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THEORIES OF COLLECTIVE GOODS REEXAMINED

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SEVERAL theories address the question of how individual members of a collectivity, acting in a self-interested manner, will contribute to the provision of a collective good. The prior question of what a collective good is has been answered in a variety of ways, with different theorists offering different definitions. It is our intention, in this work, to show how *different definitions of collective goods lead to very different conclusions about the likelihood that self-interested individuals will contribute to the collective effort.* We will then focus on the two major theories of Paul Samuelson and Mancur Olson. We will conclude with a discussion of the applicability of these theories to the study of international politics.

I

Four quite different criteria are used to define what a collective good is: (1) *joint supply;* (2) *nonexcludability;* (3) *indivisibility of benefits;* and (4) *impossibility of appropriation.* These criteria are employed singly or in combination by various scholars. If it were the case that the different definitions of collective goods were completely equivalent, or that nonequivalent definitions produced the same theoretical results, then the multiplicity of criteria would not matter. In fact, some of the criteria are not equivalent and lead to quite different results. The correct application of the theories therefore requires an awareness of these differences.

We will say that a good is in *joint supply* if "a given unit of the good, once produced (or supplied), can be made at least partially available, though possibly in varying degrees, to more than one individual."[1] In a more extreme sense, a good is in joint supply if it can be made equally available to all individuals in the collectivity.[2] If a good is in joint supply, then making it available to one individual need not "reduce the amount available to others by an equal amount."[3]

Examples of goods which are in joint supply are tangible goods like museums, parks, public squares, roads, ports, canals, railways, and bridges, and intangibles like police protection, full employment, and national defense. Take the example of a public park. A large park, once built, can be used concurrently by many individuals without diminishing the enjoyment of others. There may be several reasons for this: (1) the park may be so large that no one user interferes with another, regardless of their activities; (2) the activities of users are compatible or nonconflicting (e.g., some may want to play baseball and others may want to have a picnic and there are designated areas for each type of activity to avoid picnics on the baseball field); or (3) the activities are complementary (e.g., some people go to

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[1] John G. Head, "Public Goods and Public Policy," *Public Finance* 17 (1962): 202. Parentheses added.

[2] Ibid., p. 201.

[3] Albert Breton, *The Economic Theory of Representative Government* (Chicago: Aldine, 1974), pp. 5–6.

parks to see other people). In the last case, the use of the park by others actually *increases* the enjoyment of some users. In the second case, the property of joint supply depends upon institutional arrangements which may or may not exist in every park. Thus, a park without designated areas for different types of potentially conflicting activities may not be in joint supply. Enforcement of such institutional arrangements will be necessary primarily when the park is not large enough for people to be able to move when conflicts arise.

In almost all the examples cited above of goods in joint supply, there is the possibility of "crowding effects." That is, at a certain level of collective use or consumption, additional consumption by one individual may reduce the availability of the good to others. When a park fills to capacity, it may be necessary to close it to other people. When roads or bridges become too crowded, it may be necessary to restrict access. Whether it is possible to exclude new users or consumers depends on the next criterion of a collective good.

Nonexcludability means that it is not feasible to exclude anyone from consuming or sharing the benefits of the good. Thus, even though an individual does not contribute to the costs of supply he may still consume the good or benefit from its supply.[4] Clearly, very few goods have this characteristic. Exclusion is never completely impossible, since there are always a variety of institutional and technological arrangements which can be introduced to exclude potential consumers.[5] For example, one can put scrambling devices on television sets so that individuals must pay to be able to view certain programs or use radar instead of lighthouses to guide ships in coastal waters. Nevertheless, these exclusionary arrangements may be more expensive than providing the good in the first place. Thus, it may make sense simply to forget about exclusion and to hope that the good will be paid for by some of the users.

A third defining characteristic of a collective good is *indivisibility of benefits.* Although there is a great deal of confusion on this issue (indivisibility is often confused with nonexcludability),[6] we will say that benefits are indivisible when it is not possible to assign fractional shares of the total benefit to individual consumers based on their share of consumption. The reason for this may be that there are "consumption externalities." That is, at least one person's utility is affected by someone else's consumption or utility.[7] Consumption externalities will arise, therefore, whenever individuals consider the overall distribution of consumption as well as their own consumption in assessing the value of a particular good. This may occur, for example, in individual assessments of educational arrangements, health care, and the distribution of income in a given community. An individual may benefit from the provision of health care to his neighbors even though he does not directly "consume" any himself.

