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VOLUNTARY GROUP RESPONSE TO TYPES OF COLLECTIVE GOODS

by

Larry Kiser

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Collective goods have been defined into three primary types distinguished by the attributes of nonsubtractibility, infeasibility of exclusion, and a combination of both nonsubtractibility and nonexclusion. But these distinctions are often blurred in analysis involving collective goods. Mancur Olson's theory of groups and collective goods is an example, with the result that Olson claims unwarranted generality for his theory of small groups. The following develops the implications for voluntary provision of collective goods by focusing on the distinctions among the different types of collective goods.

Assume an individual i with a declining marginal value function for a good X. Also assume that the production of X is subject to constant costs and that for a given range of production, individual i's valuation of the good exceeds the costs of production. Such a situation is represented in Figure I-A, where perfect competition among suppliers and utility maximization by the consumer leads i to purchase T_i -O units of X. (Labeling in the diagrams follows Olson's notation). Individual i realizes value that exceeds the costs of the additional units until the T_ith unit. Beyond that level the additional costs exceed the additional value. The T_ith unit, as Olson indicates, is the point where additional net advantage to individual i from purchasing X equals zero. ($dA_i/dT = 0 = dV_i/dT - dC/dT$)

Nonexclusionary Goods

The group problem is introduced by assuming that good x is nonexclusionary, meaning that other individuals cannot feasibly be included from consuming X once it is supplied. The diagram shows this by adding a second individual m, whose valuation of X is represented in Figure I-B. If i and m constitute the group, group valuation of good X is, then, represented by a horizontal summation of the individual value curves, as drawn in Figure II, giving dV_g/dT.

When individual i purchases X, m competes freely with i for the available units. While m is not willing, according to the diagrams, to pay the necessary costs of producing X, he is certainly willing to consume the good if someone else pays the costs. This creates a problem for individual i. If i purchases T_i-O units of X, and m begins to share in the consumption, the expected value of i's purchases is not realized and i is forced into disequilibrium. Individual i will respond in either of two ways, (1) by reducing purchases until his marginal value is again equal to or greater than costs or (2) by financing additional production to prevent individual m from competing away i's initial units. The response depends on the value of X to individual i relative to the costs of providing the units, and on the value of X to individual m.

If i responds by reducing his purchases of X, this only results in greater competitive pressure from m for the available units, which in turn aggravates the disequilibrium for i. No matter how much i reduces his expenditure he fails to realize the additional value from some of the units that he buys, because m consumes some of the units. Thus, i continues to reduce his purchases until zero units are available and voluntary action fails to provide any of the collective good. This will result unless m can be pursuaded also to contribute, but as Figure I-B is drawn that contribution will not be forthcoming, because m does not value X enough to pay the competitive per unit price.

On the other hand, individual i's valuation of X may be so great that his consumer surplus (area ZXP in Figures I-A and II) is sufficient to encourage i to buy off m's competition for the available units. Individual i could arrange with the producer to supply additional X freely to individual m, thereby removing m's competition for the T_i-O units. Of course, such an arrangement will increase the costs to i, but i's consumer surplus may be sufficient to warrant the added costs. In effect, i would exchange some of his surplus for reduced pressure from m for securing available units of X. But the exchange would have to be through some subsidy arrangement that does not affect the per unit price X, for any direct increase in the price would cause i to buy less rather than more X. The arrangement would have to involve some kind of payment that would not influence i's marginal decisions about purchasing X.

The limit to which i is willing to subsidize m's consumption is determined by the size of i's surplus relative to the costs of removing m's competition for available units. The more units i is willing to provide for m and the lower m's valuation of X, the more likely i will succeed in removing m's competition. But the subsidy arrangement will not work if the cost of providing the units which m positively values exceeds i's consumer surplus.

These influences are illustrated in Figures I and II, where individual m places a positive value on T_m-O units of X and the cost of providing those units is the area under dC/dT. As i is trying to protect the T_i-O units for his own consumption, the costs to i to remove m's pressure will equal the area under dC/dT for T_m-0 units added to the right of T_i. This is the area of rectangle $XYT_{i+m}T_i$ in Figure II. Success of the subsidy arrangement, therefore, requires that the area of $XYT_{i+m}T_i$ be less than or equal to the area of triangle ZXP.

