the amount up or down to the nearest EUR 0.05 or PLN 0.05. The actual conversion rates used were 0.4 Euro for Germany, 0.35 Euro for Spain and 1 Zloty for Poland.

Table 2
Sample characteristics.

	Mean (sd)	Median	Max.	Min.
Female	0.07 (0.25)	0.00	1	0
Age	47.6 (8.85)	49.0	70	25
Farmer participates in Agro-environmental and climate measures	0.39 (0.49)	0.0	1	0
Organic farmer	0.29 (0.46)	0.0	1	0
Large farm (>30 Has.)	0.45 (0.50)	0.0	1	0
Trait reactance index	3.86 (1.51)	4	7	1
Environmental concern index	5.38 (0.88)	5.3	7	2.83
N	600			

Source: own elaboration.

reactance. For the measurement of environmental concern, respondents were asked to rate their level of agreement or disagreement with six statements using a seven-point Likert scale. The statements used are the five items with highest loading of the New Environmental Paradigm (Dunlap, 2008; Dunlap & Van Liere, 1978) plus an ad-hoc item focusing on agriculture (last item). Trait reactance was measured using the first two factors of Hong's Psychological Reactance Scale (Hong & Faedda, 1996) focusing on emotional response towards restricted choice (first three items) and reactance to compliance (last three items). The specific wording of the items can be found in the supplementary materials (SM4).

3.6. Data collection and power analysis

Participants were active farmers involved in making important decisions on their farms who had received CAP direct payments in 2019. Using farmers as study participants was more appropriate than a student pool given the experiment's focus on policy (Cason & Wu, 2019). The experiment was implemented online with 600 farmers in Germany, Spain and Poland. Expedite *a priori* considerations about statistical power were driven by constraints in sample size. We performed simplified power calculations for plausible scenarios and realized that the design would allow us to detect large effects (Cohen's d = 0.8) at country level (assuming t-Tests) and medium effect sizes (Cohen's d = 0.5) for within-subject comparisons (also assuming t-Tests[11]).

Farmers were recruited by a market research firm using a push-to-web approach. The company called farmers identified in public phone directories to invite them to participate in the study. If they accepted and met the eligibility criteria for the survey, they were asked for their email and sent a personalized link to the survey which was implemented in the company's on-line system. A total of 1,445 invitations were sent to farmers, of which 787 resulted in a click to the link (54.5% response rate) and 600 (200 per country) completed questionnaires (23.8% attrition). The attrition rate was not different across treatments. The data collection took place between September and October 2020.

4. Empirical strategy and econometric approaches

There are three key dependent variables: (1) voluntary contribution, i.e. the (absolute) number of tokens voluntarily contributed to the environment; (2) total contribution, i.e. the (absolute) total number of tokens contributed to the environment, including both voluntary and mandatory contributions; and (3) the relative contribution, calculated as the voluntary contribution divided by the income available for voluntary contribution (i.e., initial income minus mandatory contribution). All the dependent variables have a non-normal distribution (Shapiro–Wilk p-values < 0.05). Therefore we use non-parametric tests to compare contributions to the environment by treatment to analyse treatment effects for the main policy findings. When comparisons are between subjects, we use Mann-Whitney U tests, and when they are within subjects, we use Wilcoxon rank tests to incorporate the non-independence between observations.[12] Since we did not pre-register directional hypotheses, following a conservative approach we use two-sided tests throughout. We apply Bonferroni corrections to adjust for multiple hypotheses testing, by manually applying a stricter threshold for the pairwise comparisons of treatments. We report p-values, but we use stricter cut-offs for the policy treatment comparisons in that we divide the usual 1%, 5% and 10% thresholds by the number of tested statistical main policy hypotheses.

In additional exploratory analyses, we also explore the impact of covariates (including trait reactance and environmental concern) on contributions with panel regression models. Voluntary and total contributions to the environment were censored below and above, as (1) total contributions could not be lower than the mandatory contribution and (2) voluntary contributions could not be larger than the income available after the mandatory contribution was deducted. Since 137 observations were left-censored, we used a tobit modelling approach (Tobin, 1958) to avoid potential bias associated with ignoring this effect. We used random effects panel specifications of the model to account for the fact that our data included three observations per respondent, corresponding to their decisions made in each round of the experiment. In line with the pre-registration, we also replicate the analysis considering only the first decision (therefore not considering the panel structure).

As the items used in trait reactance and environmental concern indexes show good internal consistency[13] the trait reactance and environmental concern indexes are constructed as simple averages of the items in each scale (see SM4). Missing observations were dropped (15

[11] Further details on the power analysis can be found in the pre-registration report referenced in footnote 3.

[12] We have between subject comparisons when focusing on the first decision only or when, using the pooled data, comparing across different levels of the framing factor (e.g. MAND_0 vs INC_0). Within subject comparisons are those carried out for the pooled data across different levels of the intensity of variation factor for a given level of the framing factor (e.g. MAND_0 vs MAND_35).

[13] Cronbach alpha higher than 0.90 and first component in principle component analysis resembling an unweighted average and explaining around 80% of total variability.

Table 3
Descriptive statistics of main outcome variables per treatment and level (pooled across countries and decisions).

Framing	Treatment	Intensity of Variation: Mandatory contribution	Intensity of Variation: Initial net income	Sample size	Voluntary contribution: Median	Voluntary contribution: Mean (S.d.)	Total contribution (voluntary + mandatory): Median	Total contribution (voluntary + mandatory): Mean (S.d.)	Relative voluntary contribution (%) *: Median	Relative voluntary contribution (%) *: Mean (S.d.)
Variation in mandatory contribution (net income = 300)	MAND_0	0		300	70	77.8 (47.2)	75	82.8 (47.2)	23.7	26.4 (16.0)
	MAND_35	35		300	30	42.45 (35.3)	70	82.5 (35.3)	11.5	16.3 (13.6)
	MAND_85	85		300	10	19.1 (26.9)	100	109.1 (26.9)	4.8	9.1 (12.8)
Variation in initial net income (mandatory contribution = 5)	INC_0		0	300	60	70.1 (42.9)	62	75.1 (42.9)	20.3	23.8 (14.5)
	INC_35		−35	300	47.5	52.2 (39.0)	52.5	57.2 (29.0)	18.3	20.1 (15.0)
	INC_85		−85	300	20	34.7 (39.7)	25	39.7 (39.7)	9.5	16.5 (18.9)

*Calculated as voluntary contribution divided by income available for voluntary allocation (initial net income minus mandatory contribution).
Source: own elaboration.

Table 4
Pairwise tests (Mann-Whitney U test for between subject comparisons and Wilcoxon-rank for within subject ones) of single treatments against each other for meaningful levels (pooled across countries and decisions).

	MAND_0	MAND_35	MAND_85	INC_0	INC_35	INC_85
MAND_0 (n = 300)						
MAND_35 (n = 300)	19.985*** -1.585 19.036***					
MAND_85 (n = 300)	20.703*** −14.531*** 19.779***	20.781*** −19.501*** 19.504				
INC_0 (n = 300)	1.776 1.776 1.776					
INC_35 (n = 300)		-3.761** 9.264*** -3.761**		14.335*** 14.335*** 9.901***		
INC_85 (n = 300)			-6.248*** 17.856*** -6.248***	18.053*** 18.053*** 11.594***	17.752*** 17.752*** 11.511***	

For each cell, we report the value of the z-statistic for rejecting the null hypothesis of equal values and significance level based on Mann-Whitney or Wilcoxon rank tests for (i) voluntary contributions, (ii) total contributions and (iii) voluntary contributions as % of income available for voluntary allocation are reported. Significance levels are corrected for multiple hypothesis testing (nine comparisons).
*$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: own elaboration.

individuals, three with missing values for both, six with missing values for the environmental concern, and six for the trait reactance). The indexes were standardized before including in the regressions as independent variables.

