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Public Goods, Private Interest and Altruism

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This study shows through an example of a public good-like commodity, that the market might possibly provide the commodity even when there is no rivalry in its consumption and the exclusion of non-payers is costly. The actions of the market actors motivated by private interest both on the demand and supply side may render public (eg. government) decision unnecessary, and thus the necessary welfare losses associated therewith (like taxation, public choice, allocation of resources, particular interests) can be avoided. I will also show, that altruistic behaviour – which is, in a way quite distant from the logic of the market – does not necessarily enhance efficiency.

Keywords: public goods, altruism

1. Introduction

Economic theory and practical evidences show, that private demand for public goods, which is, the individuals' willingness to pay, and the supply of these goods frequently results in socially suboptimal quantity of these goods. Economic theory, however, clearly suggests possible solution most of the time as well. This solution is typically not a kind of centralised decision mechanism, that appears a plausible solution, but there are generally methods that can be activated, devised by the entrepreneur on the supply side. It is always advisable to consider these methods, as in this case we do not have to calculate with the transaction costs and other efficiency losses linked to the public provision of these goods (costs of taxation, allocative losses in connection with realisation of partial interests). In this short paper I would like to illustrate my above view through an example of an arbitrarily chosen public good-like commodity. As a by-product of this simple model it can also be shown how, under certain circumstances, it does not matter whether self-interested market behaviour is accompanied by altruistic behaviour.

Well-known definitions for a public good mention *non-rivalrous consumption* (Samuelson 1955, Mansfield 1975), *non-excludability* (Fisher 2000, Pearce 1993), *extern effects* (Buchanan – Stubblebine 1962, Cornes–Sandler 1996), *indivisibility* (Stiglitz 2000) of the good and possibly *governmental provision* (Rodda 2001) as differentiating characteristic.[1] I will now take non-rivalry as a sole important

[1] On the notion of public goods in detail see Mozsár (2003).

characteristic of a public good, which also means that congestion will not happen in spite of a growth in the number of consumers. Non-excludability as a frequently mentioned attribute of a pure public good will be handled as a *second condition*, which might go together with the first, but it results in different kinds of problems. It can also characterise private goods, and should be handled differently. A third dimension of the public good problem is whether the good in question is discrete or continuously divisible. In the first case, we only have to make a „yes-no" decision, or more of this kind consecutively, in the other case decision have to be made about the quantity too. In this paper I will investigate a perfectly discrete good, the consumption of which is non-rivalrous, there is no congestion and non-payers can only be excluded at prohibitively high cost.

In this sentence most of the papers that I am aware of would have said that non-payers are *non-excludable*, but the main problem is the *high cost of exclusion*, not the technical impossibility of exclusion. Thus „non-excludability" in reality means, that taking on the cost of exclusion leads to a socially not efficient outcome, since the costs associated with exclusion would mean a greater burden on society than the potential loss associated with solutions allowing free riding (where loss results form suboptimal allocation of resources or form supply provided by the government) or with the altogether failure of supply. „Too costly" exclusion techniques may hinder the market altogether from producing the good. In this case the entrepreneur has to discover or invent less costly excluding techniques. But if exclusion is currently indeed „too costly", the possibility of free riding has to be considered and one should investigate, whether private solutions could possibly lead to efficient outcome under the circumstances.

2. The case of a single potential buyer

In the most simple case there exist *one and only one* consumer whose reservation price exceeds the production cost of the good in question. In such cases it is possible, that this person alone provides the public good by herself. The only condition for this to happen is, that her disutility (envy) resulting from others' free riding should not decrease her *net* welfare from consuming the public good below the production cost of it, and that she should be sure that without her contribution the public good would not be produced at all. In other words, she has to have *perfect information* over the others' willingness to pay. The only rational thing to do for her is to produce the public good, access to which is now the same as it would be with a private good. The positive value others attach to this good now does not play any role, since the good is assumed to be discrete and congestion effects are ruled out.

