there are people or groups with an incentive to provide only partial or distorted information.

In the bureaucratic model, there is a close analogy with the theory of the firm. Those who administer a programme inevitably have more information than the legislative branch, and this is institutionalized in such procedures as congressional hearings. The differential information limits the ability of legislators or voters to take decisions or to monitor the performance of government agencies. (Moreover, since it is costly to acquire information, it may be socially desirable to allow an element of slack.)

These two aspects—conflicts of interest and imperfect information—take us into areas that are far from fully treated in the case of the private economy. We cannot therefore appeal to a widely accepted body of theory, and much of the discussion is qualitative in nature.

## 10-2 VOTING AND DECISIONS

This section is concerned with the electoral process and its relationship with decision-making in a constitutional democracy. The most straightforward version of this process is that of direct democracy, as in New England town meetings or Swiss municipalities, where decisions are taken directly by individual voters rather than indirectly via elected representatives. Although of limited relevance to modern societies, it serves to introduce some of the crucial questions.

### Direct Democracy

We consider initially a single decision, which we take to be the level of government spending, $G$. This is financed by a pre-specified tax system, assumed to be a uniform poll tax, $T$. If the utility of individual $i$ depends only on $G$ and disposable income $Y^i - T$, then the preferences of $i$ can be depicted as in Fig. 10-2. The effective budget constraint generated by different values of $G$ is such that each extra unit of public spending costs $\$1/P$ where $P$ is the size of the population. If the indifference curves are strictly convex to the origin, then there is a single preferred value of $G$ for individual $i$, denoted by $G^i$ and given by the tangency at $Q$. If the quantity of public goods were smaller, then the individual would be on a lower indifference curve, and the same applies at higher quantities (see the dashed indifference curve and points $R$ and $S$). The individual utility is, given convexity, a function of $G$ which is $\cap$-shaped. There is a single peak. (As drawn, the peak is interior to the interval $[0, PY^i]$, but it could be located at the endpoint.)

If everyone had the same preferences as individual $i$, the same pre-tax income $Y^i$, and the same perception of the tax required, then there would be

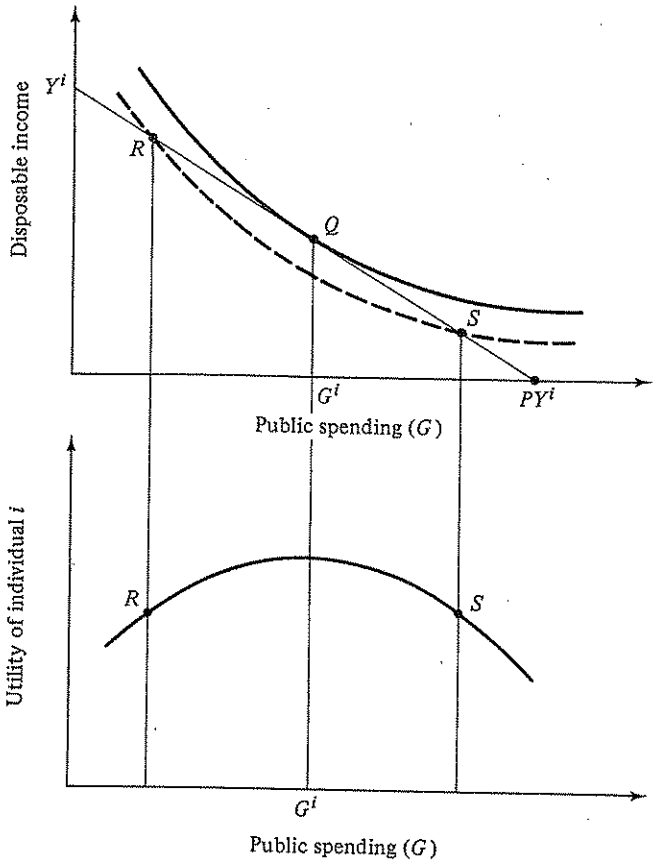


**Figure 10-2** Individual preferences for public spending.

no disagreement over the level of public spending. Where these conditions do not hold, then the preferred levels differ—see Fig. 10-3, for the case of three individuals, $h$, $i$, $j$. In the case of private goods, the existence of differences in preferred quantities poses no problems; each person can choose his desired quantity. The essence of the public choice problem is that only a single decision can be made and the conflicting preferences have to be reconciled. One obvious solution is to let a single individual make the decision. The public decision is then the level of $G$ preferred by this (enlightened or unenlightened) despot. This is however of limited interest in a positive theory of the state. Of greater relevance is majority voting.

Suppose first that we have pure majority voting—one man, one vote. We also assume that there is an odd number of individuals and that they vote "sincerely"; i.e., they do not strategically misrepresent their preferences. In the model of a single decision described above there is a majority voting

equilibrium, which is the level of public goods preferred by the median individual. This may be seen heuristically by considering a vote between $G$ and $G+\Delta G$, where $\Delta G$ is an infinitesimal positive increment. All those whose preferred value of $G$ is strictly to the right of $G$ support such an increase (given the preferences shown). If we begin with $G = 0$, everyone votes for an increase, but the majority falls successively until we reach $G^m$, the most preferred point of the median individual. Any further increase would be opposed by a majority. In this case we have the simple result that the preferences of the median voter are decisive.

