Online Appendix for "Growth and Inequality in Public Good Provision"

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Contents

A Screenshots

	Tokens at the beginning of this period	Tokens placed in group account	Share of group account return	Tokens in the end of the period
You	9	5.00	4.87	9
Other1	11	2.00	4.87	14
Other2	12	6.00	4.87	11
Other3	1	0.00	4.87	6

Figure A.1: Information the participants see after each period in NOPUNISH treatment. Fictitious participant "You" contributed 5 of his 9 tokens and received a share of 5 (4.87 rounded up) from the group account resulting in $9 - 5 + 5 = 9$ tokens before punishment.

	Tokens at the beginning of this period	Tokens placed in group account	Share of group account return	Total tokens before subtraction	Number of tokens to subtract
You	9	5.00	4.87	9	
Other1	11	2.00	4.87	14	
Other2	12	6.00	4.87	11	
Other3	1	0.00	4.87	6	

Figure A.2: The screen shot of the punishment stage. The assignment of "Other" categories were randomized in each period.

	Tokens at the beginning of this period	Tokens placed in group account	Share of group account return	Total tokens before subtraction	You subtracted	You got subtracted by others	Sum of subtractions by others	Tokens in the end of the period
You	9	5.00	4.87	9			4.00	3
Other1	11	2.00	4.87	14	1.00	1.00	4.00	9
Other2	12	6.00	4.87	11	2.00	0.00	4.00	6
Other3	1	0.00	4.87	6	3.00	3.00	6.00	0

Figure A.3: Information available to the participants after the punishment phase. The fictitious participant "You" punished "Other1" by 1, "Other 2" by 2 and was punished 1 (*3) by "Other 1" resulting in 9-3-3=3 tokens at the end of the period. Plans regarding "Other 3" were not executed (indicated by a pop up window not shown here), because player 3 was already set to zero.

B Questionnaire and Experimental Instructions

B.1 Instructions NOPUNISH Treatment

General information

You are about to participate in a decision making experiment. If you follow the instructions carefully, you can earn a considerable amount of money depending on your decisions and the decisions of the other participants. Your earnings will be paid to you in cash at the end of the experiment

This set of instructions is for your private use only. During the experiment you are not allowed to communicate with anybody. In case of questions, please raise your hand. Then we will come to your seat and answer your questions. Any violation of this rule excludes you immediately from the experiment and all payments. The funds for conducting this experiment were provided by the Marie Curie Reintegration Grant from the EU.

Throughout the experiment you will make decisions about amounts of tokens. At the end of the experiment all tokens you have will be converted into Euros at the exchange rate 0.05 Euro for 1 token and paid you in cash in addition to the show-up fee of 2 Euros.

During the experiment all your decisions will be treated confidentially. This means that none of the other participants will know which decisions you made.

Experimental Instructions

The experiment will consist of 10 decision making periods. At the beginning of the experiment, you will be matched with 3 other people in this room. Therefore, there are 4 people, including yourself, participating in your group. You will be matched with the same people during the entire experiment. None of the participants knows who is in which group.

Before the first period you, and each other person in your group, will be given the endowment of 20 tokens.

At the beginning of the first period you will be asked to allocate your endowment between a private account and a group account.

The tokens that you place in the private account have a return of 1 at the end of the first period. This means that at the end of the first period your private account will contain exactly the amount of tokens you put into the private account at the beginning of the period. Nobody except yourself benefits from your private account.

The tokens that you place in the group account are summed together with the tokens that the other three members of your group place in the group account. The tokens in the group account have a return of 1.5. Every member of the group benefits equally from the group account. Specifically, the total amount of tokens placed in the group account by all group members is multiplied by 1.5 and then is equally divided among the four group members. Hence, your share of the group account at the end of the first period is

1.5 * (sum of tokens in the group account) / 4

Your endowment at the beginning of the second period will be equal to the amount of tokens contained in your private account at the end of the first period plus your share of the group account at the end of the first period.

At the beginning of the second period you will be again asked to allocate the endowment that you have at the beginning of the second period between a private account and a group account. Both the private and the group account work in exactly the same manner as in the first period, namely, they have the same returns.

The structure of the experiment at all subsequent periods is identical: your endowment at the beginning of each period is equal to the amount of tokens in your private account at the end of the previous period plus your share of the group account at the end of the previous period.

At the end of each period, you will be informed about

- The endowment all four group members had at the beginning of the period

- How much each group member allocated to the group account and to their respective private accounts.
- Your share of the group account (remember it is the same for all group members).

All other participants will receive exactly the same information.

Your total income in the end of the experiment is equal to the amount of tokens in your private account and your share of the group account at the end of period 10. At the end of the experiment there will be a short questionnaire for you to fill in.

B.2 Instructions PUNISH Treatment

General information

You are about to participate in a decision making experiment. If you follow the instructions carefully, you can earn a considerable amount of money depending on your decisions and the decisions of the other participants. Your earnings will be paid to you in cash at the end of the experiment

This set of instructions is for your private use only. During the experiment you are not allowed to communicate with anybody. In case of questions, please raise your hand. Then we will come to your seat and answer your questions. Any violation of this rule excludes you immediately from the experiment and all payments. The funds for conducting this experiment were provided by the Marie Curie Reintegration Grant from the EU.

Throughout the experiment you will make decisions about amounts of tokens. At the end of the experiment all tokens you have will be converted into Euros at the exchange rate 0.05 Euro for 1 token and paid you in cash in addition to the show-up fee of 2 Euros.

During the experiment all your decisions will be treated confidentially. This means that none of the other participants will know which decisions you made.

Experimental Instructions

The experiment will consist of 10 decision making periods. Each period consists of two stages. At the beginning of the experiment, you will be randomly matched with 3 other people in this room. Therefore, there are 4 people, including yourself, participating in your group. You will be matched with the same people during the entire experiment. None of the participants knows who is in which group.

Before the first period you, and each other person in your group, will be given the endowment of 20 tokens.

At the first stage of the first period you will be asked to allocate your endowment between a private account and a group account.

The tokens that you place in the private account have a return of 1 at the end of the first stage. This means that at the end of the first stage your private account will contain exactly the amount of tokens you put into the private account at the beginning of the first stage. Nobody except yourself benefits from your private account.

The tokens that you place in the group account are summed together with the tokens that the other three members of your group place in the group account. The tokens in the group account have a return of 1.5. Every member of the group benefits equally from the tokens in the group account. Specifically, the total amount of tokens placed in the group account by all group members is multiplied by 1.5 and then is equally divided among the four group members. Hence, your share of the group account at the end of the first stage of the first period is

1.5 * (sum of tokens in the group account) / 4

In the second stage of the first period you will be asked to react to the decisions made during the first stage of the first period. At this point, you will already know the decisions taken by each group member at the first stage. You will decide whether you want to subtract tokens from any other group member or not. The members that you decide to subtract tokens from will lose the amount of tokens you chose. Subtracting tokens from someone else is costly for you too. The following table illustrates the relation between your cost in tokens and the amount of tokens that are taken away from the member of your group:

Tokens subtracted	Cost for you
3	1
6	2
9	3
...	...
$3y$	y

You may subtract different amounts of tokens from different group members. Other group members will be able to subtract tokens from you as well. You lose the sum of tokens that other three group members decided to subtract from you. Any group member including you can only lose maximum the amount of tokens he or she has.

At the beginning of the second period your endowment will be equal to the amount of tokens contained in your private account at the end of the first stage of the first period plus your share of the group account at the end of the first stage of the first period, minus your cost for subtracting others' tokens and minus the amount of tokens subtracted from you by other members.

At the first stage of the second period you will be again asked to allocate the endowment that you have at the beginning of the second period between a private account and a group account. Both the private and the group account work in exactly the same manner as in the first period, namely, they have the same returns. At the second stage of the second period you will be asked to react to the decisions made during the first stage of the second period in exactly the same manner as in the first period.

The structure of the experiment at all subsequent periods is identical: your endowment at the beginning of each period is equal to the amount of tokens in your private account at the end of the first stage of previous period, plus your share of the group account at the end of the first stage of the previous period, minus your cost from subtracting other members' tokens at the second stage of the previous period, minus the amount of tokens subtracted from you by other members at the second stage of the previous period.

At the end of each period, you will be informed about

- The endowment all four group members had at the beginning of the period
- How much each group member allocated to the group account and to their respective private accounts
- Your share of the group account (remember it is the same for all group members)
- How many tokens each member subtracted from you.

All other participants will receive exactly the same instructions.

Your total income in the end of the experiment is equal to the amount of tokens left after last subtraction in your private account and your share of the group account at the end of period 10. At the end of the experiment there will be a short questionnaire for you to fill in.

B.3 Questionnaire

The following questions were asked after both PUNISH and NOPUNISH treatments.

- What is your gender?
- What is your nationality?
- What is your year of birth?
- What is your field of studies?

- For how many years have you been studying at university?

