Do farmers follow the herd? The influence of social norms in the participation to 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

"No to technocratic ecology, yes to farmers' common sense" – this slogan chanted by French farmers during demonstrations in 2014 reveals a strong cultural resistance of the farming community to the growing weight of environmental objectives in agricultural policies. Yet, although there is increasing evidence that farmers' motivations for adopting pro-environmental farming practices are not exclusively driven by economic calculus, agri-environmental policies have not evolved much in the last 15 years. One of the dominant policy instrument used in these policies are contracts in which farmers who voluntarily commit to adopt pro-environmental practices receive incentive payments to compensate their costs or foregone profits. Several important agri-environmental policies rely on this approach: Agri-Environmental Schemes (AES) in Europe, different programmes of Payment for Environmental Schemes (PES) implemented mainly in developing countries and the Environmental Quality Improvement Programme (EQIP) in the Unites States[1].

The underlying assumption of these programs is that compensating farmers for the additional cost of adopting pro-environmental practices is sufficient to induce a change. However, in practice, it is observed that some farmers are extremely reluctant to switch to new farming practices even when the payment level is above additional costs and income foregone (Kuhfuss et al., 2014). This has resulted in limited participation rates especially in areas of intensive farming and in limited environmental outcomes (Dobbs and Pretty, 2008; Solagro, 2013).

Several hints indicate that social norms may be at play in the adoption of AES and pro-environmental practices. The importance of "roadside farming", that is to say, how farmers observe each other's practice by the side of the road and how it influences their decisions, is often mentioned as a determinant of behavior (Burton, 2004). According to some empirical work based on surveys, farmers' decision to adopt an AES is influenced by the opinion of other farmers on AES (Defrancesco *et al.*, 2008). They are also more likely to participate if they live close to a an area where AES adoption is high (Allaire *et al.*, 2009). Other studies based on experimental approaches reveal that farmers are more likely to adopt an AES or maintain their pro-environmental practices at the end of the contract, in case a high number of farmers does so (Chen *et al.*, 2009; Kuhfuss *et al.*, 2016b). Besides, the role of social norms, sometimes referred as social comparison or conditional cooperation, has been highlighted in the context of other pro-environmental behavior, for example in the field of energy consumption (Allcott, 2011), water consumption (Ferraro *et al.*, 2011), curbside recycling (Schultz, 1999), littering (Cialdini *et al.*, 1990) and charitable contributions (Shang and Croson, 2009).

Despite the potential extensive role of social norms in the adoption of AES, this factor has been largely omitted in the way contracts and policies have been so far designed. This may partially explain the limited participation of farmers in AES and their limited effectiveness. In this article, we intend to investigate how 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

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[1] We will henceforth use the acronym AES as a generic term for these contracts.

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 Literature review on social norms

The influence of social norms on individual decisions has been only recently investigated in economic theory. In order to analyze the influence of social norms on farmers' adoption of AES we therefore first explore the contributions of social-psychology on the definitions of social norm and how they influence human behavior. We then briefly review the existing economic model that include social norms.

1.1 Different types of social norms

Social norms describe how individual actions are influenced by the behavior or opinions of others. 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).