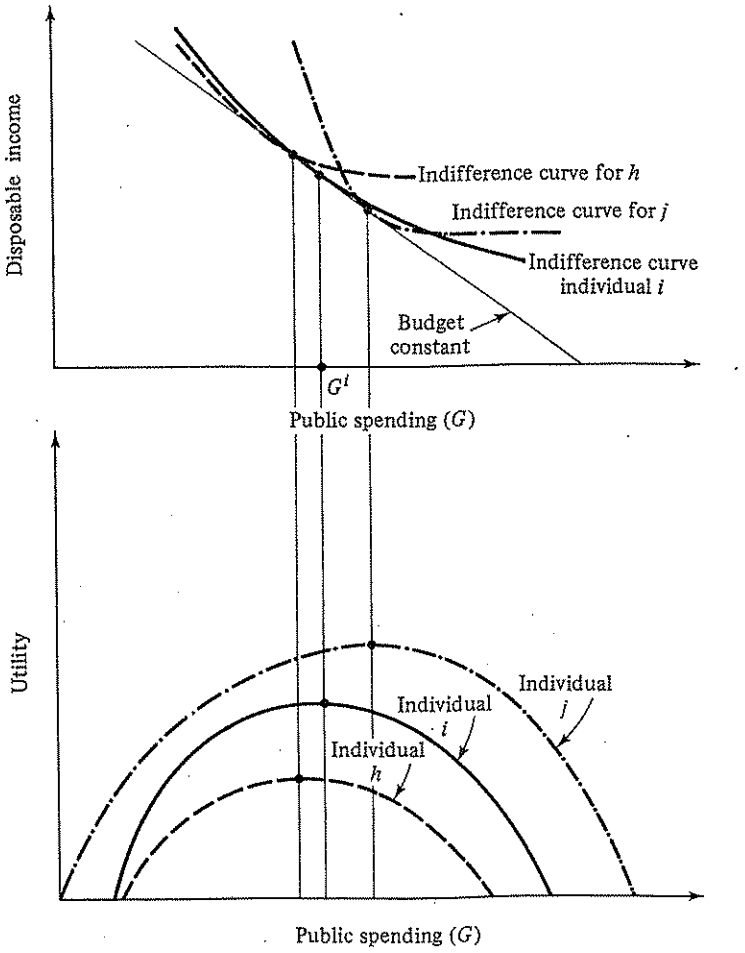


**Figure 10-3** Different tastes for public goods.

The median voter model can be applied directly to yield predictions about the determinants of public expenditure. Suppose for example that people differ only in pre-tax income, and that the preferred level of public goods is a monotonic (say, increasing) function of income. The majority voting equilibrium is then the public goods quantity demanded by the person with median income, and—if tastes are unchanged—we should expect the level of spending to vary with median income. It is clear that the equilibrium depends on the method of finance. If, for example, the poll tax were to be replaced by a proportional income tax, this would in general change the tax burden on the median person, and hence—assuming that he remains decisive—change the voting outcome. There is of course no reason to expect the same person to be the median voter as policy changes; the identity of the median voter may alter.

**Exercise 10-1** Suppose that everyone has a utility function $U = (1-a)\log(Y^i - T^i) + a\log G$, where $T^i$ denotes taxes paid. Show that the majority voting equilibrium with a poll tax is such that $G/P = aY^m$, where $Y^m$ is the median pre-tax income. Show that if the tax employed is proportional, there is unanimous agreement on $G/P = a\bar{Y}$, where $\bar{Y}$ denotes the mean. What happens if the tax is progressive?

The median voter model provides strong predictions; it does so however at the expense of strong assumptions (including that voting is sincere and that there is a single dimension to the decisions being taken, aspects discussed later). We should stress in particular the very considerable informational requirements. The voter has to be able to assess the benefits from public spending (typically *ex ante*) and to form a view of the implications for taxation. For example, the increase in the income tax rate needed to finance an expansion of government spending can be predicted only on the basis of the assumed response of households. Given the costs to the individual voter of acquiring this kind of information, it is not surprising that intermediaries have emerged. Direct democracy has tended to be replaced by representative democracy, and political parties, pressure groups and others have sought to provide the information needed by the electorate.

## Existence of Voting Equilibrium

The median voter model has been widely used in both theoretical and empirical (see Section 10-5) work; it does, however, rest on the assumption that a majority voting equilibrium exists. This depends on the pattern of preferences. In particular, those shown in Fig. 10-3 have the "single-peaked" property. Where this condition (or slightly weaker versions—see Kramer,

1973) fails to hold, the celebrated voting paradox may arise. To illustrate this, we modify the model and suppose that the public good is an *alternative* to a private good. An obvious example is education, where a child attends either a state school or a private school. In the latter case the family is still liable to the tax, but may choose the private school because the level of expenditure is closer to that preferred. The pattern of preferences is now illustrated by Fig. 10-4. For levels of government expenditure below $G_0$, individual $i$ chooses private provision (see Stiglitz, 1974a, for further discussion of this example).

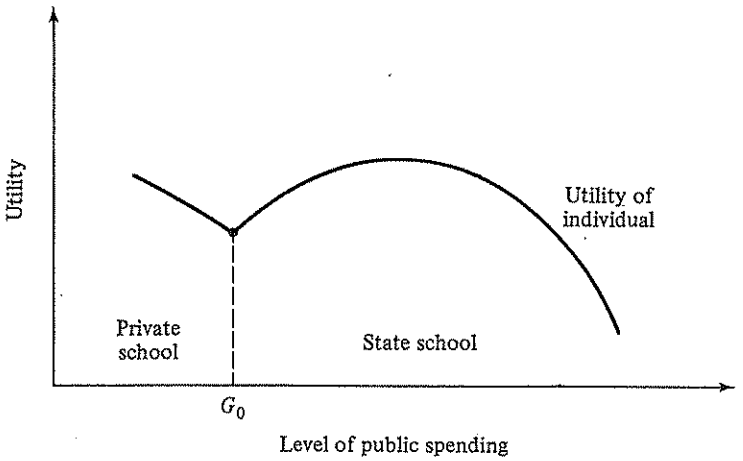


**Figure 10-4** Non-single-peaked preferences.

Suppose now that there are three (equal-sized) groups, rich, average and poor, and that there are three possible levels of expenditure, high (H), medium (M) and low (L). The rich in this range always prefer private provision, so that their ranking is as shown in Fig. 10-5. The only effect of an increase in government spending is to increase their taxes and they are opposed. The poor do not choose private provision, and their ranking is assumed to be M preferred to H preferred to L (see Fig. 10-5). The average group however choose private provision when $G$ is low or medium, hence preferring the lower level of state spending, but switch to public provision when $G$ is high, this being their overall preferred level. It is then clear that there is no determinate outcome to majority voting; it depends on the order of voting between high (H), medium (M) and low (L). In a vote of L versus M, L wins (preferred by rich and average); in a vote of L versus H, H wins (preferred by average and poor); in a vote of H versus M, M wins (preferred by rich and poor).