Suppose you have a hypothetical choice between a bet and a sure outcome. What would you choose in the following cases:

- €10 Euro or 100 Euro with 50% chance and €0 Euro with 50% chance
- €20 Euro or 100 Euro with 50% chance and €0 Euro with 50% chance
- €30 Euro or 100 Euro with 50% chance and €0 Euro with 50% chance
- €40 Euro or 100 Euro with 50% chance and €0 Euro with 50% chance
- €50 Euro or 100 Euro with 50% chance and €0 Euro with 50% chance
- €60 Euro or 100 Euro with 50% chance and €0 Euro with 50% chance
- €70 Euro or 100 Euro with 50% chance and €0 Euro with 50% chance

Personality questions: indicate how strongly you agree with the following statements (1 means disagree strongly, 7 agree strongly).

- I am a quick thinker
- I get easily offended
- I am very satisfied with myself
- I am very dependent on others
- Generally speaking, I am happy
- Work plays a very important role in my life
- Family plays a very important role in my life
- Friends play a very important role in my life
- Religion plays a very important role in my life
- Politics plays a very important role in my life
- Generally, most people can be trusted
- In the long run, hard work brings a better life
- The government should take responsibility that people are better provided for
- Incomes should be made more equal

In addition the participants were asked if they would be willing to donate some of their earnings to Doctors without Borders.

C Proofs of Section 3

In this section we establish the theoretical results discussed informally in Section 3. We start with some notation, then prove our first results on the structure of NE and SPE in our public good games with growth. Finally, we expand our model by introducing behavioral types which allow us to model reputation effects, and we provide a result on the structure of sequential equilibria in the induced incomplete information game.

C.1 Notation and preliminaries

Players and histories. Let I be the set of four players. Each player receives a random index $i \in \{1, \dots, 4\}$ at the beginning of the game. Hereinafter we identify each player with the respective index. Furthermore, let H denote the set of non-terminal histories and Z denote the set of terminal histories. There are two types of non-terminal histories, contribution and punishment histories, denoted by H^c and H^p respectively. The root of the game is a contribution history, i.e., $h_1 \in H^c$. Games without punishment contain only contribution histories. On the other hand games with punishment contain both contribution and punishment histories. In the latter case, the two types of histories occur in an alternating order, i.e., the direct predecessor of each $h \in H^c \setminus \{h_1\}$ belongs to H^p, and vice versa, the direct predecessor of each $h \in H^p$ belongs to H^c. Moreover, the final non-terminal history is a punishment history, i.e., the direct predecessor of each $z \in Z$ belongs to H^p.

Paths of play. A path is a sequence of histories beginning with the root of the game h_1, ending at a terminal history $z \in Z$, and containing a unique immediate successor for each non-terminal history, i.e., it is the collection of z's predecessors. Hence, a path is uniquely determined by the respective terminal history. We define the length of a path to be the number of (terminal and non-terminal) histories. Obviously, in our public good game without punishment each path is of length $T+1$, where T is the number of periods, i.e., a path contains a single (contribution) history for each period. In our public good game with punishment each path is of length $2T+1$, where T is again the number of periods, i.e., a path contains two histories for each period, a contribution history and a subsequent punishment history. In both cases, let H_t denote the non-terminal histories at stage t. Thus, in the game without punishment, a path is a sequence $(h_1, h_2, \dots, h_T, z)$ such that $h_t \in H_t$. On the other hand in the game with punishment a path is a sequence $(h_1^c, h_1^p, h_2^c, h_2^p, \dots, h_T^c, h_T^p, z)$ such that $h_t^c \in H_t^c := H_t \cap H^c$ and $h_t^p \in H_t^p := H_t \cap H^p$.

Strategies. Let A_i^h be the finite set of actions that player i has at $h \in H$. If h is a contribution history,

$$A_i^h := C_i^h := \{0, \dots, N_i^h\},$$

where N_i^h denotes the number of tokens in i's private account upon reaching the contribution history h. Obviously, A_i^h depends on the amount of tokens that player i has accumulated in her private account so far. This is for instance why our public good game without punishment is not a repeated game, as opposed to the standard case where $N_i^h = 20$ for all $h \in H^c$. If, on the other hand, h is a punishment history,

$$A_i^h := P_i^h := \Big\{ \ (p_{i,j})_{j \neq i} \in \mathbb{N}^3 : \sum_{j \neq i} p_{i,j} \leq W_i^h \ \Big\}$$

where $3p_{i,j}$ is the number of tokens that i subtracts from j's private account, and W_i^h is the number of tokens in i's private account upon reaching the punishment history h.[1] As usual, let $A_i := \prod_{h \in H} A_i^h$ denote the set of i's strategies and $A := \prod_{i \in I} A_i$ denote the set of strategy profiles. For an arbitrary $a \in A$, let $c_i^h(a) := a_i^h$ be i's action at the contribution history $h \in H^c$. Likewise, let $p_i^h(a) := a_i^h$ denote i's action at the punishment history $h \in H^p$.

An arbitrary strategy profile $a \in A$ induces a unique path $H(a)$. In a game without punishment, let $(c_i^1(a), \dots, c_i^T(a))$ denote i's observed actions (contributions) along the path $H(a)$. Likewise, in a

[1] Obviously, player i's total cost from punishing cannot exceed the number of tokens in her private account at the corresponding history.

game with punishment let $(c_i^1(a), p_i^1(a), \ldots, c_i^T(a), p_i^T(a))$ denote i's observed actions (contributions and subsequent punishments) along the path $H(a)$.

Payoff functions. Let us begin with our *public good game without punishment*: Fix an arbitrary strategy profile $a \in A$, and take each player i's observed contributions $(c_i^1(a), \ldots, c_i^T(a))$ along the realized path $H(a)$. Then, for each $t \geq 1$, we inductively define

$$N_i^{t+1} := N_i^t - c_i^t(a) + \frac{r}{4}\sum_{j=1}^{4} c_j^t(a), \tag{1}$$

with $N_i^1 := N_i^{h_1} = 20$ and r denoting the returns of the public good. Then, we define player i's payoff function $u_i : A \to \mathbb{R}$ in by

$$u_i(a) = N_i^{T+1}. \tag{2}$$

Now, fix an arbitrary $h \in H$ and an arbitrary strategy profile $a \in A$. Then let $a' \in A$ be a strategy profile – possibly other than a – such that (i) $h \in H(a')$, and (ii) a' agrees with a at all histories weakly following h. Then, we define player i's payoff from a conditional on the history h by

$$u_i(a|h) = u_i(a'). \tag{3}$$

Now, let us switch our focus to our *public good game with punishment*: Consider an arbitrary strategy profile $a \in A$, and take each player i's observed contributions $(c_i^1(a), p_i^1(a), \ldots, c_i^T(a), p_i^T(a))$ along the realized path $H(a)$. Recall that at the beginning of the game the players are ordered from 1 to 4, i.e., each player has received a unique index $i \in \{1, \ldots, 4\}$. Now, let $\mathcal{J}_i$ be the collection of nonempty subsets $J \subseteq I$ such that (a) $i \notin J$ and (b) if $k \in J$ then $j \in J$ for all $j \in \{1, \ldots, k\} \setminus \{i\}$. Then, for each $t \geq 1$, we inductively define

$$W_i^t := N_i^t - c_i^t(a) + \sum_{j \in I} c_j^t(a) \tag{4}$$

$$N_i^{t+1} := \min_{J \in \mathcal{J}_i^t} \left\{ W_i^t - \sum_{j \in J} 3p_{j,i}^t(a) \right\} - \sum_{j \neq i} p_{i,j}^t(a) \tag{5}$$

with $N_i^1 := N_i^{h_1} = 20$. Then, we define i's payoff function $u_i^p : A \to \mathbb{R}$ by

$$u_i^p(a) = N_i^{T+1}. \tag{6}$$

Now, once again fix an arbitrary $h \in H$ and an arbitrary strategy profile $a \in A$. Then, similarly to the game without punishment, $a' \in A$ be a strategy profile such that (i) $h \in H(a')$, and (ii) a' agrees with a at all histories weakly following h. Then, define player i's payoff from a conditional on the history h by

$$u_i^p(a|h) = u_i^p(a'). \tag{7}$$

Finally, note that in all our cases, we assume $r = 1.5$.

C.2 Predicted behavior: Results and Proofs

In the game without punishment (resp., with punishment) we say that a strategy $a_i \in A_i$ is a a best response to $a_{-i} \in A_{-i}$, and we write $a_i \in BR_i(a_{-i})$, whenever $u_i(a_i, a_{-i}) \geq u_i(b_i, a_{-i})$ (resp., whenever $u_i^p(a_i, a_{-i}) \geq u_i^p(b_i, a_{-i})$) for all $b_i \in A_i$. The strategy profile a is a Nash equilibrium (NE) whenever $a_i \in BR_i(a_{-i})$ for every $i \in I$. Likewise, in the game without punishment (resp., with punishment) we say that a strategy $a_i \in A_i$ is a best response to $a_{-i} \in A_{-i}$ conditionally on h, and we write $a_i \in BR_i(a_{-i}|h)$, whenever $u_i(a_i, a_{-i}|h) \geq u_i(b_i, a_{-i}|h)$ (resp., $u_i^p(a_i, a_{-i}|h) \geq u_i^p(b_i, a_{-i}|h)$), for all $b_i \in A_i$. The strategy profile a is a subgame perfect equilibrium (SPE) whenever $a_i \in BR_i(a_{-i}|h)$ for every $i \in I$ and every $h \in H$. It is well-known that in games with observable actions, SPE are consistent with the backward induction procedure.

