DEMOCRACY TO PROMOTE COORDINATION
AN EXPERIMENTAL APPROACH

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ABSTRACT

When agents in a group engage in activities with strategic complementarities, a coordination problem arises due to multiplicity of equilibria. In this organizational context, the design of mechanisms that reduce strategic uncertainty can enhance coordination and induce the most beneficial outcome e.g. higher productivity. We test this assertion through an experimental design of games with strategic complementarities in which the profitability of an action increases for an agent when others are also partaking in it. A costly action such as voting for/against a merger of two groups is shown to promote efficient coordination in subsequent decisions, compared to a dictator rule that imposes the merger.

Key Words: Experimental economics, coordination, mechanism design, minimum effort game, voting

JEL Classifications: C72, C79, C92

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1. INTRODUCTION

In organizational settings, achieving efficient coordination is frequently a serious problem because many games related to economics have multiple equilibria, and predicting which equilibrium will be selected is a difficult task. Previous experimental evidence shows that large groups in particular never coordinate efficiently unless a mechanism is employed to induce synchronization. Luckily, game theory and experimental economics have been important and useful tools for organizational research. Hence, the purpose of this study is to search for measures that would improve efficient coordination by using the two aforementioned streams of research.

Suppose we have firms that are highly dependent on human capital[1], activist groups, clubs or political parties; in any of these settings, actions that the members choose are crucial in determining the productivity of the organization. In such environments, agents usually engage in activities with strategic complementarities, i.e. the benefit of taking an action increases if others are also taking the same action. Having strategic complementarities suggests that, among many possible strategies, agents would like to coordinate on a certain one to maximize their benefits. However, this usually creates strategic uncertainty, and thus multiple equilibria. As a result, we face a coordination problem among the agents in a group. A mechanism inducing the improving equilibrium, hence increasing the productivity of the group, should decrease the uncertainty about what the other members of the group would do. Given that a collective action such as voting that is costly for the whole group would only be carried out by agents that are willing to implement the improving equilibrium; it creates a credible signal of the intention to coordinate.

The mechanism that inspires the experimental design in this paper is provided by Cabrales and Calvó-Armengol (2007). The authors argue that voting, a costly action taken by the whole group can induce an improving equilibrium in the firm that goes through a downsizing or an upsizing. In this paper, the goal is to first provide an experimental design to test the predictions of the theory along with further implications, and second, check how far this mechanism would take us once we relax certain assumptions of the theory. The

[1] Such as consultancy firms or companies in the service sector.

focus of this paper is the merger of two groups.[2] In the setting of firms, this can also be interpreted as the merger of two firms. On the one hand, the case for mergers is interesting since coordination failures in mergers have been a hot topic in previous experimental literature (Camerer and Knez (1994); Weber and Camerer (2003); Feiler and Camerer (2006)). On the other hand, the use of mergers brings out the possibility for an empirical test.

We study a total of four treatments and their associated controls which can be divided into two broad categories in terms of the strategies available to the members of the groups, i.e. two versus three effort levels to choose from. For each set of treatments, there are two selection rules, i.e. majority voting, and unanimity voting. For their controls, we use a dictator rule in the selection process.[3] This rule is implemented to check the robustness of our results. We can also argue that with this setting we compare two mechanisms, i.e. democracy versus dictator rule. The role of procedural justice and correspondingly democracy is widely discussed in the organizational and political economy literature. For example, Thibaut and Walker (1975) show that individuals are more willing to accept unfavorable outcomes, if they believe the procedures that produced them are fair.[4] Frohlich and Oppenheimer (1990) conclude that broader democratic participation in choosing a tax system and a principle of redistribution have positive effects on productivity. Our results are in line with these findings. We find that democracy promotes efficient coordination on the high effort level in all the cases we consider, whereas dictator rule is unable to induce efficient coordination except when only a proportion of the members are needed to choose high effort level to induce efficiency.

Various factors such as, communication, focal points, precedence, risk-dominance, payoff dominance, loss avoidance, security, representation of the game and complexity are important in determining the selection among multiple equilibria.[5] This is the case since in many situations, players use best-response strategies, based on the beliefs of what other

[2] As mentioned before, these groups can be interpreted as firms that are highly dependent on human capital, activist groups, clubs or political parties.
[3] In unanimity rule, all the members of the firm should agree to reach an outcome, whereas with dictator rule, the manager of the group decides for the whole group. In our case, the manager is the experimenter.
[4] Please refer to Ambrose (2002) for a survey on organizational justice research.
[5] More information on these factors, are available in the chapter on "Coordination" by Camerer (2003).

players might do. A summary of previously suggested measures and mechanisms to induce efficient coordination by making use of the aforementioned factors are in continuation.

In the relevant literature, the *stag-hunt* game [6] has been widely utilized in describing situations with strategic complementarities. In this game, the payoffs are symmetric for each player, but equilibria are different and pareto-ranked. The stag-hunt game has been particularly useful for studying focal points[7]; and, previous work shows that focal points which represent the common ground among players' outcomes are the same in equilibrium, but equilibria are different. Another well-known game that has been used to study coordination is the *battle of the sexes.* [8] In this game with asymmetric payoffs, both of the players are willing to coordinate but they disagree on which strategy to coordinate. Cooper et al.[9] conduct experiments on both battle of sexes and stag-hunt games in several studies. In their experiments on battle of sexes game, they find that coordination failure is common as predicted by the mixed-strategy equilibrium.[10] Among several treatments they use for this game, the *outside option* treatment specifically relates to this paper. Outside option stands for an alternative that is provided to the subjects in case they decide not to play the coordination game that is presented to them. Once the outside option is offered to the subjects, Cooper et al. (1993) find that only 20% of the time players choose to take the outside option; and among those who play, 90% of them receive their preferred payoff. The authors use outside options also in the study of stag-hunt games and find that with the existence of a plausible outside option, subjects stay out of the game almost half of the time; however, they converge to the efficient outcome 77% of the time once they decide to play the game. In our experiment, we use games that are comparable to the stag-hunt game, and through the use of the mechanism at hand we are able to induce all the subjects to decide to play the game and converge to the efficient outcome.

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6 The stag-hunt game can shortly be described with the following example; two hunters can hunt a rabbit, earning 1 each, or together hunt a stag to get 2 each. However, if one of the hunters goes alone for a stag, he receives 0.

7 Mehta et al. (1994)

8 A battle of sexes game is described as two people being interested in coordinating their action and both of the players are better off if they take the action together, rather than being alone. However, the payoffs are asymmetric, i.e. players prefer different actions.

9 Cooper, R., D.V. DeJong, R. Forsythe, and T.W. Ross (1990), (1992), (1993)

10 They find 59 % and the mixed-strategy equilibrium predicts 62.5% mismatch rate.

Previous work by Van Huyck et al.[11] regarding minimum or median effort games has been essential in the study of coordination. General results by Van Huyck et al. indicate that strategic uncertainty leads to coordination failure; however, there are some factors that can facilitate the difficult task of reaching the efficient equilibrium in coordination games. Van Huyck et al. (1993)[12] conclude that the introduction of a cost can eventually induce coordination. Their experiment shows that the subjects do not converge to the efficient outcome when they are endowed with the right to participate, but always converge to the efficient outcome when they purchase the right to participate.[13] Cachon and Camerer (1996) use a median effort game to measure coordination and describe *loss-avoidance* as a new equilibrium selection principle.[14] They argue that charging a fee to play the game creates coordination on better equilibria. The fact that people coordinate on better equilibria relates to the idea that people are willing to recuperate sunk costs, and thus take their decisions accordingly.

Generally, communication might be helpful for coordination but it is not a definite solution to miscoordination. The results of previous experiments on the stag-hunt game show that efficiency is not easy to attain without communication. It only works if it selects a unique equilibrium and if players believe in what is said through communication. In many experiments, while one-way communication works very well for coordination, two-way communication does not perform as well in battle of sexes games. However, two-way communication works better than one-way communication in stag-hunt games. One can argue that communication conveys another coordination problem, i.e. it requires agents to coordinate their beliefs about the meaning of messages that are exchanged. It is possible to think that one-way communication is more effective as it creates less confusion for the other agents that are involved to form their expectations. In an organizational context, Brandts and Cooper (2007) find that communication is a better tool than financial incentives in inducing coordination. Therefore, returning to the scope of this paper, it is plausible to think that a

11 Van Huyck, J.B., Battalio, R.C., and R.O. Beil (1990), (1991), (1993)

12 They provide a repeated two stage game in which they test whether the subjects converge to the efficient equilibrium in the product market.