Cialdini *et al.* (1990) propose a division of social norms, subsequently taken up by many authors: the descriptive norm and the injunctive norm. 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) 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.
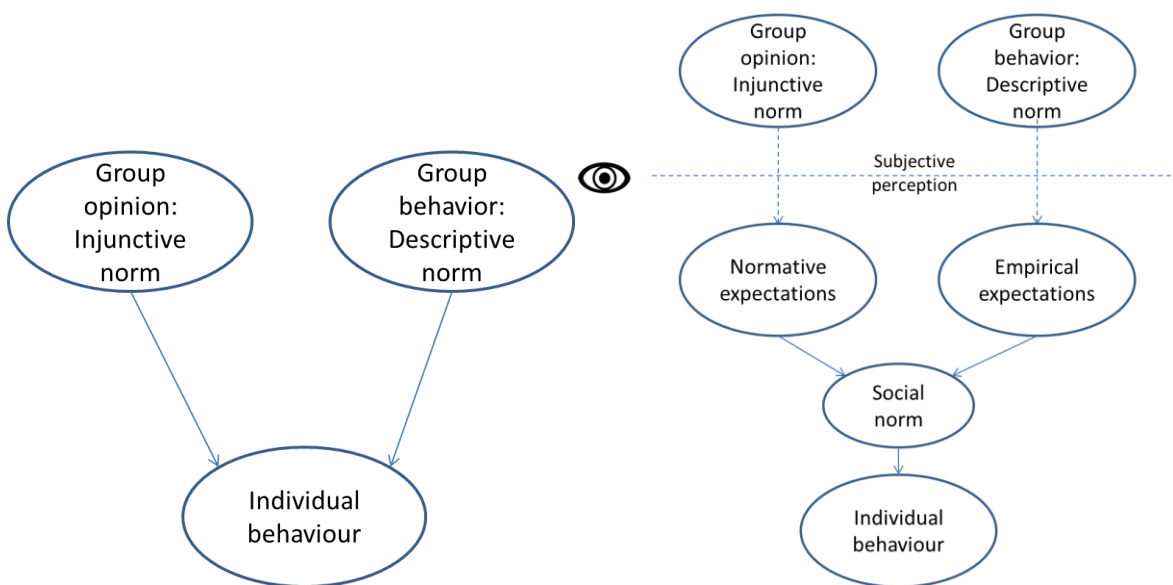

Figure 1: Influence of social norms on individual behavior according to Cialdini *et al.* (1990) (left) and according to Bicchieri (2006) (right)

1.2 Theoretical modeling of social norms

Social norms have been modeled in different ways in the literature. Lindbeck *et al.*(1999) consider a social norm as a stigma for carrying out an antisocial activity (a negative payoff) that decreases with the number of people who infringe it. Rege (2004) consider that people who do not adopt a pro-environmental activity are disapproved if they meet someone that adopts it but they have less chance to meet them than someone with the same behavior. Nyborg et al. (2006) propose a model in which 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. Finaly, 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.

In these models, the descriptive norm is generally considered only as an increasing function of adoption, i.e. a more or less strong support for the adoption of a pro-social activity. It is weak when

few people adopt and strong when the behavior becomes more common in the population. The existence of conservative forces that may urge people not to adopt a pro-social activity, when few people adopt it, is generally not considered. These phenomena can be nevertheless found in present or past human history, where strong social pressure to maintain anti-social activities exists. We believe that such forces may be at work in the adoption of pro-environmental behavior in farming communities.

Another aspect of the role of social norms that is not well captured is the way the injunctive norm is formed and subsequently influences behavior. There is very little information in the literature that gives hints on how the general opinion on what should be done is formed and therefore how it could be modeled.

In the subsequent section, we will intend to integrate these aspects - the negative effect of the descriptive norm in situations of low adoption and a mechanism of formation of the injunctive norm - in a model of adoption of AES.

2   Modelling the effect of social norms on the adoption of AES

In this model, we study farmers' enrolment in AES in the presence of an injunctive and a descriptive norm. The theoretical framework is close to Rege's model (2004).

2.1   Theoretical framework

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, $\bar{e} = x$. In other words, we consider a context in which the individual farmer does not perceive the benefits of his individual contribution. The strategic aspect of the public good game is therefore not taken into account in this model.

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 $p > c$.*

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2.2 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. $x > \frac{1}{2}$.
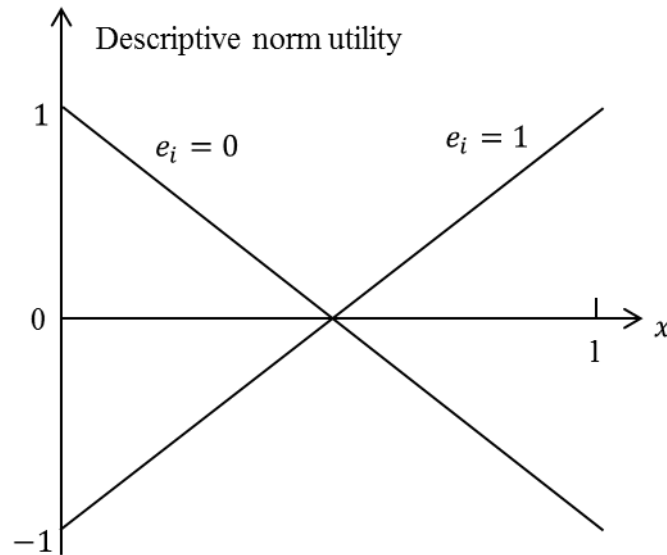

Figure 2: Variation of descriptive norm utility according to participation

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:

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

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

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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 $c - 2\lambda \leq p \leq c + 2\lambda$.