Proposition 3 *Consider the public good game (with growth as defined above) without punishment.*

(i) *The unique SPE is such that every player contributes 0 at every history, i.e., if $a \in A$ is a SPE, then $c_i^h(a) = 0$ for every $i \in I$ and for all $h \in H$.*

(ii) *Every NE is such that every player contributes 0 at every history on the equilibrium path, i.e., if $a \in A$ is a NE, then $c_i^h(a) = 0$ for every $i \in I$ and for all $h \in H(a)$.*

Proof. (i) This part of the proof follows the standard backward induction argument. Let $a \in A$ be an SPE. For an arbitrary $t \in \{1, \ldots, T\}$, suppose that $c_i^{h'}(a) = 0$ for all $i \in I$ and all $h' \in H_{t+1} \cup \cdots \cup H_T$. Of course, if $t = T$, then our previous assumption becomes trivially vacuous. Now for an arbitrary $h \in H_t$, it suffices to prove that $c_i^h(a) = 0$ for all $i \in I$. Assume that this is not the case, i.e., assume that there is some $i \in I$ such that $c_i^h(a) > 0$. Take another strategy $b_i \in A_i$ such that $c_i^{h''}(b_i, a_{-i}) = c_i^{h''}(a)$ at every $h'' \neq h$ moreover $c_i^h(b_i, a_{-i}) = 0$. This implies that $c_j^{h'}(a) = c_j^{h'}(b_i, a_{-i}) = 0$ for all $h' \in H_{t+1} \cup \cdots \cup H_T$, and therefore i's private account will contain at the end of the game the amount of tokens it will contain after the history h. Hence,

$$\begin{aligned}
u_i(a_i, a_{-i}|h) &= N_i^h - c_i^h(a) + \frac{r}{4}\sum_{j=1}^{4} c_j^h(a) \\
&< N_i^h + \frac{r}{4}\sum_{j\neq i} c_j^h(a) \\
&= N_i^h - c_i^h(b_i, a_{-i}) + \frac{r}{4}\sum_{j=1}^{4} c_j^h(b_i, a_{-i}) \\
&= u_i(b_i, a_{-i}|h)
\end{aligned}$$

thus implying that $a_i \notin BR_i(a_{-i}|h)$ and therefore a is not an SPE, which contradicts our hypothesis above. Hence, $c_i^h(a) = 0$ for all $i \in I$ and all $h \in H_t$, which completes the proof.

(ii) Let $a \in A$ be a NE, and recall that by $(c_i^1(a), \ldots, c_i^T(a))$ we denote i's observed actions along the equilibrium path $H(a)$. Now, suppose that there exists some $t \in \{1, \ldots, T\}$ such that $c_i^t(a) > 0$. Let t be the last period where this is the case, i.e., $c_i^\tau(a) = 0$ for all $\tau \in \{t+1, \ldots, T\}$ and for all $i \in I$. Now, consider the strategy b_i such that $c_i^{h'}(b_i, a_{-i}) = c_i^{h'}(a)$ at every $h' \notin H(b_i, a_{-i}) \cap \big(H_{t+1} \cup \cdots \cup H_T\big)$, and moreover $c_i^{h'}(b_i, a_{-i}) = 0$ at every $h' \in H(b_i, a_{-i}) \cap \big(H_{t+1} \cup \cdots \cup H_T\big)$, i.e., b_i contributes 0 at all (realized) histories that weakly follow h and agrees with a_i at all other histories. Then, observe that b_i is a profitable deviation from a_i given a_{-i}, since

$$\begin{aligned}
u_i(a) &= 20 - \sum_{\tau=1}^{T} c_i^\tau(a) + \frac{r}{4}\sum_{\tau=1}^{T}\sum_{j=1}^{4} c_j^\tau(a) \\
&= 20 - \sum_{\tau=1}^{t} c_i^\tau(a) + \frac{r}{4}\sum_{\tau=1}^{t}\sum_{j=1}^{4} c_j^\tau(a) \\
&< 20 - \sum_{\tau=1}^{t} c_i^\tau(b_i, a_{-i}) + \frac{r}{4}\sum_{\tau=1}^{t}\sum_{j=1}^{4} c_j^\tau(b_i, a_{-i}) \\
&\leq 20 - \sum_{\tau=1}^{t} c_i^\tau(b_i, a_{-i}) + \frac{r}{4}\sum_{\tau=1}^{t}\sum_{j=1}^{4} c_j^\tau(b_i, a_{-i}) + \frac{r}{4}\sum_{\tau=t+1}^{T}\sum_{j=1}^{4} c_j^\tau(b_i, a_{-i}) \\
&= 20 - \sum_{\tau=1}^{T} c_i^\tau(b_i, a_{-i}) + \frac{r}{4}\sum_{\tau=1}^{T}\sum_{j=1}^{4} c_j^\tau(b_i, a_{-i}) \\
&= u_i(b_i, a_{-i}).
\end{aligned}$$

Hence, $a_i \notin BR_i(a_{-i})$, thus contradiction our initial hypothesis that a is a NE. Therefore we conclude that there is no $t \in \{1, \ldots, T\}$ such that $c_i^t(a) > 0$, which completes the proof. ■

The following result is rather straightforward to prove, by applying – similarly to the part (i) of the previous proposition – the backward induction procedure.

Proposition 4 *Consider the public good game (with growth as defined above) with punishment. The unique SPE is such that every player contributes 0 at every contribution history and punishes 0 at every punishment history (both on and off the equilibrium path), i.e., if $a \in A$ is a SPE, then $c_i^h(a) = 0$ for every $i \in I$ and for all $h \in H^c$ and $p_i^h(a) = 0$ for every $i \in I$ and for all $h \in H^p$.*

Proof. Let $a \in A$ be an SPE. The proof proceeds by induction on t. In particular, we first prove our claim for T. Subsequently, we take an arbitrary $t \in \{1, \ldots, T-1\}$, and we assume that our claim is true for every $\tau \in \{t+1, \ldots, T\}$. Then, it suffices to prove our claim for t.
Initial step. Take an arbitrary $h \in H_T^p$ – not necessarily on the path induced by a – and assume that $p_{i,j}^h(a) > 0$ for an arbitrary pair $(i,j) \in I \times I$. Then, it follows directly that

$$\begin{aligned} u_i(a_i, a_{-i}|h) &= \min_{J \in \mathcal{J}_i^T} \Big\{ W_i^T - \sum_{j \in J} 3p_{j,i}^h(a) \Big\} - \sum_{j \neq i} p_{i,j}^h(a) \\ &< \min_{J \in \mathcal{J}_i^T} \Big\{ W_i^T - \sum_{j \in J} 3p_{j,i}^h(b_i, a_{-i}) \Big\} - \sum_{j \neq i} p_{i,j}^h(b_i, a_{-i}) \\ &= u_i(b_i, a_{-i}|h), \end{aligned}$$

with b_i being i's strategy that agrees with a_i at all $h' \neq h$, while $p_{i,j}^h(b_i, a_{-i}) = 0$. Indeed, notice that $p_{j,i}^h(a) = p_{j,i}^h(b_i, a_{-i})$ and $p_{i,j}^h(a) > 0 = p_{i,j}^h(b_i, a_{-i})$. This is because i's own punishment to j will be executed irrespective of the value of $\min_{J \in \mathcal{J}_i^T} \{ W_i^T - \sum_{j \in J} 3p_{j,i}^h(a) \}$.

Now take an arbitrary $h \in H_T^c$ – not necessarily on the path induced by a – and assume that $c_i^h(a) > 0$ for an arbitrary $i \in I$. The proof is almost identical to the one of the previous proposition. Indeed, take another strategy $b_i \in A_i$ agreeing with a_i at every $h' \neq h$, while $c_i^h(b_i, a_{-i}) = 0$. Given that the strategy profile $a \in A$ prescribes that no player punishes at any history in H_T^p, we obtain

$$\begin{aligned} u_i(a_i, a_{-i}|h) &= N_i^h - c_i^h(a_i, a_{-i}) + \frac{r}{4} \sum_{j=1}^{4} c_j^h(a_i, a_{-i}) \\ &< N_i^h + \frac{r}{4} \sum_{j=1}^{4} c_j^h(a_i, a_{-i}) \\ &= u_i(b_i, a_{-i}|h). \end{aligned}$$

Inductive step. Now fix an arbitrary $t \in \{1, \ldots, T-1\}$, and we assume that for every $\tau \in \{t+1, \ldots, T\}$, it is the case that (i) $c_i^h(a) = 0$ for all $h \in H_\tau^c$ and all $i \in I$, and (ii) $p_{i,j}^h(a) = 0$ for all $h \in H_\tau^p$ and all $(i,j) \in I \times I$.

