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Institutions and Behavior: Experimental Evidence on the Effects of Democracy

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A novel experiment is used to show that the effect of a policy on the level of cooperation is greater when it is chosen democratically by the subjects than when it is exogenously imposed. In contrast to the previous literature, our experimental design allows us to control for selection effects (e.g., those who choose the policy may be affected differently by it). Our finding implies that democratic institutions may affect behavior directly in addition to having effects through the choice of policies. Our findings have implications for the generalizability of the results of randomized policy interventions. (*JEL* C91, D02, D12, D72)

Previous research has suggested that democratic institutions may affect cooperative behavior. For example, Pranab Bardhan (2000) finds that farmers are less likely to violate irrigation rules when they themselves have crafted those rules. Bruno S. Frey (1998) finds that Swiss cantons with greater democratic participation face lower tax evasion. David I. Levine and Laura D. Tyson (1990); John P. Bonin, Derek C. Jones, and Putterman (1993); and Sandra E. Black and Lisa M. Lynch (2001) find that worker participation in workplace decisions may positively affect productivity. In experimental settings, Jean-Robert Tyran and Lans P. Feld (2006); Arhan S. Ertan, Talbot Page, and Putterman (2010); and Matthias Sutter, Stefan Haigner, and Martin G. Kocher (forthcoming) find that punishment and rewards in public good games have a greater impact on behavior when they are allowed democratically.

A central problem with the interpretation of the results in these papers is that one cannot rule out the possibility that there are unobserved factors that explain both responses to policies and either the degree of participation in policymaking or the particular policies selected. This problem arises even in the case of the experimental studies in which groups are formed randomly, because those groups choosing a particular policy, for example, may have different preferences than those who do not choose that policy. In this paper we show how this problem of selection may be solved in the laboratory. In particular, we examine the question of whether the effect of a policy depends on whether it is imposed endogenously (through a democratic process) or exogenously. Our results thus contribute to the understanding of the role of democratic institutions and treatment effects more generally.

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The basic structure of our experimental design is as follows. Subjects participate in several prisoners' dilemma games and may choose, by simple majority, to establish a policy that could encourage cooperation. This policy consists of a fine on unilateral defection, which transforms the game into a coordination game in which both mutual defection and mutual cooperation are Nash equilibria. In some cases the experimental software randomly overrides the votes of the subjects and randomly imposes, or not, the policy. Before proceeding to play again with either the original or the modified payoffs, the subjects are informed of whether payoffs are modified and whether it was decided by their vote or by the computer. This set-up allows us to compare the behavior of individuals and groups that voted in the same way and were presented with the same game (coordination versus prisoner's dilemma) but differed by whether the game was chosen endogenously (democratically chosen by the subjects) or exogenously (randomly chosen by the computer). By conditioning on the subjects' vote, we control for the fact that those that voted for the policy may differ in important ways from those who did not (for example, subjects who choose the policy may be more likely to value cooperative behavior and cooperate after the policy is implemented). As we condition on the subjects' vote, any remaining effect associated with endogenous choice of the policy cannot be due to differences between those that voted for the policy and those that did not. That is, the difference cannot be attributed to selection.

Even after selection is controlled for, the results show that the effect of the policy (i.e., the fine) on the percentage of cooperative actions is significantly greater when it is democratically chosen by the subjects (endogenous) than when it is imposed by the computer (exogenous). We find that the effect of the fine on cooperation is 40 percent larger if it is imposed democratically. Moreover, we show that this effect of democracy is not due to the informational content of a democratic change of policy.

Our findings suggest that democratic institutions may affect not only the types of policies adopted but also the impact of a given policy, so that a democratically selected policy will not have the same effect when imposed undemocratically. Given the size of the groups studied in this experiment, our results may be particularly useful in understanding the effects of democratic procedures in small settings such as villages in developing countries and the effects of worker participation in firms. Our evidence also relates to the literature comparing behavior between endogenous and exogenous games.[1] In this literature, differences in behavior are sometimes considered evidence of selection, and in other cases they are considered evidence that endogeneity affects behavior.[2] Our experimental design allows us to control for potential unobservable characteristics and, hence, to identify the difference of behavior between endogenous and exogenously chosen games.

Our findings have implications for the study of treatment effects more generally. Much applied work in economics seeks to identify the treatment effect of policies, institutions, or products. Since people usually choose their policies, institutions, and products, it is necessary to account for selection into treatment to measure the "true" treatment effect (i.e., one that does not reflect selection). Based on such estimates, policy recommendations may be made to assign the treatment without choice (that is, exogenously). Our experimental results suggest that such policy recommendations may be unwarranted given that the treatment effect may differ based on whether it is exogenously or endogenously determined, even after controlling for selection.[3]

[1] See, for example, John B. Van Huyck, Raymond C. Battalio, and Richard O. Beil (1993); Iris Bohnet and Dorothea Kübler (2005); Jan Potters, Martin Sefton, and Lise Vesterlund (2005); Gary Charness, Guillaume R. Fréchette, and Cheng-Zhong Qin (2007); and Edward P. Lazear, Ulrike Malmendier, and Roberto A. Weber (2006).

[2] The exception is Vincent Crawford and Bruno Broseta (1998), who explain the results in Van Huyck, Battalio, and Beil (1993) by the interaction of selection and endogeneity effects.

[3] Our work also relates to the literature linking institutions to economic performance (see Douglass C. North 1981; Rafael La Porta et al. 1998; Daron Acemoglu, Simon Johnson, and James A. Robinson 2001; and William Easterly and

TABLE 1—STAGE GAME PAYOFFS (*in points*)

Initial/unmodified payoffs			Modified payoffs		
	Other's action			Other's action	
Own action	C	D	Own action	C	D
C	50	10	C	50	10
D	60	40	D	48	40

I. Experimental Design

In each experimental session, subjects participate anonymously through computers.[4] The subjects are randomly divided into groups of four for the entire session. Groups consist of four subjects so as to maximize the probability of a tie in the voting stage that is described below. Each session consist of two parts. In part 1, subjects play ten rounds of the prisoner's dilemma game in Table 1 (Initial/Unmodified Payoffs).[5] The exchange rate is 50 points for one dollar. After each round each subject is randomly matched with another subject in his or her group for the next round. In part 2 of the experiment the subjects play ten rounds as in part 1 but the payoffs can be modified at the beginning of this part to the payoffs in Table 1 (Modified Payoffs). The modification of payoffs consists of imposing a tax or fine on unilateral defection.[6] While under the initial payoffs the unique Nash equilibrium is mutual defection, under the modified payoffs both mutual defection and mutual cooperation are Nash equilibria.

We chose a prisoner's dilemma game as the initial game, as the tension between personal incentives and efficiency is not only an important feature of human interaction but also a feature that groups attempt to solve by imposing different kinds of policies. We chose a prisoner's dilemma game over other kinds of social dilemma games (e.g., public good games) as the former is simpler, which allows a simple explanation of the policy. The modified game was chosen to be a coordination game, as it is intuitive to think that the incentive to follow policies and regulations may depend on the behavior of others and may result in a multiplicity of equilibria.[7]

Whether the payoffs are modified in the policy selection stage is determined as follows. First, subjects vote on whether to modify payoffs. Second, the computer randomly chooses whether

Ross Levine 2003 among others), the experimental literature on cooperation and its determinants (see John H. Kagel and Alvin E. Roth 1995 for a survey), the experimental literature on the effects of rewards and punishments on public good games (see Ernst Fehr and Simon Gächter 2000; Josef Falkinger et al. 2000; and James Andreoni, William T. Harbaugh, and Vesterlund 2003), and the experimental literature on the determinants of voting turnout and the effects of different voting rules on information aggregation and efficiency (see Arthur Schram and Joep Sonnemans 1996; Rebecca B. Morton and Kenneth C. Williams 1999; Angela A. Hung and Charles R. Plott 2001; Jacob K. Goeree and Charles A. Holt 2005; Jens Grosser and Schram 2006; Alessandra Casella, Andrew Gelman, and Thomas R. Palfrey 2006; David K. Levine and Palfrey 2007; and Marco Battaglini, Morton, and Palfrey 2007, among others). Palfrey (2007) provides a survey of the experimental literature on political economy in general. Our results are also related to the social psychology literature on procedural justice showing that subjects' evaluation of a given outcome may depend on the fairness of the procedures that have led to that outcome (see, for example, John Thibaut and W. Laurens Walker 1975 and E. Allan Lind and Tom R. Tyler 1988). An important element studied in this literature is whether subjects have an opportunity to express their opinions during the procedure (on "voice" see Robert Folger 1977 and Kees van den Bos 1999). For the related idea in economics of procedural utility see Frey, Matthias Benz, and Alois Stutzer (2004). For a discussion of the effects of institutions on behavior that combines economics and psychology see Bohnet (2006).

