

Three Union Regulations for Environment Protection Agency

or

A Game with 12 bank notes by Joseph E. Mulla, *Independent Researcher*

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Personage: Protection Agency, Environment Board, Union Members/Outsiders and Moderator

It is now almost a common truth that society needs to avoid environment contamination or damage become significant for nature protection programs of the government and wild life preservation efforts. A possible outcome of such efforts might occasionally be a voluntary solution, which results that some industries are keyed up to find a break not to participate in environment protection. In the following we blow things out of all proportions, but the reader may find it informative to trace the interaction of interests between companies and environment protection agency, which takes into account the nature/content of industry activities. Contrary to the efficiency of a voluntary solution, what our solution is not, we still hope that we are at right advancing in the direction of self-governing decision-making process.

Suppose, that environment protection agency is determined to supervise contaminating activities. The agency hopes to reduce society losses with regard to wasted natural resources. To find industry pollution activities the agency has recommended proceeding with an inspection. Inspection disclosed that companies out of the normal activities polluted or damaged the environment in accordance with Table 1:

Table 1

<i>Industry Effects</i>	<i>Groundwater Contamination</i>	<i>Deterioration of Lakes</i>	<i>Fuel Damage</i>	<i>Loss of Forest Cover</i>	<i>Ozone depletion</i>	<i>Total</i>
<i>Comp. nr.1</i>		○	○			2
<i>Comp. nr.2</i>	○	○		○	○	4
<i>Comp. nr.3</i>		○	○	○		3
<i>Comp. nr.4</i>	○	○		○	○	4
<i>Comp. nr.5</i>			○	○		2
<i>Comp. nr.6</i>	○	○	○	○	○	5
<i>Comp. nr.7</i>		○	○			2
<i>Total</i>	3	6	5	5	3	22

The agency asked the companies to close these activities and they promised to start projects to shut down the contamination or to downgrade the industry negative effects of all ○-activities and to live up totally to 22 promises. The agency believes the companies and apparently it is positive that all these ○-activities will disappear from the

list in the follow-up inspection as closed or contained \otimes -activities. In addition, agency explained that all are free to self-govern or to broke their promises without any penalties. Nevertheless, the agency is aware about companies' unreliable nature in keeping to their promises. Therefore, the agency decides to award companies, which do not damage or contaminate the environment and projected to organize them into a union of "Environment Protection". Agency established a fund for awards payoffs, max 12 bank notes, to cover the awards expenses. But, for some reason, the account of follow-up inspections as to fulfill promises is under budget constraint = 4, while the inspection of a particular damaging activity has its firm price per activity = 1.

The *first rule in force* will be to award a company by a bank note which will not broke its promises to close the contamination or to reduce the damage effect at least at k activities among all \circ -activities in the row of the Table 1. The agency decided not inform in advance how many \otimes -activities will be actually chosen in the award decision k . This secret, the agency thinks, will be rather more than less encouraging over rational companies to keep to their promises. However, the agency thinks, that to preserve the effectiveness of the project, despite the budget constraint for the inspection, it will be acceptable to circumvent inspection of some activities (columns) with only few \otimes -promises fulfilled. For this reason to act as the agency desired, i.e. to diminish inspection expenses, by the *second rule in force*, a moderator of the union will be awarded personally depending on the following rule. The award basket of moderator will be equal to the lowest number of promises fulfilled by the union members among activities in columns of Table 1 with regard to union members only. Moreover, to encourage a collective responsibility as coming members of the union not to "spring off in the long run" out of promises the agency proposed the *third rule in force* that the coming union regulation must emanate a threat: all awards, inclusive moderator's personal award, will be lost if some union member does not keep to its promises – still living up less than to k promises in the follow-up inspection. Note, that if no one of union members' keeps to a promise, an outsider might keep to a promise staying away from contaminating activities, as the outsider promised in the past. These promises fulfilled by outsiders do not count what so ever in moderator's award!

