Agglomeration Bonuses as Asymmetric Incentives: An experiment

Gueye M. *

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Abstract

We assess the impact of asymmetric incentives, such as agglomeration bonus schemes for biodiversity conservation, on coordination. Agglomeration bonuses provide incentives for spatial coordinated efforts of conservation. However, standard agglomeration bonus schemes do not take into account the spatial heterogeneity of the externalities. From a theoretical point of view, asymmetric incentives achieve this goal as they minimize regulation costs and ensure coordination on an efficient equilibrium outcome (Bernstein and Winter, 2012). In this study, we use a laboratory experiment to test whether optimally-designed asymmetric incentives ensure full participation of individuals. Our main result suggest that a larger asymmetry in agents' incentives yields a better pattern of coordination.

1 Introduction

Coordination issues are a common phenomenon in several fields of real life, specially in environmental economics. In this study, we take the example of biodiversity conservation to highlight the stake of coordination problems in the presence of externalities. Biodiversity conservation is specific, as it requires coordinated effort across space. Hence, when one producer provides conservation efforts, these are beneficial to neighboring producers as well (Broch et al., 2013). Thus, neighborhoods receive positive externality from the biodiversity conservation. Without internalization and because of the spatial positive externalities, market failure will arise (Brandts and Cooper, 2006).

Voluntary contracting devices can allow coordinating conservation between different neighborhood producers. Payments for ecosystem services (PES) are one of these devices.

*Montpellier SupAgro, INRA, UMR1135 LAMETA, F-34000 Montpellier, France. E-mail address: mamadou.gueye@supagro.fr

In PES programs, producers of ecosystem services are compensated for the quantity of services they create, e.g. carbon sequestration and climate regulation, air purification or pest and disease control (Wunder, 2005). However, the voluntary structure of these contracts limits their efficiency. Reed (1994) reports that these voluntary contracts can fragment the habitat into several protected area instead of building a large connected one, neglecting the benefits of contiguous habitat.

Smith and Shogren (2001, 2002), Parkhurst et al. (2002) and Parkhurst and Shogren (2007) propose agglomeration bonus as an instrument designated to create such a contiguous habitat. This economic instrument serves to complement the PES. Agglomeration bonuses mechanism propose a bonus contracts for a joint conservation area between neighboring producers. As Broch et al. (2013) about the biodiversity conservation, the participation decision on the agglomeration bonus scheme also generates positive externalities on the neighborhoods. Furthermore, these externalities can be of different levels and create heterogeneities between individuals. Indeed, the amount of externalities generated by an individual to his neighborhood is likely different from what he receives from the latter. It clearly seems that agglomeration bonus contracts cannot take into account this specificity. Agglomeration bonus contracts provide homogeneous contract addressed to a context characterized by the presence of externalities between the individuals. In this case, individuals have necessarily different incentives.

Literature on contracting with externalities shows that in the context of externalities between the individuals, the homogeneous contracts are inefficient (Segal, 1999). Indeed, when externalities are positive, the contracts are merely suboptimal. It becomes useful to implement a contract scheme that realign the incentives of the individuals. In a deeply theoretical analysis, Bernstein and Winter (2012) consider a similar framework and find that "Divide and Conquer" (DAC henceforth) contracts can provide efficiency in contracting with externalities. The intuition is to motivate individuals according to a predefined ranking. The ranking is established using the structure of the externalities between the individuals. For instance, if an individual receives less amount of externalities in relation to his vis à vis, then he will be ranked before the latter. According to the ranking of individuals, the decision-maker may discriminate between individuals by providing a more attractive contract to the individual ranked first, and so forth. These types of contracts have then "Divide and Conquer" characteristics (Segal, 2003). More precisely, according to an arbitrary ranking, the DAC contracts provide incentives to participate knowing that the individuals that precede each individual in the ranking participate and the individuals following in the ranking abstain. These contracts are discriminant in the sense that they specify different incentives to homogeneous agents.

DAC contracts have the advantage to achieve lower cost, especially by taking into account the heterogeneous externalities generated by individuals among each other. In facts, with the DAC contracts, participants receive asymmetric payoffs. They are discriminated against each other. Due to the discriminant nature of the DAC contracts, we suspect that individuals can have heterogeneous behaviors that can differ to the one predicted by Bernstein and Winter (2012). Theoretical prediction stated that DAC contracts implement full participation towards the more efficient equilibrium, but they do not give indications about the socially way of individuals uptake. The individual might have other motivations like inequality aversion, risk aversion, altruism, etc, that can deter their participation.