The data set and Stata code to reproduce the analysis are included in the supplementary materials (SM5 and SM6). As planned in the pre-registration, we did not exclude any potential outlier.

5. Results and discussion

5.1. Sample

Summary statistics of the sample characteristics are presented in Table 2, country-specific details can be found in Table A1 in the annex. Our sample is representative of the general population of farmers in the three countries in terms of age, gender and size. However, we have an over-representation of organic farmers and of farmers participating in agri-environmental and climate measures.

5.2. Pairwise comparisons

Descriptive statistics of the outcome variables by treatment are presented in Table 3. We report the mean and median voluntary contributions to the environment, the total contribution to the environment (mandatory plus voluntary), and the relative voluntary contribution. Data are pooled across countries and decisions. However, the results are robust when only first decisions are considered (Table A2 in annex) and when taken for each country separately (Tables A3 to A5 in the annex). Results of tests for significant differences between outcome variables for all meaningful pairwise tests of single treatments are presented in Table 4. This includes all mandatory treatments against each other, all income treatments against each other and equivalent levels of variation in mandatory contribution and income.[14]

We use the Kruskal-Wallis omnibus procedure to test the hypothesis

[14] MAND_0 vs INC_0, MAND_35 vs INC_35, and MAND_85 vs INC_85.

Table 5
Random effects tobit regression of farmers' contributions (pooled across countries and decisions).

Variable	Dependent variable		
	Voluntary contribution (absolute number of tokens)	Total contribution (mandatory + voluntary)	Relative voluntary contribution*
Constant	−56.168***	−56.168***	−3.034
	(10.4116)	(10.4116)	(4.001)
Trait reactance index	34.556***	34.556***	16.207***
	(6.2874)	(6.2874)	(2.369)
Environmental concern index	2.731	2.731	0.130
	(6.0361)	(6.0361)	(2.275)
Mandatory	−0.745***	0.255***	−0.224***
	(0.0219)	(0.0219)	(0.008)
Mandatory*trait reactance index	−0.029	−0.029	−0.0119
	(0.0213)	(0.0219)	(0.008)
Mandatory*environmental concern index	0.003	0.003	−0.0002
	(0.0222)	(0.0222)	(0.008)
Income	0.457***	0.457***	0.101***
	(0.2111)	(0.2111)	(0.008)
Income*trait reactance	−0.106***	−0.106***	−0.051***
	(0.0218)	(0.0218)	(0.008)
Income*environmental concern index	−0.015	−0.015	−0.002
	(0.0210)	(0.0210)	(0.008)
Age	−0.330**	−0.330**	−0.121*
	(0.1598)	(0.1598)	(0.062)
AECM participant	9.433***	9.433***	3.734***
	(2.9704)	(2.9704)	(1.152)
Livestock	8.692*	8.692*	3.421*
	(4.5543)	(4.5543)	(1.766)
Crops	9.724**	9.724**	3.711**
	(4.5128)	(4.5128)	(1.750)
2nd choice	−3.391**	−3.391**	−1.164**
	(1.3283)	(1.3283)	(0.499)
3rd choice	−5.068***	−5.068***	−1.930***
	(1.3344)	(1.3344)	(0.501)
Sigma_u	30.902***	30.902***	12.056***
	(1.0778)	(1.0778)	(0.415)
Sigma_e	22.212***	22.212***	8.363***
	(0.4794)	(0.4794)	(0.181)
Rho	0.6594	0.6594	0.675
	(0.0191)	(0.0191)	(0.0185)
Model diagnostics			
LL	−7,940.837	−7,940.837	−6,389.106
LL (constant only)	−8,596.990	−8,554,774	−6,977.609
Observations	1,755	1,755	1,755
Groups	585	585	585
Parameters	18	18	18

Standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: own elaboration.
[*] Calculated as voluntary contribution divided by income available for voluntary allocation (initial net income minus mandatory contribution).

that at least one of the distributions is different from at least one other distribution across the six different treatments of the experiment. We could reject the hypothesis that the six distributions are the same for the voluntary (Chi2 = 502.34; p < 0.01), total (Chi2 = 543.49; p < 0.01) and relative contribution to the environment (Chi2 = 349.65; p < 0.01). These results hold when the analysis is done for the first decisions only (Table A6 in the annex) to avoid the potential effect of order.

When taken at individual country level, the results are mostly robust with respect to the pooled country analysis (see Tables A7 to A9 in the annex). The most striking difference relate to the fact that, for the Polish sample, the substitution between mandatory and voluntary contribution, which happens when moving from MAND_0 to MAND_35, reveals a stronger crowding out effect (the total contribution falls significantly). The other difference is that there are no significant differences between MAND_35 and INC_35 for the German sample.

5.2.1. Variation in mandatory contribution

We start by focusing on the effect of varying the mandatory contribution to the environment. First, we look at the effect on voluntary contribution, keeping in mind that the data is censored above at different amounts between the different levels. When mandatory contribution increases (as in MAND_35 compared to MAND_0, or MAND_85 compared to MAND_35 and MAND_0), voluntary contribution decreases significantly. This crowding out effect is significant for both absolute and relative voluntary contributions across all comparisons, with one exception – the relative voluntary contribution does not differ between MAND_85 and MAND_35. These results clearly support the hypotheses based on moral licensing and reactions to distrust. We do not have data on farmers' emotional reactions to these different levels of mandatory contributions that would back up these theoretical accounts of the effects we find. However, results are in line with these theories – when farmers have to contribute more to the environment on a compulsory basis, they contribute less to the environment voluntarily.

Second, we analyse the results for the total contribution, that is, the addition of mandatory and voluntary contributions. For this comparison, the minimum (i.e. 5) and maximum (i.e. 300) total contributions were equal across all levels of mandatory contribution. There is no significant difference between the total contribution in MAND_35 and in MAND_0. This means that farmers decreased (increased) their voluntary contributions by approximately the same magnitude as the increase (decrease) in mandatory contribution. The total contribution under MAND_85 is significantly higher than under both MAND_35 and

Table 6
Descriptive statistics for CAP budget impact and final net income.

	Compensation needed for voluntary contributions minus budget available for eco-schemes*			Final net income		
Treatment	**Mean**	**Median**	**Coefficient of variation**	**Mean**	**Median**	**Coefficient of variation**
MAND_0	n.a.	n.a.	n.a.	287.22	288.00	0.02
MAND_35	n.a.	n.a.	n.a.	255.76	257.00	0.01
MAND_85	n.a.	n.a.	n.a.	208.09	209.00	0.01
INC_0	63.09	54.00	0.61	287.99	289.00	0.01
INC_35	11.95	7.75	2.94	254.78	255.25	0.02
INC_85	−53.76	−67.00	−0.67	206.53	208.00	0.02

n.a.: not applicable as there is no reduction in direct payments to fund eco-schemes.
Final net income calculated as NI-MC-0.1*VC.
Source: own elaboration.
* Positive values show a lack of budget to compensate voluntary contributions; negative values show an excess of budget.

Table A1
Sample descriptive statistics by country.

	Germany				Poland				Spain			
	Mean (sd)	Median	Max.	Min.	Mean (sd)	Median	Max.	Min.	Mean (sd)	Median	Max.	Min.
Female	0.08 (0.26)	0.00	1	0	0.07 (0.25)	0.00	1	0	0.07 (0.25)	0.00	1	0
Age	48.34 (9.53)	50.0	70	26	46.85 (9.20)	48.0	68	25	47.66 (7.68)	48.0		
AECM participant	0.29 (0.45)	0.0	1	0	0.47 (0.50)	0.0	1	0	0.39 (0.49)	0.0	1	0
Organic	0.28 (0.45)	0.0	1	0	0.31 (0.46)	0.0	1	0	0.29 (0.45)	0.0	1	0
Large farm (>30 Has.)	0.52 (0.50)	1	1	0	0.42 (0.49)	0.0	1	0	0.42 (0.49)	0.0	1	0
Reactance index	3.71 (1.43)	3.8	7	1	4.47 (1.03)	4.5	6.67	1.67	3.41 (1.75)	3.17	6.83	1
Environmental concern index	5.30 (0.90	5.3	7	2.83	5.13 (0.80)	5.1	7	3.17	5.70 (0.85)	5.8	7	3.17
N	200	200	200									

AECM: agri-environmental and climate measure.
Source: own elaboration.