Indivisibility of benefits can also arise out of the nature of the good. If the good itself is indivisible, like a road or a bridge, it is difficult to assign fractional shares of total consumption to individual consumers.[8] Institutional arrangements like tolls, taxes on ton-miles of use, and the like are based on only crude approximations of the individual's share of total consumption. Even though there are no consumption externalities, i.e., all individuals' utility depends only on their own

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[4] Mancur Olson, *The Logic of Collective Action: Public Goods and the Theory of Groups,* rev. ed. (New York: Schocken Books, 1971), p. 14; and Norman Frohlich, Joe A. Oppenheimer and Oran Young, *Political Leadership and Collective Goods* (Princeton: Princeton University Press, 1971), p. 3.

[5] Head, "Public Goods and Public Policy," p. 205.

[6] See, for example, James M. Buchanan, *The Public Finances,* 3d ed. (Homewood, Ill.: Irwin, 1970), p. 23.

[7] William Oakland, "Joint Goods," *Economics* 36 (August 1969): 253–68; John G. Head, *Public Goods and Public Welfare* (Durham: Duke University Press, 1974), p. 187.

[8] Head, "Public Goods and Public Policy," p. 201.

consumption, there can be indivisibility of benefit because it is hard to determine what their level or share of consumption actually is.

A fourth defining characteristic of a collective good is *impossibility of appropriation.* A good is impossible (difficult) to appropriate if it is impossible (difficult) to establish the ownership of the good. Thus, the collectiveness of the good arises out of "imperfection in property title."[9] For example, it used to be that no one could claim to own the world's oceans. The reason for this was that any such claim had to be defended against other possible claimants and no nation, including those which might have been able to do this, found it worth doing. More recently nations have come to claim ownership over the oceans in two ways: by extending their national jurisdictions outward from the coast and by claiming ownership in a collective or communal sense (as in the appropriation of the seabed of the North Sea by bordering nations). Thus, there may be two reasons why it may be difficult to establish the individual ownership of a good — because it is owned by no one or because it is owned collectively.

Ownership can be imposed by authority. The appropriability of a good has less to do with the intrinsic nature of the good than with the willingness of some authority to pay the costs of enforcing claims to title or ownership. For example, if an international regime had to enforce claims to national ownership of migratory fish, it would probably have to resort to a massive tagging and tracking operation to determine the origin and movements of fish throughout the globe. Not only would the costs be great in economic terms, but also the political feasibility of such a project would be in question. Nevertheless, it could be done.

Clearly the four defining characteristics of collective goods are interrelated. If it is impossible to appropriate a good, it will be difficult to assign fractional shares to individual consumers. If benefits are indivisible, then it may be difficult to exclude noncontributing individuals from enjoying the benefits. But it is possible for a particular good to have one characteristic but not another. For example, a good may be appropriable at the same time that benefits are indivisible (as when a hospital, road or bridge is privately owned). Or, in the case of health care, medical care permits the practice of exclusion and physicians' services are usually highly appropriable and not in joint supply. Nonetheless, one individual, for altruistic or self-interested reasons, may gain a sufficient satisfaction from another's ability to obtain proper health care to support government assistance for medical care costs. In this case, the consumer deems the benefits of health care to be indivisible even though the service is appropriable, excludable and not in joint supply. One last example of the separability of defining characteristics involves the case where "goods and services with jointness aspects may, and in fact often will, pose no price-exclusion problems."[10] For example, one can use "scramblers to forestall the reception of radio and television programs, barriers to shut off entry to an exhibition or a circus, tollgates to stop the free flow of circulation on a road, tickets to contemplate Caravaggio's paintings."[11] *The lesson to be drawn from these examples is that even though the characteristics of a collective good are not mutually exclusive, neither are they perfectly correlated with one another. The importance of this imperfect interrelatedness arises from the fact that different characteristics, taken separately, or in combination, may have different economic and political consequences.* In order to demonstrate this, it will be necessary to discuss several theories of collective goods which explore the possible consequences of different defining characteristics. In the next section, we will focus mainly on two theories: those of Paul Samuelson and Mancur Olson.

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[9] John G. Ruggie, "Collective Goods and Future International Collaboration," *American Political Science Review* 66 (September 1972): 887–88.

[10] Head, "Public Goods and Public Policy," p. 207.

[11] Breton, *The Economic Theory of Representative Government*, p. 38.