In this study, we use lab experimentation to assess groups and individual behavior via a voluntary participation game in which individual payoffs are derived from the incentives of the Bernstein and Winter (2012) model. Our game includes three equilibria that are Pareto ranked, a Pareto efficient equilibrium in case of full participation and two payoff equal risk dominant equilibria in case of at least one participation (we will explain below why we are equilibrium with one participation). We define by coordination the situation in which same group members choose the Pareto efficient equilibrium and propose to analyse group's coordination. We also defined two treatments that differ by their payoff structures. Thus, we compare a low asymmetric payoff treatment versus a high asymmetric payoff treatment by studying the difference of coordination frequencies between these treatments. We use this comparison in order to assess the kind of payoff asymmetry that offer better performances empirically. Three modules of treatments are added to elicit individual preferences: The modified dictator game (Blanco et al., 2011), the classical Ultimatum game and the Holt et al. (2002) Game. The first two treatments allow us to elicit inequality aversion, whereas the last one allows us an elicitation of the risk aversion.

The results indicate a weak coordination both in high asymmetric and low asymmetric payoff treatments. That confirms a non surprising known coordination failure. These findings can be a consequence of the ranking. We shows that the more the individual is far in the ranking, the less he participates. More interestingly, we also find that groups significantly prefer to coordinate on the high asymmetric payoff treatment instead of the low asymmetric one. Thus, increasing payoff asymmetry enables the coordination.

Papers in experiment study coordination games and give some indication about the reasons why coordination failures arise (Devetag and Ortmann, 2007), but very few among them are interested about the payoff asymmetries. Closely related to our topic, Crawford et al. (2008) argue that a slight asymmetry of payoffs suffices for miscoordination, but increasing the asymmetries reverses the path of coordination failure. We use a different coordiantion game and find the same result. While they use a 2x2 battles of sex with labels salience[1] presented with two symmetric equilibria, we study a 3x2 voluntary participation game with three Pareto ranked equilibria in which the efficient equilibrium Pareto dominates the risk dominant equilibria. Concretely, we study a game that exhibits a less degree of conflict between these equilibria when increasing asymmetries. Our paper then tends to generalize their finding. On the other hand, Lòpez-pèrez et al. (2015) propose a selection principle called equity and show that like risk dominance selection principle, equity favours coordination. They use several types of coordination games. Each one contains two equilibria: a unique equity equilibrium and another equilibrium from the theory of equilibrium selection. These equilibria are not necessarily ranked in the sense of Pareto. Our study differs from their because we do not focus on the selection principle like equity, but only on the impact of the payoff asymmetries on coordination uptake.

The remainder of this study is structured as follows. Section 2 describes the theoretical model, which is the basis of our experiment. We emphasize the main theoretical result from Bernstein and Winter (2012) and address some behavioral assumptions for the experiment. Section 3 develops the experimental design. We define the protocol with the details of the procedure and the different treatments. Section 4 presents the very preliminary results of the experiment. A short section 5 provides some elements of discussion. Section 6 conclude.

2 Theoretical framework and predictions

In this section, we aim to describe how Bernstein and Winter (2012) built their optimal incentive mechanism. This part will be followed by the presentation of our specific voluntary participation game and the behavioral hypotheses.

2.1 The model

Bernstein and Winter (2012) model outlines a situation in which one principal contracts with several agents in presence of externalities between the agents. Formally, Let us suppose the participation problem given by the triplet (N, w, c) . The set N represents the agents. w is the nxn (n is the number of agents) matrix of bilateral externalities between agents, in which each $w_i(j)$, the cross intersection between line and column, represents the added value received by agent i when he participates jointly with agent j. Finally, c defines the opportunity cost of each agent.

Their model reposes on some hypotheses. First they assume that c is constant for all the agents. Agents have the same opportunity cost. In addition, agent's preferences are

[1] X-Y game in their game with X more salient than Y because it precede y on the alphabet.

additively separable that, means the added value for agent i joining a set T of participating agents is given by $\sum_{j \in T} w_i(j)$, the overall externalities coming from his participating neighbors. The bilateral externalities are strictly positives i.e. $w_i(j) > 0$. Moreover, an agent gains no additional value from being alone, $w_i(i) = 0$. Finally, the principal cannot provide payoffs that are contingents to the participation behaviors of the other agents.

The contract happens in two steps: at first, the principal offers a specified vector of contracts V $(\upsilon_1, \upsilon_2, ..., \upsilon_n)$, each agent i receives $\upsilon_i > 0$ if he participates or $\upsilon_i = 0$ if not. Secondly, the agents face a game in which they have two strategies: to participate or not. If an agent i participates with a set of T agents, he gets $\sum_{j \in T} w_i(j) + \upsilon_i$. If he does not participate, he gets c.

The objective of the principal is to bring all agents towards the full participation equilibrium [2] which means that all agents choose to participate. Whereas, the non-participation equilibrium arises when at least one individual refuses the contract.