In summary, voluntary collective action may or may not provide for the supply of nonexclusionary goods. Prediction requires knowledge of the costs function and of the value functions for each individual in the group. Collective action in a small group can fail even when one individual values the good enough to finance privately the production of some units.

The group optimum results where the marginal value to the group equals the marginal costs ($dV_g/dT - dC/dT = 0$, in Olson's terms), and that occurs at T_i in Figure II. Thus, voluntary action, according to the foregoing, will not provide for an optimal supply of a nonexclusionary collective good; supply will be either sub- or supraoptimal. The only cases in which optimality obtains is when no individual values the good sufficiently to pay the costs of production (i.e., all individual dV/dT functions lie below dC/dT), or when the value functions are zero elastic. If the dV/dT functions are less than dC/dT, voluntary action will provide for zero production, and zero production is optimal. And if the value functions are zero elastic, the additional units required to remove the competitive pressure from another consumer will equal the addition required to achieve optimality. This second situation would be rare and can be ignored for most analyses. (Note: Olson assumes this form for individual value functions on p. 23.)

The supraoptimality that results when the individual financing the collective good is able to exchange consumer surplus to eliminate competitive consumption by others departs fundamentally from Olson's conclusions. He recognizes no instance for supraoptimal supply of a collective good through voluntary group action (see pl 31). But Figure II shows that supraoptimality results if area XYTi4mTi is less than or equal to area ZXP. In that case, voluntary action results in the supply of T_{i+m} units of X, whereas T_i is optimal.

Nonexclusionary/Nonsubtractible Goods

Olson's conclusions about suboptimality and voluntary provision of collective goods holds only for the nonexclusionary/nonsubtractible type. Analysis of that type follows.

Figure III shows the results form redefining X as a nonexclusionary/ nonsubtractible collective good. While the cost and individual value functions are identical to those in Figure II, the value to the group is fundamentally different. In Figure III group value is derived by summing individual value functions vertically rather than horizontally. This is because all individuals consume the same units; thus the group value yielded by any given unit is the sum of the values realized by each individual consuming the unit. Group value for the T_ith unit, for example, is represented by the vertical distance at T_i to the i curve plus the vertical distance to the m curve. That equals the vertical distance at T_i to dV_g/dT.

Derivation of the group result is more straightforward in this case than in Figure II. Here individual i remains in Equilibrium at the T_ith unit of X regardless of individual m's participation in the consumption. Individual i is encouraged neither to reduce nor increase his purchases of X, because the availability of the supply to individual i is unaffected by m's consumption. Therefore, as long as one individual in a small group values the good enough to pay the production costs, an amount will be supplied to the group.

But the supply will be suboptimal. Noncontributing consumers have an incentive to remain as noncontributors; thus the additional financing required to increase the supply from T_i-0 to T_o-0 units will not be forthcoming. The only instances yielding optimal results would occur either where dV_g/dT lies entirely below dC/dT, or where consumers have zero elastic value functions. In the first instance, which is the only realistic case, the optimal supply is zero, and voluntary collective action would result in zero supply. These results are consistent with Olson's analysis.

Effect of Group Size

The effect of group size on voluntary provision of collective goods is illustrated by introducing additional. individuals into the analysis, as shown in Figure IV and V. Figure IV illustrates the effect for nonexclusionary goods, and Figure V the effect for nonexclusionary/nonsubtractible goods.

Figure IV shows that individual i will have increasing difficulty protecting his T_i-0 purchases as an additional individuals enter the group. Whereas individual i formerly sacrificed consumer surplus to finance T_{i+m} –T_i units for individual m, now i must finance T_{i+m+n}-T_i extra units. Without the extra units individuals m and/or n will compete with i for the T_i-O units, thereby forcing the disequilibrium that leads to zero supply. The diagram shows clearly that the additional expenditure required of i can easily exceed his surplus and destroy his incentive to finance any of the good. If individual i places a sufficiently high value on X, however, financing the additional units could be worthwhile.