Table A2
Descriptive statistics of main outcome variables per treatment (pooled across countries, first decisions only).

		Intensity of Change			Voluntary contribution		Relative voluntary contribution*		Total contribution (voluntary + mandatory)	
Framing	**Treatment**	**Mandatory contribution**	**Initial net income**	**Sample size**	**Median**	**Mean (S.d.)**	**Median**	**Mean (S.d.)**	**Median**	**Mean (S.d.)**
Variation in mandatory contribution (net income = 300)	MAND_0	0		103	75	82.8 (49.6)	25.4	28.1 (16.8)	80	87.8 (49.6)
	MAND_35	35		98	30	39.3 (28.6)	11.5	15.1 (11.0)	70	79.3 (28.6)
	MAND_85	85		99	10	22.9 (36.0))	4.8	10.9 (17.1)	100	112.9 36.0))
Variation in initial net income (mandatory contribution = 5)	INC_0		0	102	70	72.4 (39.1)	23.7	24.5 (13.3)	75	77.4 (39.1)
	INC_35		−35	102	50	58.8 (45.1)	19.2	22.6 (17.4)	55	63.8 (45.1)
	INC_85		−85	96	20	37.1 (42.3)	9.5	17.7 (20.1)	25	42.1 (42.3)

Source: own elaboration.
*Calculated as voluntary contribution divided by income available for voluntary allocation (initial net income minus mandatory contribution).

MAND_0. However, this effect is linked to the choice of the level of mandatory contribution, which in this level was set to 90 tokens, which was higher than the mean total contribution under MAND_35 and MAND_0. From a policy perspective, these results suggest that a mild increase in environmental compulsory requirements (as between MAND_0 and MAND_35) for farmers may not produce higher environmental benefits. In order to significantly increase total contributions (and thus, the corresponding total environmental benefits), mandatory contribution needs to increase substantially (as in MAND_85), so that it offsets the associated decrease in farmers' voluntary contribution.

5.2.2. *Variation in income*

We then assess the effect of the variation of initial net income (corresponding to a variation in income-support direct payments) on voluntary contributions. For the absolute voluntary contributions, the data are censored above at different amounts between the different levels of initial income. Results show a significant decrease in voluntary contributions as income decreases (INC_35 vs. INC_0 and INC_85 vs.

Table A3
Descriptive statistics of main outcome variables per treatment for the German sample (pooled across decisions).

Framing	Treatment	Intensity of Change			Voluntary contribution		Relative voluntary contribution*		Total contribution (voluntary + mandatory)	
		Mandatory contribution	Initial net income	Sample size	Median	Mean (S.d.)	Median	Mean (S.d.)	Median	Mean (S.d.)
Variation in mandatory contribution (net income = 300)	MAND_0	0		101	75	81.5 (47.0)	25.4	27.6 (15.9)	80	86.5 (47.0)
	MAND_35	35		101	40	41.9 (32.8)	15.4	16.1 (12.6)	80	81.9 (32.8)
	MAND_85	85		101	10	20.3 (27.2)	4.8	9.7 (12.9)	100	110.3 (27.2)
Variation in initial net income (mandatory contribution = 5)	INC_0		0	99	80	73.9 (44.2)	27.1	25.1 (15.0)	85	78.9 (44.1)
	INC_35		−35	99	50	48.4 (34.0)	19.2	18.6 (13.1)	55	53.4 (34.1)
	INC_85		−85	99	20	28.1 (28.1)	9.5	13.4 (13.4)	25	33.1 (28.1)

Source: own elaboration.
*Calculated as voluntary contribution divided by income available for voluntary allocation (initial net income minus mandatory contribution).

Table A4
Descriptive statistics of main outcome variables per treatment for the Polish sample (pooled across decisions).

Framing	Treatment	Intensity of Change			Voluntary contribution		Relative voluntary contribution*		Total contribution (voluntary + mandatory)	
		Mandatory contribution	Initial net income	Sample size	Median	Mean (S.d.)	Median	Mean (S.d.)	Median	Mean (S.d.)
Variation in mandatory contribution (net income = 300)	MAND_0	0		99	50	71.8 (54.4)	16.9	24.3 (18.4)	55	76.8 (54.3)
	MAND_35	35		99	20	45.8 (44.6)	7.7.	17.6 (17.2)	60	85.8 (44.6)
	MAND_85	85		99	5	21.8 (33.3)	2.4	10.4 (15.9)	95	111.8 (33.4)
Variation in initial net income (mandatory contribution = 5)	INC_0		0	101	50	65.7 (44.5)	16.9	22.3 (15.1)	55	70.7 (44.5)
	INC_35		−35	101	35	57.7 (49.2)	13.5	22.2 (18.9)	40	62.7 (49.2)
	INC_85		−85	101	20	47.8 (52.7)	9.5	22.7 (25.1)	25	52.8 (52.7)

Source: own elaboration.
*Calculated as voluntary contribution divided by income available for voluntary allocation (initial net income minus mandatory contribution).

both INC_0 and INC_35). Relative contributions decrease as income decreases. This finding contradicts results from *meta*-analyses in dictator games on the effect of varying initial endowment on relative donations (Engel, 2011; Larney et al. 2019). However, this effect could be due to the specific context of our study and the compensated nature of the voluntary contribution. Taking into account the fact that total contributions had different levels of upper censoring, the comparison across the three levels of income is less robust. However, we do note a significant decrease in total contributions as income decreases.

5.2.3. *Variation in mandatory contribution vs. Variation in income*

Because we used the same gaps between the three levels in both factors of framing of variation, we can compare contributions and assess the effect of framing. Censoring above is the same for total contributions across framing factors, hence they are worthwhile comparing.

MAND_0 and INC_0 were virtually the same situations, with the exception that farmers were informed of the different sources of variation (i.e., in mandatory contribution or in income). As one would reasonably expect, we find no significant difference in voluntary contribution between MAND_0 and INC_0, nor in absolute, nor in relative terms.

We do find a significant difference in (absolute and relative) voluntary contributions between MAND_35 and INC_35, and between MAND_85 and INC_85. Voluntary contributions are systematically lower in the 'mandatory contribution variation' framing than in the 'income variation' framing. Increasing mandatory contributions to the environment thus crowds out voluntary contributions more than decreasing income in the same magnitude. To a certain extent, these results confirm the robustness of the findings regarding the variation in mandatory contribution. Regarding the income variation framing, we introduced this treatment to assess the effect of a budget shift from income-support direct payments to voluntary eco-schemes. Even if from a policy perspective, this variation in income is linked to the environment, this was not made explicit in the experiment to our participants and did not have a direct link to the environmental benefits provided in the token allocation task. We further discuss this in Section 5.3.

Table A5
Descriptive statistics of main outcome variables per treatment for the Spanish sample (pooled across decisions).

		Intensity of Change			Voluntary contribution		Relative voluntary contribution*		Total contribution (voluntary + mandatory)	
Framing	Treatment	Mandatory contribution	Initial net income	Sample size	Median	Mean (S.d.)	Median	Mean (S.d.)	Median	Mean (S.d.)
Variation in mandatory contribution (net income = 300)	MAND_0	0		100	80	80.1 (38.9)	27.1	27.2 (13.2)	85	85.1 (38.9)
	MAND_35	35		100	37.5	39.7 (26.1)	14.4	15.3 (13.2)	77.5	79.7 (26.1)
	MAND_85	85		100	10	15.1 (17.8)	4.8	7.2 (8.5)	100	105.1 (17.8)
Variation in initial net income (mandatory contribution = 5)	INC_0		0	100	70	70.8 (39.7)	23.7	24.0 (13.5)	75	75.8 (39.7)
	INC_35		−35	100	50	50.3 (30.9)	19.2	19.4 (11.9)	55	55.3 (30.9)
	INC_85		−85	100	15	28.1 (30.3)	7.1	13.4 (14.4)	20	33.12 (30.3)

* Calculated as voluntary contribution divided by income available for voluntary allocation (initial net income minus mandatory contribution).
Source: own elaboration.