[4] We adapted the Multistage software by SSEL-Caltech/CASSEL-UCLA.

[5] For neutrality, the actions C and D are denoted as 1 and 2 in the experimental sessions.

[6] For neutrality, there was no mention of taxes or fines in the experimental sessions.

[7] Note that both games are symmetric. As mentioned by a referee, the results could vary, in principle, if these games were asymmetric.

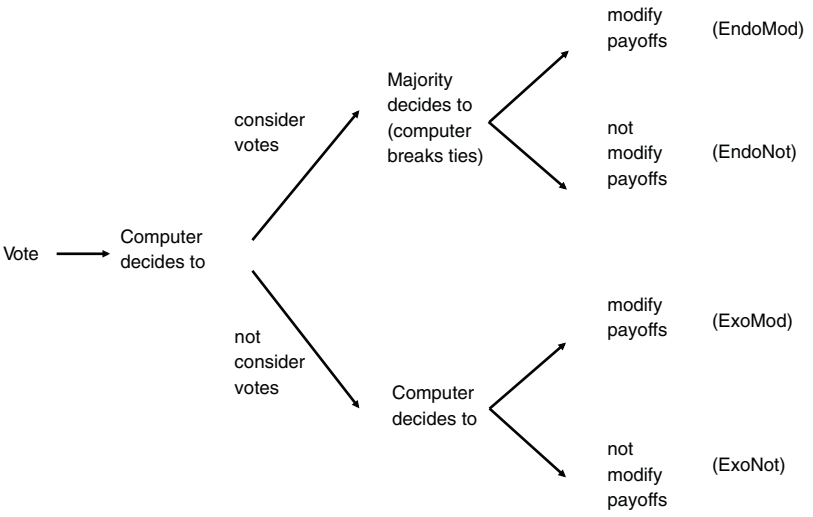

FIGURE 1. VOTING STAGE

to consider the votes in each group. If the computer considers the votes, then the majority wins and in case of a tie the computer breaks the tie. If the computer does not consider the votes in a group, it randomly chooses whether to modify payoffs or not in that group. The voting stage is summarized in Figure 1. The subjects' computer screens inform them whether the computer randomly chose to consider the votes and whether payoffs were modified. The subjects do not learn the exact distribution of votes, including whether the computer needed to break a tie.[8] We denote the four possible outcomes of the voting stage as EndoMod, EndoNot, ExoMod, and ExoNot, where Endo denotes that the votes of the group were considered, Exo denotes that the computer overrode the group, and Mod denotes that payoffs were modified versus Not. After the voting stage, the subjects play ten more rounds with other subjects in their group, with the payoff matrix depending on the results from the policy selection stage.

After the ten rounds in part 2, the subjects answer a series of questions that allow us to assess the subjects' understanding of the experimental design and their reasoning in the voting stage and after. In addition we ask them for personal characteristics such as: academic major, class, math and verbal SAT scores,[9] and political philosophy. These questions allow us to study how personal characteristics affect the voting decisions and the impact of the policy. Finally, the subjects participate in a "beauty contest" game in order to gauge their strategic sophistication.[10]

We present next a short theoretical analysis of the game subjects play in this experiment. First, note that under the initial payoffs (prisoner's dilemma game) there is a unique Nash equilibrium in the stage game which is inefficient: both players play D. Second, under the modified payoffs (coordination game) there are two Nash equilibria in pure strategies, an efficient and an

[8] Since subjects know whether the group voted for modification or not when the votes are considered, while that is not the case when votes are not considered, some of the effect of democracy that we will be measuring may well stem from the institution's informational effect. In Section IV we investigate how much (if any) of the effect of democracy is attributable to its information content.

[9] Ignacio Palacios Huerta (2003) found no misreporting of SAT scores among Brown undergraduates in a previous experiment.

[10] Each subject chose a number between zero and 100 and the subject with the closest number to two-thirds of the average of all numbers in the group earns 100 points. The unique Nash equilibrium of this game is to choose zero. See Antoni Bosch-Domènech et al. (2002) and references therein for a detailed description of beauty contest games and the role of levels of strategic reasoning in explaining behavior in these games.

inefficient one: CC and DD, respectively. Since in the experiment there are a finite number of repetitions and in addition subjects are randomly rematched after each round, we assume in this theoretical analysis that predictions from the one-shot games are valid also for the finite repetition (see John Duffy and Jack Ochs 2009).

How should subjects vote? While modified payoffs allow subjects to cooperate in equilibrium, mutual defection remains an equilibrium outcome. As such, if subjects expect to coordinate on mutual defection under modified payoffs, they have no incentive to vote for modification. Subgame perfection does not provide a prediction regarding voting. The optimal vote depends on subjects' expectation of others' behavior under the modified payoffs game. Subjects that expect to achieve mutual cooperation under modified payoffs should vote for modification. In contrast, subjects that expect no change in behavior under modified payoffs have little incentive to vote for modification.[11]

Will subjects coordinate on the efficient outcome (CC) under modified payoffs? Under the modified payoffs the efficient outcome is an equilibrium outcome. However, previous experimental literature has shown the difficulty of coordinating on the efficient equilibrium in coordination games.[12] But if prior behavior affects behavior in the current game, having the subjects choose to modify payoffs may affect the equilibrium selection process in the resulting coordination game.[13] Knowing that the coordination game was chosen by the group may increase the probability that the efficient equilibrium becomes focal.

II. Strategies to Identify the Effect of Democracy

To estimate the impact of democracy we cannot simply compare cooperation rates across the four vote stage results (EndoMod, ExoMod, etc.). This is the case even when both the formation of groups and consideration of the votes were random. The reason is that while groups were randomly formed, they are not necessarily identical. Groups with endogenous modification may be different from groups with exogenous modification: subjects in the former may have preferences for cooperative behavior that affect both cooperation and the decision to modify payoffs. In the presence of this type of selection, comparisons of cooperation levels between subjects in groups with endogenous and exogenous modifications can be misleading.

To make this point explicit and develop an appropriate identification strategy, we develop a simple formal framework. In particular, we consider a simplified game in which individuals are matched in groups, they vote, they learn the mechanism used to select payoffs (votes or randomly by the computer), they learn the payoffs (initial or modified), and then they play

[11] Off-equilibrium reasoning can justify voting for modification even for a subject who plans to defect after the vote. The reason is that if modification results in an increase in cooperation, this subject may obtain a higher profit. As such, voting for modification may be part of a "bait" strategy. However, if this subject does not expect the modification of payoffs to increase cooperation by much, he could prefer to remain under the unmodified payoffs as this would give him a greater payoff each time the other subject cooperates off-equilibrium.

[12] For example, Russel W. Cooper et al. (1990) and Van Huyck, Battalio, and Beil (1990), among others, have shown that in experimental coordination games subjects may coordinate on the "safer" equilibrium over the efficient one. In our experiment, cooperation is optimal for a subjects only if the partner cooperates with a probability higher than 30/32. Mutual cooperation is not very robust to uncertainty over others' behavior. For this reason, we may observe that subjects coordinate on mutual defection under modified payoffs.

