



Economic incentives and political inequality in the management of environmental public goods[☆]

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ABSTRACT

We study how the allocation of power in a voting procedure affects the regulation and extraction of environmental public goods. In an appropriation game experiment, different endowments induce heterogeneous preferences among the three group members regarding their preferred quota, aimed at increasing social efficiency by restricting aggregate extraction. The players vote by submitting a proposal; one among the submitted proposals is implemented, selected at random, but across treatments, we vary the odds that a type sets the regulation.

Participants vote for their selfishly preferred quota between half and two-thirds of the time. Although setting quotas decreased aggregate extraction by roughly 10%, we do not find differences between treatments. Once quotas are removed, extraction rises back to inefficient levels. Our results suggest that, although participants are reciprocal, they neglect the positive equilibrium effects of a stricter regulation.

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. Differences in economic interests and capabilities lead to heterogeneous costs and benefits from regulation (Heckathorn, 1993). Even if nominally invoking the principle of fairness, different actors support strikingly dissimilar burden-sharing rules (Johansson-Stenman & Konow, 2010; Kesternich et al., 2021). Differences in political power threaten the legitimacy of rules and agreements (Vollan, 2008), and eventually hamper compliance. In the domain of resource management, communities often achieved more socially desirable outcomes when they crafted their own rules rather than having to comply with externally imposed regulation (Ostrom, 2006).

Political inequality is not necessarily detrimental to the bargaining and implementation of environmental agreements, nor guarantees its success. Compare, for instance, the role of the United States in 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 & Briscoe, 1997). In the latter, the withdrawal of the United States significantly reduced the effectiveness of the Kyoto protocol and its climate change mitigation efforts (Bohringer, 2002). Hence, political inequality can reduce bargaining costs and fast-track potential agreements, but it can also hamper legitimacy among the other actors. Thinking of lobbying as an example of political inequality, it is more likely to produce regulations that reflect private interests than technically informed decisions (Potter, 2002).

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Two questions emerge. First, what environmental regulation do political and economic inequalities produce? Second, how do people respond to the rules issued under unequal power and does it matter for welfare?

We answer these questions in an online lab experiment. Experiments allow manipulating economic and political inequality controlling for other factors. Case studies or happenstance data usually fail to account for confounding factors shaping regulation, levels of inequality and degree of political influence.¹

In our experiment, we randomly form groups of three participants that independently 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. Whereas the economic inequality is given by three player “types” and is always the same, we randomly vary which type holds more political power. Hence, we can study how the alignment between economic incentives and a higher likelihood to set environmental regulation affects the extraction patterns from the common resource.

Players differ in their endowment, creating heterogeneous production capacities. Each group comprises a “Rich”, a “Middle class”, and a “Poor” member. In the first part of the experiment, players choose their extraction level under the constraint of their endowment. In the second part, participants vote for an environmental regulation, a quota, selected through a random dictator mechanism. There are three possible quota levels. If players have selfish preferences, they will rationally choose the quota level closer to the endowment (exactly one unit below). Since in each treatment there is a type more likely to set the regulation, we can study (i) whether participants use their political power to set their selfishly preferred quota (which we will call hereafter the *SP-quota* for brevity), and (ii) whether the way in which a rule is decreed changes resource extraction patterns (and ultimately, welfare).

In a baseline treatment, which we call *Democracy*, vote ballots are equally allocated across players. In the other treatments, one of the players faces increasing prospects to decide what quota will be set (i.e., a 7/9 chance), whereas the other two players get a smaller chance to set this regulation (1/9 each). We thus have a *Plutocracy* treatment, where the choice of the Rich type is more likely to be selected; a *Demarchy*² treatment, where the most likely choice corresponds to the Middle type; and a *Ptochocracy* treatment, where the choice of the Poor type is the most likely.

By means of our design, we can also test whether participants would behave according to the Nash equilibrium, choose the *SP-quota* and maximize their restricted extraction level, or think as a group (Bacharach, 1999; Sugden, 1993) and achieve more socially-desirable outcomes. Two behavioral mechanisms may support this alternative hypothesis. First, as Freeman and Anderson (2017) point out, more stringent regulation levels can lead to coordination in more socially-desirable outcomes. Hence, participants may correctly anticipate that voting for the lowest quota can be interpreted as an intention to cooperate (i.e., lower resource extraction). Second, participants may perceive the quota outcome from *Democracy* as more legitimate given their equal weights in the decision. This legitimacy may spur attention

¹ Regarding this type of evidence, Vedeld (2000) studied the Fulani agropastoralists in the Niger Delta and reported that political inequality dampens collective action when there is a divergence of economic interests among the elite. Cross-country evidence on the relationship between economic and political inequality is typical of the literature on the Environmental Kuznets Curve, which uses the income gradient within or between countries to assess the impact of better economic conditions on the sensibility towards the environment (Cole et al., 1997; Dasgupta et al., 2002; Stern, 2004).

² We apply this label to our treatment with a bit of abuse of the actual meaning of demarchy, a government system where officials are randomly selected from a predefined pool. This description fits our treatment well if one considers a society where the middle class represents a large majority.

towards collective goals (Spruyt et al., 2016) and favor cooperative outcomes.

