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Adoption of environmentally-friendly agricultural practices under background risk: experimental evidence

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Résumé : A l'aide d'une expérience de terrain contextualisée avec des étudiants en agriculture français, nous analysons l'impact du risque de fond sur l'adoption de pratiques agro-écologiques et évaluons comment un paiement incitatif de type mesure agro-environnementale ou paiement vert peut influencer les décisions d'adoption dans un tel environnement risqué. Alors que le caractère risqué des pratiques a l'effet négatif attendu sur le taux d'adoption, nous montrons que le risque de fond a aussi un impact dissuasif. Le paiement incitatif a un impact positif, mais celui-ci est quasiment nul dans les agriculteurs font face à la fois à un risque de fond et un risque sur les pratiques. Les résultats mettent en lumière les synergies potentielles entre le verdissement de la PAC et le soutien aux instruments de gestion des risques.

Abstract: Using a framed field experiment with French agricultural students, we analyse the impact of background risk on decisions to adopt environmentally-friendly practices and evaluate how incentive payments can influence adoption decisions in such a risky environment. While a foreground risk impacting only green practices has an expected detrimental impact on adoption, background risk also discourages farmers. The incentive payment has a positive impact on adoption but is significantly less efficient in the presence of both foreground and background risks. Results shed light on potential synergies between greening the CAP and strengthening CAP support to farm risk management.

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1. Introduction

Among the prime challenges facing EU agriculture and its common policy post 2020, one is to go further into the adoption of environmentally-friendly agricultural practices and sustainable land management (European Commission 2017b). This requires discussion on how to incentivize farmers to manage the environment better, in an efficient and effective way.

There is a large body of literature in agricultural economics on the determinants of environmentally friendly farming practices adoption. Two main barriers to adoption are generally mentioned: First, farmers support private costs to implement environmentally friendly practices, but the ecosystem services generated benefit to all, therefore leading to the well-known problem of under-provision of the public good (Ledyard 1995). Second, environmentally friendly farming practices such as reduced tillage, reduction of pesticide use or longer rotation can be perceived as risk increasing. Because farmers are risk averse, this reduces the adoption of agro-environmental practices (Acs et al. 2009).

Farmers can choose to avoid the foreground risk associated with environmentally-friendly practices by not engaging in those practices, but the agricultural activity is particularly risk-prone given that farmers can manage only some part of the production process while natural conditions beyond the farmer's control also have a significant impact[2]. The resulting variations in farm output, combined with a relatively low price responsiveness of supply and demand, also cause agricultural markets to be rather volatile (Tangermann 2011). Over time, technological progress such as irrigation, pesticides and fertilization has allowed agricultural producers to improve the degree to which they can manage the influence of natural factors. But in the case of catastrophic risks, the instruments available on the farm and the household or the market instruments such as hedging or insurance do not allow to pool or shift the risk (OECD 2009). Some risks have simply to be borne. These risks are called 'background risks' precisely because they are part of the environment where decisions are taken. The agricultural industry faces a level of exposure to background risks that does not exist in many other industries (Herberich and List 2012). Taking into account the background risk to which individuals are exposed can significantly improve our understanding of behavior under risk in many contexts, including the decision to adopt risky environmentally-friendly practices.

The objectives of the paper are twofold. First, we analyse the impact of background risk on decisions to adopt environmentally-friendly practices (whether they are risky or not). Second, we evaluate how incentive payments, such as those proposed under the first and second pillars of the CAP: the green payment and agri-environmental schemes, can influence decisions in such a risky environment.

To answer the above questions, we conducted a framed field experiment with 124 French agricultural students of the Pays de la Loire region based on a public good game. We chose a public good game to capture the ecosystem services provided by environmentally-friendly practices, such as pollination services or biocontrol, providing public good benefits for the community. Participants decide how much of their land they would like to farm according to conventional (corresponding to the private

2 Risk and uncertainty are used interchangeably in this article since with the widespread acceptance of probabilities as subjective beliefs, the distinction between risk and uncertainty is meaningless (Moschini and Hennessy 2001).

account) or to environmentally-friendly practices (corresponding to the public account). Environmentally-friendly practices provide ecosystem services but entail an opportunity cost for farmers and can bring riskier private returns. According to their treatment group, participants face foreground and/or background risk. In this article, we refer to "foreground risk" to mention the uncertainty on the cost of implementation of environmentally friendly farming practices, while "background risk" correspond to the uncertainty on the yields and prices for agricultural output, for example due to climatic events, that is affecting all agricultural output independently from the choice of practices. These two sources of risks are considered as independent. Before the public good game, we have run two complementary tasks to elicit risk aversion and social preferences. The game is contextualized in order to capture the context of European agriculture and the subject pool consists of stakeholders (students in agriculture). The main arguments supporting the use of an experiment to address our research question are developed in the next section.

Our contribution is twofold: first, we analyse the adoption of agri-environmental practices and the effect of agri-environmental subsidies in a context of multiple risk sources: foreground risk and background risk. While many theoretical and empirical studies analyse the role of foreground risk and risk aversion on input choices, technology and insurance adoption, most of the empirical and theoretical models describing farmers' decisions ignore background risk (see next section).

Second, we contribute to the experimental literature by analyzing the role of background risk in cooperative games, where strategic uncertainty already represents a source of risk[3]. To do so, we introduce background risk in a public good game. While previous experimental studies based on public good games have analyzed the combined impact of environmental (foreground) risk and strategic uncertainty (Dickinson 1998, Gangadharan and Nemes 2009, Levati, Morone, and Fiore 2009, Levati and Morone 2013), none of them have studied the impact of background risk. Other experimental studies have focused on the impact of background risk on willingness to take risks, but in individual games (Harrison et al. (2007), Lusk and Coble (2008), Lee (2008), and Beaud and Willinger (2014)). To our knowledge, no published experimental study has focused on the impact of background risk in cooperation games.

The next section provides background information based on a literature review. Section 3 describes the design of the experiments, and section 4 the theoretical predictions. Results are presented and discussed in Section 5. Finally, the conclusions are presented in the last section.

3 Strategic uncertainty refers to the uncertainty attached to other group members' response (Messick., Allison and Samuelson, 1988).

2. Background

Methodologies for policy evaluation have made several major advances in the past decades and economic experiments are at the forefront of these recent methodological developments, in particular for agricultural policy evaluation (Colen et al. 2016). We first review two main arguments supporting the use of an experiment to address our research question. Then, we present a review of the literature on the impact of background risk on willingness to take risks in the agricultural sector but also more generally, as well as the impact of risk on the voluntary contribution to a public good.

