Unequal power, voting, and the management of common resources*

Francesco Bogliacino[†] César Mantilla[‡] and Daniel Niño[§]

April 13, 2022

Abstract

Given stakeholders with unequal resources, will a democratic procedure be more efficient than an unequal distribution of political power? We address this question experimentally. Participants play an appropriation dilemma as Poor, Middle and Rich types. They are asked to vote for a quota to limit the maximum extraction, then implemented through a random dictator procedure. Political inequality is introduced by allocating more votes to one of the three types. Theoretically, each type selfishly prefers the quota closer to their endowment, although the lowest would be socially desirable. Participants followed this prediction between half and two-thirds of the time. The quotas decreased the absolute extraction by about 17.5%, even though participants chose extraction levels closer to their quota-adjusted maximum capacity. Nonetheless, we do not find systematic differences in extraction patterns between treatments, rejecting the hypothesis of procedural fairness in this context. Finally, the quota removal led to inefficient extraction levels.

Keywords: Political inequality; economic inequality; environment; experiment; public goods; institutional choice.

JEL Codes: C92; D62; D72; N5

*Daniel and Francesco acknowledge financial support from Universidad Nacional de Colombia, Convocatoria Jóvenes Investigadores 2019. Francesco also thank Open Evidence for financial support via the contract 18810 with Universidad Nacional de Colombia. César thanks financial support from the program “*Inclusión productiva y social: programas y políticas para la promoción de una economía formal, código 60185, que conforma la Alianza EFI, bajo el Contrato de Recuperación Contingente No. FP44842-220-2018.*”. We thank Camilo Gomez, Felipe Montealegre, Ferney Rincón, and Rafael Charris who helped with data collection. We appreciate comments from Yady Barrero and Alexander Rincón, who commented on Daniel’s Master thesis on which this work is partly built, and from participants to various seminars and conferences, including BEBES. The usual disclaimer applies.

[†]**Corresponding author.** Escuela de Economía, Universidad Nacional, fbogliacino@unal.edu.co

[‡]Economics Department, Universidad del Rosario, cesar.mantilla@urosario.edu.co

[§]Universidad Nacional, dninoe@unal.edu.co

1 Introduction

The management of environmental public goods requires the adoption of norms and regulations by actors that differ in the scale of their operation and the size of their political power. The simultaneous presence of economic and political inequalities when choosing to adopt regulation causes the following political conundrum. On the one hand, diversity in economic interests and capabilities determines the heterogeneity in costs and benefits from regulation (Heckathorn, 1993): even if nominally invoking the principle of fairness, different actors support strikingly different burden-sharing rules (Johansson-Stenman and Konow, 2010; Kesternich et al., 2021). On the other hand, the unlevelled political landscape causes differences in the perceived legitimacy of rules and agreements (Vollan, 2008).

The interplay between economic and political inequalities in the management of environmental public goods is documented mostly through anecdotal evidence. For instance, for the Fulani agro-pastoralists in the Niger Delta (Vedeld, 2000), the political inequality dampens collective action when there is a divergence of economic interests among the elite. Economic inequality makes it harder to agree on mutually beneficial terms, whereas political inequality jeopardizes the legitimacy of these agreements because of the “unfairness” of the process.

More generally, political inequality is not necessarily detrimental for the bargaining and implementation of environmental agreements; neither guarantees its failure or success. Compare, for instance, the Montreal and Kyoto Agreements. In the former, the breakthrough of hydrofluorocarbons to substitute the more noxious chlorofluorocarbons (CFCs) was made by DuPont, a North American company whose political connections helped ban CFCs (Maxwell and Briscoe, 1997). In the latter, the withdrawal of the United States significantly reduced the environmental effectiveness of the international environmental agreement (Bohringer, 2002). Hence, political inequality can hamper legitimacy, but it might also reduce bargaining costs.

Our purpose is to study both dimensions of inequality in a laboratory setting. We aim to understand how cooperation is affected when interest groups of heterogeneous economic capacities condition the environmental policy. The laboratory offers a solution to the challenge of exploring this question using happenstance data. Cross-country evidence on the relationship between economic and political inequality, and the resulting environmental outcomes, are plagued with endogeneity problems. This approach is typical of the literature on the Environmental Kuznets Curve, which uses income gradient within or between countries to assess the impact of better economic conditions on the sensibility towards the environment (Cole et al., 1997; Stern, 2004; Dasgupta et al., 2002). Exploiting the introduction of institutional changes provides poor support for generalized inference, as country-level evidence hampers the possibility to find a good counterfactual, given our interest in exploring political inequality.

We run an online laboratory experiment where participants decide how to allocate their unequal endowments between a high-return but polluting project and a low-return project that does not cause a negative externality. In the first stage, group members are heterogeneous only in their production capacity. Each group comprises a “Rich”, a “Middle class”, and a “Poor” member. In the second stage, participants vote for an environmental regulation, a quota, selected through a random dictator mechanism. There are three possible quota levels. The lower the quota level, the larger the number of player types constrained by the

policy. The between treatment variation resides in the allocation of political power within the group. In a baseline treatment, which we call *Democracy*, votes are equally allocated across participants. In the other treatments, one of the participants becomes pivotal as he gets a 7/9 chance of deciding what quota will be set, whereas the other two players get a 1/9 chance. We thus have a *Plutocracy* treatment, where the choice of the Rich type is more likely to be selected; a *Demarchy*¹ treatment, where the most likely choice corresponds to the Middle type; and a *Ptochocracy* treatment, where the choice of the Poor type is the more likely.

Since each player type has a preferred quota under selfish preferences (i.e., the one closest to her endowment), one would expect political inequality to produce very different regulations. These regulations will be accompanied by the maximization of extraction levels, given the constraint imposed by the quota. Instead, under the assumption that agents are conditional cooperators, the equilibrium outcome is the establishment of the most stringent quota to reduce the maximum negative externality. When it comes to extraction, conditional cooperators might adopt extraction levels below their maximum extraction capacity.

Our results are in-between these predictions: votes reflect rational self-interested choices, whereas the extraction ranges between 75 and 85 per cent of the allowed extraction level. This result is puzzling because participants typically vote as, but do not harvest like, rational self-interested players. Moreover, aggregate extraction does not diverge across treatments. Among theorists and experimentalists interested in cooperation, the most scrutinized form of inequality has been the unequal distribution of endowments. The theoretical predictions on its effect are mixed. Although diversity in interests makes collective action harder, agents with larger endowments are willing to bear a larger share of the cost of cooperation in exchange for decreasing the negative externality, by which they are disproportionately affected (Olson, 1989; Baland and Platteau, 1999). The experimental evidence is more conclusive: economic disparities decrease cooperation in resource dilemmas (Cardenas, 2003; Hayo and Volland, 2012) and in the voluntary provision of public goods (Cherry et al., 2005). At least three institutions have been tested to prevent inequality from harming cooperation: communication, burden sharing rules, and voting. Hackett et al. (1994) and Tavoni et al. (2011) show that communication is usually effective in overcoming economic disparities mainly by allowing richer agents to signal their intention to redistribute. Burden sharing rules based on the smallest common denominator (i.e., players' actions are given by the lowest proposed contribution) are socially efficient with respect to the standard voluntary contribution mechanism, but universal rules perform better than rules tailored by player-type (Kesternich et al., 2014).

Concerning voting, Margreiter et al. (2005) modifies a common-pool resource (CPR) game with heterogeneous players, allowing each player to propose a vector of extractions. If any proposal gets a simple majority, it is implemented. Otherwise, each player decides her extraction in a decentralized manner. Whereas voting brings outcomes closer to social efficiency when groups are homogeneous, proposals are more complex to approve in heterogeneous groups due to a miscoordination reflected in multiple extraction vectors. Thus, besides

¹We apply this label to our treatment with a little abuse of the actual meaning of demarchy, a government system where officials are randomly selected from a predefined pool. This description fits well our treatment if one thinks about a society where the middle-class represents a large majority.

showing that voting procedures do not solve the coordination problem *per se*, we document how an equal distribution of political power is not more effective than unequal distributions. As a public choice perspective would suggest, *Democracy* could be inferior to the allocation of more power to the party that is benefiting more from the pro-environmental policy.

