Self governance under weak rule of law and anti-social punishment: An experimental study among Kavango forest users

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Abstract: In order to assess forest resource harvesting and subsequent punishment behaviour in the Kavango woodland savannah of Namibia, we used a framed public goods field-experiment. The extraction game was framed as a task to withdraw timber from a commonly owned and jointly managed forest with external and internal punishment treatments. In this region with a weak rule of law we show that internal punishment (and thus self-governance) is the preferential rule measured in terms of cooperation and resource protection compared with external punishment (Government intervention). We find that antisocial punishment (i.e. the sanctioning of people who cooperate), which often occurs in settings with a weak rule of law, does not prevent cooperative self-governance. We test various hypotheses on the micro-level determinants of antisocial punishment and combine our findings with ethnographic evidence on cooperation and rule of law in the society. We highlight the role of individual revenge and group composition with competitive people as drivers for anti-social punishment.

Key words: Public goods; Southern Africa; antisocial punishment; revenge; competitiveness

JEL Codes: C93; D02; D03

1. Introduction

In many communities all over the world people work together to provide goods and services that are not provided by their government. They build and maintain roads, religious buildings, and community halls; operate volunteer fire control groups or neighbour patrols and establish rules for maintenance and management of public goods or natural resources. On top of that, a wave of decentralisation has been taking place in many transitional and developing countries that requires communities to engage in governance. Such self governance seems to rest on people's willingness to limit the amount of free-riding within groups by applying costly punishment – a phenomenon that has been observed worldwide to differing degrees (Henrich, et al. 2006; Marlowe, et al. 2008). Ostrom et al. (2000; 1992) emphasize that a large enough share of individuals with pro-social motivations coupled with costly informal *sanctions* of free riders make self governance in the sense of higher cooperation possible. The importance of punishing free-riders to sustain norms of cooperation has been highlighted in one-shot interactions among anonymous and unrelated individuals (Fehr & Gächter 2000).

While the so called 'pro-social' or 'altruistic' punishment (PSP) is defined as the act of incurring personal costs in order to punish a norm violator without obtaining any personal benefits antisocial punishment (ASP) is defined as 'the sanctioning of people who behave pro-socially' and hence means the punishing of co-operators by the free-riders (Herrmann, et al. 2008; Nikiforakis 2008). Gächter and Herrmann (2006) and Herrmann et al. (2008) argue that spiteful punishment exists in many societies and might have undermining effects on cooperation, and thus self governance might only work in certain regions of the world. In their study undertaken in 15 different countries, Herrmann et al. (2008) documented the widespread occurrence and between country variation of antisocial punishment. They find that the success of co-operation in the provision of public goods strongly depends on the absence of antisocial punishment. Seeking for explanations they have investigated various properties of the setting and claim that weak norms of civic cooperation[1] and a weak rule of law[2] in a country impel the occurrence of antisocial punishment which limits the possibility of self-governance.

[1] According to Herrmann et al. (2008:1365) 'norms of civic cooperation are expressed in people's attitudes to tax evasion, abuse of the welfare state, or dodging fares on public transport (i.e. taken from World Value Survey (WVS): The statements are (i) "Claiming government benefits to which you are not entitled", (ii) "Avoiding a

Already Ostrom (1990) pointed to the fact that weak central authorities might undermine local level efforts to build up a functioning decentralized management system (and thus that different levels of institutions complement each other) and to the importance of nested, polycentric governance. However, and most importantly, the statement[3] by Gächter & Herrmann (2006) and Herrmann et al. (2008) implicitly implies that as a consequence of the limits to self-governance of informal sanctioning, formal law enforcement should be promoted in countries with a weak rule of law. However, since Gächter & Herrmann (2006) and Herrmann et al. (2008) do not test externally enforced sanctions it might well be that with weak rule of law and/or low civic norms external punishment might perform even worse than informal internal punishment. Our experiment explicitly tests both forms of punishment in a setting of weak rule of law.

Using an external punishment treatment with grauduate sanction and imperfect law enforcement and an internal punishment treatment we find both punishment scenarios lead to a reduction in earnings compared to the scenario without rules. As in Gächter and Herrmann (2006), we find a negative welfare effect with lower earnings per round in the informal punishment scenario (avg.= 7.3) compared with no rules (avg.=13.2) and external sanctioning (avg.= 12.1). The low earnings in informal sanctioning were caused by the high cost of punishing (avg.= -1.9) and the high cost of being punished (avg.= -5.8) compared with much lower penalty in the external punishment scenario (avg.= -1.8). However in contrast to Gächter and Herrmann (2006), internal punishment leads to more

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fare on public transport", and (iii) "Cheating on taxes if you have a chance"). They are all situations that can be modelled as public goods problems. The stronger norms of civic cooperation are in a society, the more free riding might be viewed as unacceptable and the more it might be punished in consequence. The flip side of the argument is that cooperators, who behave in a normatively desirable way, should not get punished; strong norms of civic cooperation might act as a constraint on antisocial punishment'.

[2] The Rule of Law indicator measures "the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, the police, and the courts, as well as the likelihood of crime and violence". 'The strengths of the rule of law in a society might also have an impact on antisocial punishment. If the rule of law is strong, people trust the law enforcement institutions, which are being perceived as being effective, fair, impartial and bound by the law. Revenge is shunned. If the rule of law is weak the opposite holds. Thus the rule of law reflects how norms are commonly enforced in a society' (Ibid.)

[3] They conclude, that "*understanding ASP is especially of relevance for the debate about social capital and in particular a literature [Ostrom 1990, Ostrom et al. 1994] that argues that informal sanctions often substitute for formal enforcement mechanisms if these are lacking or not working well [by saying that] … the fact that antisocial punishment is negatively correlated with the strength of the rule of law and also with cooperation levels suggests that the quality of the formal law enforcement institutions and informal sanctions are complements (rather than substitutes).*"

cooperative resource harvesting strategies than external punishment (t=4.03; df= 1198; p<.0) and also compared to the no punishment scenario (t=14.5; df= 1199; p<.0). This is even more surprising as we observe that up to one third of the issued punishments are antisocial. Thus, our result shows a more favourable perspective on self-governance than the previous results by Herrmann et al. (2008). Since the true nature of costly punishment remains a matter of debate (Milinski & Rockenbach 2008) we further analyse the social context of our experiment as well as micro determinants for pro-social and anti-social punishment.

Overall, our experiments differ from previous studies, since we use a slightly different public good game where we frame a typical resource extraction situation, use a different subject pool with more socio-demographic variation, and we can compare internal to external punishment. Lastly, we focus on micro determinants of antisocial punishment which so far have not been studied extensively in the field and add group characteristics and ethnographic material to the analysis. The paper has the following structure: In the next section grounding on ethnography we describe the setting of our study site and sketch the influence of the legal system ruling resource extractions since this has been proposed to be a main determinant for the occurrence of ASP. In the subsequent sections we explain the experimental design, the two punishment treatments, the recruitment and the samples socio-demographic characteristics as well as the process of data collection. In the result section we report the positive impact of informal sanctions on cooperation and analyze the determinants of anti-social punishment and pro-social punishment. We test the proposed hypotheses on dominance/competitiveness, revenge, strategic considerations, as well as the influence of socio-demographic variables and civic cooperation.

2. Setting of the experiment

Our subject pool, rural subsistence farmers depending on staple products like millet and maize, lives in the forest savannah of the Kavango Region in the North-East of Namibia. An estimated 80% of the 202.000 inhabitants of this region, of different ethnic backgrounds, still depend on rainfed agriculture, livestock keeping and the utilization of natural resources. A contrast between urban commercial

development and widespread overall rural poverty is strikingly visible. Rural farmers live in villages largely without electricity and sanitation and households. This harsh setting is characterized by unstable rainfall, infertile soils, little access to cash and markets and constant threat of temporary poverty and starvation. People face incentives to expand agricultural activities and to commodify common goods like thatching grasses or broad-leaf timber species to compete for cash income with differing success. Such commodification processes threaten the Kavango woodland savannah (Fox 2002; Mendelsohn & el Obeid 2003; Pröpper 2009), which is one of the few remaining forest resources for a country that is threatened by deforestation.

The *institutional* environment is characterized by little official control. The villages are usually ruled by elected traditional headmen who are part of a three level traditional authority applying a traditional law on the grounds of coexistence of two bodies of law in Namibia – the statutory and the traditional. As outlined elsewhere in respect to the protection of public goods, the rule of different layers of legislative and executive organs (statutory and traditional) can be described as *weak* (Pröpper 2009). The few existing institutional bodies, such as headmen/women, local councils and committees, involve mostly the same senior community members and follow the immediate need to collectively manage public goods, e.g. the common water-point, school infrastructure, prevention of fire or the resolution of resulting conflicts. Enforcement of compliance, e.g. in the form of traditional policing on the presence of statutory authorities is weak. The system of traditional law bases mainly on material compensation in the form of cattle payments for any sort of misdemeanour. Against a background of widespread poverty – 50 % of households do not own cattle – these fines often cannot be executed – though they have some deterring effect. The weakness of the rule of law combines insufficient resource protection incentives and strong incentives to free-ride, since there is a considerable market for low-price timber products in Namibia and even more in South Africa (Pröpper 2009). Free-riding by exploiting forest resources creates the problem of over-harvesting resources, especially the irreplaceable and undervalued hardwood timber species (Pröpper 2009).