[13] See the literature on forward induction (Elon Kohlberg and Jean-Francois Mertens 1986 and Eric van Damme 1989) and related experimental literature (Cooper et al. 1992; Van Huyck, Battalio, and Beil 1993; Gérard P. Cachon and Colin F. Camerer 1996; and Crawford and Broseta 1998). Note however that forward induction, as defined by van Damme (1989), has no bite in the game we analyze. Intuitively, the modification of payoffs does not affect the payoff from mutual defection (the unique equilibrium outcome under the initial payoffs) and, hence, voting for modification is not inconsistent with planning to defect. Moreover, it can be shown that the elimination of weakly dominated strategies does not eliminate the equilibrium in which subjects vote for modified payoffs and then defect even if payoffs are modified.

the stage game.[14] An individual i's action in the stage game may depend on the mechanism that selected payoffs $M \in \{Endo, Exo\}$ (votes or randomly by the computer), the payoffs chosen $P \in \{Mod, Not\}$ (modified and nonmodified), his vote $v_i \in \{Y, N\}$, and his type μ_i. Thus we may write the probability that subject i cooperates as

$$C_i(M, P, v_i, \mu_i). \tag{1}$$

The type μ_i includes any personal characteristic that is unobserved to the researcher but that may be correlated with both the subject's probability of cooperation and his or her voting decisions. For example, the subject may have preferences for cooperative behavior that affect both cooperation and the decision to modify payoffs.[15] In addition, subjects may differ in their expectations of how often a modification of payoffs would result in mutual cooperation and, hence, may have different propensities to vote for modification and to cooperate after a modification.

In this framework, an individual's vote can depend only on his type, as he is randomly matched with the others and does not know either their type or how they will vote

$$v_i = v(\mu_i). \tag{2}$$

Further, (2) may be substituted into (1) to give, abusing notation,

$$C_i(M, P, \mu_i). \tag{3}$$

To test for differences in outcomes between endogenous and exogenous modifications, we test whether, given the payoff structure P (*Mod* or *Not*), actions differ by mechanism M (Endo versus Exo). Consider, then, the expected difference in behavior by selection mechanism given a payoff structure P:

$$\begin{aligned} E(C_i \mid Endo, P) - E(C_i \mid Exo, P) \\ = \int [C_i(Endo, P, \mu_i) f(\mu_i \mid Endo, P) - C_i(Exo, P, \mu_i) f(\mu_i \mid Exo, P)] \, d\mu_i \end{aligned} \tag{4}$$

where $f(\mu_i \mid M, P)$ is the conditional density of the type given the selection mechanism and the payoff matrix. Note further that P is informative about μ when payoffs are determined by voting but not when payoffs are determined by the computer, and thus

$$f(\mu_i) = f(\mu_i \mid Exo, P) \neq f(\mu_i \mid Endo, P). \tag{5}$$

Thus the difference (4) may be nonzero even if there are no differences in behavior by mechanism: $C_i(Exo, P, \mu_i) = C_i(Endo, P, \mu_i)$.

We employ two strategies to solve this identification problem.

[14] In particular we abstract from the fact that players may have learned something about people in their group from the prevote rounds. This creates a potential inference problem, which we discuss below.

[15] On social preferences see Charness and Matthew Rabin (2002); Fehr and Urs Fischbacher (2002); and Camerer and Fehr (2004) among others.

First, we use individual-level data and condition on both the payoff structure P and the individual vote v_i. This approach works because $f(\mu_i|Endo, P, v_i) = f(\mu_i|Exo, P, v_i) = f(\mu_i|P, v_i)$: once one knows how somebody votes, the payoffs are no longer informative about type under either computer or voter regimes. Thus,

$$(6) \quad E(C_i|Endo, P, v_i) - E(C_i|Exo, P, v_i) = \int [C_i(Endo, P, v_i, \mu_i) - C_i(Exo, P, v_i, \mu_i)] f(\mu_i|P, v_i)\, d\mu_i$$

can only be nonzero if, for some positive measure set of types, behavior differs by mechanism (*Endo* versus *Exo*).[16] Our experimental design yields the data necessary to make this comparison.

Second, we use group-level data and groups for which the vote is tied. Note that for these groups all four voting stage outcomes are possible. Moreover, as these groups voted in the same fashion, they should be similar in their personal characteristics. Their outcomes in the voting stage differed only due to random luck. Thus, the densities in (5) are equal: $f(\mu_i|Exo, P) = f(\mu_i|Endo, P)$. As a result we can compare $E(C_i|Endo, P) - E(C_i|Exo, P)$ for these groups to uncover the effect of democracy. However, identifying the effects of democracy by focusing on these groups is done at a considerable loss of data, as we can use only the small subset of the observations with a tied vote for this analysis.

III. Experimental Results

We conducted 18 experimental sessions from May to November 2006 in a computer lab at Brown University. A total of 276 subjects participated in the experiment, with an average of 15 subjects per session. The subjects were Brown University undergraduates recruited through advertisement in university Web pages and signs posted on campus. Table 2 displays the characteristics of subjects. A high number of subjects correctly answered the questions regarding the experiment. For example, more than 90 percent of the subjects remembered correctly the result from the voting stage. The subjects earned an average of $24.68, with a maximum of $29.50 and a minimum of $17.75. Given that sessions lasted on average little more than half an hour, the earnings represent a significant hourly rate.

The average level of cooperation was 18 percent in the first part of the experiment. The level of cooperation was decreasing with experience, with a maximum of 31.9 percent in round 1 and a minimum of 6.9 percent in round 10 (the last round of part 1). Both the level and evolution of cooperation in this experiment are similar to those on other experiments on prisoner's dilemma games (see, for example, Cooper et al. 1996; Yoella Bereby-Meyer and Roth 2006; Dal Bó 2005; and Masaki Aoyagi and Fréchette 2009); they also resemble those in the voluntary contributions mechanism literature (John O. Ledyard 1995).

A. *Results from the Voting Stage*

Of the 276 subjects, 147 (53.26 percent) voted to modify payoffs and 129 (46.74 percent) voted not to modify payoffs in the second part of the experiment. Voting for modification (**votemod**) is

[16] The key condition here is that the votes of the other players are not correlated with a player's type or with his vote. This is true given random assignment as long as individuals have no information about each other at the time of voting —as assumed in our simplified framework but possibly violated in the actual experiment given the prevote rounds played by participants. We have shown using the same analytic methods that this problem can be addressed by conditioning on individual histories of play in the prevote rounds. Our analysis shows that, first, votes are statistically independent across members of each group, and second, our estimates are not affected by controlling for individual histories.

Table 2—Summary Statistics of Sessions

	Total/means	Standard deviation
Subjects	276	
Economics (percent)	12.68	
Class	2.02	1.11
Political philosophy	2.09	0.77
SAT math	725.04	68.27
SAT verbal	721.40	60.01
Beauty contest number	37.68	19.63
Subject comprehension		
Vote stage (percent)	92.03	
Initial payoffs (percent)	89.13	
Modified payoffs (percent)	80.43	
Earnings		
Maximum	29.50	
Average	24.68	2.18
Minimum	17.75	

Note: Economics is the percentage of economics majors in the session; Class is equal to 1 for freshmen, 2 for sophomore, etc.; Political philosophy is equal to 1 for very liberal to 5 for very conservative; Beauty contest number is the number chosen in the beauty contest game.

positively and significantly correlated with the math SAT scores and negatively and significantly correlated with the number provided in the "beauty contest" game—see Table 3. This suggests that both cognitive ability and strategic sophistication are related to voting for modification of payoffs. Voting also seems to depend on the subjects' experience in the first part of the experiment. Subjects that cooperated more and those that faced little cooperation are more likely to vote for modification. Surprisingly, neither the class, the political philosophy, nor the major are correlated with the voting decisions.

The fact that a large proportion of subjects (46 percent) voted to remain in a prisoner's dilemma game is of interest and has implications for the large political economy literature on inefficient polices and delayed reforms.[17] This experiment shows that subjects will not necessarily vote for reforms that may make efficient behavior incentive compatible.

We define the variable "vote share" as the number of votes in favor of modification of payoffs in a group. This variable ranges from 0 to 4. The mode of the distribution of this variable is 2. There is evidence that voting decisions are independent within groups. Figure 2 shows the observed cumulative distribution function of voteshare (solid line) and the distribution that would arise if subjects decide their votes independently of each other (binomial, depicted as a dashed line). As Figure 2 shows, there is little difference between the two distributions. In fact the difference is not statistically significant (p-value $= 0.68$).[18] A random-effects analysis of voting does not reject that there are no random effects at the group level, suggesting that voting decisions are independent within groups (p-value $= 0.368$).