Additionally, removing the voting procedure leads to an increase in extraction, rejecting the presence of crossover effects. This result goes against the hypothesis that quotas can serve as focal points for coordination and connects our findings with the literature on how quotas affect harvesting decisions. Cardenas et al. (2000) show that a quota regulation with imperfect monitoring is efficiency-enhancing at the beginning but, once participants realize the low probability of inspection, cooperation is eroded. We argue that a similar crowd-out occurs once the quotas are removed in our experiment. Velez et al. (2012) show that when real users of common resources can vote for a high or a low penalty for noncompliance to a quota, participants opt for the latter one. As a consequence, the introduction of a quota did not increase efficiency. This behavioral pattern might explain why, in our experiment, Middle and Poor types have a positive probability of voting for the less stringent quota. Participants myopically overweight the consequences of restrictions on their set of strategies, neglecting how these restrictions might affect others to a greater extent.

This article proceeds as follows. Section 2 describes our experimental design, predictions, and analysis plan. Section 3 reports the voting and extraction results. Discussion and concluding remarks are shown in Sections 4 and 5, respectively. A Supplementary Online Materials (SOM) annex includes the experimental protocol in English and Spanish. Further statistical analyses are confined to an Appendix.

2 Experimental design

2.1 The experimental decisions and procedures

We perform an online laboratory experiment programmed in oTree (Chen et al., 2016). The game consists of an appropriation dilemma: a linear public goods game with negative framing (Andreoni, 1995). Each group member has a different endowment or “extraction capacity.” We thus have a “Rich”, a “Middle”, and a “Poor” type per group. These roles are randomly assigned and maintained throughout the experiment. The corresponding labels of the player types are “X”, “Y”, and “Z”, respectively. The experiment consists of 21 rounds, divided into seven blocks of three rounds each. Although the type of each participant is fixed in the experiment, new groups are formed at the beginning of each block. We use blocks to increase the number of voting decisions we observe from each participant. We argue that the random rematching after each block eliminates the reputational and reciprocity concerns that may emerge in cooperation games.

In Blocks 1 to 3, and 7, the three rounds comprise only an extraction phase. In this phase, each player decides how to allocate her endowment between an extractive project with high individual returns (α_A per unit), which also causes a negative externality (β per unit); and an alternative project with low individual returns (α_B per unit) with no externality. The endowment e_i differs between types. For the “Rich” type we have $e_R = 12$, for the “Middle” type we have $e_M = 9$, and for the “Poor” type we have $e_P = 6$.

Defining x_i as the number of tokens allocated to the extractive project, the payoff for each participant i can be calculated as:

$$\pi_i = \alpha_A x_i + \alpha_B (e_i - x_i) - \beta \sum_{i=1}^n x_i \quad (1)$$

As in the standard public game literature, it must hold that $\alpha_A - \beta > \alpha_B > \alpha_A - n\beta$.

The first round of Blocks 4 to 6 comprises a voting phase before the extraction phase. Here, each group member votes for a binding maximum level of extraction, or quota $q_j \in \{5, 8, 11\}$. The quota is selected using the random dictator procedure (Kocher et al., 2016), and is kept for the block (i.e., for three consecutive rounds with the same group members). The nine ballots employed in the random dictator are allocated differently between treatments. In the baseline condition, each type has three ballots. In the other three treatments, where political power is unequally distributed, a type has seven ballots, and the other two types have one ballot each. More specifically, our treatments are:

- *Democracy*: each vote is randomly drawn with probability 3/9;
- *Plutocracy*: the vote from the “Rich” type is drawn with probability 7/9, and the votes from the “Middle” and “Poor” types are drawn with probability 1/9;
- *Demarchy*: the vote from the “Middle” type is drawn with probability 7/9, and the votes from the “Rich” and “Poor” types are drawn with probability 1/9;
- *Ptochocracy*: the vote from the “Poor” type is drawn with probability 7/9, and the votes from the “Rich” and “Middle” types are drawn with probability 1/9.

The endowment of each player type is common information. After each round, participants receive feedback regarding their payoff and the group investment in the extractive project. In the blocks with voting, participants are informed about the selected quota but not about the distribution of votes.

Our design has three elements worth to be mentioned. First, we use an explicit environmental framing (e.g., we talk about an “extractive project” and a “quota”) to favor comprehension and emphasize the inequalities in our setting. Second, when voting, the available quotas correspond to one unit below each one of the type’s endowments. In this way, the quota always constraints the extraction of at least one type. Moreover, as quotas do not coincide with the endowment, there is no cognitive shortcut to select their maximum allowed extraction as quota, and the experimenter demand effect is also reduced (Zizzo, 2010). Instead, (Poor and Middle type) players must decide whether they prefer a minimal constraint for themselves in order to reduce other players’ options significantly or to avoid self-restraining at the expense of a potentially larger negative externality produced by others. Third, in the last block, we remove the voting institution to identify whether quotas served as a coordination device that improves cooperation even when maximum extraction levels are not limited.

All sessions took place on an online platform at Unbiased Lab at Universidad Nacional. We could not run lab sessions because of the pandemic. We sent random invitations to participants from the subject pool, including undergraduate students. General instructions

were read aloud. Comprehension was checked through two multiple-choice questions before the start of Block 1. The instructions regarding the voting procedure were provided prior to the beginning of Block 4. The full experimental protocol in English and Spanish can be found in the SOM. IRB approval has been obtained from the Universidad Nacional, and all participants provide informed consent. Hypotheses and analyses have been pre-registered on Aspredicted (# 63930).

2.2 Game theoretical predictions

Recall that the appropriation dilemma has the same structure as a linear public goods game with an extraction framing. Therefore, the dominant strategy is a corner solution. That is, participants maximize their payoffs by setting their extraction equal to their endowment ($x_i = e_i \forall i \in \{R, M, P\}$). In blocks without a quota, the predicted aggregate extraction with selfish incentives will be 27 units.

In the blocks with voting, we can compute the equilibrium behavior by backward induction. Notice first that, due to the linearity in the payoff function, setting a quota does not change the fact that the optimal choice is a corner solution: the maximum allowed extraction, either defined by the endowment or by the quota, remains as the dominant strategy. The question is which quota is preferred by each player type.

Let us start with the Rich. The expected payoff is $11\alpha_A + \alpha_B - 26\beta$ if $q = 11$, $8\alpha_A + 4\alpha_B - 22\beta$ if $q = 8$, and $5\alpha_A + 7\alpha_B - 15\beta$ if $q = 5$. Note that more restrictive quotas reduce the direct benefit from the extractive project but also reduce the negative externality. Nonetheless, the condition $\alpha_A - \beta > \alpha_B$ guarantees that the reduction in the externality is insufficient for the Rich type to opt for stringent quotas, thus voting for $q = 11$.

In the case of the Middle type, the expected payoff when setting $q = 8$ (given by $8\alpha_A + \alpha_B - 22\beta$) exceeds the expected payoff when setting $q = 11$ (given by $9\alpha_A - 26\beta$) because the reduction in the negative externality from constraining the Rich type is more beneficial than the extraction of one additional unit. The payoff with $q = 5$ (given by $5\alpha_A + 4\alpha_B - 15\beta$) is also lower. In this case, the self-imposed restriction with respect to $q = 8$ is more costly than the externality reduction. Finally, the Poor type prefers $q = 5$ (with a payoff $5\alpha_A + \alpha_B - 15\beta$) because, with any higher quota (yielding a payoff of at most $6\alpha_A - 22\beta$, with $q = 8$), the additional gain from extraction does not compensate the larger externality.