Take an arbitrary $h \in H_t^p$ – not necessarily on the path induced by a – and assume that $p_{i,j}^h(a) > 0$ for an arbitrary pair $(i,j) \in I \times I$. Then, following exactly the same reasoning as in the initial step (and given the fact that according to the strategy profile a, every player will contribute 0 and will punish 0 at all histories that follow h), it will be the case that

$$u_i(a_i, a_{-i}|h) < u_i(b_i, a_{-i}|h),$$

with b_i being the strategy that agrees with a_i at all $h' \neq h$ while $p_{i,j}^h(b_i, a_{-i}) = 0$.

Finally, consider an arbitrary $h \in H_t^c$ – not necessarily on the path induced by a – and again assume that $c_i^h(a) > 0$ for an arbitrary $i \in I$. Then similarly to the initial step, take another strategy $b_i \in A_i$ agreeing with a_i at every $h' \neq h$, while $c_i^h(b_i, a_{-i}) = 0$. Given that the strategy profile $a \in A$ prescribes that no player contributes or punishes a positive amount at any history following h, we obtain

$$u_i(a_i, a_{-i}|h) < u_i(b_i, a_{-i}|h),$$

which completes the proof. ■

C.3 Reputation effects to predicted behavior

In their seminal paper, Kreps et al. (1982) showed that in a finitely repeated prisoner's dilemma, once a small grain of imperfect information is introduced, cooperation for a minimum number of periods is sustained as part of every sequential equilibrium (see also Kreps et al., 1982). In particular, in their setting they consider a player who – at the beginning of the game – assigns some small probability $\mu > 0$ to the event that the opponent will follow the tit-for-tat (henceforth, TFT) strategy, and maintains this belief unless it is contradicted by the actual path of play. Here we extend this idea to public good games (with and without growth). Let us first formally introduce the setting.

Tit-for-tat strategy. We define tit-for-tat (TFT) in the game without punishment as the strategy that begins with a (full) contribution of $a_i^{h_1} = N_i^{h_1}$ tokens at the initial history h_1, and then at every subsequent history h_t the player's proportional contribution (wrt to the endowment $N_i^{h_t}$ at that period) is as close as possible the minimum proportional contribution chosen by her opponents at the immediate predecessor h_{t-1}, i.e.,

$$a_i^{h_t} \in \arg\min_{a_i \in A_i^{h_t}} \left| \frac{a_i}{N_i^{h_t}} - \min_{j \neq i} \frac{a_j^{h_{t-1}}}{N_j^{h_{t-1}}} \right| .$$

Obviously, in the standard case without growth the previous definition yields $a_i^{h_t} = \min_{j \neq i} a_j^{h_{t-1}}$.

Information structure. We assume that at the beginning of the game, each player $i \in I$ believes with probability $\mu > 0$ that every opponent $j \neq i$ follows the TFT strategy and with probability $1 - \mu$ that every opponent is rational.[2] Then, at each history *that is consistent with all of her opponents having played according to TFT so far*, player i continues having the same beliefs.[3] On the other hand, if *at least one opponent has already deviated from TFT*, player i updates her beliefs, now assigning probability 1 to every $j \neq i$ being rational. Finally we assume that these beliefs are commonly believed.[4]

This informational context can be formally modelled as an incomplete information game, using a type-based model, as further developed by Battigalli and Siniscalchi (1999, 2002). Formally, for each player $i \in I$, there are two types $T_i = \{t_i^R, t_i^{TFT}\}$, viz., the rational type t_i^R whose payoff function at each history is the one given the standard public good game (with or without growth), and the TFT type t_i^{TFT} whose payoff function is such that TFT is a strictly dominant strategy. At every history h where all opponents of i have played in accordance to TFT at every preceding history, every $t_i \in T_i$ has beliefs described by the probability measure $\lambda_i^h(t_i) \in \Delta(T_{-i})$ which keeps assigning probability μ to $(t_j^{TFT})_{j \neq i}$ and probability $1 - \mu$ to $(t_j^R)_{j \neq i}$. On the other hand, at every history h where at least one opponent $j \neq i$ has deviated from TFT at some preceding history, every $t_i \in T_i$ has beliefs described by the probability measure $\lambda_i^h(t_i) \in \Delta(T_{-i})$ which attaches probability 1 to $(t_j^R)_{j \neq i}$. Note that in this framework, it is commonly believed at some history h that every player is rational, if for all $i \in I$ and for every $t_i \in T_i$ it is the case that $\lambda_i^h(t_i)\big((t_j^R)_{j \neq i}\big) = 1$. This is for instance the case at histories h where at least two players have deviated from the TFT strategy at preceding histories (see Observation 2 below).

Let us first make two rather straightforward preliminary observations.

Observation 1 *Fix an arbitrary history $h \in H$ where it is commonly believed that every player is rational. Then, it is commonly believed that every player contributes 0 from that history onwards.*

[2]We could have instead allowed i to form beliefs about each opponent independently. However, this would only make our analysis more complex without changing the qualitative nature of our results.

[3]The underlying idea is very similar to the one of strong belief, which is widely used in the characterization of forward induction in dynamic games (Battigalli and Siniscalchi, 2002). In particular, strong belief says that an event is believed as long as it is consistent by past observation.

[4]Kreps et al. (1982) use the term commonly known. This is due to the fact that at the early years of game theory "knowledge" was used for "probability 1 belief". Nowadays, it is standard to use the term "belief" and "common belief" instead.

The proof of this claim is identical to the one in Kreps et al. (1982, Step 1). In particular, if it is commonly believed that everybody's type is t_i^R, then it is commonly believed that a standard public good game is played, and by backward induction it follows that every player will choose 0 at every subsequent history, both on and off the equilibrium path.

Observation 2 *Consider a history $h \in H$ such that at least two players have deviated from the TFT strategy. Then, it is commonly believed that every player will contribute 0 from that history onwards.*

To see that this is the case, recall that when a player i deviates from the TFT strategy, then every $j \neq i$ believes (at every subsequent history) that every $k \neq j$ is rational, i.e., at h every $t_j \in T_j$ assigns probability 1 to $(t_k^R)_{k \neq j}$. Thus, if two players deviate from the TFT strategy then every player believes that everybody else is rational and this is commonly believed. Hence, from the previous observation, it becomes commonly believed that everybody will contribute 0 from that history onwards.

C.3.1 Standard public good game without growth

Now, suppose that we are in the standard setting without growth. Then, the following result shows that upon being observed that a player has chosen an action that is not consistent with the TFT strategy, it becomes commonly believed that everybody will contribute 0 from that point onwards.

Lemma 5 *Fix an arbitrary history $h \in H$ such that only player i has deviated from the TFT strategy. Then, it becomes commonly believed that every $j \in I$ will contribute 0 from that history onwards.*

Proof. If i has deviated from the TFT strategy at some history preceding h, every $j \neq i$ believes that every $k \neq j$ is rational, whereas i keeps assigning at h probability μ to the event that every $j \neq i$ is of type t_j^{TFT}. Obviously, every rational player will contribute 0 at every history in H_T – where T is the total number of rounds – and this is commonly believed. Now, consider some history $h_{T-1} \in H_{T-1}$ that follows h. First, notice that every $j \neq i$ believes that every $k \neq j$ is rational, and therefore will contribute 0 at every subsequent period. Hence, t_j^R will also contribute 0 at h_{T-1}, as she (correctly) believes her current action does not affect the opponents' future action. Now, let us turn to player i, and assume that no player other than i has deviated from TFT up to h_{T-1}, thus implying that i keeps attaching probability μ to the opponents' type profile being $(t_j^{TFT})_{j \neq i}$. Furthermore, let us assume that the t_j^{TFT} would contribute x at h_{T-1}. Then, i's expected payoff from choosing $y \leq x$ at h_{T-1} is equal to

$$U_i^{h_{T-1}}(y) = \mu\Big(\underbrace{20 - y + \frac{1.5}{4}y + \frac{1.5}{4}3x}_{\text{payoff at } T-1} + \underbrace{20 + \frac{1.5}{4}3y}_{\text{payoff at } T}\Big) + (1-\mu)\Big(\underbrace{20 - y + \frac{1.5}{4}y}_{\text{payoff at } T-1} + \underbrace{20}_{\text{payoff at } T}\Big),$$

which is maximized when $y = 0$, thus implying that the rational t_i^R will contribute 0. This also means that the TFT type t_j^{TFT} would also contribute 0 at every history in in H^T that follows h_{T-1}, as he will imitate i. Continue inductively to prove that at h it is commonly believed that every player will contribute 0. ■

Proposition 6 *Fix an arbitrary symmetric sequential equilibrium and let $(h_1, \ldots, h_T, z)$ be the equilibrium path. Then, there is some $t \in \{1, \ldots, T\}$, such that every rational player t_i^R contributes the full endowment N_i^h at the first t histories (i.e., at all $h \in \{h_1, \ldots, h_t\}$), and 0 at the remaining histories (i.e., at every $h \in \{h_{t+1}, \ldots, h_T\}$).*

