Anti-norm agreements – collusion against the sanctioning mechanism

Working paper
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H. Autto[1]

Abstract: This working paper defines and studies anti-norm agreements. Anti-norm agreements are agreements of mutual no-sanctioning between some actors in the norm community. These agreements make it possible for all agreement parties to deviate from the norm. Using James Coleman's formalization we show that anti-norm agreements are never efficient against the norm under perfect social system. However, when the assumption of perfect social system is dropped anti-norms can be efficient against the norm. We report preliminary simulation results on how vulnerable a simple sanctioning mechanism is against anti-norm agreements. Population dispersion is identified as a key theoretical variable. Finally, results are discussed in light of common-pool resource studies. We suggest how some combinations of empirical variables might lead to this type of enforcement problems. (Key-words: norms, enforcement, collusion, common-pool resources)

1. INTRODUCTION

This working paper defines anti-norm agreements and proposes hypothesis for empirical study using James Coleman's (1990) economy of actions. By anti-norm agreements we mean agreements of mutual no-sanctioning between some individuals in the norm community. As these agreements make it possible for the agreement parties to deviate from the norm, they are examples of collusion against the public interest and of discrepancy between different levels of rationality. I show that these agreements are never efficient against the norm under perfect social system, i.e. assuming perfect information and no transaction costs. However, in imperfect systems agreements can be efficient against the norm.

I study the robustness of a specific norm enforcing sanctioning mechanism (heroic sanctioning) to these agreements. By a sanctioning mechanism I mean the process of transmission of sanctions. Against heroic sanction mechanism anti-norm agreements can emerge between individuals who are in key position to sanction each other. An interpretation of this is that people take advantage of their structural positions in the sanctioning mechanism. The key theoretical variable behind this type of collusion appears to be the type of population dispersion. If the dispersion is clustered, it is more likely that collusion occurs. As more people observe each others extraction decisions or are able to transmit sanctions to a deviator the less likely it is that anti-norm agreements emerge. Applying this discussion to common-pool resource users we suggest how extraction method and resource characteristics explain some of the population dispersion and, therefore, also enforcement difficulties that stem from collusion. From the point of view of an external monitoring institution this means that there is special need to obtain information from those parts of the system that rely on few peer monitors/sanctioners.

[1] Public Choice Research Centre, University of Turku. E-mail: hannu.autto@utu.fi

Before studying anti-norm agreements it is necessary to define norms. Literature on norms is wide and there are many approaches to the topic. I do not attempt a review here (for one, see Horne 2001), but merely introduce the approach followed in this paper. Using the syntax for institutional statements of Institutional analysis and development (IAD) - framework (Ostrom 2005) norms can be defined to be statements that contain the following parts:

(Attribute)	: to whom the statement applies,	*Everyone*
(Deontic)	: a modal verb, i.e. ‘may’, ‘must’, or ‘must not’	*must not*
(AIM)	: describes actions to which the deontic is assigned,	*fish more than X kg per week*
(Conditions)	: defines when and where the statement applies.	*always, in lake Y.*

An example of a daily expression that contains these components is: “None is allowed to fish more than X kilograms per week in lake Y.” This statement is analyzed above using the syntax. More specifically, I am interested in (1) conjoint, (2) Prisoner’s Dilemma norms which are (3) packed by external sanctions:

(1) Beneficiaries and targets of the norm are conjoint sets (Coleman 1990, 246-249). Beneficiaries are individuals who benefit from the norm and therefore they have incentives to contribute for the norm emergence. Target actors are individuals to whom the norm applies. (2) Individuals have a temptation to deviate from the norm, which implies that the norm does not merely solve a coordination problem. The norm aims to change the incentive structure so that individuals avoid Pareto-inferior outcomes. (Ullman-Margalit 1977.) Finally, (3) the norm changes the incentive structure by introducing external sanctions. People who sanction are assumed to be norm beneficiaries.[2] I take this to be a useful abstraction of common-pool resource situations for current purposes.

As this paper is about collusion against the norm it is assumed that the norm has already emerged. People have solved the collective level public good provision problem of how to introduce credible and efficient sanctions. Thus, Pareto-inferior outcomes are avoided. The point made here is that there is a possibility for further dynamics. Some sub-groups might find it beneficial to collude against the norm using their ability to hamper the local efficiency of sanctions. This ability stems from individuals’ importance for norm enforcement as peer sanctioners and monitors. One of the biggest stories of rational choice is the potential discrepancy between individual and collective levels of rationality. Another well-known discrepancy lies between rationalities of the collective and its sub-groups. This paper aims to highlight a less studied instance of the latter. This might shed some light on why we observe heterogeneous norm compliance. Not only some individuals but also some sub-groups may be able to deviate from the norm, although it has been successfully established. Stable anti-norm agreements (or simply, anti-norms) might co-exist with the norm.