Table A6
Pairwise tests (Mann-Whitney) of single treatments against each other for meaningful levels (pooled across countries and first decisions only).

	MAND_0	MAND_35	MAND_85	INC_0	INC_35	INC_85
MAND_0 (n=300)						
MAND_35 (n=300)	7.116*** 0.391 6.366***					
MAND_85 (n=300)	9.214*** -5.412*** 8.201***	6.227*** -7.585*** 5.358***				
INC_0 (n=300)	1.068 1.068 1.068					
INC_35 (n=300)		-3.498*** 4.516*** -3.498***		3.247** 3.247** 1.965		
INC_85 (n=300)			-3.271*** 9.735*** -3.271***	6.484*** 6.484*** 4.642***	4.481*** 4.481*** 3.329***	

For each cell, we report the value of the z-statistic for rejecting the null hypothesis of equal values and significance level based on Mann-Whitney tests for (i) voluntary contributions, (ii) total contributions and (iii) voluntary contributions as % of income available for voluntary allocation are reported. Significance levels are corrected for multiple hypothesis testing (nine comparisons).
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: own elaboration.

5.3. *Tobit regressions*

To control for the censoring effects and to further understand the role of covariates including behavioural factors, we run a tobit model. We do so pooling all countries and all decisions. The level of mandatory contribution and of income are included as two continuous variables, with their three corresponding levels[15] (see Table 1). We include the two behavioural constructs (reactance and environmental concern) and their interactions with the two framing factor variables as independent variables.[16] As each respondent is exposed to the three levels of the change in intensity factor in a random order and because we pool the three decisions in our analysis, we include dummy variables to control for potential order effects. Last, we include farm and farmer characteristics that can affect pro-environmental behaviour as controls. Table 5 presents the results of random effects Tobit models explaining farmers' contributions to the environment. Models are fitted for voluntary contribution (first column), total contribution (second column) and the relative contribution (third column) as dependent variables. By design, coefficients in the first and second model are all the same except for the mandatory framing variable.

Focusing on the impact of mandatory contributions, we see that voluntary contributions decrease as mandatory ones increase. Our results show a crowding-out effect of approximately 75%. The positive

[15] This assumes that the impacts of the variation in the level of intensity is linear. We have tested this assumption by running the same specification including the levels of intensity of variation as dummy variables and found that this was not the case (see table A10 in the annex). There is a decreasing impact of mandatory and voluntary contributions (from 1 when moving from MAND_5 to MAND_35 to 0.75 when moving from MAND_5 to MAND_90). The pattern holds for the income-framing factor, showing a smaller reduction in voluntary contributions at the higher end of the income reduction. As the rest of the results are consistent across modelling approaches, we discuss the results of the model with continuous variables representing the levels.

[16] The results for tobit regressions without interactions of the two behavioural constructs with the framing factor variable are equivalent (see table A11 in the annex) and we focus our discussion on the model with interactions.

Table A7
Pairwise tests (Mann-Whitney U test for between subject comparisons and Wilcoxon-rank for within subject ones) of single treatments against each other for meaningful levels in Germany (pooled across decisions).

	MAND_0	MAND_35	MAND_85	INC_0	INC_35	INC_85
MAND_0						
(n=300)						
MAND_35	11.632***					
(n=300)	0.661					
	10.876***					
MAND_85	11.892***	11.762***				
(n=300)	–7.242***	–12.042***				
	10.972***	10.567***				
INC_0	0.842					
(n=300)	0.842					
	0.842					
INC_35		-1.545		9.705***		
(n=300)		5.722***		9.705***		
		-1.545		7.856***		
INC_85			-2.623*	11.157***	10.352***	
(n=300)			11.643***	11.157***	10.352***	
			-2.623*	8.829***	8.135***	

For each cell, we report the value of the z-statistic for rejecting the null hypothesis of equal values and significance level based on Mann-Whitney or Wilcoxon rank tests for (i) voluntary contributions, (ii) total contributions and (iii) voluntary contributions as % of income available for voluntary allocation are reported. Significance levels are corrected for multiple hypothesis testing (nine comparisons).
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: own elaboration.

Table A8
Pairwise tests (Mann-Whitney U test for between subject comparisons and Wilcoxon-rank for within subject ones) of single treatments against each other for meaningful levels in Poland (pooled across decisions).

	MAND_0	MAND_35	MAND_85	INC_0	INC_35	INC_85
MAND_0						
(n=300)						
MAND_35	10.832***					
(n=300)	-5.616***					
	10.259***					
MAND_85	11.997***	12.209***				
(n=300)	–9.692***	–10.110***				
	11.410***	11.338***				
INC_0	0.454					
(n=300)	0.454					
	0.454					
INC_35		-2.467		7.573***		
(n=300)		4.616***		7.573***		
		-2.467		2.678*		
INC_85			-5.134***	8.634***	8.436***	
(n=300)			7.942***	8.634***	8.436***	
			-5.134***	1.857	0.929	

For each cell, we report the value of the z-statistic for rejecting the null hypothesis of equal values and significance level based on Mann-Whitney or Wilcoxon rank tests for (i) voluntary contributions, (ii) total contributions and (iii) voluntary contributions as % of income available for voluntary allocation are reported. Significance levels are corrected for multiple hypothesis testing (nine comparisons).
*$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: own elaboration.

effect of the mandatory variable for total contributions is the reverse of the crowding-out effect, with an increase of total contributions of 25% for each increase in the level of mandatory ones.[17] As we have seen in the pairwise comparison, the positive effect is mainly driven by the high mandatory contribution in the third level. However, the increase in mandatory contributions also reduces the share of available income that is dedicated to the environment. Income has a positive and significant effect for all output variables.

To compare the impact of both framings of variation, one needs to look at the absolute values of the coefficients for income and mandatory contribution. This is because one additional token in mandatory contribution corresponds to one less token of available income for voluntary allocation even if initial net income remains unchanged (i.e. at 300 tokens). The impact on voluntary contributions of a decrease in available income due to increased mandatory requirements is 60% higher than when this decrease is due to a reduction in initial net income (1*(-0.745) vs (-1)*0.457). This confirms the results from the pairwise comparisons suggesting that an increase in mandatory contribution decreases voluntary contributions more than an equivalent reduction in income. Regarding total contribution, if the decrease of available income is due to an increase in mandatory contribution, total contributions increase (1*0.255), while if it is due to a reduction in initial net

[17] An alternative explanation to this behaviour would be that farmers follow a satisfying rule (Camerer et al. 1997). That is, farmers could have a particular amount that they view as an optimum that they want to donate, irrespective of the nature of the donation (mandatory or voluntary). The coherent output with such a behaviour would be that decreases in voluntary variation would only be observed in the mandatory framing. As we also found a positive relationship between income and voluntary contributions, we cannot confirm this behavioural pattern.

Table A9
Pairwise tests (Mann-Whitney U test for between subject comparisons and Wilcoxon-rank for within subject ones) of single treatments against each other for meaningful levels in Spain (pooled across decisions).