Summing up, under common knowledge of rationality, every type will vote for the quota closer to her endowment and choose the maximum allowed extraction level. Moreover, the distribution of political power does not affect these predictions, as the preferred quota of each type is independent of the weights in the random dictator procedure.

2.3 Variables and analysis plan

We preregistered three regression analyses. First, we will study the voting patterns with the dependent variable $VoteQ_{isb}^*$, coded as one if the participant i (in session s), in block b , voted for the quota level closer to her endowment, and zero otherwise. We will estimate the following Linear Probability Model using the data from blocks four-to-six:

$$VoteQ_{isb}^* = \sum_k \theta_k T_i^k + \nu_b + \epsilon_{isb} \quad (2)$$

where T_i^k is the set of treatment dummies, equal to one if the participant i is in treatment $k \in \{Plutocracy, Demarchy, Ptochocracy\}$, with *Democracy* being the omitted category; ν_b representing the block fixed effects, and ϵ_{isb} capturing the unobservables.

Under the rational choice theory, $\theta_k = 0 \forall k$, as voting for the quota closest to her endowment is the dominant strategy, irrespective of the distribution of weights in the voting procedure. By contrast, under the theory of procedural fairness, *Democracy* might call for policies closer to the common good with respect to lobby-driven institutional systems, where private interests become more salient. As a result, we test $\theta_k = 0$ against the alternative that $\theta_k > 0$ for the Rich and Middle types.² We will also test, for each type, the independence of the distribution of votes over quotas across treatments using a chi-squared test.

Second, we will study the extraction patterns with the dependent variable $y_{isb} \in [0, 1]$. y_{isb} is the normalized extraction level of player i (in session s and round r), computed as her absolute extraction Y_{isr} divided by her maximum feasible extraction. The maximum feasible extraction is given by the minimum between the endowment and the quota. We exploit the introduction of the voting institution in blocks 4-6 to identify the causal effect of the treatments using a Difference-in-Differences approach, as per Equation 3.

$$y_{isr} = \sum_k (\gamma_k T_i^k + \tau_k Vote_{sr} + \delta_k Vote_{sr} \times T_i^k + \phi_k B7_{sr} \times T_i^k) + \alpha B7_{sr} + \mu_r + \epsilon_{isr}, \quad (3)$$

where T_i^k is the set of treatment dummies described above, $Vote_{sr}$ is an indicator variable for blocks 4-6 (where the quotas are set via the voting institution), and $B7_{sr}$ is an indicator variable for block 7 (without voting). The coefficients δ_k tell us how the normalized extraction changes once quotas are set under different political systems (i.e., *Plutocracy*, *Demarchy*, and *Ptochocracy*). The coefficients ϕ_k capture the crossover effects of quotas once the voting institution is removed. A resulting $\phi_k < 0$, for any treatment k , would suggest that the use of quotas had a permanent positive effect on cooperation. By contrast, if $\phi_k > 0$ for any k , we can argue that quotas were artificially restricting extraction and crowd-out the cooperative behavior existing before the introduction of the voting phase.

Once the quota has been set, the effects of the political systems are the combination of (a) the reaction to the adopted policy and (b) the reaction to the way the policy was chosen. Hence, to better understand which of the two effects drive the observed treatment effects (or lack thereof), we conduct a third type of analysis. It exploits a natural experiment occurring in our data: there are instances in which minorities set the quotas. They occur with a 2/9 chance, and participants do not know the distribution of individual votes. If political minorities expect the quota closer to the endowment of the majority's type, deviations from this quota can be interpreted as "surprises". We can explore whether the normalized extraction y_{isr} varies with unexpected deviations from the Nash equilibrium predictions. In practice, this corresponds to the following cases: in the *Plutocracy* treatment, a quota $q \neq 11$ is selected; in the *Demarchy* treatment, a quota $q \neq 8$, and in the *Ptochocracy* treatment,

²For Poor types, their self-interested choice is aligned with the welfare-maximizing quota, $q = 5$.

a quota $q \neq 5$. We estimate Equation 4 with the extraction decisions from blocks 4-6, separately for $k \in \{Plutocracy, Demarchy, Ptochocracy\}$. We omit the *Democracy* treatment because the choice from each player type is equally likely to be selected (i.e., there is no unexpected quota).

$$y_{isr} = \beta ShockQ_{ir}^d + \sum_j (\alpha_j Type_i^j + \gamma_j ShockQ_{ir}^d \times Type_i^j) + \mu_r + \epsilon_{isr}, \quad (4)$$

where $ShockQ_{ir}^d$ is an indicator variable for a shock perceived by participant i , in round r , in direction $d \in \{-, +\}$ with respect to the expected quota (i.e., this variable becomes 1 if $q \neq 11$ under *Plutocracy*, if $q \neq 8$ under *Demarchy*, and if $q \neq 5$ under *Ptochocracy*). Here, the direction d indicates whether the shock was positive (i.e., a quota higher than expected) or negative (i.e., a quota lower than expected). $Type_i^j$ is an indicator variable of the player type $j \in \{Rich, Middle, Poor\}$ (the omitted category will be the type with political power in each treatment), and μ_r is the round fixed effect. The β parameters provide an estimation of the causal effect of a shock on the type with political power. The γ provides an estimation of the differential response to the shock by minorities with respect to the class in charge.

We focus our interpretation on the coefficients γ_j , and not on the β , as the former provides a cleaner test of the surprise effect than the latter. It is possible that types holding political power will vote for an unexpected quota, producing a “surprise” even if minorities played no role in this outcome. When this occurs, the estimation of the β will be prone to selection bias as it is correlated with the extraction decisions by the type in power. Instead, being ignorant of the distribution of votes, minorities will always be surprised by an unpredicted quota, regardless of who cast the ballot beneath it.

3 Results

We have 203 separate observations collected in 15 sessions. We had to drop two observations for an error in the recording of the votes. This is the distribution of participants in the treatment: 51 in *Ptochocracy*, 51 in *Demarchy*, 50 in *Plutocracy*, and 51 in *Democracy*.

3.1 Quotas and voting patterns

Table 1 reports the distribution of the adopted quotas by treatment. The quota $q = 5$ is the most frequently implemented (40% of the time). Additionally, the most common quota in each treatment follows closely the prediction of rational choice theory: under *Ptochocracy*, $q = 5$ is selected 61% of the time; under *Demarchy*, $q = 8$ is selected 49% of the time; and under *Plutocracy*, $q = 11$ is selected 56% of the time. A Pearson Chi-squared test reveals that the distribution of implemented quotas differs across treatments (p -value < 0.001).

The distribution of votes by type and treatment is displayed in Table 2. The Rich and Poor types vote more frequently for the preferred quota under the Nash equilibrium, about 52 and 63 percent of the time, respectively. The distribution of votes does not differ statistically across treatments for these player types (respectively $\chi^2 = 3.64$, $p = 0.72$ and $\chi^2 = 7.23$, $p = 0.30$). By contrast, the Middle types vote for $q = 8$, their preferred quota,

Table 1: Distribution of implemented quota by treatment

Quota	Democracy	Demarchy	Ptochocracy	Plutocracy	Total
5	21	17	33	14	85
	38.9%	33.3%	62.3%	25.9%	40.1%
8	19	25	12	10	66
	35.2%	49.0%	22.6%	18.5%	31.1%
11	14	9	8	30	61
	25.9%	17.7%	15.1%	55.6%	28.8%

276 44% of the time. This value is lower than for other types, because under the *Plutocracy*
277 treatment, the Middle type is more likely to swing to either $q = 11$ (37%) or $q = 5$ (35%).