For the analysis I follow Coleman (1990), who uses an extended version of barter economy model to study norms. In Chapter 2 I give informal conditions for anti-norm agreements. In Chapter 3 I introduce the model. In Chapter 4 I formalize conditions using the model and show why agreements are never efficient against the norm under perfect social system. In Chapter 5 I report preliminary findings on the robustness of a specific

[2] But in some parts I discuss more formal sanctioning agency, which relies on information via peer monitoring. Following IAD-syntax we are then speaking of rules.

sanctioning mechanism against agreements. Chapter 6 concludes with hypothesis for CPR-environments.

2. DEFINING ANTI-NORM AGREEMENTS

Let us assume that the norm has been realized, and some sanctioning mechanism is in place. The first observation towards the demand of an anti-norm is that some actors might find it beneficial to agree not to sanction each other. What is there to gain from such an agreement?

The possible gain for actors is that their agreement makes it possible for them to deviate, because their agreement not to sanction each other decreases the capability of the rest of the actors to impose efficient sanctions on them. The possibility to deviate after the agreement is then a necessary condition for its existence. This first condition can be stated as follows:

Condition 1: *Every actor in the agreement is able to deviate after the agreement.*

This type of agreement can be interpreted as an example of Douglas Heckathorn's (1990, 377-378; 1993, 32) 'oppositional control', which refers to actors ability to resist others' control attempts. One way for an actor to reduce others' control attempts is to buy their rights of sanctioning with his right to sanction them.

Condition 1 makes it possible that there is something to gain from the agreement so it may be a good move for actors. But it does not alone guarantee it. By allowing other individuals in the agreement to deviate, any given individual suffers the externalities (or lack of them, if externalities are positive) of others' actions. Therefore, the second condition for the agreement is:

Condition 2: *For every actor in the agreement the benefit from the deviation is bigger than the sum of his lost interests over externalities of other actors in the agreement.*

This condition reduces the maximum number of individuals in the agreement. Anti-norm agreements can be given an intuitive description. A proposal for one could be: "How about you let me do the action X, if I let you do the action X too?" Despite the externalities (that are negative in this case) of other actors executing the action X, the actor may be willing to tolerate them up to some point, if this toleration guarantees that he is able to execute action X himself. Two fishermen, for example, may agree not to act upon each others' catches that are above quotas, because they are then both able to over-fish and enjoy the increased sale benefits. But they would not like every fisherman to do the same, because this would generate too many negative externalities. These agreements might also stem implicitly. If a peer observes her neighbour deviating, she might (instead of sanctioning or reporting) tolerate the behaviour, conclude that the neighbour is not able to sanction or report her, and deviate herself. Mutual no-sanctioning allows now both of them to deviate.

Next we introduce the essentials of the economy of actions in order to formalize previous conditions. The main reason for the use of economy of actions is that it allows us to take into account properties of the social system[3] and differing power of individuals in the system.

3. ESSENTIALS OF THE ECONOMY OF ACTIONS

Economy of actions is an extended barter economy model. Following definitions are standard[4], except that a specific utility function is assumed. This is done, because the theory requires that we calculate the competitive equilibrium (see Coleman 1990, 675). We assume Cobb-Douglas utility function:

$$U_i = c_{i1}^{x_{1i}} c_{i2}^{x_{2i}} \dots c_{im}^{x_{mi}}$$

where $U_i \equiv$ utility of individual i,
$c_{ij} \equiv$ amount of good j held by individual i, where $i = 1,\dots,n$ and $j = 1,\dots,m$
with scaling $\sum_{i=1}^{n} c_{ij} = 1$.

and where x_{ji} are parameters expressing the contribution that good j makes towards the utility of individual i. We impose two constraints on x_{ji}:

$x_{ji} \geq 0,$. and
$\sum_{j=1}^{m} x_{ji} = 1$, where $i = 1,\dots,n$ and $j = 1,\dots,m$.

These constraints imply that each good contributes towards the utility of individual i positively (if at all). They also imply declining marginal utility (except if $x_{ji} = 1$ for one good and 0 for others). Coleman's (1990, 675) insight of how this description of an economical system can be used to analyse a wider social system is to let quantities c_{ij} correspond to control over events, and the quantities x_{ij} to interests to events.

Quantities introduced above can be given in matrix notation:

$C = \|c_{ij}\|$ (an $n \times m$ matrix), and
$X = \|x_{ji}\|$ (an $m \times n$ matrix).