The *social* setting of cooperative and competitive social relations, norms and motivations of actors may be just as influential for players' choices. In the absence of a statutory social security and insurance system, it is social capital, kinship ties, family networks and related *norms of cooperation* and reciprocity which function as the backbone of the rural society. But a fundamental condition of the transforming society seems to be its growing internal economic stratification (Pröpper 2009). The unequal access to resources like authority and power, availability of transport, cash through labour, pensions or remittances, and hence to consumer goods and urban markets are clearly being perceived as causes of social inequalities (ibid.). Envy, an environment of competition and related anti-social attacks are resulting phenomena which have been documented to come forth within the highly prevalent complex of witchcraft (ibid.).[4] Emergent seems to be a tension between individualized competition for scarce resources and the collective norms of cooperation for maintaining social order, as we have seen elsewhere that especially young male players used the anonymity of a trust game to break free from the norms of collectivity (Pröpper 2008). In the absence of cash income this domestic and communal collectivity, expressed by norms of civic interaction[5] and enforced by dominant senior network elders, is often experienced by competitive individuals as a social control constraining individual freedom. The harvesting and selling of natural resources, such as some most lucrative timber species, is an activity that lies at the heart of this tension.

The sketched situation offers a classic setting to investigate whether co-operation is achieved by the group and whether informal sanctioning institutions or government interventions can improve co-

[4] Economic success is often explained with the use of witchcraft. Envy is frequently mentioned as a prevalent motive to explain the suspected anti-social attacks of witchcraft. Such behaviour can take the form of subliminal verbal attacks and gossip and can turn into accusations of the worst kind of antisocial behaviour, which is believed to be the use of several practices of witchcraft to seriously attack others for personal motives. The whole complex of envy based witchcraft remains unobservable and hence rarely breaks out into open conflict. Many cases have been documented though where people who have an extraordinary economic performance are secretly being accused of using supernatural forces e.g. the help of a ghost worker in the form of a snake that consumes human souls but provides for wealth and prosperity. Equally any kind of unexplainable misfortune that happens to actors can be explained with the attack of an envious witch instrumentalising supernatural forces to level social stratification.

[5] People know each other well as community members, neighbours, friends, or relatives, and address each other with strongly enforced politeness – *nkareso* –, respect and elaborate forms of greeting, nicknames and teknonyms – a rule of addressing others with the name of their first-born child plus a gender specific pre-syllable. Especially apparent in a norm of seniority directed towards the elders – *vakondi* – a term which is regularly translated with 'the grown-ups' and does roughly account for people of about 60 years of age or older. These people are respectfully addressed as *musamane* or *mukurukadi* – the old man/old woman.

operation. The situation is comparable to the countries in Herrmann et al. (2008) where anti-social punishment could be observed. To facilitate this comparison we compared the general level of trust and the rule of law of Namibia with the global perspective applied in the study of Herrmann et al. (2008). Namibia is not an outlier but ranges slightly above the world average for both indicators.[6] Namibia ranges higher in rule of law than the eastern countries (Russia, Ukraine, Belarus and China) but lower than those countries with the highest occurrence of antisocial punishment (Greece, Saudi Arabia and Oman). However, in such a setting anonymity cannot be controlled for in the same way like in a laboratory. Actors all know each other when they enter the 'field lab', know each others' social histories and have multiple potential form of relationship. Hence the field experiment attempts to establish a bounded anonymity (cf. Pröpper 2008; Wiessner 2009) that offers the possibility to study natural resource related choices *in vivo*.

3. The Experiment

3.1. Experimental design and procedure

Grounding on the above remarks, our experiment was framed as a task to individually and privately extract resources from a common forest for own use or extract resources jointly with the community, while the latter increases group payoff. Our game and real-world setting resembles a public good experiment where group benefits are larger if individual harvest is restrained and people contribute to the public good (i.e. community forest).[7] We use this context as it is directly related to the participants' real life and thus reduces confusion among the participants that might have been the case with a context free instruction. It is also likely to stimulate more emotions and thus produce more realistic (sanctioning) behaviour.

[6] The Kavango sample is quite representative for the rural areas of Namibia. At least, a student population as is usually taken in experiments would be even more unrepresentative since students are more educated and come from urban households with higher income.

[7] Although we are aware that the forest resembles a common-pool resource with rivalry in use and non-excludability, our design resembles a public good game since we only model the rivalry with a threshold value. We did not use a CPR since it seemed more understandable in our context that income rises if one sells and harvest as a group (contribute to a PG) than by reducing the number of tree an individual harvests.

Our public goods experiment is played with N=5 players and 20 rounds. The game was framed as a task to extract timber and other non-timber forest resources (FR) from a commonly owned forest or to leave them for the group account.[8] Players were informed that they could extract for their private account or leave FR to the public account. FR extracted into the private account were private profit[9], whereby FR units left in the common forest were doubled and shared among the five players, which leads to a marginal return from the public good of 0.4, the standard in public good experiment (Fehr and Gächter, 2000). The *sustainable* yearly harvestable amount of forest resources was announced to be 50 units for the group in each round. If the group total extracted was more than 50 units of forest resources, private returns for all forest resources were halved. An individual i decides to extract FR between 0 and 20, i.e. $x_i \in \{0..20\}$. The aggregate harvest level is $X = x_i + x_{-i}$, with $x_{-i} = \sum_{j=1}^{N} x_j$, for j ≠ i, and the individual payoff function in the Extraction Game is given by:

$$(1) \qquad \pi_i(x_i, x_{-i}) = \frac{2(50 - X)}{N} + x_i \text{ if } X \leq 50$$

$$(2) \qquad \pi_i(x_i, x_{-i}) = \frac{1}{2} x_i \text{ if } X > 50$$

In this experimental setting there are two Nash equilibrium at X=50 and X=100.[10] However, the social optimum is X=0 where, all players would be better off if none of the players extracts any unit (i.e. harvesting 0FR). Table 1 exemplifies this for symmetric harvesting decisions: When all five players choose to extract zero their group gain is 100, while if all choose the maximum private harvest the group gain is only 50. However, each person has an incentive to deviate from the social optimum as private gains increase by 60% if a player chooses to extract the maximum possible private amount and the rest of the group behaves cooperative.

[8] Examples were given: Fresh wood, dry wood, grass, medicine, fruits, wild animals. Limiting the extraction to timber resources alone would have left all the players that do extract from a forest but do not extract timber with no incentive.

[9] Ten forest resources are equal to 1 Namibian Dollar (1 Forest resource = 10 cents).

[10] The reason given to the players why a group harvest higher than 50 units leads to half the price of the forest resource is that the yearly regeneration is exceeded and too many young trees were harvested with lower quality and thus lower market price in Rundu, Windhoek or South Africa. With this threshold we have a group profit minimum if all player extract 11 resources and equal profit for extracting 10 resp. 20 resources. If X<50 each individual has an incentive to increase his harvest and once the aggregate harvest is above X>50 each individual has a further incentive to harvest more. The two symmetric Nash equilibrium in pure strategies are though x_i=10 and x_i=20

<Table 1 here>

After round 10 we introduced two different treatments, 1.) an *external* punishment treatment where group members extractions would be randomly controlled by the game monitor simulating an external control institution and over-harvesting would be punished, and 2.) an *internal* punishment treatment where group members could punish each other at own costs. While many field studies used a treatment with imperfect external punishment (Cárdenas, et al. 2000; Ostrom, et al. 1994), the internal punishment, which is most common in laboratory experiments, has to our knowledge been applied two times in field settings before (Gächter & Herrmann 2006; Visser & Burns 2006) and only Gächter & Herrmann (2006) analyse the impact of anti-social punishment on co-operation.[11]

In our external punishment rule we told players that the optimal strategy would be to harvest zero forest resources and we implemented a sanction if more than zero forest resources were harvested. In each round only one player was randomly monitored (i.e. detection probability of 20 per cent). A gradual penalty was imposed if it was found out that the monitored player was not following the rule. Since each player only knew his own player number, sanctioning took place anonymously. The player that was inspected and was found to have extracted forest resources had to pay an additional fine as high as the amount of resources he decided to harvest (e.g. somebody extracting 5 resource units received a fine of 10 units and no profits from individual harvest or the group account). In our internal punishment treatment players were told that the new rule enables them to punish each other. After each round the players' extraction decisions were announced publicly and written on a whiteboard by naming the player number and corresponding extraction level. The information remained on the board during the rest of the experiment so that one could also see the 'history' of each player's contribution. Real life punishment is not without social costs of conflict. Hence punishment in our experiment cost the punisher 1 FR and reduced the punished players amount of allocated FR by 3 FR.

[11] There is also evidence from the field, where anti-social punishment occurred as well, suggesting that informal punishment leads to higher contributions that may be sustained and that the positive impact of informal sanctions is larger in unequal groups (Visser & Burns 2006).

Our experiments were carried out in four villages and in each village we played six sessions (3 internal and 3 external punishment) à 5 players.[12] In total 120 people participated in our experiments. The part of the whole sample under consideration for internal punishment consisted of 60 players (4 villages à 3 sessions à five players). All village households were equally informed two days before the experiment to send up to two players who would be able to understand the rules and participate in the game. Thus, a fair chance for all households was paired with the attempt to limit intra household and consanguine family cooperation as well as the activation of strong *domestic* social norms On the day of the game, before recruiting actual players it was made sure that all sending households would be represented. Players then were recruited *randomly*. It was taken care that consanguine matrilineal relatives would play in different sessions. Players were then assigned to sessions *randomly* as well. A table with sociodemographic information of the participants is given in the appendix.