Voluntary collective action within a range of small group sizes, thus, can provide for nonexclusionary goods, and the result is likely to be increasingly supraoptimal as the small group enlarges. But voluntary provision is not likely in large groups for the consumer surplus of the providers will probably be insufficient to finance the supply to a large number of additional consumers. The large group situation, moreover, increases the likelihood that a large number of high value users, like individual i, will exist, and this introduces free rider incentives for them as well as the low value users.

The result is that providers of nonexclusionary goods will consider ways of protecting their consumption alternative to financing additional production. They will also consider institutional means for limiting the group of consumers, and the cost of this alternative might be low enough after the group reaches some minimal size to encourage even low value users in the group to contribute.

Figure V presents the effect of enlarging group size that Olson discusses. Here i nonsubtractibility removes the competition among consumers for individual its purchases of T_i-O units and thereby removes the incentive for the individual financing, within a range of small groups, to adjust. The diagram shows that the voluntary equilibrium becomes increasingly suboptimal, as additional consumers will probably cause dV_g/dT to intersect dC/dT at higher units of X. This is evidenced by $T_o'-T_i$ in Figure V being greater than T_o-T_i in Figure III.

Of course as the groups become large the free rider incentives build resulting ultimately in zero supply. Thus, as Olson shows, large groups aggravate the tendency toward suboptimality.