Our findings fall between these predictions: participants chose their *SP-quota* between half and two-thirds of the time, whereas the extraction ranges between 75 and 85 percent of the maximum allowed. This result is puzzling because participants that vote like rational self-interested players do not necessarily harvest like ones. Moreover, we find that aggregate extraction does not diverge across treatments. With these results, we tentatively respond to our initial questions as follows: environmental regulations *partially* reflect political inequalities, but allocating this political power to the party that, by pure self-interest, should limit extraction (and thus reduce the maximum negative externality) seems insufficient to obtain more efficiency-enhancing outcomes.

Our results contribute to the existing experimental literature on inequality, voting, and social dilemmas. Economic disparities decrease cooperation in resource dilemmas (Cardenas, 2003; Hayo & 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 by allowing richer agents to signal their intention to redistribute. Burden-sharing rules based on agreeing on the maximum allowed extraction (or the minimum contribution) improve efficiency with respect to the standard voluntary contribution mechanism (Kesternich et al., 2014). Margreiter et al. (2005) allows each player to propose a vector of extractions, yielding implementation if it is chosen by simple majority (otherwise, they choose their extraction levels in a decentralized manner). With homogeneous groups, voting leads to socially enhancing outcomes. By contrast, heterogeneous groups are less likely to approve proposals due to the variety of individually preferred extraction vectors.

We find that voting institutions introducing quotas have a limited added value beyond the mechanical effect of stricter constraints. Our novelty is to show that the unequal allocation of political power does not aggravate the problem. We do not find that *Democracy* promotes more socially desirable allocations compared to systems with political inequality (i.e., there is no effect of leveling up the likelihood of setting the quota across players). Nor do we find that giving more political power to the player type whose *SP-quota* is more restrictive, which may lead to a mechanical reduction of the total negative externality, reduces the aggregate extraction. This contrasts to Olson’s (1989) idea that collective action can be propelled in unequal environments if the holder of more power is more disproportionately affected.

If we interpret our unequal political power as lobbying capacity, our results also speak to Freeman and Anderson’s (2017) study of competitive lobbying over common-pool resource (CPR) regulation. Their main result is that CRP harvesters are willing to pay from their earnings to reduce the quota (or extraction cap), but the payments are insufficient to reach efficiency because free-riders benefit twice from not lobbying: they spend less than their counterparts, and their extraction capacity is less constrained. We show that, even if the political power is costless (i.e., participants do not need to spend resources on lobbying to reduce extraction caps), the aggregate extraction remains far from the socially-desirable outcome.

One last implication of our findings adds evidence to the experimental literature on how voters ignore equilibrium effects (Dal Bó et al., 2018). We argue that political power failed to enforce lower extraction patterns because participants paid more attention to how the stringent quotas restricted them, rather than to the general restriction imposed on all CPR users. Velez et al. (2012) show that when real users of common resources can vote for a high or a low penalty for non-complying to a quota, participants opt for the latter. As a consequence, the introduction of a quota did not increase efficiency. This complex effect of motivation is aggravated by crowding out. In our study, extraction increases once the voting procedure is removed. This

result goes against the hypothesis that quotas can serve as focal points for coordinating on efficiency-enhancing outcomes. Similarly, 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 expired in our experiment.

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, as the action causes a negative externality. Compared to public goods games with positive framing, cooperation tends to be lower (Andreoni, 1995; Khadjavi & Lange, 2015), leadership is less effective (Frackenkohl et al., 2016), and participants tend to focus more on the part of the endowment that they tend to keep (Dufwenberg et al., 2011; Van Dijk & Wilke, 2000). Based on these previous results, the negative framing suits better our aim to increase the notion of conflict between the $n = 3$ group members, as their endowment, or “extraction capacity”, differ. We thus have a “Rich” (R), a “Middle” (M), and a “Poor” (P) type per group. These roles are randomly assigned and maintained throughout the experiment.³ 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.

Let us introduce the game in its simplest form. 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 two projects, A and B. The former, A, is an extractive project with high individual returns (α_A per invested unit), which also causes a negative externality (β per unit). The latter, B, is an alternative project with low individual returns (α_B per invested 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 $x_i \in \{0, \dots, e_i\}$ as the number of tokens allocated to the extractive project A, the payoff for each participant $i = 1, \dots, n$ can be calculated as:

$$\pi_i = \alpha_A x_i + \alpha_B (e_i - x_i) - \beta \sum_{i=1}^n x_i, \quad \text{s.t. } x_i \leq e_i$$

As in the standard public game literature, it must hold that $\alpha_A - \beta > \alpha_B > \alpha_A - n\beta$. In our setting, we will set $\alpha_A = 17$, $\alpha_B = 5$, $\beta = 5$, and $n = 3$.

We now explain the game variation in which quotas may cap the maximum extraction level. In the first round of Blocks 4 to 6 (i.e., rounds 10, 13, and 16), the extraction phase is preceded by a voting phase. Here, each group member votes for a maximum level of extraction, or quota $q_j \in \{5, 8, 11\}$. The quota q is selected using the random dictator procedure (Kocher et al., 2016) and is kept for the block (i.e., for the three consecutive rounds with the same group members).

