Do social norms influence farmers' participation in agri-environmental schemes?

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Abstract

This article analyses the role played by social norms in farmers' decisions to enroll into an agri-environmental scheme (AES). First, it develops a simple theoretical model highlighting the interplay of descriptive and injunctive norms in farmers' utility functions. Second, an empirical valuation of the effect of social norms is provided based on the results of a stated preference survey conducted with 98 wine-growers in the South of France. Proxies are proposed to capture and measure the weight of social norms in farmers' decision to sign an agri-environmental contract. Our empirical results indicate that the injunctive norm seems to play a stronger role than the descriptive norm.

Keywords agri-environmental contracts, social norms, behaviour

JEL code Q18, D03

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Introduction

There is a growing interest in the field of economics on the role of social norms in human decisions. Put in a simple way, social norms can be defined as informal rules that an individual thinks he should follow, based on his perception of the opinion and the action of the people he interacts with. This definition is not incompatible with economic rationality and models have recently tried to introduce social norms to understand how they affect predictions.

Taking into account these social norms in economic models and in the design and implementation of public policies is fundamental as they might interact positively with laws, regulations and monetary incentives but may also reduce or even counteract their effects (Cialdini, 2007). Social norms are sometimes considered as costless ways to ensure cooperation and the provision of a number of public goods. Without social norms, coercion or economic incentives—requiring large public spending—would often be necessary to ensure that collective action problems are solved. "*Norms of honesty, loyalty, reciprocity and promise keeping, to name but a few cooperative norms, are crucial to the smooth functioning of social groups*" (Bicchieri and Muldoon, 2014). Conversely, if norms are inadequate such as for example the widespread farmers' norm of keeping a field "clean" of any weed, which implies high herbicide use with adverse effects on water quality, they can generate "public bad" and hamper the effectiveness of public policies. The question of the role of social norms in environmental matters is increasingly investigated. Do they facilitate or do they hinder the adoption of pro-environmental behavior? How can they be mobilized to improve the effect of environmental policies? How do they interact with more classic public instruments such as economic incentives?

Social norms may be at play in the adoption of agri-environmental schemes (AES) and pro-environmental practices. It indeed requires farmers to move from a social value of "productivist" to a "post productivist" social value that includes roles such as conservation managers (Burton, 2004). The importance of "roadside farming", that is to say, how farmers observe each other's practice on fields on the side of the road and how it influences their decisions has been highlighted in several studies (Burton, 2004). The lack of considerations for the role of norms may explain the limited participation of farmers to these agri-environmental schemes, explaining at least partially their limited effectiveness. In this article, we intend to investigate whether social norms influence the adoption of AES. This question raises theoretical issues, for the understanding of the effect of these norms on AES, as well as empirical issues, for the quantification of these effects in the field. We intend to address both dimensions in this paper.

Understanding the role of social norms is crucial, as interventions could be modified to harness the role of social norms or avoid its negative effects. This would ultimately improve the effectiveness of agri-environmental programs.

This article is structured as follows. The first section explores the definitions of social norms and reviews the existing theoretical models that take into account the role of social norms in pro-social behavior, with a focus on pro-environmental behavior. Based on this review we propose a theoretical model of the influence of social norms on the adoption of AES. We then present in section 2 a review of empirical methods to analyze the role of social norms and the empirical approach we have set. Finally, we present the results of our empirical study in section 3. In the last section, we conclude on the political implications of this study.

1 Social norm models

1.1 Different types of social norms

Social norms describe how an individual's actions are influenced by the behavior or opinions of his social group. These actions are either prescribed or proscribed, *"don't do or do X"* (Elster, 1989). They are a sort of informal law system implemented at the level of a group (Cialdini and Trost, 1998).

Bicchieri (2006) considers that social norms "refer to behavior, to actions over which people have control, and are supported by shared expectations about what should/should not be done in different types of social situations". This definition introduces three important concepts. First, norms can only exist when there are common expectations about the appropriate behavior. If these expectations are not sufficiently widespread they cannot gain the status of norms. They require a certain form of consensus. In her views, social norms are "the unintentional and unplanned outcome of human interaction". Second, being based on expectations, these norms are subjective and go through the prism of perceptions. Third, different norms apply to different contexts, they are context dependent. In other words, norms specify the most socially appropriate action in a particular context (Kimbrough and Vostroknutov, 2013).

An important problem in public policies is that norms can be either socially beneficial or not, in the sense that they can either contribute to social welfare or on the contrary hamper social welfare. They can either promote pro-social or anti-social activities. Different norms can even apply to the same context that can sometimes be conflictual. Going back to the example of a farmer who has to choose his weed control practice, the norm that prescribes to keep the field as

clean as possible and the one that proscribes to pollute the environment are conflictual and a farmer may be more subject to one or the other, depending on the context and the social group he refers to.

Three different reasons for conforming to social norms are mentioned in the literature: expectations of social rewards and/or punishments (social incentive rationale), the behavior of others may represent an information of what is likely to be an effective action (social information rationale) (Thøgersen, 2014) and finally people may follow others because it is a costless way to take decisions (social heuristics rationale).

Cialdini *et al*. (1990) propose a division of social norms, taken up by many authors: descriptive norms and injunctive norms. The descriptive norm is what is typical or normal, i.e. what most people do. It mainly provides information about what will likely be an effective action "if everyone is doing it, it must be a sensible thing to do". It provides an information advantage and a decision shortcut when choosing to behave in a given situation. The injunctive norm refers to what constitutes morally approved and disapproved conduct, *i.e*. what ought to be done. Injunctive norms influence people because they are the promise of social sanctions/rewards. Because actions that are approved are often the ones that are observed, there is often confusion between the two.

Although both norms may influence behavior, they are not in force at all times and in all situations. Norms need to be activated in order to have an effect and this requires the norm to be made salient, *i.e*. attention needs to be focused on this particular norm. In presence of conflicting norms, the influential norm is the most salient one in a given situation (Cialdini *et al*., 1990).

Bicchieri (2006) considers that descriptive norms, as such, are not social norms unless people think that they are expected by others to carry out the common behavior observed in the society. Although based on a similar distinction of norms, she proposes a slightly different theory. She argues that two types of expectations are involved in social norms: empirical expectations, or what we believe others do (a sort of subjective descriptive norm), and normative expectations, what we believe others think ought to be done (a sort of subjective injunctive norm). People have conditional preference for fulfilling the norm, provided empirical expectations and normative expectations are met. In other words, people would prefer to follow a social norm on condition that (a) they expect others to follow it and (b) they believe that, in turn, they are expected by others to follow the norm. If these two conditions are not simultaneously present, there is not really a social norm. These two theories are presented in Figure 1.

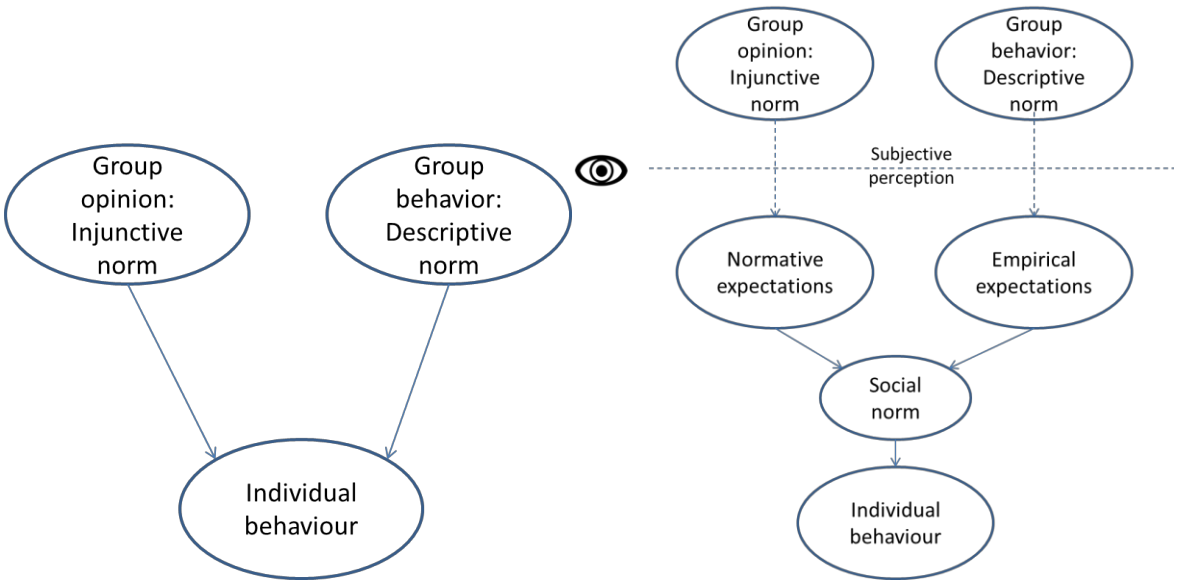


Figure 1: Influence of social norms on individual behavior according to Cialdini *et al*. (1990) (left) and according to Bicchieri (2006) (right)