Proof. Take a strategy profile such that every player contributes 20 at all histories up to history h_t and 0 all other histories following h_t as well as at all histories off this path. First, we show that this is a sequential equilibrium. For starters observe that off the path $(h_1, \ldots, h_T, z)$ every player is rational, and this is commonly believed, implying that each player's beliefs satisfy the requirements of a sequential equilibrium. Now, let us take an arbitrary history $h \in \{h_1, \ldots, h_T\}$. Notice that at h_t, each player i continues believing with probability μ that all $j \neq i$ are of type t_j^{TFT}. This is because, up to that history, no player has deviated from the TFT strategy. However, at every history following h_t the *rational player* will contribute 0, viz., both at h_{t+1} as well as off the path. Moreover, let $K_t := T - t + 1$ denote the number of periods remaining at a history in H_t, and therefore at our history h_t. Hence, by choosing any strategy that assigns a contribution $x < 20$ at h, player i's expected payoff becomes

$$U_i^{h_t}(x) \quad = \quad \underbrace{20 - x + \frac{1.5}{4} 3 \cdot 20 + \frac{1.5}{4} x}_{\text{payoff at } t} + \underbrace{20(K_t - 1)}_{\text{payoff at remaining periods}}$$

Obviously, among all the possible deviations from TFT, the optimal one is to choose $x = 0$, in which case

$$U_i^h(0) = \frac{45}{2} + 20K_t.$$

On the other hand the TFT strategy induces an expected payoff of

$$\begin{aligned} U_i^{h_t}(TFT) &= \mu(1.5 \cdot 20K_t) + (1-\mu)\Big(\underbrace{1.5 \cdot 20}_{\text{payoff at } t} + \underbrace{\frac{1.5}{4}20}_{\text{payoff at } t+1} + \underbrace{20(K_t - 2)}_{\text{payoff at remaining periods}}\Big) \\ &= \frac{5}{2}(\mu - 1) + (10\mu + 20)K_t. \end{aligned}$$

Hence, $U_i^h(TFT) > U_i^h(0)$ if and only if

$$K_t > \hat{K}_t(\mu) := \frac{50 + 5\mu}{20\mu}, \tag{8}$$

where $\hat{K}_t(\mu)$ is the least number of remaining periods so that players continue to contribute. ■

C.3.2 Public good game with growth

Now, we are going to show that the main conclusion of Proposition 6 continues holding in public good games with growth, i.e., the structure of sequential equilibria is the same. However, what changes is the lower bound on the number of periods that the players contribute their whole endowment, i.e., *cooperation lasts longer*. For computation simplicity, we are going to focus on cases where $\mu < 10/35$. This is a rather mild assumption, as this entire literature restricts attention to very small μ's (e.g., see Kreps et al., 1982).

Lemma 7 *Let $\delta < 10/35$ and fix an arbitrary history $h \in H$ such that only player i has deviated from the TFT strategy. Then, it becomes commonly believed that every rational player will contribute 0 from that history onwards.*

Proof. The proof follows similar steps as the one of Lemma 5 above. The difference is that at some history in $h \in H_{T-1}$ where only player i has deviated up to that point, i's expected payoff as a function of i's proportional contribution $\beta \in [0, 1]$ is

$$\begin{aligned} U_i^h(\beta) &= \mu\Big(\underbrace{N_i^h}_{\text{endowment at } T-1} \underbrace{- \beta N_i^h + \frac{1.5}{4}\beta N_i^h + \frac{4.5}{4}\alpha N_j^h}_{\text{payoff at } T-1} + \underbrace{\frac{4.5}{4}\beta\big(N_j^h - \alpha N_j^h + \frac{1.5}{4}\beta N_i^h + \frac{4.5}{4}\alpha N_j^h\big)}_{\text{payoff at } T}\Big) \\ &+ (1-\mu)\Big(N_i^h - \beta N_i^h + \frac{1.5}{4}\beta N_i^h\Big) \\ &= \mu\Big(N_i^h - \frac{2.5}{4}\beta N_i^h + \frac{4.5}{4}\alpha N_j^h + \frac{4.5}{4}\beta\big(N_j^h + \frac{0.5}{4}\alpha N_j^h + \frac{1.5}{4}\beta N_i^h\big)\Big) + (1-\mu)\big(N_i^h - \frac{2.5}{4}\beta N_i^h\big) \end{aligned}$$

with $\alpha \in [0, 1]$ denoting the proportional contribution of every $j \neq i$ at h. Then, notice that, given our condition on δ, the expected payoff $U_i^h(\beta)$ is maximized for $\beta = 0$, irrespective of α. To see this, we differentiate $U_i^h(\beta)$ wrt to β, and then using the facts that $\alpha \leq 1$ and $\beta \leq 1$ and $N_j^h < N_i^h$, we obtain

$$\frac{\partial U_i^h}{\partial \beta} < \mu\Big(\frac{2}{4}N_j^h + \frac{2.25}{16}N_j^h + \frac{13.5}{16}N_j^h\Big) - (1-\mu)\frac{2.5}{4}N_j^h$$

which is in turn negative if $\mu < 10/35$. Hence, i will contribute 0 at $h \in H_{T-1}$. This implies that at the last history both t_j^R as well as t_j^{TFT} will contribute 0. Then, by working backwards we inductively prove that every player will contribute 0 at all histories following the first deviation of i, and this is commonly believed. ■

Proposition 8 *Let $\delta < 10/35$. Fix an arbitrary symmetric sequential equilibrium and let $(h_1, \ldots, h_T)$ be the equilibrium path. Then, there is some $t \in \{1, \ldots, T\}$, such that every rational player t_i^R contributes the full endowment N_i^h at the first t histories, i.e., at all $h \in \{h_1, \ldots, h_t\}$, and 0 at the remaining histories, i.e., at every $h \in \{h_{t+1}, \ldots, h_T\}$.*

Proof. The proof of this claim is almost identical to the one of Proposition 6 above. In particular, first notice that at h_t, each player i continues believing with probability μ that all $j \neq i$ are of type t_j^{TFT}. This is because, up to that history, no player has deviated from the TFT strategy. Hence, by choosing any strategy that deviates from contributing $\beta = 1$ at h_t, player i's expected payoff becomes

$$U_i^{h_t}(0) = N_i^{h_t} + \frac{1.5}{4} 3N_i^{h_t}.$$

On the other hand the TFT strategy induces an expected payoff of

$$U_i^{h_t}(TFT) = \mu\big(1.5^{K_t} N_i^{h_t}\big) + (1-\mu)\big(\frac{1.5^2}{4} N_i^{h_t}\big).$$

Hence, we obtain $U_i^{h_t}(TFT) > U_i^{h_t}(0)$ whenever it is the case that

$$K_t > \hat{K}_t^G(\mu) := \log_{1.5} \frac{6.25 + 2.25\mu}{4\mu},$$

where $\hat{K}_t(\mu)$ is the least number of remaining periods so that players continue to contribute. ■

D Additional Tables and Figures

This section contains additional tables and figures. Table 7 summarizes the number of independent observations, participants and sessions in all our treatments. Table 8 shows the order of sessions for our main treatments.

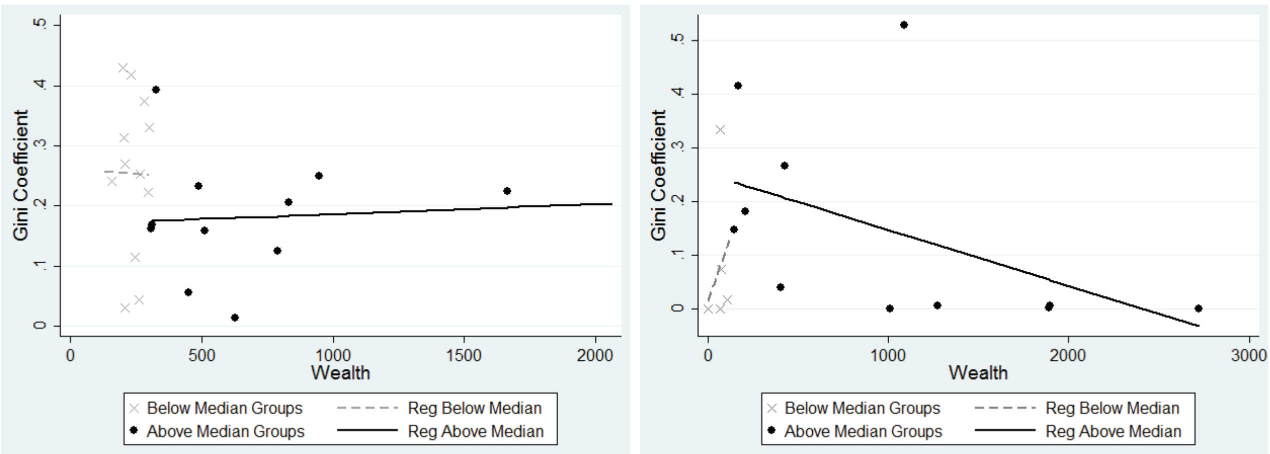
	15 periods	10 periods	Overall
W/o Punishment (NOPUNISH)	15 (60,2)	23 (92,3)	38 (152,5)
With Punishment (PUNISH)	15 (60,2)	21 (84,3)	36 (144,5)
No Inequality w/o punish (NOPUNISH-NOINEQUALITY)	-	24 (96,3)	24 (96,3)
No Inequality with punish (PUNISH-NOINEQUALITY)	-	14 (56,3)	14 (56,3)
No Growth w/o punish (NOPUNISH-NOGROWTH)	-	29 (116,4)	29 (116,4)
No Growth with punish (PUNISH-NOGROWTH)	-	23 (92,3)	23 (92,3)

Table 7: Number of Independent Observations (Participants, Sessions).