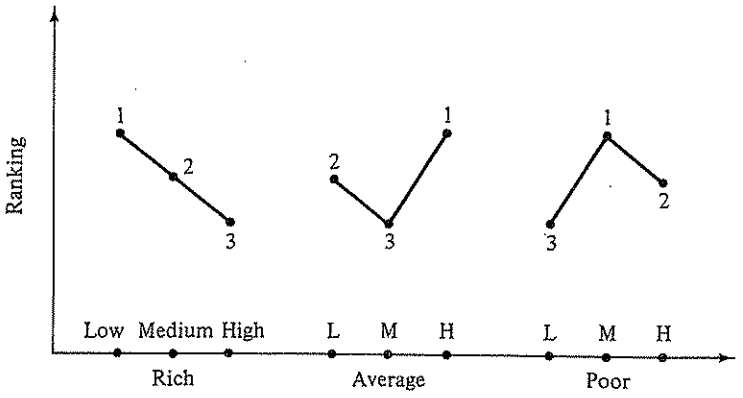


**Figure 10-5** Cyclical voting.

In the situation we have just depicted, there is no majority voting equilibrium: there is no decision that can win a majority against *all* other options.[2] This famous voting paradox, noted as early as the eighteenth century by Borda and Condorcet, has given rise to a voluminous literature. In particular, it has been asked whether there are political mechanisms, other than dictatorship, that, without restricting the nature of the preferences of voters and the choices that they can make, do not give rise to the non-existence problem. It is the very considerable achievement of Arrow (1951) to have shown that under fairly weak conditions no such alternative political mechanism exists. These conditions may be summarized as follows:[3]

(U) the mechanism must work for all logically possible individual preference orderings;
(P) if everyone prefers x to y, then society must also prefer x to y (the weak Pareto principle);
(I) social choice over a set of alternatives must depend on the orderings of the individuals only over these alternatives and not on "irrelevant alternatives";
(D) there should be no individual such that, whenever he prefers x to y, society prefers x to y irrespective of the preferences of everyone else (no-dictatorship).

[2] Such situations are sometimes described as "cycling", or as exhibiting intransitivities. A transitive ranking is one in which A preferred to B and B preferred to C implies A preferred to C. In our example, we can see that the ordering is not transitive.

[3] We do not attempt to give a full or rigorous account. See, among others, Sen (1970b, 1977a) and Pattanaik (1971).

The Arrow Impossibility theorem showed in effect that there exists no social ordering (social welfare function) satisfying these conditions, where there are at least three alternatives. Translated into the context of positive political decision-making, this can be shown to mean that the only voting methods that can guarantee the existence of an equilibrium under every possible pattern of individual preferences are dictatorial (for a precise statement, see for example Wilson, 1970, and Kramer, 1977b).

Majority voting satisfies conditions P, I and D. Where it breaks down is that it does not satisfy U, as we have seen with the example of the voting paradox given earlier. Suppose therefore that we consider one of the alternatives: "rank order" voting. This yields a determinate outcome. For example, with the case shown in Fig. 10-5, we have:

| | Rank | | | |
|---|---|---|---|---|
| | Poor | Average | Rich | Total |
| Low | 3 (3) | 2 | 1 | 6 (6) |
| Medium | 1 (2) | 3 | 2 | 6 (7) |
| High | 2 (1) | 1 | 3 | 6 (5) |

The outcome is a tie (not depending on the order of voting). However, it does not satisfy condition I. Suppose that we consider the choice between L and M, ranked equally with the preferences shown, but that poor individuals decide that they prefer H to M (see ranks in brackets). Their ranking of L and M is unchanged, but low is now preferred by the rank order voting method. (With sincere majority voting the choice between L and M would be unaffected.)

The burden of the Arrow theorem is, therefore, that there exists no mechanism for making social choices that satisfy the four specified conditions simultaneously. This has naturally led to the search for ways in which they can be relaxed. In the case of majority voting, we have already seen one line of approach—to restrict the range of preferences. The property of single-peakedness exhibited by the first model has been shown (Black, 1948) to ensure existence of a voting equilibrium. However, the example of private education demonstrates that absence of single-peakedness is far from pathological,[4] and once we move to two dimensions the corresponding conditions are extremely restrictive: they are "probably not significantly less restrictive than the condition of complete unanimity" (Kramer, 1973, p. 296). The source of the difficulty is illustrated by the case

[4] The condition of single-peakedness is a restriction excluding certain preferences. Weaker exclusion conditions may be imposed (see Kramer, 1973), but they are still highly restrictive.

of two public goods in Fig. 10-6.[5] The indifference maps there generate the voting paradox. Individual $i$ with a peak (preferred combination of $G_1$ and $G_2$) at $Q_i$ ranks the three policies $w$, $y$, $z$ in that order. Individual $j$ with peak $Q_j$ ranks them in order $z$, $w$, $y$, and individual $h$ has ranking $y$, $z$, $w$. There is therefore no determinate outcome to majority voting. The conditions equivalent to single-peakedness essentially fail to hold if the marginal rates of substitution of any three voters differ (Kramer, 1973). Since it seems quite apparent that social decisions are likely to involve many dimensions (e.g., multiple expenditure programmes, different parameters of the tax system), this is an important result.

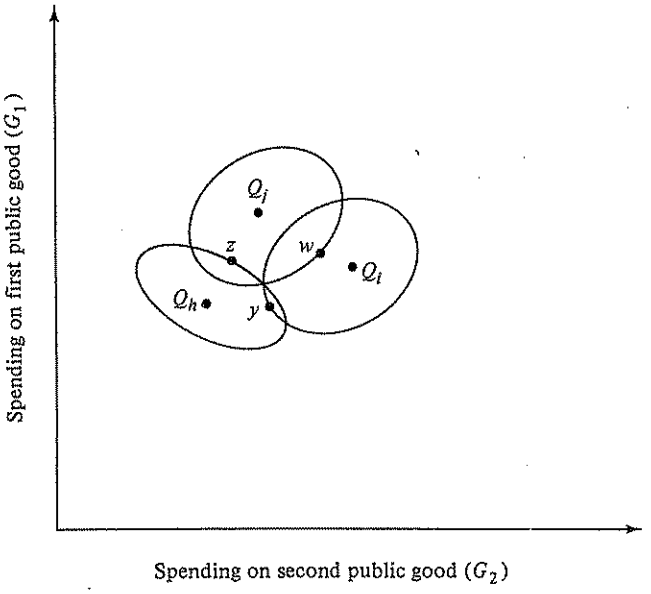


**Figure 10-6** Preferences over two public goods—example of non-single-peakedness.

Other attempts to restrict preferences of voters seem equally to have had limited success. Thus, conditions have been put forward limiting the distribution of voters' preferences (e.g., Plott, 1967), but these are also very restrictive. Similarly, it has been assumed that voters consider only alternatives in a small neighbourhood of the current position. Under fairly