1.2 Theoretical modeling of social norms

Norms have recently been included in a number of micro-economic models. Lindbeck *et al*.(1999) analyze the impact of social norm in the context of a State that provides welfare benefits to unemployed people. In this model, people are considered to be subject to a social norm of not living off other people's work, experienced as a feeling of disapproval. However, the effect of this disapproval is considered to decrease with the amount of unemployed people. According to the social norm literature, this model considers that there is an injunctive proscriptive norm of not living of social welfare but that the effect of this social norm decreases with number of people that infringe it (the descriptive norm). This formulation is close to Bichieri's model of social norm (Figure 1) although it does not consider the issue of perception of the norms.

Rege (2004) proposes a public good model that integrates the fact that contributing or not exposes you to approval or disapproval from those who contribute. In this 2 step game, people chose to contribute or not to the public good and in the second step meet other players. If a player does not contribute and meets another player who contributed in the first step, he feels disapproval. On the contrary a contributor feels approval if he meets another contributor. The model also considers a parameter of social viscosity that reflects the fact that players have more odds to meet a person with the same behavior as theirs. This article uses evolutionary game theory to determine how people converge to the equilibria of this game.

Blasch and Ohndorf (2015) develop a theoretical model that is based on the same modeling approach as Rege (2004) to which they add a subjective estimation of the contributors rate and the feeling of pure and impure altruism provoked by the contribution to a public good. Their hypothesis is that all these factors affect the willingness to participate in an offsetting scheme. These hypotheses are confirmed in a large scale choice modeling carried out in Germany and the United States.

Nyborg et al. (2006) propose a model that is inspired by the norm-activation theory of Schwartz (1977) that considers the impact of the feeling of responsibility to carry out a pro-environmental behavior. According to Nyborg *et al*. (2006), individuals feel responsible to carry out the behavior if they consider others take this responsibility, a sort of "socially contingent moral motivation". In other words, individuals perceive a responsibility payoff that increases with the percentage of adoption of this behavior in the population. The model therefore mixes different notions of norms such as personal norms and descriptive norms. They apply this approach to a public good game. Adding this responsibility payoff to the traditional public good game turns it into a coordination game (if personal norms are strong enough) that has 3 types of equilibria: i) one in which no one adopts the pro-environmental behavior ii) one in which everybody adopts, and finally iii) one in which the responsibility payoff exactly compensates the difference between the cost of contributing to the public good and the private benefit of the public good. The model is subsequently used to test how policy instruments can ensure the transition from one equilibrium to another using the same evolutionary game theory tools as in Rege (2004).

Benabou and Tirole (2012) propose a very different approach, based on a social signaling model, that puts together the feeling of distinctness and conformity or the role of personal and social norms. Agents are characterized by a level of intrinsic motivation to carry out a pro-social activity. They are also submitted to a reputational payoff that reflects the judgement of others as they assess intrinsic motivations, which is private information, in light of the agents' actions. The relative importance of the feeling of distinctness and conformity depends on the distribution of intrinsic preferences. If few people adopt the virtuous behavior, a heroic action such as saving ones' life risking your own, only those with strong intrinsic motivation will undertake it and will receive a great honor for doing so. On the contrary, if almost everybody adopts the behavior, a norm like "not killing people", will require very limited intrinsic motivations and deviations from this norm will provoke a strong stigma. Interestingly, for the first case, an increased adoption of the pro-social behavior will reduce social rewards (substitutability) while for the second case an increased adoption will strengthen social rewards (complementarity).

Despite their different entry points, these models generally consider the impact of others' action on individual decision, which is certain form of descriptive norm, except the Benabou and Tirole (2012). Even in the models that rather deal with the injunctive norm, the level of participation of others is the key variable: in Rege (2004), the injunctive norm is directly linked to the number of contributors that people meet and in Lindeck *et al*. (1999) there is an assumption that the strength of the injunctive norm decrease with the number of people who do not respect it. Considering that injunctive norms are supposed to be what people think "ought to be done", there should be an effort to model this particularity. There is very little information in the literature that gives hints on how the opinions on what should be done are formed and therefore how they could be modeled.

1.3 Modelling the effect of descriptive and injunctive norms on the adoption of AES

Inspired by these models, we propose a model of farmers' enrolment in AES in the presence of an injunctive and a descriptive norm. The theoretical framework is close to Rege's model (2004).

We consider a continuum $[0,1]$ of identical farmers. Each farmer $i \in [0,1]$ has to decide either to participate in AES ($e_i = 1$) or not ($e_i = 0$). Enrolment in AES corresponds to a contribution of a fixed amount, $e_i = 1$, to a public good that benefits the whole society.

Let x denote the share of enrolled farmers in AES, $x \epsilon [0,1]$. Since there is a continuum of farmers, we consider that a farmer i's enrolment has no effect on the average provision of public good, $\bar{e} = x$.

To represent farmer i's preferences without taking into account the influence of social norms, we use the simplest specification:

$$U_i = (p - c)e_i + \beta \bar{e}$$

with c the cost to enrol in AES, p the AES payment and β the farmer's private benefit derived from the average provision of the public good, $\bar{e}$.

The difference in farmer i's utility between enrolling and not enrolling in AES is given by:

$$\Delta U = U_i^1 - U_i^0 = p - c$$

Farmers enrol in AES only if $\Delta U > 0$.

Result 1: *Without social norms, farmers enrol in AES if and only if* $p > c$.

Descriptive norm

We propose to specify the utility gains or losses associated with the conformity to the social descriptive norm u_{DN} with the following specification:

$$u_{DN} = (2e_i - 1)(2x - 1)$$

This specification reflects the fact that individuals perceive a utility (disutility) when they conform (do not conform) to the descriptive norm. As shown in Figure 2, if the farmer does not enrol in AES ($e_i = 0$), he gets a positive utility from acting like all other farmers if $x = 0$. But his utility decreases as x increases and becomes negative when the majority of farmers enrols in AES, *i.e.* when $x > \frac{1}{2}$.

If the farmer enrols in AES ($e_i = 1$), his utility from not conforming to the descriptive norm is negative when $x = 0$, but increases with x and becomes positive as soon as the majority of farmers acts like him, i.e. $x > \frac{1}{2}$.

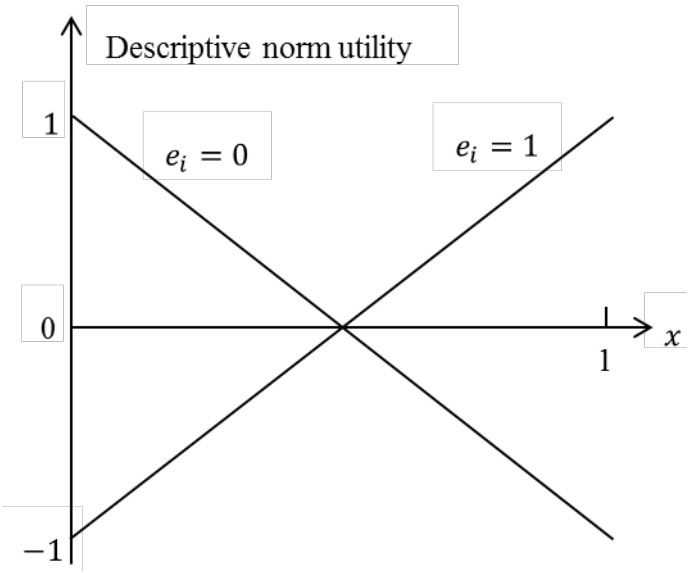


Figure 2: Variation of descriptive norm utility according to participation

This specification entails that the descriptive norm is not only exerted by people who adopt a pro-social behavior but also by people who don't. This novel approach intends to reflect the observed resistance of farmers to participate in pro-environmental policies.