The quota q may alter the participant i 's action set. Let us define $\hat{x}_i \in \{0, \dots, \min\{e_i, q\}\}$ as the choice under the new constraint. Under quotas, the payoff becomes:

$$\pi_i = \alpha_A \hat{x}_i + \alpha_B (e_i - \hat{x}_i) - \beta \sum_{i=1}^n \hat{x}_i, \quad \text{s.t. } \hat{x}_i \leq \min\{e_i, q\} \quad (1)$$

Note that the selected quota q may impose different restrictions across player types. Take its less stringent value, $q = 11$. In this case,

³ In the instructions, the corresponding labels of the Rich, Middle, and Poor player types are “X”, “Y”, and “Z”, respectively.

only the Rich player is restricted because $e_P < e_M < q < e_R$. By contrast, the most stringent quota, $q = 5$, will restrict the extraction level of all players because $q < e_P < e_M < e_R$. This is why, assuming self-interested preferences, different player types may want to impose different values of q . With this in mind, we shift our attention to the quota selection procedure, where we exogenously vary the “influence” of each player type.

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, one type has seven ballots, and the other two 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.

At the beginning of the experiment, participants were informed of the three player types in each group and their endowments. They were also informed about the total number of blocks and rounds and were told that at the beginning of Block 4, an additional rule would be announced. They only learned their type after the general instructions and a comprehension test. After each round, participants receive feedback regarding their payoff and the group investment in the extractive project (i.e., the aggregate extraction). In the first round of 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. As we argued above, our framing with a negative externality may foster a climate of conflict between types, which is more suitable to study whether quotas dampen or heighten the tension.

Second, when voting, the choice set for quotas includes three options: 11, 8, and 5. Notice that these values correspond to each type's endowment minus one unit. In this way, the quota always constrains the extraction of at least one player type. Moreover, as quotas do not coincide with the endowment, there is no cognitive shortcut to select their maximum allowed extraction as the quota. Had the options on the ballot been the endowments, participants might have been cued to select their own. This would represent a form of research-induced bias, commonly referred to as experimenter demand effect. Although there are different ways to deal with experimenter demand (e.g., direct measurement, as discussed in de Quidt et al. (2018, 2019)), non-deceptive obfuscation is probably the most common solution (Zizzo, 2010). We followed the latter solution and removed the cue: participants would have been more likely to vote for the quota matching their endowment. As a result, (Poor and Middle type) players must decide whether they prefer a minimal constraint to reduce other players' options significantly or, instead, to avoid self-restraining at the expense of a potentially larger negative externality.

Third, the combination of fixed groups—within blocks—with group rematching—between blocks—allows measuring both the group dynamics of the social dilemma and multiple outcomes of the institutional arrangement of interest. In our case, we can study three voting outcomes (in Blocks 4 to 6) and the subsequent extraction behavior during three rounds within the chosen quota. The online environment requires shorter experiments, and we opted for 21 rounds after some piloting.

Since the standard practice in public goods games is to have multiple rounds to allow for learning and conditional reciprocity, we assumed that three rounds were the minimal span to produce such effects. By symmetry, we introduced three blocks with and without voting, plus a final block in which we removed the voting (and, therefore, the quota). This last block aims to test whether the restricted extraction levels may persist after participants experience their socially desirable effect, even if maximum extraction levels are no longer restricted.

All sessions took place on an online platform at Unbiased Lab at Universidad Nacional. 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 before the beginning of Block 4. We paid a standard show-up fee, and one randomly selected block. On average, participants received 19,067 COP.⁴

After block 7 (rounds 19–21), participants filled in a post-experimental questionnaire with socio-demographic questions, a module on attitudes towards the environment (New Ecological Paradigm — NEP, Stern et al., 1995), and a module that employs non-incentivized questions to measure reciprocity (Falk et al., 2018). The entire experimental protocol in English and Spanish can be found in the SOM. IRB approval has been obtained from the Universidad Nacional, and all participants provided 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. In the absence of a quota, participants maximize their payoffs by setting their extraction equal to their endowment ($x_i = e_i, \forall i \in \{R, M, P\}$). This prediction leads to an aggregate extraction of 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 the dominant strategy. The question is which quota is preferred by each player type.

Let us start with the Rich type. 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. With this explanation, we explicitly define our SP-quotas: 11, 8, and 5, for the Rich, Middle, and Poor types, respectively.

⁴ By the time in which the sessions took place, this amount was approximately 5.1 USD.

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 SP-quota, and zero otherwise. By session, we meant a trial (i.e., a complete execution of the experimental protocol). Each session is divided into blocks. We will estimate the following Linear Probability Model using the data from blocks four-to-six:

$$VoteQ_{isb}^* = \sum_k \theta_k T_i^k + v_b + \epsilon_{isb}, \tag{2}$$

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; v_b representing the block fixed effects, and ϵ_{isb} capturing the unobservables. Here, θ_k is the average impact of the treatment (the political system) on the outcome.

Under rational choice theory, $\theta_k = 0 \forall k$, since voting for the SP-quota is the dominant strategy, irrespective of the distribution of weights in the voting procedure. By contrast, the egalitarian character of *Democracy* might call for policies closer to the common good with respect to lobby-driven institutional systems, where private interests become more salient. Social psychology and the law have argued that citizens are more likely to abide by rules and defer to authorities that are legitimate (Tyler, 2006). Reversing an argument from the literature on populism, legitimacy increases the perceived political efficacy and spurs attention towards societal welfare (Spruyt et al., 2016). As a result, we test $\theta_k = 0$ against the alternative that $\theta_k > 0$ for the Rich and Middle types.⁵ We 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 $y_{isr} \in [0, 1]$. We define y_{isr} as 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 minimum value between the endowment and the quota gives the maximum feasible extraction. 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 Eq. (3). Note that our smaller unit of analysis becomes the round, differently from Eq. (2) where it was the block, because participants extract for three rounds within each block whereas they vote just once per block.