In agricultural policy evaluation, greater attention is nowadays paid to identifying cause-effect relationships of policies. In an economic experiment, data that are generated in a controlled setting, with a randomized assignment of participants to treatment and control groups. This allows for a clear identification of the impact of several explanatory factors and causality. To answer our research question, it is important to distinguish the impact of foreground risk, background risk and strategic uncertainty. In the real world, farmers face uncertainty about the economic consequences of their actions due to their limited ability to predict things such as weather, prices and biological responses to different farming practices, but also strategic uncertainty associated with the efforts of other land managers in the provision of environmental services. But these sources of risks are not necessarily independent and naturally occuring data do generally not allow to disentangle the impact of several explanatory factors, contrarily to experimenter-generated data.

Second, behavioral studies have highlighted the need to account for elements of the decision context beyond the simple profit maximization assumption, in order to predict economic agents' responses to different policy instruments. Risk is widely seen as an issue of critical importance to understand farmers' decision making and to evaluate policies affecting those decisions (see for instance Tevenart et al. (2017) or Liu and Huang (2013)). Several authors showed that farmers tend to have a risk averse behavior rather a risk seeking one (see for instance Binswanger (1980), Chavas and Holt (1996) and Bougherara et al. (2017)). Farm level mathematical programming models have started to account for farmers' risk aversion, by relying on complex utility functions going beyond profit maximization. However a critical assessment of the literature performed by Pannell, Malcolm and Kingwell (2000) reveals that "the aspects of agricultural risk most commonly modeled are often issues of secondary importance in determining how farms are managed". Moreover, those models ignore background risk. For example, in their model aiming at understanding low adoption of agri-environmental measures, Ridier et al. (2013) assume that yield risk due to climate variability is the only source of risk. They voluntarily ignore market risk in order to focus on the risk of implementing new farming practices. Experimental measures of decisions in risky context are model-free, in the sense that they do not require auxiliary assumptions about the shape of the utility function and perception of probabilities (Noussair, Trautmann and van de Kuilen 2014). This allows to account for more complex and diverse sources of risk. Here it allows us to account for both foreground and background risk.

Beyond the foreground risk associated with environmentally-friendly practices, we are interested in the impact of background risk on the adoption of such practices. Theoretical literature has analyzed whether the presence of background risk lead to more or less cautious behavior. Relying on von

Neumann and Morgenstern's (1944) expected utility (EU) theory, Gollier and Pratt (1996) have identified the structure of individuals' preferences guaranteeing that an individual is risk vulnerable, i.e. he behave in a more cautious way if an actuarially neutral background risk is added to his or her initial wealth. While risk vulnerability as defined by Gollier and Pratt (1996) implies decreasing absolute risk aversion (DARA), Quiggin (2003) showed that, for the wide class of risk-averse generalized expected utility preferences that exhibit constant risk aversion, an individual who is exposed to background risk would be willing to take more foreground risk. Because alternative theories have different predictions about the impact of background risk on risk-taking behavior, experiments can help to know whether most persons are risk vulnerable or not. Laboratory and field experiments conducted by Harrison et al. (2007), Lusk and Coble (2008), Lee (2008), and Beaud and Willinger (2014) all support the risk vulnerability conjecture: an individual who is exposed to background risk would be willing to take less foreground risk. The only available study on farmers is by Herberich and List (2012) who have run a similar experiment than Harrison et al. (2007) comparing US farmers and students. While they were expecting farmers to be more risk tolerant given the added background risk present in the agricultural industry (either through sorting or experience over time), they found that farmers were slightly more risk averse than students but obtained no conclusive results with regard to the impact of background risk on risk aversion.

This literature focuses on individual decisions and strategic uncertainty is therefore absent. However, to answer our research question, it is important to account for the strategic uncertainty associated with cooperation. Indeed, adopting environmentally-friendly practices can be seen as a contribution to a public good, given the ecosystem services that can be provided by such practices.

In the experimental literature applied to environmental issues, several authors have analyzed whether individuals contribute voluntarily to public goods when they are exposed to different kinds of risks and uncertainties (Dickinson 1998; Gangadharan and Nemes 2009; Levati, Morone and Fiore 2009; Levati and Morone 2013). Contrarily to previous studies, Gangadharan and Nemes (2009) have kept the strategic uncertainty constant across treatments in order to study properly the effects of random external factors (environmental uncertainty). They found that risky marginal returns from a public good lower contributions significantly. However, they did not find that elicited risk aversion provides a consistent pattern of behavior in the public good game. Levati and Morone (2013) have shown that the impact of environmental uncertainty depends on the employed parametrization. They compared a control treatment with a known marginal per capita return (MPCR) to a treatment with a risky MPCR, but where the MPCR is still such that contributing to the public good increases efficiency even in the worst state of nature. With such parameters, they found that contributions in the risk treatment is not significantly different from contributions in the control treatment.

To our knowledge, whether an individual exposed to background risk would be less willing to take a decision involving strategic uncertainty, such as contributing to a public good, remains an open question. No theoretical nor experimental article has focused on the impact of background risk in cooperation games. Our experimental design allows to answer this question by testing whether background risk reduces contribution to a public good, both with fixed and risky marginal returns.

3. Experimental design

We conducted a framed field experiment with 124 French agricultural students based on a public good game. We chose a public good game to capture the ecosystem services provided by environmentally-friendly practices, who provide benefits for the community. This also allows us to analyze the impact of background risk on decisions involving strategic uncertainty.

The game

Each participant forms part of a group of n=2 players[4] and disposes of L hectares. Participant have to divide this land L between ‘‘green farming” (gi) and ‘‘conventional farming”. Given that green farming is benefiting to the group (through ecosystem services), the individual payoff depends on both their own contribution to green farming and the total area farmed with green practices in the group. The adoption of environmentally-friendly practices can be supported by an incentive payment scheme: s per hectare. One can think of the agro-environmental payment of the rural development policy and the green payment in the first pillar of the CAP as two examples of incentive payments per hectares conditional to the observance of certain environmental standards or practices. The payoff function is:

$$\pi_i = bL - c_c(L - g_i) - c_g g_i + \beta \sum_{i=1}^{2} g_i + s\, g_i$$

The net private benefits from farming depends on the financial yields (*bL)*, minus the costs multiplied by the number of hectares farmed with each type of practices.