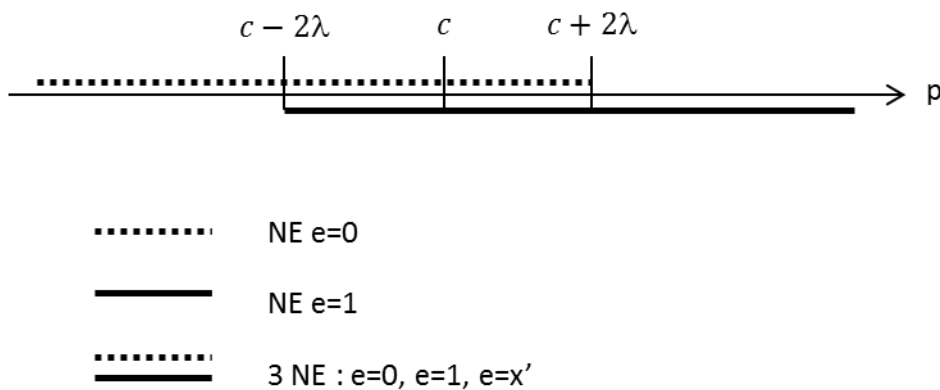Figure 3 presents the conditions on p for the existence of the Nash Equilibrium.

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.
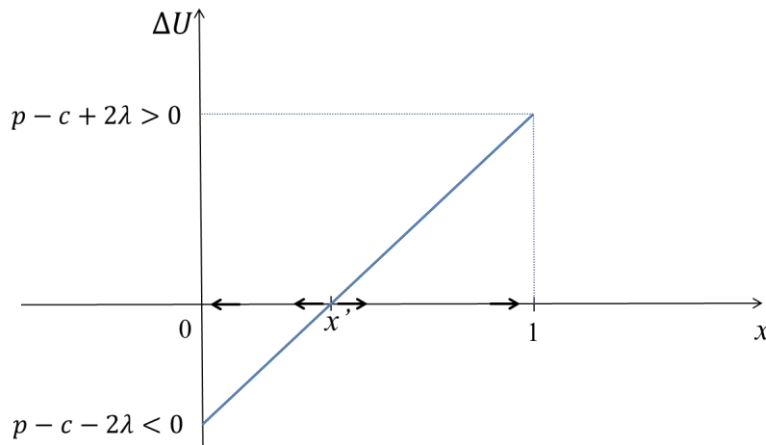

Figure 4: Difference in farmer i's utility in the coordination game when $c - 2\lambda < p < c + 2\lambda$

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.

2.3   Injunctive norm

Two features characterize the injunctive norm that intervenes in AES adoption. First, we assume that this injunctive norm 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).
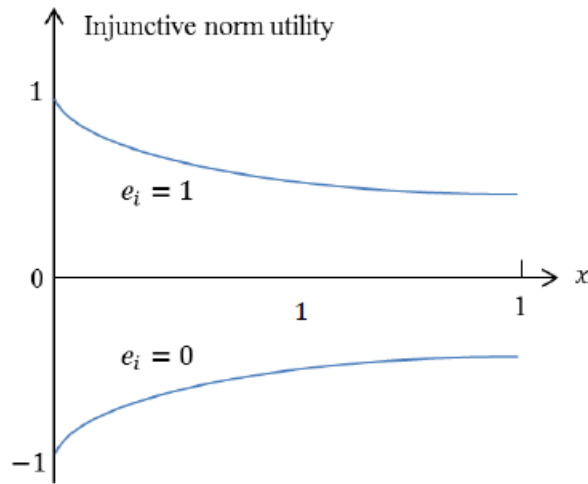
Figure 5: Variation of injunctive norm utility according to participation