[5] Suppose that public goods are financed by a uniform poll tax and that the utility function of individual $i$ is

$$U^i[Y^i-(G_1+G_2)/P, G_1, G_2]$$

where the first argument is income net of the necessary tax. Holding $G_2$ constant, utility first increases with $G_1$ and then falls; this generates the closed contours shown in Fig. 10-6.

weak conditions, with only one decision variable, such a "local" equilibrium can be shown to exist (Kramer and Klevorick, 1974), but whether it provides a persuasive resolution to the "majority voting paradox" depends on the extent to which choices are limited to small perturbations of the existing situation. (Many would argue that, since the fixed costs of change are large, it is only significant departures that are usually considered within the political process.) Finally, a set of restrictions that ensures existence in the case with several public goods is provided by Slutsky (1977). Basically, he reduces the multi-dimensional case to one dimension by imposing a linear restriction on the levels of the different public goods. Again it is not clear how far this is a relevant restriction.

What happens when a majority voting equilibrium does not exist has been explored in a number of studies. These have emphasized the importance of controlling the agenda (i.e., determining the order in which votes are taken) and of strategic voting (i.e., voting that may not represent one's true preferences). Thus, it may be argued that, after all the potential policies have appeared in at least one vote, then the outcome of the last vote will be accepted. There is therefore a determinate outcome (ruling out ties); e.g., in the education example, with the order of voting (L against M, winner against H), the outcome is H. In this case, the determination of the order of voting—and the termination rule—is clearly crucial, and the indeterminacy may simply be pushed one stage further back.

Strategic voting may be a way of altering the agenda. If we go back to the education example, and suppose that the first vote is between L and M, then if the rich vote sincerely L wins, and in the second round H defeats L. On the other hand, if the rich had voted for M in the first round, then M would have gone on to win in the second round. The rich group can therefore secure a preferred outcome (M rather than H) by misrepresenting their preferences.[6] Such strategic voting has been examined by Farquharson (1969), Gibbard (1973), Satterthwaite (1975), and others. In particular, it has been shown that the conditions for a voting procedure to be strategy-proof (i.e., no one has an incentive to vote strategically) are equivalent to the Arrow conditions. Hence there exists no (non-dictatorial) voting procedure that is strategy-proof. (The reader should also consider the possibility of "log-rolling" or "vote trading"—see Buchanan and Tullock, 1962; Wilson, 1969; and Tullock, 1970.)

## Representative Democracy

To this juncture, we have discussed the aggregation of individual preferences directly into a public decision. With few exceptions, almost all

[6] Borda is said to have retorted, when the scope for manipulation was pointed out, that "my scheme is only intended for honest men!" (Black, 1958, p. 182).

decisions in the public sector are taken by elected representatives or civil servants. Occasionally, a referendum imposes direct constraints on the actions of the representatives, but this tends to be the exception in most countries.

Let us suppose that representatives belong to political parties. If party competition may be represented along a single spectrum (e.g., "left–right"), if individual preferences are single-peaked, and they vote sincerely, then as before a majority voting equilibrium exists. On the other hand, the behaviour of the political parties is itself endogenous and we have to explain the way in which each chooses its position on the political spectrum. Suppose first that parties are interested solely in winning elections, not in policies as such. Thus, in the Hotelling–Downs (see Downs, 1957) model of two party competition, the parties—just as in the case of spatial competition—choose the midpoint, i.e., the preferred point of the median. A party that did not choose this platform (e.g., for ideological reasons preferring less government spending) would be defeated if the other did. In the determination of government spending we would not expect—in this simple model—the replacement of direct by representative democracy to change the results. An empirical study based on the preferences of the median would still be valid; and there would not be any need in equilibrium situations to introduce party political dummy variables (a party whose ideology took it away from the median would not be victorious in an election and its policies would not be observed).

The result described does however depend on strong assumptions. Although the move to representative democracy may reduce the dimensionality, there may remain more than one dimension (e.g., "liberal–non-liberal" as well as "left–right"). In this case no pure strategy equilibrium in general exists for parties; i.e., there is no vector of strategies such that, given the strategies of others, no party wishes to change its platform. Various approaches have been suggested, including *mixed* strategies, for example where there is a set of policies each played with strictly positive probability (Shubik, 1970), or where there are stochastic abstentions (Hinich, Ledyard and Ordeshook, 1972). Alternatively, one can seek to model disequilibrium behaviour. For example, Kramer (1977a) assumes that in each election the incumbent party defends its established policy, whereas the opposition chooses its policy freely to maximize its vote. (The hypothesis supposes that voters have a short memory: they expect continuity only from the incumbent.)

The view of political parties as simply organizations for winning political power is clearly only a caricature. Party platforms are influenced by "ideology". A socialist party supports government provision; a big business party opposes taxation. Alternatively, parties may be dominated more by individuals than by issues, and the process may be one of competition for political leadership (Schumpeter, 1954). On a third view,

parties may be seen as alternative "managerial teams" for running the economy and providing public services. In such a case, it is not so much differences in values as differences in judgements about managerial competence that are the main determinants of elections.

The representative democracy model also raises a number of questions concerning the behaviour of voters. In particular, how does the voter obtain information about the likely performance of the parties, and what determines whether or not he votes? These issues have been extensively discussed by Downs, who identifies several key steps in a "rational" voting process, including gathering information relevant to each issue, forming factual conclusions about alternative policies, appraising the consequences in the light of voters' goals, and aggregating over issues into a net evaluation of each party. In this process, there is an asymmetry between the incumbent and the opposition parties: "the incumbent's policies and personnel have been put to the test of very recent practice at the time of election, while the oppositions' probable performance can be inferred only from its statements of intention and its previous performance in office" (Kramer, 1977b, p. 699).