With this descriptive norm specification, farmer i's utility is:

$$U_i = (p - c)e_i + \beta\bar{e} + \lambda(2e_i - 1)(2x - 1)$$

$$\Delta U = p - c + 2\lambda(2x - 1)$$

λ is a scale parameter: it can be interpreted as the weight of the descriptive norm in the utility function of farmers; or alternatively as the salience of the descriptive norm.

As in Rege (2004), let x' be defined by $\Delta U = 0$, $x' = \frac{1}{2} - \frac{p-c}{4\lambda}$

Result 2:

- *The game has a Nash equilibrium in which every farmer enrols in AES if and only if* $p \geq c - 2\lambda$.
- *The game has a Nash equilibrium in which no farmer enrols in AES if and only if* $p \leq c + 2\lambda$.
- *The game has a Nash equilibrium in which a share* x' *of farmers enrol in AES if and only if* $c - 2\lambda < p < c + 2\lambda$.

Proof: $\Delta U = 0$ if and only if $x = x'$. Note that ΔU is an increasing function of x. Thus $\Delta U \geq 0$ if and only if $x \geq x'$ and $\Delta U \leq 0$ if and only if $x \leq x'$.

Furthermore, note that $x' \leq 1$ if and only if $p \geq c - 2\lambda$. If $x = 1$, farmer *i* choosing $e_i = 1$ will not deviate unilaterally from his choice because $\Delta U \geq 0$. Thus, $e_i = 1$ for all i is a Nash equilibrium (NE e=1) if and only if $p \geq c - 2\lambda$

In the same way, note that $x' \geq 0$ if and only if $p \leq c + 2\lambda$. If $x = 0$, farmer i choosing $e_i = 0$ will not deviate unilaterally because $\Delta U \leq 0$. Thus $e_i = 0$ for all i is a Nash equilibrium (NE e=0) if and only if $p \leq c + 2\lambda$,

$e_i = 1$ for a share x' of farmers enrolling in AES is also a Nash equilibrium (NE e=x') if and only if $c - 2\lambda \leq p \leq c + 2\lambda$.

Figure 3 presents the conditions on p for the existence of the Nash Equilibrium.

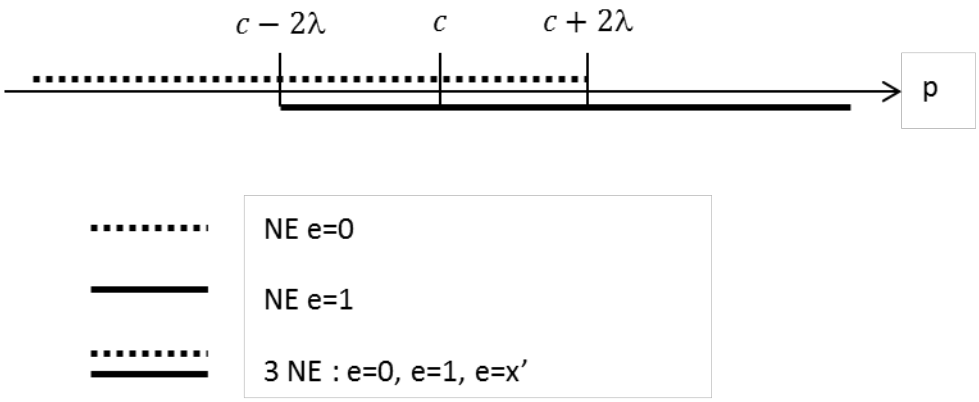


Figure 3: Nash equilibria with the descriptive norm in relation with the value of p

Corollary: $p > c$ is no longer a sufficient condition for farmer i to enrol in AES (when enrolment rate is low), nor $p < c$ a sufficient condition for farmer i not to enrol in AES (when enrolment rate is high).

$p > c + 2\lambda$ is a necessary and sufficient condition to have a single Nash equilibrium in which all farmers enrol in AES.

$p < c - 2\lambda$ is a necessary and sufficient condition to have a single Nash equilibrium in which no farmer enrols in AES.

Result 2 implies that when we include descriptive norms in the model, we obtain a coordination game if $c - 2\lambda < p < c + 2\lambda$. In this case, the game has three Nash equilibria; one in which every farmer enrols in AES, one in which no farmer enrols and one in which a share x' enrol in AES.

However, the game has only two asymptotically stable states ($x = 0$ and $x = 1$) as shown in Figure 4. Indeed, the mixed Nash equilibrium is not an asymptotically stable state in an evolutionary game setting. See Appendix A for a formal proof.

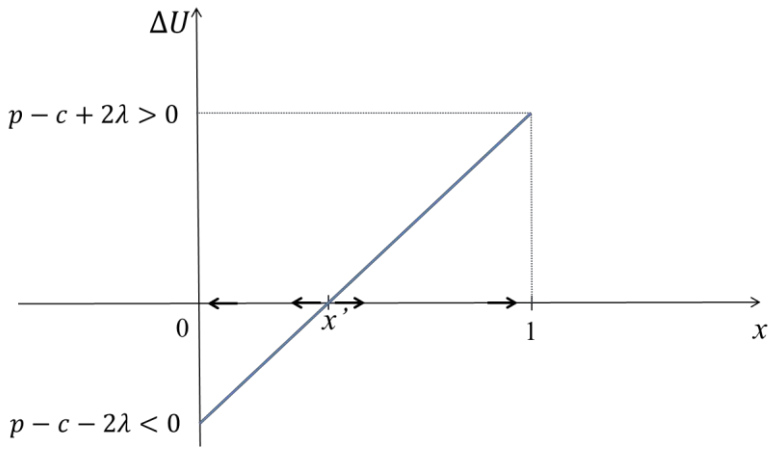


Figure 4: Difference in farmer *i*'s utility in the coordination game when $c - 2\lambda < p < c + 2\lambda$

This model illustrates that the descriptive norm can be an obstacle in the early phases of implementation of an AES programme. In the conditions where the three equilibria are possible ($c - 2\lambda < p < c + 2\lambda$), unless participation reaches a minimum threshold (x'), the descriptive norm is an impeding factor for enrolment. Only when a minimum level of participation is reached (x') does the descriptive norm reinforce farmers' enrolment rate.

Injunctive norm

Two features characterize the injunctive norm we want to model. First, we assume that the injunctive norm to enrol in AES comes from the whole society: farmers but also and mainly from non-farmers. This specification is an innovation as injunctive norms are generally considered to be exerted by peers. However, a preliminary survey on AES adoption revealed that people who seem to have an influential opinion are not neighbour farmers but rather other members of the society such as spouses and farm advisors (Le Coent, 1016). Second, we assume that the injunctive norm is exerted more strongly when the level of the environmental public good $\bar{e}$ is low. Indeed, when no farmer is enrolled in AES, the level of the environmental public good is at its lowest level. It is usually when the society strongly urges farmers to change their practices and to enrol in AES. However, as the state of the environment improves, *i.e.* the provision of public good increases, the injunction to enrol in AES weakens. Contrary to the descriptive norm, the injunctive norm is a driving force for enrolment when few farmers participate. However, when AES uptake increases, the injunctive norm plays a lesser role. This model specification is original because the injunctive and social norms are generally considered

to be congruent since "what is approved is often what is typically done" (Cialdini *et al*. 1990). In our case, descriptive and injunctive norms pull in two opposite directions when adoption rate is low.

Assume that conforming to the injunctive norm yields the following (dis)utility u_{IN}, which takes the following specification:

$$u_{IN} = \frac{2e_i - 1}{\bar{e} + 1} = \frac{2e_i - 1}{x + 1}$$

This specification reflects the fact that farmers perceive a utility (disutility) when they conform (do not conform) to the injunctive norm which decreases as x increases. If the farmer does not enrol in AES ($e_i = 0$), he feels social disapproval. Disapproval decreases as the enrolment rate (and therefore the provision of public good) increases. Alternatively, if the farmer enrols when no-one else does so, he feels social approval ($e_i = 1$). But social approval decreases as x increases (Figure 5).