A principal proposing a vector V with the following structure specifies DAC contracts in this context.

$$\upsilon = (c, c - w_2(1),\, c - w_3(1) - w_3(2),\, \ldots,\, c - \sum_{j=1}^{n-1} w_n(j)) \tag{1}$$

This vector of incentives depends mainly on the following arbitrary ranking, $\rho = (1, 2, 3, ..., n)$.

This offer means that agent 1 gets his opportunity cost by participating. The agent 2 gets his opportunity cost minus his added value when he participates jointly with agent 1. The agent 3 gets his opportunity cost minus his additional payoff when he participates jointly with agent 1 and agent 2, and so forth.

The optimal contract depends on the optimal ranking of the agents. In order to rank agents optimally, they organize a virtual tournament ranking in which each agent is challenged by the other agents. Hence, according to the analysis in Bernstein and Winter (2012), ranking the agent optimally means that if $W_i(j) > W_j(i)$, then agent j wins against agent i. Agent j is then ranked first. They also assume that the tournament is acyclic. Formally, it means that a tie is not a solution of the challenge: either agent i wins or he loses.

From the above context , Bernstein and Winter (2012) propose the following result:

Result: *Let (N, w, c) be the participation problem for which the corresponding tournament is acyclic. Let ρ be the tournament ranking. The optimal full implementation*

[2] That is what Bernstein and Winter (2012) call full implementation contracts referring to the situation in which all individuals participate in the unique Nash Equilibrium.

contracting scheme is given by the DAC with respect to ρ [3].

The intuition of DAC contracts is that the principal makes each agent's participation strategy dominant in the game. Adding the optimal ranking, he lowers his cost of implementing the full participation.

2.2 Behavioral assumptions

Now, let's suppose that the externalities take the value such as $w_1(2) = 28$, $w_2(1) = 27$, $w_1(3) = 22$, $w_3(1) = 21$, $w_2(3) = 31$ and $w_3(2) = 30$. Using the definition of optimal ranking, we get $w_1(2) > w_2(1)$, $w_1(3) > w_3(1)$ and $w_2(3) > w_3(2)$. Hence, we rank individual 3 first, following by individual 2 and individual 1 is the last. The rank ρ is then equal to $(3, 2, 1)$. This ranking is optimal and characterizes the structure of the vector of incentive which is equal to $V = (60, 29, 10)$. We can observe that individual 2 creates the higher level of externalities, i.e. $w_1(2) + w_3(2) = 58$, but he is ranked second. This is because of the specific definition of the tournament ranking. By definition, the rank of an individual depends on the set of agents that value his participation more than the other way round.

The DAC is efficient in the sense that it drives all the individuals towards the equilibrium of full participation at the lowest cost for the principal. The underlying intuition is that the principal can offer $c = 60$ to the agent ranked first (agent 3 here). The payoff of this agent is then $c + w_3(1) + w_3(2) = 111$ if agent 1 and 2 participate. If not, he gets $c = 60$, which is equal to the opportunity cost. His dominant strategy is then to participate. Knowing that agent 3 participates, the principal offers $c - w_2(3) = 29$ to agent 2. The payoff of agent 2 becomes $c - w_2(3) + w_2(3) + w_2(1) = 87$, if agent 1 participates. The principal makes his participation strategy dominant as well. Finally, he offers $c - w_1(2) - w_1(3) = 10$ to agent 1, thus he gets $c = 60$ in case of participation. The principal makes agent 1 indifferent between participating or not.

If we define by 1 the index meaning that the agent chooses to participate and 0 if not, the combination $(1, 0, 0)$ for example, indicates that agent 3 participates, but agent 2 and 1 respectively do not. Table 1 shows the payoffs of each agent according to the eight possible combinations.

The payoff matrix on table 1 is used in our 3x2 voluntary participation games. In these games, individual's has two strategies, either he participates by choosing 1 or he refuses and chooses 0. The payoff of each individual depends on the combination that occurs after the choosing step. The coordination problem is then characterized by the presence of three equilibria: The Pareto dominant and social efficient equilibrium $(1, 1, 1)$

[3] See the appendix of Bernstein and Winter (2012) for detailed proofs of this result.

Table 1: Payoff matrix

	Combinations	Payoffs		
	(A, B, C)	*A*	*B*	*C*
1	(0, 0, 0)	60	60	60
2	(1, 0, 0)	60	60	60
3	(0, 1, 0)	60	29	60
4	(0, 0, 1)	60	60	10
5	(1, 1, 0)	90	60	60
6	(1, 0, 1)	81	60	32
7	(0, 1, 1)	60	56	38
8	(1, 1, 1)	111	87	60

- Gains is the earning of each agent.
- (A, B, C) means that the first index is for agent 3, the second for agent 2 and the last one for agent 1.

and two risk dominant equilibrium $(0, 0, 0)$ and $(1, 0, 0)$. Coordination prevails when the social efficient equilibrium is observed. The payoff on coordination is called asymmetric payoff in the rest of the study.