II

Samuelson defines a "collective consumption good" to be a good which "all enjoy in common in the sense that each individual's consumption of such a good leads to no subtraction from any other individual's consumption of the good."[12] The mathematical expression for this definition is $X_i = X$ for all i, where X_i is the amount of the good consumed by individual i and X is the total amount consumed. Unlike private goods, where the *sum* of individual consumption equals total consumption, here the total consumption equals the individual consumption for each and every individual.

Samuelson has been criticized for lumping together two essentially different types of situations under the same heading. In both situations the total quantity made available for consumption to the collectivity is the same as that made available to any individual, but in one case individuals can choose whether or not to consume the good while in the other no choice is possible.[13] For example, one has no choice but to consume the collective bad of air pollution and the collective good of pollution prevention. One does not have to consume (use) a public park or a highway. A possible way of avoiding this problem would be to distinguish between the availability of a good and its consumption. In Samuelson's original definition no such distinction is made.

Given this definition and the assumptions that (1) individual utility depends only on individual consumption (no "consumption externalities"); (2) both utility and production functions are smooth and convex (diminishing marginal utility and production); and (3) there are both private and collective goods. Samuelson finds that the pareto optimal[14] level of supply of collective goods occurs when the marginal rate of transformation of any collective good into any private good equals the sum of the marginal rates of substitution of the collective good for the private good for all the individuals in the collectivity.[15] If there is a "numeraire" private good in the system, like money, then the marginal cost of the collective good must equal the sum of the marginal rates of substitution of the good for money for all the individuals in the collectivity, if there is to be a pareto optimal level of supply. A private good will be supplied at a pareto optimal level if the marginal cost of the good equals the marginal rate of substitution of the good for money for *each* individual, and the marginal rate of substitution is the same for all individuals at this point.

In other words, if A is a private good and B is a collective good, then the goods will be supplied at a pareto optimal level when members of the collectivity "pay the same unit price for A while consuming different amounts thereof; and (probably) pay different unit prices for B while consuming the same amount."[16] Since

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[12] Paul A. Samuelson, "The Pure Theory of Public Expenditure," *Review of Economics and Statistics* 36 (November 1954): 387.

[13] Breton, *The Economic Theory of Representative Government*, pp. 37–8; William H. Riker and Peter C. Ordeshook, *An Introduction to Positive Political Theory* (Cambridge: MIT Press, 1973), p. 261.

[14] The pareto optimality criterion for utility distributions can be stated as follows: a utility distribution is pareto optimal if in order to make one or more individuals better off, it is necessary to make one or more worse off. The use of the pareto optimality criterion in welfare economics stems from the desire to avoid interpersonal utility comparisons. One unfortunate consequence of this choice is that there may be more than one pareto optimal distribution of utility. We will discuss this concept further in the text.

[15] Paul A. Samuelson, "Diagrammatic Exposition of A Theory of Public Expenditure," *Review of Economics and Statistics* 37 (November 1955): 353–54; Jack Ochs, *Public Finance* (New York: Harper and Row, 1974), p. 31.

[16] This is a paraphrase of a sentence in Richard Musgrave and Peggy Musgrave, *Public Finance in Theory and Practice* (New York: McGraw-Hill, 1973), p. 65.

[17] Samuelson, "Diagrammatic Exposition," p. 356.

[18] Ibid., pp. 351–52.

a competitive market system produces uniform prices for all individuals, at the same time that it guarantees a pareto optimal supply of private goods, it usually fails to guarantee an optimal supply of collective goods. Thus, Samuelson's theory suggests that something other than the competitive market system is needed to determine the way in which collective goods are paid for and distributed. The most obvious candidate for this job is some form of government, but it can also be some form of socially regulated price discrimination. According to Samuelson, governments should try to restrict themselves to supplying collective goods and leave private goods to the market system.[17]

Similar results are obtained when the assumption of strict equality between individual and collective consumption is relaxed.[18] That is, the market system fails to supply an optimal amount of a good "which, though not available equally to all, has the property that the amount available to one individual does not reduce that available to others by an equal amount."[19] This is precisely what we have chosen to call "joint supply" in section I. But Breton calls it a "non-private good" and others use the terms "joint consumption" or "nonrivalness of consumption."[20] Clearly some terminological uniformity is needed here. But in any case, *joint supply leads to the failure of markets to supply an optimal amount of collective goods.*

Do other definitions of collective goods yield the same theoretical results? Let us examine another theory which emphasizes the nonexcludability criterion instead of joint supply. Mancur Olson has developed just such a theory.