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

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

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

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.
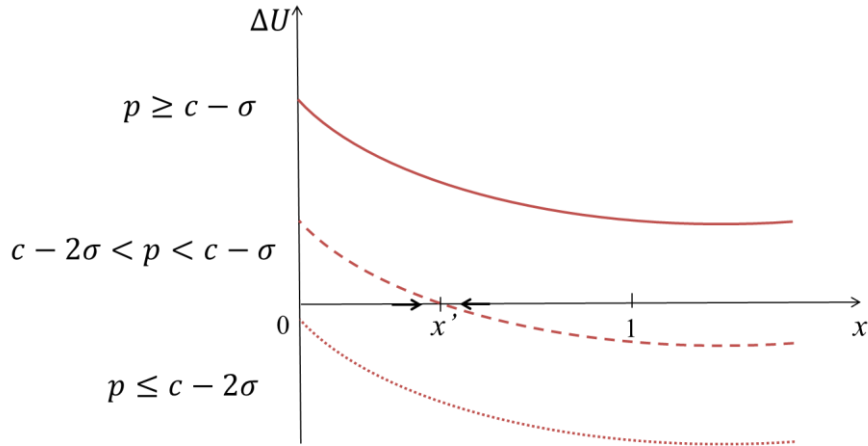

Figure 6: Difference in farmer i's utility in the three cases according to the value of p compared to $c - 2\sigma$ and $c - \sigma$
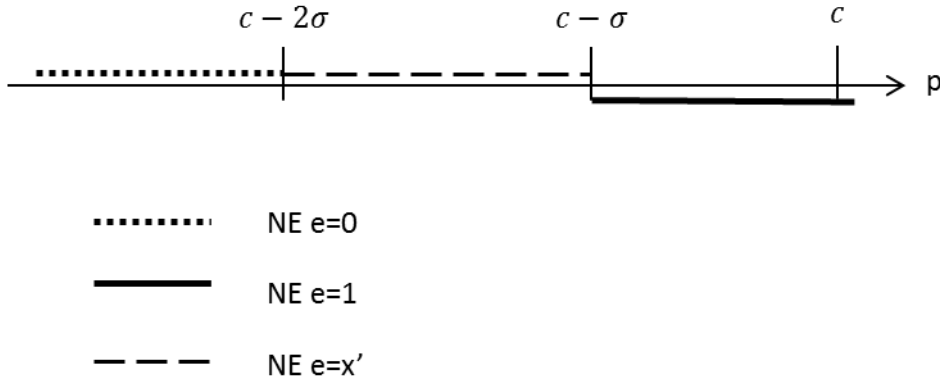
Figure 7: Nash equilibria with the injunctive norm in relation with the value of p

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.

2.4 Combining descriptive and injunctive norms

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 $\sigma \geq 8\lambda$.

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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.
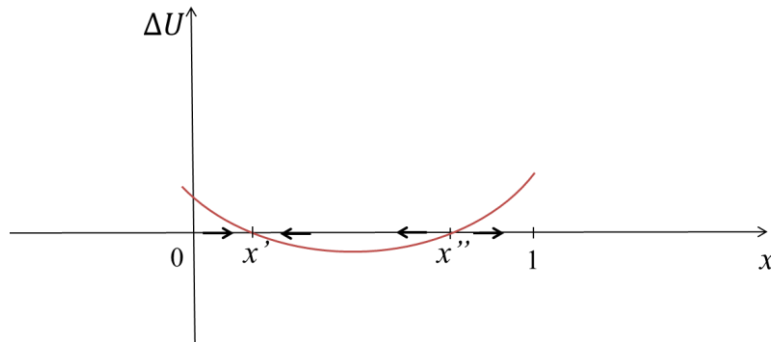

Figure 8: Utility variation for subcase 2b)

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.

Finally, our model provides insights on the isolated and combined effects of the descriptive and injunctive social norms on the adoption of AES. The model reveals that different situations are possible depending on the relative weight or salience of the norm: λ and σ. In the following section, we develop an empirical approach in order to determine if social norms intervene in AES adoption and the relative weight, λ and σ, of each norm. Hopefully, this will help us identify the model case that best applies to the current situation. Consequently, we will use the predictions of the model to draw policy implications to improve AES adoption in the conclusion.