This representation makes clear that the activity of voting may involve the individual in non-trivial costs. If he acts solely from self-interest, then there are good reasons for expecting him not to participate in the democratic process. Suppose first that he has clearly formed preferences and all necessary information. Then he may still not vote for his preferred alternative if there are positive net costs to voting. This may be seen as a special case of the "free-rider" problem, discussed later in conjunction with public goods. In that situation, a person may choose not to contribute to a public facility on the grounds that others will pay enough to cover its finance (and he can have a "free ride"). In the voting case, he may choose not to vote because he calculates that he is unlikely to be decisive (i.e., there will be a majority for one outcome independently of his vote). The infinitesimal probability of being the decisive vote, coupled with the significant costs of voting, may indeed mean that no individual has an incentive to vote, even on issues of considerable importance.

The assumption of individual self-interest also applies to the acquisition of information. For the reasons just described, people may not have an incentive to assemble the information required to vote intelligently. At the same time, it is clear that the information provided by the parties is not purely informative, and that the transfer of the process of providing information to the parties does not mean that it is costless. Those financing the advertising of parties expect to receive a return on their outlay. The benefits do not have to be of a strictly pecuniary kind; individuals may enjoy the status of high office, even if they do not benefit financially from it, and advertising is a method of purchasing the status. (The cost of providing the information is then financed by the "rents" from political office.)

Nevertheless, there is a widespread view that much of the benefit accruing from the support of a party are of a strictly financial kind; this is particularly true of industry lobby support. In such cases, the payment of supporters may involve measures that distort the operation of the economy. For example, the enactment of import quotas, designed to compensate particular industrial supporters, may impose substantial additional costs. The elected government is unlikely to be fully "efficient" in its pursuit of the national interest.

There is therefore a quandary. If individuals are motivated by self-interest, then they have no incentive to acquire information, and this has to be supplied by the political parties and other interested organizations. On the other hand, the latter may require enough "slack" in the political system to allow vested interests to obtain a return for their investment, implying that certain decisions may be contrary to the national interest. This clearly has implications for the design of the political structure.

The assumption that individuals act out of self-interest, narrowly defined, is of course open to question, and Downs himself sought to explain electoral participation as the basis of "each citizen's realization that democracy cannot function unless many people vote" (Downs, 1957, p. 274). There may be a variety of social sanctions which lead to a high level of participation. Similarly, for political parties ideology may play a significant role (it is also a means of reducing information costs, allowing voters to predict party response). The incorporation of such behavioural considerations is clearly a necessary development of this approach.

Finally, we have not discussed the way in which elected representatives themselves reach decisions in the legislature and its committees. In part this involves issues similar to those discussed with regard to direct democracy; in part it is concerned with the control of the legislative branch over the bureaucracy, to which we now turn.

## 10-3 ADMINISTRATION AND BUREAUCRACIES

The administration of legislation is typically entrusted to a bureaucracy (where the term is used more in its Weberian, rather than its common, perjorative, sense). Expenditure programmes may be executed by the Department of Defense, by the State Highways Board or by agencies such as the Office of Economic Opportunity or the National Institutes of Health. Many different approaches can be adopted to the analysis of bureaucratic behaviour, and much can be learned from the work on administrative science and political sociology. For economists, who came late to the study of bureaucracy, it has been natural to start from the parallel with the private sector of the economy.

system operates, but that they are usually presented in a way in which it is difficult to test the conclusions against competing hypotheses. This is, of course, also true of a number of the theories we presented earlier. In the next section, we discuss a selection of the empirical work in testing alternative theories.

### Summary of Theoretical Approaches

The first model considered in this Lecture was that of direct democracy, where under certain conditions public decisions are determined by the preferences of the median voter. The conditions required are strong, and it is quite possible that no majority voting equilibrium exists, but the median voter case provides a useful benchmark—and is examined empirically in the next section.

The median voter model has been successively modified to allow for important features of the actual political process. In a representative democracy we have to consider the motives and behaviour of voters, parties and legislators. Among the factors we have identified as particularly important are the costs of acquiring information and the interests of political parties in supplying such information. In considering the relations between legislators and government administration, one can follow the parallel with private organizations, considering initially the behaviour of the government agency as a unit and then taking account of its internal structure. The motives of those who direct government agencies may well depart from those of the legislative branch, and, although control mechanisms are employed, they are typically not sufficient to ensure complete compliance. Within the agency itself, the need for control commonly gives rise to a hierarchical structure, which imposes additional administrative "overheads".

Finally, the operation of both the electoral process and administrative procedure is likely to be affected by special interest groups and by differential power. The ability of those with resources (either money or information) to influence the outcome of voting may secure a self-sustaining equilibrium. The pursuit of self-interest may lead to the formation of pressure groups, particularly where the numbers involved are small (e.g., trade associations) and where sanctions can be applied to ensure cohesion. Alternative versions of the class interest theory see the state as acting as the instrument of one class (capital), or as reflecting the balance of power between capital and labour.

## 10-5 EMPIRICAL STUDIES OF PUBLIC EXPENDITURE

As we have seen, there are a number of theories of the operation of the public sector, developed to varying degrees, which are at varying distances

from being empirically testable. In this section, we first consider in detail the median voter model, which is that most easily translated into an empirically verifiable form, and then consider the other theories in more general terms.

## Testing the Median Voter Model

Let us suppose that we are seeking to explain the cross-section differences in public spending, for example, between states or communities. In principle, the application of the median voter model is straightforward. If, for example, the demand function is taken to be log-linear, the level of public spending may be written as

$$\log G = a + b \log Y_m + c \log p_m \tag{10-4}$$

where $Y_m$ denotes the after-tax income of the median voter and $p_m$ the marginal "price" of public goods to him. It would then be possible to estimate the coefficients econometrically and to test the median voter hypothesis against alternatives, such as that the decisive voter is at the mean (e.g., with differential voting) or other quantiles of the income distribution.