According to the theoretical prediction of Bernstein and Winter (2012), only the social efficient equilibrium $(1, 1, 1)$ subsists to the strategic elimination imposed by the DAC incentives. Indeed, with DAC incentives, each individual's dominant strategy is to participate. In the behavioral point of view, because of the risk, trade-off might be existing between these equilibria. This could necessarily imply different behaviors during the choice process. That is why we propose three hypotheses to assess coordination.

Hypothesis 1: *Coordination failure will frequently happen.*

From our point of view, individuals do not fully participate when they face this game. This game involves some degree of risk. For example, by choosing the participation strategy, individual 1 can lose if individual 3 or individual 2 chooses not to participate. This situation will happen especially if individual 2 anticipates that individual 1 will not participate and chooses not to participate as well. Taking into account this fact, we think that individuals will not frequently choose to participate. The non-participation will be observed more often for the individual ranked last.

Hypothesis 2: *The more the payoff are asymmetric, the less the participation is important.*

The level of asymmetry may increase the non-participation rates. Asymmetries can be set in different manners. Therefore, we record the individual behaviors if the contracts specify high asymmetries versus low asymmetries. High asymmetries occur when the spread between agents' payoffs is too large. Low discrimination is the opposite case. We expect that with low payoff asymmetries, individuals participate more often.

Hypothesis 3: *Non-participation is linked to individual behavioral preferences.*

Discrimination between individuals makes the contracts more profitable for some of them. For instance, in case of full participation, the agent ranked first gets a higher payoff than the agent ranked last who gets his opportunity cost. We may expect that the agents can perceive discriminant contracts as not fair. Thus, the intensity of the inequality between the payments could be a measure of this behavior. In our example, the less favored agent has the opportunity to increase equality, by refusing the offer. Let's consider the agent ranked last, i.e. agent 1. He has the possibility to refuse the contract if he judges the payments not fair. We can also expect that this agent may be inequity averse Fehr and Schmidt (1999). We will use individual elicited levels of inequity aversion and test whether they explain participation decisions.

3 Protocol

3.1 Experimental design

The coordination game used in this study is closely related to the incentive mechanism in Bernstein and Winter (2012). We propose to study a 3x2 voluntary participation game in which three individuals have each one two strategies, either he participates (henceforth represented by the index 1) or he does not participate (represented by the index 0). Thus, eight possible combinations outcome can be realised. These combinations contain two Nash equilibria. The social efficient equilibrium in which all individuals choose 1 and the risk dominant one where all individuals choose 0 or only individuals ranked first choose 1. The presence of these equilibria highlights the coordination problem in our experiment.

In the lab context, we reproduce faithfully the framework of the theoretical model for better control and replicability. In fact, we replace the agents in the model by the individuals of our experiment and the principal is the lab experimenter. We then build a context-free environment in which individuals receive payments according to their performances in the experiment. Any information about agglomeration bonus, ecosystem services, conservation or participation choices are given to the individuals. The payoff matrix are common knowledge. The individuals cannot communicate during the experiment.

The design of the experiment consists of five treatments. Two main treatments, namely the high asymmetric treatment (High Asym.) and the low asymmetric treatment (Low Asym.). Three additional treatments are added to observe individual characteristics:

An application of the modified dictator game (MD) (Blanco et al., 2011), the classical Ultimatum game (Ult) and the Holt & Laury game (HL). All treatments are detailed below.

3.2 Procedure

The experiment is ran in the experimental economic laboratory of Montpellier (LEEM). Ztree software is used to program and conduct it (Fischbacher, 2007). All individuals are recruited via ORSEE (Greiner et al., 2004) from the participant pool at the University of Montpellier. Upon arrival in the experimental room, each individual was seated in the personal box with a computer he uses for his choices. The instructions are distributed and loudly read by the experimenter before each treatment. In treatment High Asym. and Low Asym., Participants know that they are randomly assigned to a group of 3 members. They also know that the groups remain constant for these treatments. This partner setting (Andreoni et al., 2008) is preferred not because it represents more faithfully the decision environment of the individual as defined in the theoretical framework, but because it allows us to learn more about the group's behavior during the treatments. After finishing the first two treatments, participants are rematched and pooled into a groups of 2 members for MD and Ult treatments. The HL treatment do not need a group formation.

In this experiment, 16 sessions are executed. In each session, an average of 18 individuals are pooled in six groups. Overall, 90 independent observations are registered from 270 individuals. Experimental currency (ECU) are used during the game. The earning of each individual will be converted into Euros at the end of the session. The duration of a session is about 90 minutes and each individual gets an average of 15 Euros per session plus a show up fees varying between 2 Euros for the students from the University of Montpellier and 6 Euros.