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

Estimating the role of social norms on the adoption of AES is not straightforward. In the behavioral economics literature, experimental approaches are generally used to estimate the influence of different behavioral factors (Cialdini *et al.*, 1990; Schultz, 1999; Shang and Croson, 2009; Allcott,

2011; Ferraro *et al.*, 2011). These approaches have the advantage to estimate a robust causality link between the behavioral factor and the studied outcome. They however usually analyze the different behavioral factors in isolation and require the introduction of an exogenous variation of the norm to estimate the impact on the studied behavior. Although this approach could be used to analyze the effect of the descriptive norm, using this approach for both the injunctive and the descriptive norm appeared to be unfeasible. On the other hand, social psychology uses stated preference surveys with standardized questions to estimate the role of a variety of behavioral determinants of behavior, including descriptive and injunctive social norms. We therefore apply insights from social psychology to estimate the impact of social norms on the adoption of AES.

3.1   Survey methodology

a) Survey context and sample

In Europe, AES are proposed to farmers for a diversity of objectives. In order to limit the possible heterogeneity coming from the diversity of socio-cultural context and the diversity of contracts, we decided to focus our study on one region, the Languedoc-Roussillon in the South of France and one specific type of AES: AES aiming at reducing pesticide use for the protection of drinking water quality. In this context, AES are proposed to farmers in specific water catchments that present water quality issues.

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 in order to limit one of the main endogeneity problem of these studies. Indeed, 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. This problem was a priori limited because the questionnaire was sent exactly at the moment farmers were taking their decision to enroll or not in these AES.

The survey was sent to 700 wine growers with an email address and were eligible for the adoption of these AES. The invitation to participate in the survey was sent by facilitators who are involved in the implementation of AES at the territorial level. 98 farmers eligible to the proposed AES finally responded to the questionnaire. This represents a response rate of 14% which is quite good for this type of survey.

b) The questionnaire
-   **Social norm questions**

In this questionnaire, the main issue is to develop questions to capture the role of social norms. The overall idea of the questionnaire on social norms is not to ask farmers to declare whether they are influenced by social norms, which would be subject to large declaration bias, but rather to have an estimation of their perception of the social norm and to determine with an econometric analysis whether this influences their decision to adopt an AES.

The social norm questions are elaborated based on the literature review on the definition of norms presented in section 1 from Cialdini et al. (1990) and Bicchieri (2006). We consider the following definitions in our context:

- *Descriptive norm*: what farmers believe other farmers will do in terms of adoption of AES
- *Injunctive norm*: what farmers believe others think about their adoption of AES

In these definitions, subjective beliefs are considered as the determinant of behavior rather than the actual behavior or opinion of others (Bicchieri, 2006). Another important aspect is that the *descriptive norm* only considers the behavior of other farmers while the *injunctive norm* includes the perception of a much wider spectrum of people.

In the questionnaire, the *descriptive norm* question is directly linked to the previous definition and is similar to the one used in other referent studies (e.g. Thøgersen, 2008):

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

The principle of this open question is to determine beliefs on the behavior of a community of reference (Thøgersen, 2008). We consider here that "farmers of the territory" represents this community. We keep the notion of "territory" vague so that farmers could decide 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 farming community of reference (municipality, watershed, cooperative...).

For the injunctive norm, we use the approach suggested by Ajzen (1991), to consider the opinion of salient referents or "important others" to determine the influence of the injunctive norm:

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

Farmers indicate their level of agreement with a 5 point unipolar Lickert scale, hereafter called the agreement scale: 1= strongly disagree; 2=disagree; 3=neutral; 4=agree; 5=strongly agree.

To these "standard" questions used to evaluate the influence of social norms, we add a set of additional questions to capture possible other dimensions of the norm. We for example add a question on the perception of the injunctive norm amongst other farmers of the territory:

"*The majority of farmers of my territory are in favor of AES.*" (Agreement scale)

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).

Finally the questionnaire includes 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.*"

- **Outcome questions: the adoption of AES**

The outcome behavior we try to estimate is the decision to adopt an AES. It is based on declared behavior. Two different questions were asked to analyze this decision:

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

We kept the formulation "decided to sign" as most farmers who had already decided to sign hadn't officially signed the contract at the moment of the survey.