There are however several difficulties. First, there is the problem of identifying the median voter. With identical tastes, uniform turnout in voting, and a monotonic relationship between income and desired public spending (taking account of the method of finance—see below), the median voter has the median income. If however the quantity demanded is not a monotonic function of income, or if there are differences in tastes, then we cannot necessarily identify the median voter in this way. This question is discussed by Bergstrom and Goodman (1973), who provide sufficient conditions under which the median income remains relevant. These conditions, which restrict the form of variation in the incomes of the sub-populations and in differences in tastes, are quite strong; and the issue becomes even more problematic if differential voting means that the decisive elector is not necessarily the median.

Second, the form of the demand function depends on the method of finance and the voter's perception of the tax system. The empirical studies have varied considerably in approach. Borcherding and Deacon (1972) simply assume that the tax share of the median voter is $1/P$, where $P$ is the size of the population. In contrast, Bergstrom and Goodman (1973) discuss in detail the tax share of the median voter. They assume that perceived shares are randomly distributed around the share of property tax paid at the median income. There are however reasons why there may be *systematic* misperception. It is frequently argued that citizens tend to understate the cost of public services, since part of the taxation is concealed. Conversely, it may be argued (Gevers and Proost, 1978) that voters take a more sophisticated view of the trade-off between taxation and the level of

public spending, allowing for the general equilibrium effects of tax changes.

Third, the cost of public spending varies across observations, as discussed for example by Borcherding and Deacon, depending on differences in factor prices. It also reflects the degree of "publicness" of the good and the economies or diseconomies of scale in its production. To represent the former, let us suppose that a total quantity of public good $G$ generates benefits to the individual of

$$G^* = GP^{-\alpha} \tag{10-5}$$

so that $\alpha = 1$ may be taken as corresponding to a private good, and $\alpha = 0$ to a pure public good. The cost of $G$ is assumed to be given by

$$qGP^{\gamma} \tag{10-6}$$

with $\gamma > 0$ representing increased per unit costs in a large population, and $\gamma < 0$ economies of scale in production in large populations. The median voter then chooses $G^*$ subject to an effective cost per unit

$$p_m = t_m q P^{\alpha+\gamma} \tag{10-7}$$

where $t_m$ denotes the tax share of the median voter, and $q$ the price per unit. The desired level of $G^*$ is given by (10-4):

$$\log G^* = a + b \log Y_m + c \log(t_m q P^{\alpha+\gamma}) \tag{10-8}$$

and the expenditure in *per capita* terms (denoted by $E/P$) is, from (10-5) and (10-6):

$$\log(E/P) = a + b \log Y_m + c \log t_m + (1+c) \log q - [1-(1+c)(\alpha+\gamma)] \log P \tag{10-9}$$

Fourth, we need to consider the precise sense in which the estimation of the equation represents a "test" of the median voter model. As noted by Romer and Rosenthal (1979), the model is rarely set against an explicit alternative, and in a number of cases it is not possible to reject the competing hypothesis that the spending is some multiple of that desired by the median voter or that another percentile (rather than the median) is decisive.

In order to illustrate these issues we have taken one of the many studies that have been carried out, that by Pommerehne and Schneider (1978), based on data for 110 Swiss cities in 1970.[11] They begin by estimating an equation similar to (10-9), where $E$ represents aggregate municipal public expenditure, $Y_m$ median net of tax income in the city, $t_m$ the median tax share (assumed to be equal to the share in income tax), and $P$ the residential population. The cost variable, $q$, is assumed constant across

[11] Studies for the United States include Bergstrom and Goodman (1973), Borcherding and Deacon (1972), Inman (1978), Lovell (1978) and Rubinfeld (1977).

cities. The resulting equation in *per capita* terms is

$$\log_e(E/P) = \underset{}{-11.90} + \underset{(6.97)}{1.29}\log_e Y_m - \underset{(10.84)}{0.70}\log_e t_m - \underset{(7.93)}{0.63}\log_e P \qquad \bar{R}^2 = 0.535$$

(the figures in brackets are $t$-statistics). It is possible to test this equation against alternatives, and this has been done by Pommerehne and Frey (1976) for the case where the mean, rather than the median, is decisive.[12] However, no test is possible of the hypothesis that $E$ is *proportional* to that desired (the model yields no prediction of the size of the constant term—see Romer and Rosenthal, 1979). The individual coefficients imply an income elasticity of around unity, and that $0.3(\alpha+\gamma) = 0.37$. Since the maximum value for $\alpha$ is 1.0, this implies that $\gamma$ is positive.

Pommerehne and Schneider go on to elaborate the model in two major respects. The first concerns the perceptions of tax burdens by the electorate. We have referred in Lecture 2 to attempts to calculate the perceived tax rate implicit in labour supply decisions; the approach of Pommerehne and Schneider is to postulate that the degree of under-estimation of the tax rate increases with the degree of complexity of the tax system and that under-estimation leads to a higher desired level of spending (as they note, both assumptions are debatable). As an index of the degree of complexity, they take the Herfindahl concentration index of tax revenues from different sources,[13] which is assumed to multiply the actual tax price. The index is unity when there is only one source of revenue, and less than 1.0 when there are multiple sources. A negative coefficient is predicted; and, as shown by row 2 in Table 10-1, this is found empirically. The choice of index is clearly arbitrary, but similar results are obtained for other measures, such as the share of highly "visible" taxes (personal income and wealth taxes).

The second development of the model is to allow for the differences in democratic institutions. Pommerehne and Schneider divide their sample into direct democracies (where decisions are taken in general assemblies open to all voters), representative democracies with referenda, and representative democracies without referenda. It seems reasonable to assume that the median voter model would become less relevant as we move from direct democracies to representative democracies without referenda, and this is indeed suggested by rows 3, 5 and 7 in Table 10-1 (although no formal framework for testing this hypothesis is provided).

[12] The overall level of explanation, as measured by $R^2$, is similar in the two equations estimated by Pommerehne and Frey, but the coefficient of the tax share is insignificant in the version with mean income, and the parameters generally are less plausible.

[13] The index is $\Sigma R_i^2$ where $R_i$ is the share of tax revenue for the $i$th revenue category. The distinctions between categories are to some degree arbitrary, and obviously the index does not capture all aspects of complexity.