13 In the literature, there are other mechanisms suggested in order to achieve efficient coordination. Brandts and Cooper (2006) find that increase in benefits through bonuses improves coordination. Bornstein et al. (2002) conclude that one can improve intragroup coordination through intergroup competition.

14 Loss-avoidance in their paper stands for players avoiding strategies that have either only negative payoffs or negative equilibrium payoffs.

mechanism to affect these expectations in a similar manner would be useful to induce coordination.

As there is more strategic uncertainty in larger groups, reaching the efficient equilibrium becomes more difficult. A solution to the coordination problem in minimum effort games is studied by Weber (2006). He states that it might be difficult to attain efficient coordination in groups that start off large. However, he concludes that by starting with small groups that can coordinate and increasing the group size by adding new entrants who are aware of the history of the group, one can create efficiently coordinated large groups.

The *Forward induction* argument is essential in the scope of this study as the mechanism to be tested is designed to align the expectations of the agents. When a player does not know which type of player the other one is, she may form expectations on future actions by observing the past behavior of the other player. Forward induction assumes that future actions will be rational.[15] It conveys a strong belief in sequential rationality, i.e. if there are two pure strategies s_i and s_i^* for a player i that are consistent with a history of play, and among these strategies only s_i is strictly dominated, given the history, no other player j would believe that i plays s_i. Forward induction can be theoretically powerful in ruling out some of the Nash equilibria.[16] However, this argument may encounter some difficulties in real life and thus it needs experimental testing. Brandts and Holt (1995) use several battle of sexes games with an outside option in their experiments. They argue that forward induction works fairly well in games where it coincides with simple dominance argument, but it fails in games where dominance does not apply. Moreover, they state that even iterated dominance arguments may not work empirically once the outside option presented to the subjects is not a sure option but rather a coordination game. The authors also claim that previous experiments by Cooper et al. focus mainly on the case where forward induction argument coincides with the dominance argument. In this paper's context, given our mechanism at hand, it is reasonable to focus on games in which the forward induction argument complies with the one of dominance.

15 Similar to backward induction, which assumes that past actions were rational, and the player reasons about what could have happened previously.
16 Kohlberg and Mertens (1986), and Kohlberg (1989)

As it is mentioned before, merger failures have been extensively studied in the literature. Even though Huck et al. (2004) points out the potential profitability of mergers, there is significant research on the inefficiencies that are created as a result of mergers. For example, Tichy (2001) points out that in 58% of the cases, profits come out weaker than in the respective non-merging control group, and stronger in only 11%. These inefficiencies resulting from mergers can be studied as a coordination problem. Camerer and Knez (1994) argue that, on the one hand, due to the group size effect, one can expect a merged group to do worse. On the other hand, mergers might give the small groups an opportunity to restart and consequently reach an improving equilibrium. This point relates to the aim of the mechanism to be tested in this paper. The authors find that the first argument dominates and the mergers fail given their experimental set-up. Therefore, it would be useful to strive for a setting which can improve the performance of mergers.

Several works in the literature attempt to relate coordination failure to the conflicting cultures of the merged firms. Controlling for the group size effect, Weber and Camerer (2003) conclude that failure to coordinate activity in mergers is based on cultural conflict; and note that subjects overestimate the performance of the merged firm. In addition, the subjects attribute decrease in performance to members of the other firm rather than to situational difficulties created by conflicting culture. Moreover, using a similar methodology, Feiler and Camerer (2006) also find that merged groups perform worse in the given task.[17]

This paper is structured as follows. First, an explanation for the mechanism at hand and the theoretical implications for the current experimental design are provided. Subsequently, experimental procedures and design are introduced followed by a discussion of hypothesis and the results. The last section concludes and discusses the possibilities for further research.

2. THE THEORY

Cabrales, A., and A. Calvó-Armengol (2007) defines the cooperative action that is taken by the members of the firm as taking an action that contributes to the productivity of the firm. Given this framework, as long as individual and collective interests are aligned in the firm,

[17] Subjects were slower in guessing which of the pictures the other member (manager) was describing if they are in the merged group.

i.e. productive members of the firm are better off as more people in the firm contribute to its productivity, one should focus on the coordination problem, and study if the mechanism at hand will be able to induce efficient coordination in various contexts.

This paper studies a game on merger of two groups. These groups can be thought of as two firms that are highly dependent on human capital, two activist groups or clubs that have similar ideals, and interests or two political parties. In this game, two small groups, which consist of 5 people, will vote whether to merge or not with each other; consequently, if the two small groups are merged, the members of the large group will decide on their effort levels. The strategy set for the players as well as their payoff functions which depends on the voting rule we implement will be explained subsequently.

The set of players in one group is defined as P and its cardinality is equal to p. Moreover, the set of players in the other group is Q with a cardinality q. In the first stage of the game, p players of one group and q players of the other group vote to decide whether to merge or not. So the players in the new organization are defined by the set P^* and its size is $p^* = p + q > p$. Suppose that the new organizational size p^* is more efficient than p and q; therefore, the organization prefers to increase its size to p^*. However, one should note that the organization will go through a costly process to increase its size to p^*. This can be implemented by stating that the Pareto-superior outcome in the smaller size is higher than the Pareto-inferior outcome in the larger size. One should note that this process is not costly per se, in the sense that none of the players would have to pay a fee. However, they will face an indirect cost since; first, there is an increase in strategic uncertainty due to the increase in the size of the group[18], and second, there is a probability of not coordinating efficiently in the larger size and the payoff one could receive is lower than the smaller size in case players fail to coordinate on the efficient equilibrium.

The mechanism[19] suggests that upsizing in the case of mergers requires k-majority approval, i.e. if k fraction of players in both groups decide to merge, the merge will happen. It is possible to implement different types of acceptance rules in the voting stage, such as;

18 Agents would need to coordinate on the efficient outcome with more people, which create more uncertainty.
19 Cabrales and Calvó-Armengol (2007)

majority rule, unanimous agreement, or alternatively a rule between the two, i.e. a fraction which is more than half of the voters. In the second stage, the new set of players ($p + q$ players) chooses to contribute to an action that enhances productivity of the group or not to contribute, i.e. they will choose an effort level that can be high or low. In the first stage of the game, there are two possible strategies; *"Merge"* (*M*), and *"Not Merge"* (*NM*). In the second stage, players are required to choose among possible effort levels. When there are two effort levels available, there are two possible strategies; *"A"*, and *"B"*, where *"A"* denotes high effort and *"B"* denotes low effort. Let s denote the strategy set for the players in both groups, and i denotes players, then $s_i = \{(M,A), (M,B), (NM,A), (NM,B)\}$. Whereas, when there are three effort levels, high, medium and low; there are three strategies available for the members of the firm in the second stage. The effort levels are defined as *"1"*, *"2"* and *"3"*, which correspond to low, medium and high efforts respectively. As a result, the strategy set s for the players in both groups with three effort level is $s_i = \{(M,1), (M,2), (M,3), (NM,1)$ $(NM,2), (NM,3)\}$.