It is then possible to calculate values of events in the competitive equilibrium, when people are trying to maximize their utility by exchanging control over events. Let us define the value of the event:

$v \equiv \|v_j\|$ (an $m \times 1$ matrix).

[3] Most of which are, however, not discussed in this paper.
[4] Definitions in this chapter follow Coleman (1990).

The total value of individual i's resources is obtained by summing up values of each of the events that he holds:

$$r_i = \sum c_{ij} v_j \tag{1}$$

This quantity also corresponds to power that the actor holds in the system. Total amounts of power and value in the system are arbitrary, so we introduce a scale of value:

$$\sum_{i=1}^{n} r_i = \sum_{j=1}^{m} v_j = 1$$

The maximization problem that each individual faces subject to his resource constraint is:

$$\max U(c_{i1},...,c_{im}) \text{ subject to } r_i = \sum c_{ij} v_j$$

Using these definitions it is possible to calculate the value of the event k, v_k, in the system:[5]

$$v_k = \sum_{i=1}^{n} x_{ki} \sum_{j=1}^{m} c_{ij} v_j \text{ or in matrix notation} \tag{2}$$

$$v = XCv \tag{2'}$$

For m events there are $m-1$ independent equations of the form (2). Since the initial distribution of control, C, and interests, X, are assumed to be known, these equations can be solved for the m quantities v_k using (2). Then equation (1) can be used with the known v_k to find the power of individuals, r_i. Finally, the distribution of control, c^*_{ik} at equilibrium can be calculated using (3):

$$c^*_{ik} = \frac{x_{ki} r_i}{v_k} \tag{3}$$

A short intuitive description of the system could be the following. People have different interests to events, which can be given as the interest matrix X, where each cell contains a parameter telling how much the event contributes to the utility of the individual. Parameters can be compared so that we know which events are more important to the individual than others. People also have different initial controls over events. These can be given in a form of the control matrix C, where each cell contains the amount of control the individual has on the event. If the parameter is zero, he has no control over it, and if it is one, he has full control over it. But the control can also be shared so that the parameter is in between 0 and 1 (events are divisible). People then aim to maximize their utility by exchanging controls of events with other individuals. Each individual's power is not only dependent on his control over events, but also on the value of those events in the system. Events have different values as individuals' prefer some more than others. Control over event that nobody is interested in cannot be used in exchange, so it is useless as a power

[5] We omit proofs here. They are found in Coleman (1990, 682-684).

resource. The power in the system could then be defined as person's initial control over events that others are interested in (compare this to a budget).

4. NORMS AND ANTI-NORMS IN THE ECONOMY OF ACTIONS

In order to study a conjoint norm proscribing a set of actions J define two regimes, a and b, for outcomes when actions are taken (a) and are not taken (b). Each action in J causes negative externalities to others, but each actor has an interest to carry out the action.

$a_j \equiv$ regime a for set J of actions: negative interests in actions of set J are set to zero in X, and interests are renormalized.
$b_j \equiv$ regime b for set J of actions: positive interests in actions of set J are set to zero in X, and interests are renormalized.

As interest matrix X is different under these two regimes, we also have regime specific power:

$r_{ai} \equiv$ power of actor i in regime a
$r_{bi} \equiv$ power of actor i in regime b.

Still assuming that norm beneficiaries have solved the collective level problem we can give quantified measures on how much each beneficiary is willing to contribute for sanctioning a deviator and what is the necessary level of sanctions required for them to be effective against a given deviator (the necessary deterrence level). Sums of values of actions in J under regimes are

$$v_{a_j} = \sum_{k \in J} x_{kk} r_{ak} \text{ , and}$$
$$v_{b_j} = \sum_{k \in J} \sum_{i \neq k} x_{ki} r_{bi} \text{ . (Coleman 1990, 801.)}$$

These sums are useful, because they can be used to compare values of actions to values of externalities. Using a slightly abusive notation we refer to a single element of the sum v_{a_j} as $v_{ai}(= x_{ii} r_{ai})$. This element is merely the value of individual's action to himself, e.g. deploying an additional fishing net. The value of externalities of this same action to others is an element of v_{b_j}, namely $\sum_{\substack{i=1 \\ i \neq j}}^{n} x_{ji} r_{bi}$, and we refer to this element as v_{bi}. Using these definitions we can then give the condition that there are enough power and interest in the system to effectively sanction deviators. This condition is

$$x_{jj} r_{aj} < \sum_{\substack{i=1 \\ i \neq j}}^{n} x_{ji} r_{bi} \text{ , for every actor } j \text{ in the system} \qquad \text{(condition 0)}^{6}$$

[6] This inequality is the same as inequality (30.6) in Coleman (1990, 803), but extended for every actor in the system.