Let us look more closely at the incentives of moderator and union members with regard to the awards. It is clear, as we already noticed, that highly rational companies would try to shut down or contain rather more than fewer activities from the list as they promised in order to reduce the risk not to be awarded with a higher k -decision. So, the members of the coming union (members with higher environment protection standards) will certainly count on higher k 's and therefore they will try to prevent outsiders – those with relatively low “*protection standards*” – having relatively lower k 's – to become the members of the union. Mind that all members and the moderator personally will lose the awards if a union member in the long run intends to broke too many \otimes -promises, i.e. to fulfill less than k promises. On the other hand, the personal award basket of moderator might be quite empty if the number k is relatively high. Below we illustrate the last statement by example.

Let us take a look at the Table 1 and let the award will be granted at $k = 1$ or 2 . The agency expects that by fulfilling promises to close down all \circ -activities in Table 1 (all 22 \circ -activities turn into 22 \otimes -activities) every company will become a member of the union: the most preferable solution by other means, f. e. voluntary. Indeed, each company is to be awarded by a bank note. Nevertheless, the agency cannot afford the project due to budget constraint: expenses of follow-up inspection equal 5, i.e. exceed the budget by 1. The moderator's basket size equals to 3. On the other hand the moderator may persuade the coming members of the union not to keep to their promises at “*Groundwater Contamination*” and “*Ozone Depletion*” activities. All union members will still preserve their well-earned awards sounds the argument of moderator. This solution, as everyone can see, is in the interests of both: The moderator award increases from 3 to 5, and the agency expenses on inspection drop from 5 to 3; only 3 activities have to be inspected instead of 5, see the Table 2 below, in compliance with the budget constraint = 4.

Table 2

<i>Industry Effects</i>	<i>Deterioration of Lakes</i>	<i>Fuel Damage</i>	<i>Loss of Forest Cover</i>	<i>Total</i>
<i>Comp. nr.1</i>	\otimes	\otimes		2
<i>Comp. nr.2</i>	\otimes		\otimes	2
<i>Comp. nr.3</i>	\otimes	\otimes	\otimes	3
<i>Comp. nr.4</i>	\otimes		\otimes	2
<i>Comp. nr.5</i>		\otimes	\otimes	2
<i>Comp. nr.6</i>	\otimes	\otimes	\otimes	3
<i>Comp. nr.7</i>	\otimes	\otimes		2
<i>Total</i>	6	5	5	16

Table 3

<i>Deterioration of Lakes</i>	<i>Total</i>
\otimes	1
\otimes	1
\otimes	1
\otimes	1
	0
\otimes	1
\otimes	1
6	6

One can also notice that the total award expenses may now rise up to maximum 12 bank notes. However, someone from the environment board may insist that the proposal to vote for $k = 1$ is undesirable from an additional intersection since the moderator can misrepresent the members' preferences. Indeed, by this motion the moderator may offer one bank note to an environment board member for signaling about the decision $k = 1$. Now, the moderator by knowing $k = 1$ may propose to the union members not to live up to all activities except one – the “*Deterioration of Lakes*”. With this regard, the moderator may compensate nr.5 company losses by one bank note¹. If not, the company nr.5 is at right to receive an award since it may keep to promises to stay away from activities other than “*Deterioration of Lakes*”, and therefore the company nr.5 may threaten to send a signal to the board regarding the moderator's fraud. Moderator's award in this case, following the regulation rules in force (see Table 3), will be 6 minus 1 for the signal, and minus 1 for the compensation. That makes 4 what is greater than 3, as the Table 1 suggests. Thus, the board may follow the line of reasoning for counter argument to the proposal $k = 1$ and to insist on the decision $k \geq 3$ in order to prevent moderator's misrepresentation (fraud).

One may argue that $k \geq 3$ yields a grater effect of environment contamination because undesirable activities of companies' nr. 1,3,5 and 7 is now irrelevant. These companies will be excluded from the union of “Environment Protection” and will be free to self-govern, i.e. to break or not the promises (without any penalties as we already know) regarding their resumption of all these contaminating activities once again. However, someone may counter argue that, if the exclusion of companies' nr. 1,3,5 and 7 happens, as anyone can see from the Table 4 below, the remaining companies 2,4 and 6 will still be awarded and will still downgrade the total environment contamination or damage.