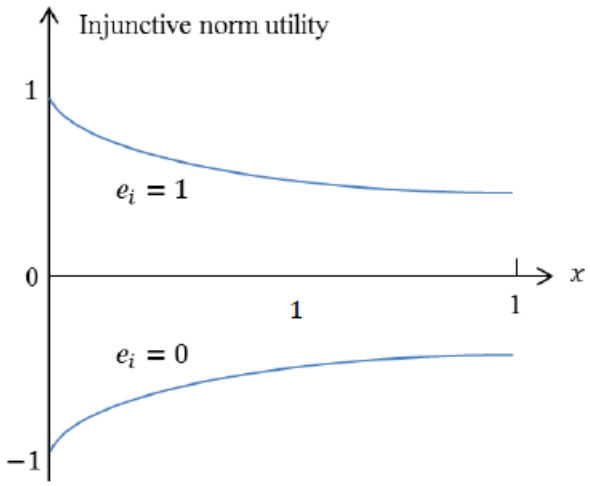


Figure 5: Variation of injunctive norm utility according to participation

With this injunctive norm specification, farmer i's utility is:

$$U_i = (p - c)e_i + \beta\bar{e} + \sigma\frac{2e_i - 1}{x + 1}$$

$$\Delta U = p - c + \frac{2\sigma}{x + 1}$$

with σ a scale parameter for the injunctive norm reflecting the weight of the injunctive norm into the total utility or its salience

Let x' be defined by $\Delta U = 0$.

Result 3:

- *The game has a Nash equilibrium in which every farmer enrols in AES if and only if* $p \geq c - \sigma$.
- *The game has a Nash equilibrium in which no farmer enrols in AES if and only if* $p \leq c - 2\sigma$.
- *The game has a Nash equilibrium in which a share* x' *of farmers enrol in AES if and only if* $c - 2\sigma < p < c - \sigma$.

Proof: As illustrated in Figure 6, note that ΔU is monotonously decreasing in x on $[0,1]$. Thus, $e_i = 1$ for all i is a Nash equilibrium if and only if $\Delta U > 0$ when $x = 1$, *i.e.* if and only if $p > c - \sigma$. Then, $e_i = 0$ for all i is a Nash equilibrium if and only if $\Delta U < 0$ when $x = 0$, *ie* if and only if $p < c - 2\sigma$. Finally, $e_i = 1$ for a share $x' = -\frac{2\sigma}{p-c} - 1$ of farmers enrol in AES if and only if $c - 2\sigma \leq p \leq c - \sigma$. The three Nash equilibria in relation to the value of p are presented in Figure 7.

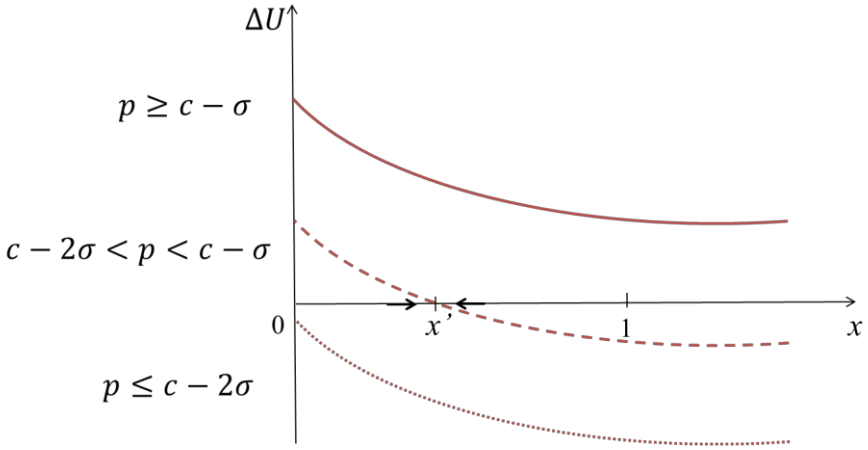


Figure 6: Difference in farmer *i*'s utility in the three cases according to the value of *p* compared to $c - 2\sigma$ and $c - \sigma$

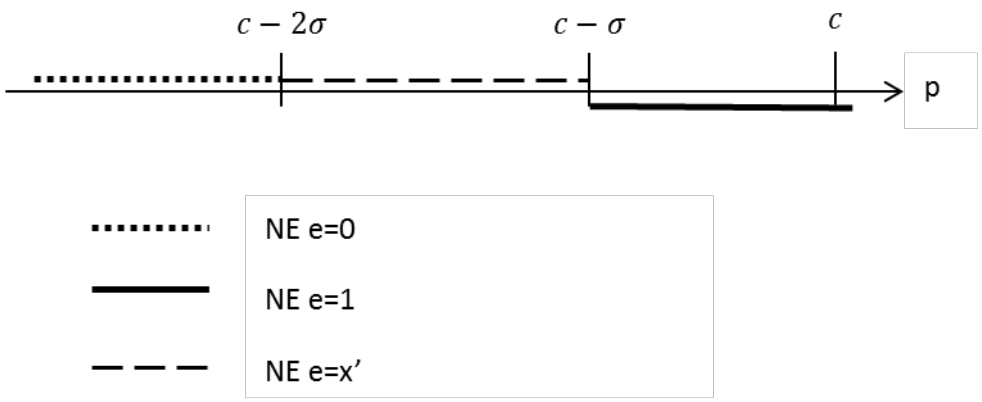


Figure 7: Nash equilibria with the injunctive norm in relation with the value of p

Corollary: As defined here, the injunctive norm shall only have a positive impact on enrolment. $p < c$ is no longer a sufficient condition for farmers not to enrol in AES as the injunctive norm effect (social approval vs social disapproval) may compensate a payment which might be lower than the cost of enrolment.

Contrary to Result 2 for the model with the descriptive norm, Result 3 shows that the game is not a coordination game. Indeed, the necessary and sufficient conditions for each Nash equilibrium do not overlap with each other (Figure 5). Thus we do not need to refer to an evolutionary analysis to confirm that the three Nash equilibria are the three asymptotically stable states of this game.

Combining descriptive and injunctive norms in farmer i's utility gives:

$$U_i = (p-c)e_i + \beta\bar{e} + \lambda(2e_i - 1)(2x - 1) + \sigma\frac{2e_i - 1}{x+1}$$

$$\Delta U = p - c + 2\lambda(2x-1) + \frac{2\sigma}{x+1}$$

$\frac{d\Delta U}{dx} = 0$ if $x = \hat{x} = \sqrt{\frac{\sigma}{2\lambda}} - 1$.

ΔU is decreasing if and only if $x < \hat{x}$ and ΔU is increasing if and only if $x > \hat{x}$

Let ΔU_{min} be ΔU when $x = \hat{x}$.

This more complex specification leads to different cases depending whether:

- $\hat{x} \leq 0$ (case 1), if and only if $\sigma \leq 2\lambda$
- $0 < \hat{x} < 1$ (case 2) if and only if $2\lambda < \sigma < 8\lambda$ or
- $\hat{x} \geq 1$ (case 3) if and only if $\sigma \geq 8\lambda$.

Falling into one case or another therefore only depends on the relative weight that farmers grant to descriptive norm (λ) and subjective norm (σ).

Each of these three cases has three or five subcases (see Appendix B for a description of each subcases).

One interesting case is the case 2 in which λ and σ are relatively similar. The subcase 2b) is particularly challenging because it presents three Nash equilibria: two in which only a share of the population enrols in the AES (x' and $''$) and one in which everybody enrols. However there are only two asymptotically stable states in this coordination game: $x = x'$ and $x = 1$ This case is presented in Figure 8.

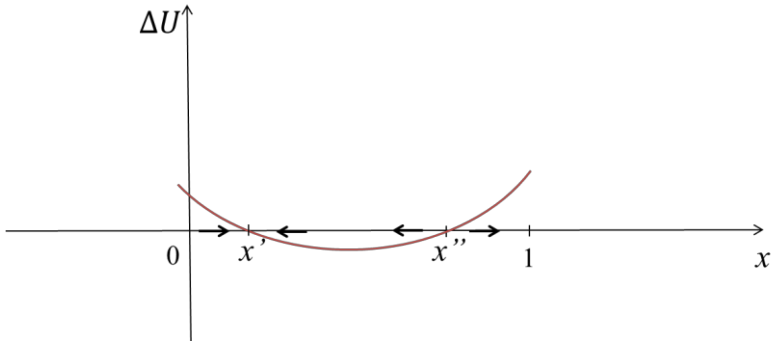


Figure 8: Utility variation for subcase 2b)

A first level of participation x' can be attained mainly thanks to the effect of the injunctive norm. However, beyond that point, only if the participation rate reaches a level superior to x'' can the descriptive norm guarantee a significant improvement in enrolment, up to full participation.