The aforementioned fraction k is also important in determining the payoffs in the larger firm. According to the proposed theory, for the iterative dominance argument to work in selecting the equilibria, we need at least kp^* players to coordinate on the strategy that would give them the Pareto-Superior payoff, for coordination on this strategy to be beneficial in the larger organization. Consequently, it is weakly dominant to accept to increase the organization size, i.e. *"Merge"*, and to efficiently coordinate in the next stage, i.e. choose *"A"* if there are two effort levels or choose *"3"* if there are three effort levels. The payoffs for the three effort level and two effort level games are determined in a similar manner, therefore, for simplicity, it is sufficient to provide an example for constructing the payoffs of the game used in this experiment with two effort levels.[20]

For example, on the one hand, for the unanimity voting case, the players get the high-payoff if all the participants efficiently coordinate, and low payoff if any of the players decides to exert low effort, i.e. play *"B"*. On the other hand, for the majority voting case which corresponds to 3/5 of the players voting to merge in the specific application used in this

20 A fuller treatment on theory can be found in Cabrales and Calvó-Armengol (2007). However, a simple example on the theory with three effort levels is also available on request.

paper, the players get the high-payoff if 3/5 of players in the large group choose the high effort level, i.e. *"A"*. This assumption on payoffs suggests that the voting rule should be aligned with the way the strategic complementarity benefits the members of the firm. While this is a useful theoretical requirement in selecting the equilibrium, we will relax this assumption in one of the treatments *(Majority 3)*. [21] In this treatment, we use a minimum-effort game with three effort levels. This implies that all the members of the group should exert the highest effort level *"3"* in order to efficiently coordinate. The use of the minimum-effort game along with majority voting implies relaxing the assumption on *kp** coordinators. Therefore, in this regimen, it is no longer weakly dominant to *"Merge"* and choose *"3"*. This treatment is introduced to check how far the mechanism will take us and observe if voting also acts as a behavioral signal. We will also introduce a coordination game in case players decide to stay in the smaller group and this will expand the strategy set available to them.[22] However, as long as the voting rule and the payoffs are based on the *k* fraction of players, the expansion on the strategy set will not influence the weakly dominant strategy.[23]

Suppose that payoffs are symmetric for the players, and all agents are needed to coordinate by playing *"A"* at the second stage to receive the high-payoff *x*. Moreover, low-payoff *y* and *z* are respectively obtained by players that play *"B"* and *"A"* if the players fail to coordinate in *"A"* in the second stage; and payoff *w* is obtained by all players if they fail to merge as a result of the voting at the first stage. This can be more formally written as follows. I_{MP} denotes the set of *p* players that choose to merge in the first stage, and it is defined as $I_{MP} = \{i \in P / s_i = (M, \cdot)\}$, and I_{MQ} denotes the set of *q* players that choose to merge in the first stage, and it is defined as $I_{MQ} = \{i \in Q / s_i = (M, \cdot)\}$. Moreover, I_A denotes the set of players that choose A in the second stage, and it is defined as $I_A = \{i \in P* / s_i = (\cdot, A)\}$. The

21 Majority 3 corresponds to Treatment 2.1 which will be explained in the section for experimental procedures and design. In the three effort level case, we use the same minimum-effort game for both unanimity and majority voting.

22 The strategy set with two effort levels become s_i = {(*M,AA*'),(*M,AB*'),(*M,BA*'),(*M,BB*'),(*NM,AA*'), (*NM,AB*'),(*NM,BA*'),(*NM,BB*')}, whereas the strategy set with three effort levels become s_i = {(*M,11*'), (*M,12*'), (*M,13*'),(*M,21*'), (*M,22*'), (*M,23*'),(*M,31*'), (*M,32*'), (*M,33*'),(*NM,11*'), (*NM,12*'), (*NM,13*'),(*NM,21*'),(*NM,22*'), (*NM,23*'),(*NM,31*'),(*NM,32*'), (*NM,33*')}

23 Which is to choose to "*Merge*" and consequently coordinate efficiently in the larger group by exerting a high effort level.

cardinality of these sets are denoted by $|I_{MP}|$, $|I_{MQ}|$ and $|I_A|$ respectively. Payoff functions for each player $\pi_i : S \to \Re$ are defined as below.

$$\pi_i(s) = \begin{cases} x \text{ if } s_i = (M, A) \ , |I_{MP}| > kp \ , |I_{MQ}| > kq \text{ and } |I_A| \geq kp^* \\ y \text{ if } s_i = (M, B) \ , |I_{MP}| > kp \text{ and } |I_{MQ}| > kq \\ w \text{ if } |I_{MP}| < kp \text{ and/or } |I_{MQ}| < kq \\ z \text{ if } s_i = (M, A), |I_{MP}| > kp \ , |I_{MQ}| > kq \text{ but } |I_A| < kp^* \end{cases}$$

where $z < y < w < x$

For clarification, the payoff matrix for the merged group is given below.

Other Players' decisions

Your Decision		If a **sufficient number[24] of the other** participants choose **A**	If a **sufficient number[25] of the other** participants **DO NOT** choose **A**
	If you choose **A**	***x***	***z***
	If you choose **B**	***y***	***y***

3. EXPERIMENTAL PROCEDURES AND DESIGN: [26]

For each session in the experiment, there are 20 subjects that play 30 rounds.[27] At the end of each round subjects are randomly matched with each other to play the following round. Each round consists of three parts for treatment groups and two parts for control groups. In all the settings, payoffs of an individual depend on her own actions and the actions of the other participants in her group as suggested by a typical coordination game. The sessions are conducted in LEEX at Universitat Pompeu Fabra (UPF), using z-Tree.[28] A total of 140 undergraduate students from various departments of UPF participated in this experiment. Participants answered control questions at the beginning and a questionnaire at the end of the experiment in order to check their understanding of the mechanism. All the participants were paid in cash at the end of each session.

[24] Depending on the voting rule.
[25] Depending on the voting rule.
[26] Please see Appendix I for an example of the instructions.
[27] Except for Majority 3 treatment where 20 subjects played 20 rounds.
[28] Zurich Toolbox for Readymade Economic Experiments developed by Fischbacher and Schmid.

In this experiment, there are two groups of 5-people that could possibly form a big group of 10-people through voting. As mentioned before, the treatments and their associated controls are divided into two broad categories. In the first set of treatments, participants choose among a high and a low effort, and these effort levels are presented to them as *"A"* and *"B"*. In the second set of treatments, participants choose among high, medium and low effort levels that are represented as "*3*", "*2*", and "*1*" respectively. For each set of treatments, there are two selection rules, i.e. majority voting, and unanimity voting. For their controls, we use a dictator rule, i.e. two groups of 5-people are forced to merge and form the 10-people group at the second part of the round. A round for each treatment and their controls can be summarized as follows:

Treatment 1.1 *(Majority 2)* and Control *(Dictator 1)*:

- All the groups play a 5-player coordination game. Their payoffs are given by Table I.
- Two groups are matched with each other and they decide whether or not to merge with the group that they are matched with by majority voting. *(No voting for the Dictator 1)*
- For the groups to merge, we need at least 3 out of 5 of the subjects in each group to vote *"Merge"*. If both groups accept to merge, they play the 10-player coordination game and their associated payoffs are given by Table II.a. *(The participants in Dictator 1 directly play the 10-player coordination game.)*
- If they do not merge, then small groups play the 5-player coordination game again.

Table I

		Other Players' decisions	
		If **all (4) of the other** participants choose **A**	If **at least one of the other** participants choose **B**
Your Decision	If you choose **A**	**110**	**50**
	If you choose **B**	**80**	**80**

Table II.a

		Other Players' decisions	
		If **5 or more of the other** participants choose **A**	If **4 or less of the other** participants choose **A**
Your Decision	If you choose **A**	**130**	**50**
	If you choose **B**	**70**	**70**

In order to eliminate any confusion related to the matching process, we match the groups with each other prior to the merging decision. This also allows us to provide an externally valid design, since in the real world two companies that decide to merge are predetermined.

In this experiment, the first game is independent of the voting stage. However, once the payoffs are given to the subjects as a result of their decisions in the first game, we can expect them to adjust their expectations about their own groups and form their expectations for the other group according to the payoffs they receive and possibly fail to comply with the predictions of the forward induction argument. In the second part, the subjects decide by voting whether to stay in the 5-player game or switch to the 10-player game. Given payoff structure by Table I and Table II.a, there is an expected cost for the players of the small group associated with accepting to merge since not coordination in the 10-player game is costly compared to the 5-player game. This is implemented for subjects to better grasp the risks associated with forming a larger group.

Treatment 1.2 *(Unanimity 2)* and Control *(Dictator 2)*:

- All the groups play a 5-player coordination game and their payoffs are given by Table I, which is shown before.
- Two groups are matched with each other and they decide whether or not to merge with the group that they are matched with by unanimity rule. *(No voting for the Dictator 2)*
- For the groups to merge, we need all the subjects in each group to vote *"Merge"*. If both groups accept to merge, they play the 10-player coordination game. Their payoffs are shown in Table II.b. *(The participants in Dictator 2 directly play the 10-player coordination game.)*
- If they do not merge, then small groups play the 5-player coordination game again.