Table 4

<i>Industry Effects</i>	<i>Groundwater Contamination</i>	<i>Deterioration of Lakes</i>	<i>Fuel Damage</i>	<i>Loss of Forest Cover</i>	<i>Ozone Depletion</i>	<i>Total</i>
<i>Comp. nr.2</i>	⊗	⊗		⊗	⊗	4
<i>Comp. nr.4</i>	⊗	⊗		⊗	⊗	4
<i>Comp. nr.6</i>	⊗	⊗	⊗	⊗	⊗	5
<i>Total</i>	3	3	1	3	3	13

¹ Quite unpleasant suggestion.

Now the award basket of moderator equals 1, since the company nr.6 alone prefers to live up to shut down the “Fuel Damage” activity. The awards expenses will decrease from 10 to 4. However, the agency may compromise with the moderator to increase his award to 3, excluding “Fuel Damage” from the Table 4 inspection list, since the inspection of “Fuel Damage” with only one company nr.6 exceeds the budget by 1 anyway. Note that the total expenses for awards rise now once again to 6, see Table 5, c.f. the suggestion above not to live up to close or to contain the “Groundwater Contamination” and the “Ozone Depletion” activities.

Table 5

<i>Industry Effects</i>	<i>Groundwater Contamination</i>	<i>Deterioration of Lakes</i>	<i>Loss of Forest Cover</i>	<i>Ozone depletion</i>	<i>Total</i>
<i>Comp. nr.2</i>	⊗	⊗	⊗	⊗	4
<i>Comp. nr.4</i>	⊗	⊗	⊗	⊗	4
<i>Comp. nr.6</i>	⊗	⊗	⊗	⊗	4
<i>Total</i>	3	3	3	3	12

Is this decision rational? Suppose not, and let $k = 5$ is the board proposal. Now, only the company nr.6 is a potential participant in the project, see Table 6.

Table 6

<i>Industry Effects</i>	<i>Groundwater Contamination</i>	<i>Deterioration of Lakes</i>	<i>Fuel Damage</i>	<i>Loss of Forest Cover</i>	<i>Ozone Depletion</i>	<i>Total</i>
<i>Comp. nr.6</i>	⊗	⊗	⊗	⊗	⊗	5
<i>Total</i>	1	1	1	1	1	5

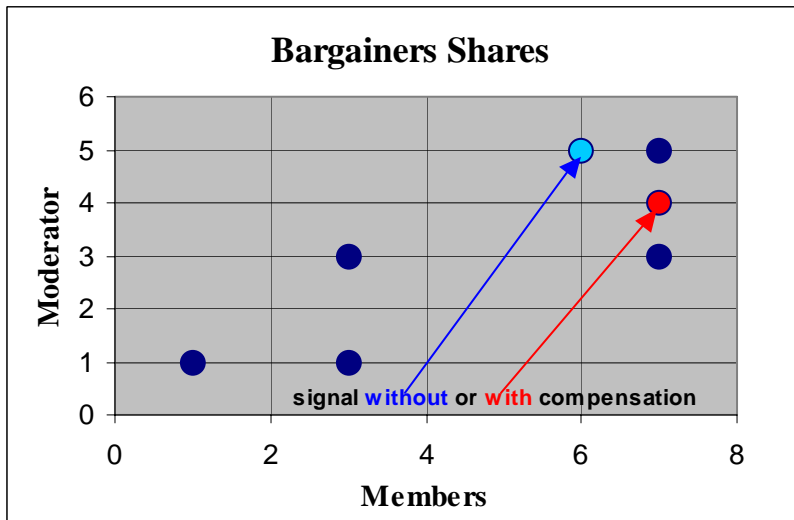
The moderator may disagree to organize an “Environment Protection” union, because his award is only one bank note. From the other side, it is not exactly the motive of agency either to exceed the budget amount on inspection to inspect all 5 activities with only one potential company in keeping to its promises. The agency decides to vote against $k = 5$ proposal at the environment board. Our game ends here and we do not tell the whole truth what was the decision at the company’s board.²

To reach a conclusion, the basic nature of agency’s difficulty to make a decision lies in between to pick up a row in the following table:

² For the game theory purists we recommend to turn to the study <http://www.data laundering.com/download/nonjoke.pdf>.