	MAND_0	MAND_35	MAND_85	INC_0	INC_35	INC_85
MAND_0 (n=300)						
MAND_35 (n=300)	11.908*** 2.120 11.829***					
MAND_85 (n=300)	12.014*** –8.660*** 11.796***	12.065*** –11.879*** 11.799**				
INC_0 (n=300)	2.145 2.145 2.145					
INC_35 (n=300)		-2.840** 6.094*** -2.840**		7.496*** 7.496*** 5.699***		
INC_85 (n=300)			-3.197** 11.287*** -3.197**	11.097*** 11.097*** 9.115***	11.402*** 11.402*** 10.260***	

For each cell, we report the value of the z-statistic for rejecting the null hypothesis of equal values and significance level based on Mann-Whitney or Wilcoxon rank tests for (i) voluntary contributions, (ii) total contributions and (iii) voluntary contributions as % of income available for voluntary allocation are reported. Significance levels are corrected for multiple hypothesis testing (nine comparisons).
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: own elaboration.

Table A10
Random effects tobit regression of farmers' contributions with income and mandatory levels as dummy variables (pooled across countries and decisions).

	Dependent variable		
Variable	**Voluntary contribution (absolute number of tokens)**	**Total contribution (mandatory + voluntary)**	**Relative Voluntary contribution***
Constant	75.983*** (8.6359)	80.983*** (8.6359)	25.522*** (3.3578)
Trait reactance index	3.938*** (1.4280)	3.938*** (1.4280)	1.534*** (0.5553)
Environmental concern index	−1.137 (1.4674)	−1.137 (1.4674)	−0.471 (0.5706)
Mandatory40	−34.445*** (1.7613)	0.555 (1.7613)	−9.834*** (0.6744)
Mandatory90	−63.780*** (1.8486)	21.220*** (1.8486)	−19.207*** (0.7034)
Income265	−19.679*** (1.7720)	−19.679*** (1.7720)	−4.324*** (0.6787)
Income215	−39.647*** (1.79.22)	−39.647*** (1.79.22)	−8.857*** (0.6843)
Age	−0.319** (0.1600)	−0.319** (0.1600)	−0.116* (0.0622)
AECM participant	9.580*** (2.9733)	9.580*** (2.9733)	3.3781*** (1.1563)
Livestock	8.585* (4.5565)	8.585* (4.5565)	3.374* (1.7713)
Crops	9.753** (8.6359)	9.753** (8.6359)	3.731*** (1.7551)
Sigma_u	30.933*** (1.0782)	30.933*** (1.0782)	12.069*** (0.4170)
Sigma_e	22.215*** (0.4804)	22.215*** (0.4804)	8.498*** (0.1845)
Rho	0.660 (0.0191)	0.660 (0.0191)	0.669 (0.1872)
Model diagnostics			
LL	−7,949.63	−7,949.63	−6,412.01
LL (constant only)	−8,596.99	−8,554.77	−6,977.61
Observations	1,755	1,755	1,755
Parameters	14	14	14

*Calculated as voluntary contribution divided by income available for voluntary allocation (initial net income minus mandatory contribution).
Standard errors in parentheses.
*$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: own elaboration.

income, it deceases ((-1)*(0.457). This can be also looked at considering increases in income, if farmers' available income for voluntary contributions increases, higher total contributions to the environment will be achieved.

Focusing on the impact of our behavioural variables, first we do not see an impact of environmental concern on contributions. This is true

Table A11
Tobit regression of farmers' contributions main effects only (pooled across countries and decisions).

	Dependent variable		
Variable	Voluntary contribution (absolute number of tokens)	Total contribution (mandatory + voluntary)	Relative Voluntary contribution*
Constant	−60.056***	−60.056***	−4.555
	(10.4275)	(10.4275)	(4.0182)
Trait reactance index	3.969***	3.969***	1.539
	(1.4302)	(1.4302)	(0.5709)
Environmental concern index	−1.167	−1.167	−0.479
	(1.4695)	(1.4695)	(0.5709)
Mandatory	−0.749***	0.251***	−0.225
	(0.0221)	(0.0221)	(0.0083)
Income	0.459***	0.459***	0.103
	(0.0214)	(0.0214)	(0.0081)
Age	−0.320**	−0.320**	−0.116
	(0.1601)	(0.1601)	(0.0622)
AECM participant	9.447***	9.447***	3.744
	(2.9769)	(2.9769)	(1.1566)
Livestock	8.517*	8.517*	3.353
	(4.5636)	(4.5636)	(1.7724)
Crops	9.658**	9.658**	3.700
	(4.5215)	(4.5215)	(1.7561)
Sigma_u	30.892***	30.892***	12.062
	(1.0828)	(1.0828)	(0.4177)
Sigma_e	22.584***	22.584***	8.557
	(0.4874)	(0.4874)	(0.1856)
Rho	0.652	0.652	0.665
	(0.0194)	(0.0194)	(0.0188)
Model diagnostics			
LL	−7,961.46	−7,961.46	−6,417.49
LL (constant only)	−8,596.99	−8,560.83	−6,977.61
Observations	1,755	1,755	1,755
Parameters	12	12	12

*Calculated as voluntary contribution divided by income available for voluntary allocation (initial net income minus mandatory contribution).
Standard errors in parentheses.
*$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: own elaboration.

both for the variable as stand-alone or as interacted with the two framing factor levels. As our donations to the environment were described as the adoption of environmentally friendly farming practices, this seems at odds with the literature that suggests environmental concern is a main driver of adoption (Foguesatto et al. 2020, Pannell et al. 2006). Moreover, this seems at odds with the positive impact of AECM participation; however, both variables are only weakly correlated (correlation coefficient 0.20).

As a stand-alone variable, trait reactance increases all three output variables. That is, farmers with a high (low) tendency to perceive external actions as a threat to their freedom tend to contribute more (less) tokens to the environment. This significant and positive main effect of trait reactance can be explained for several reasons. Steindl et al. (2015) review the evidence on the role of reactance as a motivation and find that highly reactant people are behaviour-oriented: they have an 'urge to do something' when they detect a problem (Brehm & Brehm, 1981). Arguably, high-reactant farmers could be more prone to contribute to the environment in order to solve environmental problems. Contrary to our expectations, the interaction of trait reactance with mandatory contribution is not significant, which is similar to what has been reported in Thomas et al. (2019). We also find a significant, but negative interaction effect between trait reactance and variations in income (described as changes in direct payments from the CAP) on contributions to the environment. In other words, the contributions of farmers with high levels of trait reactance are less affected by income variations. This would be against what we would expect, as changing levels reflects changing policy, somehow making the reduction of freedom more evident.

Focusing on farm and farmer characteristics, older farmers tend to allocate fewer tokens to the environment, while farmers specialized in livestock or in crops (as opposed to mixed farmers), and those already participating in an agri-environmental and climate measure allocate more. Finally, results show that the order in the sequence in which each treatment was presented has a negative and significant effect.

As mentioned in Section 5.2, there is a risk in directly comparing the findings between the variation framing factors because of the potential confound associated with changes in environmental benefits, which are explicit in the mandatory contribution variation treatment and not in the income variation treatment. To see whether this could be the case we take advantage of an additional question included in the questionnaire in which farmers were asked to declare their level of agreement with the statement "*I believe in the environmental benefits of [this] programme*"; [this] being the "a Tree For You" NGO. One would see evidence of confounding effect if the interaction effects between beliefs in the environmental benefits of the programme and the variation of tokens would differ across the two variation framing factors. To test this, we ran the models reported in Table 5 including the perception of environmental benefits as an independent variable and interacted it with the type of intervention treatment variables (see Table A12 in the annex).

We find a significant and positive correlation between perceived environmental benefits and all three dependent variables. This reflects that people who believe more in the benefits of the NGO action allocate more tokens to it, which is a theoretically sound finding. More important for the risk of confounding effects, the interaction between the belief in the environmental benefits of the program and the mandatory contribution variation factor was negligible and not significant; however, the interaction of this variable with the income variation factor was significant. Famers who strongly believe in the benefits delivered by the

Table A12
Random effects tobit regression of farmers' contributions with belief variable (pooled across countries and decisions).