[17] See Stephen Coate and Stephen Morris (1995) and Avinash Dixit and John Londregan (1995) on inefficient redistribution, and Raquel Fernández and Dani Rodrik (1991) and Alberto Alesina and Allan Drazen (1991) on reform delays.

[18] Since the theoretical distribution is not continuous we do not use the usual Kolmogorov-Smirnov test but a modification proposed by Anthony N. Pettitt and Michael A. Stephens (1977). The p-value is calculated by Monte Carlo simulation under the null that voteshare follows a binomial distribution with probability of success equal to the observed one (0.5326).

TABLE 3—DETERMINANTS OF VOTING
Dependent variable: voting for modification (Votemod)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Own part 1 cooperation	0.47 [0.161]***								0.655 [0.170]***
Partners' part 1 cooperation		−0.419 [0.211]**							−0.765 [0.221]***
Class			−0.029 [0.027]						−0.02 [0.028]
Guess number				−0.003 [0.002]**					−0.004 [0.002]**
SAT verbal					0.001 [0.001]**				0.001 [0.001]
SAT math						0.001 [0.000]***			0.002 [0.001]***
Econ							0.077 [0.090]		0.008 [0.091]
Political								0.003 [0.041]	0.033 [0.040]
Constant	0.448 [0.042]***	0.608 [0.048]***	0.59 [0.063]***	0.657 [0.065]***	−0.308 [0.369]	−0.3 [0.324]	0.523 [0.032]***	0.517 [0.091]***	−0.904 [0.466]*
Observations	276	276	276	276	264	265	276	254	245
R^2	0.03	0.01	0	0.02	0.02	0.03	0	0	0.15

Notes: All results are from OLS regressions. The dependent variable is Votemod, which is an indicator variable for whether the subject voted to modify payoffs. Standard errors in brackets.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

B. *Exogenous Versus Endogenous Treatment Effect: Individual Level Analysis*

As discussed earlier, the difficulty identifying the effect of democracy is that the subjects in groups with endogenous modification may be different from those in groups with exogenous modification. In this section we solve this problem by conditioning on the voting behavior of the subject. Once we control for a subject's vote, whether he or she is under endogenous or exogenous modification is uncorrelated with any unobserved personal characteristic. Thus, greater cooperation under endogenous versus exogenous modification is evidence that democracy affects behavior.

Panel A in Table 4 shows the number of observations (subjects) by vote stage result and vote. The minimum number of observations in a cell is 17, and the maximum is 55. There is little difference in the cooperation rates in round 10 (the last round of part 1) by vote stage results (see panel B of Table 4). In fact, there are no statistical differences in cooperation (p-value 0.88).[19] Therefore, before the voting stage subjects are statistically identical in terms of their levels of cooperation.

In the study of the effect of democracy we initially focus on behavior in round 11 (the first round of part 2). Panel C in Table 4 shows the percentage of cooperation at the beginning of part 2 (round 11) by voting stage result and individual vote. Aggregating over the votes of the individuals, we observe that subjects under endogenous modification cooperated more than subjects under

[19] The p-values in this section correspond to Wald tests. The results are robust to performing Wilcoxon-Mann-Whitney tests when applicable.

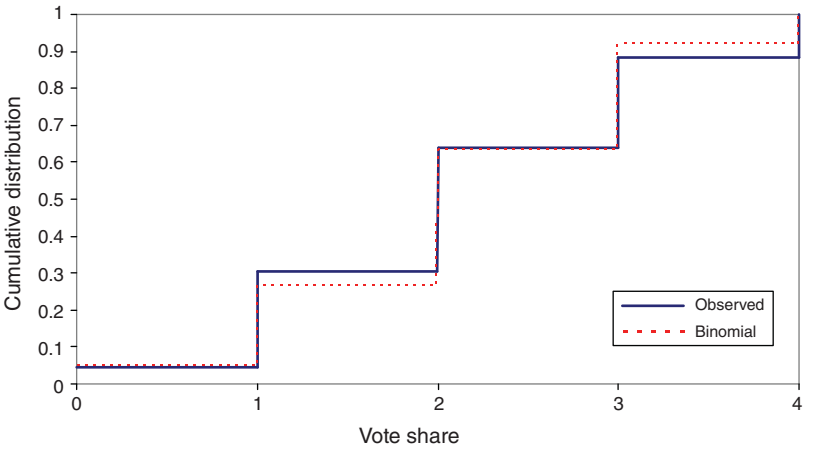

FIGURE 2. CUMULATIVE DISTRIBUTION OF VOTE SHARE

TABLE 4—THE EFFECT OF DEMOCRACY–INDIVIDUAL LEVEL DATA

	Consider votes		Not consider votes		
Vote for modify	Modify (EndoMod)	Not modify (EndoNot)	Modify (ExoMod)	Not modify (ExoNot)	Total
Panel A. Number of observations by vote stage outcome and individual vote					
No	17	55	31	26	129
Yes	55	25	33	34	147
Total	72	80	64	60	
Panel B. Cooperation percentage in round 10					
No	5.88	3.64	9.68	11.54	
Yes	5.45	4.00	9.09	8.82	
Total	5.56	3.75	9.38	10.00	
Panel C. Cooperation percentage in round 11					
No	41.18	14.55	41.94	3.85	
Yes	81.82	24.00	57.58	23.53	
Total	72.22	17.50	50.00	15.00	

exogenous modification: 72 percent against 50 percent. This difference is statistically significant at the 1 percent level (p-value 0.003—see Table 5, column 1). However, as discussed before, this difference is not an unbiased estimate of the effect of democracy. First, groups with endogenous modification have a larger share of subjects that voted for modification than groups with exogenous modification (see Table 4, panel A). Second, subjects who voted for modification are more likely to cooperate under modification than those who did not vote for modification (see Table 4, panel C). This may imply that another factor affects both the vote of the individual (which affects the voting stage result of his group) and his behavior in part 2, thereby biasing our estimates. However, as discussed previously, we can obtain an unbiased estimate by controlling for how the individuals voted.

Among individuals who voted for modification, those who experienced an endogenous modification of payoffs (EndoMod) had levels of cooperation of 82 percent while those who experienced an exogenous modification of payoffs (ExoMod) had only 58 percent. This difference is statistically significant at the 1 percent level (p-value 0.009—Table 5, column 2). In addition, for players that voted for modification, there is no significant difference in cooperation under the unmodified payoffs depending on whether votes were considered or not (24 percent versus

TABLE 5—THE EFFECT OF DEMOCRACY–INDIVIDUAL LEVEL DATA
Dependent variable: individual cooperation in round 11

	(1)	(2)	(3)	(4)	(5)
EndoMod	0.722				
	[0.050]***				
EndoNot	0.175				
	[0.048]***				
ExoMod	0.5				
	[0.053]***				
ExoNot	0.15				
	[0.055]***				
EndoModn		0.412	0.362	0.4	0.353
		[0.101]***	[0.102]***	[0.106]***	[0.106]***
EndoNotn		0.145	0.05	0.137	0.058
		[0.056]**	[0.067]	[0.057]**	[0.069]
ExoModn		0.419	0.314	0.4	0.316
		[0.075]***	[0.086]***	[0.075]***	[0.086]***
ExoNotn		0.038	−0.016	0.045	−0.001
		[0.082]	[0.084]	[0.087]	[0.090]
EndoMody		0.818	0.719	0.849	0.763
		[0.056]***	[0.063]***	[0.056]***	[0.064]***
EndoNoty		0.24	0.09	0.273	0.134
		[0.083]***	[0.090]	[0.087]***	[0.095]
ExoMody		0.576	0.431	0.633	0.502
		[0.072]***	[0.082]***	[0.075]***	[0.085]***
ExoNoty		0.235	0.112	0.226	0.121
		[0.071]***	[0.079]	[0.074]***	[0.080]
Own part 1 cooperation			0.618		0.569
			[0.139]***		[0.141]***
Partners' part 1 cooperation			−0.034		−0.066
			[0.179]		[0.181]
Exclude did not remember vote result	No	No	No	Yes	Yes
Observations	276	276	276	254	254
R^2	0.54	0.57	0.6	0.6	0.62

