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NEGATIVE EXTERNALITIES IN CROPPING DECISIONS: PRIVATE VERSUS COMMON LAND

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Negative externalities in cropping decisions: Private versus common land*

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Abstract

This paper analyzes to what extent the definition of property rights affects cropping decisions when these decisions generate negative externalities. To that end, we implement an experimental study where agents make cropping decisions in two different treatments: private and common land. The results show that there are no statistically significant differences between the two treatments in the contribution to the negative externality, thus revealing that the definition of property rights does not affect cropping decision in this context. Furthermore, our findings indicate that the implication of the agents in activities generating negative externalities tends to increase over time, thus amplifying its adverse consequences.

Keywords: negative externality, cropping decisions, private land, common land.

JEL classification: Q15, D62, C91, C92.

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1 Introduction

Two solutions have traditionally been proposed to address the problem of externalities described in the tragedy of the commons (Hardin, 1968): the establishment of a coercive power and the imposition of private property rights. Although there are exceptions (Ostrom, 1990), privatization and government ownership have been usually considered as panaceas for solving the problem of the commons. Nevertheless, some studies have remarked that in socio-ecological systems there are no one-size-fits-all solutions (Ostrom, 2007; Ostrom et al., 2007; Ostrom et al., 2010). The problems of overuse and destruction of natural resources are diverse and involve many different variables (biological, economic, social) and it is therefore complicated to find a single solution. Each situation requires its own diagnosis and its own solution.

An extensive literature has examined the impact of different factors on the exploitation of common property resources, including monitoring and sanctioning (Ostrom et al. 1992; Casari and Plott, 2003), information and payoff structures (Apesteguía, 2006), resource scarcity (Osés-Eraso and Viladrich-Grau, 2007; Osés-Eraso et al., 2008), among many others. However, despite the fact that private property has been proposed as a general solution to the problem of the commons, the testing of this hypothesis using experiments has received scarce attention in the literature. Some experimental studies have analyzed the effect that the definition of property rights may have on the behavior of the agents. Cox et al. (2009), for example, analyzed a trust game where initial endowment can be private or common property. They found that endowments which are induced as common property lead to marginally greater cooperation or trust, in contrast to what most scholars would expect. However, Cox and Hall (2010) showed that cooperation is lower in common property trust games when property right entitlements are strengthened. There are also cases of natural resources that have been privatized. For example, Grafton et al. (2000) examined the effects of privatization on the British Columbia halibut fishery, paying particular attention to the resources features that are key to improving the degree of efficiency.

The definition of property rights is particularly relevant in land exploitation. Farmland can be exploited under common property or under private property and in both situations cropping decisions may generate negative externalities. This is the case in contexts where externalities are related to the use of pesticides (Wilson and Tisdell, 2001), or to the occurrence of diseases due to the specialization in certain crops (Weitzman, 2000). In such cases, the externality does not know of property rights: farmers who adopt biological pest control strategies on their private land will be affected due to externalities of pesticides arising from neighboring holdings (Wilson and Tisdell, 2001), whereas farmers centered on relatively few high-yield crops encourage the development of more crop-specific parasites globally (Weitzman, 2000), regardless if the land is private or common. In addition, farmers who do not use pesticides or do not plant a specific crop may be forced to do so to avoid economic losses, thus amplifying the negative externality.

Against this background, this paper aims to examine whether the definition of property rights affects cropping decisions when these decisions generate negative externalities. To that end, we develop an experimental study where agents face cropping decisions in two different settings. In the first setting property rights are individually/privately defined (*private land treatment*), whereas in the second setting property rights fall on a well-defined community of users (*common land treatment*). This change in the definition of property rights does not modify the negative externality associated with cropping decisions; it simply modifies the context in which it develops. In the private land treatment, each player has her own plot of land, while in the common land treatment all players share a plot of land. In the two treatments agents face the same cropping decisions. In particular, they must choose between two alternative projects (i.e. crops) A and B. Project A represents externalities due to the use of pesticides or due to diseases related to crop specialization, whereas project B is free of externalities. Investment in project A is individually optimal but not socially optimal.

Our experimental design is based on Andreoni (1995) and on Osés-Eraso and Viladrich-Grau (2007). The first study analyzed cooperation in a framework of negative externalities against a framework of positive externalities, while the second modified Andreoni's design to study the appropriation of common resources. We slightly modify Andreoni's negative framework for our private land treatment and take the Osés-Eraso and Viladrich-Grau's equivalent design for our common land treatment.