The financial yields pr hectare *b* include the price, the yield and the base CAP payment, and are the same for both types of practices. The justifications for this assumption are threefold: i) most environmentally friendly practices do not provide access to different market opportunities and prices for the products since they cannot be labeled or certified. Only well-known systems of good agricultural practices such as organic farming benefit from price premiums (Bazoche et al. 2013); ii) There is no consensus on the impact of environmentally-friendly practices on yields and yields variability, notably because yield level has many determinants interacting with each other. For example, Lechenet et al. (2017) showed that using agro-ecological practices in order to reduce pesticide use does not impact productivity; iii) Apart from the obligation of keeping land in good agricultural and environmental conditions, CAP direct payments (base payment) are unconditional to farm practices. However, environmentally-friendly practices are assumed to be on average costlier ($c_g > c_c$), since alternative management strategies can be more labor consuming. For example, integrated pest management strategies, such as those based on crop diversification and rotations, are

4 While in reality the ecosystem services can benefit to a larger perimeter where several farmers are operating, we have used the smallest possible group (2) to simplify the experiment. There is a large literature on the effect of group size on contributions in public good games. For instance, Isaac et al. (1988) found no difference between groups of 4 and groups of 10 people. To our knowledge, there is no experimental evidence on the differences in the behaviors of individuals interacting in pairs (in a prisoners’ dilemma) and in groups of 4 persons.

time and information/knowledge intensive, compared to pesticide-based pest management strategy as used in conventional agriculture (Guillou et al. 2013; Lefebvre, Langrell and Gomez-y-Paloma 2015).

When one unit of land is environmentally-friendly farmed, βG points are earned by each farmer of the group, with β the ‘‘efficiency factor’’ of the green land, corresponding to the ecosystem services associated with the green practices. For example, maintenance of hedges can favour pollination services or biocontrol (Cranmer, McCollin and Ollerton 2012; Morandin and Kremen 2013; Griffiths et al. 2008; Lefebvre et al. 2017). The experiment corresponds to an impure public good game (Narloch, Pascual and Drucker 2012; Midler et al. 2015). Indeed, contributions to the public good generate collective benefits β, but also provide private benefits: b- c_g.

A profit maximizing farmer will adopt green practices and therefore contribute to the public good only if the extra profits associated with the sum of the monetary value of the ecosystem services generated by the green practice adoption and the subsidy are compensating the extra costs of these practices $\beta+s > c_g - c_c$. On the contrary, if $\beta+s < c_g - c_c$, farmers will choose not to adopt green farming practices. In addition, if $2\beta+s > c_g - c_c$, it is socially optimal that both farmers choose to adopt green practices on all their land. As a consequence, when both these conditions are satisfied, that is if $\beta+s < c_g - c_c$ and $2\beta+s > c_g - c_c$, the game represents a social dilemma.

Treatments

The two main treatment variables in our experiment are the nature of the risk faced by participants (between-subject treatment variable) and the presence of the incentive payment to foster adoption of environmentally-friendly practices (within-subject treatment variable). We are not interested in measuring the impact of a change in the risk environment for a given individual, but on the impact of accounting for background risk when analysing the impact of an incentive payment on the adoption of practices. Therefore, the between-subject design is more appropriate to analyse the impact of the treatment variable “nature of the risk”.

Participants are randomly allocated to one of the four between-subject treatments differing by the nature of the risk. In the benchmark treatment, participants know the value of the parameters c_g and b. In the other experimental treatments, we introduce risk on these parameters, but they keep the same expected values. Specifically, in the foreground risk treatment (ForeOnly), the adoption of environmentally-friendly practices is risky since costs are unknown: participants are informed that c_g can be either $\underline{c_g}$ or $\overline{c_g}$, each with probability ½. In the treatment with background risk only (BackOnly), participants are informed that the market benefits b can be either $\underline{b}$ or $\overline{b}$, each with probability ½. This background risk captures both production uncertainty on yields, price uncertainty, as well as policy uncertainty regarding the size of direct payments, impacting all the farm land independently from agricultural practices.[5] In other words, the background risk impacts both the private and the public goods. There is no foreground risk, therefore assuming that environmentally-

5 Among the manifold types of risk in agriculture, variability of output quantities and output price fluctuations are generally considered the most important elements by farmers, with price risk ranking highest in nearly all studies (OECD, 2009, p. 145).

friendly practices are not riskier than conventional ones. The fourth treatment (Fore&Back) corresponds to the realistic situation where farmers face both foreground and background risk, and these risks are independent. In all treatments, strategic uncertainty is kept constant by keeping constant group size, anonymity in the group and marginal incentives to contribute to the public good as in Gangadharan and Nemes (2009).

All participants take two decisions: first without any policy instrument ($s=0$), then with an incentive payment ($s>0$). We do not control for order effects since we are not interested in the impact of the withdrawal of this support, which would be a very unlikely policy scenario.

Parameters

We attempted to respect the same order of magnitude as an average farm in the Pays de Loire region since most students come from the region. The regional average farm size is 79.2 ha (Agreste 2017). Moreover, we have chosen the lower and higher values for the financial yields (b) and the cost of environmentally-friendly practices (c_g) such that the background risk ($Var(b)=25$) is more important than the foreground risk ($Var(c_g)=4$). Last but not least, we chose the parameters s, β, c_g and c_c such that there is a social dilemma in the absence of public policy intervention but the introduction of a subsidy $s=2$ solves this dilemma, as it is supposed to be the case with European agri-environmental measures that cover up the opportunity cost of adopting green practices. All parameters values are available in Table 1.

Table 1: Treatments and parameters

Treatments between-subject	L	b	c_c	c_g	β	Nb of participants	No policy scenario	Policy scenario
Benchmark	80	15	4	7	2	26	s=0	s=2
ForeOnly	80	15	4	5 or 9*	2	29		
BackOnly	80	10 or 20*	4	7	2	39		
Fore&Back	80	10 or 20*	4	5 or 9*	2	30		

Note: *equally probable

Experimental procedure

The sample chosen for this experiment is made of full-time students in agriculture (since at least 2 years) of the Pays de la Loire region. While lab experiments with university students remain common, a growing number of experiments involve samples of professionals. The potential reasons to behavioral differences are: the distribution of social preferences (Carpenter and Seki 2011), familiarity of the subject with the topic (Frechette 2011) and self-selection issue. Professionals tend to be more prosocial than students in lab experiments (Fehr and List 2004; Bellemare and Kröger 2007; Belot, Duch and Miller 2010). Ferre et al. (2017) is the first study to compare professionals (farm apprentices) with students in a contextualized experiment related to farming. We rely on stakeholders and a contextualized experiment because we believe the experimental context can trigger signals that do matter to the decision-making process.

The experiment was run in May 2017. It was presented to participants in one of their class. Participation was highly encouraged given that one question of the final exam was about the experiment. They had 7 days to complete it on-line. Participants were randomly assigned by the online platform to one of the four treatments when they first log-on.