Condition 0 takes also into account differing power in addition to mere interests. This is one of the reasons why economy of actions is adapted. It allows us to incorporate properties of social system and study how they affect power distribution and norms in the group. When this condition applies sanctions are effective against every individual in the system (assuming no transaction costs in sanctioning, perfect information and solved collective action level problem). We assume that this condition holds, that is, the norm is efficient in the community. Condition 0 also implies that the norm adoption has been a Pareto-optimal move.

Next I define conditions 1 and 2 (introduced in Chapter 2) for anti-norm agreements using the economy of actions. For this I introduce an agreement coalition C. These are actors who have agreed not to sanction each other. Condition 1 can then be written as

$$x_{jj} r_{aj} > \sum_{\substack{i=1 \\ i \neq C}}^{n} x_{ji} r_{bi} \text{, for every actor } j \in C \qquad \text{(condition 1)}$$

When this condition holds each member in the agreement may carry out the action despite the norm, because the agreement reduces norm community's ability to sanction an agreement party. But we also require that the gain for each individual in the agreement is strictly positive. Condition 2 can be written as

$$x_{jj} r_{aj} - \sum_{\substack{i \in C \\ i \neq j}} x_{ij} r_{bj} > 0 \text{, for every actor } j \in C \qquad \text{(condition 2)}$$

This condition reduces the size of the coalition. When conditions 1 and 2 both apply the anti-norm agreement is beneficial for members in agreement. This is a necessary condition for the agreement, but it does not yet guarantee that the agreement is feasible. The rest of the norm community now faces a new collective action problem against the agreement members. In line with earlier discussion I assume here that the second level problem is solved, so it is sufficient to calculate interests and power. For the agreement to be efficient against the norm the sum of value to agreement parties must be higher than the sum of lost value to the rest of the actors. This means that the rest of the community does not have sufficient power and interest to sanction agreement parties. This condition is given by

$$\sum_{j \in C} \left(x_{jj} r_{aj} - \sum_{\substack{i \in C \\ i \neq j}} x_{ij} r_{bj} \right) \phi \sum_{j \in C} \sum_{i \notin C} x_{ji} r_{bi} \qquad \text{(condition 3)}$$

It is relatively easy to show that condition 3 can not hold in perfect social systems, if the norm is efficient against each individual. Condition 3 is equivalent to

$$\sum_{j \in C} x_{jj} r_{aj} \;\phi\; \sum_{j \in C} \left(\sum_{\substack{i \in C \\ i \neq j}} x_{ji} r_{bi} + \sum_{i \notin C} x_{ji} r_{bi} \right). \qquad (4)$$

To show the contrary it suffices to show that each element of the sum (over *C*) in left hand side is smaller than each element of the sum (over *C*) in the right hand side. This is given by condition 0. This observation merely states that if no individual is able to deviate from the norm in a perfect social system, no sub-group is able to do that either. The rest of the community is always able to raise enough sanctions in order to make the agreement unbeneficial for parties.

The assumption of "perfect system" in economy of actions comes down to the assumption that each potential deviator faces sanctions with certainty and without transaction costs. The right-hand side of condition 3, for example, summarizes how much norm beneficiaries are jointly willing to contribute for sanctioning the agreement parties. The left-hand side summarizes how much agreement parties are jointly benefiting from the agreement. In theory, anti-norm agreements can be efficient against the norm only if condition 3 holds. When this happens, agreement parties can divide benefits so that sanctions become ineffective against each party. But this can only occur, if the agreement also causes inefficiencies to the sanctioning mechanism. This could be the case e.g. when members are in key positions to sanction or monitor each other. These efficiency losses lower the right-hand side of condition 3 making it possible for some agreements to be efficient against the sanctioning efforts. In what follows, I stop assuming perfect social system. To illustrate some potential imperfectness I study a specific (peer) sanctioning mechanism introduced in Coleman (1990).

5. ROBUSTNESS OF HEROIC SANCTIONING AGAINST ANTI-NORM AGREEMENTS

How exactly do we expect joint interest and power to turn into effective sanctions? In many common-pool resource cases people have devised some type of formal institutions to take care of monitoring and sanctioning, although in many cases informal sanctioning alone can efficiently secure high level of compliance. Most of the real world governing regimes are mixtures of formal agencies and informal (peer) enforcement. Police forces, for example, are very dependent on the supply of information by citizens in their effort to enforce law. Usually joint interest and power are needed for the establishment and upkeep of any formal institution. Economy of actions -framework provides quantified measures on how much beneficiaries are willing to contribute for the regime and what is the necessary deterrence level for each individual. When formal institutions are concerned, we need (in minimum) to define a sanctioning function that maps individuals' contributions (resources at agency's disposal, input to the agency) to the achieved level of deterrence (output of the agency).