Olson defines collective goods in the following manner: "A common, collective, or public good is here defined as any good such that, if any person X_i in a group $X_1, \ldots, X_i, \ldots, X_n$ consumes it, it can not feasibly be withheld from the others in that group."[21] A direct consequence of this definition of a collective good is the "free-rider problem."

> To the extent that the good is collective in nature, it is possible for individuals to receive it even if they do not contribute toward its supply. Consequently, individuals acting in a self-interested fashion will experience incentives to withhold their own contributions, hoping that the efforts of others will be sufficient to provide the good for the whole group.[22]

But Olson goes beyond this simple conclusion by formulating a mathematical model of nonexcludable goods.

Olson's model includes the following variables:

C = the cost of the collective good,
S_g = the size of the collectivity or group,
T = the amount of the collective good supplied,
$V_g = S_g T$ = the value of the good to the collectivity,
V_i = the value of the good to individual i,
$F_i = V_i / V_g$ = the fractional share of the total value of the good possessed by individual i (assumed to be constant), and
$A_i = V_i - C$ = the advantage of individual i.

Olson assumes that every individual attempts to maximize his advantage, i.e. the difference between the value of the good to him and the total cost. This means that no individual believes that others will contribute to the supply of the good, that each believes he will have to pay the full cost. There is no "cost-sharing" arrange-

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[19] Breton, *The Economic Theory of Representative Government,* pp. 5–6.

[20] Head, *Public Goods and Public Welfare,* pp. 78–79; Richard Musgrave, "Provisions for Social Goods," in Julius Margolis and H. Guitton, eds., *Public Economics* (London: Macmillan, 1969).

[21] Olson, *Logic of Collective Action,* p. 14.

[22] Frohlich et al., *Political Leadership,* p. 13.

ment. Olson also assumes that both the cost and the collective value of the good are continuous functions of the quantity or amount supplied (T), and that A_i, which is also a continuous function of T, is a concave downward function so that it has a unique and finite maximum value with respect to T.[23] Finally, he assumes that V_i must be greater than C before any individual considers contributing to the supply of the good.

Using these assumptions, Olson demonstrates that if the good is supplied at all, it will be supplied at a suboptimal level. The individuals who receive a greater fractional share of the value of the good will "bear a disproportionate share of the burden" supplying the good.[24] The larger the size of the group, the more suboptimally it will be supplied, if it is supplied at all.

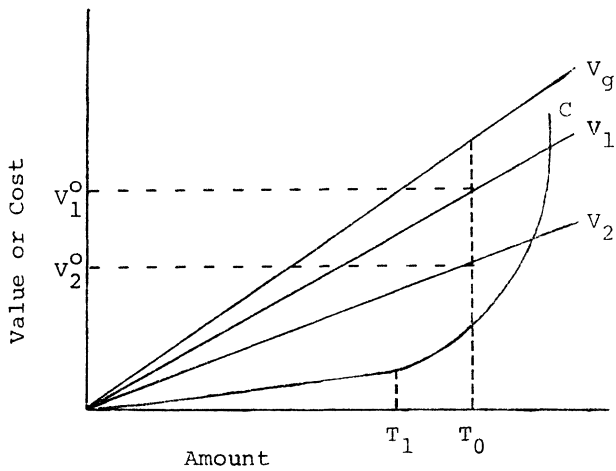
How does he obtain these results? Because of the assumptions about the continuity and shape of the cost and value functions, it is possible to find the amount which will be supplied by an individual who maximizes his advantage by equating to zero the derivative of advantage with respect to amount. That is,

$$\frac{d(A_i)}{dT} = \frac{d(V_i - C)}{dT} = 0 \quad \text{or} \quad \frac{dV_i}{dT} = \frac{dC}{dT}.$$

The amount of the good supplied by individual i (assuming that his value exceeds the cost) will be at that point where marginal cost equals the marginal value *for individual i.* The pareto optimal level of supply will occur at the point where marginal cost equals the marginal value *for the collectivity* (i.e. dV_g/dT).[25] But since the individual value is a constant fraction of the collective value, the amount supplied by any individual will always be less than pareto optimal as long as $F_i < 1$.

This reasoning is shown graphically in Figure 1. Let V_1 be the value of the good to the individual who receives the highest fractional share of the collective value and V_2 be the value of the good to the individual who receives the second highest share. In the graph below, both V_1 and V_2 are above the cost curve at some points so that both might consider contributing to the supply of the good.

FIGURE 1



[23] That is, Olson assumes that d^2A_i/dT^2 0 (on pp. 23–24).

[24] Olson, *Logic of Collective Action,* p. 29.