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. In addition, the intention to adopt a behavior is considered to be a good predictor of behavior in one of the most used psychosocial theory to predict pro-environmental behavior: the Theory of Planned Behavior (TPB) (Ajzen, 1991).

- **Other indicators**

The TPB considers that the intention to adopt a behavior can be predicted by three predictors: the attitude, the perceived behavior control and the subjective norm. Because we use the subjective norm definition to estimate the susceptibility to the injunctive norm, we also include these variables in the questionnaire.

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 is easy or not. The concept of perceived behavior control is close to the constraints used in classic economic theory, which here represents the costs associated with the adoption of AES (Lynne, 1995). The response to this question will therefore serve as a proxy to evaluate the cost of adopting the AES for the farmer.

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

3.2 Data analysis and results

a) Data analysis

The behavior that we are trying to predict is characterized by two variables: the actual decision to adopt an AES in 2015 and the intention to adopt in the 2 following years. To facilitate the analysis, we create a combined 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 already decides to sign 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:

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

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

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

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

For robustness check, we also undertake logit estimations of the variable sign AES (see table 1) that take value 1 for those who have signed an AES in 2015 and 0 otherwise.

Descriptive statistics of the social norm variables are presented in the graphics below (Figure 9).
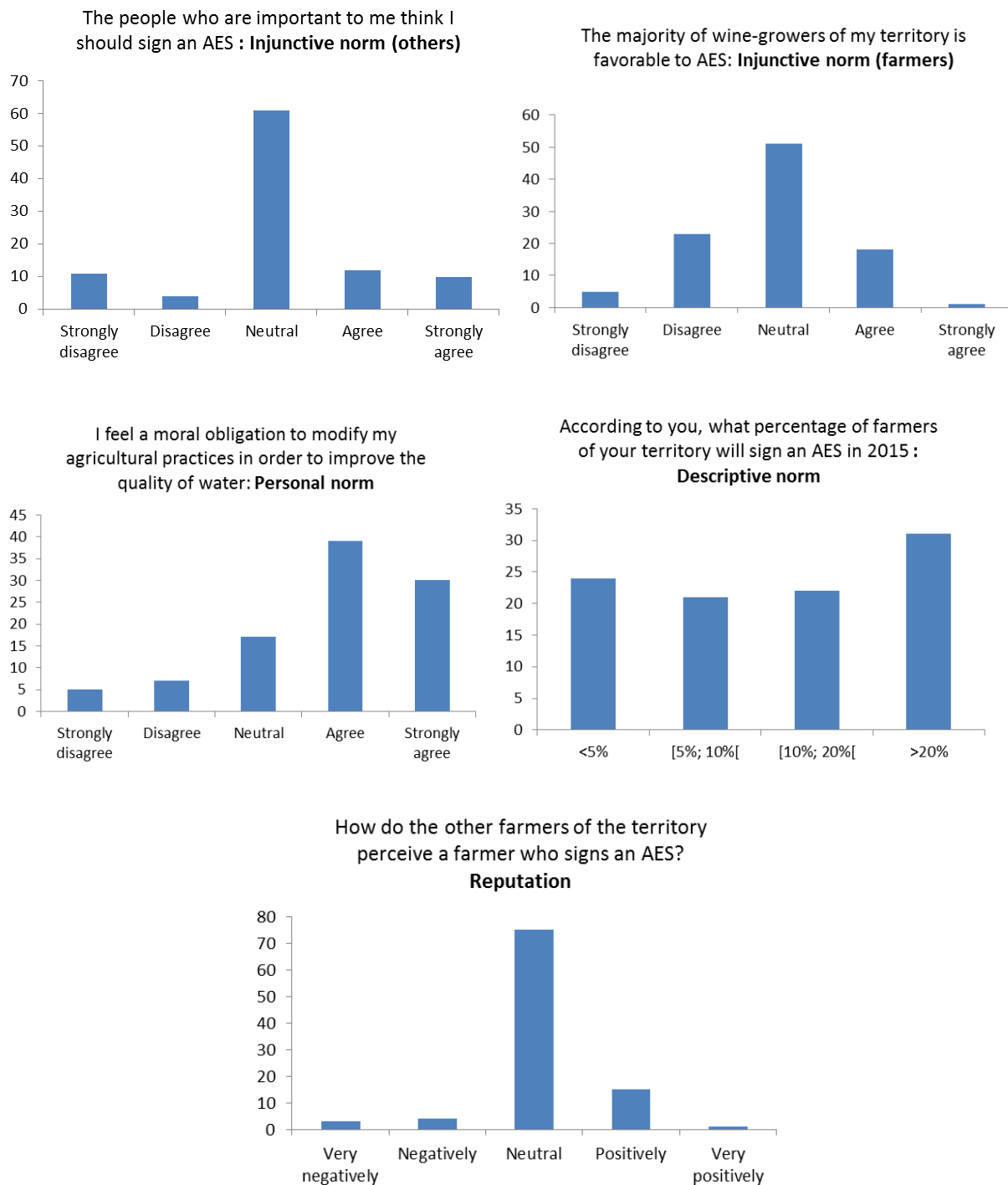