In informal settings some micro-micro -sanctioning mechanism is needed for joint interest and power to turn into sanctions. Following rational choice theory the mechanism needs to guarantee that it is worthwhile for a peer to undertake sanctioning, i.e. an action that involves costs. Coleman (1990, 278-282) describes one such simple mechanism, heroic sanctioning. Any peer can act as a heroic sanctioner, that is, she can sanction a deviator single-handedly. For this to be rational for her, she needs to be assured that other beneficiaries compensate her for the effort, as she is not single-handedly willing to bear full costs of sanctioning the deviator (supplying a public good). Whether beneficiaries have managed to assure one another is a question of solving the second level public good problem. As explained in last chapters I assume that this problem is solved. Heroic sanctioning is just one description of how joint interests and power can turn into sanctions, and my intention is only to use it to illustrate how some system characteristics may favour anti-norm agreements.

The set-up is as follows. There are 20 actors in the social system, each having a temptation to undertake an action that creates negative externalities to others (e.g. above-quota extraction in CPRs). The interest matrix for private events is generated using normal distribution with mean 80 and standard deviation 20, which tend to produce power differences of 10-15% between any individuals in maximum. The system is solved (see Chapter 3) using algorithm of Coleman (1990) in *Wolfram Mathematica 7.0* -notebook.

For studying heroic sanctioning with transaction costs I distribute actors inside a circle. The diameter of the circle is 1, so also the maximum (Euclidean) distance (*d*) between any two actors is 1. The transaction coefficient for heroic sanctioning is simply $1-d$. The nearest player always acts as a heroic sanctioner. Figure 1 below illustrates the principle with three players (1, 2 and 3) in one dimension.

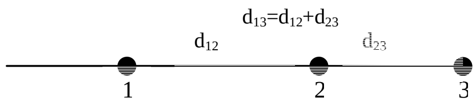


FIGURE 1: An illustration of sanctioning

The closest other player to player 1 is player 2 ($d_{12}<d_{13}$). The norm community can then sanction player 1 with efficiency $1-d_{12}$. Players 2 and 3 are closest to each other, so the community can sanction players 2 and 3 with efficiency $1-d_{23}$. It is now relatively easy to see how anti-norm agreements can be effective in this system. As an agreement is struck the potential of the rest of the community to transmit sanctions to agreement parties may be hampered by increasing transaction costs. If player 2 and 3 above are agreement parties, the rest of the community can sanction the coalition only with efficiency $1-d_{12}$. The maximum sanctioning capacity (if $d_{12}=0$) is calculated from the economy of actions - it is the aggregated value of the externality to other players. Therefore, as externalities get more severe the community is willing to use heavier sanctions.

I set up a *Mathematica* -script to calculate which members (if any) are able to form a feasible coalition against the sanctioning mechanism. Here I give a brief outlook of the script:

(i) The economy of actions -model is solved. *(ii)* Spatial positions are created and sanctioning efficiencies calculated. *(iii)* Players who are able to deviate from the norm are found and excluded from the analysis. The sanctioning mechanism can not create high-enough deterrence against these players. They have no incentive to join any coalition as they are already able to deviate.

(iv) All possible two member coalitions (subsets) of players are found. *(v)* For each coalition the joint positive valuations of members and negative valuations of the rest of the community are calculated. *(vi)* The best sanctioning efficiency of any non-member against any coalition member is found. This is the new (if changed) sanctioning efficiency against the coalition. *(vii)* The positive valuations of members are compared against the negative valuations of the rest of the community. The latter is weighted by the (new) sanctioning efficiency. If positive valuations are higher than the weighted negative valuations, agreement parties are able to share benefits in a way, which makes the sanctioning mechanism not efficient against them. These are feasible coalitions. *(viii)* Players in feasible two member coalitions are excluded from the rest of the analysis. They prefer to

deviate with letting only one other player to deviate than letting many players to deviate. *(ix)* All possible three member coalitions are found…

Here I concentrate on effects of two independent variables (interests to externalities, and spatial population dispersion) on the dependent variable (possibility of anti-norm agreements). Empirically, interests to externalities may grow e.g. after an attitude change, resource depletion, or negative changes in players exit-options.[7] Population dispersion may be random or clustered depending on the resource type, extraction method and attributes of the community. In all subsequent tests individuals' interests X_i^a to take the externality producing action follows $X \sim N(90,15)$. To test the interaction between variables I build three treatments. In treatment A population dispersion is random, i.e. drawn form a uniform distribution (see Figures 2 and 3 for illustration). In treatment B population dispersion is loosely clustered (see Figures 4 and 5) and in treatment C population dispersion is heavily clustered (see Figures 6 and 7).[8]