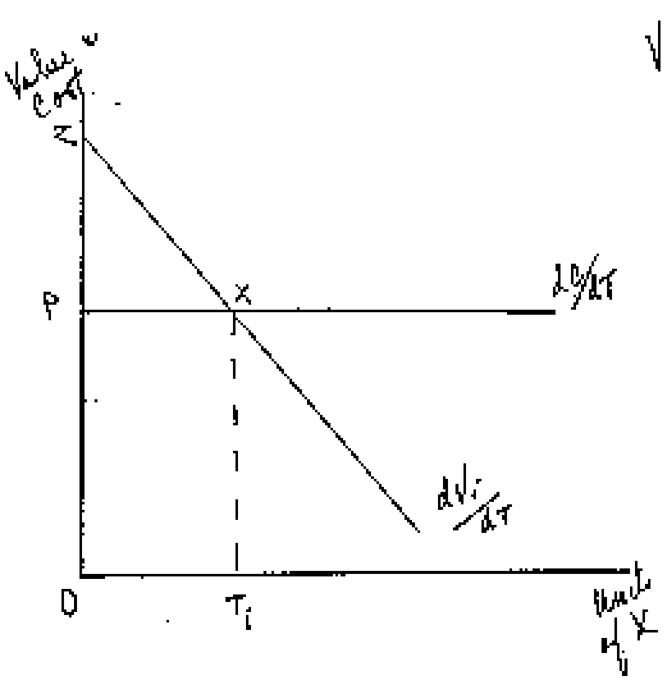

Fig I-A

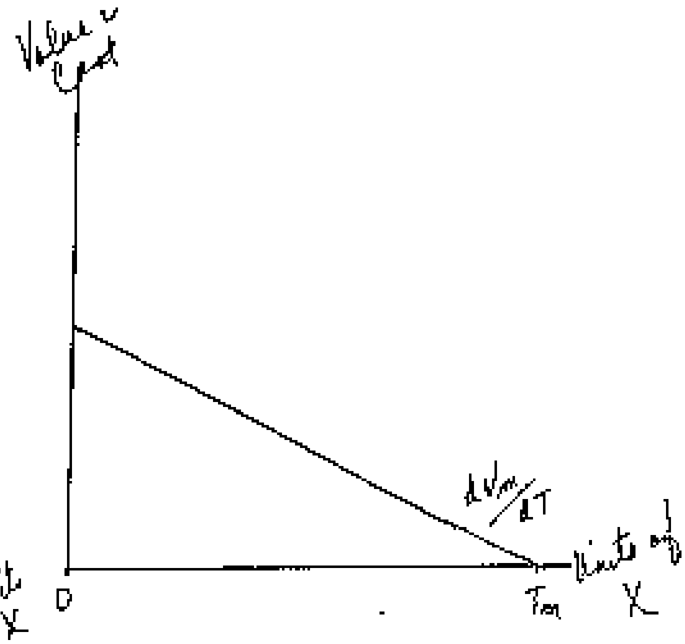

Fig. I-B

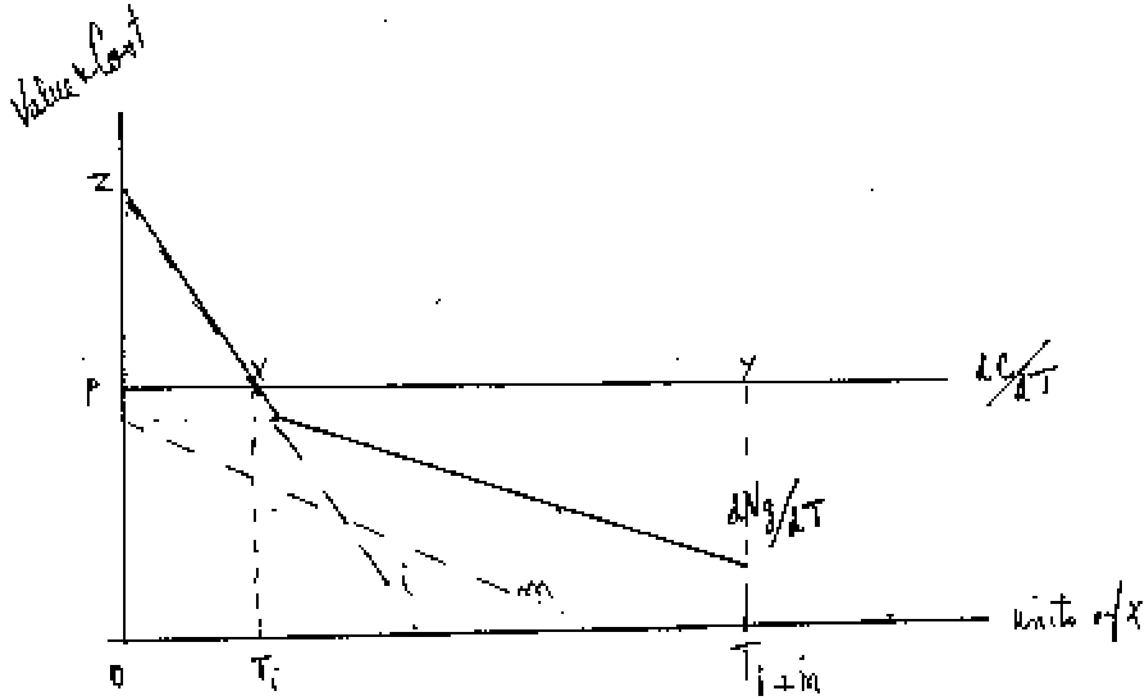