	Length	Punish	Groups
24/09/2012 11:30	15	NOPUNISH	7
24/09/2012 13:30	15	PUNISH	8
24/09/2012 15:30	15	NOPUNISH	8
05/10/2012 11:00	10	PUNISH	7
05/10/2012 13:30	10	NOPUNISH	8
05/10/2012 16:00	10	PUNISH	7
02/11/2012 11:00	15	PUNISH	7
02/11/2012 13:00	10	NOPUNISH	8
02/11/2012 14:30	10	NOPUNISH	7
02/11/2012 16:00	10	PUNISH	7

Table 8: Order of sessions for the main treatments. Sessions for the additional treatments reported on in Section 5.2 were conducted between 23/04/2014 and 25/06/2014.

Table 9 shows random effects OLS regressions of wealth on period and treatment dummy as well as interactions for the 10-period games. Table 10 shows the same analysis for the 15-period games. Tables 11 and 12 focus on inequality (Gini coefficients) as outcome. Figure D.1 shows the correlation between the wealth and Gini in period 10 only for the 23 (21) groups in NOPUNISH (PUNISH).



(a) NOPUNISH

(b) PUNISH

Figure D.1: Correlation between the wealth and Gini in period 10 only for the 23 (21) groups in NOPUNISH (PUNISH). Each point represents one group with their period 10 wealth and Gini coefficient. Dots are above median groups and crosses below median groups. Lines are fitted values from linear regression of Gini on wealth. In the graph for treatment PUNISH some below median groups with a Gini coefficient of 1 are omitted from the graph (not the regression) for expositional clarity.

	Wealth					
	(1)	(2)	(3)	(4)	(5)	(6)
period (β_1)	40.50***	18.84***	45.06***			
	(7.59)	(7.23)	(9.27)			
PUNISH (β_2)	-80.98*	-76.47***		-28.44	-140.60***	61.57
	(48.64)	(25.83)		(57.24)	(10.67)	(79.21)
period × PUNISH (β_3)	9.55	-69.17***				
	(19.09)	(18.37)				
period^2 (β_4)		1.96				
		(1.27)				
period^2 × PUNISH (β_5)		7.15**				
		(3.19)				
Constant (α)	14.19	57.51***	-24.47	236.90***	170.90***	308.90***
	(20.26)	(9.13)	(24.39)	(21.85)	(6.68)	(33.72)
Test $\beta_1 + \beta_3 = 0$	50.05***	-50.33***				
p-value	0.0043	0.0029				
Test $\beta_4 + \beta_5 = 0$		9.111***				
p-value		0.0018				
Observations	440	440	440	440	220	220
Groups	44	44	44	44	22	22
Sample	All	All	All	All	below median	above median

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9: Random effects OLS regression of wealth on period and treatment dummy. Significance at the 1,5,10 percent level is denoted by ***,** ,*, respectively. Standard errors account for autocorrelation and are clustered at the matching group level. 10 period games only.

	Wealth					
	(1)	(2)	(3)	(4)	(5)	(6)
period (β_1)	95.66**	-57.83	67.59***			
	(47.62)	(56.89)	(25.92)			
PUNISH (β_2)	149.80	-49.10		-299.20	-128.20***	-401.70
	(212.50)	(112.40)		(195.40)	(24.01)	(325.30)
period × PUNISH (β_3)	-56.12	14.07				
	(50.80)	(64.19)				
period^2 (β_4)		9.59				
		(6.51)				
period^2 × PUNISH (β_5)		-4.38				
		(7.12)				
Constant (α)	-242.7	192.2**	-167.8	522.6***	175.7***	826.1***
	(198.80)	(97.08)	(107.10)	(182.50)	(12.98)	(307.7)
Test $\beta_1 + \beta_3 = 0$	39.54**	-43.76				
p-value	0.0253	0.1409				
Test $\beta_4 + \beta_5 = 0$		5.21*				
p-value		0.0709				
Observations	450	450	450	450	225	225
Groups	30	30	30	30	15	15
Sample	All	All	All	All	below median	above median

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 10: Random effects OLS regression of wealth on period and treatment dummy. Significance at the 1,5,10 percent level is denoted by ***,** ,*, respectively. Standard errors clustered at the matching group level. 15 period games only.

	Gini coefficient					
	(1)	(2)	(3)	(4)	(5)	(6)
period (β_1)	0.017***	0.053***	0.012***			
	(0.002)	(0.009)	(0.003)			
PUNISH (β_2)	0.050**	0.084***		-0.010	0.038	-0.049**
	(0.020)	(0.030)		(0.036)	(0.061)	(0.024)
period × PUNISH (β_3)	-0.011*	-0.028				
	(0.006)	(0.018)				
period^2 (β_4)		-0.003***				
		(0.000)				
period^2 × PUNISH (β_5)		0.001				
		(0.001)				
Constant (α)	0.063***	-0.008	0.087***	0.161***	0.191***	0.129***
	(0.007)	(0.012)	(0.010)	(0.017)	(0.026)	(0.018)
Test $\beta_1 + \beta_3 = 0$	0.006	0.025*				
p-value	0.2609	0.0993				
Test $\beta_4 + \beta_5 = 0$		-0.002				
p-value		0.3002				
Observations	440	440	440	440	220	220
Groups	44	44	44	44	22	22
Sample	All	All	All	All	below median	above median

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 11: Random effects OLS regression of Gini coefficient on period and treatment dummy. Significance at the 1,5,10 percent level is denoted by ***,** ,*, respectively. Standard errors account for autocorrelation and are clustered at the matching group level. 10 period games only.

	Gini coefficient					
	(1)	(2)	(3)	(4)	(5)	(6)
period (β_1)	0.005**	0.015*	0.002			
	(0.002)	(0.009)	(0.002)			
PUNISH (β_2)	0.033	0.083*		-0.019	-0.017	-0.025
	(0.039)	(0.044)		(0.029)	(0.051)	(0.030)
period × PUNISH (β_3)	-0.006	-0.024**				
	(0.005)	(0.011)				
period^2 (β_4)		-0.000				
		(0.000)				
period^2 × PUNISH (β_5)		0.001				
		(0.000)				
Constant (α)	0.087***	0.058***	0.104***	0.134***	0.145***	0.124***
	(0.011)	(0.017)	(0.020)	(0.021)	(0.038)	(0.023)
Test $\beta_1 + \beta_3 = 0$	-0.001	0.015				
p-value	0.8656	0.2464				
Test $\beta_4 + \beta_5 = 0$		0.001				
p-value		0.3208				
Observations	450	450	450	450	225	225
Groups	30	30	30	30	15	15
Sample	All	All	All	All	below median	above median

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 12: Random effects OLS regression of Gini coefficient on period and treatment dummy. Significance at the 1,5,10 percent level is denoted by ***,** ,*, respectively. Standard errors clustered at the matching group level. 15 period games only.