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

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 how the policy was chosen. Hence, to better understand which of the two effects drives the observed treatment effects (or lack

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

thereof), we conduct a third type of analysis exploiting a feature of our experimental design: instances in which minorities set the quotas may occur with a 2/9 chance, and participants do not know the distribution of individual votes. If political minorities expect the SP-quota of the political majority, deviations from this quota can be interpreted as “surprises” or shocks. We can explore whether the normalized extraction y_{isr} varies with unexpected deviations from the majority’s SP-quota. We estimate Eq. (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 estimate the causal effect of a shock on the type with political power, and γ estimates the differential response to the shock by minorities with respect to the political majority.

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. Types holding political power may 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 independent observations collected in 15 sessions. We had to drop two observations for an error in the recording of the votes. The distribution of participants between treatments goes as follows: 51 in *Ptochocracy*, 51 in *Demarchy*, 50 in *Plutocracy*, and 51 in *Democracy*. Participants are balanced by gender (51.5% women). In Colombia, households are ranked socio-demographically on a scale from one to six (six being the richest) according to the characteristics of the house and the surroundings. This measure is used to compute the water, electricity, and gas bills (Bogliacino et al., 2018). In our sample, we have participants belonging to the six strata, but the large majority is classified as two (28.6%) and three (44.3%). Ninety percent of the participants have taken part in at least one experiment before, and 21% come from Economics, Business, and Accountancy undergraduate programs. Being university students, participants are aged 18–24.

3.1. Quotas and voting patterns

Table 1 reports the distribution of the adopted quotas by treatment. The modal quota closely follows the prediction of the SP-quota: under *Plutocracy*, $q = 11$ is selected 56% of the time; under *Demarchy*, $q = 8$ is selected 49% of the time; and under *Ptochocracy*, $q = 5$ is selected 62% of the time. A Pearson Chi-squared test reveals that the distribution of implemented quotas differs across treatments (p -value < 0.001). Note also that $q = 5$ is the most frequently implemented (40% of the time), suggesting that there are some efforts to coordinate on the more stringent but welfare-enhancing quota.

The distribution of votes by type and treatment is displayed in Table 2. The Rich and Poor types vote more frequently for their SP-quota,

Table 1
Distribution of implemented quota by treatment.

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

Note: There were 71 valid groups (i.e., that reached a decision) for this computation. The total of 212 observations correspond to the voting outcomes in the three voting rounds (10, 13, and 16), with one missing observation in the last round.

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

| Vote | Panel A: Rich type | | | |
|--|----------------------|----------|-------------|------------|
| | 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 | | | | |
| Vote | Panel B: Middle type | | | |
| | 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 | | | | |
| Vote | Panel C: Poor type | | | |
| | 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 | | | | |

Note: The 71 valid groups in three voting rounds yield a maximum of 213 observations per player type. Some players refused to vote, so we have 212 observations in Panel A, 200 observations in Panel B, and 195 observations in Panel C.

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

Table 3 reports the coefficients for the preregistered model described in Eq. (2). This is an OLS regression where the outcome is an indicator variable equal to one when the subject vote for their SP-quota. The covariates in this linear probability model are the treatments dummies, dummies for player types, and block fixed effects. The even columns include session fixed effects. We find that, in general, the likelihood of voting for the SP-quota does not vary systematically across treatments. The Rich and Poor types are more likely to vote for the SP quota than the Middle type, by 8pp and 19pp, respectively. This result confirms our findings from Table 2.

Result 1. *The majority of players vote for their SP-quota, with negligible differences across different configurations of political inequality. Rich and Poor types follow this voting pattern more often than the Middle class type*

3.2. Group extraction

Fig. 1 charts 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 treatment differences before the introduction of the extraction quotas. The absolute effect of quotas is striking: there is an average reduction in

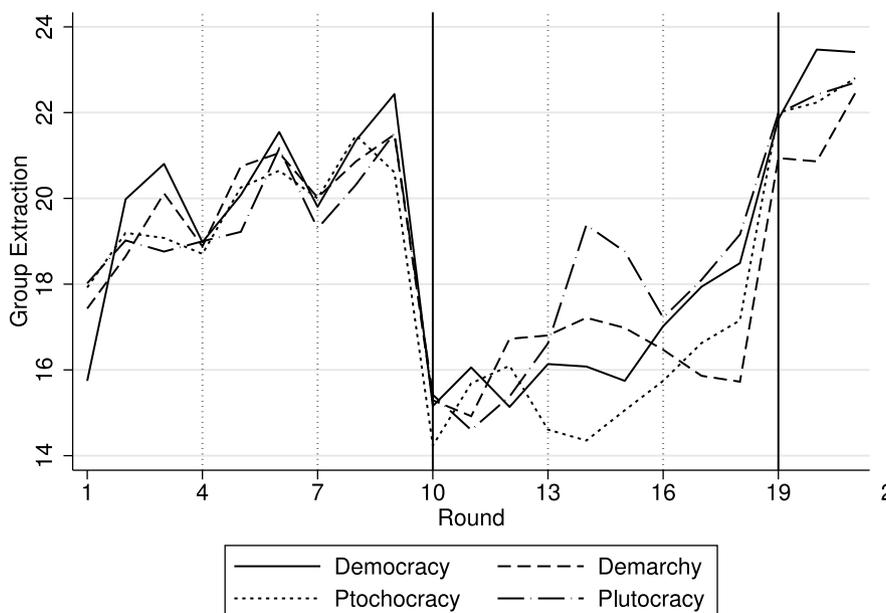


Fig. 1. Group extraction by treatment and round.