Table 2: Cast votes by player types (across panels) and treatments (across columns)

Panel A: Rich Type					
Vote	Democracy	Demarchy	Ptochocracy	Plutocracy	
$q = 5$	20.4%	25.5%	18.9%	27.8%	
$q = 8$	31.5%	23.5%	20.8%	22.2%	
$q = 11$	48.2%	51.0%	60.4%	50.0%	
Pearson Chi-squared test p -value: 0.725					
Panel B: Middle Type					
Vote	Democracy	Demarchy	Ptochocracy	Plutocracy	
$q = 5$	43.1%	35.3%	38.3%	35.3%	
$q = 8$	51.0%	51.0%	46.8%	27.5%	
$q = 11$	5.9%	13.7%	14.9%	37.3%	
Pearson Chi-squared test p -value: 0.002					
Panel C: Poor Type					
Vote	Democracy	Demarchy	Ptochocracy	Plutocracy	
$q = 5$	62.5%	58.8%	70.6%	60.0%	
$q = 8$	22.9%	23.5%	23.5%	15.6%	
$q = 11$	14.6%	17.7%	5.9%	24.4%	
Pearson Chi-squared test p -value: 0.300					

278 We now provide the regression results for the preregistered model described in Equation 2.
279 In general, the likelihood to vote for the preferred quota under the Nash equilibrium does not
280 change with respect to the *Democracy* treatment. In the *Ptochocracy* system, the likelihood
281 to vote according to the prediction increases by 5pp, it decreases by 8pp in *Plutocracy*, and
282 stays unaltered in *Demarchy*. These differences are not statistically significant, though.
283 The Rich and Poor types are more likely to vote for the selfishly preferred quota than the
284 Middle type, by 8pp and 19pp, respectively. This result confirms the observation made after
285 presenting the descriptive results in Table 2.

Table 3: Dependent variable: likelihood to vote for the preferred quota under the Nash equilibrium

VARIABLES	(1)	(2)	(3)	(4)
Demarchy	0 (0.0570)	0.0292 (0.116)	-0.00205 (0.0564)	0.0295 (0.115)
Ptochocracy	0.0599 (0.0572)	0.258** (0.103)	0.0556 (0.0566)	0.256** (0.102)
Plutocracy	-0.0826 (0.0573)	0.00694 (0.120)	-0.0806 (0.0567)	0.0184 (0.119)
Rich Type			0.0829* (0.0487)	0.0821* (0.0488)
Poor Type			0.188*** (0.0497)	0.190*** (0.0497)
Constant	0.506*** (0.0494)	0.407*** (0.0774)	0.417*** (0.0566)	0.317*** (0.0820)
Session Fixed Effects	No	Yes	No	Yes
Observations	607	607	607	607
R-squared	0.012	0.031	0.035	0.055

LPM. Other controls: Block fixed effects. Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

3.2 Group extraction

Figure 1 plots the group extraction across treatments and rounds. The average group extraction per round during the first three blocks was 19.7 (with a standard deviation of 5.3). There were no systematic differences before the introduction of the extraction quotas. The absolute effect of quotas is evident: there is an average reduction in extraction of 3.45 units (about 17.5%). After removing quotas, extraction goes back to 22 points in round 19.

We validate these results with an OLS model, where group extraction per round is explained by our treatment variables regarding political inequality, the voting stage, and block fixed effects. Table 4 confirms the reduction in the group extraction caused by the introduction of quotas during the voting stage. In model (2), the reduction in group extraction reaches roughly two units, about 10% of the average group extraction. When we control for block fixed effects, we observe that once quotas are removed, the group extraction in the final block considerably increases: 3.5 units with respect to the initial blocks (i.e., prior to the introduction of the quotas).

The coefficients of our three treatment variables are non-significant. Hence, there are no pre-trends across treatments before the voting stage. Nonetheless, our results for the interaction terms also confirm the lack of differences between treatments with the introduction of quotas in the voting stage. The largest, though still non-significant coefficient, suggests an average increase of group extraction of 1.2 units in *Plutocracy* with respect to *Democracy*. Although the least stringent quota would reduce the maximum average extraction by one

Figure 1: Group extraction by treatment and round

Table 4: OLS model explaining group extraction

	(1)		(2)	
Demarchy	-0.360	(0.700)	-0.360	(0.683)
Ptochocracy	-0.209	(0.710)	-0.209	(0.693)
Plutocracy	-0.603	(0.710)	-0.603	(0.693)
Voting stage	-4.389***	(0.758)	-1.947**	(0.945)
Demarchy $\times$ Voting stage	0.331	(1.077)	0.331	(1.051)
Ptochocracy $\times$ Voting stage	-0.642	(1.092)	-0.642	(1.066)
Plutocracy $\times$ Voting stage	1.179	(1.092)	1.179	(1.066)
Final block			3.409***	(0.696)
Block fixed effects	No		Yes	
Constant	20.66***	(0.489)	19.02***	(0.640)
Observations	522		522	
R-squared	0.190		0.236	

unit, giving more political power to the Rich type seems to slightly increase group extraction with respect to the baseline with political equality.

Returning to the lack of treatment differences, we conducted an additional test, focusing only on the voting stage. We interacted the treatments with Blocks 5 and 6 (i.e., Block 4 is the reference category). The results, reported in Table A.1 in the Appendix, confirm the lack of differences between treatments within blocks with quotas. The only interaction term that is statistically different from zero appears for *Plutocracy* in Block 5. We observe that group extraction increases 2.5 units, an effect observable in the dashed-and-dotted line between rounds 14 and 16 in Figure 1.

3.3 Normalized extraction

The main analysis of individual behavior is reported using normalized instead of absolute extraction levels. The main reason is to ease comparability, given the heterogeneity in player types and implemented quotas.

The normalized extraction is computed as the ratio between the harvested quantity and the maximum allowed extraction. This maximum allowed extraction is identical to the endowment before the introduction of quotas, or if the quotas are non-binding (e.g., for the Poor type, with $q = 8$ or $q = 11$); and it is equal to the quota when this is binding (e.g., for the Poor type, with $q = 5$). Table 5 shows that normalized extraction is roughly 75% before the introduction of the quotas for all player types. When quotas are introduced, normalized extraction increases for all player types, in a larger extent for $q = 5$ (from 75 to 86 percent, or 11pp), followed by $q = 11$ (5pp) and $q = 8$ (4pp). Moreover, the normalized extraction in Block 7, with respect to Blocks 1-3, increases by 10pp.

Table 5: Normalized extraction by player type and block

Type	Blocks 1-3	Blocks 4-6			Block 7
		$q = 5$	$q = 8$	$q = 11$	
Rich	0.727 (0.296)	0.835 (0.295)	0.765 (0.266)	0.791 (0.239)	0.808 (0.266)
Middle	0.732 (0.286)	0.846 (0.294)	0.768 (0.274)	0.797 (0.238)	0.836 (0.247)
Poor	0.779 (0.273)	0.907 (0.189)	0.831 (0.201)	0.825 (0.247)	0.896 (0.201)
Aggregate	0.746 (0.287)	0.862 (0.267)	0.787 (0.252)	0.804 (0.242)	0.846 (0.243)

Let us zoom into normalized extraction by type. The Rich type extracts on average 73% of the available resources before the quota. With the introduction of quotas, normalized extraction increases to 84% with $q = 5$, to 77% with $q = 8$, and to 79% with $q = 11$ (notice that the quota effect is non-monotonic). After removing the quota system, they raise extraction to 81%, a share higher than the pre-voting extraction. The Middle type extracts slightly more, proportionally to its resources. Starting from 73%, it increases (non-monotonically) to 85%, 77%, and 80% under the three quotas, and it jumps to 84% after the removal of the quota. Finally, the Poor type extracts 77.9% before the quotas, and it increases to 91%, 83%, and 83% under the three quotas. As in the case of the other player types, it also increases (to 90%) after the removal of the quota.

This table suggests that there are no virtuous types, just different constraints. It is

already evident that quotas do not cross over, failing to play the role of a coordination device.