This kind of solution is does in fact happen frequently in the reality, especially in the case of public goods of smaller value.[2] The probability of this kind

[2] Someone or other from the block will eventually salt the frozen sidewalk.

of solution is higher as the intensity of preferences in the group become more differentiated. Intensity of preferences is often determined by the status, for example by the wealth of the individual, and the more it is differentiated, the more probable it is, that there exist someone in the relevant group whose valuation exceeds the public good's cost of production. It is clear, that the more real estates one has, the higher she values a prospective decrease in real estate tax (as a public good), and the more she is willing to sacrifice to win the decision makers (legislators) to this case. „Small" actors are thus fairly able to exploit the „big" actor or actors, as we shall see later (Olson 1971).

3. More than one potential buyers

The situation is more difficult if there are *more than one* actors in the relevant group, whose valuation exceeds acquisition costs of the public good, because this opens up for them a way to free ride. In this case, it is not totally certain, that the good will be acquired at all (Hindriks–Pancs 2001). Let b indicate the utility of the public good to any consumer, and C the cost of acquisition. Let us assume, that $b > C$ for *every* member of the group! If a member of the group is sure, that *no other* member will provide the public good, it is rational to her to acquire it herself. Her net utility than is $b - C$. If she succeeds in free riding, however, her net utility will be b. The course of action she will take is dependent on the relation between the *certain* $b - C$ and the *expected* b when free riding. Precondition for a successful free ride is the existence of at least one actor in the group, let us call her *altruist* – as opposed to the *egoist* free rider – who is willing to finance the public good unconditionally whenever $b > C$ holds. Let us suppose, that the relevant group is a random subset of a population where the ratio of egoists is $e[e \in (0,1)]$[3].The likelihood that in a group of $n \geq 2$ there is no altruist is than e^n and thus obviously the likelihood of there being *at least one* altruist is $1 - e^n$. If we look at the situation from the point of view of an egoist, than the likelihood of there being at least one altruist among the others is $1 - e^{n-1}$. It is rational for her to abstain from acquiring the public good if

$$b - C \leq (1 - e^{n-1})b \tag{1}$$

For $n = 2$ this is true if[4]

$$\frac{C}{b} \geq e \tag{2}$$

In this case, the likelihood $[\pi(n, e)]$, that the public good will be produced equals to the likelihood of there being at least one altruist in the group.

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[3] See (Goeree et al 2002) on the relationship between alturism and group size.

[4] And if it holds for $n = 2$, than it also holds for any group larger than that.

$$\pi(n, e) = 1 - e^{n}. \tag{3}$$

According to this, the likelihood of actually producing the public good proportional to the size of the group and inversely proportional to the ratio of egoists in the population. The former relationship seems to contradict the results of Olson whose opinion is, that small groups are more successful in providing public goods than bigger ones (Olson 1997), but notice, that in this model the utilities b derived from using the good by the members of the group is independent of the size of the group (as I assumed there be no congestion), whereas in Olson's model the *sum of the member's utilities* $\Sigma b_i(n)$ is constant.

What happens, if the original population is more egoistic, or the cost-benefit ratio *more favourable*? With suitably chosen parameter values the ratio of egoists in the population will exceed C/b, that is

$$\frac{C}{b} < e\,. \tag{4}$$

In this case $b - C > (1 - e^{n-1})$, and since $e < 1$ and $C > 0$, there exist a critical group size n^{*} so, that

$b - C > (1 - e^{n-1})b$ for every $n < n^{*}$ and

$b - C \le (1 - e^{n-1})b$ for every $n \ge n^{*}$.