Table 3
Linear probability model explaining the likelihood to vote for the SP-quota.

| 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 |

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

extraction of 3.45 units (about 17.5%). The effect of removing quotas is also clear-cut: extraction increases to 22 points in round 19.

We back up these insights using an OLS model. 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), with block fixed effects, the reduction in group extraction is almost two units (10% of the average group extraction). Moreover, group extraction considerably increases in the final block: 3.4 units compared to the initial blocks (i.e., those preceding the establishment of regulation).

Note also that the coefficients of the three treatment variables, and their interaction terms with the voting stage, are non-significant. The former coefficients validate that there are no pre-trends across treatments before the voting stage. The latter confirm the lack of differences between treatments with the introduction of quotas in the voting stage. We conducted an additional test restricted to the Blocks having a voting stage. We interacted the treatment variables with Blocks 5 and 6 (i.e., Block 4 is the reference category). The results, reported in

Table 4
OLS model explaining group extraction.

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

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

Table A.1 in the Appendix, validate the lack of differences between treatments even across blocks (i.e., there are no dynamic effects).

Result 2. Setting a quota decreases aggregate extraction by 10% and the quota removal increases the aggregate extraction by a larger proportion. Political inequality does not impact aggregate extraction

3.3. Normalized extraction

In our primary analysis of individual behavior, we employ normalized instead of absolute extraction levels to ease comparability given the heterogeneity in endowments and implemented quotas. We define normalized extraction as the ratio between the harvested quantity and the maximum allowed extraction. This maximum allowed extraction falls below the endowment only when the implemented quotas are binding (i.e., $q = 5$ for all three players and $q = 8$ for the Middle and Rich types). 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, particularly for $q = 5$ (from 75 to 86 percent). Moreover, the normalized extraction in Block 7, with respect to Blocks 1–3, increases by 10pp. The main difference by player types is that for those that become more constrained by their endowment, the normalized extraction

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) |

Note: The number of observations per block is 609 (i.e., three decisions times 203 participants). Hence, in the sets of blocks 1–3 and 4–6 the total number of observations is 1827 per set.

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 × Voting stage | -0.0102 (0.0205) | -0.00111 (0.0349) | -0.0520 (0.0359) | 0.0210 (0.0360) |
| Ptochocracy × Voting stage | 0.0420** (0.0205) | 0.0973*** (0.0344) | -0.00118 (0.0365) | 0.0256 (0.0360) |
| Plutocracy × 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 × Final block | -0.0245 (0.0290) | -0.0354 (0.0493) | -0.0436 (0.0507) | 0.00300 (0.0509) |
| Ptochocracy × Final block | 0.00321 (0.0290) | 0.0345 (0.0486) | -0.0267 (0.0515) | -0.000272 (0.0509) |
| Plutocracy × 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 | 4261 | 1490 | 1406 | 1365 |

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

looms larger. The results are qualitatively similar when using absolute extraction levels (see Table A.2 in the Appendix).

We report in Table 6 the results of the estimations of the pre-registered Eq. (3). The coefficients for the three treatments are not different from zero in all four columns, indicating that randomization was also successful at the type level. The coefficient for voting stage is statistically significant and suggests an increase in normalized extraction between 17 and 25 pp, depending on the player type. Adding this coefficient with its interaction with Ptochocracy suggests that more restrictive quotas, as expected when the Poor type has the political power, increase normalized extraction. The Rich type drives this effect. Symmetrically, the interaction between the voting stage and Plutocracy yields a lower normalized extraction because the quotas are less restrictive. The Middle class type drives this effect.

Perhaps the most striking inference from Table 6 concerns the decision rule by participants in the final block, when quotas were removed. Note that the coefficient for the final block is almost identical to that for the voting stage, both when we pool all data and when we look at each type separately. We interpret this result as follows: participants responded to the quota by raising their rate of extraction with respect to their allowed maximum, but once the quota was removed, they maintained their normalized extraction level. Hence, the crowding-out of cooperative behavior may come from a shift in the participants' relative extraction, initially raised by the quota.

We complement this analysis with an additional regression (Table A.3). For each player type, we include a categorical variable

for every possible constraint: 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, $q = 5$. Since we only included the blocks with quotas, the constant indicates a high normalized extraction when $q = 5$ (81%–91%). The coefficients for less restrictive quotas confirm that players reduce their normalized extraction when these are not too stringent.

Result 3. Participants respond to the restricted extraction level (imposed by the quotas) by increasing their normalized extraction. After the removal, participants kept their (larger) rate of normalized extraction even if they were no longer constrained.

3.4. Quotas and absolute individual extraction

The analysis of normalized extraction revealed that quotas made participants less cooperative, conditional on the severity of the constraint. Since the net effect on efficiency depends on the actual quota, we perform an additional exercise with absolute extraction and categorical variables for the different maximum extraction levels. The results must be interpreted with caution because quotas are endogenously determined. Nonetheless, for each player type, they illustrate how many additional units are (on average) harvested when the constraint is eased by κ units.