This subcase could well describe the situation observed in many areas where AES have been introduced and their adoption rate remains quite limited. Thanks to payment and the effect of injunctive norms, the first equilibrium may be attained. However the descriptive norm still influences negatively adoption and does not allow to significantly improve participation to AES.

2 Empirical evaluation of the effect of social norms on AES adoption

The objective of this empirical section is to analyze the effect of social norms on the adoption of agri-environmental schemes.

2.1 Literature review

Two studies have analysed the role of social norms on the adoption of AES. Defrancesco *et al*. (2008) study the influence of numerous socio-economic factors as well as behavioural factors on the adoption of AES. They find *inter alia* that farmers who perceive that other farmers have a positive opinion on AES are more likely to adopt a contract. Allaire *et al*. (2009) use spatial econometrics in order to estimate the influence of neighbour effect in the adoption of AES. They find effects of spatial proximity at the municipality and the micro-zone level that they attribute to the effect of social networks. Although the authors do not consider this hypothesis, this effect may also be caused by the presence of a descriptive norm at these levels.

To our knowledge, two studies exist on the role of social norms on the adoption of agri-environmental contracts that use either experiments or choice experiments. In the context of a PES scheme subsidising farmers for reforestation in China, Chen *et al*. (2009) show, through a choice experiment survey, that individual intentions to re-enrol is positively influenced by the information that neighbours also intend to re-enrol, i.e. the descriptive norm. Results also show that farmers would require lower subsidies to carry out environment protection activities if a large proportion of farmers re-enrol than if few farmers would do so (Chen *et al*., 2009).

Kuhfuss et al (2016) carried out a survey with 395 French farmers. Farmers were asked whether they intended to maintain their pro-environmental practices at the term of their agri-environmental contract even without a new contract. The experiment consisted in providing different information on the behavior of other farmers from a previous survey. In the control treatment (128 respondents), farmers were not provided information. In treatment 1 (121 respondents), farmers were informed that 80% of the respondents stated that they would maintain the new practices they had adopted during the AES. Treatment 2 (141 respondents) was a different framing of the same information, “20% of the respondents stated that they would not maintain the new practices”. 61% of farmers who received the information declare that they will maintain their agricultural practices while 43% of farmers in the control treatment and this difference is highly significant. This difference is mainly attributed to the effect of the descriptive norm on individual decision to maintain agricultural practices at the end of their contractual commitment.

2.2 Survey methodology

Several challenges need to be addressed in stated-preference surveys in order to detect a causality link between explanatory variables (especially the social norm indicators) and the participation to AES, among which endogeneity and self-selection.

The main endogeneity problem comes from the fact that once farmers have enrolled in AES, they may change their characteristics/statement due to the fact that they have enrolled. For example their perception of environmental issues or their socio-economic characteristics may be changed by their participation to the AES. If we observe a statistically significant difference between participants and non-participants, it may actually be the result of their participation and not its cause. In order to mitigate this problem, we used the opportunity of the discontinuity induced by the 2014 CAP reform. In June 2015, all AES contracts ended and farmers had to decide whether to sign or not a new AES contract. Our survey was carried out exactly in this period. The endogeneity effect was therefore *a priori* limited by this exogenous event.

The self-selection bias, *i.e*. the fact that the voluntary participants' characteristics differ from non-participants' is not an issue in this type of analysis. Indeed, self-selection is actually the object of our analysis. What we want to determine is the difference in terms of characteristics and statement between farmers who participated in the AES and the ones who did not. There is however a self-selection bias related to survey participation since it was voluntary. In this study, we indeed assume that the characteristics of the people who participate are representative of the characteristics of the farmers in Languedoc Roussillon.

The questionnaire was sent to 700 vine-growers of the Languedoc Roussillon region in the South of France located in areas where AES aimed at the protection of water quality are proposed to farmers. The sample was focused on this type of farmer in order to limit the heterogeneity and because wine production represents one of the main present environmental challenges, the impact of pesticide in wine production on water quality. The invitation to participate in the survey was sent by facilitators who are involved in the implementation of AES aimed at improving water quality at the territorial level. 98 farmers eligible to the proposed AES responded to the questionnaire. The behavior we try to estimate is the decision to participate in an AES. Two different questions were asked to analyze this behaviour:

"*Have you decided to sign an AES in 2015?*" (Yes/No)

and for those who responded "No" to this question:

"*Do you have the intention to sign an AES in the two following years (2016, 2017)?*"

The idea of adding this second question was that some farmers may have decided not to sign the contract in 2015 but may have the intention to do so in the two following years. They may indeed have been constrained by exogenous factors such as budget limitation for the implementation of the policy. Adding this question helps having a more refined characterization of their behavior.

The descriptive norm is characterized by a question that evaluates the perception of the frequency of the considered behavior among our target population:

"*According to you, what percentage of farmers of your territory will sign an AES in 2015?*"

We keep the notion of "territory" vague so that farmers could decide themselves what is their territory of reference. It is not possible to specify more precisely this notion considering the heterogeneity of what farmers consider as their community of reference (municipality, watershed, cooperative...)

The injunctive norm is evaluated using two statements on which farmers are asked to indicate their level of agreement. One refers to the injunctive norm amongst other farmers of the territory:

"*The majority of farmers of my territory are in favor of AES*."

The other one refers to the injunctive norm amongst important other people (Cf subjective norm in the Theory of Planned Behavior of Ajzen (1991)):

"*People who are important to me think I should sign an AES*."

Considering that injunctive norm may also impact decision through reputation (Benabou and Tirole, 2012), we also characterize the perception of the reputational dimension of signing an AES by asking:

"*How do the other farmers of the territory perceive a farmer who signs an AES?*" (Very negatively, negatively, neither negatively nor positively, positively, very positively)

The questionnaire includes also a statement related to the personal norm of farmers based on the formulation recommended by Schwartz (1977):

"*I feel a moral obligation to modify my agricultural practices in order to improve the quality of water*."

To these questions, we add two predictors of the intention to adopt a specific behavior: the attitude and the perceived behavior control. The attitude, generally defined as "the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question" is evaluated by requesting whether farmers have a favorable opinion or not on AES. The perceived behavior control, generally defined by "the perceived ease or difficulty to perform the behavior", is evaluated by requesting farmers whether respecting the technical prescriptions of the AES on their farm was easy or not. The questions, variables and the coding of the answers are summarized in Table 1.

Variable	Description	Coding of the answers
Farmers and farm socio-economic characteristics		
Age	Age of the farmer	Years
Education	Education	0= Primary or secondary short 1=Superior or Secondary long
Area	Size of the farm	Ha
Profitability	How do you judge the profitability of your activity?	0=Not profitable or low profitability 1=Rather or very profitable
Successor	Do you believe someone will carry on farm activities after you retire?	0=No; 1=Yes
New activity	Have you had important change in your farm in the last 5 years?:	0=No; 1=Yes
Origin	Do you produce wine under a protected geographical origin label?	0=No; 1=Yes
Cooperative	Are you member of a cooperative winery?	0=No; 1=Yes
AES		
Info	Have you been informed about the possibility to sign an AES?	0=No; 1=Yes
Sign AES	Have you decided to sign an AES in 2015?	0=No; 1=Yes
Intention	Do you have the intention to sign an AES in the two following years (2016, 2017)?	0= Very or rather unlikely 1= Very or rather likely
Past AES	Have you already signed an AES in the past?	0=No; 1=Yes
Attitude	Your opinion on AES is:	0=very unfavorable, rather unfavorable or no opinion; 1=rather favorable or very favorable
Easyness	Adopting an AES for my farm is:	1=Rather easy or very easy 0=Very difficult, rather difficult or neither easy nor difficult
Social Norms		
Injunctive norm (others)	People who are important to me think I should sign an AES	1= strongly disagree; 2=disagree; 3=neutral; 4=agree; 5=strongly agree (Agreement scale);
Injunctive norm (farmers)	The majority of wine-growers of my territory is favorable to AES	Agreement scale
Personal norm	I feel a moral obligation to modify my agricultural practices in order to improve the quality of water	Agreement scale

Reputation	How do the other farmers of the territory perceive a farmer who signs an AES?	1= very negatively; 2=negatively; 3=neither positively nor negatively; 4=positively; 5=very positively
Descriptive norm	According to you, what percentage of farmers of your territory will sign an AES in 2015?	1=less than 5%; 2=between 5 and 10%;3=between 10 and 20%; 4=more than 20%

Table 1: Coding of the questionnaire variables

3 Data analysis and results

In this survey, two variables can be analyzed to capture the behavior in terms of AES: the actual decision to adopt an AES in 2015 and the intention to adopt in the 2 following years. We create a variable that takes value 0 for farmers who consider very or rather unlikely their adoption of an AES in the following 2 years, 1 for farmers who consider very or rather likely their adoption of an AES in the following 2 years and 2 if they have effectively signed an AES in 2015 (Variable AES). The variable AES is analyzed using a proportional odds ordered logit model (McCullagh, 1988).