Fig. II

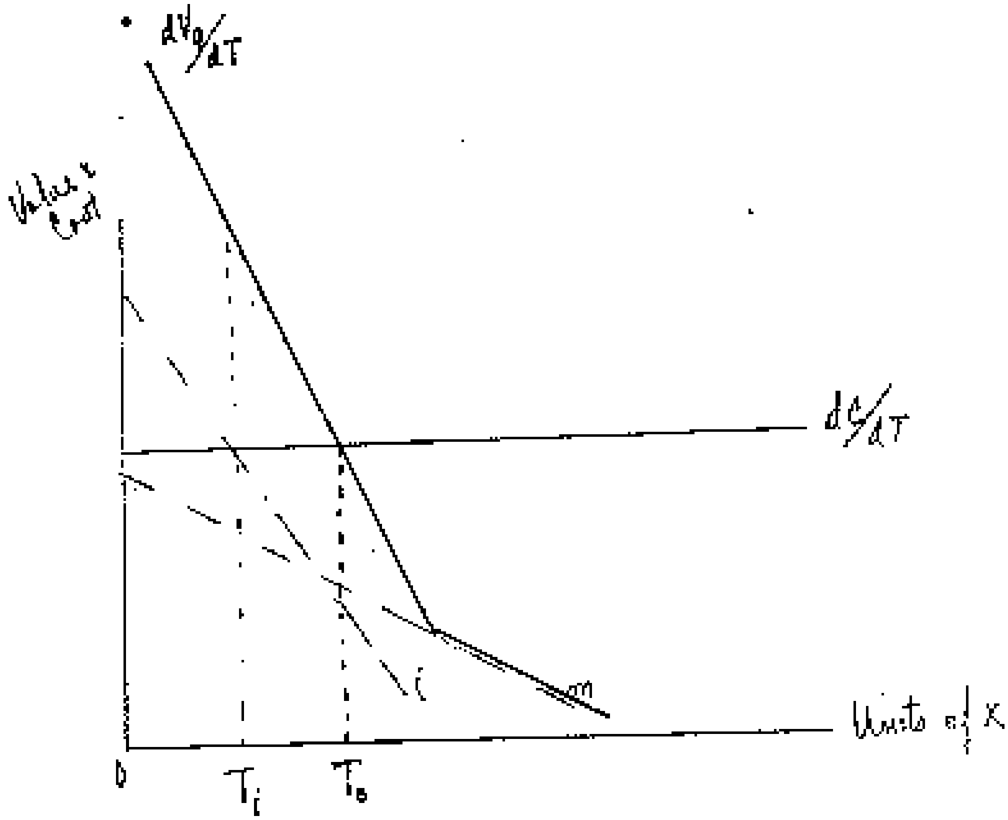

Fig. III

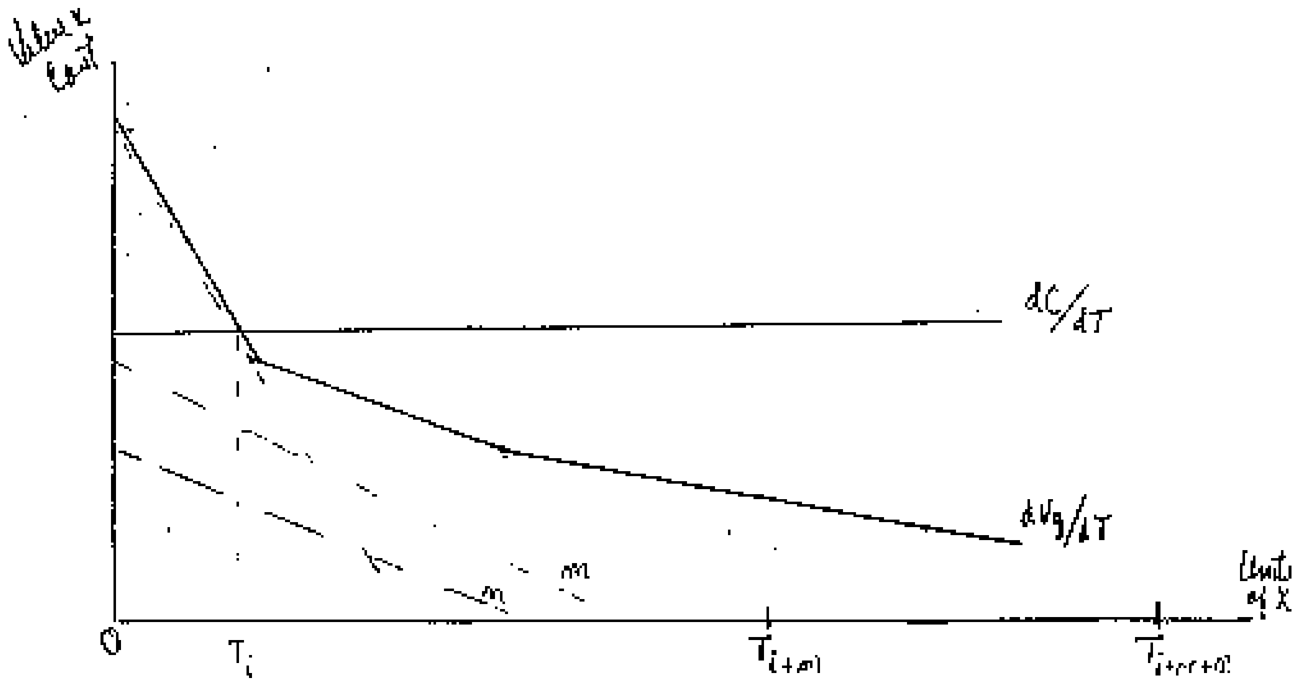
Value & Cost
dC/dT
dVg/dT
Units of X
0
Ti
m
m