Table 7 reports the coefficients for the OLS model explaining individual extraction for each player type, using the decisions from Blocks 4–6. Given the lack of treatment effects, we 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. We will now describe the coefficients that represent an increase in the maximum allowed extraction, having as reference the most stringent case of $q = 5$. In general, when the constraint is eased by one unit, about two third of that is harvested. For the Rich type, when the quotas are $q = 11$ and $q = 8$, the increase in extraction is 4.4 out of 6 and 2 out of 3, respectively (or 0.73 and 0.66 per 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 4 units (0.68 per extra unit). When the quota is $q = 8$, the increase in extraction is 1.8 out of 3 units (0.60 per extra unit). Finally, for the Poor type, when the quota is either $q = 11$ or $q = 8$, this player is limited by her endowment, and she extracts 0.6 out of the extra unit.

Result 4. When a less stringent quota eases participants' constraint, they extract between 0.6 and 0.7 of each additional unit

3.5. Unexpected quotas

In treatments with political inequality, minority players expect the SP-quota from the type holding political power. Deviations from this quota are randomly administered shocks to the minoritarian types in each treatment. These shocks let us identify the extraction response to an unexpected quota (as if the group “escaped” from the unfairness of unequal weights in the quota decision).

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.

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 × Rich | 0.0417 (0.0398) | 0.137* (0.0709) | | -0.0308 (0.0569) |
| Negative shock × 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 × Rich | 0.0404 (0.0444) | -0.0159 (0.0839) | 0.0839 (0.0545) | |
| Positive shock × 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 | 1362 | 459 | 453 | 450 |
| R-squared | 0.033 | 0.054 | 0.048 | 0.066 |

Controls: round fixed effects. Standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

We expand the regression model for normalized extraction by adding two types of shocks. 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 pooled results and the results by treatment. Minority types do not interpret negative shocks as an opportunity to coordinate on lower and more socially-efficient extraction levels. Instead, under *Demarchy*, the Rich and Poor types raise their normalized extraction by 13.7pp and 18.9pp, respectively. Under *Plutocracy*, the shocks did not have any effect. The coefficient for the negative shock suggests a reduction in extraction in the *Demarchy* treatment. However, that coefficient captures the change in behavior of the Middle type, which holds political power. In other words, rather than the results of a shock, this result may capture the intention of the Middle player to set a stricter restriction than her SP-quota, confirmed by the subsequent willingness to decrease extraction. On the other hand, the positive shocks did not affect extraction in the *Demarchy* and *Ptochocracy* treatments. The only exception is that Middle type players reduce their normalized extraction when this restriction is not $q = 5$.

Result 5. 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

By definition, the *Democracy* treatment does not have shocks because, *ex ante*, the three quotas are equally expected to occur if participants vote for their selfishly preferred option. However, we can study whether the extraction behavior depends on whether the participant's vote is aligned with the chosen quota. We report how this alignment is correlated with normalized extraction in Table A.4. We do not find any effect for the Rich type. For the Middle type, this alignment increases the extraction when the quota is 8 or 11. For the Poor type, the alignment slightly increases the extraction when the quota is 5. Overall, these results show that, if anything, participants in the *Democracy* treatment increase their normalized extraction when the chosen quota matches their vote.

3.6. Additional analyses

What explains participants' deviations from voting for the self-interested quota?

Voting choices across treatments remained stable for each type, and we consistently showed that our treatment variations did not alter the extraction patterns significantly. This lack of treatment effects suggests that the participants' decisions are considerably affected by their preferences and less sensitive to our different configurations of political inequality. In this subsection, we explore two mechanisms potentially explaining why participants may choose lower quotas than those predicted under selfish preferences: environmental concerns and reciprocity. Based on the post-experimental survey, we can explore both mechanisms using the New Ecological Paradigm – NEP scale – to measure environmental concerns (Stern et al., 1995) and the non-incentivized reciprocity questions borrowed from Falk et al. (2018). Since these measures are defined at the participant level, our dependent variable is the median quota for which each participant voted in rounds 10, 13, and 16. This aggregation allows us to set one observation per participant.

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.

We employed five questions to measure reciprocity, two for positive and three for negative reciprocity, whose responses are correlated with behavior in incentivized decision-making exercises (Falk et al., 2018). A first exercise, reported in Table A.5 in the Appendix, reveals that the non-incentivized measures of reciprocity do not predict the quota level for which participants voted. Therefore, we create a behavioral measure of reciprocity from the baseline (Blocks 1 to 3) and assess whether it explains voting behavior in Blocks 4 to 6. Our definition of reciprocity is the following:

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

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.

It has two components. First, Δx_i is the difference in extraction between two consecutive rounds in Blocks 1 to 3. The magnitude of Δx_i indicates whether participant i 's extraction considerably changed between consecutive rounds. Second, the term $|X_{i,t-1} - \bar{X}_{Blocks1-3}|$ captures the aggregate stimuli that may have triggered participant i 's decision to change her extraction level. Here, $X_{i,t-1}$ is participant i 's lagged group extraction, and $\bar{X}_{Blocks1-3}$ the average group extraction in Blocks 1 to 3.⁶ Therefore, a large $|X_{i,t-1} - \bar{X}_{Blocks1-3}|$ reveals that the group's lagged extraction is relatively high – or low – with respect to the average group's extraction. Hence, our reciprocity measure becomes larger when there is an individual reaction to the group's deviation from its average.