Solving the inequation $b - C \le (1 - e^{n-1})b$ for n one gets

$$n^{*} = 1 + \frac{\ln(C/b)}{\ln e} > 2 \tag{5}$$

Critical group size is thus bigger *the less favourable* the cost-utility ratio is, and the smaller the ratio of egoists in the basis-population. There are two possibilities:

1. if $n \ge n^*$, then the existence of at least one altruist in the group is very likely, so the dominant strategy for the egoists is not to pay, that is, to free ride. The probability of the production of the public good is the same $(1 - e^{n})$ as in the previous case.
2. if $n < n^*$, then one egoist is going to pay, the others are not. Symmetric behaviour is not a possible equilibrium, since we assumed $b > C$, so payment of one single person is enough for the public good to be produced. It is also not a possible equilibrium that no one pays, since $b - C > (1 - e^{n-1})$b. Let us denote with p the probability that a given (egoistic) person will not pay! Who does pay will earn a net utility of $b - C$. Who does not pay will earn net

b utility if someone else does pay, and 0 otherwise. The likelihood that one member of the $n - 1$ size group („the others") will pay is $1 - (ep)^{n-1}$, which is the sum of the likelihood of „there is at least one altruist" $(1 - e^{n-1})$ and „although there are no altruists, at least one of the egoists will eventually pay" $[e^{n-1}(1 - p^{n-1})]$.

If $b - C > [1 - (ep)^{n-1}]b$ than the probability of one egoist paying will increase, otherwise it will decrease. In equilibrium

$$b - C = [1 - (ep)^{n-1}]b,$$

and in that case:

$$ep = \left(\frac{C}{b}\right)^{\frac{1}{n-1}} \text{ for every } n < n^{*}. \tag{6}$$

The decrease (increase) of altruists is, in this case (when $n < n^{*}$ and $e > C/b$) offset by the increase (decrease) in the egoists' willingness to pay, thus the right hand side of the equation is constant.[5] The likelihood of the public good actually being produced will be then independent of the level of altruism:

$$\pi(e, n) = 1 - (ep)^{n}, \tag{7}$$

that is:

$$\pi(e, n) = 1 - \left(\frac{C}{b}\right)^{\frac{n}{n-1}}. \tag{8}$$

The probability of the public good actually being produced is inversely proportional to the size of the group.[6]

In the former 1) case the smaller the ratio of egoists in the population and the larger the size of the group, the more likely it is, that the public good will be produced. The precondition of a certain production of the public good is the *total absence* of egoists or an infinitely large group. These results signify what *an entrepreneur* should do: she should lower the ratio of egoists within the group or raise the size of the group concerned. In my opinion, the "magnitude" of egoism is directly proportional to *C/b* whereas the "feeling" of belonging to the concerned group is inversely proportional to it. Lowering the costs of providing the public good, which is a typical task for an entrepreneur, will lower the probability of

[5] As a reminder, *e* is the ratio of egoists within the population, *p* is the egoists' likelihood of not paying. A rise in the ratio of egoists means an increase in *e* and their higher propensity to pay means a decrease in p.

[6] Assuming $C/b = 0{,}5$ the probability of the public good actually being produced is $\pi(e, n) = 0{,}75$ when $n = 2$ and $\pi(e, n) \rightarrow 0{,}5$ when $n \rightarrow \infty$.

egoistic behaviour, and higher private advantages associated with the existence of the public good (*b*) can raise the size of the group. The private advantages associated with the existence of the public good can be supplemented with various “selective incentives” Olson mentions (Olson 1997). These selective incentives are non collective goods, the individual usage of which is conditional on taking part in financing a public good, and thus can be an effective tool in organising latent groups. In my opinion such private goods that can be used by members of a group can, in addition to their functions mentioned by Olson, induce people to be part of the group, which in turn make them interested in providing the public good that enhances welfare of the group. I do not therefore take the relevant group as given, this is why we can speak here of the “feeling of belonging to a group”. It is one of the tasks of the entrepreneur to generate and strengthen this kind of feeling in prospective consumers through informing them, providing complementary goods or in other ways.