	Mem- bers	Mode- rator	Compen- sation	Sig- nal	Bank notes used	Bank notes left	Expenses on inspection
Table 1	7	3	0	0	10	2	5
Table 2	7	5	0	0	12	0	3
Table 3	6	4	1	1	12	0	1
Table 4	3	1	0	0	4	8	5
Table 5	3	3	0	0	6	6	4
Table 6	1	1	0	0	2	10	5

Below we visualize the agency difficulty by a bargaining game to share 12 bank notes between the bargainers: (i) – The members of “Environment Protection” union of and (ii) – the moderator of the union.



So, a final topic is necessary to conclude our pleasant story³. Let three actors have been engaged in our interaction: companies N , moderator in charge off union formation and the agency accountable for society well-being. Certain companies $N = \{1, \dots, i, \dots, n\}$ – the coming members of the union x , $x \in 2^N$, have expressed their willingness to live up to promises as to shut down or contain particular contaminating activities $M = \{1, \dots, j, \dots, m\}$ in follow-up inspection list. Companies' N preferences lists, as pre-orderings⁴ P_i , $i \in N$, be given towards numbers $A = \{1, \dots, k, \dots, k_{max}\}$. For example, $P_{jm} = \langle 4, 5$, further some numbers $k > 5$ indifferently in which order, but the list ends always as $3, 2, 1$. Let a table $W = \|a_{ij}\|_n^m$ reflects the inspection result of companies participating in protection programs; $a_{ij} = 1$ if company i fulfilled its promise to shut down the contamination or damaging activity j , $a_{ij} = 0$ if not.

³ This time we have to jump into rigorous issue.

⁴ Reflexive and transitive binary relations are known also as quasi-orderings.

Characteristic functions $v^k(x)$, $k \in A$, supermodular⁵ on N are known for the coalition game; for every pair $L \subset G$, $L, G \in 2^N$, it holds that $v^k(L) \leq v^k(G)$. Also lists 2^M of allegedly inspected activities $y \in 2^M$ have been examined. We can calculate the moderator payoff $F_k(H)$ using a subtable H on crossing entries of the rows x and columns y in the original table W . By further selection of a column with the smallest amount number $F_k(H)$ from the list y the payoff $F_k(H)$ is determined by the number of 1-entries in each column in y . One might find that it not too difficult to imagine the agency gain as an advantage function $f_k(H)$ for the society contributing into protection programs. Agency expenses are equal to $-[v^k(x) + F_k(H)]$.

We propose, in conclusion, some ideas for reasonable solution of our game. The situation is similar to the Nash Bargaining Problem from 1950, where two rational partners (players' Nr.1 and 2, union members and the moderator/agency) try to find a fair agreement. It is possible to find the Bargaining Solution for each particular choice of the number k , see Mullat 2001. However, the number k choice is itself somewhat different. We have pointed out earlier that the choice $k = 4, 5$ may be useful from some ex-ante reasoning. Maximum payoffs are guaranteed for players nr.1-2 when the choice $k = 1$. Counting on that decision is irrational, because here only one contaminating activity will be shut down with the maximum number of participants but without significant effect on environment protection. The choice of higher k numbers is either counterproductive due to constraint of follow-up of inspections – a lot of different protection activities will be at hand, but with lower number of participants, what is rational only for the agency if preserving awards/payoffs assets. For example, for $k = k_{max}$ a company with the largest list of preferred k_{max} promises fulfilled as to shut down contamination activities might become the only member of the union. As it seems to us the situation is like a median voter scheme, see Barbera et. al., 1993. However, a consultation in this “white field” is necessary, because a difficulty is well known following the classic result of Gibbard (1973) and Satterthwaite (1975) theorem to meet both the individual and collective rationality objectives on “unrestricted domain”.

Literature

- Barbera S., Gul F., and Stacchetti E. (1993) “Generalized Median Voter Schemes and Committees,” *J. of Econ. Theory*, 61, 262-289.
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⁵ Function $v(x)$ is supermodular if $v(L \cup G) + v(L \cap G) \geq v(L) + v(G)$ for every pair $L, G \in 2^N$. Cherenin was the first who introduced supermodular functions.