We define a latent variable y^* that represents a level of utility, which is unobservable and defined by:

$$y^* = X'\beta + \epsilon$$

where X is a vector of variables that are considered to explain AES adoption, β is the vector of coefficient and ϵ the residual.

The variable AES, here y, takes the value 0,1 or 2 according to the value of the latent variable relatively to two thresholds α_1 and α_2:

$$p(y = 0) = p(y^* \leq \alpha_1) = F(\alpha_1 - X'\beta)$$

$$p(y = 1) = p(\alpha_1 < y^* \leq \alpha_2) = F(\alpha_2 - X'\beta) - F(\alpha_1 - X'\beta)$$

$$p(y = 2) = p(\alpha_2 < y^*) = 1 - F(\alpha_2 - X'\beta)$$

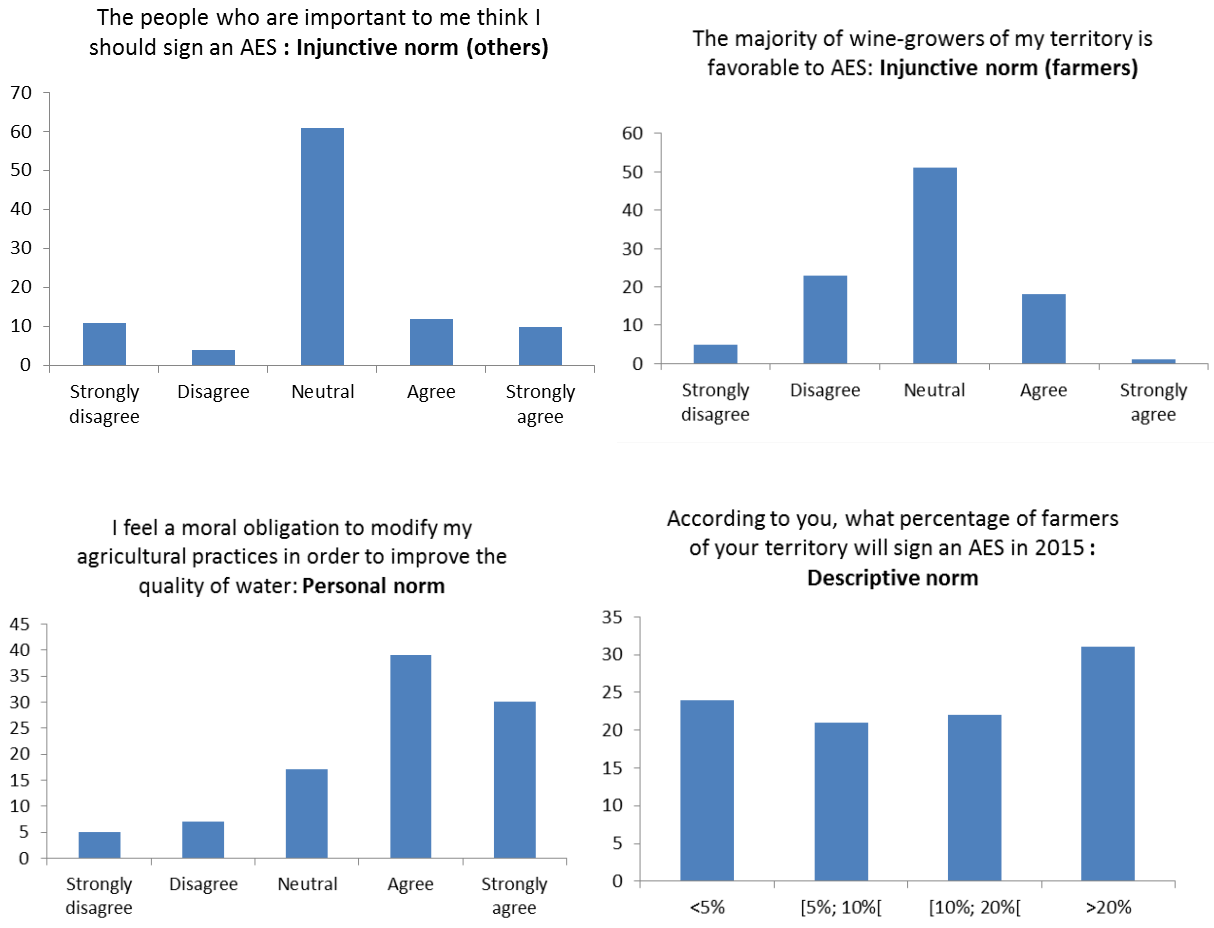
where $F(.)$ is the logistic cumulative distribution function. This model produces one set of coefficients with 2 intercepts. The underlying proportionality of odds assumption is that the coefficients that predict the change from one category of the outcome variable to the next are the same along the scale. An approximate likelihood-ratio test is performed in order to verify that this assumption is verified.

57% of farmers of the sample have decided to sign an AES in 2015. 33% of the farmers have not signed and consider their participation "very unlikely" or "rather unlikely". 10 % have not signed but consider their participation "rather likely" or "very likely". The resulting variable AES is described in Table 2.

AES	Freq.	%
0	32	33%
1	10	10%
2	56	57%

Table 2: descriptive statistics of the variable AES that integrates effective participation decisions

Descriptive statistics of the various social norm variables are presented in the graphics below (Figure 9). They highlight the fact that farmers tend to choose the neutral response for injunctive norm variables such as the perception of injunctive norm of important others, of farmers as well as the perceived reputational effect of signing an AES. The personal norm for the modification of agricultural practices is rather well established and the perception of the descriptive norm is uniformly distributed in the sample.



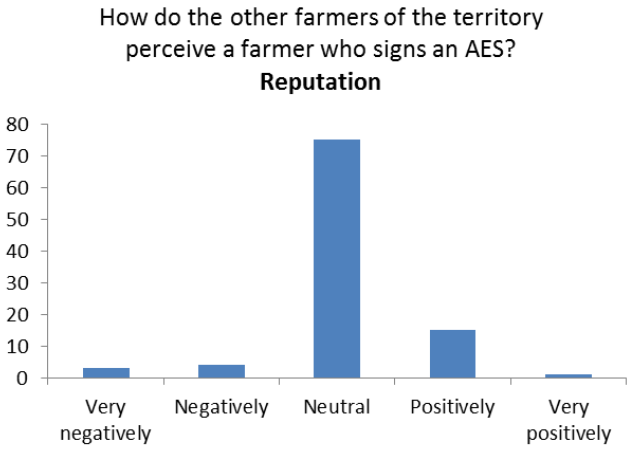


Figure 9: Descriptive statistics of the social norm indicators (In y axis is the number of farmers)

Considering the large amount of neutral response, we decide to dichotomize the social norm indicators. When the initial variables take value 4 or 5 (3 and 4 for the descriptive norm), the new variable takes value 1, and 0 otherwise. We also decide to discard the reputation indicator which displays also too many neutral responses. The estimations using the logit (1) and the ordered logit (2) are presented in Table 3.