3.2 Hypotheses and analytical strategy

We conduct our empirical analysis along two dimensions. The first dimension is related to the variables of interest. Our dependent variables include (i) the number of trees harvested by an individual in each period, (ii) the number of trees harvested by the group in each period, (iii) the number of antisocial punishment points assigned by player i to the other group members in each period, and (iv) the number of prosocial punishment points assigned by player i to the other group members in each period. We use harvesting as our measure for co-operation since earnings would reflect both the influence of sanctions, other people's choice and the choice of player i. ASP is measured in total points that an individual choose to punish someone who harvested less forest resources. Thus, the antisocial punisher is more likely to have a higher relative harvest than the other group member, which is also the expected sign and significance in Table 5; people who punish antisocially have a higher harvest (i.e. are less cooperative) and those who punish prosocially have lower harvest than the other player in the respective round. However, this need not be the case since

[12] The villages in the central Kavango region are all situated in the same ecosystem – a dry-forest and woodland savannah. They were chosen because they are all situated within a vicinity of ca. 30 km². Three villages are situated along the road that connects Rundu with the south of the country. One village is situated in the hinterland few kilometres away from that road. Village sizes in the area differ between 100-300 persons.

someone harvesting more than the average of the group can still punish prosocially if he punishes another person with even higher harvest than himself. Each dependent variable is tested in different models that vary in the set of control variables. Thus, the second dimension has to do with the explanatory variables. We analyse sociodemographic variables for (i, iii, iv), group heterogeneity measures for (i, ii, iii, iv), as well as game-specific variables that change over time for (i, ii, iii, iv) to model how group dynamics affect individual strategies over the course of the game.

Previous studies on the determinants of ASP have found that anti-social punishment is largely unrelated to socio-demographic factors (Gächter and Herrmann, 2006). However, they find that people who were a member in any voluntary organization or had a university degree punished weakly significantly more spitefully. Thus, higher degrees of education did not lower spiteful punishment, which suggests that spiteful punishment was not due to confusion. We further include personal attitudes towards norms of cooperation since it might be that the strength of an individual's perceived adherence to norms of civic cooperation in a rural village might similarly predict antisocial punishment at individual or group level. Most explanatory power comes from the game related variables. Following Herrmann et al. (2008), it might be that people act with a motive of conformity (i.e. that they want to treat people alike and thus punish free-riders and co-operators alike)[13], dominance (i.e. having a competitive personality or a desire to maximize relative payoff which is the case if punishment is cheaper for the punisher than the punished (Falk et al. 2005)), revenge (i.e. retaliating a punishment from previous round) or strategic considerations, i.e. we do not know whether antisocial punishment happens as a reaction on received punishment or whether it is proactive to keep the relative distance to the other players as high as possible (Nikiforakis (2008)). We implement the following hypotheses on revenge and dominance/competitiveness:

[13] We omit conformity from our analysis since there are no univariate correlations but specification problems in the panel regression model (i.e. being an antisocial punisher implies having high harvests which makes the likelihood of simultaneous pro social punishment unlikely and in some cases impossible). The correlation between number of times a person punished prosocially and antisocially is 0.05, suggesting that there is no relation and thus no reason to believe that people simply punish both free-riders and co-operators alike in a certain round. Also, cumulated over the total ten period there is a no significant positive correlation between ASP and PSP (0.17; p= 0.18).

- Past own punishing behaviour: It might be that people start punishing and continue to punish until the end of the game, or it might be that only the previous round punishing influences behaviour. We include lagged (cumulated) antisocial and prosocial punishment until the previous round in our models (lag_antisocial, lag_prosocial lag_antisocial_cum, lag_prosocial_cum).
- Short term revenge: Points deducted in the previous round through penalty (lag_psp_received or lag_asp_received). A positive significant coefficient for lag_receive_nothing indicates that someone punishes proactive. Since a player knows whether he harvested above or below average we define psp_received if a player harvested above group average and was punished.
- Long term revenge: Cumulated points deducted in the previous round through penalty (lag_psp_received_cum, lag_asp_received_cum or lag_received_nothing_cum).
- Dominance: Someone who harvested relatively more in the ten rounds of stage 1 (diff_harvest_cum_10) or cumulated until the actual round (diff_harvest_cum). [14]
- Self reported competitiveness: Self reported binary variable "I compare my gains to the gains of the others".

We further use three different model types and describe the included variables in the appendix**.** We start analysing the difference between the internal and external enforcement treatments on co-operation (4.2.). Here we especially test whether the effect is long-term or based on an initial reaction towards the rule. Next we focus our analysis solely on the internal sanctioning treatment. In section 4.3. we analyse how harvesting on individual and group level is affected by received ASP and received PSP. Section 4.4. tests different hypotheses on the determinants of punishment (ASP and PSP).

[14] Two points are worth mentioning: First we cannot interpret short-term dominance since relative harvest must by definition be highly correlated with ASP (but we include it as control). Second, we use relative harvest (instead of relative earnings) as measure for dominance since earnings also capture received and given punishment points which would confound our results. The correlation between relative harvest and having used antisocial punishment is 0.15 and significant at the 1% level, too. However, by definition, those who earn or harvest relatively more must be those who use ASP, thus we need to take the cumulated relative level of harvest in order to reject the dominance hypotheses.

4. Results

4.1 External vs. internal punishment

Our results suggest that both punishment types were *ineffective* in increasing group or individual *earnings*, which is in our case due to escalation of punishment and very high punishment decisions by some individuals. However, for both treatments we find evidence for a positive impact on cooperation and this effect seems to be more stable in the internal sanctioning treatment. The treatment differences between the internal and external punishment on group harvest are presented in table 2. We see in specification 2 that harvest decisions are significantly reduced by both treatments when comparing stage 1 (rounds 1-10) to stage 2 (rounds 11-20).[15]

However, as has been found, the effect of external penalty might be limited to a strong initial effect where people tend to follow the rule and then start to learn over time, that there is a chance of not being monitored which might eventually lead to a crowding-out of cooperation in the last rounds (Cardenas et al, 2000; Vollan, 2008). Thus, we also analyse whether the treatment leads to a reduction of harvest in the last four rounds of each stage - which can be interpreted as the equilibrium outcome of the experiment after individuals adjusted their behaviour towards the rule. In specification 3 and 4 of table 2 we see that the coefficient for external enforcement drops by almost 40% of its size. This means that external punishment is clearly ineffective in reducing harvesting behaviour over time.

The coefficient for internal enforcement remains stable and indicates a reduction of more than 6 trees per round and group. Consequently in what follows we will concentrate on the interactions between punishment and harvest decision in the internal sanctioning treatment to further assess the limits to self-governance stemming from antisocial punishment.

TABLE 2

[15] Specification 1 and 3 in table 2 have similar coefficients for the treatments. However due to the omission of session fixed effects the estimation of the standard errors is less precise and thus coefficients are not significant.

4.2. Internal punishment: Influences of ASP and PSP on harvesting

To analyze harvesting decisions we test the influence of ASP and PSP on two levels 1.) the *individual* harvest level and 2.) the *group* harvest level. Figure 1 shows the average earning, harvest and penalty of all players in the internal punishment over the 20 rounds. During the first stage (round 1-10) earnings are high and equally distributed within the group, but there is a sharp decrease in earnings immediately in round 11. Although harvest is steadily decreasing from round 1 to 20, earnings drop significantly due to the high amount of punishments.[16] If one looks whether an individual punished someone from his group or not, 600 punishment decision can be taken if each player only punishes one person (2400 if he would punish all the other four player). In total 303 punishment decisions were taken of which one third were antisocial. Also, punishing more than one player per round happened rarely but if so then especially in the case of ASP. The average penalty did not differ much and was 12 points for antisocial punishment (std.dev. = 16; min=3; max=90) and 11 points for prosocial punishment (std.dev. = 13; min=3; max=150).

FIGURE 1

For the analysis of individual and group harvesting we include two different punishment variables: *previous round*, in order to capture immediate effects, and *cumulated until previous round* to test for long term influences during the game. While on group level received punishment equals distributed punishment we include both received and distributed punishment when explaining individual harvest.

We first discuss the results on *individual* level. In table 3, specification (7), we find that the game dynamic effect that causes higher harvest in round t is whether a player has a higher cumulated difference of harvest in round t-1. Since we control for individual fixed effects the coefficient cannot be attributed to a selfish or competitive player 'type'. It is rather the game dynamic that leads individuals (independent on their actual level of harvest) to further increase harvest when their relative cumulated extraction from the public good increased in the last round. Thus, players are reinforcing

[16] During the first stage (round 1-10) of the internal punishment sessions' people earned on average 137.03 points (Std. Dev. 41.5) with a maximum earning of 265 and a minimum of 63. Buying punishment points and getting punished significantly reduced earnings (t=5.8, df=118, p=.000) in the second stage (rounds 11-20) to an average of 73.35 points (Std. Dev. 78.6, Min -197, Max 186). The standard deviation in earnings rose from 5.4 in stage 1 to 10.2 in stage 2. Overall points earned were 210.38 (Std. Dev. 92.6), with one player reaching a minimum outcome of -63 and the most successful player earning 423 points. Converted into Namibian Dollars, players earned an average of 21 N$ (Std. Dev. 9.3) with a maximum of 42 and a minimum of 0 (excluding show-up fee of 10 N$). 21 N$ correspond to 2 Euro and the hourly minimum wage in Namibia of N$3.8.

their strategies and play competitively which is driven by learning. More interestingly, we see that cumulated pro-social sanctions received by the individual reduce harvesting. Interestingly, it is also cumulated and not immediately received sanctions that reduce harvest.

When controlling for session fixed effects and including individual characteristics we find that people who earn a permanent income harvest more, which suggests that those players with greater need for cash are less selfish and that having permanent income symbolises status of a person which needs to be 'defended' in the experiment as well. Lastly, people who stay longer in the same village and thus have some attachment to the people in the village are more co-operative.

Table 4 presents the influence of sanctioning on *group* level. This seems to be a relevant outcome level since we ultimately aim to reduce the collective harvesting effort of the group independent on the individual reaction to the punishment. At group level sent punishment equals received punishment such that we only look at the number of ASP and PSP sent. We find an interesting additional feature. We again find that cumulated previous round pro-social punishment reduces harvest. Thus, both individuals and groups react with an increase in co-operation after "enough" pro-social punishment occurred in the group. The size of the effect in specification 9 and 11 is quite large and indicates that with every pro-social punishment point group harvest is reduced by -0.631. With a mean pro-social punishment of 6.4, group harvest is reduced by 4 trees in every round.