[25] Ibid.

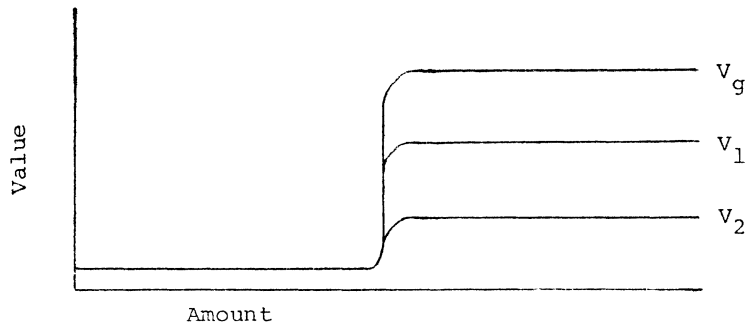
T_0 is the pareto optimal level of supply because it is the level of supply for which the marginal cost (the slope of the cost curve) equals the marginal value for the collectivity (the slope of the V_g curve). At this level of supply, individual 1 will receive a value of V^0_1 for the good and individual 2 will receive V^0_2 regardless of their contributions. But if individual 1 maximizes his advantage, the actual level of supply will be T_1 (which is less than T_0) because the slope of V_1 is less than that of V_g (in general $dV_i/dT = F_i dV_g/dT$). It is a simple matter to show that both individuals derive less benefit from this level of supply than they do at T_0. Thus, the level of supply will be suboptimal.

As the size of the collectivity increases, the value of the good for the collectivity also increases. The *degree* of suboptimality of supply will be a function of the degree to which the increase in the size of the collectivity decreases the maximum fractional share. Olson asserts that "the larger the number in the group, other things equal, the smaller the F_i's will be, the more individuals in the group, the more serious the suboptimality will be."[26]

The crucial assumptions in Olson's model are: (1) that individuals maximize "advantage"; (2) that the cost and benefit curves are continuous and well-behaved (in the sense that they produce a unique maximum advantage); and (3) that the collective value of the good is the product of the size of the group and the amount supplied. All of these assumptions' suitability for analyzing empirical cases can be challenged. Suppose, for example, that individuals maximize the quantity $(V_i - aC)$ where a is positive and less than or equal to one and represents the proportion of the total cost which i expects to have to pay in order to get any benefit from the good. Then it can be shown that the smaller a is, the less suboptimal will be the contribution to the supply of the good by any single individual. Thus, if individuals expect that others will share the costs of supply, then they may contribute enough collectively to ensure an optimal level of supply. There are other possible types of maximizing behavior, of course. For example, some individuals may be interested in maximizing their share of the total benefit (V_i/V_g) or the difference between their level of benefit and someone else's $[(V_i - V_j)$, and $i \neq j]$. Depending on the shapes of the cost and benefit curves, these types of maximizing behavior will have different implications for the level of supply.

The assumption that the cost and value curves are well-behaved is also crucial for the conclusion that supply will be suboptimal. If the value curves are shaped as in the graph in Figure 2, then supply will be nearly optimal regardless of the size

FIGURE 2



[26] Ibid., p. 28. In a recent article, John Chamberlin argues that even though large groups may experience a greater suboptimality of supply than small groups, the absolute level of supply may be greater. This will occur when "an extra unit provided by others induces no reduction, and perhaps in an increase, in the amount provided by an individual." John Chamberlin, "Provisions of Collective Goods as a Function of Group Size," *American Political Science Review* 68 (June 1974): 709.

of the collectivity because a slight increase in the amount supplied produces a large increase in the value of the good to the collectivity and each individual.[27]

The third assumption, that the collective benefit is the product of the size of the group and the amount supplied, is crucial to the conclusion that the degree of suboptimality will be greater in larger groups. The reason for this is fairly simple. As the size of the group increases, then, *ceteris paribus,* the collective value increases. Since there are now more members of the collectivity, the fractional share of any individual is likely to decline — especially if one assumes, like Olson does, that the fractional shares sum to one ($\Sigma_i F_i = 1$). This last assumption raises a number of problems, such as the possibility of interpersonal utility comparisons,[28] which we will set aside for the moment. Since the fractional shares of all the members have decreased, then the degree of suboptimality of supply, which depends solely on the size of the largest fractional share, will increase.