Variable	Dependent variable: Voluntary contribution (absolute number of tokens)	Total contribution (mandatory + voluntary)	Relative voluntary contribution*
Constant	−159.421***	−159.421***	−56.940***
	(30.1704)	(30.1704)	(11.3512)
Trait reactance index	34.665***	34.665***	16.225***
	(6.3150)	(6.3150)	(2.3734)
Environmental concern index	−4.624	−4.624	−3.704
	(6.3221)	(6.3221)	(2.3778)
Belief	20.507***	20.507***	10.594***
	(5.4178)	(5.4178)	(2.0351)
Mandatory	−0.741***	0.259**	−0.250***
	(0.1132)	(0.1132)	(0.0422)
Mandatory*belief	−0.001	−0.001	0.005
	(0.0203)	(0.0203)	(0.0076)
Mandatory*trait reactance index	−0.029	−0.029	−0.115
	(0.0214)	(0.0214)	(0.0080)
Mandatory*environmental concern index	0.005	0.005	−0.002
	(0.0233)	(0.0233)	(0.0087)
Income	0.719***	0.719***	0.255***
	(0.1021)	(0.1021)	(0.0328)
Income*belief	−0.050***	−0.050***	−0.029***
	(0.0189)	(0.0189)	(0.0071)
Income*trait reactance	−0.105***	−0.105***	−0.051***
	(0.0219)	(0.0219)	(0.0082)
Income*environmental concern index	0.003	0.003	0.008
	(0.0220)	(0.0220)	(0.0083)
Age	−0.367**	−0.367**	−0.135**
	(0.1568)	(0.1568)	(0.0608)
AECM participant	8.044***	8.044***	3.190***
	(2.9253)	(2.9253)	(1.1345)
Livestock	6.363	6.363	2.515
	(4.5049)	(4.5049)	(1.7465)
Crops	5.885	5.885	2.236
	(4.4949)	(4.4949)	(1.7427)
2nd choice	−3.407***	−3.407***	−1.200 **
	(1.3323)	(1.3323)	(0.4985)
3rd choice	−4.971***	−4.971***	−1.900***
	(1.3374)	(1.3374)	(0.5003)
Sigma_u	30.1615***	30.1615***	11.774***
	(1.0622)	(1.0622)	(0.4084)
Sigma_e	22.193***	22.193***	8.325***
	(0.4803)	(0.4803)	(0.1810)
Rho	0.649	0.649	0.667
	(0.01958)	(0.01958)	(0.0189)
Model diagnostics			
LL	−7,887.10	−7,887.10	−6,338.09
LL (constant only)	−8,556.05	−8,512.63	−6,944.44
Observations	1,746	1,746	1,746
Groups	585	585	585
Parameters	21	21	21

Standard errors in parentheses; $*p < 0.10$, $^{**} p < 0.05$, $^{***} p < 0.01$.
Source: own elaboration.
*Calculated as voluntary contribution divided by income available for voluntary allocation (initial net income minus mandatory contribution).

program reduce their contributions to the environment less when facing reduced income than those with lower beliefs.[18] Therefore, the differences between variation framing treatments are probably overestimated.

In real life, are generally aware of the additional environmental benefits that would be provided because of the resulting additional budget for ECS funded by their reduced income.

[18] Considering both extremes of the beliefs scale (1 and 7) we find a reduction of voluntary contributions of 0.669 and 0.369 respectively for each unit of reduced income. The reduction of voluntary contributions in the case of increased mandatory requirements would be 0.741.

5.4. Robustness checks

In line with our pre-registered analysis plan, we re-run the Tobit regressions with only the decision that farmers took in the first round (Table A13 in the annex). Considering only the first decision that each participant took is a more conservative approach than including all three decisions, in the sense that it makes the factor 'intensity of variation' a between-subject one, which is less likely to be subject to demand effects (Charness et al. 2012). The results confirm most of the findings above with the following exceptions. First, trait reactance does no longer affect contributions to the environment nor individually nor when interacted with the framing treatment of income variable. This absence of significant main effect of trait reactance when considering only farmers' first decision is in line with theory. High reactant individuals express their trait when confronted with a threat to their freedom of choice (Steindl

Table A13
Tobit regression of farmers' contributions (pooled across countries and first decision only).

Variable	Dependent variable		
	Voluntary contribution (absolute number of tokens)	Total contribution (mandatory + voluntary)	Relative Voluntary contribution*
Constant	−74.75***	−74.75***	−10.471
	(19.16)	(19.16)	(7.405)
Trait reactance index	18.39	18.39	10.714*
	(16.35)	(16.35)	(6.320)
Environmental concern index	10.21	10.21	4.389
	(15.78)	(15.78)	(6.095)
Mandatory	−0.794***	0.206***	−0.241***
	(0.0583)	(0.0583)	(0.023)
Mandatory*trait reactance index	−0.129**	−0.129**	−0.513**
	(0.0571)	(0.0571)	(0.023)
Mandatory*nvironmental concern index	0.0151	0.0151	0.003
	(0.0595)	(0.0595)	(0.023)
Income	0.512***	0.512***	0.120***
	(0.0588)	(0.0588)	(0.023)
Income*trait reactance	−0.0370	−0.0370	−0.027
	(0.0594)	(0.0594)	(0.023)
Income*environmental concern index	−0.0411	−0.0411	−0.012
	(0.0580)	(0.0580)	(0.022)
Age	−0.252	−0.252	−0.077
	(0.191)	(0.191)	(0.074)
AECM participant	8.240**	8.240**	3.460**
	(3.580)	(3.580)	(1.384)
Livestock	9.539*	9.539*	4.017*
	(5.474)	(5.474)	(2.117)
Crops	10.78**	10.78**	4.079*
	(5.430)	(5.430)	(2.010)
Model diagnostics			
LL	−2,792.28	−2,792.28	−2,281.60
LL (constant only)	−2,796.17	−2,796.17	−2,2285,38
Observations	585	585	585
Parameters	16	16	16

*Calculated as voluntary contribution divided by income available for voluntary allocation (initial net income minus mandatory contribution).
Standard errors in parentheses.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.
Source: own elaboration.

et al. 2015). Perhaps only variations (i.e. farmers seeing their income or mandatory contribution vary between rounds) prime reactant behaviour.

Second, and more relevant for our analysis, we do find a significant and negative effect when reactance is interacted with mandatory contributions. This is the effect expected from the literature, where reactance plays a more prominent role the more freedom is restricted. At the highest level of mandatory contribution, freedom is clearly restricted as nearly one third of initial net income is taken away for the environment.

With this analysis, we can also check whether the order effects can be taken as a signal of biased results. Day et al. (2012) classify the causes of order effects as "confounded" standard preferences like strategic misrepresentation, institutional learning or fatigue and non-standard choice behaviours like preference learning, anchoring effects and reference effects. Because we randomized the order, here we test for anchoring[19] and undertake different robustness tests. First, we repeat the pairwise comparisons of the output variables for the first decisions only (Table A6 in the annex). As we can see, the main findings remain unchanged. Second, we analyse the impact of order for each of the six treatments. In other words, we consider the anchoring effect as a potential source of explanation for the significant coefficients of the order variables in Table 5 where contributions decrease from the first to the second and third decisions. Nonetheless, the descriptive statistics displayed scarce differences of the voluntary and total contributions among decisions according to the order in which the levels were presented (Table A14 in the annex). The descriptive data trend pointed to the inexistence of that source of explanation, which was confirmed by the Kruskal-Wallis omnibus test and the post-hoc pairwise comparisons performed as a robustness test. We can then conclude that the significance of the order variables in the model is not due to anchoring, rather signalling order effects. These could be related to learning by farmers as they moved from one decision to the other which is, however, captured by the sequence variable in our model. Alternatively, rather than reflecting a learning process, ordering effects could be driven by respondents exhibiting satisficing behaviour. If respondents have already made a choice where they donated a lot, respondents who would have the impression that they have already reached a target would be less likely to donate similar amounts in subsequent rounds. However, we cannot disentangle the reasons behind the order effects.