At the beginning of the survey, participants were invited to read the instructions of the experiment explaining the different parts of the survey and the monetary incentives. In each part of the survey, they answered a quiz which tested their understanding of the instructions. The instructions are available under request.

The survey is made of five parts. First, before the public good game, we have run two complementary tasks to elicit risk aversion and social preferences. Risk aversion has been shown to have significant impact on decisions in public good games (Dickinson 1998), as well as in coordination game. Social preferences are also important drivers of contributions in public good games (Fischbacher and Gachter 2010; Balliet, Parks and Joireman 2009).

The first part of the survey aims at eliciting risk attitudes. The game is a lottery-choice task derived from the investment game (Gneezy and Potters 1997; Charness and Gneezy 2010). The participant receives an endowment of 500 points and is asked to choose what part of this endowment he would like to invest in a risky asset and how much to keep. The risky asset returns 2.5 times the amount invested with a probability of one-half and nothing with a probability of one-half. The participant keeps the points that he does not invest. The amount invested is then used as the measure of risk preferences. The relative simplicity of the method, combined with the fact that it can be implemented with one trial, makes it a useful instrument for assessing risk preferences in the field (Charness, Gneezy and Imas 2013) and we believe it is also suitable for on-line elicitation.[6]

In the second part, to measure social preferences, we have used the Social Value Orientation measure (Murphy, Ackermann and Handgraaf 2011). Participants are asked to participate in a set of dictator games where they have to share some amounts of money between themselves and another anonymous player.

The public good game is played in the third and fourth parts of the experiment. As said before, the same game was conducted twice, once without the incentive payment (part 3) and once with it (part 4).

We have chosen a "one-shot" design, which is a departure from the majority of public goods experiments, in which participants make repeated decisions in a single treatment with earnings

[6] A disadvantage of this method is that it cannot distinguish between risk-seeking and risk-neutral preferences because both risk neutral and risk seeking individuals should invest their entire endowment. However, since risk-seeking preferences appear to be relatively uncommon, and a fairly small fraction of participants choose to invest the entire amount of points, the amount invested provides a good metric for capturing treatment differences in attitude toward risk between individuals (Gneezy and Potters 1997; Charness and Gneezy 2010).

feedback provided between rounds. Our main motivation for the one-shot design was to rely on an asynchronous experimental design, which allows to loosen the constraint to have a large group of participants to participate at the same time. Moreover, as explained by Goeree et al (2002), the one-shot design allows to mitigate the possibility of reciprocity or strategic attempts to trigger others' reciprocity. Given the focus of the experiment on the impact of risk on the adoption of practices with public good properties, we did not want good or bad experiences with respect to others' contribution to the public good to influence the game.

To prevent prior attitudes and beliefs about the consequences on costs and yields of specific environmentally-friendly practices from influencing participants' behaviors, we chose not refer to a particular bundle of environmentally-friendly practices: environmentally-friendly practices are called "the purple farming system", by opposition to the "orange farming system". Participants are told the purple farming system is more environmentally-friendly, allows to maintain the same financial yield but is costlier.

Before taking their decision, participants could see two tables with their individual payoff and the additional group payoff. They were told that their total payoff is the sum of the individual and the additional group payoff. The individual payoff depends on the number of land units allocated to environmental-friendly practices by the participant, as well as the random draw(s)[7] in the treatments with risk. The additional group payoff due to ecosystem services depends on the total number of land units allocated to environmental-friendly practices in their group.

In the last part, qualitative and quantitative information was collected from the participants using survey questions.

Participants were informed that their decisions would affect the size of the earnings they would receive. Points earned in each part of the game are summed and converted at a known fixed rate into euros (200 points=1 euro). At the end of the experiment, in order to calculate the earnings, all participants were randomly matched in pairs and the computer realized the random draws. A multi-brand gift card was sent to each participant via ordinary mail with a credit corresponding to the winnings in the survey. Final earnings were thus between 9 and 23€, with an average around 16€. It took on average 30 minutes to complete the survey.

7 In treatments ForeOnly and BackOnly, the table with the individual payoff had 2 lines corresponding to the two possible outcomes of the draw. While in treatment Fore&Back, the table had 4 lines, corresponding to the four different outcomes combining the two draws.

4. Methods for data analysis

Hypotheses

We first draw the theoretical predictions of the game and then present the hypotheses tested. Table 2 shows the expected payoff according to the participant's decision and the other's decision (identical in all treatments).

Table 2: Expected payoff according to the participant's decision and the other's decision (in all treatments).

	No policy scenario						Policy scenario				
gi (self) \ gj (other)	0	20	40	60	80		0	20	40	60	80
0	**880**	860	840	820	800		880	900	920	940	960
20	920	900	880	860	840		920	940	960	980	1000
40	960	940	920	900	880		960	980	1000	1020	1040
60	1000	980	960	940	920		1000	1020	1040	1060	1080
80	1040	1020	1000	980	960		1040	1060	1080	1040	**1120**

Given the chosen parameters and in the absence of incentive payment and risk (Benchmark), choosing green farming practices instead of conventional ones represents an opportunity cost of c_g-c_c-β=*1* point per hectare. In addition, the public benefits arising from adopting green practices are uncertain since they depend on the decisions of the other member of the group. Therefore, participants' best private strategy is not to allocate any land units at all to environmentally-friendly practices (g_i=0) and to instead free-ride on others in order to earn the collective benefits. The Nash equilibrium is thus reached when both participants in the group farm all their land L with conventional practices (g_i=g_j=0). By contrast, the social optimum is reached when both group members allocate all their land units towards the environmentally-friendly farming practices (g_i=g_j=L), therefore creating a social dilemma. Accordingly, no contribution to the public good should be observed in the benchmark treatment in the no policy scenario. But previous experimental literature has shown that individuals contribute on average more to the public good than predicted by Nash equilibrium. We therefore expect a positive average number of hectares farmed with environmentally-friendly practices in the no policy scenario of the benchmark treatment.

The introduction of the incentive payment *s* changes the best strategy and thus the Nash equilibrium of the game. By compensating the opportunity cost of contributing to the public good negative (such that β + *s*> c_g - c_c), choosing g_i=80 becomes the best strategy in the benchmark treatment. The incentive therefore implements the social optimum as a Nash equilibrium.

When risk is introduced, the expected payoff of both players remains the same than in the benchmark. Thus, in the no policy scenario, the best private strategy of risk neutral participants is still not to allocate any land units at all to environmentally-friendly practices (g_i=0). However, risk aversion and risk vulnerability can explain differences across treatments. In the policy scenario, farming all hectares with environmentally friendly practices is the Nash equilibrium in all treatments.