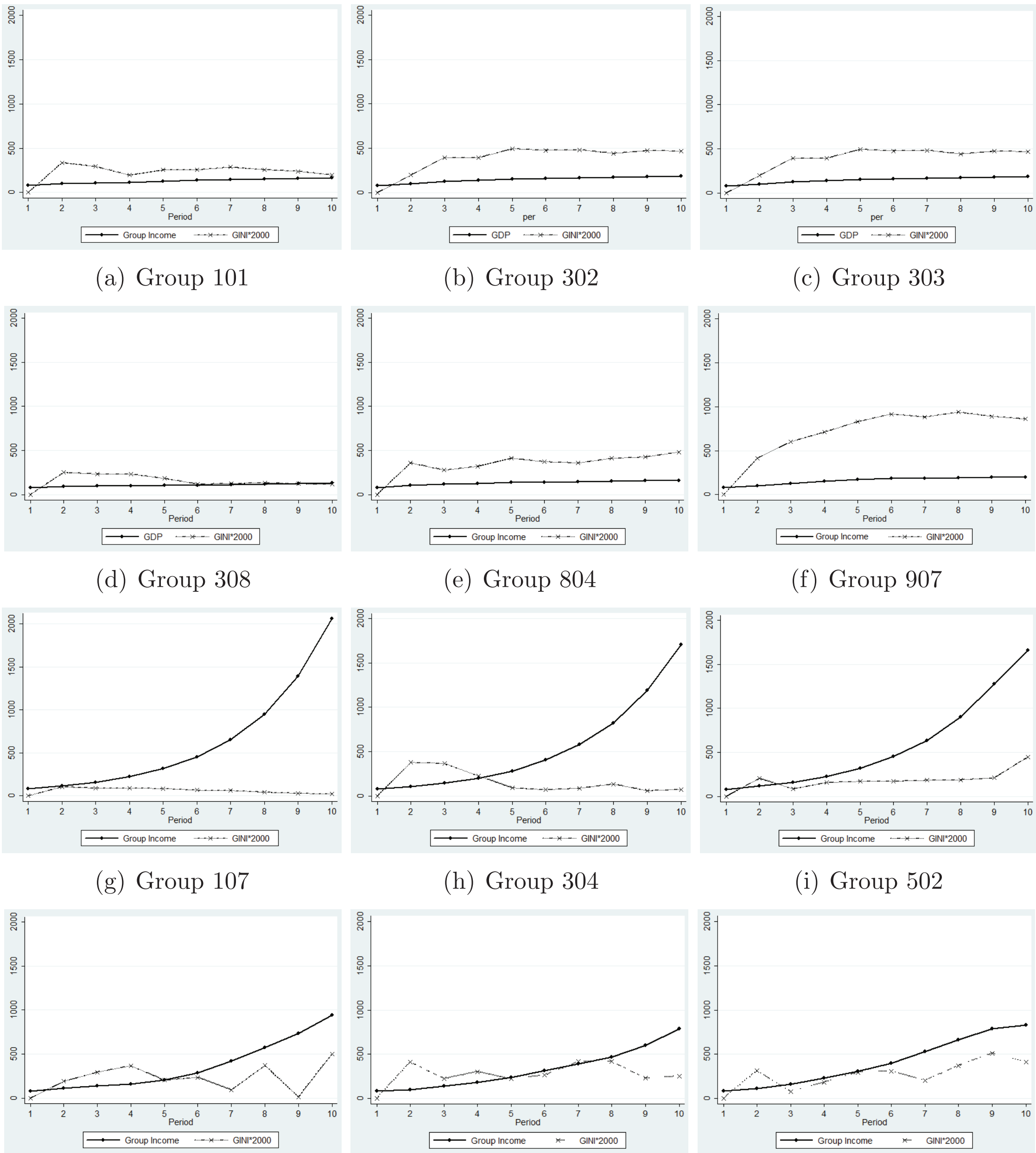
	(1) norm contribution	(2) contribution
PUNISH	11.27	8.057***
	(11.89)	(1.135)
NOPUNISH-NOGROWTH	-23.77***	
	(8.21)	
PUNISH-NOGROWTH	-23.52***	
	(8.21)	
NOPUNISH-NOINEQUALITY		26.29***
		(8.632)
PUNISH-NOINEQUALITY		50.74***
		(13.83)
Constant	24.09***	31.46***
	(8.21)	(10.99)
Observations	5,080	5,376
Number of Participants	448	504

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 13: (Normalized) contributions regressed on treatment dummies. Simple OLS regression. Standard errors clustered by matching group. Baseline is treatment NOPUNISH. ***,** ,* significance at 1,5,10 percent level.

E Matching Group Figures

Figures E.1-E.2 show the evolution of wealth and Gini coefficient over time for the six poorest and six richest matching groups in each treatment as measured by period 10 wealth. Graphs on additional matching groups are available upon request. In NOPUNISH (Figure E.1) the evolution of both indicators is relatively smooth. In PUNISH (Figure E.2) an interesting phenomenon can be observed. In groups where the Gini coefficient rises sharply in early periods (e.g. groups 201 or 208), there is so much punishment that wealth ends up being zero.



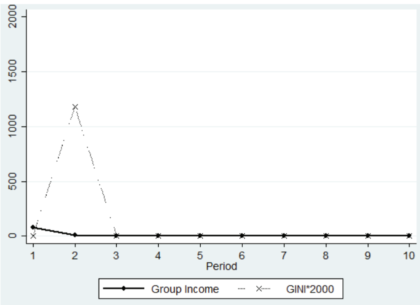
(a) Group 101 (b) Group 302 (c) Group 303

(d) Group 308 (e) Group 804 (f) Group 907

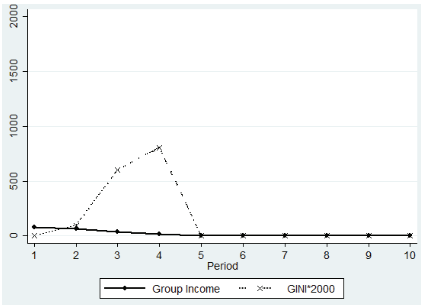
(g) Group 107 (h) Group 304 (i) Group 502

(j) Group 504 (k) Group 901 (l) Group 904

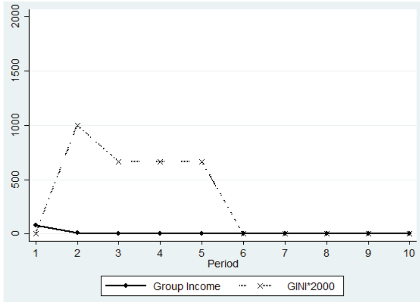
Figure E.1: Wealth and Gini coefficient across the six poorest (panels (a)-(f)) and six richest ((g)-(l)) matching groups (as measured by $t = 10$ wealth). Treatment NOPUNISH. Gini coefficient is multiplied by 2000 to be on the same scale as wealth.



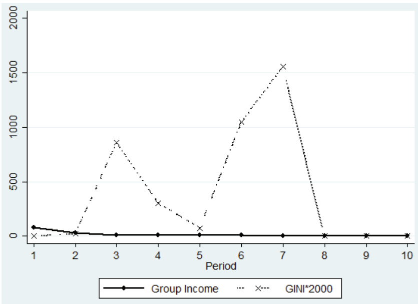
(a) Group 201



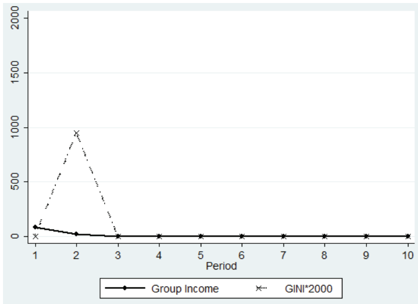
(b) Group 205



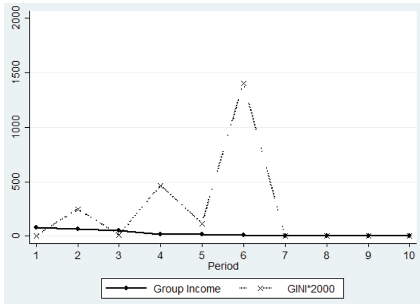
(c) Group 208



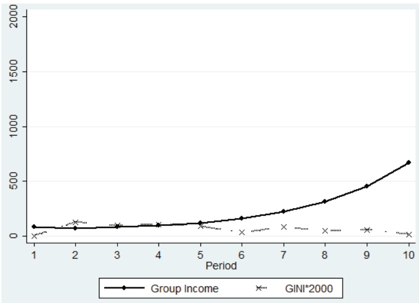
(d) Group 404



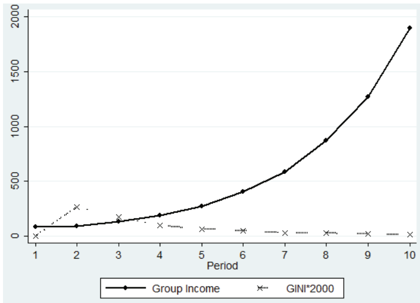
(e) Group 602



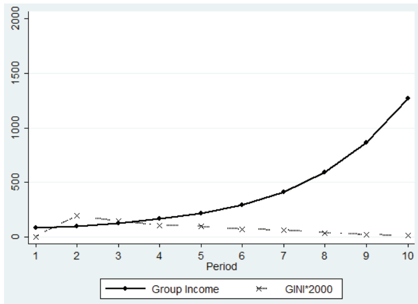
(f) Group 604



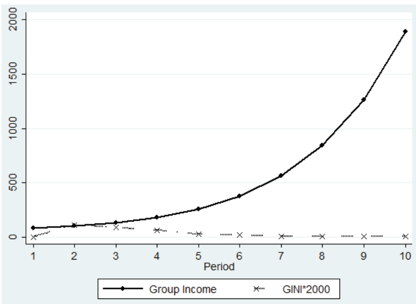
(g) Group 204



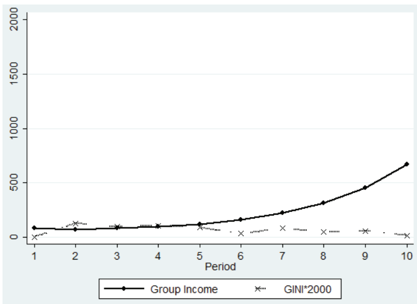
(h) Group 406



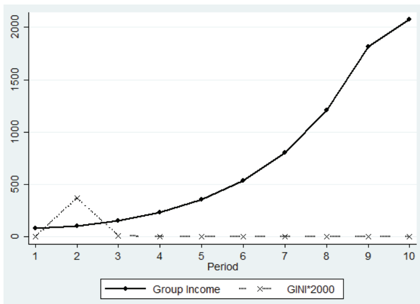
(i) Group 603



(j) Group 1001



(k) Group 1003



(l) Group 1005

Figure E.2: Wealth and Gini coefficient across the six poorest (panels (a)-(f)) and six richest ((g)-(l)) matching groups (as measured by $t = 10$ wealth). Treatment PUNISH. Gini coefficient is multiplied by 2000 to be on the same scale as wealth.