For the first two treatments, group's plays in a within setting. Within setting permits to perform more powerful statistical tests (Charness et al., 2012) by increasing the number of independent observations. The drawback of this setting is a potential existence of order effects that can limit the predictive power of the results. To reduce these order effects, we affect order randomly in accordance with the Budescu and Weiss (1987) method. Concretely, we create two blocks. The block 1 contains only the high asymmetric treatment and the low asymmetric treatment, whereas block 2 registers the remaining treatments. We then counterbalance the treatments uniquely inside block 1. Table2 represents the way of playing of each order. If order 1 is randomly chosen, then group's plays High Asym. then Low Asym., and finish with the additional treatments.

High Asym. and Low Asym. are repeated for 10 periods to get better understanding about the behavior of the individuals. Obviously, reputation effects can occur. To prevent these reputation effects, and stay faithful with the analysis, only first period and a randomly selected period from the remaining periods are selected for the payment. Thus, individuals play both, a one-shot game and a finitely repeated game. By this presentation, our goal is to compel the individuals to focus on their choices in each period, especially the first one; we also control for hedging and reputation effects.

Table 2: Orders for the expriment

<table>
<tr><td rowspan="2">Order 1</td><td colspan="2">Block 1</td><td colspan="3">Block 2</td></tr>
<tr><td>High Asym.</td><td>Low Asym.</td><td>MD</td><td>Ult</td><td>HL</td></tr>
<tr><td rowspan="2">Order 2</td><td colspan="2">Block 1</td><td colspan="3">Block 2</td></tr>
<tr><td>Low Asym.</td><td>High Asym.</td><td>MD</td><td>Ult</td><td>HL</td></tr>
</table>

Individuals merely have to choose between two numbers 0 or 1 in High Asym. and Low Asym. Hence, they create a combination that corresponds to their own group choice. The individuals know about all possible outcomes of the game before their choice.

Besides, we use strategy methods elicitation for MD and Ult treatments. These methods entitle us to record more individual decisions without fundamentally modifying the sense of the game. In MD treatment, individuals play two sequences. Sequence 1 consists of playing individually the role of dictator and choosing between two repartitions for a set of 11 questions. Each question represents a choice between an egalitarian repartition (S - S)with $S \in [0, 10]$ and an unequal repartition (10 - 0). Afterwards, they will receive information about their role in the group (dictator or receiver) and their payments depending on their role. The Ult treatment is also held in two sequences. The first sequence concerns the offer choices in which each individual receives 10 ECUs and decides on how many ECUs (S) he gives to his partner on an integer within the range 0 ECU to 10 ECUs, keeping 10 ECUs - S ECUs to himself. Then, another screen is revealed and corresponds to the acceptance sequence. In this sequence, individuals decide in the range of 11 hypothetical offers, whose repartition they accept or refuse. Finally, we show the composition of the groups and oppose the proposer's offer to the respondent's choice within each group. Thus, if the proposer chooses S ECUs and in the second period, the responder selects the acceptation, then the proposer gets 10 ECUs - S ECUs and the responder gets S ECUS. If not, they all get zero ECU. The last treatment is the classical Holt and Laury risk elicitation game. It consists in choosing between two lotteries for the individuals, safe or risky one, in a range of 10 questions. Their payments depend on both, the randomly selected question and the issue of the lottery on this question.

4 Very preliminary results

The results focus on the level of coordination and individual participation for the high asymmetric and the low asymmetric treatments. Consider the coordination item that means all groups member participate. Table 3 shows a weak frequency of coordination for each treatment (25.3% and 15.7%). It also illustrates difference between treatments. Comparing groups playing High Asym treatment with groups playing Low Asym treatment, we observe that coordination is significantly more important in the High Asym treatment than in the Low Asym treatment (Wilcoxon-Mann-Whitney, Z=2.020, p=0.0433). Moreover, we observe that there exists groups in which none of the members participate, 7.67% and 12.56% respectively for high and low asymmetric treatment. These groups play the risk dominant equilibrium.

Furthermore, Individual participation frequencies are compared between treatments. Table 3 reports that, globally individuals participate more frequently in the high asymmetric treatment than in the low symmetric treatment, 57.2% and 47.3% respectively. Wilcoxon-Mann-Whitney test (Z=2.648, p=0.0081) attests the significant difference of the individual participation frequencies. More precisely, following each role, he also reports that individuals on the role of A participate more than role B individuals which themselves participate more than role C individuals for the two asymmetric treatments. However, only role B individuals significantly change their behaviors between the treatments (Wilcoxon-Mann-Whitney, Z=2.785, p=0.0054).