Tests of differences of cooperation rates by mechanism (Endo versus Exo), payoffs (Mod versus Not), and vote (y versus n)

	p-values				
EndoNot = ExoNot	0.732				
EndoMod = ExoMod	0.003				
EndoMod = EndoNot	0.000				
ExoMod = ExoNot	0.000				
EndoNotn = ExoNotn		0.281	0.494	0.381	0.566
EndoModn = ExoModn		0.952	0.694	1.000	0.772
EndoModn = EndoNotn		0.022	0.006	0.030	0.013
ExoModn = ExoNotn		0.001	0.003	0.002	0.006
EndoNoty = ExoNoty		0.966	0.834	0.682	0.908
EndoMody = ExoMody		0.009	0.001	0.022	0.005
EndoMody = EndoNoty		0.000	0.000	0.000	0.000
ExoMody = ExoNoty		0.001	0.001	0.000	0.000

Notes: All results are from OLS regressions. The dependent variable is an indicator variable for whether the subject cooperated in round 11. The explanatory variables in column 1 are indicator variables for the vote stage result. In the rest of the columns the explanatory variables are the interaction of indicator variables for vote stage results with indicator variables for the vote of the subject. EndoMod: endogenous modification, EndoNot: endogenous nonmodification, ExoMod: exogenous modification, ExoNot: exogenous nonmodification, n and y denote the individual vote of the subject (against or for modification). Regressions in columns 3 and 5 control for the individuals' and their partners' cooperation rates in the rounds before the voting stage (Part 1). The *p*-values correspond to Wald tests based on the regression results. Standard errors in brackets.

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

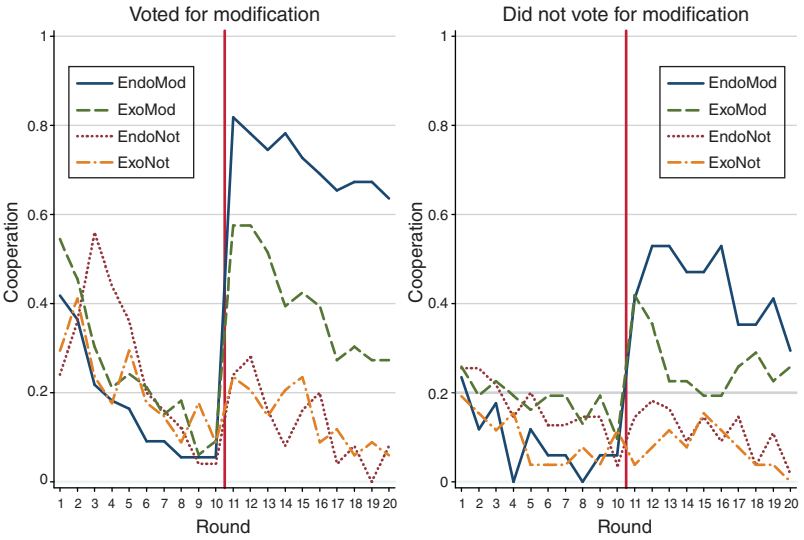

FIGURE 3. COOPERATION BY ROUND, VOTE STAGE RESULTS AND INDIVIDUAL VOTE

23.53 percent). These results are robust to controlling for own and observed behavior before the vote stage and eliminating subjects who did not remember the result of the voting stage.

In conclusion, for subjects that voted for modification, we find that democracy does not affect behavior under unmodified payoffs, but it does have a significant effect under modified payoffs. As a result, the effect of modifying payoffs is greater when the modification is endogenous than when it is exogenous: 57.82 percent versus 34.05 percent respectively.

Among individuals who did not vote for modification, cooperation levels in round 11 do not depend on the way that payoffs were chosen. Cooperation is 41.18 percent under endogenous modification and 41.94 percent under exogenous modification (p-value 0.95).

The effect of democracy can also be seen in Figure 3, which shows the percentage of cooperation by vote stage result, round, and individual vote. It is interesting to note that cooperation generally increases in round 11 for most vote stage results. Part of this increase is presumably reflective of the well-known restart effect in prisoner's dilemma games (see Andreoni and John H. Miller 1993). This jump tends to be larger for subjects that voted for modification, when payoffs are modified, and even larger when they are modified endogenously.

Interestingly, as Figure 3 shows, the difference in cooperation rates between individuals under endogenous modification (EndoMod) and exogenous modification (ExoMod) is not limited to round 11. However, after round 11 differences in cooperation between EndoMod and ExoMod cannot be fully attributed to the effect of democracy. This is because subjects under endogenous modification are more likely to meet a partner that voted for modification (and more likely to cooperate) than a subject under exogenous modification, and this can influence behavior in later rounds. To estimate the effect of democracy in later rounds it is necessary to control for the votes of partners that subjects meet in the second part of the experiment. In addition, we need to consider the fact that the behavior of a subject is not independent across rounds. A method for doing so is developed and described in detail in the online Appendix. As there is little difference in behavior between exogenous and endogenous unmodified payoffs, we focus on the effect of democracy under modification for the rest of the section.

Table 6 presents the estimates of the effect of democracy under modified payoffs for all rounds after the voting stage. For subjects who voted for modification, the effect is the largest in round

TABLE 6—THE EFFECT OF DEMOCRACY–INDIVIDUAL LEVEL DATA–ALL ROUNDS

	Vote for modify	
Round	Yes	No
11	0.242	-0.008
	[0.124]*	[0.103]
12	0.216	0.143
	[0.116]*	[0.154]
13	0.204	0.309
	[0.144]	[0.120]***
14	0.322	0.274
	[0.147]**	[0.132]**
15	0.217	0.300
	[0.138]	[0.145]**
16	0.219	0.346
	[0.154]	[0.136]**
17	0.296	0.086
	[0.154]*	[0.197]
18	0.270	0.091
	[0.153]*	[0.194]
19	0.299	0.216
	[0.157]*	[0.171]
20	0.264	0.069
	[0.160]*	[0.175]

Notes: Table reports estimated impact of democracy on likelihood of choosing C by round for groups with modified payoffs following the model in the Appendix. Jackknife standard errors by group.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

14 when the effect reaches 32 percent, and it is the lowest in round 13 when it is 20 percent. The effect is significant at the 10 percent level in seven of the rounds. It cannot be rejected that all effects are the same and that it is the same in rounds 11 and 20, both at the 10 percent significance level. Therefore, for subjects that voted for modification, democracy has a stable, large, and statistically significant effect on cooperative behavior.

For subjects who did not vote to modify payoffs, Table 6 shows an interesting pattern in the evolution of the effect of democracy across rounds. While the effect is negligible in round 11 it reaches a statistically significant level (31 percent) in round 13. The effect of democracy remains significant until round 16. This effect for subjects who did not vote to modify payoffs is due in part to their meeting subjects who voted to modify payoffs and being affected by their higher rate of cooperation under democracy. However, after round 16, the effect disappears for subjects who did not vote to modify payoffs.

Finally, the responses of subjects to the question at the end of the experiment on whether the voting stage had affected their behavior are consistent with their observed behavior. Subjects who voted for modification are significantly more likely to say that the voting stage modified their behavior under endogenous modification than under exogenous modification (p-value less than 0.01). In addition, a significant share of subjects that voted for modification mention whether votes were considered or not in explaining their behavior after the voting stage.

In conclusion, the experimental results show that there is an effect of democratic institutions in addition to the instrumental effect through policy choice.

C. *Decomposing the Total Effect of an Endogenous Modification*

The individual level analysis allows us to separate the total effect of an endogenous modification of payoffs into a selection effect and an endogenous treatment effect. We can further separate this endogenous treatment effect into an exogenous treatment effect and an endogeneity premium (the part of the endogenous treatment effect that cannot be explained by the exogenous treatment effect). For simplicity we will focus on round 11 behavior to provide this decomposition of effects.