In table 3 we can see that neither previous round antisocial punishment nor previous round cumulated antisocial punishment increases harvest in the next round. However, we find that on group level last round antisocial punishment even *decreases* harvest (Table 4, model 8 and 9). This is an extremely surprising result which is however in line with our above made statement that co-operation increased in the internal punishment treatment.[17]. Surprisingly the cooperation enhancing effect does not stem

[17] When looking at table 3 model 7, we see that the (not significant) point estimate for lagged antisocial punishment is with -0.031 larger than the estimate for lagged received antisocial punishment 0.006, which results in a hypothetical "net effect" of antisocial punishment of -0.025 . Multiplying the net effect by five (for each member in a group) we get almost the same coefficient as in table 4 model 9 for lagged antisocial punishment on group level -0.095**

from those players who had been punished but rather the effect on those who punish antisocially and reduce their harvest in the subsequent round (coefficient for having punished someone with ASP is negative but insignificant; -0.031). One reason for this effect might be that players do not want to expose themselves as high extractor, when the low extractor get punished, which would make them the target for further punishment. Thus, while a lot of cumulated pro-social sanctions reduce harvest people do not reduce their harvest if a lot of cumulated anti-social punishment happened.

TABLE 3 and TABLE 4

4.3. Determinants of punishment

In order to better understand the limits to self-governance we undertook another analytical step having a closer look into the dynamics and determinants in the internal punishment scenario. On cross country basis Herrmann et al. (2008) find that country norms of low civic cooperation explain antisocial punishment. We analyse standard questions on trust and trustworthiness (as taken from the World Value Survey), different questionnaire items on cooperativeness, as well as reported days worked in voluntary collective action. We also include socio-demographic variables since we hypothesized that age (and gender and education) might be an indicator for seniority and dominance.

To understand the players' decisions of buying and applying punishment points, we used several panel models (see table 5). As described in the appendix, our analysis is subdivided into three model types which are being applied to look at both antisocial punishment (model 12-14) and at prosocial punishment (model 15-17). With the specification into three models we derive differing results.[18] The model 12 and 13 show us that socio-demographic variables and attitudinal questions from post game interviews explain punishment decisions to some degree. However, neither age, gender, education nor ethnicity does significantly correlate with antisocial punishment. The only socio-demographic variables that significantly correlate with antisocial punishment are household size (which is driven by on outlier with 30 household members) and knowledge of the English language. Since these are more

[18] For example model 15 and 16 suggest that a person who punished antisocial previously is more likely to punish again. This effect disappears in model 17 which suggests that the true effect of punishing someone is rather an inherent feature of a person that could not be captured with our village, session, socio-demographic and attitudinal variables. For example this could be a person's emotional state, risk attitude or inclination to be spiteful that we did not measure or not adequately.

educated people this backs up our weak evidence that dominant people tend to use ASP more often. People who stated to have a low willingness to pay for community public goods were more likely to use antisocial punishment against their fellow villagers, while those with a higher willingness to contribute money to the community were more likely to punish prosocially. Interesting and surprising is the fact that players who answered yes to the question "Did you compare your gain with others after the game?" and "Were you paying attention to the behaviour of the other participants?" did use less ASP. However, both variables are positively significant on session level indicating that a group of many competitive people increases ASP. The variable *compare_gain-_others* is interesting since it captures the importance of relative earnings and competition among players. Interestingly 40% of all people in the internal punishment vs. only 11% in the external punishment treatment state they compare their gains to the gains of the others. Since treatments were allocated randomly it is likely that the peer punishment possibility induced competition and triggered a behaviour of dominance that people did not experience in the external punishment treatment. Thus, a combination of many competitive or dominant players in a group might be the reason for the high use of ASP. With regard to prosocial punishment we find that people who are members in village organisations or do voluntary collective action are significantly less likely to punish.

The next analytical step offers insight into the crucial role of *revenge*. In model (12-14) we find by definition the positive effect of relative harvest (and a negative effect in model 15-17) and a positive end game effect in the last round.[19] If a player received prosocial punishment in the previous round he is likely to use antisocial punishment. The effect appears in all models but looses its significance due to larger standard error in the fixed effect model 14.[20] However, we believe that people do not accept any penalty and thus *motives of revenge* seem indeed to be the only causal factor in our model that lead to an increase in ASP, hence ASP seems to be partly a *reactive* phenomenon. We further do not find that previous round own punishing behaviour influences the use of ASP. When comparing model

[19] Our observation is the expected sign and significance for relative harvest of a person: people who punish antisocially have a higher harvest (i.e. are less cooperative) and those who punish prosocially have lower harvest than the other player in the respective round. However, this need not be the case since someone harvesting more than the average of the group can still punish prosocially if he punishes another person with higher harvest than the average of the group.

[20] We re-estimate model 14 as random effect model and include the individual dummies.

12 and 13 with the individual fixed effects model 14, we suggest that variables of previous punishing that were significant in model 12 and 13 (i.e. person who punished prosocially in previous round or had high cumulated antisocial punishment is more likely to punish again) do not identify the causal effect on the use of ASP[21] but rather indicate a certain player 'type' who punishes more than others as it disappears once we control for individual fixed effects. The results further suggest that the player 'type' cannot be fully described with our set of observable session, socio-demographic and attitudinal variables. For example it could be that a person's emotional state, risk attitude or inclination to be spiteful describes the player 'type'.

For *prosocial* punishment (model 15-17) we find that players who distributed antisocial punishment in the previous round are more likely to use pro social punishment. Again the effect disappears when we control for individual fixed effects (model 17). Interestingly, we see that people who punished free-riders in the past are less likely to do this again. This is the opposite of what we expected if there were a 'habit' of punishing. Instead prosocial punishment seems to be a rather an occasional, goal-oriented (to reduce other's harvest) mission. While each person seems to have an individual level of punishment which is acceptable to her/him that varies between individuals there is a causal effect that once this level is exceeded a player reduces her/his punishment activities again. This effect is strong both for previous round and cumulated punishment until previous round. In model 15 and 16 previous round received ASP seems to increase the likelihood of punishing pro-socially. Although the coefficient remains at its size in model 17 the higher standard error with the individual dummies makes this relation insignificant so that our evidence for revenge both in case of ASP and PSP does not hold once we control for individual observed and unobserved characteristics that do not vary over time.

TABLE 5

[21] Here not only the standard error increases but the size and direction of the coefficient changes.

4.4. Session heterogeneity and group composition

In a next step we find that the use of ASP and PSP among sessions is quite heterogeneous, meaning that in some sessions people use a lot of ASP and PSP and in others none. If we use session fixed effects in our analysis on ASP we find that 5 out of 12 sessions are highly significant at the 1% level. Figure 2 shows ASP (as well as total punishment, harvest and earnings) per session. Such heterogeneity with sessions where punishment escalated drastically, as well as sessions having practically no ASP, is striking. At one stage we even had to limit the amount of punishment points people could impose on each other to 30 (as can already be seen by the negative profits of some individuals and even groups). In the five significant sessions the occurrence of both forms of punishment was high but only in session 15 (see figure 2) ASP was unusually high.

FIGURE 2

The results from model 12 and 15 in table 5 on the session control variables describing dominant behaviour and the high heterogeneity of the occurrence of ASP. Also, *group composition* – though assigned randomly - has something to do with the occurrence of ASP. While socioeconomic variables and attitudinal questions from post-game interviewing were not able to fully explain the effect of antisocial punishment, a qualitative re-interviewing of available players who were part of the sessions took place.[22] Indeed it turns out that in a social setting of well known social histories and established trust and distrust in other players, the group composition can affect session outcomes and that trust, dominance and revenge again play crucial roles. In session 5 the traditional headman turned out to be the main free-rider who was using anonymity to continue with a well established pattern of abusing his dominant position. He received extraordinary PSP and retaliated with little ASP. It seems that prosocial punishment has been used by other players to level one anonymous but highly dominant players behaviour. It seems reasonable that these players suspected the headman applying their everyday experience of dominance.

Session 7 has to be perceived as an outlier in the sense that three players who are related along extended kinship lines and ethnicity named love and trust as a motive for not using punishment. In

[22] The reinterviewing of players took place in 2009 one year after the experiment had been done. Due to migration and other causes not all players that originally participated in the session were available.

contrast in session 9 players were only faintly acquainted. The interviewed player explained that he felt isolated and hence did not cooperate and over-harvested. He received high PSP and ASP and clearly named revenge *nkoko* as his motive for retaliation saying "To be punished feels like a loss. To re-punish is making even, as to reclaim something."

A complete lack of trust among players who knew each other not very well but knew that one player was known to have committed a criminal offence turned out to be the given explanation for the high amount of PSP and ASP in session 15. In session 19 players confirmed to be well acquainted but did not trust each other well and did not accept others dominant behaviour. The interviewed player clearly confessed to have used high ASP for revenge. "To be punished feels like being hurt, I wanted to retaliate" was the explanation given. In session 23 players were well acquainted but in a competition for dominance supported by ethnic heterogeneity (although we measure ethnic heterogeneity in section 4.3 our data might not be specific enough to capture these subtle elements), since the group comprised a female Kwangali Headwoman and a very wealthy Nyemba man. Again the headwoman as the member of the traditional authority was the dominant free-rider who received extremely high PSP and retaliated with relatively high ASP. In qualitative reinterviewing she confirmed that "Revenge and jealousy can be motives within the game. People do not accept punishments but retaliate. Revenge even happens within families".