Table II.b

		Other Players' decisions	
		If **all of the other** participants choose **A**	If **4 or less of the other** participants choose **A**
Your Decision	If you choose **A**	**180**	**50**
	If you choose **B**	**60**	**60**

Treatment 2.1 *(Majority 3)*, Treatment 2.2 *(Unanimity 3)* and Control *(Dictator 3)*:

- All the groups play a 5-player coordination game with associated payoffs demonstrated by Table III.
- Two groups are matched with each other and they decide whether or not to merge with the group that they are matched with either by majority rule *(for Majority 3)* or by unanimity rule *(for Unanimity 3). (No voting for Dictator 3)*
- For the groups to merge in *Majority 3*, we need 3 out of 5 the subjects in each group to vote *"Merge"*. If both groups accept to merge, they play the 10-player coordination with associated payoffs shown in Table IV.
- For the groups to merge in *Unanimity 3*, we need all the subjects in each group to vote *"Merge"*. If both groups accept to merge, they play the 10-player coordination game again with associated payoffs shown in Table IV.
- The participants in the *Dictator 3* directly play the 10-player coordination game using payoff Table IV.
- If they do not merge, then small groups play the 5-player coordination game again.

Table III

Minimum Effort Level by Other Players in Your Group

Your Effort Level		**3**	**2**	**1**
	If you choose **3**	**110**	**80**	**50**
	If you choose **2**	**-**	**90**	**60**
	If you choose **1**	**-**	**-**	**80**

Table IV

Minimum Effort Level by Other Players in Your Group

Your Effort Level		**3**	**2**	**1**
	If you choose **3**	**180**	**70**	**40**
	If you choose **2**	**-**	**80**	**50**
	If you choose **1**	**-**	**-**	**70**

4. HYPOTHESIS AND EXPERIMENTAL RESULTS:

The main hypothesis is that we will obtain coordination on the improving equilibrium especially in part 3 of each round in the sessions of *Majority 2*, *Unanimity 2*, and *Unanimity 3*, whereas, it will be the opposite for the control treatments, where the dictator rule is applied. [29] However, for *Majority 3*, one should note that the assumptions of the theory are relaxed and thus we would expect an improvement from the control treatments if voting acts also as a behavioral signal.

The mechanism at hand depends on introducing the costly action *"voting"*, if there is no costly action, i.e. the dictator rule is applied, there is no signal for the members of the new firm to coordinate on the improving equilibrium. Therefore strategic uncertainty and thus difficulties in reaching efficient coordination remain present. Accordingly, we can argue that democratic processes are better in organizational research, and thus entities such as cooperatives are more likely to perform better.

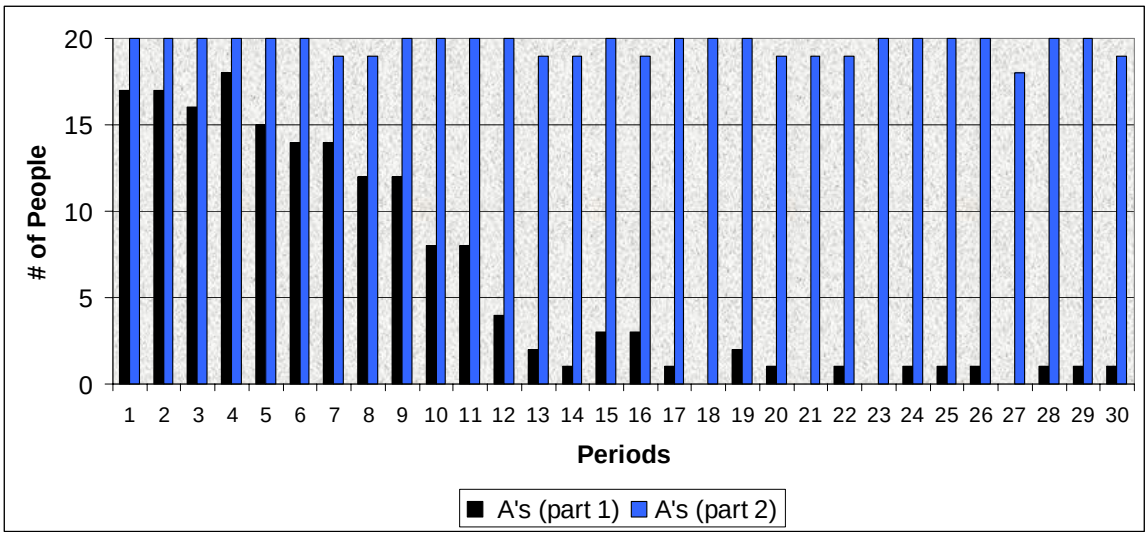
In accordance with the hypothesis at hand, from the results of *Majority 2* shown on the following page in Graph II, we can see that subjects fail to coordinate on strategy *"A"* [30] in the first part of each round, whereas they coordinate on *"A"* in the last part after the voting mechanism is implemented. However, one cannot observe a significant difference between the treatment and control groups in this case. In the control group *Dictator 1*, for which the results are shown by Graph I, we need a lower fraction of people to coordinate in *"A"* at the last part in order to achieve efficiency, i.e. we need 6 out of 10 people to choose *"A"* in part 2, whereas all 5 out of 5 members are needed to coordinate on *"A"* in part 1. As a result, subjects find it easier to efficiently coordinate. Therefore, we employ further treatments to ensure that the coordination we obtain is a result of the mechanism rather than the behavioral patterns of certain groups or subjects. One can observe the true potential of this

[29] We compare part 1 of each round for each treatment and its associated control. However, as the control groups do not have voting each round consists of 2 parts instead of 3. Therefore, we compare part 3 of each round for treatment groups to part 2 of each round for their associated control groups.

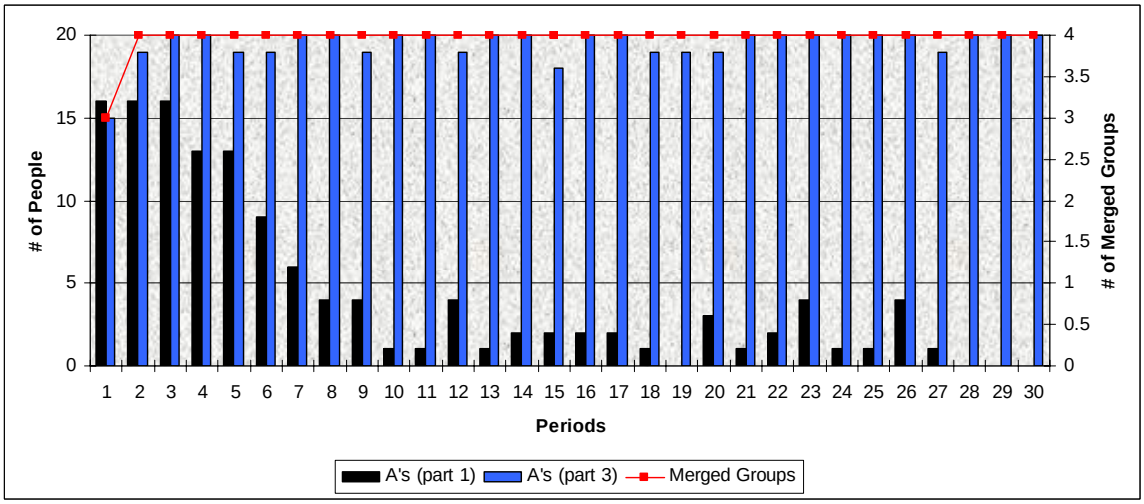
[30] Strategy *A* refers to the strategy that would give the Pareto-superior outcome if the members of group coordinated.

mechanism comparing the results of *Unanimity 2* to its control *Dictator 2*, as well as *Majority 3* and *Unanimity 3* to their associated control *Dictator 3*.