Variables	(1)	(2)
Age	**-0.08****	**-0.07****
Education	-0.93	-0.89
Area	0.01	0.01
Profitability	-0.53	-0.57
Successor	0.79	1.09
New activity	0.18	0.26
Origin	0.83	0.79
Cooperative	0.12	0.05
Info	**1.61****	**1.39***
Past AES	0.11	0.36
Attitude	**1.08***	**1.07***
Easiness	**1.19***	**1.70*****
Injunctive norm (others)	**2.22***	**2.34****
Injunctive norm (farmers)	1.34	1.03
Personal norm	**1.24****	**1.29****

Descriptive norm	-0.40	-0.37
α_1	-	-0.59
α_2	-	0.19
Nb. Of observations	96	96
Pseudo R2	0.38	0.32
Log Likelihood	-40.99	-60.60
LR chi2	49.6	56.5
Proportionnality of odds	-	NS

*** **and * refer to significance at the levels of 1%, 5% and 10%, respectively.

Table 3: Logit and ordered logit estimation of participation to AES schemes.

The analysis reveals that three variables are strongly and consistently involved in the decision to adopt or not an AES: the perceived difficulty of AES adoption, the injunctive norm from others and the personal norm. The first variable, our indicator of costs, reveals that, as claimed by standard theory, farmers who have the less difficulty to adopt, i.e. farmers for whom the cost associated with AES compliance is lowest, are more likely to participate in AES. Farmers are influenced by the injunctive norm exerted by people who matter to farmers. If they believe that these people have a favorable opinion, they are more likely to participate. Finally farmers who hold a strong personal norm, i.e. who feel a moral obligation to modify their agricultural practices to improve water quality, are also the most likely to sign an AES. Personal norm are generally considered to be an internalized form of injunctive social norms (Thøgersen, 2006). It is therefore likely that some farmers have been exposed for several years to a social pressure to modify their agricultural practices and have therefore integrated this pressure into a personal norm. This norm intervenes as a strong driver in the participation in agri-environmental policies.
On the other hand, the descriptive norm and the perceived opinion of farmers on AES do not have an impact on the probability to accept an AES. This lack of effect of descriptive norm, and the perception of the injunctive norm from other farmers could be interpreted in different ways. The first and obvious interpretation would be that farmers are not influenced by other farmers. This conclusion would mean that normative interventions may better focus on the norm imposed by other stakeholders (family, farm advisors) rather than on the norm imposed by other farmers. This lack of influence may well be due to the fact that, in the survey responses, the percentage of farmers estimated to adopt remains too low for farmers to perceive a descriptive norm leading

them to adopt an AES. This lack of heterogeneity in our data therefore prevents us from identifying a potential role of the descriptive norm.

The second possible interpretation of this limited effect may be the lack of salience of the descriptive norm. Indeed norms are considered to influence behavior when they are sufficiently salient (Cialdini *et al*., 1990). The limited influence of the decision of others on farmers' decision may therefore be due their lack of salience when they take the decision to either participate or not. Increasing this salience may therefore increase the influence of the descriptive norm.

Finally, some variables influence the decision to sign an AES only in some models or to a lesser extent: younger and better informed farmers are more likely to adopt. The attitude, which is the opinion on AES, intervenes also positively in the adoption of these contracts.

The adoption of AES in our empirical analysis seems to illustrate case 3 of our model, where the injunctive norm has a strong effect and the descriptive norm a limited one. We may actually be stuck in a stable low-adoption equilibrium x'. Section 4 will present policy recommendations to exit this low adoption trap.

The results obtained in this empirical study bear a number of limits. The first limit is the limited sample size. The aim of this study was to elaborate a relatively simple questionnaire, despite the social norm questions, that could be administered by internet and reach a larger sample of farmers. The involvement of AES facilitators of the Languedoc Roussillon in the survey was a way to reach the largest possible population. However, despite several reminders by facilitators and the research team, the response rate remained relatively low (14%), which is a general problem of this type of surveys. A possible extension of this study would therefore be to increase the geographical coverage of the survey at the national level.

The second limitation is the causality link between explanatory variables and the decision to sign an AES. Stated preference surveys generally bear this limitation. We tried to limit the reverse causality problem by carrying our assessment concomitantly with their decision to sign an AES so that we would not record a change in social norm perception due to AES adoption. However, this bias could not be fully controlled as, for example, farmers who have decided to sign an AES may self-justify themselves by stating that they are supported by their relatives. One option to overcome this problem would be to use experimental methodologies.

4 Conclusion and policy recommendations

Several conclusions can be drawn from this work. Our theoretical model shows the interplay between two types of social norms which sometimes play in opposite directions. Whereas the driving forces of the injunctive norm tend to push the AES enrollment rate upwards, but with decreasing marginal efficiency, descriptive norms can have a counteracting effect, when the proportion of enrolled farmers is low. Thus the expectation that social norms activation fosters pro-social behavior and therefore yields greater levels of public good provision for lower economic incentives (the so-called multiplier effect of social norms) is not always verified.

We show indeed that the relative weights of injunctive and descriptive norms in farmers' preferences can induce different types of collective behavior. When the weight of the descriptive norm λ is large relative to the weight of the injunctive norm σ, the two stable Nash equilibria are either no participation or full participation. When the weight of the descriptive norm λ is smaller relative to the weight of the injunctive norm σ, we also identify cases when the population might be trapped in a stable low participation equilibrium. The switch from one equilibrium to the other depends of course on the levels of net payments p-c. This suggests the design of a differentiated payment system. For example the regulator could offer a high payment rate at the start of the programme, to boost enrolment and to bring overall participation rate beyond the equilibrium point. Once this threshold participation level is reached, he can then lower the payment for new entrants since the strength of the descriptive norm combined with the injunctive norm will be sufficient to ensure full participation. This two-tier payment can be efficient whilst at the same time limit budget expenditures.

Another policy option is to influence the relative values of λ and σ. Indeed these parameters also capture the salience and visibility of social norms. The more salient a social norm, the greater its weight in the utility function. If a communication campaign promotes the necessity to reduce the use of pesticides because of their impact on nature and health, it may contribute to reinforce the scope of the injunctive norm and therefore the value of σ relative to λ, thus increasing the chances to land on a stable high (or full) participation equilibrium. The use of communication campaigns (Nyborg *et al*., 2006; Benabou and Tirole, 2012) must be considered with care. Communication messages are often targeted at norm misperceptions. "*Lifting the veil*" (Bicchieri, 2006), *i.e*. modifying the perception of the norm, is indeed much easier than modifying the norm itself. Different policies may be necessary depending on the type of misperception. The example of campaign aiming at correcting these misperceptions in order to reduce alcohol overuse is a famous example of effective social norms campaigns (Schroeder and

Prentice, 1998). The credibility of social norm communication campaigns is however problematic when the regulator decides to disclose the information that he finds most suitable to obtain the expected result. Examples of failure of social norm campaigns which misreported data or used date considered unreliable by the target population are reported in Berkowitz (2004).

Another appproach would be to strengthen communication on the adoption of other farmers and/or the opinion of other farmers during the period in which farmers decide to adopt. The experiment carried out by Kuhfuss *et al* (2016) shows the positive impact of revealing information on other farmers' decision on the maintenance of pro-environmental practices at the end of an AES contract, when the adoption rates communicated are high enough. Our model however shows that revealing this information may be counterproductive when adoption rates are low, because the descriptive norm actually limits adoption in this context. Another option is therefore to modify the design of AES in order to alter farmers' belief on the descriptive norm. Conditionning the payment of AES to a minimum level of participation can indeed increase participation through the modification of beliefs (Le Coent *et al*., 2015). Kuhfuss *et al* (2014) demonstrate that a greater farmers' enrolment can be obtained for lower payments, by conditionning only a portion of the payment to a threhsold of participation.

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APPENDIX A

Following Rege (2014), we use the replicator dynamics to represent a "virtual" learning process of trial-and error.