Fig IV

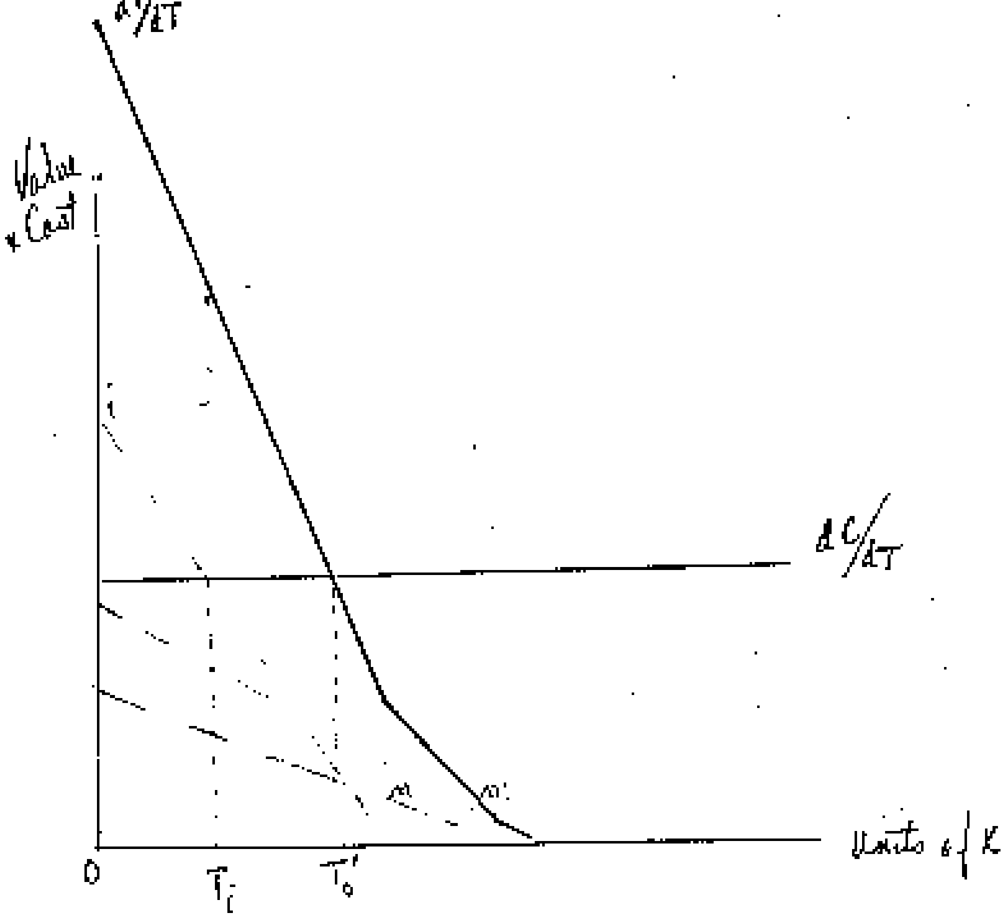
dV/dT
Value & Cost
dC/dT
Units of X
0
Ti
m
m'

Fig. V