Graph I: Control *(Dictator 1)* for Treatment 1.1 *(Majority-2)*



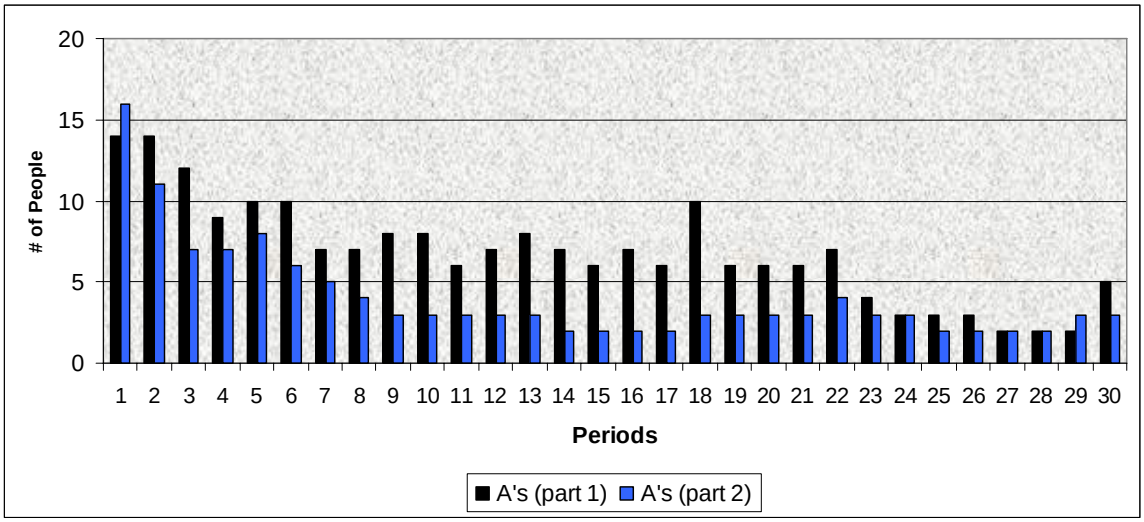
Graph II: Treatment 1.1 *(Majority-2)*



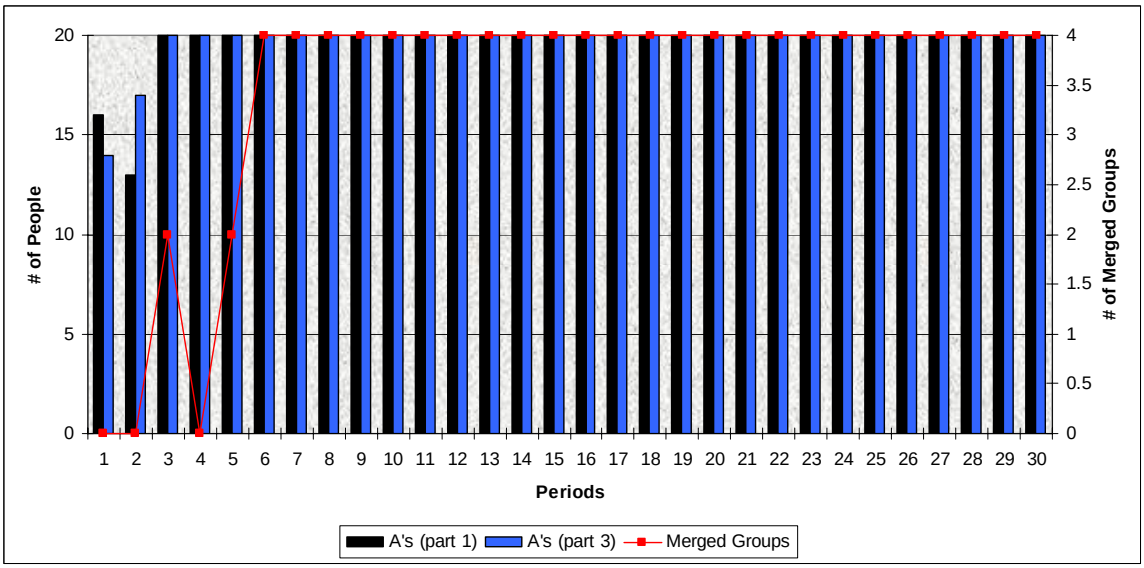
From the results shown in Graphs III and IV on the following page, respectively for the control and the treatment groups on unanimity voting with two effort levels, in each round of the experiment, we clearly observe that subjects fully coordinate on the strategy *"A"* both in the first and the last part when the voting mechanism was implemented with a unanimity rule. However, when the voting mechanism is absent, i.e. when the dictator rule is applied

for the control group, subjects quickly converge to strategy *"B"* instead of strategy *"A"*.[31] The findings for the control group are inline with the previous findings from the experimental literature where subjects converge to the secure strategy rather that the strategy that would promote efficiency when there is no mechanism to implement efficient coordination.