We now move to the regression analysis. We report in Table 6 the results of the estimations of Equation 3, which was preregistered, together with the same model estimated separately by type, to gain additional insights. The coefficients for the three treatments are not different from zero. Since they identified the differences among the treatments in Blocks 1-3, before introducing the voting stage, it seems that randomization was also successful at the type level. The effect of introducing a voting stage in *Democracy* is statistically significant: on average, normalized extraction increases by 21.5pp as a result of the introduction of the voting system. All types increase their normalized extraction: the Rich by 17.5pp, the Middle type by 25.5pp, and the Poor by 21.8pp. The increase in normalized extraction under *Demarchy* is not statistically different from the one under *Democracy*. Instead, under *Ptochocracy*, normalized extraction increases by 4.2pp on top of what happens under *Democracy*, while under *Plutocracy* the normalized extraction is 3.6pp lower than under *Democracy*. The rich type drives the effect under *Ptochocracy* and the Middle type under *Plutocracy*.

The removal of the voting stage, corresponding to Block 7, increases normalized extraction by 21.3pp with respect to Blocks 1-3, and by 16.8pp, 24.6pp, and 22.7pp for the Rich, Middle, and Poor type. Since there are no quotas in this final block, this increase in extraction reveals a cooperation decay once quotas are removed, leading to more socially inefficient outcomes. The interaction terms of the final block variable with the treatment variables are non-significant, revealing that in all treatments (and for all player types), there is a consistent increase in extraction. This result suggests that removing quotas crowds-out cooperative behavior, regardless of who holds most votes under political inequality.

We run a set of additional regressions reported in Table A.2 to understand the role of the enforced quotas better. For each type, we include each maximum allowed extraction level as a categorical variable. It included two quotas, $q = 8$ and $q = 11$, and two endowment levels when quotas were non-binding, $q = 6$ (for the Poor type) and $q = 9$ (for the Middle type). The reference category is the most stringent quota, $q = 5$. For the Rich Type, with $q = 8$ and $q = 11$ the normalized extraction is reduced by 7.6 and 8.0pp, respectively. Similarly, for the Middle type, with $q = 8$ and $q = 9$, the normalized extraction is reduced by 9.9 and 8.0pp. Finally, for the Poor type, the quota $q = 6$ reduces the normalized extraction of 4.9pp. The exploration of differential effects of quotas between treatments (columns 2, 4, and 6 in Table A.2) does not appear to yield significant statistical differences. The only exception is that Rich types increase their normalized extraction when $q = 11$ is set in non democratic treatments.

In conclusion, the voting stage increases the *normalized* extraction level as all player types move closer to their maximum allowed extraction (by about 22pp, on average). This is the joint result of the introduction of the quotas and the response to the new constraints. The additional regression exercise, reported in the Appendix, reveals that more stringent quotas drive the normalized extraction levels upward.

3.4 Quotas and absolute individual extraction

The analysis of normalized extraction revealed that the introduction of quotas induced less cooperative behavior: as the quotas restricted their maximum extraction, they tended

Table 6: Dependent Variable: normalized extraction

VARIABLES	(1) All types	(2) Rich type	(3) Middle Type	(4) Poor Type
Demarchy	-0.0133 (0.0332)	-0.0704 (0.0647)	0.0414 (0.0614)	-0.00974 (0.0415)
Ptochocracy	-0.0136 (0.0332)	-0.101 (0.0638)	0.0643 (0.0624)	6.81e-05 (0.0415)
Plutocracy	0.00435 (0.0334)	-0.0910 (0.0638)	0.0901 (0.0614)	0.0234 (0.0428)
Voting Stage	0.215*** (0.0252)	0.175*** (0.0423)	0.255*** (0.0442)	0.218*** (0.0445)
Demarchy $\times$ Voting Stage	-0.0102 (0.0205)	-0.00111 (0.0349)	-0.0520 (0.0359)	0.0210 (0.0360)
Ptochocracy $\times$ Voting Stage	0.0420** (0.0205)	0.0973*** (0.0344)	-0.00118 (0.0365)	0.0256 (0.0360)
Plutocracy $\times$ Voting Stage	-0.0361* (0.0206)	0.00209 (0.0343)	-0.0780** (0.0359)	-0.0344 (0.0371)
Final Block	0.213*** (0.0281)	0.168*** (0.0472)	0.246*** (0.0493)	0.227*** (0.0499)
Demarchy $\times$ Final Block	-0.0245 (0.0290)	-0.0354 (0.0493)	-0.0436 (0.0507)	0.00300 (0.0509)
Ptochocracy $\times$ Final Block	0.00321 (0.0290)	0.0345 (0.0486)	-0.0267 (0.0515)	-0.000272 (0.0509)
Plutocracy $\times$ Final Block	-0.0155 (0.0291)	0.0216 (0.0486)	-0.0704 (0.0507)	0.00278 (0.0525)
Constant	0.660*** (0.0276)	0.740*** (0.0513)	0.593*** (0.0504)	0.643*** (0.0393)
Observations	4,261	1,490	1,406	1,365

Random effects model. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 7: Dependent variable: absolute extraction by type

VARIABLES	(1) Rich type	(2) Middle type	(3) Poor type
Demarchy	-0.394 (0.452)	0.173 (0.414)	0.0761 (0.277)
Ptochocracy	0.0139 (0.447)	0.349 (0.422)	0.0778 (0.277)
Plutocracy	-0.523 (0.449)	0.165 (0.416)	-0.0478 (0.286)
Max.Extraction = 11	4.382*** (0.220)		
Max.Extraction = 9		2.736*** (0.217)	
Max.Extraction = 8	1.948*** (0.204)	1.809*** (0.202)	
Max.Extraction = 6			0.606*** (0.110)
Constant	4.199*** (0.345)	3.824*** (0.324)	4.334*** (0.216)
Observations	638	602	585

OLS with random effects. Block fixed effects added to all models.

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

to increase the extracted share. As the net effect on efficiency depends on the actual quota, we complement our previous analysis with an additional exercise, by player type, introducing categorical variables for the different maximum extraction levels. Since the quotas are endogenously determined, these results must be interpreted with caution. Nonetheless, they are informative on how participants react to a less stringent quota: given an increase of κ units in the maximum allowed extraction, how many additional units are on average taken.

In Table 7, we present the estimation by OLS of a model for the individual extraction, for each player type, using the decisions from Blocks 4-6. As highlighted earlier, we do not observe differences between treatments, even when we run separate regressions by player type. We now focus on the effects of the maximum extraction levels. Recall that the base category is a maximum extraction of 5 units, imposed by $q = 5$. Since there are no treatment differences, the average extraction, in this case, is 4.2, 3.8, and 4.3 for the Rich, Middle, and Poor types, respectively. That is an extraction of roughly 80 percent of the maximum allowed level.

We will now describe the coefficients when increasing the maximum allowed extraction, having as reference the most stringent case of $q = 5$. We see that, generally, the extraction increases by two-thirds of each additional unit of released constraint. For the Rich type, when the quota is set at $q = 11$, the increase in extraction is 4.4 out of the six additional units (0.73 units per allowed extra unit). When the quota is set at $q = 8$, the increase in extraction is 2 out of the three additional units (0.66 units per allowed extra unit). For the Middle type, when the quota is set at $q = 11$ and this player is limited by her endowment, the increase in extraction is 2.7 out of the four additional units (0.68 units per allowed extra unit). When the quota is set at $q = 8$, the increase in extraction is 1.8 out of the three additional units (0.60 units per allowed extra unit). Finally, in the case of the Poor type, when the quota is either $q = 11$ or $q = 8$, this player is limited by her endowment. On average, she extracts 0.6 from the allowed extra unit.

We also performed an additional exercise with the absolute extraction but taking into account the three types of blocks in our experiment. Again, we use the difference-in-differences approach exploiting the between-treatments variation in political inequality and the within-treatment variation in blocks before, during, and after the voting institution.