In sum these results confirm that PSP is used to level dominant behaviour and that the anonymity of the experiment offers a protection from dominance. The 'disrespect' of the social dominance as well as revenge can lead to retaliating with ASP. As has been outlined above the ramification of kinship in Kavango cannot be controlled for and do not necessarily have an impact on single players choice in the experiment. In a case where players nevertheless turned out to be closely emotionally linked and trusted each other this clearly influenced their choice to abstain from punishment.

5. Discussion and Conclusion

Our paper sheds some light on the nature of costly punishment: When comparing external with internal punishment we find that only internal punishment significantly reduces harvests although one third of group punishment in our internal punishment setting is antisocial and thus not intended to increase cooperation. Overall, our outlook on the limits to self governance is more optimistic than suggested by previous results from Herrmann et al. (2008). We conclude that the weak rule of law might be a general barrier to self governance due to the occurrence of ASP but that weak external monitoring with external enforcement might even be worse in such a situation (see as well Ostrom 2005: 130). Thus, instead of seeing the limits of self-governance we stress the importance of available low cost sanctions as well as the role of the conflict resolution body (government or traditional authority) which prevents some extremely spiteful behaviour as well as escalating punishment and counter punishment that we could observe in informal sanctioning so that the benefits of resource protection do not incur huge welfare losses.[23]

Our next step was to analyse the impact of punishment on cooperation levels. While we find the expected result that prosocial punishment increases cooperation we find no evidence that the occurrence of antisocial punishment decreases cooperation.

Our third result is on the micro determinants of anti-social punishment. Using individual fixed effect method we find similar to other studies that revenge (i.e. received prosocial penalties in the previous round) and dominance are leading motives for ASP. However, we show that it is only the group composition of dominant people that causes giving high antisocial punishment. Antisocial punishment is hence largely reactive. We also discover, that by being able to punish each other players endogenously evolve a personality trait of dominance/competitiveness.

Lastly, we report results from focus group discussion of selected sessions and highlight the potential role of leadership and contested leadership that spurs antisocial punishment. Similar to Fehr and colleagues (Fehr et al. 2008) found in a one-shot trust game carried out in India that a large majority of

[23] If for example we exclude both for external and internal punishment the cases where players got high costs of penalty (larger than 10 points), which restricts the sample from 1200 observations to 922, both groups earn on average 13.2 points. Gächter and Herrmann (2006) use a one-shot public good game which excludes the possibility of escalation. Thus, it seems more important to limit the very high amount of punishment. Moreover, such an escalation of sanctioning is by definition impossible in the typical external sanctioning scenario. However, there may be many cases where the accused person may not accept the penalty from the government and hires a lawyer and go to many court sessions, which is also extremely costly.

subjects from higher castes punish cooperative behaviour due to their concern for status and superiority and their strong aversion against disadvantageous inequality. Similarly, Vollan et al. (2010) find evidence for spiteful behaviour as they observe a fraction of the already privileged participants in a social dilemma game forego private benefits in order to destroy the resources of the less privileged, which in turn had detrimental effects on cooperation in the long-term.

Concerning the hypothesis that weak norms of civic cooperation increase ASP we found no significant correlations on individual level or aggregated effects for each of the sessions. It might be due to the fact that ethnographic research on the social context confirms that relatively strong norms of social interaction exist and hence individual or session differences might be small. However, it is also noticeable that such a high number of free-riders exist while cooperative norms are vital in real life. It seems that the experiment offers the individual player 1.) the possibility to decide anonymously and without having to communicate, while normally within the fabric of cultural and social rules and duties behaviour rarely remains unobserved and uncommented, 2.) the incentive to strive for personal cash income that can be kept and does not necessarily need to be shared. That means there exist no established social norms how to proceed with economic experiment gains. Both effects seem to leverage existing norms of civic interaction (e.g. based on kinship or religion) that strongly depend on communication and observation as much as norms of contributing to a collective economic goal without personal cash gains.

The absence of a functioning structure of enforcing existing legislation, the weakness of what we have described as the rule of law concerning natural resource behaviour seems to leave a void that is used by people with an inclination to show their dominance relative to the other player. Once they get punished they do not accept this and instead punish the rest of the group. One might hypothesize that in absence of a regulatory state players enforce rules on each other by themselves (Ostrom, 1990), or as Herrmann et al. (2008) suggest that the absence of a strong rule of law might open the door for vengeful behaviour. Results indicate that ambivalent perceptions of the responsibility and effectiveness of the various levels of legislative and executive institutions offer incentives to take

advantage of the leakages. Though direct correlations could not be found as our proposed measure of the perception of the rule of law did not vary between individuals (basically all people stated that it is bad to harvest forest resources without a permit etc.). From assessing the ethnographic context we can affirm the hypothesis that a weak local rule of law exists and that this circumstance supports free-riding and antisocial behaviour. Acts of illegal exploitation of public state-owned timber resources by free-riders rarely happen completely unobserved and will be gossiped about, though due to reasons outlined above they will not always be enforced. Crucial is the status and perception of ownership of such public resources. People who adopt the viewpoint that the trees are owned by the state expressed the conviction that stealing from the state is a misdemeanour. Someone who tries to enforce rules in such a case will probably suffer anti-social punishment, in the case of discovery on the spot people who want to complain about free-riders and exercise control even have to fear strong anti-social *violence*. In Epingiro the headwoman and other villagers complained that when they discovered illegal harvesters in the forest northwest of the village they were threatened to be beat up. As outlined elsewhere cases of illegal harvesting can involve members of the traditional authority (Mwiikinghi 2007) and furthermore are no guarantee that existing rules will be enforced effectively (Pröpper 2009). Our findings suggest that in search for micro level explanations of ASP we have to turn our view to the occurrence of *revenge* and also *competitiveness*.[24] We found very revengeful behaviour in the field. Obviously, in the anonymous interaction of the game many people tend not to accept prosocial punishment as a substitute for lacking official rule enforcement but rather perceive it as a constraint to personal freedom which they retaliate. Such results correspond to our ethnographic findings that apart from the conspicuous politeness, competition and envy play an equally important role in Kavango culture. The ten informants who were interviewed after the game and again a year later on the conspicuous results in their sessions confirmed that revenge – *nkoko* - is a very common motive in Kavango. It was explained as 'making even for a personal loss or for being hurt'.

[24] Likewise it has been found though that the option of costly punishment does not increase the average payoff of groups, and that players with high payoff do not use costly punishment (Dreber, et al. 2008). There are arguments that costly punishment positively co-varies with altruistic behaviour (Henrich, et al. 2006) as well as evidence for the conclusion that costly punishment has evolved for purposes like coercing individuals into submission or establishing dominance hierarchies (Dreber, et al. 2008).

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APPENDIX – Figures & Tables

The game was extensively pre-tested with a separate sample from Rundu, the local capital. The real sessions were played in separate community halls or community forestry office rooms of the different villages. Instructions for the game had been translated into the local vernacular with a double cross-check translation.[25] All experiment instructions were presented aloud orally and visually in Rukwangali by a local game administrator (see appendix for protocol). The facilitator and experimenter were the same for all sessions. The instructions included a set of examples of possible actions and outcomes. After reading the instructions, several sample rounds were played to safeguard all participants understanding of the procedure and proper handling of the material. All decisions by and transactions with participants were done anonymously by assigning player numbers randomly and using game cards to be put into envelopes. On these decision cards people could either write the number or circle the amount of trees they wanted to harvest. Punishment results were transferred in envelopes as well. A post-game questionnaire on basic demographic information, attitudinal questions and the understanding of the experimental design and decision tasks was conducted with interviewers after the session. One year after the game was played during another field visit in July 2009 several informal interviews were conducted with members of those sessions that played conspicuously social or anti-social. The choice of interview partners was restricted to people who were members in these sessions but could not cover all of them since a lot of the original players were not available due to several reasons (migration, labour-migration, diseases).

For all models we make use of the fixed effects method since we assume that our covariates are not independent from the individual (or session or village) fixed effects. This comes at the drawback of introducing 119 dummies on individual level, respectively 11 dummies on group level and therefore very high standard errors that makes some large effect insignificant. We use robust standard errors since there might be some within-panel serial correlation in the idiosyncratic error term.

[25] One translator translated all game related material into Rukwangali. A separate translator translated the material back to English to cross-check and eliminate potential mistakes.

Model (1) game-related variables only: The explanatory variables we use in the regression analyses are derived from the decisions in the game in each round like individual pro and antisocial sanction, received pro or anti social sanction and relative harvest (diff_harvest)[26], these variables can further be classified into two different "blocks": previous round and cumulated until previous round. The previous round and previous round cumulated variables are our measures to determine whether short term or long term impact of sanctions do influence co-operation (i, ii) or sanctioning behaviour (iii, iv). In this specification we include individual fixed effects to account for any inherent, fixed differences between individuals and, because individuals do not change groups in our sample, the individual fixed effects also account for any fixed differences between groups/villages. In this specification we estimate the unbiased causal effect on co-operation and/or sanctioning solely based on the choices from each round of the game.

Model (2) with additional sociodemographic variables: Our second type of model uses a range of sociodemographic variables where we especially hypothesize that variables indicating status like income, education, language knowledge might explain co-operation and sanctioning behaviour. We expect that high-income participants have less need for additional resources. In a public good game, Burns and Visser (2007) find that people with higher per capita income behave more co-operatively. Johansson-Stenman et al. (2006) and Greig and Bohnet (2008) find positive correlations between income, trust, and reciprocity. We also include different trust measures as well as self reported hours worked for the community. In this specification we control for session fixed effects in order to capture all unobserved and observed differences in the sessions that are constant over time but we do not know whether changes in game related variables are due to individual *unobserved* characteristics or game-related variables since these might be correlated.