In our analysis we pay particular attention to the potential impact on the results of the existence of differences in the subjects' preferences. For this reason, in both treatments cropping decisions are taken in two different contexts, a conditional context and a simultaneous context. In the former, each agent knows the cropping decision of others before making her own decision. In the latter, all agents make cropping decisions simultaneously and repeatedly, using only the information provided by past cropping decisions. The conditional context is based on Fischbacher et al. (2001), who applied a variant of the so-called "strategy method" (Selten, 1967) to draw out agents' preferences.

The experimental results show that the definition of property rights does not affect cropping decisions in this context. This suggests that privatization can not be considered a panacea to address the problem of negative externalities in the exploitation of common property resources. In addition, the implication of agents in crops that generate negative externalities tends to increase over time. The results also indicate that the preferences shown in the conditional context are one of the determinants of the agents' behavior in the simultaneous context. Preferences do not seem to change with the experience gained from repeating the game.

The paper is organized as follows. Section 2 introduces the theoretical framework of the private land game and the common land game. Section 3 describes the experimental design and procedure. Section 4 shows the main experimental results. Finally, conclusions and future research are presented in section 5.

2 The games

2.1 Private land treatment

Assume n landowners each of whom has a plot of potential value P. The final value of the plot depends on cropping decisions. Each landowner has an endowment e to make cropping decisions. Two different crops are available: crop or project A and crop or project B. Each endowment point invested in crop A returns m points to the landowner but reduces the landowner's plot value and the other landowners' plot value by α points. In turn, each endowment point invested in crop B returns w points to the landowner and has no additional impact on individual plots. In the rest of the paper, we refer to investment in crop A as *contribution* to the negative externality.

Each landowner invests her entire endowment between the two types of crops. Let x_i be the part of the endowment invested in crop A by landowner i, that is, contribution to the negative externality. In turn, $(e-x_i)$ is agent i's investment in crop B. The individual plot value after the cropping decisions of all landowners is $P_F = P - \alpha \sum_{i=1}^{n} x_i$. The game payoff for landowner i after the cropping decisions, π_i, is the sum of the return from her investment in crop A, the return from her investment in crop B and the plot value.

$$\pi_i = mx_i + w(e - x_i) + P - \alpha \sum_{i=1}^{n} x_i$$

where $m - n\alpha < w < m - \alpha$. That is, for each landowner the marginal net return from crop A is greater than the marginal net return from crop B, $m - \alpha > w$. Likewise, the marginal net return for all landowners from crop A is smaller than the marginal net return for all landowners from crop B, $m - \alpha n < w$. Therefore, the game represents a social dilemma where individually optimal decisions are not socially optimal. As can be checked, the Nash solution is the full contribution to the negative externality, $x_i = e$, while the efficient solution is $x_i = 0$.

2.2 Common land treatment

Assume n landowners share a plot of potential value C. The final value of the plot depends on cropping decisions. Each landowner has an endowment e to make cropping decisions. Two different crops are available: crop or project A and crop or project B. Each endowment point invested in crop A returns m points to the landowner but reduces the common plot value by β points. In turn, each endowment point invested in crop B returns w points to the landowner and has no additional impact on the common plot. As in the previous case, investment in crop A stands for contribution to the negative externality.

Each landowner invests her entire endowment between the two types of crops. Let x_i be the part of the endowment invested in crop A by landowner i, that is, the contribution to the negative externality. In turn, $(e - x_i)$ is agent i's investment in crop B. The common plot value after the cropping decisions of all landowners is $C_F = C - \beta \sum_{i=1}^{n} x_i$. We assume that this final value is equally distributed among the landowners. Therefore, the game payoff for landowner i after the cropping decisions, π_i, is the sum of the return from her investment in crop A, the return from her investment in crop B and the equal share in the final value of the common plot.

$$\pi_i = mx_i + w(e - x_i) + \frac{C - \beta \sum_{i=1}^{n} x_i}{n}$$

where $m - \beta < w < m - \frac{\beta}{n}$. That is, for each landowner the marginal net return from crop A is greater than the marginal net return from crop B, $m - \frac{\beta}{n} > w$. Similarly, the marginal net return for all landowners from crop A is smaller than the marginal net return for all landowners from crop B, $m - \beta < w$. Therefore, the game represents a social dilemma where individually optimal decisions are not socially optimal. As in the private land treatment, the Nash solution is the full contribution to the negative externality, $x_i = e$, while the efficient solution is $x_i = 0$.

Table 1 summarizes the main parameters describing the games presented above. Notice that both games are equivalent if $\beta = n\alpha$ and $C = nP$.