On the basis of these theoretical predictions, the experimental evidence on the impact of foreground risk on contribution to public good games and the impact of background risk on risk taking behavior, the hypotheses tested are the following:

Hypothesis 1: Foreground risk reduces adoption of environmentally-friendly practices (comparison Benchmark-ForeOnly).

Hypothesis 1 reflect the fact that we expect participants to be, on average, risk averse.

Hypothesis 2: Background risk reduces adoption of environmentally-friendly practices in the presence of foreground risk (comparison ForeOnly-Fore&Back).

Hypothesis 2 reflect the fact that we expect participants to be, on average risk vulnerable. Similarly, we expect that they don't react the same way to strategic uncertainty in the presence of background risk, which leads to hypothesis 3 below.

Hypothesis 3: Background risk reduces adoption of environmentally-friendly even in the absence of foreground risk (comparison Benchmark-BackOnly).

Finally, we designed the subsidy in our experiment so that the social optimum becomes a nash equilibrium of the game. As a consequence, we expect the following:

Hypothesis 4: The incentive payment increases adoption of environmentally-friendly practices in all treatments (comparison part 3 "no policy scenario"-part 4 "policy scenario")

Tests and econometric models

The decision variable analysed is the number of hectares farmed with environmentally-friendly practices, i.e. the individual contribution to the public good.

First, we examine the differences across treatments using nonparametric tests. To measure the impact of background and foreground risk (H1, H2, H3), we relied on the Wilcoxon rank-sum two-sample test to compare the choices of participants in the four between-subject treatments. In order to analyze the impact of the incentive payment on the adoption of green practices (H4), and the way it might influence it differently depending on the risk contexts, we rely on a Wilcoxon matched pair test to compare the choices of participants without and with incentive payment.

Second, to find out what motivated decisions, we rely on a random effect panel tobit model, to account for the nature of the data (the number of hectares are left-censored at zero and right-censored at 80). We use random effects at the subject level to capture the unobserved heterogeneity between participants.[8] The variables are described in Table 5 and the results are shown in Table 6.

8 The difference in predictive performance between fixed and random effects are negligible (Merrett 2012)(Merrett 2012). However, Tobit random effects estimates are biased. Given that there is no substantial trade-off in performance and un-biasedness, random effects estimation is preferred over fixed effects for voluntary contribution mechanism model estimations as it has the advantage of being able to estimate time in-variant demographic variables.

5. Results and discussion

Our sample: descriptive statistics

124 agricultural students took part in the field experiment. The participants were on average 20 years old and 54% are male. The following numbers indicate that they are concerned with agriculture and can be considered as stakeholders. 58% of them have farmers in their closest family members (parents, siblings or parental siblings). 44% of them spend more than 30 days a year on a farm. 30% of them declare they will be farmers before their thirties, and 40% do not reject this option. Less than one third of the participants already know they do not want to become farmers in the future.

We classify the participants in four categories based on an index calculated according to their choices in the set of dictator games used as a measure of their social preferences: i) competitive players, who are willing to sacrifice their own payoff to lower the payoff of the other, ii) individualistic players, who just maximize their own payoff, independently of the impact on the other player, iii) pro-social players, who aim at maximizing the joint payoff of both players and iv) altruistic players who are willing to sacrifice their own payoff to improve the payoff of their partner. In our sample, we found 11% of competitive players, 42% of individualistic ones and 47% of pro-social players. This is similar to what have been found in Murphy, Ackermann, and Handgraaf (2011), even if we have slightly more competitive players.

With respect to risk aversion, we find that participants are willing to invest 43.4 % of their endowment in the risky option. This is slightly less than results of previous experiments), where subjects were found to invest in average 57.9% (Charness and Gneezy 2012).

No significant differences were observed in the socio-demographic characteristics, risk aversion and social preferences in the four treatment groups, suggesting that random allocation of participants to the different treatments had the desired effect.

On average over all treatment groups, the average number of hectares farmed according to environmentally-friendly farming is positive and equals to 50.64 ha. 95% of the participants allocated at least 20 hectares to the green practices in the no policy scenario. Our data suggest that most participants depart from payoff-maximization and voluntary contribute to environmentally-friendly farming, potentially due to their pro-environmental or pro-social preferences. This is true in all treatments.

In the sections hereafter, results are structured according to the hypotheses developed in the preceding section. Besides the treatment effect, the impact of other variables on decisions is also discussed.

Hypothesis 1: Impact of foreground on the adoption of green practices

In the presence of foreground risk (ForeOnly), participants allocated less hectares to the environmentally-friendly practices than those in the treatment without risk (Benchmark), as can be seen through the significant coefficient of the variable ForeOnly in Table 6. This is confirmed by the results from the non-parametric tests (Table 3). This result supports hypothesis 1 and confirm that participants are on average risk averse.

Hypotheses 2 and 3: Impact of background on the adoption of green practices

Participants allocated less hectares to the environmentally-friendly practices in the presence of both foreground and background risks (impact of the variable Fore&Back in Table 6) than in the treatment with only foreground risk (impact of the variable ForeOnly). This is confirmed by the results from the non-parametric tests (Table 3). This suggests that participants behave in a more cautious way in the presence of background risk, as stated by the risk vulnerability conjecture, and supports hypothesis 2.

We also observe that when environmentally-friendly practices are not risky, participants are still reluctant to engage in such practices in the presence of background risk (BackOnly). Participants also allocated less hectares to the environmentally-friendly practices in BackOnly than in Benchmark. This confirms our presumption that individuals may also be vulnerable to the presence of strategic uncertainty: in the presence of background risk, participants are less likely to engage in risky cooperation. Hypothesis 3 is supported by our results.

Strategic uncertainty is present in all treatments given the nature of the game. Therefore, we cannot reject the hypothesis that the more cautious behaviour observed in Fore&Back compare to ForeOnly is partly due to the vulnerability to the presence of strategic uncertainty.

Last but not least, it can also be noted that having both types of risk (Fore&Back) has a lower negative impact on contributions that the sum of the individual effect of each type of risk.

Table 3: Results of Wilcoxon two samples tests, with no policy

	ForeOnly	BackOnly	Fore&Back
Benchmark	z = 3.268 Prob>|z|= 0.0011***	z = 3.742 Prob>|z|= 0.0002***	z = 4.553 Prob>|z|= 0.0000***
ForeOnly		z = -0.183 Prob>|z|=0.8551-	z = 1.813 Prob>|z|=0.0698*
BackOnly			z = 2.140 Prob>|z|=0.0324**

The number of stars indicates the significance level : *** is significant at 1 %, ** is significant at 5 %, * is significant at 10 %, - is not significant.