Table A.3 documents the lack of pre-trends in absolute extraction across treatments before the voting stage (as expected under random assignment); additionally, the table shows the crowding-out of cooperative behavior, once the quotas have been removed, after the voting stage. Nonetheless, during the voting stage, the coefficients are less telling: the coefficient for the voting stage dummy, capturing the average extraction under *Democracy*, is negative for the Rich type and positive for the Middle and Poor types. This result captures the effect of quotas, which are more stringent for the Rich type. We also observe that for the Rich type, the *Plutocracy* treatment has a positive and significant coefficient, and it reaches almost the same magnitude as the coefficient for the voting stage. In other words, the Rich type is restricted by the voting institution but is released if she benefits from political inequality to set the largest quota. An additional result is that, under *Ptochocracy*, the Middle type reduces her extraction level. This result is driven by the lower quotas adopted when the political power is in the hands of the Poor type.

3.5 Unexpected quotas

According to the Nash equilibrium predictions, under unequal political power, one would expect $q = 11$ under *Plutocracy*, $q = 8$ under *Demarchy*, and $q = 5$ under *Ptochocracy*. Any outcome in which the established quota differs from the expected quota is a shock to the minoritarian types and is randomly administered. These shocks can be used to identify the response of extraction to quotas for a given procedure. In other words, whereas the effect of the political system is a joint response to the procedural (un)fairness and to the fact that under certain rules one is expecting a particular policy, the shocks provide a *natural experiment* to identify how the extraction reacts to quota, *ceteris paribus*.

We estimate a model explaining the normalized extraction during the voting stage with two types of shocks, the player types and the interaction terms between these variables. Negative shocks correspond to scenarios where the implemented quota falls below the expected quota, given the type holding the political power. That is, $q = 5$ under *Demarchy*, and $q = 5$ or $q = 8$ under *Plutocracy*. Positive shocks correspond to scenarios where the implemented quota is above the expected quota, given the type holding the political power. That is, $q = 11$ under *Demarchy*, and $q = 8$ or $q = 11$ under *Ptochocracy*. We use as reference type the Middle type, allowing us to interpret the interaction terms as the additional effect that a given type of shock has for the Rich and Poor types.

Table 8 reports the results when pooling the treatments and separately for each one. The negative shock reduces in 7.6pp the normalized extraction for the Middle types, though this effect is driven by the *Demarchy* treatment (−10.8pp). Nonetheless, Middle types possess the political power under this treatment, meaning that the reduction in extraction might be their own decision regarding the quota rather than the response to a shock. By contrast, in the *Demarchy* treatment, the Rich and Poor types raise their normalized extraction by 13.7pp and 18.9pp, respectively. On the other hand, the positive shock does not have a statistically significant effect when pooling all the treatments. However, this shock reduces

Table 8: OLS model explaining normalized extraction in presence of a shock

VARIABLES	(1) All treatments	(2) Demarchy	(3) Ptochocracy	(4) Plutocracy
Negative shock	-0.0764*** (0.0288)	-0.108** (0.0511)		-0.000956 (0.0412)
Negative shock $\times$ Rich	0.0417 (0.0398)	0.137* (0.0709)		-0.0308 (0.0569)
Negative shock $\times$ Poor	0.111*** (0.0410)	0.189*** (0.0719)		0.0541 (0.0596)
Positive shock	-0.0181 (0.0314)	0.0244 (0.0575)	-0.0824** (0.0396)	
Positive shock $\times$ Rich	0.0404 (0.0444)	-0.0159 (0.0839)	0.0839 (0.0545)	
Positive shock $\times$ Poor	-0.0178 (0.0441)	-0.0493 (0.0811)	0.00383 (0.0548)	
Rich type	-0.0454** (0.0226)	-0.0492 (0.0450)	-0.0587* (0.0341)	-0.0359 (0.0381)
Poor type	0.0247 (0.0232)	0.0359 (0.0454)	0.0145 (0.0346)	0.0156 (0.0399)
Constant	0.802*** (0.0258)	0.793*** (0.0493)	0.829*** (0.0397)	0.771*** (0.0443)
Observations	1,362	459	453	450
R-squared	0.033	0.054	0.048	0.066

Added controls: round fixed effects. Standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

normalized extraction by 8.2pp in the *Ptochocracy* treatment for the Middle types.

Summing up, quotas larger than expected (i.e., positive shocks) tend to have very little effect, whereas quotas smaller than expected (i.e., negative shocks) might increase normalized extraction. This is true under *Demarchy*, the only treatment where shocks might occur in both directions, and for the player types representing minority's vote shares. As we mentioned before, the analysis is more convoluted for the player type holding the majority of votes. For this player type, a quota different from the expected might be the result of her own decision to deviate from the selfish predictions. In this line, the effect of the negative shock under *Demarchy* is probably due to some Middle type participants voting for the lowest quota and then becoming more cooperative.

4 Discussion

A first issue to explore is why participants deviate from the predicted vote for the self-interested quota. We find that Poor types voted for $q = 5$ about 63% of the times, Middle types voted for $q = 8$ about 44% of the times, and Rich types voted for $q = 11$ about 52% of the times. Environmental concerns and reciprocity can account for voting for quotas below those predicted under selfish preferences. On the opposite, voting for quotas above the selfish predictions can be explained by myopic self-interest: the participants fail to realize that the benefit from constraining the other group members exceeds the cost of reducing their own allowed extraction level.

We run an additional regression analysis to explore the role of environmental concerns and reciprocity. We employ the New Ecological Paradigm-NEP scale to measure environmental concerns (Stern et al., 1995). The NEP scale consists of 15 questions on a Likert scale from 1 to 5. To build the NEP score of each participant, we first revert the scale for the even questions and then sum the values across all questions. In the regressions, we employ the standardized value of the NEP score.

To construct our indicator of reciprocity, we first compute the difference in extraction between two consecutive rounds in Blocks 1 to 3: we define this value as Δx . We then take the absolute value of Δx multiplied by the difference between the lagged group extraction and the average group extraction in Blocks 1 to 3.³ That is,

$$Reciprocity_{it} = \Delta x \cdot |X_{t-1} - \bar{X}_{Blocks1-3}|$$

A large Δx indicates a considerable difference in individual extraction between rounds. A large $|X_{t-1} - \bar{X}_{Blocks1-3}|$ reveals that the group's lagged extraction is particularly high—or low—with respect to the average group's extraction. Hence, our reciprocity measure becomes larger when, at the same time, extraction increases across rounds and the group deviates from its average (i.e., when there is an individual reaction to the group's deviation).

Since the NEP score does not vary between rounds, only between participants, we also aggregate the reciprocity measure at the participant level by averaging the values of the last two rounds from Blocks 1 to 3. Similarly, for the dependent variable, we aggregate the preferences for a given quota by computing the median quota for which each participant voted in rounds 10, 13, and 16.

Table 9 reports the results for the OLS regressions explaining the choice of a quota based on the reciprocity measure and the standardized NEP score. Note that there is a negative correlation between reciprocity and the voted quota, while we do not observe any correlation between our measure of environmental concerns and the voted quota. In the second regression, we add the treatments and player types as covariates, increasing the statistical significance and doubling the size of the coefficient for reciprocity. This correlation suggests that participants who were more reactive to their group's aggregate extraction in Blocks 1 to 3 aimed to set lower quotas, putting their groups closer to the social optimum by restricting the maximum negative externality.

³Since we use the lagged extraction within the first three blocks, we excluded from the computation of the average group extraction rounds 3, 6, and 9.