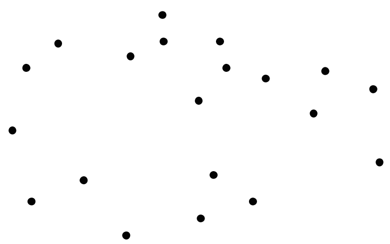


Figure 2: Homogenous dispersion (example)

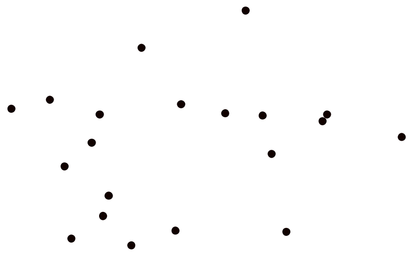


Figure 3: Homogenous dispersion (example)

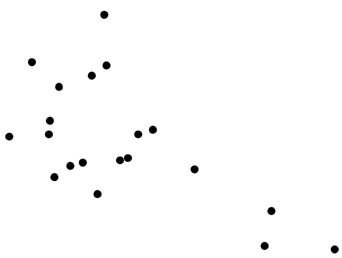


Figure 4: Loose cluster dispersion (example)

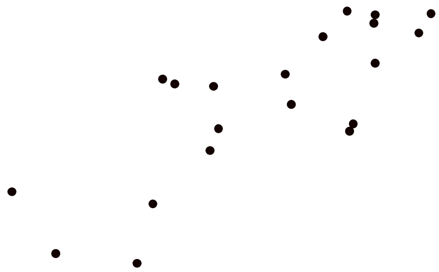


Figure 5: Loose cluster dispersion (example)

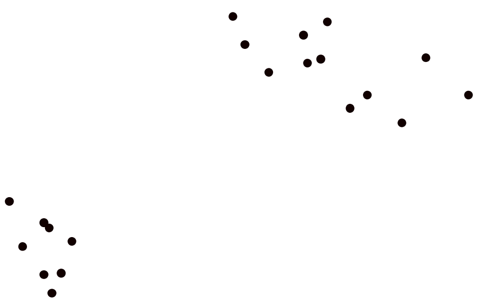


Figure 6: Dense cluster dispersion (example)

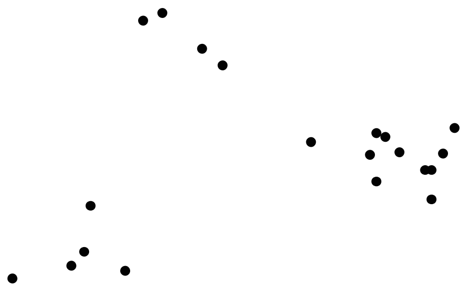


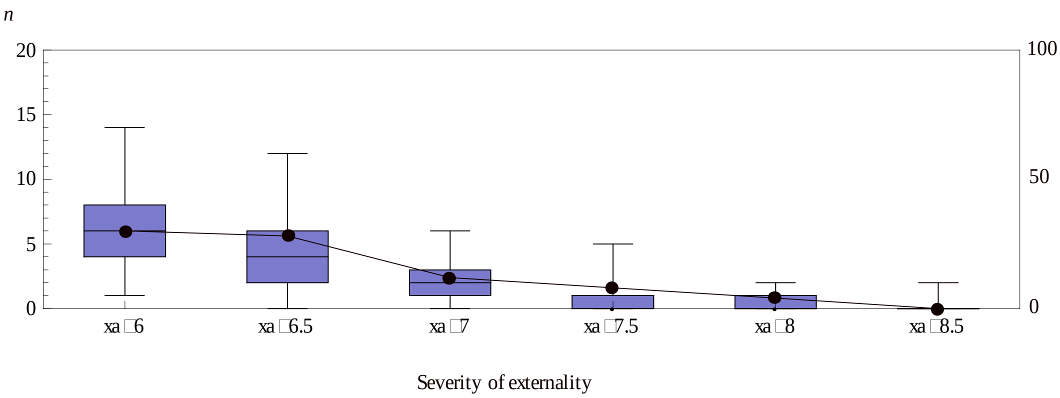
Figure 7: Dense cluster dispersion (example)

[7] As the sum of interests to externality grows in the system, so does the severity of sanctions against deviators. The interest to externality therefore approximates sanctions.
[8] I use Poisson cluster pattern (see Liu 2001). Concepts 'loose' and 'dense' here refer to average distances from cluster centres. Four cluster centre vectors are randomly picked. The number of offspring for each vector follows Poisson distribution (mean 4). For each offspring two vectors are drawn: distance from cluster centre and a directional one.