5.5. CAP budget impacts

Our data can also be analysed from the perspective of the CAP managing authority interested in predicting the potential under- or overspending of the budget shifted from income support direct payments to eco-schemes. As mentioned, the treatment related to the decrease in initial income was framed to farmers as a reduction in income support direct payments from the CAP. The second level for the income variation framing were set to reflect a 35% allocation from income support direct

[19] An anchoring effect is possible in multiple elicitations for each respondent setting and the fact that respondents may be influenced by their prior answers (Longo et al., 2015). As highlighted by Ferraro and Messer (forthcoming) in the context of auctions for conservation contracts in the US the specific behavioural mechanism of the anchor could not be isolated. In case there were significant anchoring effects it would be relevant to assess the potential framing effects derived from the ascending versus descending patterns as concluded by Deshazo (2002).

Table A14
Test for anchoring by order of decisions.

Framing of variation	Treatment	Voluntary/ Total contribution (standard deviation) In 1st Decision	In 2nd Decision	In 3rd Decision	Difference among decisions[1,2,3]
Mandatory contribution	MAND_0	82.79/87.79 (49.56)	77.78/82.79 (47.38)	72.60/77.60 (44.21)	H = 1.999; df = 2; p-value = 0.368
	MAND_35	39.34/79.34 (28.64)	43.20/83.20 (33.04)	44.74/84.74 (42.73)	H = 0.508; df = 2; p-value = 0.776
	MAND_85	22.92/112.92 (35.95)	17/107 (20.64)	17.29/107.29 (21.29)	H = 0.212; df = 2; p-value = 0.899
Initial Net Income	INC_0	72.35/77.35 (39.13)	65.10/70.10 (41.38)	72.54/77.54 (47.53)	H = 2.237; df = 2; p-value = 0.327
	INC_35	58.77/63.77 (45.13)	49.41/54.41 (32.56)	48.08/53.08 (37.74)	H = 3.076; df = 2; p-value = 0.215
	INC_85	37.13/42.13 (42.30)	38.01/43.01 (43.65)	29.14/34.14 (32.23)	H = 2.094; df = 2; p-value = 0.351

[1] The statistical approach employed is the non-parametric Kruskal-Wallis omnibus test to assess whether or not the distributions come from different populations (statistically different). H is the test statistic for the Kruskal-Wallis test that under the null hypothesis the chi-square distribution approximates the distribution of H.
[2] To confer higher robustness to the main non-parametric approach results, we conducted also a traditional parametric omnibus test ANOVA (not reported). Despite the non-normality of the dependent variable, the sample size of the three experimental conditions, the homogeneity of variance (fulfilled in most comparisons), and the fact that we have a balanced experiment this test is usually robust under these conditions. The non-significance of differences is also supported by this test.
[3] Despite both non-parametric and parametric omnibus tests the reaped non-significant differences the post-hoc pairwise comparisons were estimated as a robustness check. Although not reported they are fully aligned with the omnibus test regarding the lack of any statistical difference Pairwise comparisons followed the non-parametric Dunn's post-hoc test using Bonferroni's correction to adjust the p-values for multiple comparisons to controlling the family-wise error rate.
Source: own elaboration.

payments to eco-schemes,[20] with respect to the first level. Therefore, assuming that the direct payments budget is unchanged, and that voluntary contributions to the environment in the experiment reflect the intensity of participation in eco-schemes, we can assess whether there is an under-subscription or oversubscription on the eco-scheme budget.

Starting from the first level of the 'income variation' framing treatment (net initial income 300 tokens and mandatory contribution 5 tokens), the second and third levels respectively release 35 and 85 tokens for ECS payments. We compare the eco-scheme budget with the voluntary contributions compensated at 90% which would represent the demand for eco-scheme payments. The final net income for farmers is calculated as the initial net income, minus the mandatory contribution to the environment minus 10% of the voluntary contribution (as this is compensated by additional payments at a 90% ratio). Table 6 summarizes the descriptive statistics of both variables.

In the first level, as there is no reduction in income support direct payments to fund eco-schemes, we see that there would be a deficit of 63 tokens to finance the compensation for voluntary contributions. More informative are the results of the second and third levels. For the second level of the income treatment, the budget needed to compensate for the voluntary contributions exceeds budget allocated to eco-schemes by 11.9 tokens. The reverse happens for the extreme reduction in the third level, where the budget needed to compensate for voluntary payments would fall 53.8 tokens below the available budget. Thus, if the management authority were to ensure budget neutrality when shifting funds from income support direct payments to eco-schemes, the compensation rate should be reduced in the second level, while in the third level it should be increased.

Table 6 also reports the total final net income for the two framing factor levels. Results for each treatment are as expected due to the experiment design (net final income falls as initial net income decreases due to lower direct payments or mandatory contributions increase), however it is interesting to highlight that there are significant differences between framing factors for the same initial level of disposable income. A Mann-Whitney test rejects the null hypothesis of equal distribution between framings for the second (MAND_35 vs INC_35) and third level (MAND_85 vs INC_85) (p-values < 0.01 for the second and third levels).

[20] Although a 25% minimum budget allocation of direct payments to eco-schemes is requested in the legislation, at least 10 countries have gone beyond the minimum requirement (DG AGRI, 2022).

6. Conclusions

The purpose of this paper was to better understand the balance between voluntary and mandatory agri-environmental policy interventions in the context of the EU CAP reform. This interaction was investigated under two complementary perspectives: (1) on the one side, by studying the impact of increasing mandatory adoption on voluntary adoption, (2) on the other side, by looking at the impact of a decrease in income support which would be needed to finance the compensation of voluntary adoption. We also aimed to explore the role of two behavioural factors, environmental concern and trait reactance.

Regarding mandatory contribution, the findings reported in this study illustrate that behavioural policy interventions to promote sustainable behaviour can be ineffective, or even backfire (Sunstein, 2017). The intention of increasing farmers' mandatory contributions to the environment is to increase total contribution (i.e. total environmental benefits). However, we found that, for *moderate increases*, total contribution remains stable because farmers decrease their voluntary contributions by the same magnitude. In other words, low mandatory contribution increases perfectly crowd out voluntary contribution. A large increase in mandatory contribution does lead to higher total contributions to the environment, even if there is a strong decay in voluntary contribution. However, given the limited number of levels tested, we cannot assess whether this effect applies to all levels of mandatory contribution. In an experiment with the general population, Bruns & Perino (2021) find that a moderate mandatory contribution to the environment does increase total contribution. In their design, the amount of mandatory contribution is set close to the amount of voluntary contribution as measured before the mandate is imposed. Thus, a smaller increase in farmers' mandatory contribution to the environment could also increase their voluntary contribution.

Regarding income, we find that a decrease in farmers' income resulting from a budget shift from income-support direct payments to eco-schemes leads to lower voluntary contributions to the environment, both in absolute and relative terms. This finding challenges results from *meta*-analyses in dictator games on the effect of varying initial endowment on relative donations (Engel, 2011; Larney et al., 2019). More interestingly, we consistently find that increases in mandatory contributions crowd out voluntary contributions more than equivalent decreases in income. This would be in line with Eckel & Grossman (2003) who find an impact of alternative ways to subsidize charitable giving, achieving higher contributions with matching funds than with tax rebates. In their discussion they argue that one possible explanation for this would be the impact of the warm glow of giving (i.e. being able to voluntarily contribute and not being forced to it) beyond the benefits of the environmental good per se. However, our findings could be driven not only by the policy framing but also by unobserved heterogeneity potentially related to the varying level of environmental benefits between the two framings of variation.

We find mixed results regarding the behavioural factors included in the study. Environmental concern does not explain farmers' contribution to the environment in the experiment. This finding may be due to a number of reasons. First, the largely compensated (90%) nature of the environmental contribution might have toned down the ecological aspect. Second, farmers may have not seen the environmental benefits of the contribution in the experiment. While the first explanation cannot be tested with our data, the second can be partly discarded as more than 75% of the participants declared that the agreed with the statement that "I believe in the environmental benefits of this programme" and this variable was positively correlated with the contributions (see Table A10 in the annex).