Suppose, however, that the collective value is a function only of the amount supplied and not of the size of the collectivity. Then, if all else remains the same, the fractional shares can remain constant. If the fractional shares do not sum to one, as seems likely in most collective goods situations, then it is even possible for a fractional share to *increase* with the addition of new members. Thus, relaxing the assumptions concerning the relationships between size, amount, and collective value can change the effect of increasing size on the degree of suboptimality.[29]

Finally, Olson suggests that a collective good can be optimally supplied if the costs of supply are shared according to marginal benefits beyond the levels of maximum advantage. Such an arrangement is called "marginal cost-sharing."[30] Cost-sharing is most likely, according to Olson, in collectivities in which there is a "perceptible interdependence." That is, if "the contribution or lack of contribution of any one individual in the group will have a perceptible effect on the burden or benefit of any other individual or individuals in the group," then voluntary cost-sharing is more likely.[31] This is not unlike Anthony Downs' argument that individuals are more likely to vote if they think their vote will make a difference in the outcome of an election.[32] In the absence of this sort of perceived interdependence, rewards or punishments may be necessary to get individuals to contribute to the supply of the good. Olson calls these negative or positive inducements "selective incentives,"[33] and suggests in later chapters that most large groups offer *private goods* as selective incentives to obtain sufficient levels of participation in collective efforts.

A number of theorists have accepted Olson's formulation as the basis for elaboration of the theory. Frohlich, Oppenheimer and Young, for example, criticize Olson for suggesting that private-good incentives or coercion can be used to increase the level of supply of a collective good. They suggest that there is nothing in Olson's scheme to prevent the collector of contributions from failing to supply the good or absconding with the contributions.[34] Thus, they propose as "entrepreneurial" theory in which political leaders supply collective goods in order to maximize their "leader's surplus."

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[27] Ronald Rogowsky and Lois Wasserspring, *Does Political Development Exist? Corporatism in Old and New Societies* (Beverly Hills: Sage, 1971), p. 23. See also Norman Frohlich, Thomas Hunt, Joe Oppenheimer and R. Harrison Wagner, "Individual Contributions for Collective Goods: Alternative Models," *Journal of Conflict Resolution* 19 (June 1975): 310–29.

[28] Rogowsky and Wasserspring, *Does Political Development Exist?* p. 22.

[29] Riker and Ordeshook, *Positive Political Theory*, pp. 73–74.

[30] Olson, *Logic of Collective Action,* p. 30.

[31] Ibid., p. 45.

[32] Anthony Downs, *An Economic Theory of Democracy* (New York: Harper and Row, 1958), p. 267.

[33] Olson, *Logic of Collective Action,* p. 51.

[34] Frohlich, Oppenheimer and Young, *Political Leadership and Collective Goods*, pp. 17–18.

> Any individual who acts to supply a collective good without providing all the resources himself we will call a *political leader or political entrepreneur*. Such an individual will find this role valuable when the total resources he can collect as a leader exceed his costs, thereby producing a leader's surplus.[35]

Political leaders control production units and provide consumption units for their clients in exchange for donations (voluntary) and taxes (involuntary). Political competition provides a check against exploitation by leaders.

This approach does not challenge most of the basic assumptions of Olson's work. The main contribution of Frohlich, Oppenheimer and Young has been to provide a political rationale for the transformation of private goods into public goods through the entrepreneurial role. Contrary to Samuelson (but in accord with Olson), Frohlich, Oppenheimer and Young would have nonmarket institutions produce and distribute private goods as incentives for contributions to collective goods.

How do the approaches of the two main theorists, Samuelson and Olson, compare with one another? Samuelson uses joint supply as the defining characteristic of a collective good while Olson uses nonexcludability. In Samuelson's theory, joint supply in the context of a market system leads to market failure; that is, failure to provide (in general) a set of prices which lead to an optimal supply of both private and collective goods. In Olson's theory, nonexcludability also results in suboptimal results. But in this case, the suboptimality stems from the failure of individuals to share costs of supply. No assumption is made about the existence or nonexistence of a market system. Samuelson makes no predictions about the *degree* of suboptimality, while Olson argues that the degree of suboptimality increases with the size of the collectivity. Samuelson asserts that nonmarket institutions should be used *only* to provide collective goods and that private goods should be left to the market. Olson and Frohlich, Oppenheimer and Young suggest that nonmarket institutions will be able to supply collective goods at optimal levels only if they also supply private goods as incentives.