In case 2) the more probable the actual production of the public good the smaller the *C/b* ratio, and the smaller the concerned group. In this case the perquisite for the certain production is $C = 0$.[7]

In the above model we cannot reach the reassuring conclusion that under realistic circumstances voluntary contributions can assure the provision of the public good whenever the sum of private valuations is higher than the cost of providing the good. This (ex post) efficiency condition is maybe a too strict one too according to Menezes et al. (Menezes et al 2001). It is in fact not very appropriate to evaluate the “goodness” of an allocation mechanism on a binary (either good or bad) scale. An alternative evaluative method can be, as the aforementioned authors also suggest is to measure the probability of actually providing the public good, once provision is otherwise effective[8].

4. No potential consumer

The situation gets even more difficult, if no member of the group has a high enough willingness to pay as to finance the public good, even though its existence would be Pareto-efficient, that is

$$b_i < C, \qquad \text{for every } i \text{, and:} \qquad n \cdot b > C.$$

The contribution of any single player is insufficient in this situation to guarantee for her the availability of the public good. Her contribution is than useless

[7] Lower costs will modify the reaction of the players under some circumstances. It can happen, that it lowers willingness to pay, and thus it will not change the likelihood of the public good’s production (Menezes et al 2001).

[8] It would be good to use this kind of evaluation in general, whenever the efficiency of allocative systems, market structures are considered.

if not enough other players other than her contribute and meaningless if the public good is financed without her contribution anyway. The real question here is the probability of hers being the pivotal contribution. How probable is it, that the public good will not be produced without her contribution, but it will with it? Let us investigate first the case when $n = 2$, $b_i = 1$ (i = 1,2) and $1 < C < 2$. Denoting c_i the contribution of the *i*-th person to the costs, the public good can be financed if $\Sigma c_i \geq C$.

If the players have *perfect information* regarding the valuation of the others, than any contribution so that $C–1 < c_i < b_1 = 1$ can lead to the efficient outcome, to the procurement of the public good. The symmetric outcome is naturally the $c_1 = c_2 = C/2$.

Considering now the case of less than perfect information, let us assume, that any player values the public good at $b_i = 1$ with a probability of 0,5 and $b_i = 0$ with the same probability. While everyone is perfectly aware of her own valuation, as to the others everyone knows only this probability distribution. Depending on what happens with the contributions paid if the public good is not produced due to the behaviour of the other, two cases can be distinguished (Menezes et al 2001).

a) In the first „game” if $\Sigma c_i \geq C$ the public good will be purchased, but the potentially positive sum $\Sigma c_i – C$ will not be refunded (but will remain the profit of the producer). In the case of $\Sigma c_i < C$, however, the contributions are paid back. This variation is called subscription game. The symmetric Nash-equilibrium in this game is, that everyone contributes $c_i = 0$ if the good is invaluable, and $c_i = C/2$ whenever the good is valued at 1.[9] The outcome will always be Pareto-optimal.
b) In the other game, $\Sigma c_i < C$ is a sufficient condition to prevent the purchase of the good, but the money paid in already will not be refunded. This kind is called contribution game[10]. The contribution of player 1. is obviously zero if $b_1 = 0$. How much is she willing to pay, if she values the good at 1? In case of a contribution of $C/2$ the public good will be purchased with a probability of 50%, which means an expected value of ½, thus the expected net utility is $½ – C/2 < 0$. Maximal contribution from each player is ½, which is not sufficient to finance the public good, as we assumed $C > 1$. The resulting outcome will not be efficient[11].

This simple, two-player model with binary valuations can be generalised to $N > 2$ players or to cases in which the valuation of the players is characterised by continuous probabilistic variables of known distribution (Menezes et al 2001).

[9] Nash (or Nash-Cournot) equilibrium means, that everyone’s choice is optimal, given everyone else’s choice. This means, that no one wants to alter her strategy ex post.
[10] Typical examples of this are when the contribution is an unconditional donation or physical work.
[11] Further models that assume non constant contributions in (Menezes et al 2001).