Table 1: Cropping decisions: private vs. common land

	Private land	Common land
Land total value	nP	C
Individual marginal benefit from A	$m - \alpha$	$m - \frac{\beta}{n}$
Individual marginal benefit from B	w	w
Social marginal benefit from A	$m - n\alpha$	$m - \beta$
Social marginal benefit from B	w	w

3 Experimental design and procedure

The experiments reported in this study were conducted using the z-tree program (Fischbacher, 1999) in the computer rooms of the Universidad Pública de Navarra in December 2012. The subjects that participated in the experiments were undergraduate students from the university. In all, 60 undergraduate students aged 17 to 27 years participated in the different experimental sessions. They included 37 females and 23 males.

The parametrization of the two games is summarized in Table 2. Groups of four members played each game. The endowment was 20 points. The return from crop A was 3 points, while the return from crop B was 1 point. The external cost from crop A was 1 point in the private land treatment and 4 points in the common land treatment. The plot value was 80 points in the private land treatment and 360 in the common land treatment. Observe that we implemented equivalent games. Furthermore, the plot value after cropping decisions was zero when all subjects followed the Nash strategy.

Table 2: Treatments' parametrization

Parameter	Private land	Common land
n	4	4
e	20	20
P	80	—
C	—	360
w	1	1
m	3	3
α	1	—
β	—	4

We ran two different sessions, one per treatment. There were 32 participants in the private land treatment and 28 participants in the common land treatment. Each game was played in two different contexts: a conditional context and a simultaneous context.

In the conditional context, subjects had to decide their contribution to the negative externality (investment in crop A) knowing beforehand the contribution to the negative externality of the other members of the group. Each subject had to complete a table, the *conditional contribution table* with 21 different situations, ranging from no contribution to the negative externality of the others to full contribution. In the simultaneous context, subjects were randomly divided into matching groups of four members and the composition of the groups remained unchanged for the whole session. The actual composition of the groups was not known by the participants. Subjects made crop decisions simultaneously without knowing the decisions of the others. The game was repeated for ten rounds. After each round, participants received information about their own contribution decisions, the contribution decisions of the others, the final plot value and their earnings from the round.

The subject's payoff was calculated as follows: in the conditional context, ten decisions were randomly selected and the subject received the corresponding payoff. In the simultaneous context, the payoff was the sum of the gains in each round.

After reading the instructions, the participants had to answer a comprehension test.[1] Before beginning the experiment, all the answers were checked to make sure that the participants had understood the structure of the games. The subjects were told that, at the end of the experiment, the points would be exchanged for cash at a prespecified exchange rate. Each session lasted around one hour and the average earnings per subject amounted to about 15 Euros.

4 Results

4.1 Conditional contribution

The information provided by the *conditional contribution table* can be used to draw out the subjects' preferences (Fischbacher et al., 2001). To that end, the different individuals were classified into four categories defined as follows:

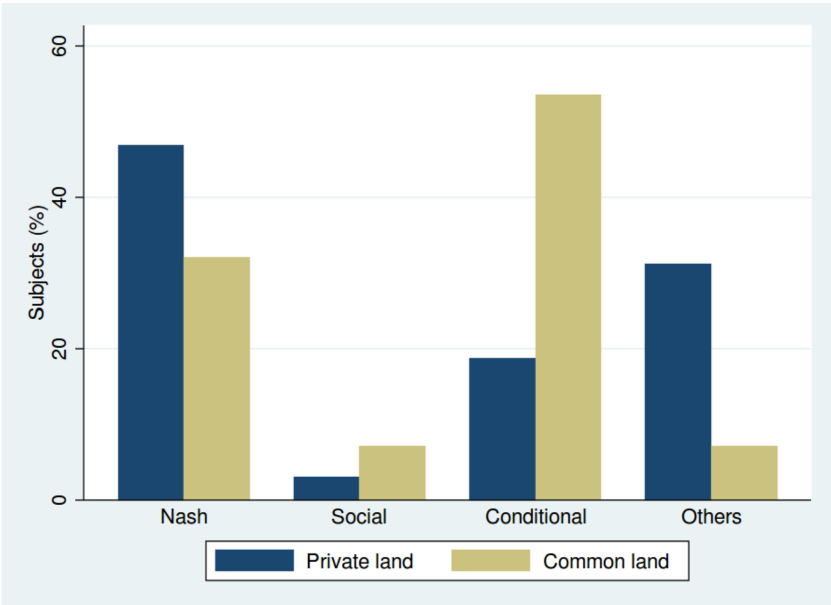
- *Nash players:* Subjects who choose the highest level of contribution ($x_i = 20$) in at least 60% of the situations.
- *Social players:* Subjects who choose the lowest level of contribution ($x_i = 0$) in at least 60% of the situations.
- *Conditional players:* Subjects with a correlation coefficient between their own and others's contribution that is statistically significant at the 5% level.
- *Other players:* Subjects who cannot be classified in any of the categories defined above.