Kruskal-Wallis equality-of-populations rank test (chi-squared = 41.771, prob = 0.0001): we can reject the hypothesis the four samples are from the same population.

Table 4 : Average number of hectares farmed with environmentally-friendly practices and results of Wilcoxon matched pair tests

	Benchmark	ForeOnly	BackOnly	Fore&Back
No policy scenario	63	50	50	41
Policy scenario	73	61	60	41
difference	z = -4.461 Prob>|z|=0.0000 ***	z = -3.691 Prob>|z|=0.0002 ***	z = -3.488 Prob>|z|=0.0005 ***	z = -0.570 Prob>|z|=0.5686 -

Hypothesis 4: Impact of the incentive payment

Participants allocated significantly more hectares to the environmentally-friendly practices in the policy scenario than in the absence of incentive payment in all treatments but Fore&Back (tests' results in Table 4 and impact of the s variable in Table 6).

However, the average number of hectares allocated to green farming is lower than the Nash equilibrium: risk neutral participants are expected to farm all their land with environmentally-friendly practices in the policy scenario given that the parameter for the incentive payment (s=2) was chosen such as to implement the social optimum as a Nash equilibrium. In the policy scenario, while 73% of the participants choose to farm all their land with green practices in Benchmark, this number drops in the presence of foreground risk (38%), background risk (44%) and both risks (23%). This confirms that participants are not risk neutral.

We have included in the econometric model interaction terms between the payment variable and the treatment variables. The interaction term is significant only in Fore&Back and nearly cancel the average impact of the payment. The absence of significant impact of the incentive payment in the treatment with both risks (Fore&Back) suggests that a fixed subsidy is not sufficient to encourage adoption of risky environmentally-friendly practices in the presence of both sources of risk. Hypothesis 4 is therefore only partially supported.

Table 5: Summary of the dependant variables used in Table 6

Name of the variable	Description	Statistics
Benchmark ForeOnly BackOnly Fore&Back	1 if the subject is assigned to the treatment with no risk (Benchmark), foreground risk only (ForeOnly), background risk only (BackOnly) and both types of risks (Fore&Back). The Benchmark treatment serves as reference.	
s	1 if there is an incentive payment, 0 otherwise	
s x Benchmark s x ForeOnly s x BackOnly s x Fore&Back	Interaction term between treatment variables and the payment variable *s*	
prosocial	1 if the subject is prosocial according to the social value orientation measure, 0 otherwise	0: 53.23% of the sample 1: 46.77%
s x prosocial	Interaction term between the SVO measure and *payment*	
RA_centered x ForeOnly RA_centered x BackOnly RA_centered x Fore&Back	Interaction term between treatment variables and *RA_centered. RA_centered* is the number of point invested in the risky asset in the risk aversion elicitation task minus the median number of points invested in the risky asset (300).[9]	mean: -17.24 sd: 80.22 min: -250 max: 200
agriconcern	Score between 0 and 3, based on the sum of the three components: - Family members: 1 if the participant has farmers in his/her family (father, mother, siblings, uncle, ant), 0 otherwise - Time spent on a farm: 1 if the participant spends more than 60 days per year on a farm, 0 otherwise - Future plans: 1 if the participant plans to become a farmer	0: 38.71% 1: 22.58% 2: 19.35% 3: 19.35%
impact_envt	1 if the subject thinks agricultural practices have a very negative impact on the environment, 2 a rather negative impact, 3 a rather positive impact, 4 a very positive impact	1: 8.87% 2: 64.52% 3: 24.19% 4: 2.42%
submitdate_diff	Difference in number of days with the log-in time of the first participant to the survey	mean: 3.83 sd: 2.18 min: 0 max: 6.42
interviewtime	Time in second between first login and submission date	mean: 1729.958 sd: 992.4071 min: 688.78 max: 9074.2

[9] This variable allows to observe the effect of risk aversion in the presence of risk. Without centering this variable, once could not measure the specific effect of the treatment variables given that RA (the number of point invested in the risky asset in the risk aversion elicitation task) is never equal to 0 in the sample.

Table 6: Results of the regression models (coefficient and statistical significance, random effects panel tobit)

VARIABLES	number of hectares farmed with environmentally-friendly practices	sigma_u	sigma_e
ForeOnly	-20.52**		
	(9.096)		
BackOnly	-20.63**		
	(8.313)		
Fore&Back	-32.35***		
	(8.807)		
s	28.86***		
	(8.353)		
s x ForeOnly	-9.054		
	(10.16)		
s x BackOnly	-7.031		
	(9.587)		
s x Fore&Back	-23.69**		
	(9.972)		
prosocial	14.44**		
	(5.704)		
s x prosocial	-10.86*		
	(6.295)		
RA_centered x ForeOnly	-0.0147		
	(0.0592)		
RA_centered x BackOnly	-0.0318		
	(0.0638)		
RA_centered x Fore&Back	-0.0560		
	(0.0578)		
agriconcern	2.799		
	(2.318)		
impact_envt	-6.208		
	(4.374)		
interviewtime	0.00168		
	(0.00249)		
submitdate_diff	-3.024***		
	(1.154)		
Constant	85.97***	20.46***	22.33***
	(13.23)	(2.721)	(1.783)
Observations	248		
Number of id	124		
Rho	.4592736	.0832102	
Log likelihood	-813.28461		
Wald chi2(14)	67.01		
Prob > chi2	0.0000		

Note: 10 left-censored observations, 155 uncensored observations, 83 right-censored observations
The Chi2 values provide evidence of the models' explanatory power. Standard errors are in parentheses beneath coefficient estimates. The number of stars indicates the significance level :
*** is significant at 1 %, ** is significant at 5 %, * is significant at 10 %.

Impact of other variables

Besides treatment effects, the random effect tobit results allow to comment on the impact of other variables on the decisions. We have collected socio-demographic and attitudinal variables, as well as information on how participants see their future in farming.

Previous studies have documented the impact of how responsible the participants felt for the environment (Beedell and Rehman 2000), but we did not observe any effect of the variable measuring whether the subject thinks agricultural practices have a positive or negative impact on the environment.[10]

The overall level of concern for farming has no explanatory power neither. We build the individual variable "agriconcern" accounting for the presence of farmers in the family of the participant, the yearly time spent on a farm, and whether he plans to become a farmer in the future. Even if participants have different background and plans for their future, it does not impact their decision in the experiment. This may be due to the high homogeneity of the sample.