Table 3: Coordination and individuals participation

		High Asym.	Low Asym.	Wilcoxon test	
% Coordination		25.3	15.7	(z=2.020)	(p=0.0433)
% Particip./Indiv.		57.2	47.3	(z=7.274)	(p=0.0000)
	% Indiv.A	88.9	83.8	(z=0.919)	(p=0.3578)
	% Indiv.B	51.7	37	(z=2.785)	(p=0.0054)
	% Indiv.C	31.11	21.22	(z=1.618)	(p=0.1056)

Notes: This table reports frequencies for various coordination indices. % Coordination is the percentage of outcomes such that the group reaches the Pareto dominant Nash Equilibrium. % Particip. is participation (in %). % Indiv. A, B, and C is participation of player A, B, and C, respectively (in %). The last column reports the Z-statistics of the Wilcoxon-Mann-Whitney test of distribution differences.

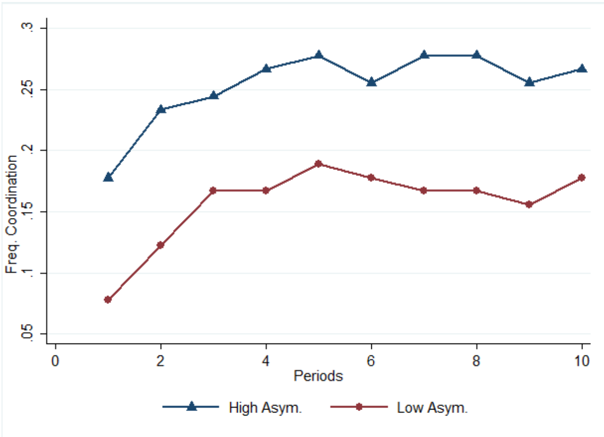
Result 1: *Highly asymmetric mechanism leads to more coordination*

Avoiding the potential order effects, we calculate coordination frequencies by periods for each treatment and graphically compare them. The results are represented in figure 1.

This figure 1 illustrates the trends of the treatments and the gap between the treatments. The blue line represents the path of the high asymmetric treatment, whereas the red one depicts the low asymmetric treatments. The trends of these curves increase over periods and can clearly illustrate the gap between high and low asymmetric treatments.

The data are also used to test order effects. The question was, do individuals play in the same way whatever the order is? The Wilcoxon ranksum test with 92 independent observations from order 1 and 88 independent observations from order 2 shows that there exists order effects at 10% level (Z=1.714, p=0.0866). Playing high asymmetric treatment then low asymmetric treatment differs to the other way round playing.

Figure 1: Evolution of coordination.



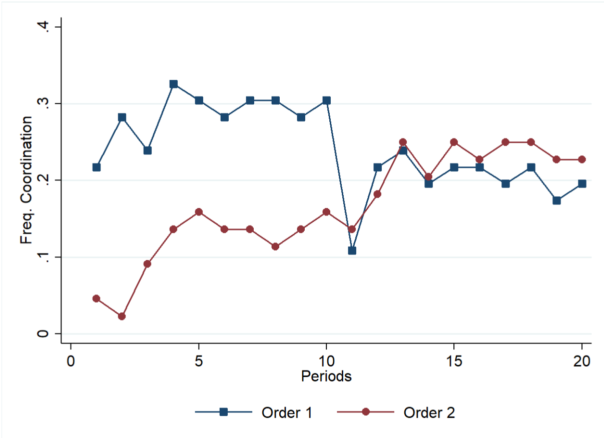
Notes: The blue line features the high asymmetric treatment whereas the red one depicts the low asymmetric treatment.

In order to get a bit more understanding about order effects, we represent the frequency of coordination for each order in the figure 2. The squares connected line represents the order 1 and the dots connected line features the order 2. In order 1 individuals, play high asymmetric treatment for 10 periods then switch to low asymmetric treatment for also 10 periods. Order 2 is the opposite case. Figure 2 shows that the gap between orders is largely important for the first ten periods and tends to merge from period 11. The difference in orders may be due to the first periods observations.

With figure 2 we also suspect the presence of sequence effects and test it. In presence of sequence effect, the individuals behavior during the second treatment are strongly affected by their choices in the first treatment. Thus, for each order, we compare the distribution of coordination in the first treatment by the distribution in second treatment. The Wilcoxon-Mann-Whitney confirms the existence of sequence effects at 10% level for only order 1 (z=1.808 p=0.0705). Sequence effects are absent for order 2 (z=0.905 p=0.3657). Consequently, playing the high asymmetric treatment first significantly influences the way of playing low asymmetric treatment whereas the opposite is not true.

Figure 2 also underlines a potential restart effect in order 1 play at period 11. At period 10 for order 1, coordination was 0.30% and falls to 0.11% at period 11. That means switching from high to low asymmetric treatment considerably affects the behavior of the individuals and corroborates our precedent observation.