Figure 1 summarizes the results obtained when these four categories are used to classify the individuals in the two treatments considered. As can be observed, in both treatments the participants are characterized by having heterogeneous preferences in relation to their contribution decisions, which should be taken into account when analyzing

[1]The instructions and the comprehension test are available from the authors upon request.

the results in the simultaneous setting. In particular, the decisions of a significant percentage of subjects in the two treatments were different from those predicted by standard economic theory assuming rational and selfish individuals. These findings are consistent with the results obtained in numerous experiments (e.g. Leyard, 1995; Fischbacher et al., 2001). Specifically, it is worth noting the high percentage of individuals classified as conditional players in the common land treatment. This may be related to the greater relevance of group identity when sharing resource property (Kramer and Brewer, 1984; Dawes et al., 1988).

Figure 1: Subjects' classification based on the *conditional contribution table*.



4.2 Simultaneous contribution

We now focus our attention on the setting in which cropping decisions are made simultaneously. To that end, we begin by examining the density functions of the distribution of the contribution decisions when the land is private property and when the land is common property. We address this issue by means of non-parametric techniques, thus avoiding the lack of generality and flexibility associated with parametric methods. The non-parametric approach does not require specifying any particular functional form beforehand, though a method to smooth the data must be selected. An immediate option is to use histograms, the oldest and best-known non-parametric density function estimator (Stangor, 2011). Histograms are useful to describe certain data characteristic, but they present several limitations.[2] For this reason, in our analysis we complement the information provided by histograms with a kernel density estimator, which has the advantage of being independent of the choice of origin (corresponding to the location of the bins in a histogram) (Wand and Jones, 1995).[3]

Figure 2: Histograms and kernel density estimates.