We then focus on the discussion of the significant impact of risk attitudes, pro-social preferences and response time.

In the farm management context, the risk attitude influences decisions related to input use such as fertiliser or pesticides (Roosen and Hennessy 2003; Liu and Huang 2013) and technology adoption (Isik and Khanna 2003; Knight, Weir and Woldehanna 2003; Liu 2013). Consequently, knowing a decision-maker's risk attitude is essential for explaining and forecasting farm management behavior (Vollmer, Hermann and Mußhoff 2017). However, here, risk aversion as elicited in the portfolio investment game does not seem to explain decisions to farm with risky environmentally-friendly practices (*RA_centered* in Table 6). This absence of impact of elicited risk is observed in all treatments. This result is consistent with Gangadharan and Nemes (2009), who did not find neither that elicited risk aversion provides a consistent pattern of behavior in their public good game with uncertainty.

The use of behavioural elicitation method for risk preferences has recently be challenged in the literature. Several authors have shown that risk preferences are not stable across elicitation methods (Pedroni et al. 2017; Reynaud and Couture 2012; Brunette et al. 2015; Deck et al. 2013; Soane and Chmiel 2005). One potential explanation is that risk preferences may be constructed when they are elicited, and different cognitive processes associated with different elicitation methods can lead to varying preferences (Pedroni et al. 2017). Another explanation of the observed risk preference instability is that they may be domain-dependent (Reynaud and Couture 2012; Deck et al. 2013; Deck, Lee and Reyes 2014; Weber, Blais and Betz 2002; Soane and Chmiel 2005). Dave et al. (2010) have

10 We also asked participants whether they think that it is the responsibility of farmers to protect the environment (see part 5 of the instructions). Participants largely declared to agree with this statement (50% tend to agree and 45% strongly agree). Given low variance in responses, and the fact that the answers to the responsibility and impact questions are correlated, we included only the impact variable in the model.

demonstrated that the more complex risk aversion measure has overall superior predictive accuracy, but its downside is that participants exhibit noisier behaviour. They conclude that for participants with higher numerical skills, the greater predictive accuracy of the more complex task more than outweighs the larger noise. Our results may suggest that our participants could have dealt with a more complex risk aversion elicitation task and that we could have found an impact of risk aversion in that case since we find that public good contribution is higher in the benchmark than in the risky treatments.

Here, we have measured social value orientation with an independent task, allowing us to observe a significant impact of social value orientation on decisions. Pro-social individuals (those who have attempted to maximize the joint payoff of both players in the set of dictator games in the second part of the survey) are more willing to farm with environmentally-friendly practices than the others. We observe a negative and significant impact of the interaction term between payment and pro-social individuals, suggesting that the payment is more effective in changing non-pro-social individuals behaviors. It also confirms results from the literature about the crowding-out of prosocial behavior by external rewards (Midler et al. 2015).

One could argue that experiments conducted on-line lack of control compared to lab experiments, in particular because once the experiment has begun, it is not as easy as it is in the lab to control information flow about the nature of the task (Harrison and List 2004). To measure whether our results are impacted by this effect, we controlled for the submission date (6.5 days between the first and the last connection) and the time dedicated to answering to the survey (on average 29 minutes). While the interview time has no significant explanatory power, participants who participated later in the week (variable submitdate_diff in Table 6) allocated significantly less land to environmentally-friendly practices. We cannot reject the hypothesis that they have communicated among them, reproducing the impact of repetition and communication in repeated public good games. Repetition generally leads to a decline in contributions. Here, we observe that this effect is the same in all treatments (between and within subjects), therefore not impacting our results on the impact of treatment variables and the interpretation presented above.

Main reasons for non-adoption and the main levers likely to favour their adoption

To complement our understanding of the reasons underlying the decision to farm according to environmentally-friendly practices, we asked participants to state what would be their main reason for non-adoption and the main lever likely to favour their adoption if they were a farmer (Table 7). All participants were invited to answer to these questions, whether they adopted these practices or not in the experiment.

Overall, the two main reasons for non-adoption are the negative impact on yields and income, as well as the difficulty to find markets with a mark-up for environmentally-friendly agricultural products. Interestingly, we can observe significant differences between participants who played the game with both foreground and background risk and the other treatment groups. Participants in Benchmark, ForeOnly and BackOnly selected the lower income as the first reason for not adopting sustainable practices. For participants in Fore&Back, the main reason is absence of markets and the income effect is the less cited. This may be due to the fact that the expected impact on income is less visible in the presence of the two sources of risk.

Overall, the main lever cited by the participants by far is the importance of collective action through groups of farmers. This is confirming the approach retained in the CAP 2014 and implemented in France through the support to Economic and Environmental Interest Grouping (GIEE).[11] Interestingly, while financial assistance to take-out insurance is the second main lever cited in Fore&Back, it has been rarely mentioned by participants in the other treatments. Those have privileged the financial assistance to invest in the necessary equipment or training as the second most cited item. The answers of the Fore&Back group confirm our result that an incentive payment set-up as a fixed amount per hectare received whatever the state of the world is not efficient in driving adoption but could be improved by making the payment scenario-dependent, according to the observed level of costs (foreground risk) and financial yields (background risk).

Table 7: Main reasons for non-adoption and potential levers

	Frequency (%)			Difference
	All	Fore&Back	Benchmark ForeOnly BackOnly	
What would prevent you from testing such a system on your farm? Give the main reason.				
I fear reduced crop yields, hence reduced income	26.61	6.67	32.98	***
I would like to sell my production at a higher price specifying that its environmental impact is reduced, but I fear I may not find markets.	26.61	40.00	22.34	*
This means acquiring additional information and skills	16.13	16.67	15.96	n.s.
It requires excessive investments.	16.13	16.67	15.96	n.s.
None of the above	14.52	20.00	12.77	n.s.
In contrast, what would help you adopt such a system? Give the main reason.				
Joining a group of farmers who collectively undertake this venture	41.13	33.33	43.62	n.s.
Financial assistance to invest in the necessary equipment or training	20.97	20.00	21.28	n.s.
Higher subsidies to make up for the loss of earnings	16.94	13.33	18.09	n.s.
Financial assistance to take out insurance to cover a drop in income	13.71	23.33	10.64	*
Technical assistance	3.23	3.33	3.19	n.s.
None of the above	4.03	6.67	3.19	n.s.

Note: According to the Kruskal-Wallis equality-of-populations rank test, we cannot reject the hypothesis that the three samples (Benchmark, ForeOnly, BackOnly) are from the same population at the 1% level. Therefore, we pool the three groups to compare with Fore&Back. According to Wilcoxon rank-sum two-sample tests, the difference between responses of participants in Fore&Back and in the other treatments is significant at the 10% level (*), 1% level (***) or not significant (n.s.).