Table 9: OLS model explaining the preferred quota (i.e., modal vote) per participant

VARIABLES	(1)		(2)	
Reciprocity measure	-0.0272*	(0.0143)	-0.0404***	(0.0131)
NEP score (standardized)	-0.0458	(0.170)	-0.0367	(0.152)
Demarchy			-0.0714	(0.432)
Ptochocracy			-0.202	(0.434)
Plutocracy			0.600	(0.431)
Middle Type			-1.594***	(0.370)
Poor Type			-2.678***	(0.373)
Constant	7.900***	(0.208)	9.312***	(0.407)
Observations	202		202	
R-squared	0.018		0.241	

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Coming back to the participants that voted for quotas above the selfish prediction, we provide two non-mutually exclusive explanations. First, following Velez et al. (2012), it may simply reflect voters' preferences against stricter restrictions in CPR management. Second, it may reflect myopic overlooking of equilibrium effects at the time of voting. Dal Bó et al. (2018) present evidence of participants of a lab experiment that voted to play a Prisoner's Dilemma instead of playing the "Harmony game," where cooperation was the dominant strategy. Dal Bó et al. (2018) point out that participants vote by being focused on how the Harmony game lowers the payoffs for all outcomes, but they neglect that the equilibrium outcome in this game is better off than the mutual defection in the Prisoner's Dilemma. We thus conjecture that our participants may have voted for larger quotas because they underappreciate how the restriction imposed on others dominates the restriction imposed on themselves - perhaps combined with an intrinsic preference against strict quota enforcement.

The second issue to explore is the lack of differences in extraction between treatments with political inequality. An unexpected result is that, although the quotas 5, 8, and 11 were more frequently selected under *Ptochocracy*, *Demarchy*, and *Plutocracy*, respectively, the differences in aggregate extraction levels between treatments were negligible. At least three factors may account for this result. First, Table 1 shows that unpredicted quotas occurred between one-third and half of the time. Moreover, the distribution of quotas under *Democracy* is the closest to an uniform distribution⁴, reducing the chance of finding differences between treatments when comparing *Ptochocracy*, *Demarchy*, and *Plutocracy* to the baseline. The reason is that this baseline treatment is sufficiently closer to each one of the treatments introducing political inequality. Second, although we have heterogeneity in endowments, higher quotas have diminishing release effects. Maximum extraction goes from 15 to 22 when q goes from 5 to 8, and 26 when q reaches 11. Therefore, the total increase

⁴Although a Kolmogorov-Smirnov test rejects that the proportion of 39%, 35%, 26% for the three quota levels is uniform. D statistic is 0.9096, yielding a p -value below 0.001.

in extraction makes it harder to detect differences between the treatments associated with the larger quotas. Third, as shown in Table 5, participants never extract at full capacity, as normalized extraction ranges between 77 and 91 percent. This behavior occurs regardless of the chosen quota.

Finally, a skeptic reader might wonder if our results are driven by the online environment where the experiment took place. Based on existing evidence, we argue that this is not the case. Previous research reveals that cooperativeness in online environments is similar to the levels in the lab, either in one-shot games (Horton et al., 2011) or in repeated games with punishment (Arechar et al., 2018). Hence, the observed levels of cooperation in our experiment are not driven by the online environment.

On a related note, Boas et al. (2020) argue that professional incentives play an essential role when promoting attention in an online environment. By sampling participants from the subject pool of lab studies, the professional incentives are salient.

5 Conclusions

We designed and conducted an online lab experiment to understand how political inequality affects cooperation in the management of a CPR in the presence of economic inequality. Previous research concluded that economic inequality could be overcome to the extent that well-endowed participants have an opportunity to redistribute. In our case, the best opportunity to redistribute was voting for the lowest quota, forcing themselves to reduce the maximum negative externality that could be exerted on others. In the case of *Demarchy* and *Plutocracy*, where the Middle and the Rich types have the higher chances to impose their preferred quota, there is a tension between the collective incentives of imposing a lower quota and the individual incentives of imposing the quota closest to their endowment.

We find that individual incentives dominate the voting decisions: all player types vote more frequently—between half and two-thirds of the time—for the predicted quota under selfish preferences. This decision is accompanied by an average extraction of roughly eighty percent of the maximum, yielding no differences between treatments in normalized or aggregate extraction.

Despite the lack of differences between treatments, two important results are common to all configurations of political inequality that are worth mentioning. First, more reciprocal participants, measured with how they react to their group’s extraction in the first three blocks (i.e., without quotas), tend to vote for lower quotas. Hence, for some participants is clear that restricting the extraction of all participants, particularly for the Middle and Rich types, can yield more socially desired outcomes. Second, quotas do not cross over. Once the quotas are removed in the last block, there is an increase in extraction in all player types.

Although we do not find differences between treatments, there are two extensions to our design that might shed further light on the role of political inequality. First, by adding imperfect monitoring to the established quota—and sanctions in case of quota violations—we might observe differences in compliance across treatments. For instance, player types with a minority of votes might comply less, denouncing the lack of legitimacy of non-democratic decisions. Second, the roles—or endowments—might be assigned based on a previous real-effort task or based on a questionnaire revealing environmental behavior (e.g., the participant’s

carbon footprint). This variation might create a sense of entitlements, increasing the likelihood of voting for the selfishly preferred quota and raising extraction to the maximum allowed level.

References

- Andreoni, J. (1995). Warm-glow versus cold-prickle: the effects of positive and negative framing on cooperation in experiments. Quarterly Journal of Economics, 110(1):1–21.
- Arechar, A. A., Gächter, S., and Molleman, L. (2018). Conducting interactive experiments online. Experimental Economics, 21(1):99–131.
- Baland, J.-M. and Platteau, J.-P. (1999). The ambiguous impact of inequality on local resource management. World Development, 27(5):773–788.
- Boas, T. C., Christenson, D. P., and Glick, D. M. (2020). Recruiting large online samples in the united states and india: Facebook, mechanical turk, and qualtrics. Political Science Research and Methods, 8(2):232–250.
- Bohringer, C. (2002). Climate politics from kyoto to bonn: from little to nothing? Energy Journal, 23(2).
- Cardenas, J.-C. (2003). Real wealth and experimental cooperation: experiments in the field lab. Journal of Development Economics, 70(2):263–289.
- Cardenas, J. C., Stranlund, J., and Willis, C. (2000). Local environmental control and institutional crowding-out. World Development, 28(10):1719–1733.
- Chen, D. L., Schonger, M., and Wickens, C. (2016). otree—an open-source platform for laboratory, online, and field experiments. Journal of Behavioral and Experimental Finance, 9:88–97.
- Cherry, T. L., Kroll, S., and Shogren, J. F. (2005). The impact of endowment heterogeneity and origin on public good contributions: evidence from the lab. Journal of Economic Behavior & Organization, 57(3):357–365.
- Cole, M. A., Rayner, A. J., and Bates, J. M. (1997). The environmental kuznets curve: an empirical analysis. Environment and Development Economics, 2(4):401–416.
- Dal Bó, E., Dal Bó, P., and Eyster, E. (2018). The demand for bad policy when voters underappreciate equilibrium effects. Review of Economic Studies, 85(2):964–998.
- Dasgupta, S., Laplante, B., Wang, H., and Wheeler, D. (2002). Confronting the environmental kuznets curve. Journal of Economic Perspectives, 16(1):147–168.
- Hackett, S., Schlager, E., and Walker, J. (1994). The role of communication in resolving commons dilemmas: experimental evidence with heterogeneous appropriators. Journal of Environmental Economics and Management, 27(2):99–126.