**Table 10-1 Local public spending regression equations: results for Swiss cities, 1970**

| Equation | Demand elasticities with respect to: Income | Tax share | Population | Complexity of tax system | $\bar{R}^2$ |
|---|---|---|---|---|---|
| 1. All 110 cities | 1.29 | −0.70 | −0.63 | — | 0.535 |
| | (6.97) | (10.84) | (7.93) | | |
| 2. All 110 cities | 1.32 | −0.64 | −0.58 | −0.33 | 0.561 |
| | (7.34) | (9.59) | (7.31) | (2.72) | |
| 3. 48 direct democracies | 1.27 | −0.72 | −0.65 | — | 0.682 |
| | (6.39) | (9.89) | (5.48) | | |
| 4. 48 direct democracies | 1.26 | −0.72 | −0.64 | −0.07 | 0.678 |
| | (6.22) | (9.67) | (5.41) | (0.66) | |
| 5. 35 representative democracies with referenda | 0.88 | −0.47 | −0.33 | — | 0.372 |
| | (1.64) | (3.72) | (2.26) | | |
| 6. 35 representative democracies with referenda | 0.89 | −0.17 | −0.10 | −0.67 | 0.467 |
| | (1.80) | (1.05) | (0.60) | (2.55) | |
| 7. 27 representative democracies without referenda | 0.44 | −0.43 | −0.51 | — | 0.149 |
| | (0.97) | (2.78) | (2.34) | | |
| 8. 27 representative democracies without referenda | 1.28 | −0.28 | −0.28 | −1.43 | 0.584 |
| | (3.59) | (2.55) | (1.77) | (5.00) | |

Figures in brackets are *t*-values. Equations estimated by ordinary least squares.
*Source:* Pommerehne and Schneider (1978, Tables 1 and 2).

Conversely, one might expect that the effect of "fiscal illusion" (measured by the index of complexity) would be greater in the representative democracy than in direct democracies, and this is again borne out by rows 4, 6, and 8 in the table. (The differences according to type of political institution are discussed further in Pommerehne, 1978.)

As in other areas of econometric work on public finance, the results of estimating median voter models are not conclusive. The models provide insight into a number of aspects, but are open to a number of criticisms. In part, these are qualifications that apply quite generally, for example, the use of single equation methods,[14] the specification of the functional form, and the treatment of the individual budget constraint. There are two aspects however that should be stressed. First, the heterogeneity of the population needs more explicit treatment, as recognized by Bergstrom and Goodman, allowing, for example, for the differences between Swiss citizens and other taxpayers, between owner-occupiers and tenants, or families with and without children. Second, the results should not be seen as constituting a test of the median voter model without a full specification of the range of competing hypotheses. Even where the median model provides a reasonable level of statistical explanation, as with direct democracies in Swiss cities, we cannot conclude that this is the only theory of public spending consistent with the evidence.

## The Growth of Public Spending

The second major source of evidence about the determinants of public spending is that based on time series. As we have seen in Lecture 1, there has been a long-run tendency for the public sector to rise as a proportion of national income. Although there is no reason to extrapolate this into the future, the past secular trend provides a convenient "stylized fact" against which to compare different views of public spending.

The median voter model suggests at once a number of possible explanations. Rewriting Eq. (10-9) to give *per capita* spending (in real terms) relative to average incomes,

$$a_1 + a_2 \log(Y_m/\bar{Y}) + a_3 \log t_m + a_3 \log q + a_4 \log P + (a_2 - 1) \log \bar{Y} \quad (10\text{-}10)$$

We can identify the following possible explanations of a rising share for government spending:

1. rising *per capita* incomes, with public expenditure having an income elasticity greater than unity;

[14] For example, it would be preferable to consider the simultaneous determination of expenditures and tax rates.

2. redistribution of income, raising the median relative to the mean (where $a_2 > 0$);
3. decrease in (perceived) tax burden of median voter (where $a_3 < 0$), which may result from changes in fiscal structure or increased fiscal illusion;
4. decrease in relative price of public sector output (where $a_3 < 0$);
5. increase in population, where rising costs and low degree of "publicness" ($a_4 > 0$).

It should be emphasized that we are not saying that these factors *have* operated in the direction indicated; indeed, it has been argued by Baumol (1967) and others that the relative price of the public sector has risen, as a result of an inherently lower rate of productivity increase. (Depending on the price elasticity, this may imply a rising share in terms of *expenditure*.)

Extending the model to include important aspects of political institutions not captured in the simple median voting model, there are other factors that may have intensified or moderated the growth of government spending:

6. extension of the franchise and increased participation of lower-income groups (e.g., via increased voter registration);
7. expansion of interest group activity (e.g., formation of trade associations pressing for aid to industry);
8. changing ideology of political parties, and shifts in the sources of financial support.

The "political" factors listed above may either supplement or replace the median voter model. Thus, one may view parties in a representative democracy as constrained by the electoral process but enjoying certain room for manoeuvre (on account of the issues concerning information, etc., discussed earlier). This line of argument is similar to that given prominence in Peacock and Wiseman's seminal study (1961). They were particularly concerned to explain why increases in public spending in the United Kingdom had tended to occur in discrete steps. The explanation advanced for these "displacement effects" is that the ability of governments to increase expenditure is limited, on the supply side, by the revenue that can be raised, and that people's ideas about the "tolerable" level of taxation tend to be relatively stable. Thus, in normal periods the growth of public expenditure tends to be relatively steady. On the other hand, there are periodic "social disturbances", during which people tolerate methods of financing previously considered unacceptable and the acceptance remains when the disturbance has disappeared. As a result, "expenditures which the government may have thought desirable before the disturbance, but which it did not then dare to implement, consequently become possible" (Peacock and Wiseman, 1967, p. xxxiv). Moreover, the kind of social disturbances considered by them,

notably wars, may impose new obligations on the government and reveal new needs (an "inspection effect"). The mechanisms by which these processes operate are not fully spelled out (although see Breton, 1974).

The electoral/political explanations must be supplemented by consideration of the interests of the bureaucracy, and this suggests two further factors:

9. the aim of government agencies to expand provision, coupled with incomplete control by the legislature;
10. increasing costs of administrative hierarchies.