Model (3) with additional group composition: Since we find highly significant session dummies in some of the model (2), it is interesting to find out more about the characteristics of the various groups that drive these results. The third model uses session control variables instead of *session fixed effects* which should estimate the remaining coefficient less precisely, but does provide additional information on the session variables. Potentially relevant to our analysis are the members in the group

[26] diff harvest = own harvest – (others' harvests / n-1)

belonging to nyemba or tjokwe ethnic group, respectively the number of people from formal religion which we believe are the main indicators for heterogeneity and social distance between players. We further compute group averages for three post-experiment perception variables that indicate whether a person paid attention on how the other player played during the game and especially whether they would compare their experimental earnings with the other players. We interpret high values of these variables as inclination towards competitiveness. In this specification we include village and time (round-played) dummies as controls, but we might still have *unobserved* session and individual effects.

Table 1 Individual profit as a function of others harvest

My private resources	Others' average private resources	My gain	Group gain
0	0	20	100
0	20	0	40
20	0	32	80
20	20	10	50

Table 2: Comparison of internal and external punishment with pre treatment

	(1)	(2)	(3)	(4)
	Rounds 1-10 & 11-20		Rounds 7-10 & 17-20	
treat_internal	-7.426	-6.650***	-6.672*	-6.354***
	(3.191)	(1.787)	(2.639)	(2.237)
treat_external	-5.024	-5.800**	-3.120	-3.438
	(3.194)	(2.658)	(4.138)	(2.914)
group_nyemba	-1.126		-0.829	
	(1.123)		(0.918)	
group_tjokwe	0.909		0.581	
	(1.446)		(1.503)	
session_rel	-8.205		-5.766	
	(5.124)		(4.974)	
session_others_harvest	2.428		1.683	
	(7.777)		(7.249)	
session_other_behaviour	13.812		8.930	
	(9.277)		(7.690)	
mean_compare_gain_others_s	-10.941		-13.795	
	(9.702)		(8.872)	
Constant	34.297	32.846***	33.758*	30.781***
	(15.350)	(0.801)	(13.088)	(0.918)
Observations	480	480	192	192
Village fixed effects	Yes		Yes	
Session fixed effects		Yes		Yes
Observations	480	480	192	192
r2_o	0.137	0.0846	0.171	0.0835
r2_w	0.228	0.149	0.232	0.111
r2_a	0.215	0.146	0.198	0.102
r2_b	0.959	0.0969	0.609	0.125

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

Table 3 Panel estimate of individual harvest dependent on received and distributed ASP and PSP (internal punishment treatment)

	(5)	(6)	(7)
Individual_harvest		Rounds 11-20	
lag_prosocial_total	-0.000	-0.001	-0.016
	(0.029)	(0.030)	(0.027)
lag_antisocial_total	0.002	-0.024	-0.031
	(0.057)	(0.041)	(0.058)
lag_antisocial_total_cum	-0.037	0.002	0.030
	(0.028)	(0.030)	(0.048)
lag_prosocial_total_cum	0.008	-0.012	-0.018
	(0.008)	(0.013)	(0.019)
lag_receive_psp	0.015**	0.008	0.008
	(0.004)	(0.009)	(0.013)
lag_receive_asp	-0.000	-0.005	0.006
	(0.005)	(0.017)	(0.021)
lag_receive_psp_cum	-0.009	-0.014***	-0.023*
	(0.005)	(0.005)	(0.013)
lag_receive_asp_cum	0.004	0.001	0.005
	(0.022)	(0.012)	(0.015)
lag_diff_harvest	0.124*	0.132***	-0.015
	(0.048)	(0.039)	(0.044)
lag_diff_harvest_cum	0.075***	0.078***	0.038***
	(0.008)	(0.012)	(0.011)
diff_harvest_cum_10	-0.058**	-0.061***	
	(0.015)	(0.016)	
round	-0.034	-0.016	-0.005
	(0.067)	(0.040)	(0.048)
round_20	0.587	0.577	0.571*
	(0.407)	(0.356)	(0.329)
age	0.018	0.018	
	(0.021)	(0.015)	
sex	0.392	0.013	
	(0.195)	(0.204)	
head	-1.013***	0.247	
	(0.110)	(0.274)	
hh_size	0.084*	0.053**	
	(0.027)	(0.023)	
married	0.137	-0.054	
	(0.499)	(0.299)	
formal_rel	0.529	-0.080	
	(0.637)	(0.245)	
att_services	0.227*	-0.024	
	(0.092)	(0.081)	
english	0.363	-0.024	
	(0.294)	(0.121)	
years_village	-0.027**	-0.034**	
	(0.007)	(0.014)	
schooling	-0.149*	-0.002	
	(0.048)	(0.029)	
regular_income	0.907**	0.430*	
	(0.167)	(0.219)	
alert	-1.017	0.045	
	(0.514)	(0.265)	

trust_villagers	0.459***	-0.061	
	(0.062)	(0.084)	
others_harvest	-0.209	0.143	
	(0.250)	(0.145)	
other_behaviour	0.078	0.150	
	(0.260)	(0.269)	
influenced_others	-0.042	-0.059	
	(0.288)	(0.285)	
cooperation	0.333**	0.002	
	(0.100)	(0.118)	
collective_action	-1.041	-0.002	
	(0.547)	(0.345)	
membership	-0.373	-0.143	
	(0.243)	(0.185)	
willingnes_pay	-0.229	0.253	
	(0.326)	(0.258)	
compare_gain_others	0.018	-0.157	
	(0.287)	(0.320)	
problem_nrm	-0.187	-0.274	
	(0.172)	(0.300)	
group_nyemba	-0.288		
	(0.205)		
group_tjokwe	0.055		
	(0.379)		
session_rel	-3.073		
	(1.320)		
session_others_harvest	1.048		
	(1.604)		
session_other_behaviour	2.228		
	(1.766)		
mean_compare_gain_others_s	-2.816		
	(1.853)		
Constant	4.926	4.891***	5.590***
	(4.570)	(0.696)	(0.656)
Observations	1200	1200	1200
Village fixed effects	Yes		
Session fixed effects		Yes	
Individual fixed effects			Yes
r2_b	0.623	0.0112	0.501
r2_a	0.545	0.567	0.0313
r2_w	0.560	0.580	0.0410
r2_o	0.542	0.466	0.3645

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

Table 4 Panel estimate of group harvest dependent on distributed ASP and PSP (internal punishment treatment)

	(8)	(9)	(10)	(11)
group_harvest round 11-20	Random effects		Fixed effects	
lag_group_antisocial_total	-0.140*	-0.095**	-0.105	-0.092
	(0.074)	(0.042)	(0.159)	(0.103)
lag_group_prosocial_total	-0.069	-0.025	0.129*	-0.019
	(0.049)	(0.043)	(0.074)	(0.060)
lag_group_antisocial_total_cum	0.530	0.438	-0.839	0.413
	(0.495)	(0.460)	(0.584)	(0.344)
lag_group_prosocial_total_cum	-0.264	-0.685*	-0.136	-0.631**
	(0.265)	(0.358)	(0.238)	(0.257)
round	-0.870**	-0.548	-0.299	-0.574*
	(0.418)	(0.395)	(0.596)	(0.317)
round_20	6.036***	5.536***	4.736	5.563*
	(2.051)	(2.082)	(3.734)	(2.842)
group_nyemba	1.105		3.712***	
	(1.209)		(1.182)	
group_tjokwe	0.956		4.389***	
	(0.926)		(0.507)	
session_rel	-17.118***		10.685	
	(5.652)		(7.620)	
session_others_harvest	-1.613		-1.036	
	(5.399)		(6.137)	
session_other_behaviour	-18.786***		-6.832	
	(7.237)		(6.596)	
mean_compare_gain_others_s	-8.522		-20.532***	
	(5.443)		(5.086)	
Constant	70.777***	32.827***	26.767**	33.918***
	(10.430)	(5.356)	(12.021)	(5.373)
Observations	120	120	120	120
Village fixed effects	Yes		Yes	
Session fixed effects		Yes		Yes
r2_w	0.202	0.231	0.262	0.230
r2_o	0.709	0.770	0.316	0.00779
r2_b	0.926	1	0.821	0.0219

Robust standard errors (clustered on session level for random effects model) in parentheses;
*** p<0.01, ** p<0.05, * p<0.1