Total Effect.—From the totals in the first two columns in panel C of Table 4 we calculate the effect of the policy under democracy (EndoMod versus EndoNot) and find that the total effect of an endogenous modification on cooperation is 55 percent. Note that the totals of these columns can be calculated as weighted averages of the cooperation rates by type of vote if we use as weights the proportion of subjects who voted for and against modification. If we denote as $g(v \mid P, M)$ the proportion of subjects who voted for $v \in \{Y, N\}$ given the payoff structure $P \in \{Mod, Not\}$ and the mechanism $M \in \{Endo, Exo\}$ and we denote as $C(v \mid P, M)$ the proportion of cooperation for subjects who voted for v given the payoff structure and mechanism, the total effect is:

$$TE = \sum_{v \in \{Y, N\}} [g(v \mid Endo, Mod) C(v \mid Endo, Mod) - g(v \mid Endo, Not) C(v \mid Endo, Not)].^{20}$$

Selection Effect.—The selection effect captures the changes in cooperation that arise not from the change in treatment but from the change in the proportion of types of subjects. Thus, the selection effect can be measured as:

$$SE = \sum_{v \in \{Y, N\}} [g(v \mid Endo, Mod) - g(v \mid Endo, Not)] \; C(v \mid Endo, Not).$$

From Table 4 we calculate the selection effect as a 4 percent increase in the cooperation rate.[21]

Endogenous Treatment Effect.—The endogenous treatment effect corresponds to changes in cooperation due to an endogenous change in the payoff matrix and not due to changes in the proportion of the different types of voters. In addition, the endogenous treatment effect must be equal to the difference between the total effect and the selection effect. Thus, the endogenous treatment effect is:

$$EndoTrE = \sum_{v \in \{Y, N\}} g(v \mid Endo, Mod)[C(v \mid Endo, Mod) - C(v \mid Endo, Not)].$$

From Table 4 we calculate the endogenous treatment effect as 50 percent.[22]

Exogenous Treatment Effect.—The exogenous treatment effect corresponds to the change in cooperation due to an exogenous modification of payoffs. As such we must leave the proportion

[20] The total effect can be calculated from Table 4 as follows: $TE = ((17/72)41.18 + (55/72)81.82) - ((55/80)14.55 + (25/80)24) = 54.72$.

[21] $SE = (17/72 - 55/80)14.55 + (55/72 - 25/80)24 = 4.27$.

[22] $EndoTrE = (17/72)(41.18 - 14.55) + (55/72)(81.82 - 24) = 50.45$.

of the different types of voters constant but change the behavior due to exogenous modification. Moreover, the proportion of the different types of voters must be consistent with the ones used to calculate the endogenous treatment effect. Thus, we can calculate the exogenous treatment effect as:

$$ExoTrE = \sum_{v \in \{Y, N\}} g(v \mid Endo, Mod)[C(v \mid Exo, Mod) - C(v \mid Exo, Not)].$$

From Table 4 we calculate the exogenous treatment effect as 36 percent.[23]

Endogeneity Premium.—Having calculated the endogenous and exogenous treatment effects, we can calculate the endogeneity premium. The difference between the endogenous treatment effect (50 percent) and exogenous treatment effect (36 percent) constitutes the endogeneity premium: 14 percent.

Decomposition.—The total effect from endogenous modification of payoffs can be separated in three components: the selection effect, the exogenous treatment effect, and the endogeneity premium. Our estimates show that in this case the selection effect explains 8 percent of the change in behavior, the exogenous treatment effect explains 66 percent, and the endogeneity premium explains 26 percent. The difference between exogenous and endogenous treatment effects is large: the endogeneity premium is more than three times the size of the selection effect and more than 40 percent of the exogenous treatment effect. These results suggest that, even after controlling for selection, when studying the impact of institutions or policies on behavior it may be important to distinguish whether they are endogenous or exogenous.

D. *Exogenous Versus Endogenous Treatment Effect: Group Level Analysis*

In this section we consider the group as the unit of analysis, and we focus on groups with evenly split votes since they allow us to estimate the difference between exogenous and endogenous modification controlling for underlying characteristics of the groups, which are essentially the same. The evidence we present is consistent with the idea that the effect of the payoff modifications depends on whether the modification was endogenous or exogenous to the group. However, the result is not conclusive due to the statistical power of the analysis (by looking at evenly split groups we lose 46 of the 69 groups—see Table 7).

Table 7, panels B and C, shows the level of cooperation by the result of the voting stage and the vote share of the groups. There is little difference in the cooperation rates of groups with vote share 2 in part 1 (see panel B of Table 7). In fact, there are no statistical differences in cooperation across all four voting stage results (p-value 0.47).[24] If anything, the groups with exogenous modification (ExoMod) cooperated more in the first part of the experiment than those with endogenous modification (EndoMod), but this difference is not statistically significant (p-value 0.24). Therefore, before the voting stage all groups were basically identical in terms of cooperation levels.

Focusing on groups with evenly split votes (voteshare $= 2$), we observe that the cooperation levels after the voting stage under the unmodified payoffs are very similar between groups whose

[23] $ExoTrE = (17/72)(41.94 - 3.85) + (55/72)(57.58 - 23.53) = 36$.

[24] For all the statistical tests in this section we consider only one observation per group. In this case the observation is the average cooperation rate in the group in the first ten rounds of the experiment. The p-values correspond to Wald tests. The results are robust to performing Wilcoxon-Mann-Whitney tests when applicable.

TABLE 7—THE EFFECT OF DEMOCRACY–GROUP LEVEL DATA

	Consider votes		Not consider votes		
Vote share	Modify (EndoMod)	Not modify (EndoNot)	Modify (ExoMod)	Not modify (ExoNot)	Total
Panel A. Number of groups by vote stage outcome and vote share					
0	X	3	0	0	3
1	X	9	5	4	18
2	6	8	5	4	23
3	5	X	6	6	17
4	7	X	0	1	8
Total	18	20	16	15	69
Panel B. Cooperation percentage in part 1					
0	X	19.17			
1	X	21.39	31.00	11.25	
2	11.25	16.88	16.50	16.88	
3	12.00	X	17.92	19.58	
4	20.36	X		10.00	
Panel C. Cooperation percentage in part 2					
0	X	21.67			
1	X	11.67	24.50	12.50	
2	51.67	8.44	43.50	9.38	
3	48.00	X	32.50	12.50	
4	88.93	X		7.50	

votes were considered (EndoNot) and those whose votes were not (ExoNot): 8.44 percent and 9.38 percent respectively (panel C of Table 7). As democracy has no effect under unmodified payoffs, we can focus on the difference between endogenous and exogenous modification (EndoMod versus ExoMod) to calculate the difference in treatment effects. We find that groups with endogenous modification (EndoMod) had 51.67 percent cooperation after voting versus 43.50 percent for the groups with exogenous modification (ExoMod). The statistical significance of these differences is provided in Table 8. The difference of 8 percent in favor of endogenous modification (EndoMod) versus exogenous modification (ExoMod) is not always statistically significant. It is significant at the 10 percent level if we eliminate from the analysis groups with subjects that did not remember the vote stage result. Finally, the payoff modification has a large effect on cooperation rates: a 43 percent and 34 percent increase for endogenous and exogenous modification. While this increase is always significant for endogenous modification (p-values less than 0.002, see Table 8) it is not significant for exogenous modification under all specifications.

To study the effect of democracy under modified payoffs (EndoMod versus ExoMod) we can also focus on the small number of groups with voteshare 3.[25] As shown in Table 7, of groups with voteshare 3, those under endogenous modification reach higher cooperation rates than those with exogenous modification (48 percent versus 32.5 percent). However, this difference is not statistically significant. Similarly, to study the effect of democracy under unmodified payoffs (EndoNot versus ExoNot) we can also focus on the small number of groups with voteshare 1. Consistent with previous results, Table 7 shows that there are no differences in cooperation between endogenous and exogenous unmodified payoffs for groups with voteshare 1 (11.67 percent versus 12.5 percent).

[25] However, these groups do not allow us to study the differences in treatment effects as it is not possible to have observations for endogenous unmodified payoffs (EndoNot).