More complicated models bring up many new issues and make lots of new insights, but in our case they all mark pretty much the same path as our above compact model. More general analysis also supports the superiority of the subscription game over the contribution game just as it is confirmed in laboratory experiments. Perhaps our opinion is not fictitious, that in contribution game situations secondary („selective", if you like) incentives like self-esteem or prestige play a greater role than potential benefits from the public good itself. This is suggested by the significant national differences in donation habits. In subscription games, however, the contrary can be assumed.

Let us now assume, that from a group of n at least $1 \le w \le n$ members have to contribute to the production of the public good. For the sake of simplicity let us again fix the amount of contribution at c per person. Denoting with m_n the number of contributors in the group of n, the probability that there is exactly $m_{n-1} = w - 1$ contributors in any group of $n - 1$ (the „others"), that is, the player in question is a pivotal contributor is:

$$prob(m_{n-1} = w-1) = \binom{n-1}{w-1}(ep)^{n-w}(1-ep)^{w-1}, \qquad (9)$$

where e denotes again the ratio of egoists within the population, and p the probability that an egoist will not pay. The indifference condition for a given group-member, assuming contribution game is:

$$prob(m_{n-1} \ge w-1)b - c = prob(m_{n-1} \ge w)b. \qquad (10)$$

Subtracting the right hand probability from both sides and rearranging we get:

$$prob(m_{n-1} = w-1)b = c. \qquad (11)$$

In the equilibrium:

$$\binom{n-1}{w-1}(ep)^{n-w}(1-ep)^{w-1} = \frac{c}{b}. \qquad (12)$$

The probability also, that in a group of n only $m < w$ members contribute, and therefore the public good will not be produced is the sum of probabilities $m = s$, $s < w$

($s = 1, \ldots, w - 1$), that is:

$$\pi_w^{nem}(e,n) = \sum_{s=0}^{w-1}\binom{n}{s}(ep)^{n-s}(1-ep)^{s}. \qquad (13)$$

The probability of the public good being produced is than obviously:

$$\pi_w^{igen}(e,n) = 1 - \pi_w^{nem}(e,n) = 1 - \sum_{s=0}^{w-1} \binom{n}{s} (ep)^{n-s} (1-ep)^s \ . \tag{14}$$

Because of (6), *ep* is constant, the altruist/egoist ratio again does not affect the probability of producing the public good. This probability will decrease as the group size increases until n^* (Hindriks–Pancs 2001), above that this probability increases. Increase in the number of necessary contributors also decreases the probability of the production of the public good.

5. Conclusion

The task of the par excellence entrepreneur is to discover opportunities by which she is able to enhance net social welfare, and collect reward for her doing so from those who enjoy this enhanced welfare. Every situation commonly discussed under the topic of „market failure" is thus an opportunity to market players. An environment should be created, where the entrepreneur can reach her goal, and at the same time also fullfills her social function („invisible hand").

In this paper we investigated a public good, which is an eclatant example of market failure, and three possible relevant groups. We assumed a public good in the consumption of which – in our terminology: naturally – there is no rivalry, no congestion effect, and excluding non-payers would be socially inefficient due to exclusion costs. We analised a (relevant) group, in which at least one member's willingness to pay exceeds the production cost of the public good, then one in which this holds for more members and lastly one in which the provision of the public good is conditional on common financing.

In the more complicated cases (2. and 3.) we pointed out those factors – cost/benefit ratio, group size, selective incentives – which an entrepreneur could modulate, thus making the opportunity to enhance welfare also an opportunity to earn money. We also pointed out, that in the analised situations the not so market-conform altruistic behaviour do not necessarily enhance the efficiency of the allocation.

Of course most of the public goods that are generally viewed as such can have many other specific characteristics (congestion, excludability of non-payers) that bring up newer problems and call for new solutions. The objective of this paper was solely to show, that these (*private*) opportunities can in fact exist.

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