Figure 9: Descriptive statistics of the social norm indicators (In y axis is the number of farmers)

Considering the large amount of neutral response, we 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 discard the reputation indicator which displays too many neutral responses.

b) Results and discussion

The results of 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 an AES in the two models: the perceived easiness of AES adoption, the injunctive norm from important others and the personal norm. The first variable (easiness), 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 also influenced by the injunctive norm exerted by people who matter to them (Injunctive norm (others)). 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.

The descriptive norm (descriptive norm) and the perceived opinion of farmers on AES (Injunctive norm (farmers)) do not have a significant impact on the probability to accept an AES. This result is quite surprising as we expected farmers to be influenced by the opinion and the decisions of

their peers. Different reasons could explain this non-significant impact. 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 injunctive norm exerted by other stakeholders. Indeed another parallel survey we carried out in the same region reveals that family and farm advisors have a stronger influence than neighbor farmers (Le Coent, 1016). This lack of influence may otherwise be due to the low and homogeneous subjective percentage of farmers expected to adopt an AES throughout our sample. This lack of heterogeneity in our data therefore limits our capacity to identify a potential role of the descriptive norm. Finally, 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 at the moment of the decision (Cialdini *et al.*, 1990). Increasing this salience may therefore increase the influence of the descriptive norm.

Finally, other variables influence the decision to sign an AES: 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.

All in all, the adoption of AES in this empirical analysis seems to illustrate case 3 of our model, where the injunctive norm has a significant effect and the descriptive norm a limited one. In this case presented in appendix A, the effect is so limited that farmers behave as if there was no descriptive norm. In this situation, when the payment level is intermediate, the situation may remain blocked in a stable low-adoption equilibrium x', that could explain the present low AES adoption rated. In section 4, we propose policy recommendations to escapte this low adoption trap.

The results obtained in this empirical study bear a number of limits. The first limit is the reduced sample size. The aim of this study was to elaborate a relatively simple questionnaire, despite the usual complexity of social norm questions, which could be administered via internet to reach a large sample of farmers. The involvement of AES facilitators of the Languedoc Roussillon in the survey was also 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 limit is the robustness of 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 by claiming they feel morally supported by their social network.

4 Conclusion and policy recommendations

This paper analyzes both theoretically and empirically the influence of social norms on the adoption of agri-environmental schemes.

Our theoretical model analyses the interplay between two types of social norms which sometimes play in opposite directions. Whereas the injunctive norm tends 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 in which the population might be trapped in a stable low participation equilibrium. The empirical analysis based on a web survey with 98 respondents on the adoption of herbicide reduction AES, reveals that the latter case probably prevails in this situation. Several policy recommendations can be drawn from this theoretical and empirical approach.

The switch from the low equilibrium to the higher one 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 high equilibrium point. Once this threshold participation level is reached, he can then reduce 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.

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* (2016b) 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.

The use of communication campaigns (Nyborg *et al.*, 2006; Benabou and Tirole, 2012) must also 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 data considered unreliable by the target population are reported in Berkowitz (2004).