TABLE 8—THE EFFECT OF DEMOCRACY–GROUP LEVEL DATA–VOTE SHARE = 2
Dependent variable: group cooperation rate in part 2

	(1)	(2)	(3)	(4)
EndoMod	0.517	0.404	0.538	0.45
	[0.090]***	[0.117]***	[0.094]***	[0.123]***
EndoNot	0.084	−0.085	0.079	−0.047
	[0.078]	[0.139]	[0.071]	[0.134]
ExoMod	0.435	0.27	0.3	0.19
	[0.099]***	[0.149]*	[0.094]***	[0.136]
ExoNot	0.094	−0.075	0.108	-0.015
	[0.111]	[0.158]	[0.109]	[0.155]
Part 1 cooperation		1.002		0.704
		[0.687]		[0.636]
Exclude did not remember vote result	No	No	Yes	Yes
Observations	23	23	18	18
R^2	0.74	0.77	0.76	0.78

Tests of differences of cooperation rates by mechanism (Endo versus Exo) and payoffs (Mod versus Not)

	p-values			
EndoNot = ExoNot	0.946	0.944	0.822	0.806
EndoMod = ExoMod	0.550	0.333	0.096	0.074
EndoMod = EndoNot	0.002	0.001	0.002	0.001
ExoMod = ExoNot	0.033	0.028	0.204	0.176

Notes: All results are from OLS regressions. The dependent variable is the cooperation rate by group in the 10 rounds after the voting stage (part 2). The explanatory variables are indicator variables for the vote stage result. EndoMod: endogenous modification, EndoNot: endogenous nonmodification, ExoMod: exogenous modification, ExoNot: exogenous nonmodification. Regressions in columns 2 and 4 control for the cooperation rate of the group before the voting stage (part 1). Standard errors in brackets. The *p*-values correspond to Wald tests based on the regression results.

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

In sum, the results based on group-level analysis are consistent with the results from the individual-level analysis but, due to small samples sizes, are not always statistically significant.

IV. Democracy and Information

Why does democracy have an effect in this experiment? One hypothesis is that an endogenous modification affects behavior because it reveals to the subjects that their partners are more likely to have voted for modification, affecting the subjects' beliefs about the partners' future behavior and thus affecting their own behavior. A second hypothesis is that it is the endogeneity itself which affects behavior. Knowing that the policy was imposed by the decision of the group may directly affect subjects' behavior. For example, endogenous modification may strengthen the establishment of a cooperative social norm or may operate as a coordination device.

In this section we provide two pieces of evidence that indicate that information is not the main force behind the effect of democracy in this experiment.

TABLE 9—COOPERATION PERCENTAGE IN ROUND 11 BY "SOPHISTICATION"–YES VOTERS

Math SAT	EndoMod	ExoMod	Difference
Panel A. Math SAT as "sophistication"			
High	76.92	76.47	0.45
Low	86.21	37.50	48.71
B.C. number	EndoMod	ExoMod	Difference
Panel B. Beauty contest number as "sophistication"			
High	75.00	53.33	21.67
Low	85.71	61.11	24.60

Notes: High and Low correspond to the division of the sample at the median value of the corresponding measure of "sophistication" (740 for Math SAT and 33 for the Beauty Contest Number). EndoMod: endogenous modification, ExoMod: exogenous modification.

A. *Information and Sophistication*

The information hypothesis requires subjects to update their belief about their partners' future behavior based on the realization of the vote. It could be argued that more sophisticated subjects (in terms of cognition or strategic ability) would be more likely to update their beliefs and modify their behavior accordingly. Under this premise, we can test the importance of the information channel by comparing the effect of democracy for high and low sophistication subjects as proxied by their Math SAT scores and their choices in the beauty contest game.[26]

The evidence does not support the information hypothesis. Regardless of the measure of sophistication, it is not the case that sophisticated subjects have a greater response to democracy. The difference in cooperation between endogenous and exogenous modification is greater for low Math SAT subjects than for high Math SAT subjects, as shown in Table 9, panel A. Moreover, there is no significant difference in the effect of democracy between subjects with high and low numbers in the beauty contest game, as shown in Table 9, panel B.

This evidence suggests that the democracy effect we identify in this paper is not due to the extra information provided by democracy.

B. *Controlling for Information*

The analysis of the previous subsection hinges on a particular assumption (that sophisticated subjects are more likely to respond to information) which is not being tested. An advantage of experimental economics is that it is possible to modify the experimental design instead of relying on additional assumptions. In this subsection we present results from an experiment that modifies the previous design in such a way that information about votes is kept constant between exogenous and endogenous modification, allowing us to test the information hypothesis.

The experimental design in these additional sessions was exactly as in the original sessions with two differences. First, after voting subjects saw an additional screen informing them whether at most two or at least two subjects in the group voted for modification.[27] In this way a subject under endogenous modification and a subject under exogenous modification who saw that at least two subjects voted for modification have the same information regarding the votes of other subjects in the group. In this way we can compare groups with the same payoff matrix, same information,

[26] We thank an anonymous referee for suggesting this test of the information hypothesis.

[27] For groups with evenly split votes the information was randomized with all subjects in the group receiving the same information.

Table 10—Summary Statistics of Additional Sessions

	Total/means	Standard deviation
Subjects	148	
Economics (percent)	23.65	
Class	1.93	1.01
Political philosophy	2.02	0.84
SAT math	736.91	65.60
SAT verbal	724.15	70.52
Beauty contest number	37.88	21.93
Subject comprehension		
Vote stage (percent)	97.30	
Initial payoffs (percent)	81.76	
Modified payoffs (percent)	91.22	
Earnings		
Maximum	30.00	
Average	24.53	2.15
Minimum	17.50	

Note: Economics is the percentage of economics majors in the session; Class is equal to 1 for freshmen, 2 for sophomore, etc.; Political Philosophy is equal to 1 for very liberal to 5 for very conservative; Beauty contest num. is the number chosen in the beauty contest game.

but different origin of the change of payoffs (exogenous versus endogenous). Second, both the probabilities that the computer would not consider the votes and that it would modify payoffs were set at 90 percent. The reason for this is to have a large number of exogenous modification groups to compare with the endogenous modification groups in the original sessions.[28]

We conducted 10 additional experimental sessions from March to May 2009 in the same computer lab at Brown University as the original sessions. A total of 148 subjects participated in the additional sessions.[29] Table 10 displays the characteristics of subjects, which are largely comparable to the characteristics in the original sessions. As before, a high number of subjects correctly answered the questions regarding the experiment. The subjects earned an average of $24.53, with a maximum of $30 and a minimum of $17.50.

The average level of cooperation was 17.3 percent in the first part of the experiment. The level of cooperation was decreasing with experience, with a maximum of 30.5 percent in round 1 and a minimum of 10.1 percent in round 10 (the last round of part 1). Both the level and evolution of cooperation in the additional sessions are similar to those in the original sessions. Of the 148 subjects in the additional sessions, 54.72 percent voted to modify payoffs in the second part of the experiment compared to 53.26 percent of the original sessions (p-value of difference is 0.773).

Table 11 provides the information necessary to test whether the difference in behavior between endogenous and exogenous modification we find in the original sessions can be attributed to differences in information. The first two columns in this table reproduce the data from the original sessions focusing on modified payoffs (EndoMod and ExoMod). The last two columns provide data from the groups experiencing exogenous modifications in the additional sessions separating the subjects by whether they knew that there were at least two or at most two votes in favor of modification in their group (ExoModH and ExoModL).[30]

[28] The subjects were not informed of the probabilities in either experiment. The instructions said that "the computer will randomly choose whether to consider the votes or not in your group" and "it will randomly choose whether to modify payoffs or not."

[29] None of these subjects participated in the original sessions.

[30] In the additional sessions, 14 percent of the subjects did not end with an exogenous modification, and their behavior is not presented in this table as it is not necessary for the analysis. All the results in this and the previous section remain if their behavior is also considered.

TABLE 11—THE EFFECT OF DEMOCRACY CONTROLLING FOR INFORMATION–MODIFIED PAYOFFS

	Original sessions Consider votes		Additional sessions Not consider votes Vote share	
Vote for modify	Yes (EndoMod)	No (ExoMod)	≥ 2 (ExoModH)	≤ 2 (ExoModL)
Panel A. Number of observations				
No	17	31	20	38
Yes	55	33	56	14
Total	72	64	76	52
Vote for modify	(EndoMod)	(ExoMod)	(ExoModH)	(ExoModL)
Panel B. Cooperation percentage in round 11				
No	41.18	41.94	35.00	23.68
Yes	81.82	57.58	62.50	64.29
Total	72.22	50.00	55.26	34.62
Panel C. Cooperation percentage in part 2				
No	43.53	26.45	22.00	18.42
Yes	71.82	40.00	50.36	33.57
Total	65.14	33.44	42.89	22.50

Note: The column Vote share ≥ 2 (≤ 2) corresponds to the subjects under exogenous modification in the additional sessions who were informed that at least (at most) two subjects in the group had voted for modification.