Table 9 reports the results for the OLS regressions explaining the choice of a quota through the (experimentally measured) reciprocity variable 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 coefficient size for reciprocity. This correlation is consistent with the hypothesis that participants who were more reactive to their group's aggregate extraction in Blocks 1 to 3 aimed to set lower quotas, pushing the group closer to the social optimum by restricting the maximum negative externality.

Result 6. *Participants' votes below their SP-quota are highly correlated with reciprocal motives within the experiment. Survey-based measures of environmental preferences and reciprocity do not explain these voting choices*

We now center our attention on the participants that voted for quotas above the selfish prediction, for whom we have two non-mutually exclusive conjectures. First, following Velez et al. (2012), this behavior may reflect voters' preferences against stricter restrictions in CPR management. Second, it may reflect myopic overlooking of equilibrium effects when voting. Dal Bó et al. (2018) present evidence from a lab experiment where participants voted to play a Prisoner's Dilemma instead of playing the "Harmony game", where mutual 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. Still, they neglect that the equilibrium outcome in this game is better than the mutual defection in the Prisoner's Dilemma. Hence, our participants may have voted for larger quotas because they underappreciate how the restriction imposed on others dominates the restriction imposed on themselves, perhaps in combination with an intrinsic preference against strict quota enforcement.

⁶ Since 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 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 × Block 5 | | 0.789 (1.304) |
| Demarchy × Block 6 | | -1.509 (1.304) |
| Ptochocracy × Block 5 | | -1.288 (1.322) |
| Ptochocracy × Block 6 | | -0.837 (1.325) |
| Plutocracy × Block 5 | | 2.527* (1.322) |
| Plutocracy × 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 with random effects for absolute extraction by player type.

| Variables | (1) | (2) | (3) | (4) |
|----------------------------|------------------|-------------------|------------------|------------------|
| | All types | Rich type | Middle type | 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 × Voting stage | 0.207 (0.194) | 0.358 (0.395) | -0.131 (0.314) | 0.197 (0.214) |
| Ptochocracy × Voting stage | -0.0241 (0.194) | 0.554 (0.389) | -0.712** (0.320) | -0.0384 (0.214) |
| Plutocracy × 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 × Final block | -0.270 (0.274) | -0.425 (0.558) | -0.392 (0.445) | 0.0180 (0.303) |
| Ptochocracy × Final block | 0.0588 (0.274) | 0.414 (0.550) | -0.241 (0.451) | -0.00163 (0.303) |
| Plutocracy × 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 | 4261 | 1490 | 1406 | 1365 |
| 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.

Why do we fail to observe differences across 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

Table A.3
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 × Max.Extraction = 8 | | 0.124* (0.0691) | | 0.0946 (0.0755) | | |
| Demarchy × Max.Extraction = 11 | | 0.0765 (0.0860) | | | | |
| Demarchy × Max.Extraction = 9 | | | | 0.103 (0.0923) | | |
| Demarchy × Max.Extraction = 6 | | | | | | -0.0186 (0.0547) |
| Ptochocracy × Max.Extraction = 8 | | 0.00760 (0.0704) | | 0.00991 (0.0752) | | |
| Ptochocracy × Max.Extraction = 11 | | 0.182** (0.0746) | | | | |
| Ptochocracy × Max.Extraction = 9 | | | | 0.0976 (0.0810) | | |
| Ptochocracy × Max.Extraction = 6 | | | | | | -0.0562 (0.0512) |
| Plutocracy × Max.Extraction = 8 | | 0.0804 (0.0768) | | -0.0670 (0.0826) | | |
| Plutocracy × Max.Extraction = 11 | | 0.127* (0.0732) | | | | |
| Plutocracy × Max.Extraction = 9 | | | | 0.105 (0.0765) | | |
| Plutocracy × 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.4
Normalized extraction in the *Democracy* treatment when the vote is aligned with the quota.

| Dependent variable: | Rich | Middle | Poor |
|---------------------------|-----------------------|-----------------------|----------------------|
| Normalized extraction | (1) | (2) | (3) |
| Vote aligned with quota | -0.0713 (0.0569) | -0.0150 (0.0792) | 0.154* (0.0891) |
| Quota = 8 | -0.130** (0.0509) | -0.277*** (0.0985) | 0.147 (0.0927) |
| Quota = 11 | -0.161*** (0.0582) | -0.235*** (0.0798) | 0.0508 (0.101) |
| Vote aligned × Quota = 8 | 0.0454 (0.0774) | 0.269** (0.121) | -0.177 (0.114) |
| Vote aligned × Quota = 11 | 0.0382 (0.0877) | 0.336** (0.136) | -0.0888 (0.123) |
| Constant | 0.829*** (0.0560) | 0.789*** (0.0913) | 0.759*** (0.0952) |
| Observations | 162 | 153 | 144 |
| R-squared | 0.175 | 0.177 | 0.089 |

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

under *Democracy* is the closest to a uniform distribution,⁷ 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 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 in extraction

⁷ Although 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.

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 per cent. This behavior occurs regardless of the chosen quota.