Table 5 Panel regression of buying punishment points for ASP or PSP

	(12)	(13)	(14)	(15)	(16)	(17)
	antipunishplayer_total			propunishplayer_total		
lag_antisocial_total	0.039	0.032	-0.015	0.128***	0.113***	-0.006
	(0.122)	(0.104)	(0.095)	(0.019)	(0.025)	(0.059)
lag_prosocial_total	0.032***	0.026***	0.009	0.024	-0.007	-0.110**
	(0.005)	(0.009)	(0.017)	(0.050)	(0.051)	(0.050)
lag_antisocial_total_cum	0.174	0.168**	0.097	-0.018	-0.034	0.030
	(0.088)	(0.075)	(0.128)	(0.044)	(0.043)	(0.073)
lag_propsocial_total_cum	0.004	0.001	0.003	0.053*	0.021	-0.156***
	(0.011)	(0.013)	(0.012)	(0.017)	(0.020)	(0.052)
lag_receive_psp	0.020**	0.020***	0.019			
	(0.004)	(0.004)	(0.016)			
lag_receive_asp				0.031*	0.029***	0.021
				(0.011)	(0.008)	(0.028)
lag_receive_nothing	-0.104	-0.085	-0.049	0.132	0.223	0.234
	(0.049)	(0.094)	(0.111)	(0.140)	(0.179)	(0.190)
lag_receive_psp_cum	-0.001	-0.001	0.002			
	(0.001)	(0.002)	(0.003)			
lag_receive_asp_cum				0.003	0.000	0.028
				(0.005)	(0.012)	(0.019)
lag_receive_nothing_cum	0.124	0.139**	0.161	-0.054	0.009	-0.117
	(0.062)	(0.064)	(0.115)	(0.080)	(0.077)	(0.114)
diff_harvest	0.071*	0.070**	0.083**	-0.098**	-0.096**	-0.096***
	(0.025)	(0.029)	(0.035)	(0.028)	(0.037)	(0.033)
diff_harvest_cum	-0.011**	-0.010*	-0.005	0.011	0.011	-0.002
	(0.002)	(0.005)	(0.003)	(0.005)	(0.008)	(0.004)
diff_harvest_cum_10	0.009***	0.008*		-0.011	-0.011	
	(0.002)	(0.005)		(0.006)	(0.009)	
round	-0.152*	-0.158**	-0.162	-0.033	-0.051	0.102
	(0.049)	(0.065)	(0.107)	(0.078)	(0.074)	(0.097)
round_20	0.188*	0.187*	0.190*	0.216	0.206	0.161
	(0.072)	(0.102)	(0.105)	(0.107)	(0.211)	(0.170)
age	0.010**	0.009		-0.005	-0.015	
	(0.002)	(0.006)		(0.010)	(0.010)	
sex	-0.053	-0.048		0.081	-0.086	
	(0.051)	(0.077)		(0.311)	(0.378)	
head	0.031	0.011		0.114	0.554	
	(0.112)	(0.153)		(0.401)	(0.382)	
hh_size	0.039**	0.039*		-0.021	-0.028	
	(0.010)	(0.022)		(0.024)	(0.025)	
married	-0.135	-0.067		0.237	0.270	
	(0.172)	(0.104)		(0.228)	(0.199)	
formal_rel	-0.154	-0.136		-0.242	-0.385	
	(0.151)	(0.113)		(0.234)	(0.298)	
att_services	-0.022	0.003		0.008	0.010	
	(0.035)	(0.027)		(0.046)	(0.081)	
english	0.119***	0.136		-0.000	-0.026	
	(0.019)	(0.083)		(0.129)	(0.182)	
years_village	-0.014	-0.010		0.001	-0.009	
	(0.006)	(0.011)		(0.013)	(0.012)	
schooling	-0.002	-0.009		0.028	0.053	
	(0.017)	(0.019)		(0.025)	(0.051)	
regular_income	0.060	0.085		-0.205	-0.312	

	(0.104)	(0.103)		(0.151)	(0.260)	
alert	-0.051	-0.059		-0.050	0.016	
	(0.064)	(0.107)		(0.170)	(0.205)	
trust_villagers	-0.013	0.010		0.056*	0.026	
	(0.027)	(0.028)		(0.021)	(0.052)	
others_harvest	0.043	0.056		0.215	0.343*	
	(0.078)	(0.063)		(0.120)	(0.189)	
other_behaviour	-0.292*	-0.313*		0.093	0.142	
	(0.101)	(0.158)		(0.154)	(0.310)	
influenced_others	0.139	0.175		-0.260***	-0.453**	
	(0.119)	(0.146)		(0.016)	(0.210)	
cooperation	0.056*	0.044		0.052	-0.025	
	(0.020)	(0.051)		(0.064)	(0.081)	
collective_action	0.039	-0.010		-0.384*	-0.210	
	(0.243)	(0.183)		(0.156)	(0.202)	
membership	-0.074	-0.062		-0.233**	-0.358	
	(0.062)	(0.093)		(0.040)	(0.216)	
willingnes_pay	-0.200**	-0.244*		0.484	0.314	
	(0.041)	(0.122)		(0.230)	(0.209)	
compare_gain_others	-0.289*	-0.281**		-0.254	-0.385	
	(0.103)	(0.101)		(0.338)	(0.400)	
problem_nrm	-0.126	-0.123		-0.038	0.028	
	(0.081)	(0.114)		(0.226)	(0.232)	
group_nyemba	0.007			0.063		
	(0.027)			(0.051)		
group_tjokwe	0.069			-0.198		
	(0.095)			(0.155)		
session_rel	-0.141			-1.614		
	(0.624)			(0.811)		
session_others_harvest	-0.044			-0.715**		
	(0.176)			(0.143)		
session_other_behaviour	0.830			-0.467		
	(0.433)			(0.607)		
mean_compare_gain_others_s	0.890***			0.880		
	(0.152)			(0.673)		
Constant	1.562**	1.834**	2.128*	3.129	1.280	-0.439
	(0.399)	(0.830)	(1.147)	(2.126)	(1.287)	(1.125)
Observations	1200	1200	1200	1200	1200	1200
Individual fixed effects			Yes			Yes
Session fixed effects		Yes			Yes	
Village fixed effects	Yes			Yes		
r2_b	0.180	0.718	0.711	0.474	0.0268	0.625
r2_w	0.405	0.347	0.0843	0.172	0.0803	0.169
r2_o	0.395	0.382	0	0.141	0.0	0.04
r2_a	0.384	0.327	0.0750	0.142	0.0527	0.161

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

Figure 1 Earnings, harvest, penalty during the internal punishment game.

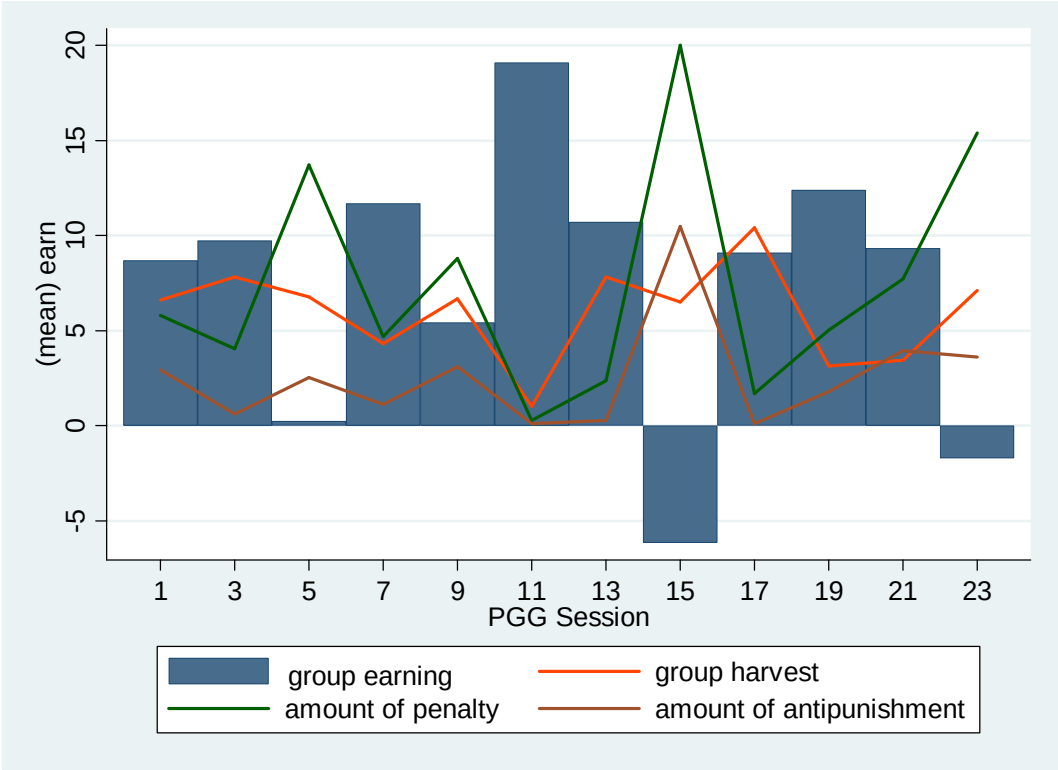

Figure 2 Distribution of earning, harvest, penalty and ASP by session (only round 11-20).

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The majority of participants stated that they were occupied in rural subsistence farming and 48% of participants stated to have a regular income (Std. Dev. 0.5). Households are comprised of a mean of 8.8 people (Std. Dev. 5.2). While the largest rural household has to support 30 members a major fraction lies below the average value. On average people had lived in the villages for a mean of 12.2 years (Std. Dev. 8.1). The average age in the whole sample was 31 years (Std. Dev. 11.7) with the youngest players being 19 years old and the oldest players being 71 years of age. Low average age data mirror the pyramidal age distribution of the very young Kavango society. The ethnic affiliation in the sample differed as well, mirroring the mixed ethnic composition of the villages. The largest fraction in the sample were people who consider themselves Kwangali with 38% (Std. Dev. 0.5), followed by two groups whose members migrated to the region during recent decades as a consequence of the war in neighbouring Angola, namely Nyemba 23% (Std. Dev. 0.4), and Tjokwe 13.3 % (Std. Dev. 0.3). People within the sample had an average school education of 7.1 years (Std. Dev. 4.2). Those below the mean age of 31 had on average 8.8 years of schooling while those above only 4.6 years. Separate calculation for women and men showed that women had on average 6.8 years of school education.