I test how the increasing severity of externalities affects both free-riding (single deviation) and collusion (group deviation) in each treatment. One would expect that as externalities and therefore sanctions get more severe, less free-riding is taking place. This intuition is also confirmed by simulation results here. But results also point out another phenomenon. In clustered populations some individuals are able to change the free-riding strategy to collusion. The same does not happen in homogenous populations.

Figures 8, 9 and 10 summarize the simulation results. Horizontal axes capture severity of externality increasing to the right.[9] For each six (discrete) values of externality 100 simulations are run.[10] Box-and-whisker plots show the distribution of *the number of single deviators* in the runs. The box spans from .25 quintile to .75 quintile, and “whiskers” report the span of the whole dataset. Boxes are accompanied with curves, which depict *the probability of collusion* in each set of runs. These probabilities are calculated simply by dividing the number of runs where some form of collusion occurred by the total number of runs in the set. Vertical axes capture numbers of deviators for box-and-whiskers (see left hand side) and probabilities for the curve (see the right hand side).

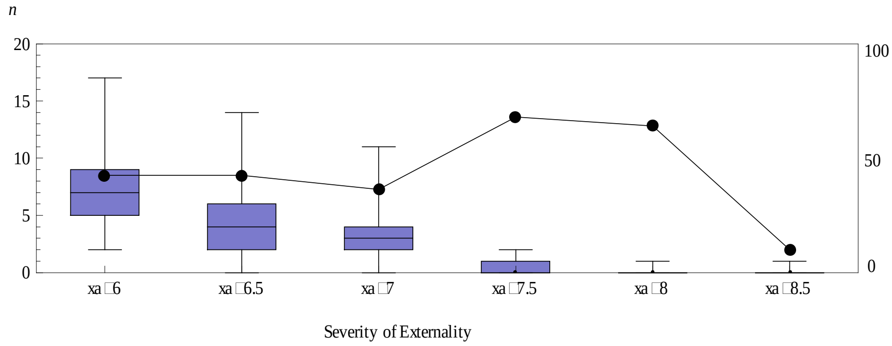
FIGURE 8 : Homogenous dispersion



In homogenously dispersed populations the probability of collusion follows the overall decrease of deviators when externality is getting more severe. This sanctioning mechanism is not particularly vulnerable for collusion in these populations, although results suggest that some collusion can occur together with individual deviation. Something very different is going on in clustered populations.

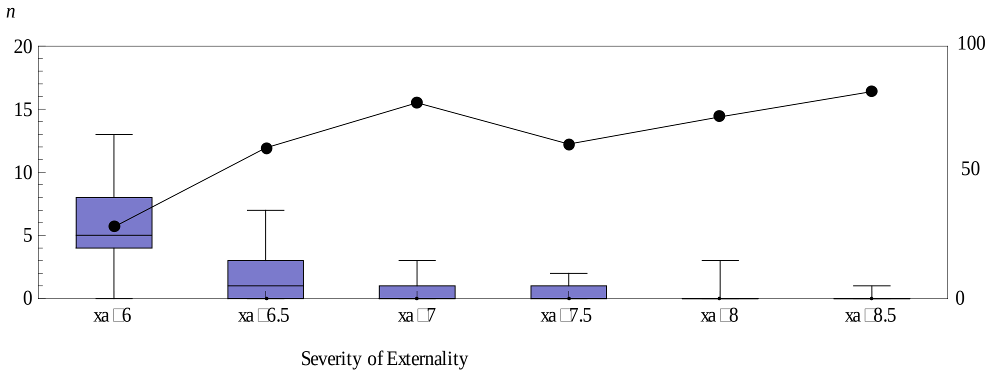
[9] The first value is about 7% of the average value of the action itself and the final one is about 10%. In this system it means that it first takes a joint contributions of 15 persons to sanction a deviator, and finally only 10.
[10] Note: only 50 from 4th onwards. These are preliminary tests, please do not cite without permission. Note also that for these preliminary tests, only collusion coalitions up to 6 members were considered. Bigger coalitions are possible (although unlikely), and this might somewhat increase the probability of collusion in clustered communities.

FIGURE 9 : Loosely Clustered Dispersion



In loosely clustered populations there is an inverse relation between the number of free-riders and collusion. Initially, increasing severity of externality (and severity of sanctions) starts to decrease the number of free-riders, but not the probability of collusion. When the sanctioning mechanism starts to be strong enough to deter individual members more sub-groups find it beneficial to collude against it. Individuals may “adapt” their strategy from individual free-riding to joint collusion. This highlights the fact that we are dealing with two separate phenomena that need not occur together. When xa=7.5 or xa=8 in Figure 9 there is very little free-riding, but a high probability of some sort of collusion. Finally, however, sanctions are strong enough to deter collusion attempts. But in loosely clustered populations this occurs much later than in homogenously staggered populations.