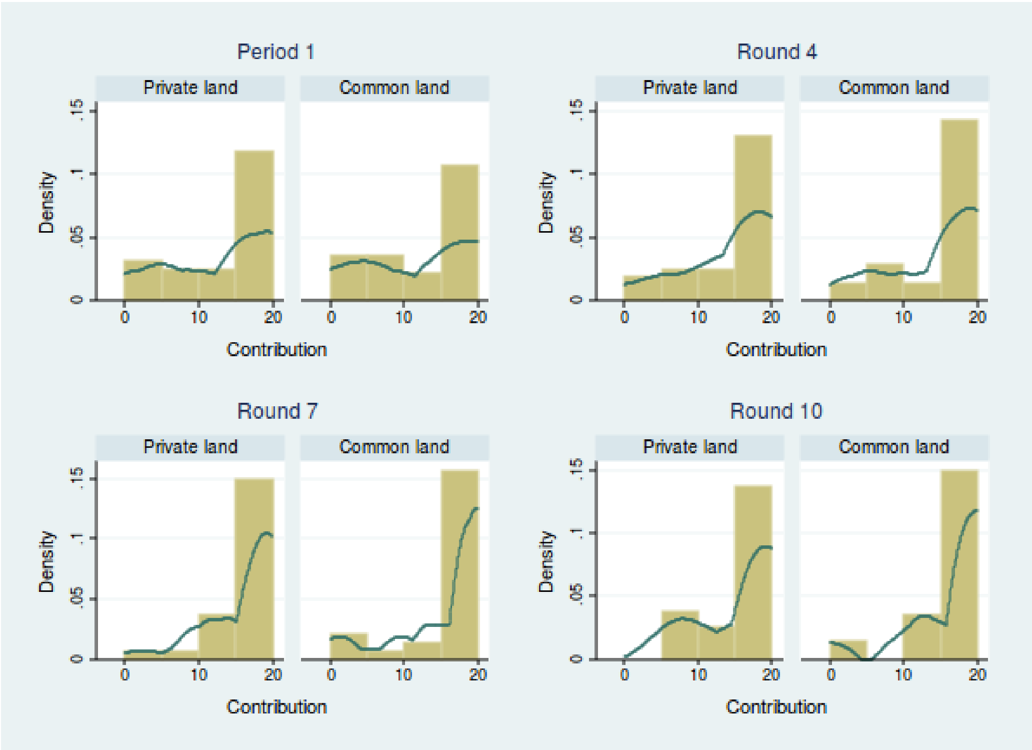


Figure 2 shows the results obtained when these non-parametric methods are used to estimate the density functions of the distribution of the contribution decisions in the two treatments. As can be seen, the external shape of the distribution is very similar when the land is private property and when the land is common property, regardless of the round considered. In order to confirm this visual impression, we performed several two-sample Kolmogorov-Smirnov tests of equality of distributions.[4] Table 3 reveals that the results of these tests do not allow us to reject the null hypothesis of equality of distributions in any case, thus confirming that there are no statistically significant differences in contributions to the negative externality between private and common

[2]For example, the problem of how to define the origin and length of each interval, and the possibility of improving the accuracy and efficiency of the estimates (Silverman, 1986).

[3]Specifically, the Epanechnikov kernel function was used, while the smoothing parameter was determined according to Silverman (1986, p.48).

[4]Given the relatively reduced sample size, the p-values of the Kolmogorov-Smirnov test were obtained by modifying the asymptotic p-value by using a numerical approximation technique.

land. This result shows that the definition of property rights does not significantly affect cropping decisions. Accordingly, privatization cannot be considered a universal solution to address the problem of externalities in the exploitation of common property resources, which is consistent with the evidence provided by Ostrom (2007) and Ostrom and Cox (2010), among others.

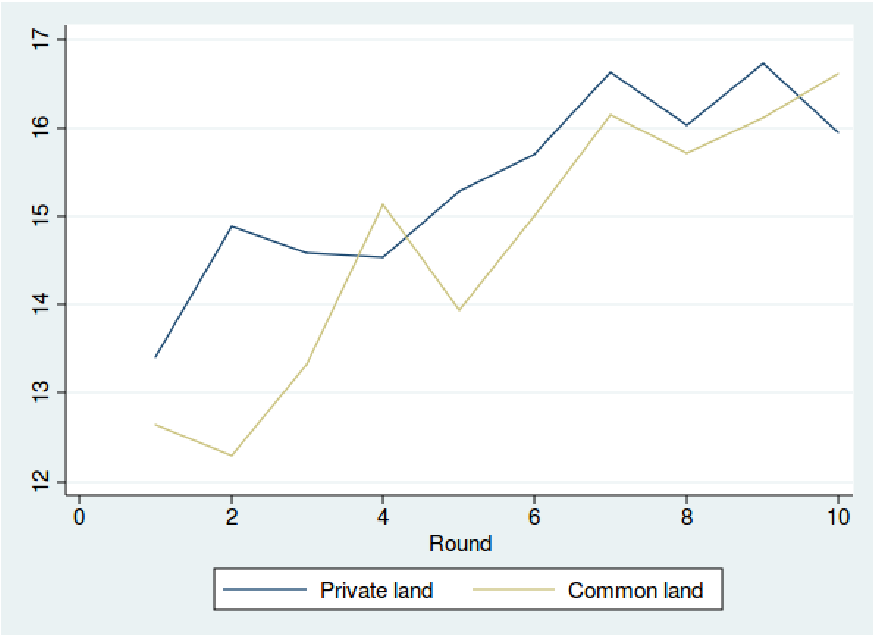
Table 3: Kolmogorov-Smirnov tests.

	Statistic	p-value		Statistic	p-value
Round 1	0.076	1.000	Round 6	0.161	0.767
Round 2	0.196	0.515	Round 7	0.080	1.000
Round 3	0.201	0.485	Round 8	0.076	1.000
Round 4	0.128	0.901	Round 9	0.107	0.991
Round 5	0.196	0.515	Round 10	0.143	0.878

Figure 2 also shows that contributions to the negative externality are relatively high in both treatments. Nevertheless, this does not imply that the initial situation remained stable over time. In particular, regardless of the treatment considered, our estimates reveal that the density located at the upper end of the distribution increased throughout the various rounds, thus indicating that the contribution to negative externality tends to raise over time. This pattern is illustrated in the average contributions shown in Figure 3. In fact, the increasing tendency observed in the levels of average contribution is consistent with the results obtained when fitting a simple time trend by least-squares. This result suggests that the implication of the agents in activities generating negative externalities increases over time, thus amplifying its adverse consequences.