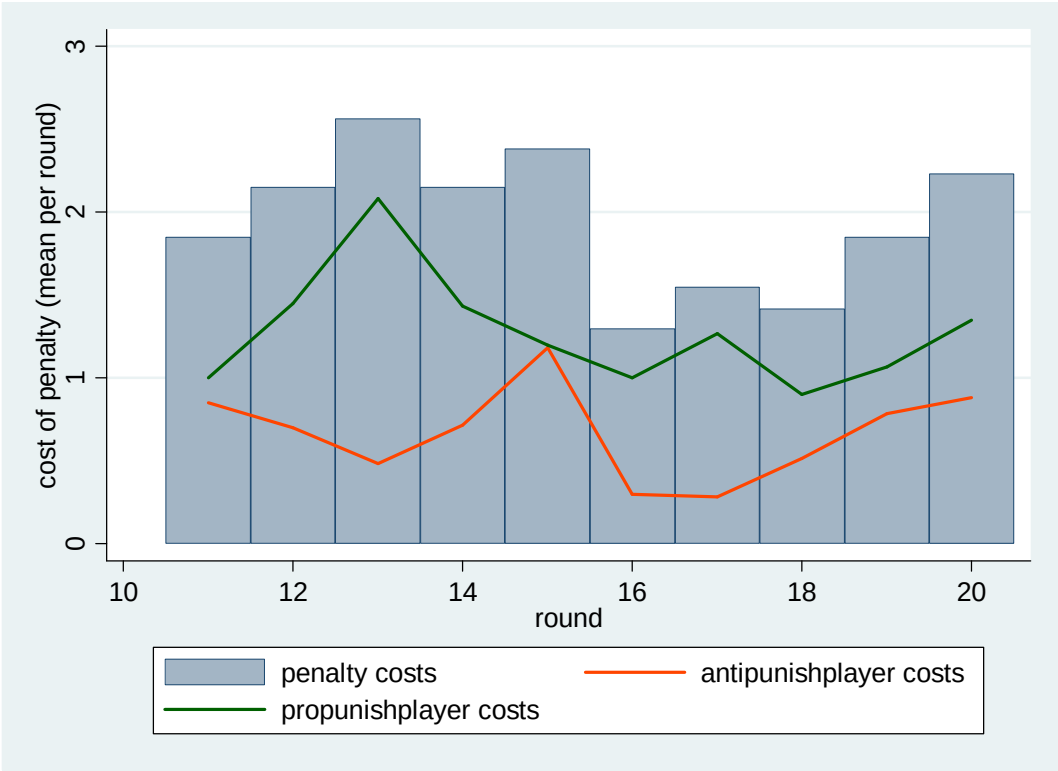
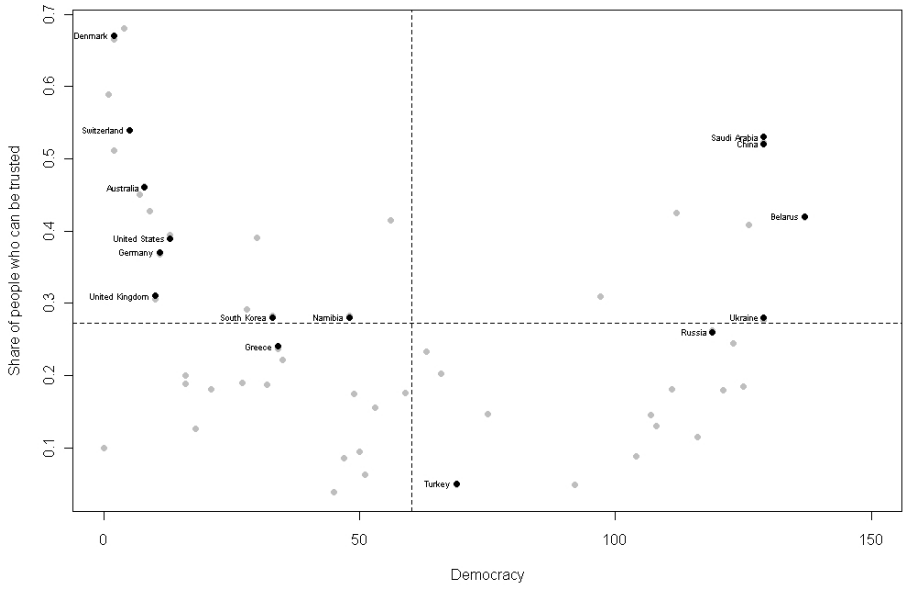


Figure 3 Distribution of ASP and PSP over time (costs to the punisher)

That ASP is a reactive phenomenon can be seen from Figure 3 in the Appendix that illustrate how penalties and antisocial punishment evolve over time. A strong increase in PSP from round 11 to 13 is visible while at the same time ASP is decreasing. This high initial punishment of free-riders which should curb other's harvest (and it does in most laboratory settings) leads to an increase in ASP until in round 15 players buy as much punishment points for ASP as for PSP. After the peak in round 15 ASP drops sharply and then increases again steadily until the end of the game. Thus, although ASP is prevalent from the beginning it is a reaction to either received punishment or to unsuccessful attempts to punish others, or both. Indeed we do find a correlation of 0.2 between previous round received PSP and next round ASP which is significant at the 1% level (while the correlation between previous round received PSP and prosocial punishment is insignificant with 0.03).



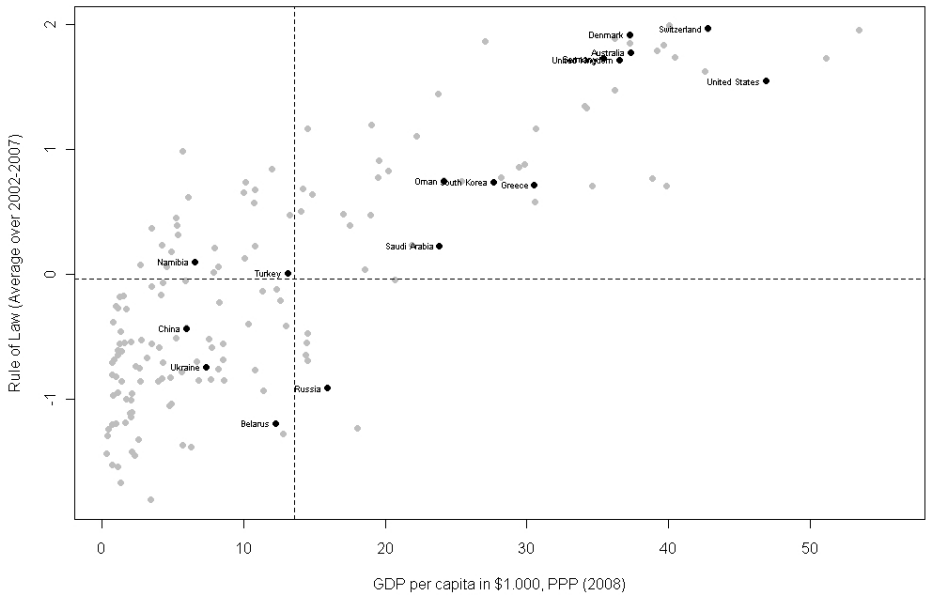


Figure 4 and 5: Distribution of GDP, norms of trust and rule of law in the countries where Herrmann et al. (2008) conducted their experiments as well as Namibia and all other countries for which data are available in the respective data set (grey dots without labels). Lines indicate world averages of the respective variable.

Locating the general level of trust and the rule of law of Namibia (not Kavango) within a global perspective it can be seen in figures 1, 4 and 5 in the online supplementary material that the level of generalized trust in Namibia is as high as in Greece or Russia where a lot of ASP occurred – but much lower than Saudi Arabia (where also a lot of ASP occurred). Comparative country data on cooperative norms were not possible to obtain for Namibia. The only available measure is the general trust measure (which is also not available for Oman) taken from 'Afrobarometer'. However, general trust corresponds to norms of civic

cooperation as it is a prerequisite for an individual to cooperate with unrelated strangers. G-trust is less specific than the index used by Herrmann et al. (2008). In our rural Namibian context not paying for a bus fee is not possible (they are collected by the driver immediately)and subsistence farmers as in our study do not pay taxes.

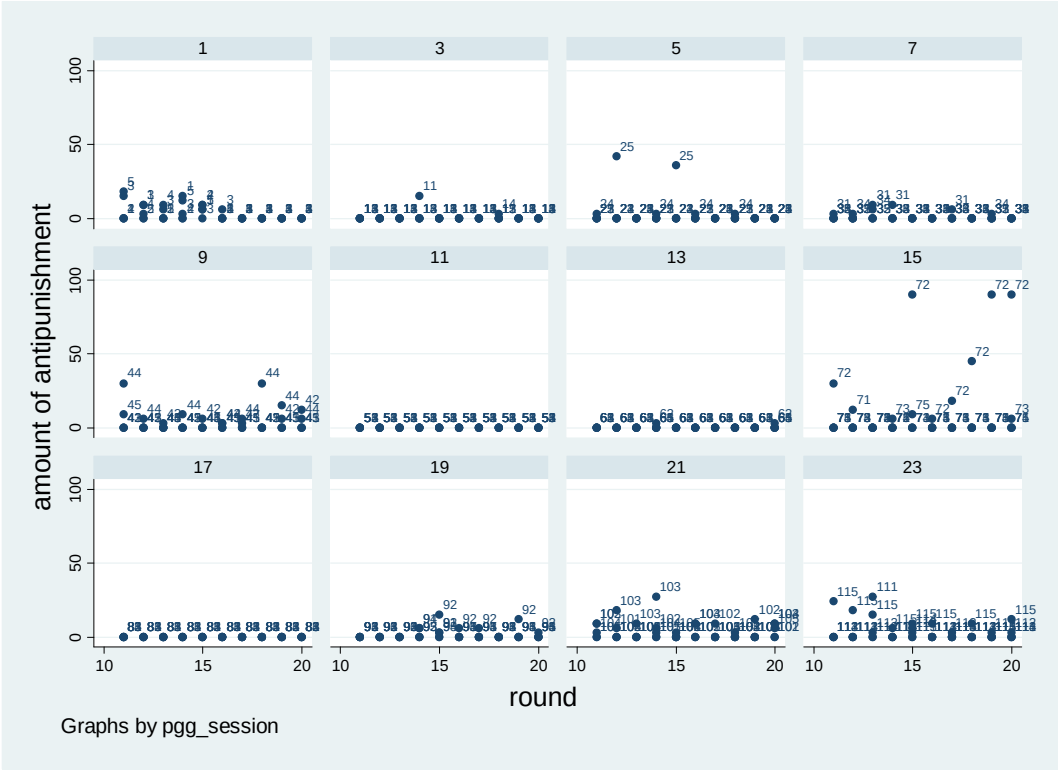


Figure 6 Distribution of ASP (points deducted from other players) by session and over time.