What if the good is both nonexcludable and in joint supply? This is what Olson calls an "inclusive" collective good, as opposed to a good which is nonexcludable but not in joint supply (an "exclusive" good).[36] A number of scholars have argued that Samuelson's original definition of a collective consumption good, by equating individual consumption with total consumption, in effect means that the good is both in joint supply and nonexcludable.[37] One might say that Samuelson's theory applies to goods which are in joint supply but for which exclusion may or may not be possible, while Olson's theory applies mainly to goods for which exclusions is impossible but which are not in joint supply. Thus, it remains to be seen whether the market system supplies an optimal level of "exclusive" goods or whether self-interested individuals will contribute toward an optimal supply of a good which is in joint supply, but for which exclusion is possible, when there is no cost-sharing.

Musgrave and Musgrave suggests that if a good is not in joint supply, then the market will produce prices which help to ration the use of the good in accordance with individual preferences. However if exclusion is impossible, or merely costly, it may be difficult to enforce the price system. If price-rationing is not possible, then the supply of the good may be suboptimal.[38] That is, a prerequisite of the successful operation of the market system is that goods are not in joint supply and that it is possible to exclude potential consumers. Both exclusive and inclusive goods do

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[35] Ibid., pp. 6–7.

[36] Olson, *Logic of Collective Action*, p. 38.

[37] For example, Head, "Public Goods and Public Policy," p. 215.

[38] Musgrave and Musgrave, *Public Finance in Theory and Practice*, p. 53.

not qualify. The question posed by Samuelson's work of whether or not self-interested individuals will contribute toward an optimal supply of a good in a joint supply, but for which exclusion is possible, when there is no cost-sharing has not been answered yet (to our knowledge). Until this question is answered, we cannot be sure that an emphasis on excludability issues in making public policy on collective goods' issues might not be effectively ignoring the crucial variable, joint supply.

There has been much confusion on the matters discussed here. We do not expect that our formulation will end this confusion. Nevertheless, it seems to us that an explicit recognition of the fact that different scholars have used different definitions of collective goods and have derived different theoretical conclusions from them, should help ultimately to clarify this area of inquiry.

In this section we have focused on only two of the four possible defining characteristics of collective goods, joint supply and nonexcludability. In the next section, we will discuss a third characteristic, the indivisibility of benefits, and its implications for the use of the pareto optimality criterion as a minimal requirement of social choice.

III

The benefits of a good are indivisible when it is impossible to assign fractional shares of the total benefit to individuals. This may be the result of "consumption externalities," "the interdependence of utility functions, or of indivisibilities in the good itself." Both Olson and Samuelson assume that utilities are *not* interdependent. Neither discusses the implications of indivisibilities in the goods themselves, although they cite examples of such goods. Olson, by assuming smooth cost and value curves with respect to the quantity supplied, implicitly assumes that the collective good is divisible.

We will focus, in this section, on the theoretical implications of the interdependence of utility functions and set aside the problem of indivisibility of the good itself. These implications are rather serious for the theory as a whole, since they undermine our ability to apply the theory of collective goods to real situations.

When utilities are interdependent, "making one person richer without making anyone else poorer does not necessarily increase social welfare."[39] When utilities are interdependent, i.e., when an individual's utility depends on the consumption of others as well as his own, then an outcome which is pareto optimal in terms of consumption may not be pareto optimal in terms of utility. When utilities are not interdependent, the two kinds of pareto optimality coincide. In more intuitive terms, when utilities are interdependent, increasing one person's consumption without decreasing that of others does not necessarily increase social welfare. For example, suppose that all the individuals in a particular collectivity have egalitarian utility functions. That is, they all prefer situations in which consumption is distributed equally to those in which consumption is distributed unequally. A situation in which one individual is much better off but everyone else remains the same in terms of consumption will not necessarily be preferred to the original situation.

The effect which this theoretical result has on collective goods theory is rather devastating. Given that one cannot determine whether a particular situation is optimal or suboptimal merely from examining the distribution of consumption, but only after computing the effects of consumption on individual utilities, then the crucial problem becomes determining the form of the utility functions. This is extremely difficult and often requires the use of heroic assumptions. Some scholars have suggested that when utilities are interdependent it may be wise simply to

[39] Sherman Robinson, "Income Distribution and the Social Welfare Function," unpublished manuscript, Research Program in Economic Development, Woodrow Wilson School, Princeton University, February, 1975, p. 13.

abandon the pareto optimality criterion in favor of social welfare criteria which are less distributionally neutral.[40] This would undermine the basis of both Olson's and Samuelson's theories, since both use pareto optimality as the yardstick of social desirability.