At this point it should be recalled that the information provided by the *conditional contribution table* shows that subjects are heterogeneous (Figure 1). Accordingly, it is important to investigate to what extent the crop decisions vary in the different individual typologies identified previously. To that end, Figure 4 displays the average contribution in the four categories distinguished above: *Nash players*, *social players*, *conditional players* and *other players*. As can be observed in Table 4, the Kruskal-Wallis rank tests reveal the existence in the two treatments of statistically significant differences in the levels of average contribution among the various groups. This shows that subjects preferences do not seem to change with the experience gained from repeating the game, thus confirming the relevance of the classification proposed in the previous section. Furthermore, Figure 4 also shows that each category is characterized by a different behavior, regardless of the treatment considered. Thus, *Nash players* choose the highest levels of contribution when the land is private property or common property, and their decisions do not change significantly over time. By contrast, *social players* register the

Figure 3: Average contribution.



lowest levels of contribution, but only when the land is common property.[5] In turn, the conditional players are characterized by an intermediate level of contribution during the first rounds, which tends to increase over time. Finally, *other players* show a medium level of contribution that remains relatively stable throughout the different rounds.

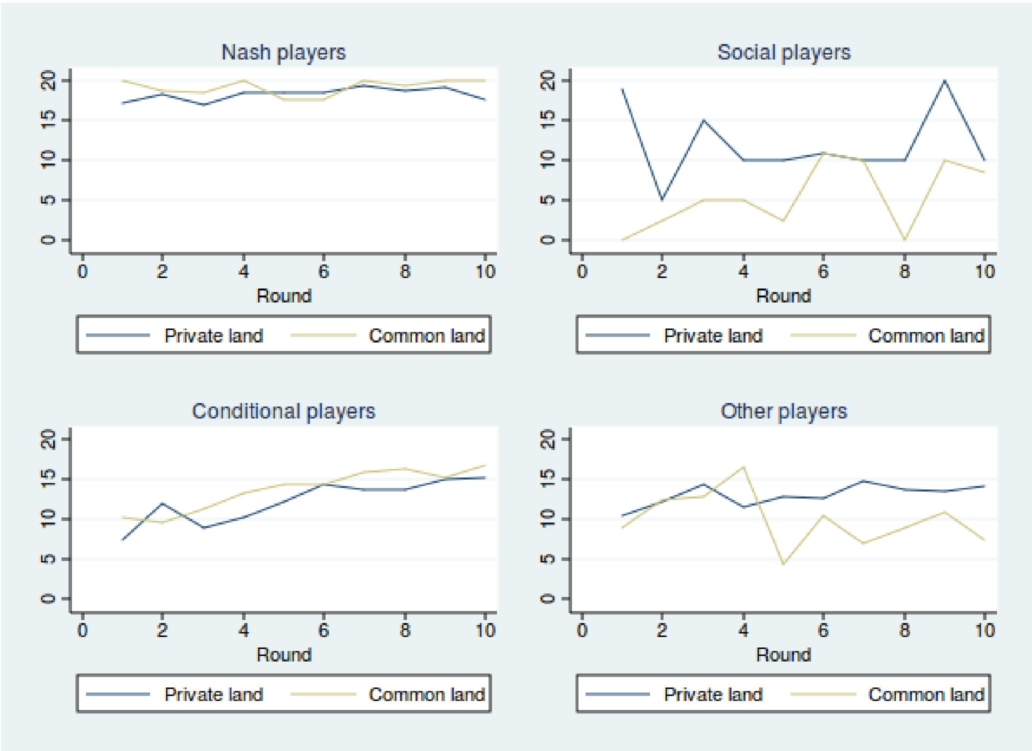
Table 4: Kruskal-Wallis rank tests.

Treatment	Private land	Common land
Chi-squared	17.435	30.432
p-value	0.001	0.000

In order to complete these results, we now examine the determinants of individual contribution to the negative externality through a regression analysis. Our dependent variable is the contribution of subject i in group j during round t, x^j_{it}. As explanatory variables we include the contribution of the remaining members of the group in the previous round. Additionally, we investigate whether the fact of being above or below the group average may influence subsequent decisions. To investigate this issue, we define the following variables (Osés-Eraso and Viladrich-Grau, 2011): *above average contribution*, $AA^j_{it} = max\{(x^j_{it} - \bar{x}^j_t), 0\}$; and *below average contribution*, $BA^j_{it} = max\{(\bar{x}^j_t - x^j_{it}), 0\}$

[5]This results should be treated with some caution due to reduced number of subjects included in this category (Figure 1).