4. Conclusions

We conducted an online lab experiment to understand the interplay between endowment inequality and political inequality when setting a regulation that limits the extent of extraction of an environmental public good. We addressed two questions. First, we asked whether participants used political power to set their selfishly preferred quota, as predicted by Nash equilibrium. We find this to be the case between

Table A.5
OLS model explaining the preferred quota (i.e., modal vote) using survey-based measures of reciprocity.

| Variables | Dependent variable: preferred quota (i.e., median vote) per participant | | | | | | | | | |
|--------------------------|---|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|----------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| NEP score (standardized) | -0.0344 (0.172) | -0.0327 (0.155) | -0.0350 (0.171) | -0.0257 (0.155) | -0.0517 (0.174) | -0.0353 (0.158) | -0.0107 (0.174) | -0.00432 (0.157) | -0.0409 (0.171) | -0.0269 (0.156) |
| Positive reciprocity 1 | -0.0186 (0.122) | 0.0897 (0.113) | | | | | | | | |
| Positive reciprocity 2 | | | -0.0414 (0.114) | -0.0413 (0.104) | | | | | | |
| Negative reciprocity 1 | | | | | -0.0342 (0.0630) | -0.0195 (0.0578) | | | | |
| Negative reciprocity 2 | | | | | | | 0.0604 (0.0698) | 0.0527 (0.0637) | | |
| Negative reciprocity 3 | | | | | | | | | -0.0422 (0.0681) | -0.00738 (0.0623) |
| Constant | 7.840*** (1.112) | 7.996*** (1.026) | 7.883*** (0.603) | 8.951*** (0.622) | 7.798*** (0.286) | 8.833*** (0.441) | 7.447*** (0.313) | 8.552*** (0.445) | 7.898*** (0.402) | 8.792*** (0.497) |
| Observations | 202 | 202 | 202 | 202 | 202 | 202 | 202 | 202 | 202 | 202 |
| R-squared | 0.000 | 0.206 | 0.001 | 0.204 | 0.002 | 0.204 | 0.004 | 0.207 | 0.002 | 0.204 |
| Treatment controls | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes |
| Player type controls | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes |

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

Positive reciprocity 1: “When someone does me a favor, I am willing to return it”.

Positive reciprocity 2: Gift-giving to a stranger.

Negative reciprocity 1: “If I am treated very unjustly, I will take revenge at the first occasion, even if there is a cost to do so”.

Negative reciprocity 2: “How willing are you to punish someone who treats **you** unfairly, even if there may be costs for you?”.

Negative reciprocity 3: “How willing are you to punish someone who treats **others** unfairly, even if there may be costs for you?”.

half and two-thirds of the time. The stability of vote shares across treatments, for all types, suggests that individual preferences matter more than political inequality. Regarding these preferences, our measure of reciprocity based on participants’ play before the introduction of the voting procedure is a good predictor of voting for more restrictive and socially-enhancing quotas. By contrast, survey-based measures of environmental preferences and reciprocity do not have explanatory power.

Second, we asked whether choices that mainly reflected the interests of a single party, due to different configurations of political power, affect economic behavior (resource extraction). Introducing the quotas reduced the extraction, but there were no systematic treatment differences. Neither *Democracy* led to lower extraction by changing the mindset towards the collective goal, nor the concentration of political power in the Poor or Middle type players led to stricter quotas by simple self-interest. Overall, the data did not show treatment differences. The main explanation is that players adjusted their relative extraction upward when the quota was binding. Even worst, after the quota removal, they kept harvesting around 80% of their maximum allowed extraction, crowding out their pre-quota willingness to extract at an intermediate level. Based on existing evidence, we argue that the lack of treatment effects is not driven by the online environment where the experiment took place. 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). Moreover, our participants were sampled from the subject pool of lab studies. This feature fosters a repeated relationship with participants that promotes attention in an online environment, according to Boas et al. (2020) comparison of experiments across different online pools.

There are two lessons to be drawn. First, climate change mitigation requires a deepening of environmental regulations, and their success depends on how this regulation responds to heterogeneous economic interests. The public acceptance of these regulations, which dwells in the politicians’ interest, depends on the alignment of material interests and political power and the government’s ability to explain the welfare benefits resulting from equilibrium outcomes. Second, regulations may crowd out intrinsic motivations when users of environmental public goods set their appropriation in proportion to their maximum capacities. The constraints imposed by quotas are interpreted as signals to increase the rate of extraction. Our concern is that once the regulated

quotas are removed, the higher rate of extraction may remain high, increasing the negative externalities.

Two extensions to our design 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 reduced political influence may be less compliant as a signal of the illegitimacy of the established regulation. Second, the types might be assigned based on a previous real-effort task or a questionnaire revealing environmental behavior (e.g., the participant’s carbon footprint). This variation might create a sense of entitlement, increasing the likelihood of voting for the SP-quota and raising extraction to the maximum allowed level. However, it may also create sorting effects (i.e., more environmentally aware participants willing to enforce the stringent regulation) that make the *Ptochocracy* condition efficiency-enhancing.

Data availability

Data and code located at OSF: <https://osf.io/pqxja/>.

Appendix

A.1. Additional tables

See Tables A.1–A.5.

Appendix B. Supplementary data

Supplementary material related to this article can be found online at <https://doi.org/10.1016/j.socec.2023.102006>.

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