- Hayo, B. and Vollan, B. (2012). Group interaction, heterogeneity, rules, and co-operative behaviour: Evidence from a common-pool resource experiment in south africa and namibia. Journal of Economic Behavior & Organization, 81(1):9–28.
- Heckathorn, D. D. (1993). Collective action and group heterogeneity: voluntary provision versus selective incentives. American Sociological Review, pages 329–350.
- Horton, J. J., Rand, D. G., and Zeckhauser, R. J. (2011). The online laboratory: Conducting experiments in a real labor market. Experimental Economics, 14(3):399–425.
- Johansson-Stenman, O. and Konow, J. (2010). Fair air: distributive justice and environmental economics. Environmental and Resource Economics, 46(2):147–166.
- Kesternich, M., Lange, A., and Sturm, B. (2014). The impact of burden sharing rules on the voluntary provision of public goods. Journal of Economic Behavior & Organization, 105:107–123.
- Kesternich, M., Löschel, A., and Ziegler, A. (2021). Negotiating weights for burden sharing rules in international climate negotiations: an empirical analysis. Environmental Economics and Policy Studies, 23(2):309–331.
- Kocher, M. G., Martinsson, P., Persson, E., and Wang, X. (2016). Is there a hidden cost of imposing a minimum contribution level for public good contributions? Journal of Economic Psychology, 56:74–84.
- Margreiter, M., Sutter, M., and Dittrich, D. (2005). Individual and collective choice and voting in common pool resource problem with heterogeneous actors. Environmental and Resource Economics, 32(2):241–271.
- Maxwell, J. and Briscoe, F. (1997). There’s money in the air: the cfc ban and dupont’s regulatory strategy. Business Strategy and the Environment, 6(5):276–286.
- Olson, M. (1989). Collective action. In The Invisible Hand, pages 61–69. Springer.
- Stern, D. I. (2004). The rise and fall of the environmental kuznets curve. World Development, 32(8):1419–1439.
- Stern, P. C., Dietz, T., and Guagnano, G. A. (1995). The new ecological paradigm in social-psychological context. Environment and Behavior, 27(6):723–743.
- Tavoni, A., Dannenberg, A., Kallis, G., and Löschel, A. (2011). Inequality, communication, and the avoidance of disastrous climate change in a public goods game. Proceedings of the National Academy of Sciences, 108(29):11825–11829.
- Vedeld, T. (2000). Village politics: Heterogeneity, leadership and collective action. Journal of Development Studies, 36(5):105–134.
- Velez, M. A., Stranlund, J. K., and Murphy, J. J. (2012). Preferences for government enforcement of a common pool harvest quota: Theory and experimental evidence from fishing communities in colombia. Ecological Economics, 77:185–192.

- 635 Volla, B. (2008). Socio-ecological explanations for crowding-out effects from economic field
636 experiments in southern africa. Ecological Economics, 67(4):560–573.
- 637 Zizzo, D. J. (2010). Experimenter demand effects in economic experiments. Experimental
638 Economics, 13(1):75–98.

A Appendix

A.1 Additional Tables

Table A.1: Dependent Variable: Group extraction

VARIABLES	(1)	(2)
Demarchy	-0.0292 (0.535)	0.211 (0.922)
Ptochocracy	-0.891 (0.543)	-0.181 (0.935)
Plutocracy	0.577 (0.542)	-0.496 (0.935)
Block 5	0.995** (0.469)	0.491 (0.922)
Block 6	1.681*** (0.470)	2.105** (0.922)
Demarchy $\times$ Block 5		0.789 (1.304)
Demarchy $\times$ Block 6		-1.509 (1.304)
Ptochocracy $\times$ Block 5		-1.288 (1.322)
Ptochocracy $\times$ Block 6		-0.837 (1.325)
Plutocracy $\times$ Block 5		2.527* (1.322)
Plutocracy $\times$ Block 6		0.691 (1.322)
Constant	15.38*** (0.465)	15.40*** (0.652)
Round Fixed Effects		
Observations	665	665
R-squared	0.030	0.047

OLS. Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Table A.2: OLS model for normalized extraction with max. extraction levels as covariates

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	Rich Type		Middle Type		Poor Type	
Demarchy	-0.0676 (0.0628)	-0.142* (0.0770)	-0.00127 (0.0628)	-0.0709 (0.0771)	0.0163 (0.0487)	0.0257 (0.0605)
Ptochocracy	-0.0214 (0.0620)	-0.0691 (0.0709)	0.0470 (0.0638)	0.0179 (0.0713)	0.0162 (0.0488)	0.0446 (0.0552)
Plutocracy	-0.0779 (0.0622)	-0.145* (0.0784)	0.0188 (0.0630)	-0.0107 (0.0776)	-0.00362 (0.0503)	0.0423 (0.0633)
Max.Extraction = 8	-0.0764*** (0.0259)	-0.132*** (0.0463)	-0.0996*** (0.0277)	-0.118** (0.0506)		
Max.Extraction = 11	-0.0803*** (0.0279)	-0.175*** (0.0499)				
Max.Extraction = 9			-0.0802*** (0.0298)	-0.154*** (0.0523)		
Max.Extraction = 6					-0.0494** (0.0194)	-0.0158 (0.0350)
Demarchy $\times$ Max.Extraction = 8		0.124* (0.0691)		0.0946 (0.0755)		
Demarchy $\times$ Max.Extraction = 11		0.0765 (0.0860)				
Demarchy $\times$ Max.Extraction = 9				0.103 (0.0923)		
Demarchy $\times$ Max.Extraction = 6						-0.0186 (0.0547)
Ptochocracy $\times$ Max.Extraction = 8		0.00760 (0.0704)		0.00991 (0.0752)		
Ptochocracy $\times$ Max.Extraction = 11		0.182** (0.0746)				
Ptochocracy $\times$ Max.Extraction = 9				0.0976 (0.0810)		
Ptochocracy $\times$ Max.Extraction = 6						-0.0562 (0.0512)
Plutocracy $\times$ Max.Extraction = 8		0.0804 (0.0768)		-0.0670 (0.0826)		
Plutocracy $\times$ Max.Extraction = 11		0.127* (0.0732)				
Plutocracy $\times$ Max.Extraction = 9				0.105 (0.0765)		
Plutocracy $\times$ Max.Extraction = 6						-0.0694 (0.0559)
Constant	0.862*** (0.0473)	0.908*** (0.0535)	0.812*** (0.0482)	0.842*** (0.0533)	0.870*** (0.0379)	0.850*** (0.0422)
Observations	638	638	602	602	585	585

Added control: Block fixed effects. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.3: OLS model with random effects for absolute extraction by player type

VARIABLES	(1) All types	(2) Rich type	(3) Middle Type	(4) Poor Type
Demarchy	-0.272 (0.394)	-0.845 (0.730)	0.373 (0.532)	-0.0584 (0.237)
Ptochocracy	-0.275 (0.394)	-1.210* (0.720)	0.579 (0.540)	0.000408 (0.237)
Plutocracy	-0.0315 (0.396)	-1.093 (0.720)	0.810 (0.532)	0.140 (0.244)
Voting Stage	-0.108 (0.237)	-1.815*** (0.479)	0.686* (0.387)	0.981*** (0.265)
Demarchy $\times$ Voting Stage	0.207 (0.194)	0.358 (0.395)	-0.131 (0.314)	0.197 (0.214)
Ptochocracy $\times$ Voting Stage	-0.0241 (0.194)	0.554 (0.389)	-0.712** (0.320)	-0.0384 (0.214)
Plutocracy $\times$ Voting Stage	0.431** (0.195)	1.543*** (0.389)	-0.196 (0.314)	-0.0972 (0.221)
Final Block	1.874*** (0.265)	2.016*** (0.534)	2.213*** (0.432)	1.361*** (0.296)
Demarchy $\times$ Final Block	-0.270 (0.274)	-0.425 (0.558)	-0.392 (0.445)	0.0180 (0.303)
Ptochocracy $\times$ Final Block	0.0588 (0.274)	0.414 (0.550)	-0.241 (0.451)	-0.00163 (0.303)
Plutocracy $\times$ Final Block	-0.112 (0.275)	0.259 (0.550)	-0.634 (0.445)	0.0167 (0.312)
Constant	6.125*** (0.311)	8.885*** (0.579)	5.338*** (0.438)	3.860*** (0.228)
Observations	4,261	1,490	1,406	1,365
Number of id	203	71	67	65

Added control: Round fixed effects. Standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$