Figure 2: Coordination by order

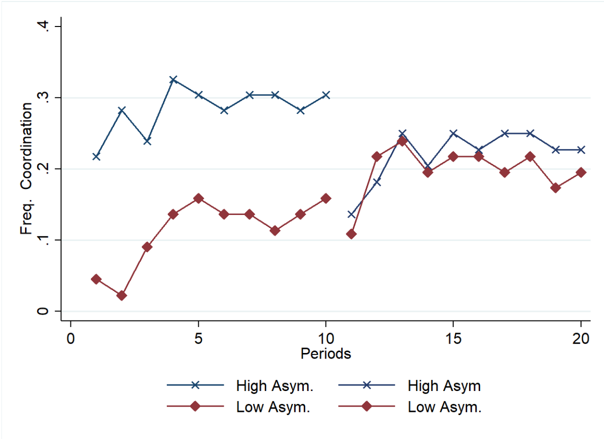


Notes: Squares connected line features order 1 and dots connected line is for order 2. Individuals play one treatment, either high or low asymmetric treatment, for the first ten periods then switch to another treatment for the remaining periods. Significant difference between high asymmetric treatment and low asymmetric treatment for order 1 at 10% level (Wilcoxon-Mann-Whitney z=1.808 p=0.0705). No difference between high asymmetric treatment and low asymmetric treatment for order 2 (Wilcoxon-Mann-Whitney z=0.905 p=0.3657)

Now, we divide the distribution of each order in two clusters to study the performance of high asymmetric on low asymmetric treatment by sequence (between analysis). Cluster 1 goes from 1 to 10 periods whereas cluster 2 covers the remaining periods. In each cluster, one can figure out the distribution of each treatment in corresponding periods. For instance, in periods 1 to 10, individuals in order 1 play high asymmetric treatment while individuals in order 2 play low asymmetric treatment. Figure 3 represents these two clusters. Stars connected lines in this figure represent the high asymmetric treatments and diamond connected lines are for low asymmetric treatments. We can observe that differences between treatments hold uniquely in cluster 1 with 28,48% and 11.36% as coordination frequencies, respectively for high asymmetric and low asymmetric treatment. Yet, the frequency of coordination for high asymmetric treatment stay higher than for low asymmetric treatment (22.04% vs 19.78%)in cluster 2. By the way, even when order and sequence effects exist, the high asymmetric treatment offer better performances relative to low asymmetric treatment.

Result 2: *It is always better to begin with high asymmetric offers and finish with low asymmetric offers instead of the opposite in order to achieve the same goal.*

Figure 3



Notes: Stars connected lines features the high asymmetric treatments and diamonds connected lines the low asymmetric treatments. Significant difference between two treatments between the ten first periods (Wilcoxon-Mann-Whitney z=2.651 p=0.0080) and no significant difference during the remaining periods (Wilcoxon-Mann-Whitney z= 0.177 p=0.8597)

Besides, we estimated the impact of asymmetric treatments by means of ordinary least squares (OLS) regression using linear probability model (Hellevik, 2009). Two dependant variables are addressed for the regression, especially the dummy of coordination when 1 means all groups members participate and the dummy individual involved in which 1 equal at least one individuals choose to participate. We control for groups and time fixed effects. Linear model is used here instead of classical logistic model because the latter cannot take into the decision of the non switching individuals when we control for fixed effects. The results are reported in Table 4 and strongly corroborate our result 2. In fact, groups significantly decrease their coordination of about 10% when they switch from high asymmetric to low asymmetric treatment. Moreover, group's members lowers their participation with low asymmetric treatment compared to high asymmetric treatment.

For now, individual preferences are not completely integrated in the analysis. however, we can note that 53,70% of them are altruists. We build altruism variable using the modified dictator game of Blanco et al. (2011). This variable is a dummy equal 1 if individuals chose the offer 5 - 5 instead of 10 - 0 from the set of offer. We choose to compare these offers because they have same costs. Yet, we also find that individuals are risk averse on average. Intuitively, we have reasons to think that altruism and risk may be the main explanations for the success of high asymmetric treatment, that's why we

Table 4: Regression with linear probability model

Model	LPM	LPM
Dep. var	Coordination	Group inv.
Asym.=1	-0.10	-0.08
	(0.01)***	(0.02)***
Obs	4,250	4,250
Group fixed effect	yes	yes
Time fixed effect	yes	yes

Notes: *** significant at 1%. Robust standard errors in parentheses. Asym. equal to 1 if low asymmetric treatment. Group inv. equal 1 if there exists at least one individual who participates by group. Coordination equals 1 if the overall members of the groups participate. LPM means Linear Probability Model. Reported standard errors are adjusted for serial correlation.

will study them.

5 Discussion

In hypothesis 1, we stated that coordination will be weak for each treatment. Not surprisingly, the results confirm our hypothesis. Coordination failures on Pareto efficient equilibrium again exist. In our context, asymmetrically paying individuals to participate in biodiversity conservation via agglomeration bonuses reaches globally less participation. This may due to the structure of the game (Devetag and Ortmann, 2007). First, because risk dominant equilibrium is more attractive than the Pareto efficient equilibrium. Second, individuals may not clearly understand the matrix of payoff according to weak level of choosing risk dominant equilibrium.