Figure 4: Average contribution in the various categories.



where $\bar{x}_t^j$ is the average contribution of group j in round t. Furthermore, we include three dummy variables to identify *Nash players*, *social players* and *conditional players* according to the classification proposed in section 4.1. Likewise, an additional dummy variable is also added to distinguish between private and common property land. Finally, in order to investigate whether individual contributions are affected by the evolution of time, the model incorporates time-specific effects common to all subjects.

Together with the decision of which explanatory variables to include in the analysis, we have several estimation strategies to choose among. Given that our dataset has the characteristics of panel data, in principle we could resort to a fixed effects model or a random effects model. Faced with this quandary, we opted to estimate a random effects model for two reasons. First, as pointed out by Greene (1993, p.479) and Wooldridge (2002, p.247), the random effects model is more appropriate than the fixed effects model when the unobserved effects are uncorrelated with the control variables. In our case, the estimated correlation between the unobserved effects and the explanatory variables is relatively low ($\rho = 0.084$), which suggests that the random effects model is preferable in this case. Second, the random effects model makes it possible to estimate all the parameters of the model, whereas the fixed effects model only allows us to estimate the parameter of the time-varying variables. This is particularly important in our context, since we are especially interested in determining the effect of the different dummy variables defined above on individual contributions.

Table 5 shows the results obtained when different versions of our model are estimated using robust standard errors adjusted for intra-group correlation. As can be seen, there is a positive and statistically significant relationship between the contribution chosen by the remaining members of the group in the previous round and the dependent variable. This confirms that individual contribution to the negative externality is affected by the behavior adopted by the rest of the group in the past. Likewise, the difference between the contribution selected and the group average in the previous round contributes significantly to explaining the variation experienced in the dependent variable. In particular, our estimates indicate that AA and BA exert a positive and negative effect, respectively, on individual contribution. That is, the higher the difference with the average from above, the greater the individual contribution to the negative externality. Likewise, the higher the difference with the average from below, the lower the individual contribution. This seems to show the lack of a convergence process toward the average in this context.

Table 5 also reveals that the coefficient of the dummy variable used to identify the *Nash players* is positive and statistically significant in all cases. This means that those subjects classified in this category in the conditional setting are characterized by choosing a significantly higher contribution, which is consistent with the information provided by Figure 4. In turn, the coefficient of the dummy variable for the *social players* is negative in all cases, although it is only statistically significant when the land is private property. The type of treatment is also important when determining the impact on the

Table 5: Determinants of individual contribution: Random effects model.

	(1)	(2)	(3)
Constant	4.065***	4.678***	1.974
	(1.259)	(1.715)	(1.838)
Contribution of the rest (t-1)	0.207***	0.196***	0.218***
	(0.024)	(0.034)	(0.034)
Above average contribution (t-1)	0.792***	0.710***	0.884***
	(0.102)	(0.132)	(0.138)
Below average contribution (t-1)	-0.444***	-0.508***	-0.306***
	(0.108)	(0.169)	(0.113)
Nash players	3.073***	2.668***	5.117***
	(0.668)	(0.523)	(0.534)
Social players	-2.362	-1.243***	-1.569
	(2.063)	(0.363)	(3.391)
Conditional players	0.733	-0.282	2.988***
	(1.171)	(1.923)	(0.649)
Common land	0.146		
	(0.606)		
Round 2	-0.886	0.598	-2.563***
	(0.789)	(0.975)	(0.927)
Round 3	-0.775	-0.457	-1.016
	(0.538)	(0.568)	(0.804)
Round 4	-0.309	-0.491	0.067
	(0.639)	(0.991)	(0.797)
Round 5	-0.701	0.488	-1.961
	(0.849)	(0.649)	(1.579)
Round 6	0.070	0.532	-0.529
	(0.815)	(1.250)	(1.026)
Round 7	0.527	1.180	-0.386
	(0.755)	(1.020)	(1.149)
Round 8	-0.285	0.177	-0.792
	(0.741)	(0.729)	(1.422)
Round 9	0.496	1.102	-0.073
	(0.914)	(1.022)	(1.505)
Treatment	Private and common	Private land	Common land
R-squared overall	0.415	0.384	0.471
Number of subject	60	32	28
Groups	15	8	7
Observations	540	288	252

Notes: Robust standard errors in parentheses. * Significant at 10% level, ** significant at 5% level, *** significant at 1% level.

individual contributions of *conditional players*, whose positive effect on the dependent variable is statistically significant only when the the land is common property. Overall the results in Table 5 again confirm the heterogeneity of the subjects' preferences in our sample, and the relevance of the classification proposed in the previous section when explaining the contribution decisions at the individual level.