Another option is therefore to modify the AES payment rule in order to modify beliefs on the behavior of others and thus the perseived descriptive norm. Conditionning the payment of AES to a minimum level of farmers' participation can indeed increase participation through the modification of beliefs on the behavior of others (Le Coent *et al.*, 2015). Kuhfuss *et al* (2014, 2016a) 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: $\hat{x} \le 0 \quad \Leftrightarrow \quad \sigma \le 2\lambda$

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:
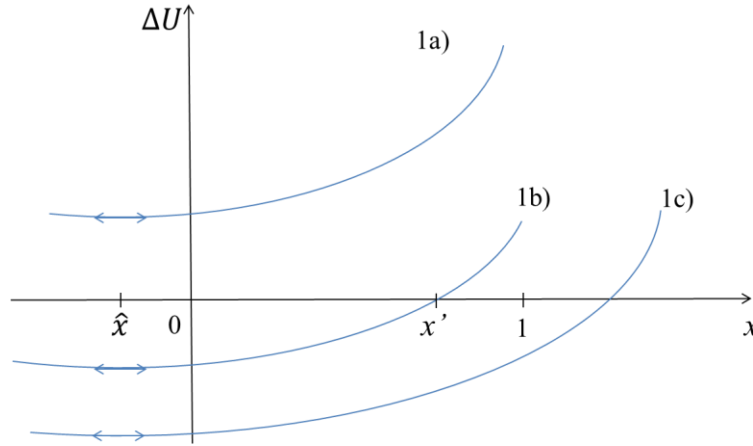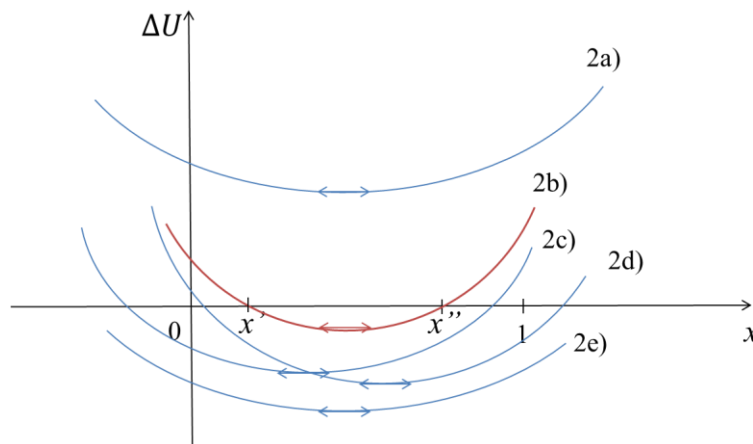

1a) If $\Delta U > 0$ when $x = 0$ then $\Delta U > 0 \; \forall x \in [0,1]$. Thus there is a unique Nash equilibrium in which all farmers enrol in AES ($x = 1$).

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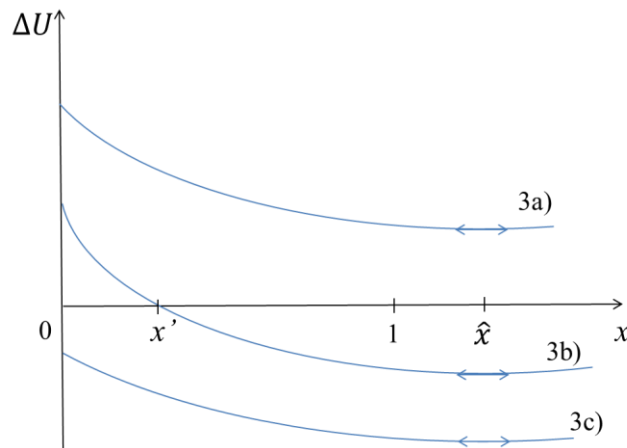
2c) If $\Delta U_{min} \leq 0$ and $\Delta U < 0$ when $x = 0$ and $\Delta U > 0$ when $x = 1$ then there is a unique $x' \in [0,1]$ such that $\Delta U(x') = 0$. In that case there are three Nash equilibria: $x = 0$, $x = 1$ and $x = x'$. However there are only two asymptotically stable states $x =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

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« Do farmers follow the herd? The influence of social norms in the participation to agri-environmental schemes.»

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