[11] Collective environmental action can benefit from CAP support to cover cooperation costs (feasibility study, animation, promotion) and the support can be granted over a longer time period compare to individual support (EU regulation No 1305/2013 on support for rural development by the European Agricultural Fund for Rural Development).

6. Conclusion

We discuss here the results of the experiment and the broader policy implications. We also present the limitations of this study, as well as suggest ideas for future research.

Risk is widely seen as an issue of critical importance to farmers' decision making and to policies affecting those decisions. However, the impact of risk on the adoption of environmentally-friendly practices has not fully been explored: this analysis has been restricted to the impact of the level of risk associated to each type of practice. However, while farmers can choose to avoid the risk associated with environmentally-friendly practices by not engaging in those practices, there are other risks farmers are exposed to without (or with very limited) possibility of control: the background risk. Using a framed field experiment with 124 French agricultural students, we have analysed the impact of background risk on decisions to adopt environmentally-friendly practices and evaluate how incentive payments can influence adoption decisions in such a risky environment.

Regarding the results of this study, the first contribution is to show that participants put in a farming situation were willing to protect the environment even with a cost. Turning to the effects of the treatments, as expected, we observe that risks linked to green farming practices discourage farmers from adopting them. More interestingly, we have shown that background risk is also detrimental to the adoption of green farming. It suggests that participants are both risk averse and risk vulnerable. We also highlighted a vulnerability to strategic uncertainty. Moreover, we found that the incentive payment is generally efficient in increasing adoption of green practices but fail to do so in the presence of both foreground and background risks.

In terms of policy implications, our results suggest that reflexion on how to incentivize farmers to manage the environment better, in an efficient and effective way, should account not only for the risk underlying the adoption of more environmentally-friendly practices, but also for the background risk. Indeed, it is often argued that CAP payments allocated per hectare compliant with a set of environmental requirements (such as agri-environmental measures or the green payment) could favor adoption of environmentally-friendly practices by covering the extra costs and the risk premium associated with the adoption of such practices compared to conventional farming. But given the low efficiency of such instrument in the presence of (foreground and) background risk, further research could focus on the role of risk management tools to encourage adoption of environmentally friendly practices.

In the actual European agricultural context, both protecting the environment and managing the risks faced by farmers are gaining importance, as suggests the recent communication of the European Commission on CAP 2020 (European Commission, 2017). On one side, the debate about risk-related agricultural policies has intensified in response to growing volatility of prices on EU markets for agricultural products, resulting from successive rounds of CAP reform since the early 1990s and the consequent wider opening of domestic EU markets to international price signals (Tangermann 2011). On the other side, the concern of European citizens for the environment is growing, with 26.6% of them (outside of farmers) considering that pressures on the environment and on natural resources is one of the three major challenges for the European agriculture (European Commission 2017a) pulling a shift towards more sustainable consumption and production.

So far, CAP support to sustainable agriculture and risk management were mostly discussed separately. However, our results suggest that there might be synergies between risk management instruments and agri-environmental measure: proposing better insurances for farmers that are conditional to the transition towards more sustainable systems could foster the adoption of the riskier and more costly practices attached to them while helping farmers maintaining a safe level of income. Already in the beginning of the 21st century, Coble et al (2003) examined the possibility that agricultural insurance could be used in the United States to encourage producers to adopt practices that are beneficial for the environment. These agricultural-environmental insurance aims at protecting farmers from the risks associated with pollution-reducing management (Huang 2002). The experience of “Fondo Risemina Mais” in Veneto, Italy, is interesting in that respect (PANEurope n.d.). This is, to our knowledge, one of the very few experiments in Europe of such agricultural-environmental insurance. In that example, farmers have access to crop insurance financed by a mutual fund in case of pest damage to maize, as well as damage due to adverse weather conditions, if they agree to comply with good agricultural practices and integrated pest management (including crop rotation), follow the recommendations of the arable crop protection bulletins from the Veneto Agriculture institute, and report any claims within the specified time periods. The payment is therefore not systematic as it is the case with agri-environmental measures, but triggered only in case of unfavorable local climatic conditions or pest attacks. Future research could measure the impact of such instrument on the adoption of environmentally-friendly practices. There is scope for an experimental study to address this question given the numerous behavioral factors likely to influence the perceived value of such insurance by farmers. Aside from the characteristics of the insurance offer, the decision maker's perceptions of the risk, his or her risk aversion, whether risk aversion is or not the driving factor behind the environmental degradation and the alternative risk management strategies may strongly influence a producer's willingness to accept such insurance scheme (Coble et al. 2003). Ignoring any of these factors may lead to a gross error when predicting participation. In addition, there might also be trade-offs between risk management instruments and agri-environmental measures if policy makers are not taking both objectives into account when designing policies. For instance, according to Müller et al. (2017), traditional climate insurances can favor the adoption of riskier agricultural practices and production choices, such as decreasing the number of crops farmers grow on their land, this lack of crop diversity then impacting negatively the biodiversity and the resilience of the farm. These results, together with ours, underline the importance of studying the coherence (trade-offs and synergies) of agricultural policies aiming at different objectives prior to their implementation.

The impact of policy instruments to promote environmentally-friendly practices in risky contexts is also likely to be conditional on the type of practices studied. While we have assumed in the experiment that environmentally-friendly practices are risk increasing, as discussed in Bougherara and Nauges (2018), there is mixed evidence in the empirical literature regarding the impact of agricultural practices on risk, in particular for practices relying on inputs reduction: some sustainable practices might be risk increasing while others are risk reducing (Horowitz J. K. and Lichtenberg E. 2008; Serra et al. 2006;

Di Falco and Chavas 2006; Gardebroek Cornelis, Chavez María Daniela and Lansink Alfons Oude 2009; Koundouri et al. 2009). Promoting these practices therefore requires different policy instruments in these various cases. More research is thus necessary to better understand how the transition towards more sustainable agricultural systems might impact the risks faced by different types of farmers according to the type of practices.

Finally, this study confirmed that it is possible to use experimental economic methodology to understand decision making in the context of farming. Beyond this particular research question, one can argue that such experimental evaluation tools allow to provide cheap and timely results, when behavioral factors are likely to modify farmers' behaviors and traditional evaluation tools fail to account for such factors and disentangle their impacts. Ideally, the experiment should be replicated with farmers in several EU countries. Nevertheless, decisions of agricultural students observed in a controlled experiment are already sufficient to challenge conclusions from traditional evaluation tools.

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