Furthermore, the coefficient of the dummy variable used to distinguish between the two treatments is not statistically significant, which indicates that there are no differences between private and common land in terms of contribution to the negative externality. Note that this result confirms our previous findings in Figure 2 and Table 3. Finally, the signs of the coefficients of the time-specific effects included in the model seem to suggest that contribution increases during the last rounds, which would be consistent with our previous results. Nevertheless, this conclusion should be treated with caution, as most of these coefficients are not statistically significant at conventional levels.

Given the characteristics of the dependent variable, we now repeat the analysis carried out above using a Tobit model that explicitly takes into account the lower and upper limits of x^j_{it}. The results of this additional sensitivity check are presented in Table 6. As can be observed, our previous findings remain unaltered when this alternative estimation approach is employed, thus reinforcing the robustness of the results in Table 5.

5 Conclusions

In this paper we have analyzed the impact of the definition of property rights on cropping decisions when these decisions generate negative externalities. To that end, we have developed an experimental study where agents make cropping decisions in two different settings. In the first setting property rights are individually/privately defined (*private land treatment*), whereas in the second setting property rights fall on a well-defined community of users (*common land treatment*). In our analysis we have paid particular attention to the potential influence on the results of the existence of differences in the subjects' preferences. For this reason, in both treatments cropping decisions are made in two different contexts, a conditional context and a simultaneous context. In the former, each agent knows the cropping decision of the rest before making her own decision. In the latter, all agents make cropping decisions simultaneously and repeatedly, using only the information provided by past cropping decisions.

The results show that there are no statistically significant differences between the two treatments in the contribution to the negative externality, thus revealing that the definition of property rights does not affect cropping decisions in this context. This

Table 6: Determinants of individual contribution: Tobit model.

	(1)	(2)	(3)
Constant	-0.339	0.208	-0.626
	(2.925)	(3.125)	(3.771)
Contribution of the rest (t-1)	0.335***	0.310***	0.342***
	(0.057)	(0.057)	(0.092)
Above average contribution (t-1)	1.300***	1.439***	1.100***
	(0.258)	(0.235)	(0.379)
Below average contribution (t-1)	-0.740***	-0.715***	-0.690***
	(0.159)	(0.260)	(0.206)
Nash players	8.336***	6.444***	14.782***
	(1.654)	(1.440)	(1.835)
Social players	-3.693	-1.366**	-2.787
	(3.607)	(0.636)	(6.491)
Conditional players	1.397	0.828	4.512***
	(1.909)	(2.906)	(1.585)
Common land	1.257		
	(1.580)		
Round 2	-1.647	0.797	-5.426***
	(1.494)	(1.999)	(1.792)
Round 3	-1.357	-0.954	-2.761
	(1.082)	(0.804)	(2.231)
Round 4	-0.894	-2.032	-0.074
	(1.510)	(2.286)	(1.232)
Round 5	-1.033	0.662	-3.971
	(1.774)	(1.976)	(3.224)
Round 6	0.206	0.738	-0.939
	(1.703)	(2.376)	(2.574)
Round 7	1.336	2.153	-0.093
	(1.608)	(1.960)	(2.802)
Round 8	-0.583	0.638	-2.472
	(1.628)	(1.372)	(3.233)
Round 9	1.128	2.506	-1.029
	(1.880)	(2.080)	(3.391)
Treatment	Private and common	Private land	Common land
Pseudo R-squared	0.117	0.101	0.147
Number of subject	60	32	28
Groups	15	8	7
Observations	540	288	252

Notes: Robust standard errors in parentheses. * Significant at 10% level, ** significant at 5% level, *** significant at 1% level.

suggests that privatization cannot be considered as a one-fits-all-solution to address the problem of externalities in the exploitation of common property resources. Furthermore, our findings indicate that the implication of the agents in activities generating negative externalities tends to increase over time, thus amplifying its adverse consequences.

These results open new questions for future research. It is worth noting that, in the private property analysis, we have considered that the land is distributed evenly among the various landowners. However, in general, private property plots have varying dimensions. In this situation, the negative externalities from crop decisions may be non-assumable for small landholders; a fact that may be determinant in shaping agents' behavior. It is also interesting to note that this paper develops a repeated experiment to analyze cropping decisions. However, results may vary if the problem is analyzed dynamically and losses in land value caused by negative externalities are extended to the following periods. Focusing on common property, another question arises as to what happens to cropping decisions if there is a community board that sets standards. In this case, the key is the control and sanctions mechanisms implemented to ensure compliance with these standards. The intervention of this community board may give rise to important differences with the cropping decisions in private land.

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