To summarize, we have found that interdependence of utilities, one form of indivisibility of benefits, greatly complicates the application of collective goods theory to empirical cases. If there is no such interdependence, it is still necessary to decide whether the good in question is non-excludable, in joint supply, or both. Before one can apply the theoretical findings of Olson or Samuelson, it is necessary to make some defense of the reasonableness of their respective assumptions for the case in question. For example, if it seems impossible to exclude potential consumers of the good, then one must show that it is reasonable to assume that (1) the individuals act in a self-interested, advantage-maximizing way; (2) the cost and benefit curves are continuous and well-behaved; and (3) the collective value is the product of the size of the collectivity and the amount supplied, before one can predict anything about, say, the degree of suboptimality of supply. This sort of defense is rarely seen in applications of collective goods theory because, we suspect, the underlying assumptions of the theories have been poorly understood.

IV

In this final section, we will suggest three things that a theory of collective goods which is useful for the study of international politics will have to do. First, it has to take into account the fact that there are more than two types of units (collectivities and individuals). Not only are there the various-sized units of analysis, such as nations or regions, but also cross-cutting or overlapping units like multinational corporations and intergovernmental organizations. Each aggregate has, to some extent, interests which are not necessarily in the sum of the utilities of individual members.

Second, such a theory must include as variables such important phenomena as decision rules, transaction costs, and technology. Decision rules are the formulae for determining the procedures by which binding covenants can be made. They include rules governing voting procedures, pricing, ownership, rationing, and allocation. It would be extremely useful to know how the use of different decision rules affects the supply of collective goods.[41]

Transaction costs are the costs of running or maintaining any system of collective exchange. Transaction costs include costs of exclusion, of communication and of assessing and using available information.[42] In general, transaction costs are higher for exchanges between nations than for exchanges within nations. Nevertheless, these costs may fluctuate due to changes in technology and in decision rules. A theory which includes this variable explicitly would be more useful than one that does not.

Technology and technological change are, in large part, the basis for the current interest in applying collective goods theories to international politics. The introduction of new technologies like climate modification, marine mining, satellite communication and nuclear weaponry requires collective decisions about what may be described as collective goods. That is, the decisions concern outcomes which may

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[40] Ibid., p. 28.

[41] For an example of a work which investigates the implications of majority voting rules for decisions where utilities are interdependent, see Koichi Hamada, "A Simple Majority Rule on the Distribution of Income," *Journal of Economic Theory* 6 (June 1973): 243–64.

[42] Kenneth Arrow, "Political and Economic Evaluation of Social Effects and Externalities," in *Frontiers of Quantitative Economics*, ed. Michael Intrilligator (Amsterdam: North Holland, 1971), pp. 4 and 14.

be both individually and collectively valued. Collective goods theories might be able to tell us something about how a new technology will or should be introduced given differential effects on individuals and the collectivity. But so far, little theoretical effort has been exerted on the question of how specific technologies affect individual utilities.[43]

Technological change can have a great impact on transaction costs, and transaction costs are clearly a factor in the costs and benefits of different decision rules. Most international actors are aware that the value of a collective decision is contingent upon the decision rules, transaction costs and technologies which go along with the decision. Thus, a theory which is useful for the study of international politics will take these variables into account.

Finally, more work must be done on the consequences of behavior which can not properly be labeled "rational." Collective goods theories are theories of rational choice. That is, they attempt to explain behavior in terms of the calculated pursuit of self-interest. Yet, intuitively and empirically, we know that people do not always act in a purely self-interested fashion. An individual would not vote, for example, if the only reason for doing so was the direct benefit he expected to receive. Bureaucratic organizations are likely to pursue multiple ideals, even though these ideals may be in conflict. A firm may pursue profit and a large share of the market simultaneously. A nation may pursue power and wealth. The use of most rational choice models (like the collective goods theories discussed above) requires an integration of goals into "utility," an integration which is often missing in reality.[44]

Whether or not an expanded theory of collective goods could handle these new tasks without losing its parsimony, we can not say. The current state of the theory is, unfortunately, inadequate for the situations of greatest interest to students of international politics. If such an expanded theory is to be developed, it should develop along the lines suggested above, and it probably should be developed by those who wish to study international politics themselves. This will require a much deeper understanding of existing theories than has been demonstrated in the past.

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[43] Ruggie's previously cited article is an exception. Breton also has suggested that technological arrangements be included explicitly in collective goods theories.

[44] John Steinbruner, *The Cybernetic Theory of Decision* (Princeton: Princeton University Press, 1974), pp. 28–31.