The cooperation rate in round 11 under exogenous modification for voters who voted for modification and were informed that there were at least two votes for modification in their group is significantly smaller than the cooperation rate under endogenous modification (62.5 percent for ExoModH versus 81.82 percent for EndoMod, p-value of 0.027). This shows that the effect of democracy for subjects that voted for modification cannot be wholly attributed to the informational content of democracy. While we cannot reject statistically the hypothesis that information plays no role, from the observed cooperation rates we can attribute only 20 percent of the democracy effect of the original sessions to the information channel.

Moreover, note that the cooperation rates under exogenous modification in the additional sessions do not depend on the information regarding the votes in the group (62.5 percent for ExoModH versus 64.3 percent for ExoModL, p-value of 0.903).[31] This suggests that information about the group vote share does not affect behavior and that the effect of democracy we found in the original sessions cannot be attributed to the information that democracy allows.

As before, when we control for information, democracy has no effect in round 11 for subjects that did not vote for modification (35 percent for ExoModH versus 41.18 percent for EndoMod, p-value of 0.68). And information about the group vote share does not affect cooperation by subjects that did not vote for modification under exogenous modification in the additional sessions (35 percent for ExoModH versus 23.68 percent for ExoModL, p-value of 0.368).

Interestingly, as the left panel of Figure 4 shows, for those subjects who voted for modification cooperation rates continue to differ in rounds 12 to 20 as well between those acting under endogenous modification (EndoMod) and those with identical information (that at least two subjects in the group voted for modification) but acting under exogenous modification (ExoModH). As a result, the cooperation rate in part 2 is 71.82 percent under endogenous modification and

[31] Moreover, these two cooperation levels are not significantly different from the cooperation level under exogenous modification in the original sessions (p-values of 0.65 and 0.676).

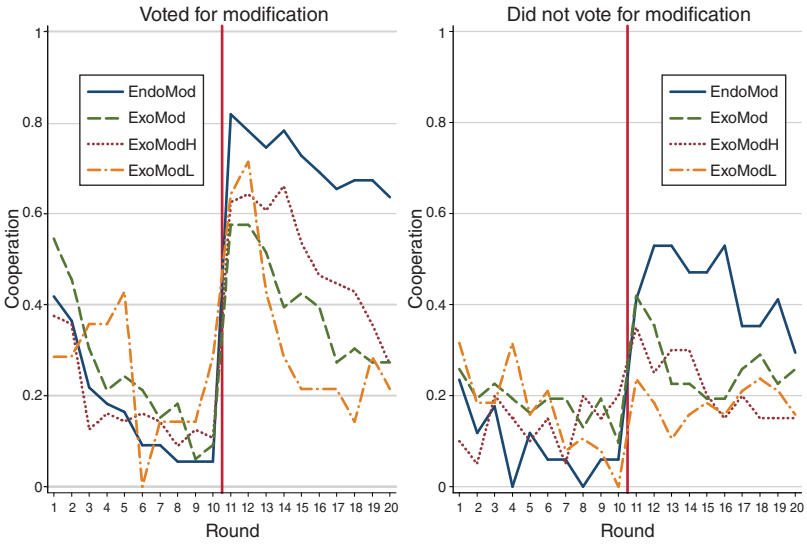

FIGURE 4. COOPERATION BY ROUND AND INDIVIDUAL VOTE UNDER MODIFIED PAYOFFS ORIGINAL AND ADDITIONAL SESSIONS COMPARISON

Note: EndoMod and ExoMod denote endogenous and exogenous modification in the original sessions; ExoModH and ExoModL denote exogenous modification when the group knew that there were at least two or at most two votes in favor of modification, respectively, in the additional sessions.

50.36 percent for exogenous modification with at least two subjects that voted for modification (see Table 11, panel C; the difference is statistically significant with p-value of 0.056).[32, 33]

When we study behavior in all rounds after the voting stage, the effect of democracy is not limited to subjects who voted for modification. As Figure 4 and Table 11, panel C, show, for subjects who did not vote for modification, cooperation is greater under endogenous modification than under exogenous modification with at least two subjects that voted for modification (43.53 percent for EndoMod versus 22 percent for ExoModH, p-value of 0.041).

In sum, we find no evidence that information differences between endogenous and exogenous modification explain the observed difference in behavior. Similar results are obtained if we compare behavior at the group level conditioning on the voting share as in Section IIID.

V. Conclusions

Previous literature has suggested that democratic institutions might have an effect on individual behavior in addition to their instrumental effect through policy choice. In fact, the idea that

[32] This p-value corresponds to a Wald test with one observation per subject and clustering by group.

[33] Subjects that voted for modification and are acting under exogenous modification are more likely to cooperate after the voting stage when they know that at least two subjects in the group voted for modification (50.36 percent versus 33.57 percent in Table 11, panel C; also see Figure 4). However, this cannot be taken as evidence in favor of the information hypothesis as subjects are not comparable across these treatments. The reason is that subjects in groups with a high voting share in favor of modification are more likely to interact with subjects who voted for modification than subjects in groups with a small vote share, and this can affect behavior from round 12 onward. Once we control for this difference, as is done in Section IIIB and explained in the Appendix, we find that information about the vote share has no effect on behavior under exogenous modification in any of the rounds.

democracy may influence the effect of policies can be traced to Alexis de Tocqueville (1839).[34] However, it has been empirically difficult to provide strong evidence for such an effect due to the endogeneity of democratic institutions and policies. In this paper, we show that a modification of payoffs from a prisoner's dilemma game to a coordination game has a greater impact on behavior when the modification was implemented democratically than when it was imposed randomly by a computer. Moreover, we establish that this is due both to a selection effect (the fact that players who vote to modify payoffs differ from those who do not) and, mainly, an "endogeneity premium" effect (the fact that similar individuals facing the same game may behave differently depending on whether the game was chosen by them or imposed). We show that the latter effect is not a result of the fact that democracy leads to the transmission of information among subjects.

Our results indicate that the effect of a given policy may depend on whether it is chosen democratically or imposed on the subjects through another mechanism. We believe these results may be useful in interpreting results on democratic processes in small settings such as villages in low-income countries, a subject that has been the focus of considerable attention in the recent empirical development literature. Our results also may provide insight into research on the effects of worker participation in firms and into the design of procedures in small groups such as academic departments. It is not clear the extent to which these results apply to democratic processes at the level of the state or nation. We hope to look in part at this issue in future work by studying whether the effect of democracy depends on the size of groups.

More generally, our results show that a treatment effect may depend on whether the treatment is endogenous or exogenous. This suggests that it may be important to consider the mechanism by which a policy will be chosen in practice when designing an evaluation study of that policy. For example, the effects of a policy to directly monitor attendance of schoolteachers that arise when the policy is randomly allocated across schools may be quite different from the effects of a policy that will be chosen in part by the teachers in each school.[35] Of course, this implication also follows in a context in which selection and heterogeneous treatment effects are present (for example, the monitoring technology may be more likely to be adopted in schools in which this technology may be particularly effective). The additional insight of the present paper is that even after controlling for selection into a policy, the effect of a democratically chosen policy may not be the same as that of the same policy imposed from outside.

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[34] "It is not always feasible to consult the whole people, either directly or indirectly, in the formation of the law; but it cannot be denied that, when such a measure is possible, the authority of the law is much augmented. This popular origin, which impairs the excellence and wisdom of legislation, contributes prodigiously to increase its power." de Tocqueville (1839), 228. On other theories stating that political participation is intrinsically beneficial see Carole Pateman (1970); Dennis Thompson (1970); and Steven E. Finkel (1985). An emergent literature in development economics on the effects of local democracy (e.g., Foster and Mark R. Rosenzweig 2005, and Timothy Besley, Rohini Pande, and Vijayendra Rao 2005) has also paid attention to plausibly exogenous sources of variation in democracy but has largely ignored the possible direct effects of democratic institutions.

[35] On monitoring and teachers' attendance see Esther Duflo, Rema Hanna, and Stephen Ryan (2008).

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