Graph III: Control *(Dictator 2)* for Treatment 1.2 *(Unanimity-2)*



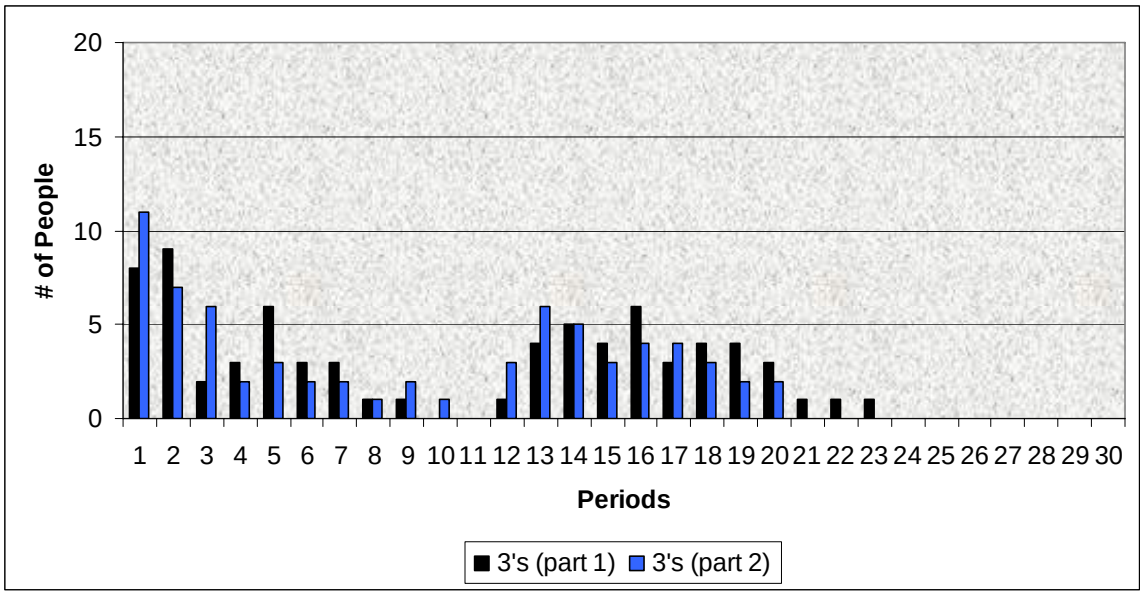
Graph IV: Treatment 1.2 *(Unanimity-2)*



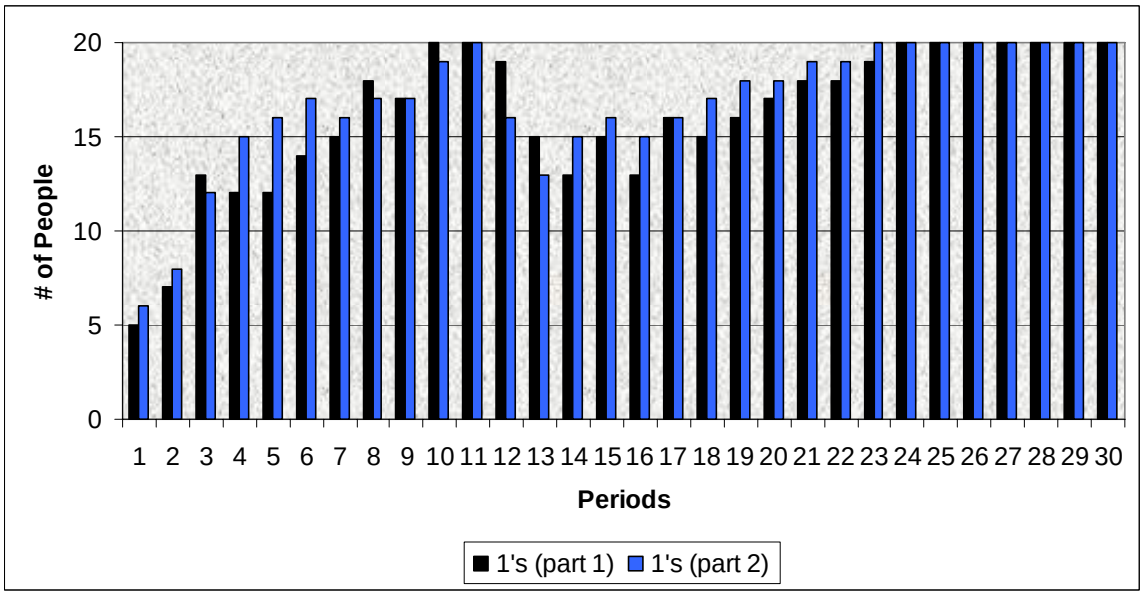
[31] As a result of coordinating on strategy *"B"*, subjects receive the Pareto inferior payoff.

Graphs V and VI show the results of the control group for both of the treatments with three effort levels, namely *Unanimity 3* and *Majority 3*. Similar to the control group for *Unanimity 2* treatment, from the results of the current control group we can see that the participants diverge from exerting high effort level *"3"* and converge to the secure strategy *"1"*, i.e. exerting the lowest effort level.

Graph V: Control *(Dictator 3)* for Treatments 2.1 *(Majority-3)* and 2.2 *(Unanimity-3)*

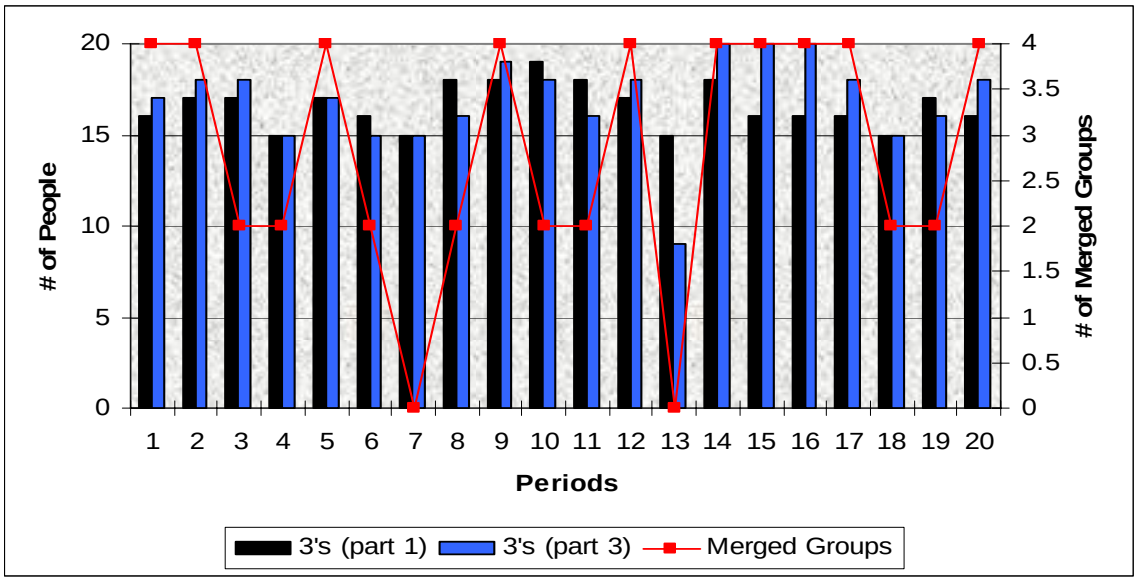


Graph VI: *Dictator 3*



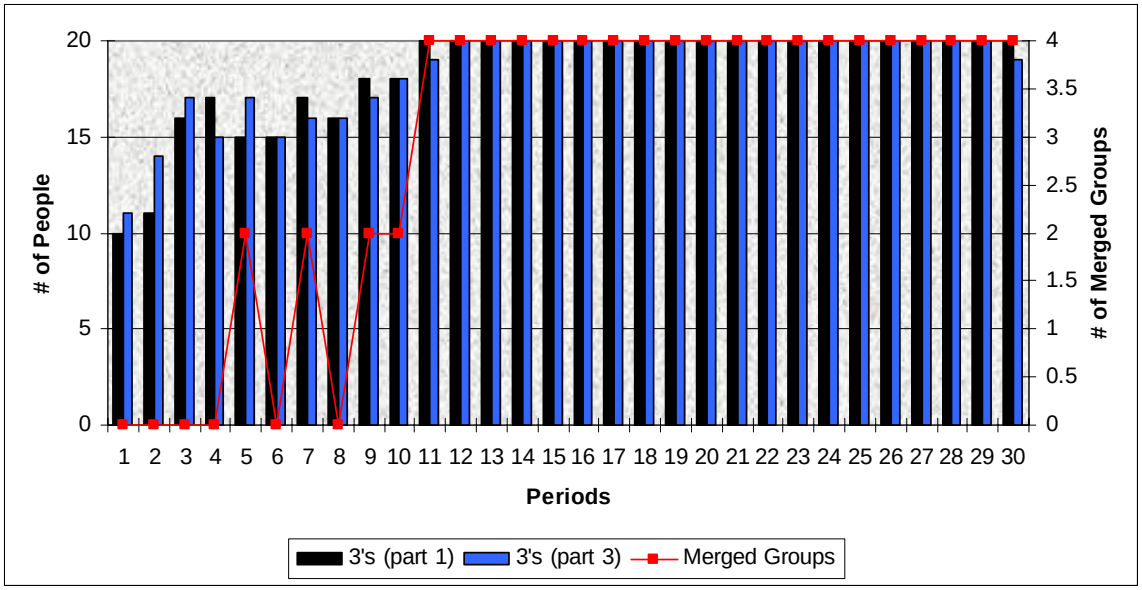
Graphs VII and VIII correspond to the results from sessions *Majority 3* and *Unanimity 3* respectively. We should note that, even though the assumptions of the underlying mechanism at hand were relaxed in the majority voting case, coordination in *"3"* both in the first part and the last part are significantly higher than the control group.

Graph VII: Treatment 2.1 *(Majority-3)*



From the results of *Unanimity 3* shown in Graph VII, one can notice the clear difference between the control group and the treatment group. As a result of unanimous voting, subjects decided to merge and exert the high effort *"3"*.

Graph VIII: Treatment 2.2 *(Unanimity-3)*



It should be visually obvious to the reader that the samples of this experiment do not follow a normal distribution, and accordingly the results from Shapiro-Wilk and Skewness/Kurtosis tests we run on our experimental data comply with this argument.[32] Therefore, we need to focus on non-parametric tests to withdraw some statistical conclusions. The non-parametric tests used to check whether the treatment groups behave statistically different than each other and their associated control, also indicate the same conclusions we grasp from the analysis of graphs shown above. On the one hand, for the sessions with two effort levels, overall results from two-sample Kolmogorov-Smirnow and Wilcoxon rank-sum (Mann-Whitney) tests show that there are differences in the distributions of the control and treatment groups for unanimity voting, i.e. *Dictator 2* versus *Unanimity 2*, whereas we fail to reject differences in the distributions of the control and treatment groups for majority voting, i.e. *Dictator 1* versus *Majority 2*. The results from variance-ratio test and robust tests for equality of variance where we compare the variances of each sample also comply with these findings. On the other hand, for the sessions with three effort levels, Kolmogorov-Smirnov and Wilcoxon rank-sum tests indicate differences in distributions among the control group *Dictator 3* and the treatments *Majority 3* and *Unanimity 3*, as well as a difference between the two treatments *Majority 3* and *Unanimity 3*. However, aforementioned tests are general tests about the distributions and variances of the samples. In order to draw conclusions on efficiency, especially when comparing the two treatments with three effort levels we are more interested in the average of the number of participants that choose the high effort level in each session. Therefore, in order to get clarity about differences in means we also use a test suggested by Schlag (2007). The results from this test show that while the mean of the number of subjects that choose high effort level for the control group *Dictator 3* is significantly different than both treatment groups *Majority 3* and *Unanimity 3*, there is no significant difference between the means in sessions *Majority 3* and *Unanimity 3* (see Appendix II).