"*The replicator dynamics say that the growth rate of the population share using a certain strategy equals the difference between the strategy's current payoff and the current average payoff in the population (Weibull, 1995, p. 73).*"

In our case, the replicator dynamics is given by:

$$\dot{x}(x) = x(U_i^1(x) - \overline{U}(x))$$

Where $\overline{U}(x) = xU_i^1(x) + (1-x)U_i^0(x)$

$$\dot{x}(x) = x(1-x)\Delta U(x)$$
$$\dot{x}(x) = x(1-x)[p - c + 2\lambda(2x-1)]$$

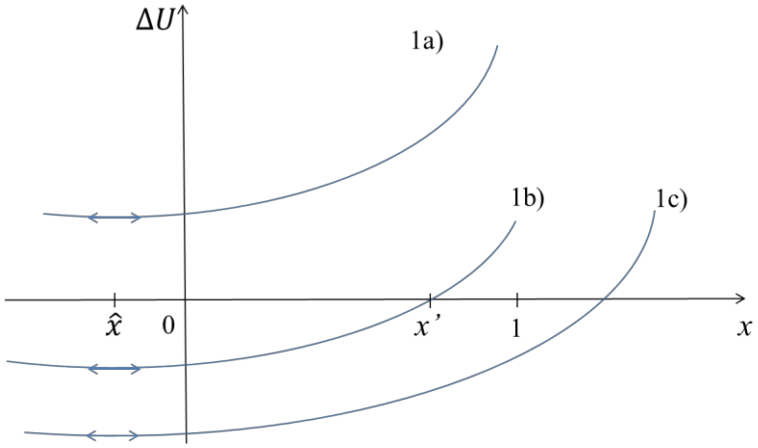
Stationary states are determined by $\dot{x}(x) = 0$. Thus, there are three stationary states: $x = 0$, $x = 1$ and $x = x' = \frac{1}{2} - \frac{p-c}{4\lambda}$.

For $0 < x < 1$, $\dot{x} > 0$ if $\Delta U = p - c + 2\lambda(2x-1) > 0$ and thus if and only if $x > \frac{1}{2} - \frac{p-c}{4\lambda} = x'$. Symmetrically, for $0 < x < 1$, $\dot{x} < 0$ if $\Delta U = p - c + 2\lambda(2x-1) < 0$ and thus if and only if $x < \frac{1}{2} - \frac{p-c}{4\lambda} = x'$. Hence, $x = x'$ is not an asymptotically stable state because if the share of farmers who enrol in AES moves above $max\{0, x'\}$, then $x > x'$ and $\Delta U > 0$. Therefore more farmers will enrol in AES. This process will continue until all farmers are enrolled and the asymptotically stable state $x = 1$ is reached. Symmetrically, if the share of farmers who enrol in AES moves below $min\{1, x'\}$, then more farmers will quit the AES. This process will continue until all farmers leave the AES and the asymptotically stable state $x = 0$ is reached.

APPENDIX B

Case 1: $\hat{x} \leq 0 \quad \Leftrightarrow \quad \sigma \leq 2\lambda$

The weight of the injunctive norm is not too strong relatively to the weight of the descriptive norm. In this first case ΔU is always increasing on $x \in [0,1]$ and there are 3 subcases:



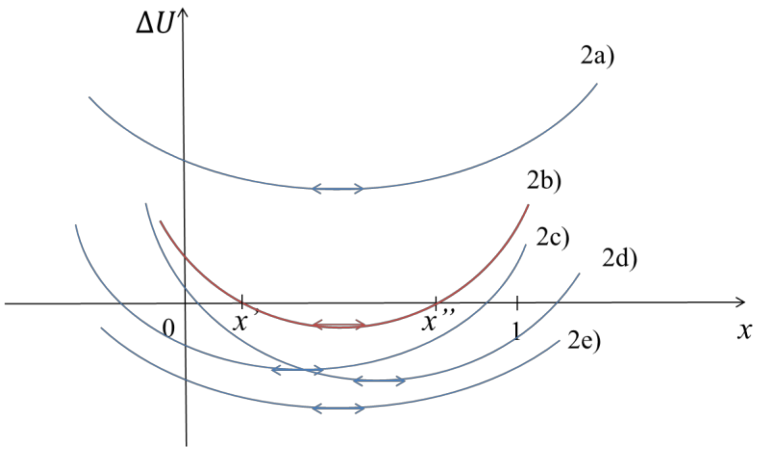
1a) If $\Delta U > 0$ when $x = 0$ then $\Delta U > 0 \; \forall x \in [0,1]$. Thus there is a unique Nash equilibrium in which all farmers enrol in AES ($x = 1$).

1b) If $\Delta U < 0$ when $x = 0$ and $\Delta U > 0$ when $x = 1$ then there is a unique $x' \in [0,1]$ such that $\Delta U(x') = 0$. In that case there are three Nash equilibria: $x = 0$, $x = 1$ and $x = x'$. However there are only two asymptotically stable states $x = 0$ and $x = 1$.

1c) If $\Delta U < 0$ when $x = 1$ then $\Delta U < 0 \; \forall x \in [0,1]$ thus there is a unique Nash equilibrium in which no farmer enrols in AES ($x = 0$).

Case 2: $0 < \hat{x} < 1 \Leftrightarrow 2\lambda < \sigma < 8\lambda$

The weight of the injunctive norm is not too strong and not too weak relatively to the weight of the descriptive norm. In this second case, ΔU is first decreasing until $\hat{x}$ and then increasing. There are 5 subcases:



2a) If $\Delta U_{min} > 0$ then $\Delta U > 0 \; \forall x \in [0,1]$ thus there is a unique Nash equilibrium in which all farmers enrol in AES ($x = 1$).

2b) If $\Delta U_{min} \leq 0$ and $\Delta U > 0$ when $x = 0$ and $\Delta U > 0$ when $x = 1$ then there are two $x \in [0,1]$ (x' and x") such that $\Delta U(x') = \Delta U(x") = 0$. In that case, there are three Nash equilibria: $x = x'$, $x = x"$ and $x = 1$. However there are only two asymptotically stable states in this coordination game: $x = x'$ and $x = 1$.

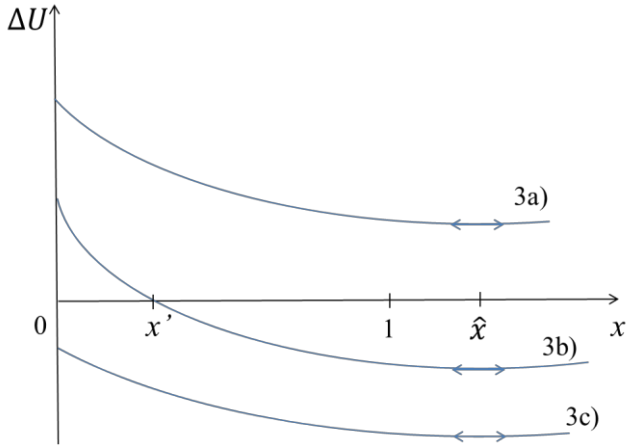
2c) If $\Delta U_{min} \leq 0$ and $\Delta U < 0$ when $x = 0$ and $\Delta U > 0$ when $x = 1$ then there is a unique $x' \in [0,1]$ such that $\Delta U(x') = 0$. In that case there are three Nash equilibria: $x = 0$, $x = 1$ and $x = x'$. However there are only two asymptotically stable states $x = 0$ and $x = 1$.

2d) If $\Delta U_{min} \leq 0$ and $\Delta U > 0$ when $x = 0$ and $\Delta U < 0$ when $x = 1$ then there is a unique $x' \in [0,1]$ such that $\Delta U(x') = 0$. In that case there is a unique Nash equilibria: $x = x'$.

2e) If $\Delta U_{min} \leq 0$ and $\Delta U < 0$ when $x = 0$ and $\Delta U < 0$ when $x = 1$ then $\Delta U < 0 \; \forall x \in [0,1]$ thus there is a unique Nash equilibrium in which no farmer enrols in AES ($x = 0$).

Case 3: $\hat{x} \geq 1 \quad \Leftrightarrow \quad \sigma \geq 8\lambda$

The weight of the injunctive norm is strong relatively to the weight of the descriptive norm. In this last case ΔU is always decreasing and there are 3 subcases:



3a) If $\Delta U > 0$ when $x = 1$ then $\Delta U > 0 \; \forall x \in [0,1]$ thus there is a unique Nash equilibrium in which all farmers enrol in AES ($x = 1$).

3b) If $\Delta U > 0$ when $x = 0$ and $\Delta U < 0$ when $x = 1$ then there is a unique $x' \in [0,1]$ such that $\Delta U(x') = 0$. In that case there is a unique Nash equilibria: $x = x'$.

3c) If $\Delta U < 0$ when $x = 0$ then $\Delta U < 0 \; \forall x \in [0,1]$ thus there is a unique Nash equilibrium in which no farmer enrols in AES ($x = 0$).