Regarding reactance, we find somewhat puzzling results. When analysing all three decisions together, we find a positive relationship between reactance and voluntary contributions together with a negative impact when interacted with the income variation framing. However, when we focus only on first decisions, these impacts are no longer significant and we find a negative interaction between reactance and the level of mandatory contributions. The latter is more in line with what we find in the literature where reactance plays a more prominent role the more freedom is restricted.

Interestingly, we find that farmers in our sample are willing to contribute a significant proportion of their income (10.8% – 28.1%) to the environment, even though they were not fully compensated. This finding challenges the widespread view that farmers will not switch to sustainable practices if the payment levels do not (fully) offset the costs of adoption (Piñeiro et al. 2020). However, this finding probably also shows that the administrative burden that farmers must face for claiming the compensation for enrolling into voluntary schemes plays a major role in their decision. In our experiment, there was no administrative cost and no delay to obtain the compensation.

6.1. Policy implications

The analysis of the current voluntary agri-environmental measures brings out that they are moderately effective in improving the environmental performances of participating farms, although the costs appear extraordinarily high (Bertoni et al. 2020). Take up of voluntary agri-environmental measures is limited (Hasler et al. 2022). Expectations of the broader EU public about the roles of agriculture do not support unconditional subsidies focused primarily on production and farm income (Pe'er et al. 2019), given the conflict between their environmental and income support objectives. Escalating natural losses on agricultural land call for a reform to meet higher environmental objectives, with a cost-effective mix of voluntary and mandatory measures. Our paper contributes to a long-standing academic debate regarding the sustainability performance and productivity of income-support payments conditioned to the mandatory adoption of baseline environmentally friendly agriculture (Galli et al. 2020; Khafagy and Vigani, 2022). We show that higher mandatory standards shall ensure wider adoption of agri-environmental practices, by aligning income coming from direct payments with higher environmental requirements. This argument is in line with scholars' calls for transformation of direct payments into payments for public goods (Pe'er et al. 2020; Scown et al. 2020).

Our results show that higher contributions to the environment can be obtained from willing contributions to the environment when having more income than from making farmers comply with higher mandatory ones. However, upcoming changes in CAP will involve both lower income due to reduced income support direct payments and higher mandatory contributions due to enhanced conditionality. This combination will reduce farmer voluntary contributions to the environment. The effect on total contribution will only be positive if the increase in conditionality is higher than the shift of budget to eco-schemes, as shown by the relative size of mandatory and voluntary framing variables in Table 5 for total contribution (0.255 / 0.457). However, due to the experimental design we cannot fully attribute this to the change in the policy as both types of intervention also differ on the level of environmental benefits provided. We also find that the impacts of variation of income and mandatory contributions are not linear and that as changes in income and mandatory contributions grow the relative size of the framing variables is reduced, however the difference in the effect of both instruments remains.

Therefore, even when farmers seem to be willing to contribute to the environment, when facing reduced incomes, total contributions to the environment will only increase if there is an increase in the level of mandatory ones. The findings concerning mandatory contribution suggest that only a strong increase of the mandatory layer of the CAP could provide higher total contributions to the environment, but our experimental design does not take into account that this conditionality will give access to lower income support. As in our sample 22% of total farm income comes from direct payment (66 tokens) shifting 25% of the income support direct payment budget to finance eco-schemes entails a reduction in income of 16.5 tokens. Our results predict that such a reduction in income would lead to a reduction of 7.5 tokens of voluntary contributions (-16.5 times 0.457). In order to compensate for such a reduction, mandatory contributions should increase by nearly 30 tokens in order to maintain total contributions constant (7.5 divided by 0.255). This is a six-fold increase compared to our initial situation of five tokens as mandatory contribution.

While we have mainly interpreted the findings regarding mandatory contribution from the perspective of an *increase* in environmental regulations, one may also look at these findings from the perspective of *decreasing* mandatory contributions. This would correspond to agri-environmental deregulation. Looking at the findings from this perspective, we see that a decrease in environmental obligations increases voluntary contributions, with the potential to leave total contributions unchanged or even increased if farmers' income increases.

6.2. Limitations and future research

Our study presents several limitations that call for further research. First, the findings regarding the impact of the intervention framing factor discussed above should be taken as an upper bound of the real impact of a pure policy intervention change. As mentioned, the implementation of the intensity of variation factor (0, +/-35 and +/-85) in the different levels of the framing factor (MAND and INC) does not only differ on the nature of the policy but also in the level of environmental benefits associated to them. In the real world, farmers are aware that the reduction in income support leads to more budget for ECS and thus indirectly environmental benefits.

Despite the context provided in our experiment, the highly stylised nature of the decision that participants took entailed that important other factors were not considered. For instance, participants in the behavioural game made their decisions in social isolation. In real life, other farmers' decisions can strongly affect the adoption of sustainable farming practices (for instance, Kuhfuss et al. 2016). Furthermore, in the experiment, the perception of costs and benefits of the adoption of sustainable practices was very salient and transparent (i.e. number of tokens contributed to the environment, compensation for voluntary contribution) and there was no risk involved. In real life, many biases may distort the perceptions of costs and benefits (for a review, see Dessart et al. 2019). Finally, unlike in real life, participants' made only three decisions (meant to be independent from one another thanks to the real incentives scheme) leaving aside potential long-term positive learning effects and the formation of new habits, which evidence shows plays a role in the adoption of certain sustainable practices, such as crop rotation (Ward et al. 2016). In short, the simplified context and decision task in our experiment may question the parallelism and external validity of the results. Field experiments with a higher degree of external validity should ideally attempt to replicate our findings.

The fixed compensation for voluntary contributions might also drive our results. One could vary the compensation levels in a future study to see whether these are robust to this parameter (see Andreoni & Miller, 2002 for a framework). Again in real life the level of compensation that eco-schemes provide to farmers are most likely to be heterogeneous.

Some of the counterintuitive or unexpected findings from our research also call for further investigation. The positive main effect of trait reactance on farmers' contribution to the environment (when pooling all three decisions) would deserve attempts at replication. The negative interaction effect of trait reactance with variations of income also calls for more research.

Last, our field work was undertaken during the COVID pandemic. Melo (2022) and Lotti and Pethiyagoda (2022) find an increase in donations when using dictator games during this period. While we believe that by focusing on differences between treatments and using a contextualized version of the dictator game the effects of COVID should be minor, confirming whether this is the case once the pandemic is over remains an open question.

CRediT authorship contribution statement

Jesus Barreiro-Hurle: Conceptualization, Formal analysis, Investigation, Methodology, Software, Data curation, Visualization, Validation, Writing – original draft, Writing – review & editing, Supervision. **Francois J. Dessart:** Conceptualization, Investigation, Methodology, Data curation, Validation, Funding acquisition, Project administration, Writing – review & editing, Supervision. **Jens Rommel:** Conceptualization, Formal analysis, Investigation, Methodology, Software, Data curation, Validation, Writing – review & editing. **Mikołaj Czajkowski:** Conceptualization, Formal analysis, Investigation, Methodology, Software, Validation, Writing – review & editing. **Maria Espinosa-Goded:** Conceptualization, Formal analysis, Investigation, Methodology, Software, Validation, Writing – review & editing. **Macario Rodriguez-Entrena:** Conceptualization, Investigation, Methodology, Validation, Writing – review & editing. **Fabian Thomas:** Conceptualization, Investigation, Methodology, Validation, Writing – review & editing. **Katarzyna Zagorska:** Conceptualization, Investigation, Methodology, Validation, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A

See Table A1, Table A2, Table A3, Table A4, Table A5, Table A6, Table A7, Table A8, Table A9, Table A10, Table A11, Table A12, Table A13, Table A14.

Appendix B. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.foodpol.2023.102481.

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