5. CONCLUSIONS AND FURTHER RESEARCH:

The results of the mechanism are very promising for both two and three effort level games and both of the voting rules. Comparing dictator rule to democracy, we find that democracy

[32] Please refer to Appendix II for detailed results.

always induces the Pareto optimal outcome, whereas dictator rule does not work if all the agents need to choose the optimal action. For the treatments *Unanimity 2*, *Unanimity 3* and *Majority 3*, voting not only increases efficient coordination in the last stage after the merger occurs but also increases efficient coordination in the first stage when the subjects are in their smaller group. This clearly shows that voting creates a credible signal for all the participants to coordinate by exerting the highest effort level and implementing the Pareto-superior equilibrium. Given the positive results for two and three effort levels, this study can further be developed by using more effort levels as of Van Huyck et al.(1990).

As mentioned before, the mechanism at hand can be compared to having a coordination game as an outside option. In the literature it is shown that subjects usually fail to use sophisticated levels of iterated dominance and forward induction, and when the outside option is not a sure value but rather a game subjects have difficulty in coordinating on the efficient outcome. However, in our case, even when the outside option is a game, voting works as a simple mechanism and subjects efficiently coordinate.

A striking result comes from the comparison of *Majority 2* treatment and its control group *Dictator 1*. As stated in Section 4 of the paper, we can observe that subjects efficiently coordinate even for the control group when merging is mandatory, since they need only a fraction of the group to coordinate on the high effort level to achieve efficiency. However, we should still note that the number of people needed to coordinate in the large group is still larger than the number of people in the small group.[33] This raises the question of whether people think in absolute numbers or ratios while coordinating; and, creates an interesting line of research. Another conclusion to be withdrawn from this result is in terms of cost-benefit analysis of democracy versus dictator rule. It is plausible to think that we can utilize dictator rule in cases where it works since it can be argued that it is cheaper and easier to implement. However, as stated before processes can be as important as the outcome itself, and thus a likable mechanism such as democracy can be more preferable.

[33] 6 versus 5 people

The specific choice of merging in this experiment is plausible as it also gives us the possibility to broaden this research by empirical studies in which one can compare mergers versus takeovers of the firms. Our results confirm previous findings in the literature about the importance of procedural justice in organizations. It can be expected that mergers where consent is more expressly given are more profitable than takeovers. Furthermore, this study also allows us to give recommendations on the process of mergers. The use of mergers also allows us to conclude that coordination in the last stage does not simply relate to the phenomena of starting small.

Another possible study that can be conducted to measure this mechanism is the one on upsizing/downsizing where the initial group decides to include/exclude an extra individual at a given point in time. This would also relate to organizational research in terms of determining the optimal size of the firm. In this line of research, it is possible to use different rules for voting and coordination. It is also plausible to conduct experiments with several rounds to check the robustness of our results. However, we should note that the scope of this mechanism is not limited to firms. It could as well be implemented in order to study games in political context, and provide an insight to the success of political parties in the elections or transition periods to democracy. Furthermore, we can also extend the scope of this research to cooperation games to see how far our mechanism would take us in the existence of conflicting individual and group interests. Strategic complementarity of payoffs are self-enforcing in a coordination games, but not in a game in which individuals have an incentive to defect. Camerer and Knez (2000) suggest that cooperation develops over time and question whether cooperation transfers across different types of games. Accordingly, it is reasonable to check whether we can use our coordination mechanism as a precedent of cooperation.

Another question that can be posed is whether voting weights based on hierarchical structures of the firm affect our results. In order to study this issue it plausible to introduce network structures depending on the principle-agent setup of the organization, adjust voting weights accordingly and check for the implications of the mechanism.

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APPENDIX I

Instructions for Treatment 1-1 (Majority-2)

Thank you for participating in this experiment. Your earnings at the end of this experiment depend on your decisions and the decisions of the other participants. Moreover, you will receive a show-up fee of 3 Euros. If you read and apply the following instructions carefully, you can earn a considerable amount of money. Therefore, it is very important that you read the instructions with care. The money you earn (which depends on the points you receive) will be paid in cash at the end of the experiment. During the experiment you are not allowed to talk to each other. Whenever you need, please raise your hand and feel free to ask questions to the experimenter in private. Please do not ask questions aloud.

The experiment consists of 30 rounds, and each round is divided into three parts. During the experiment you will be part of a group. The members of the groups will be determined randomly at the beginning of each round. Therefore, the members of your group will be different in each round. The members of each group are not necessarily sitting side by side. The information about the three parts of each round will be given in continuation. At the beginning of each part, please refer to the specific instructions and please read them carefully.

PART 1

In this stage, you are part of a group of 5 people. There are 4 groups in the experiment and all groups in the experiment consist of five people. If you have any questions please raise your hand.

Decision in Part 1:
At this stage, you have to choose **A** or **B**.

Payoff in Part 1:
Your earnings will be determined according to the points you receive, and these depend on your decisions and the decisions of the other members of your group. The points you will receive in this part is determined according to the payoff table below **(Table I)**. All groups in this experiment receive the same payoff table, which will be explained in continuation.

Table I

Other Players' decisions

		If **all (4) of the other** participants choose **A**	If **any of the other** participants choose **B**
Your Decision	If you choose **A**	**110**	**50**
	If you choose **B**	**80**	**80**

In Table I, rows indicate your decision of **A** or **B**, and columns show the decision of the other players, i.e. how many of the other players choose **A** or **B**. In each cell, the numbers are the payoffs that you can receive given your choice and the other players' choices. For example, if you choose **A,** and if 4 of the other participants choose **A**, you receive 110; whereas, if you choose **B,** and if either one of the other participants choose **B**, you receive 80.

Information in Part 1:
You will be reminded of your choice. Moreover, you will be informed about the decisions of the other members of your group and the points you receive in this part.

PART 2

You are still a member of the same 5-people group. There are 4 groups in the experiment (including yours), all these groups consist of five people. At the beginning of this stage, your group will be randomly matched with one of the 3 remaining groups. This part of the experiment consist of a voting stage.

Decision at the Voting Stage:
In each group, you will vote whether TO MERGE or NOT TO MERGE with the other 5-people group you are matched with at the beginning of this stage. In other words, you will vote whether you want to be in a group of 10 players or stay in your group of 5 players.

We will use majority rule for voting, i.e. if 3 or more people in your group accept to merge with the other firm, and if 3 or more people in the other group accept to merge with your group, the two groups will form a larger group of 10 people.

Information at the Voting Stage:
While you take your decision at this stage, you will be reminded of your choice, the points you obtained in part 1 and the choices of the other members of your group. Please remember that you will not receive any information about the choices of the members of the other group.

PART 3

In this part, there are two possibilities depending on the decisions of your group and the other group from the voting stage.

1. <u>Possibility 1</u>: If your group DID NOT MERGE with the other group

Since your group did not merge with the other group as the result of the voting stage, you are still a member of your 5-people group. Please note that the members of your group are still the same from the previous parts of this round.

- ***Decision in Part 3:***

  You have to choose **A** or **B**.

- ***Payoff in Part 3:***

  Your points depend on your decisions and the decisions of the other members of your group. In this case your payoff will be determined according to **Table I**. Please note that this table is the same table used in Part 1 and it has already been explained in page 1.

<u>Table I</u>

Other Players' decisions

		If **all (4) of the other** participants choose **A**	If **any of the other** participants choose **B**
Your Decision	If you choose **A**	**110**	**50**
	If you choose **B**	**80**	**80**

2. <u>Possibility 2</u>: If your group MERGED with the other group

Since your group merged with the other group as the result of the voting stage, you are now a member of 10-people group.

- ***Decision in Part 3:***

  You have to choose **A** or **B**.

- ***Payoff in Part 3:***

  Your points depend on your decisions and the decisions of the other members of your group. In this case your payoff will be determined according to **Table II**, which will be explained below. Please note that the points defined in **Table II** are different than the ones in **Table I**.