FIGURE 10 : Densely Clustered Dispersion



One interesting observation to be made from densely clustered populations is that free-riding converges to zero faster than in other treatments. This is simply because there is always a potential punisher around to transmit the sanction without great transaction costs. But this also creates a good environment for collusion as the number of apt punishers for each potential deviator is low (revisit Figures 6 and 7). Sub-groups may be far away from each other, and this makes inter-group sanctioning expensive. Intra-group sanctioning, on the other hand, is very fragile to collusion. In these types of communities it is very likely that externality stems from collusion – not individual free-riding. A quick take-away is that the discrepancy between what is rational for a sub-group and what is rational for the whole community occurs more often in communities with heavy clusters.

The assumed sanctioning mechanism is a very simple one – and it is offered only as a starting point. Further research it obviously needed. But note the following. The sanctioning mechanism is imperfect, because it is vulnerable to transaction costs. The analysis could be easily extended to sanctioning mechanism with imperfect monitoring. Consider a formal agency that delivers sanctions to deviators. Assume that the agency has no- or limited monitoring capability of its own and, therefore, it relies on information via peer monitoring (peers monitoring each other and reporting deviations to the agency). Peers gather information on each other's behaviour during their "normal routines". That is, we assume no intentional information gathering, but mere automatic observation during individuals' daily routines. If we further assume that the probability of getting caught depends on how close the next peer is, we have a very similar looking model to the one tested here. This would then suggest that the sanctioning agency may lack reliable information from clustered communities.

Common-pool resource situations are an important set of empirical cases of conjoint norm implementation. This study field has traditionally been rich on small *n*-case studies, which have lead to an identification of rather large number (25+) of relevant variables that explain the success or failure of resource management. Arun Agrawal (2002) among others has addressed the need for theoretical work that could lead to testable hypothesis on the various interactions between key empirical variables. One of the critical enabling conditions for sustainability of commons that Agrawal (2002, 62-63) distinguishes from earlier comparative works is ease in enforcement of rules. Collusion, of course, is counter-productive to this goal. Another set of enabling conditions concerns technology, and one important piece of technology is the extraction method. I would suggest that the extraction method together with some resource and user group characteristics can explain much of the variance in population dispersion (which seems to be a key theoretical variable behind collusion) between cases. In some cases extraction decision is a public act in a sense that a large number of norm beneficiaries are able to monitor it without great costs. This is the case at least when the whole community works and lives in the same geographical area, resource system is small and has a low level of mobility. Villagers extracting wood from local forests might very well fit to this description. But some resources favour extraction strategies that lead to naturally clustered populations. Consider traditional cases of herders, hunters and perhaps also fishermen. Because of characteristics of the resource, it is not a good strategy to maintain homogenous dispersion as (1) it might be sub-optimal utilization of the resource, and (2) small-scale public goods might need to be provided for the extraction to take place (hunting stag, not hare; secure property rights over herd against other humans and nature; etc.). It might be that the population evolves towards clusters, that is, groups fish at different spots although they do utilize the same resource and share the externalities. According to earlier conclusions on collusion this type of population dispersion might lead to enforcement problems, if the enforcement mechanism relies on peer monitoring and sanctioning.

6. CONCLUSIONS

We have defined anti-norm agreements and drawn hypothesis for empirical study. Using Coleman's formalization we have shown that anti-norm agreements are never efficient against the norm, if the norm is efficient against individual free-riders. This means that these agreements must utilize imperfectness of sanctioning mechanism. We have studied the robustness of one such sanctioning mechanism, namely heroic sanctioning, against this type of collusion in a conjoint norm environment. More specifically we have studied the interaction between severity of externality, population dispersion, individual free-riding and collusion. The preliminary simulation analysis suggests following hypothesis:

(1) Collusion occurs more often in clustered populations than in homogenous ones.

(2) Individual free-riding occurs less often in populations with dense clusters.
(3) In homogenous populations both the likelihood of collusion and the amount of individual free-riding are inversely related to the severity of sanctions.
(4) In clustered populations there is an interaction effect between individual free-riding and collusion in the parameter region where sanctions are enough to deter individual free-riders.
(5) Due to (4) and unlike in homogenous populations, the likelihood of collusion is not a monotonic function of the severity of sanctions in clustered populations.

These conclusions are discussed in light of studies on common-pool resources. Relying on earlier works a set of empirical variables that may lead to this type of enforcement problems is suggested.

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