F Questionnaire Data

In this section we summarize the results from our post-experimental questionnaire. All questions can be found in Online Appendix B. Before we discuss the responses we should mention that due to computer problems in some of the sessions our questionnaire data are incomplete. Those problems were exogenous to session and participant characteristics, so our collected data should be representative. However, the reader should be aware that they don't contain all our participants. We were able to collect full questionnaires from 124 out of 152 participants in treatment NOPUNISH and 84 out of 144 participants in treatment PUNISH. Table 14 summarizes the key characteristics of our participants. About half of them are female. Also about half are German, but there are also significant percentages of Dutch, Western European (Belgium, Luxemburg, France or UK) and Eastern European participants. They are on average 21.5 years old in both treatments. The youngest participant was 17 and the oldest 35. Around 40 percent of them are business students and almost all others students from other fields (very few non-students). They have spent on average 2 years at university. Our risk aversion measure has full support in our sample and there are no significant treatment differences in the distributions of any of the variables mentioned in Table 14.

	NOPUNISH	PUNISH
Gender (Share female)	0.42	0.52
Share German	0.56	0.43
Share Dutch	0.13	0.10
Share BEL/LUX/FRA/UK	0.11	0.13
Share Eastern Europe	0.10	0.20
Average Age (Range)	21.5(18, 35)	21.5(17, 28)
Share Business	0.41	0.40
Share Economics	0.20	0.12
Share European Studies	0.07	0.12
Share Psychology	0.08	0.05
Years studied (Range)	2.1(0, 10)	2.0(0, 5)
Risk Aversion (Range)	3.39(0, 7)	3.19(0, 7)

Table 14: Summary Statistics Questionnaire Data. Only Nationality Categories and Fields of Study with more than 10 percent answers are mentioned explicitly. The variable risk aversion can take values from 0 to 7, where 0 is most risk averse and 7 least risk averse.

Table 15 summarizes the responses to the personality questionnaire. Again the distribution of answers is very similar across treatments.

	NOPUNISH	PUNISH
Q1 I am a quick thinker	5.18	5.40
Q2 I get easily offended	3.58	3.66
Q3 very satisfied	5.07	5.16
Q4 very dependent	2.67	2.75
Q5 generally happy	5.71	5.75
Q6 work important	4.77	4.89
Q7 family important	5.67	6.03
Q8 friends important	6.01	6.05
Q9 religion important	2.47	2.26
Q10 politics important	3.65	3.60
Q11 most people trusted	3.72	3.88
Q12 hard work better	5.48	5.44
Q13 government responsible	4.29	4.45
Q14 incomes equal	3.78	3.76

Table 15: Summary Statistics Questionnaire Data, Mean Reply to Personality Characteristics Questions of the form "How strongly do you agree to the following statements?" 1 - disagree strongly, 7 - agree strongly. The exact statements can be found in Online Appendix B.

We then regress our measures of growth (wealth) and inequality (Gini) in the two treatments on the questionnaire data. We use simple OLS regressions of wealth and Gini in period 10 on individual questionnaire data and we cluster standard errors by matching group. Table 17 shows the results for treatment NOPUNISH. Overall our questionnaire measures have a hard time to explain the variation in wealth and Gini and almost all of them are insignificant. There might be somewhat of a gender effect in treatment NOPUNISH. In particular wealth seems to be lower in groups with more women. Strong agreement to the statement “Friends play an important role in my life” seems to predict somewhat higher wealth in treatment NOPUNISH. Both of these results should be interpreted with care, though, since we regress on quite a large set of variables. The overall message seems to be that our questionnaire data *cannot* explain the variation in wealth and Gini coefficient.

	NOPUNISH	PUNISH
above median wealth	2.31	1.70
	(2.18)	(1.42)
below median wealth	2.24	1.46
	(1.53)	(3.17)

Table 16: Average Donation (Std. Dev.) in Euros to Medics without Borders.

Table 18 shows the results of the analogous regression for treatment PUNISH. Here the result is even clearer. None of the variables seems systematically able to explain any of the variation in wealth or Gini observed in this treatment. There is a significant coefficient on risk aversion, indicating that higher risk aversion of group members might lead to higher wealth in these treatments. This effect would be intuitive if risk averse participants react more strongly to the threat of punishment, but it disappears once we stop controlling for the personality characteristics.

Finally we have a look at how much our participants decide to donate to Medics without Borders. Table 16 shows the average donation in Euros to medics without Borders. Participants in treatment PUNISH seem to donate somewhat less than participants in treatment NOPUNISH. We compare the distribution of donations using a two-sided ranksum test where we treat each individual donation as an independent observation. The two treatments are significantly different ($p = 0.0432$) on aggregate and if we restrict to below median groups ($p = 0.0134$), but not restricted to above median groups ($p = 0.4711$).

More interestingly, though, participants from groups with wealth above the median do *not* seem to contribute more on average than those from groups with below median wealth. There is no significant difference in treatment NOPUNISH ($p = 0.9195$) and a marginally significant difference in treatment PUNISH ($p = 0.0506$).

This is despite the fact that participants from groups with above median wealth earn 178 tokens on average in period 10 (189 in treatment PUNISH), while those from groups with below median wealth earn only 56 tokens (23 tokens) on average in period 10. This evidence suggests hence that participants in groups with above median wealth are *not* per se more altruistic than others.

	(wealth)	(wealth)	(Gini)	(Gini)
gender	-147.55^{**}	-151.23^{**}	-0.04^{*}	-0.02
	(70.58)	(58.84)	(0.02)	(0.02)
age	-21.46	-17.36	-0.00	-0.00
	(21.89)	(19.57)	(0.00)	(0.00)
risk aversion	-38.45	-35.06	0.00	0.00
	(26.31)	(23.62)	(0.01)	(0.01)
Q1	-29.48		-0.00	
	(19.14)		(0.01)	
Q2	-2.33		0.00	
	(15.53)		(0.00)	
Q3	-8.93		-0.00	
	(42.65)		(0.01)	
Q4	-10.22		0.00	
	(24.77)		(0.00)	
Q5	28.45		0.02	
	(41.43)		(0.01)	
Q6	-6.60		0.00	
	(26.88)		(0.00)	
Q7	-30.41		-0.00	
	(25.03)		(0.00)	
Q8	96.04^{**}		-0.00	
	(38.20)		(0.01)	
Q9	-15.25		0.00	
	(25.27)		(0.00)	
Q10	46.12		-0.02^{*}	
	(28.45)		(0.01)	
Q11	11.35		0.00	
	(16.87)		(0.00)	
Q12	3.88		-0.00	
	(24.16)		(0.00)	
Q13	-60.60		0.00	
	(42.82)		(0.01)	
Q14	8.16		-0.00	
	(12.98)		(0.00)	
constant	43100.80	35194.95	3.91	1.02
	(43656.74)	(39033.02)	(10.07)	(8.02)
Observations	124	124	124	124
Groups	31	31	31	31
R^2	0.1387	0.0607	0.0780	0.0110
VCE robust S.E.	Yes	Yes	Yes	Yes

Table 17: OLS regression of period 10 wealth and Gini coefficient on questionnaire characteristics. Treatment NOPUNISH

	(wealth)	(wealth)	(Gini)	(Gini)
gender	−40.17	−47.60	−0.04	−0.03
	(169.29)	(204.07)	(0.04)	(0.05)
age	−7.17	0.10	0.01	0.01
	(26.43)	(25.60)	(0.01)	(0.02)
risk aversion	124.04**	73.43	0.00	0.00
	(58.87)	(47.51)	(0.02)	(0.02)
Q1	−2.91		0.01	
	(62.92)		(0.01)	
Q2	−40.90		0.02	
	(28.99)		(0.02)	
Q3	−30.15		−0.00	
	(50.43)		(0.01)	
Q4	−52.27		−0.02	
	(102.48)		(0.02)	
Q5	−67.12		−0.01	
	(68.65)		(0.02)	
Q6	117.22		−0.00	
	(75.48)		(0.01)	
Q7	5.52		0.02	
	(81.70)		(0.02)	
Q8	−53.67		−0.00	
	(61.58)		(0.01)	
Q9	74.55		0.01	
	(55.88)		(0.01)	
Q10	−14.53		−0.01	
	(40.04)		(0.01)	
Q11	34.14		0.00	
	(41.89)		(0.02)	
Q12	−53.44		0.00	
	(107.01)		(0.02)	
Q13	−41.32		0.01	
	(34.60)		(0.01)	
Q14	3.71		−0.02	
	(81.51)		(0.02)	
constant	15173.64	67.15	−20.02	−28.47
	(52764.84)	(50911.71)	(35.82)	(40.83)
Observations	84	84	84	84
Groups	21	21	21	21
R^2	0.1430	0.0243	0.1213	0.0352
VCE robust S.E.	Yes	Yes	Yes	Yes

Table 18: OLS regression of period 10 wealth and Gini coefficient on questionnaire characteristics. Treatment PUNISH