<u>Table II</u>

Other Players' decisions

		If **5 or more of the other** participants choose **A**	If **4 or less** participants choose **A**
Your Decision	If you choose **A**	**130**	**50**
	If you choose **B**	**70**	**70**

In Table II, rows indicate your decision of **A** or **B**, and columns show the decision of the other players, i.e. how many of the other players play **A**. Knowing how many other players play **A**, you can also determine how many of the other players choose **B**. For example, if 2 of the other players choose **A**, then 7 of the other players choose **B**. Each cell shows the payoffs that you can receive given your choice and the other players' choices of **A** or **B**. For example, if you choose **A,** and if 2 of the other participants choose **A**, you receive 50; whereas, if you choose **A,** and if 5 of the other participants choose **A**, you receive 130.

INFORMATION AT EACH ROUND

In each round, you can refer to the information from previous rounds (your decisions, decisions of the other members of your group and your payoffs). Please remember that you are randomly matched with different people at the beginning of each round.

PAYMENT

Total points you receive in each round will be converted to Euros where 750 points will be equivalent to 1 Euro. Moreover, as it is mentioned before, you will receive a show-up fee of 3 Euros. Your earnings will be paid out in private by cash.

APPENDIX II

I. NORMALITY TESTS:

For both Shapiro-Wilk (SW) and Skewness/Kurtosis (SK) tests, the null hypothesis is normality of the distribution of the data at hand. If $p<0.05$, the argument is that the statistic rejects the null hypothesis of normality.

a. TWO EFFORT LEVELS:

		Shapiro-Wilk W test		Skewness/Kurtosis tests for Normality		
						joint
Session Name	**Variable**	**Obs**	**Prob>z**	**Pr (Skewness)**	**Pr (Kurtosis)**	**Prob>chi2**
Dictator 1[34]	**A's (part 1)**	30	0.000***	0.064*	0.044**	0.034**
	A's (part 2)	30	0.000***	0.008***	0.357	0.030**
Majority 2[35]	**A's (part 1)**	30	0.000***	0.002***	0.281	0.012**
	Merge decision	30	0.000***	0.000***	0.000***	0.000***
	A's (part 3)	30	0.000***	0.000***	0.000***	0.000***
Dictator 2[36]	**A's (part 1)**	30	0.429	0.229	0.678	0.417
	A's (part 2)	30	0.000***	0.000***	0.000***	0.000***
Unanimity 2[37]	**A's (part 1)**	30	0.053*	0.000***	0.000***	0.000***
	Merge decision	30	0.008***	0.015**	0.523	0.052*
	A's (part 3)	30	0.034**	0.000***	0.000***	0.000***

*Note: *, **, and *** show significance at 10 %, 5 % and 1 % respectively.*

The null hypothesis of normality is rejected by both of the tests for all the treatments and controls except for the sample of *A*'s in part 1 of the session *Dictator 2*. However, in *Unanimity 2*, while we reject normality for the sample of *A*'s in part 1 at 1% significance SK test, we are only able to reject normality with SW test at a level of 10%. Moreover, while we reject normality of the merge decision at 1% according to SW test, we reject normality only with 10% significance according to SK test.

[34] Control Group for *Majority 2* (Treatment 1.1)
[35] Treatment 1.1
[36] Control Group for *Unanimity 2* (Treatment 1.2)
[37] Treatment 1.2

b. THREE EFFORT LEVELS:

		Shapiro-Wilk W test		Skewness/Kurtosis tests for Normality		
						joint
Session Name	**Variable**	**Obs**	**Prob>z**	**Pr (Skewness)**	**Pr (Kurtosis)**	**Prob>chi2**
Dictator 3[38]	**3's (part 1)**	30	0.004***	0.024**	0.464	0.066*
	3's (part 2)	30	0.000***	0.002***	0.022**	0.002***
Majority 3[39]	**3's (part 1)**	20	0.428	0.592	0.389	0.570
	Merge decision	20	0.014**	0.155	0.749	0.303
	3's (part 3)	20	0.001***	0.006***	0.009***	0.003***
Unanimity 3[40]	**3's (part 1)**	30	0.000***	0.000***	0.012**	0.000***
	Merge decision	30	0.000***	0.000***	0.008***	0.000***
	A's (part 3)	30	0.000***	0.001***	0.048**	0.003***

*Note: *, **, and *** show significance at 10 %, 5 % and 1 % respectively.*

The null hypothesis of normality is rejected by both tests at 1% significance for all the samples from *Unanimity 3*. Moreover, for treatment *Majority 3*, while we reject normality at a level of 1% for the decision in part 3 by both tests, and for merge decision by SK test, we fail to reject normality for the decision in part 1. For the session *Dictator 3*, we reject normality at 1% by both tests except for the decision in part 1 where rejection with SW is at 10% significance.

II. NON PARAMETRIC TESTS

For both two-sample Kolmogorov-Smirnow (K-S) and Wilcoxon rank-sum (Mann-Whitney) tests, the null hypothesis is the equality of distributions of the samples compared. If $p<0.05$, the argument is that the statistic rejects the null hypothesis of equal distributions. For the Variance Ratio test and for the other robust tests utilized below, the null hypothesis is the equality of variances of the two samples.

[38] Control Group for *Majority 3* (Treatment 2.1) and *Unanimity 3* (Treatment 2.2)
[39] Treatment 2.1
[40] Treatment 2.2

a. TWO EFFORT LEVELS:

			K-S test	Wilcoxon test	Variance Ratio test	Robust tests for equality of variance		
Sessions Compared	**Variable Compared**	**Obs**	**P-value**	**Prob > |z|**	**P < F_L + P > F_U**	**Pr > F (W0)**	**Pr > F (W50)**	**Pr > F (W10)**
Dictator 1 vs Majority 2	**A's (part 1)**	60	0.799	0.764	0.228	0.019**	0.217	0.056*
	A's (last part)[41]	60	1.000	0.723	0.002***	0.194	0.431	0.35
Dictator 2 vs Unanimity 2	**A's (part 1)**	60	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	A's (last part)	60	0.000***	0.000***	0.000***	0.001***	0.021**	0.009***

*Note: *, **, and *** show significance at 10 %, 5 % and 1 % respectively.*

b. THREE EFFORT LEVELS:

			K-S test	Wilcoxon test	Variance Ratio test	Robust tests for equality of variance		
Sessions Compared	**Variable Compared**	**Obs**	**P-value**	**Prob > |z|**	**P < F_L + P > F_U**	**Pr > F (W0)**	**Pr > F (W50)**	**Pr > F (W10)**
Dictator 3 vs Majority 3	**3's (part 1)**	50	0.000***	0.000***	0.001***	0.002***	0.013**	0.005***
	3's (last part)	50	0.000***	0.000***	0.810	0.745	0.850	0.813
Dictator 3 vs Unanimity 3	**3's (part 1)**	60	0.000***	0.000***	0.668	0.947	0.431	0.771
	3's (last part)	60	0.000***	0.000***	0.548	0.863	0.504	0.728
Majority 3 vs Unanimity 3	**3's (part 1)**	50	0.000***	0.000***	0.000***	0.008***	0.366	0.058*
	Merge Decision	50	0.139	0.026**	0.769	0.180	0.035**	0.055*
	3's (part 3)	50	0.011**	0.008***	0.768	0.832	0.671	0.949

*Note: *, **, and *** show significance at 10 %, 5 % and 1 % respectively.*

The null hypothesis of the test suggested by Schlag (2007) is the equality of the two sample means. This test does not make any assumption about the distribution of the samples, and thus it is suitable for our experimental data. As mentioned before, comparing *Unanimity 3* to *Majority 3* we fail to reject any differences in sample means. The test statistic (*rj-value*) for this comparison are 0.0063, 0.0046, and 0 for decision in part 1, decision in part 2 and merge decision respectively. Moreover, comparing *Unanimity 3* to its control *Dictator 3*, we get a significant difference is sample means. For both of the decisions in the first part and the last part of these sessions the *rj-value* is equal to 1, which leads to the rejection of null hypothesis of equality of means.

[41] We compare Part 2 of control groups to Part 3 of treatment groups