However, This latter result establishes a prior for the analysis of our hypothesis 2. We hypothesised that coordination will be better when payment are low asymmetrically offered. Results suggest the contrary. In other words, highly asymmetric incentives globally performs well compared to low asymmetric one. This finding is exclusively due to the behavior of role B individuals. While behavior of role A and C individuals stay constant, the behavior of individuals on role B decrease over time. One can think that these individuals take more risk when they face large payments that is the case in high asymmetric treatment. This finding means that individuals depict some kind of risk loving and altruism or maybe the mixture of the two individual characteristics. These are what we further explore.

References

Andreoni, J., Croson, R., et al. (2008). Partners versus strangers: Random rematching in public goods experiments. *Handbook of experimental economics results*, 1:776–783.

Bernstein, S. and Winter, E. (2012). Contracting with heterogeneous externalities. *American Economic Journal: Microeconomics*, 4(2):50–76.

Blanco, M., Engelmann, D., and Normann, H. T. (2011). A within-subject analysis of other-regarding preferences. *Games and Economic Behavior*, 72(2):321–338.

Brandts, J. and Cooper, D. J. (2006). A Change Would Do You Good .... An Experimental Study on How to Overcome in Organizations Coordination Failure. *American Economic Association*, 96(3):669–693.

Broch, S. W., Strange, N., Jacobsen, J. B., and Wilson, K. A. (2013). Farmers' willingness to provide ecosystem services and effects of their spatial distribution. *Ecological Economics*, 92:78–86.

Budescu, D. V. and Weiss, W. (1987). Reflection of transitive and intransitive preferences: A test of prospect theory. *Organizational Behavior and Human Decision Processes*, 39(2):184–202.

Charness, G., Gneezy, U., and Kuhn, M. A. (2012). Experimental methods: Between-subject and within-subject design. *Journal of Economic Behavior & Organization*, 81(1):1–8.

Crawford, B. V. P., Gneezy, U., and Rottenstreich, Y. (2008). The Power of Focal Points Is Limited : Even Minute Payoff Asymmetry May Yield Large Coordination Failures. (1988):1443–1458.

Devetag, G. and Ortmann, A. (2007). When and why ? A critical survey on coordination failure in the laboratory. pages 331–344.

Fehr, E. and Schmidt, K. M. (1999). A theory of fairness, competition, and cooperation. *Quarterly journal of Economics*, pages 817–868.

Fischbacher, U. (2007). z-tree: Zurich toolbox for ready-made economic experiments. *Experimental economics*, 10(2):171–178.

Greiner, B. et al. (2004). The online recruitment system orsee 2.0-a guide for the organization of experiments in economics. *University of Cologne, Working paper series in economics*, 10(23):63–104.

Hellevik, O. (2009). Linear versus logistic regression when the dependent variable is a dichotomy. *Quality & Quantity*, 43(1):59–74.

Holt, C. A., Laury, S. K., et al. (2002). Risk aversion and incentive effects. *American economic review*, 92(5):1644–1655.

Lòpez-pèrez, R., Pintèr, À., and Kiss, H. J. (2015). Journal of Economic Behavior & Organization Does payoff equity facilitate coordination ? A test of Schelling's conjecture . *Journal of Economic Behavior and Organization*, 117:209–222.

Parkhurst, G. M. and Shogren, J. F. (2007). Spatial incentives to coordinate contiguous habitat. *Ecological Economics*, 64(2):344–355.

Parkhurst, G. M., Shogren, J. F., Bastian, C., Kivi, P., Donner, J., and Smith, R. B. (2002). Agglomeration bonus: an incentive mechanism to reunite fragmented habitat for biodiversity conservation. *Ecological economics*, 41(2):305–328.

Reed, F. (1994). 11. the wildlands project: Land conservation strategy. *Environmental Policy and Biodiversity*, page 233.

Segal, I. (1999). Contracting with externalities. *Quarterly Journal of Economics*, pages 337–388.

Segal, I. (2003). Coordination and discrimination in contracting with externalities: Divide and conquer? *Journal of Economic Theory*, 113(2):147–181.

Smith, R. B. and Shogren, J. F. (2001). Protecting species on private land. In *Protecting Endangered Species in the United States: Biological Needs, Political Realities, and Economic Choices*, pages 326–343. Cambridge University Press Cambridge.

Smith, R. B. and Shogren, J. F. (2002). Voluntary incentive design for endangered species protection. *Journal of Environmental Economics and Management*, 43(2):169–187.

Wunder, S. (2005). Payments for environmental services: some nuts and bolts. Technical report.