These factors operate independently of those discussed earlier, and it has indeed been argued that expenditure behaviour can be explained entirely in this way. Thus, Davis, Dempster and Wildavsky (1966) argue that the budgetary process can be represented by two straightforward relationships. In the simplest form, the requests by an agency are a fixed multiple of the previous appropriation made by the legislature (more generally, a linear function of the previous appropriation and previous request) plus a random component; in turn, the appropriation is a fixed proportion of the request plus a random component. The conditions under which this "rule of thumb" behaviour is likely to emerge from more basic assumptions clearly need to be examined.

Finally, the class interest theories would see the expansion of public spending as resulting from either:

11. the transfer of power to the working class, and the expansion of redistributive expenditure; or
12. the need for government intervention to secure the conditions for profitable accumulation of capital.

It is clear that any attempt to estimate empirically these different models, and to test the different hypotheses, is likely to encounter substantial difficulties. First, there is the definition of the public sector. As brought out in Lecture 1, there is no precise boundary, and theoretical constructs are not immediately matched in the national income accounts. The different hypotheses apply to varying extent to different concepts. Should we consider total spending, or only spending on goods and services? Should we consider the expenditure of individual agencies? Second, the hypotheses need to be put in a form where they can be empirically tested. Thus, in the case of the Peacock and Wiseman theories, we need to specify the circumstances in which the displacement effect takes place (even if we are only testing for structural breaks). The theories based on class interest require that one can use a non-tautological indicator of relative power.

Third, as with other econometric work, one has to consider the rest of the model in which the equation is embedded. In the past, inadequate attention has been paid to the simultaneous nature of the relationships. Typically, equations have been estimated with $G$, taken here as government spending on goods and services, as the dependent variable, and national income as one of the explanatory variables. However, this is a reversal of the usual macroeconomic treatment, where $G$ is regarded as exogenous and income as the dependent variable. It is possible that the system is recursive, but in general the model should be treated as a simultaneous system.

### Concluding Comments

The natural development of the work described in this section is the construction of full-scale models of politico-economic interactions, combining the explanation of government decisions as functions of economic (and political) circumstances with the modelling of the influence of government actions on the behaviour of the economy. At a theoretical level, there are models of the "political business cycle", where governments are assumed to design macro-policy to secure electoral advantage, given a set of economic constraints (see, for example, Nordhaus, 1975, Ben-Porath, 1975, MacRae, 1977, and Frey, 1978). At an empirical level, Frey and Schneider have estimated models for the United States (1978c), United Kingdom (1978a) and West Germany (1978b), in which the choice of instruments by the government depends on its electoral popularity (and ideological goals) and popularity depends on economic indicators.

In principle, these developments are most important. In seeking to make the activities of the government endogenous rather than exogenous, they are very much in the spirit of this Lecture. At the same time, it appears over-optimistic to expect that the empirical implementation will yield immediate, definitive findings. Experience with the estimation of individual relationships, such as labour supply functions or investment equations, has shown the problems in providing an unambiguous interpretation of the evidence or in testing alternative specifications. The history of the construction of macroeconomic models points to the many difficulties likely to arise in the estimation of a fully satisfactory simultaneous model integrating political and economic considerations.

## READING

This Lecture is based on a wide range of material, and only a brief guide to reading can be given. For further discussion of the results on voting, see Sen (1970b) and Pattanaik (1971); for a review of the recent theoretical results

LECTURE

# SIXTEEN

# PUBLIC GOODS AND PUBLICLY PROVIDED PRIVATE GOODS

## 16-1 INTRODUCTION

This Lecture deals with the public provision of goods and services. We are concerned with four basic questions:

1. How do we characterize those goods that are, or ought to be, provided publicly?
2. If the government knew the preferences of all members of society, how ought the supply of each of the public goods to be determined?
3. How are the supplies of public goods in fact determined, and how does this contrast with the optimal provision?
4. How can the government ascertain the preferences of the members of society regarding the provision of public goods?

These questions are of considerable importance and have generated a great deal of controversy. There are those who claim that the government is engaged in supplying goods that ought to be privately marketed, for instance, that education ought to be privately rather than publicly provided. There are others who claim that public programmes receive insufficient funds and that there are activities at present privately supplied that ought to be provided by the government. What we shall have to say here does not resolve these controversies, but we believe that a careful consideration of the kinds of issue treated in this Lecture will help focus the debate.

At the outset we need to make an important distinction, between public *production* and public *provision*. The two are often confused, though both logically and in practice they are distinct. The government provides for the

National Defence, yet much of the production of the goods purchased for national defence is within the private sector. The government has, in many countries, a monopoly of the mail service, yet it charges for the use of mail in a manner little different from that of private enterprise. In the previous Lecture we dealt with the pricing of publicly produced commodities; here we are concerned with goods and services that are provided freely, perhaps in rationed amounts, to all members of society. (We are also at this stage concerned with public goods for the whole society; local public goods are discussed in the next Lecture.)

## Characteristics of Publicly Provided Goods

The free provision of goods may be seen as the limiting case of subsidization, i.e., the delivery to consumers of commodities at a price below the cost of production. In this sense, the analysis of this Lecture, and that of public sector pricing, are aspects of the same subject. There is however a distinct feature of public provision which this approach does not capture and which is the focus of much of our discussion: with public provision there is not necessarily any monitoring of usage, whereas with any price, positive or negative, usage must be recorded.

The issue of monitoring usage introduces the first aspect that is relevant to characterizing those goods that are, or ought to be, publicly provided: it may be impossible, or extremely costly, to charge for the use of a specified commodity. In other words, it may not be possible to *exclude* non-contributors. This is essentially a technical question, and depends on the available technology. In the case of television, calculation of the extent of use depends on it being possible to determine from outside whether the receiver is in operation or on the employment of scrambling devices. It has been suggested that automatic metering devices could be installed to record the passage of vehicles through the highways system and that with large-scale computer networks it would be feasible to charge for actual usage. For some goods, such as national defence, it is hard to imagine that even future developments in information processing will allow individual benefit to be determined; so that for these exclusion is indeed impossible.[1]

Where exclusion is not technically impossible, it may still be decided to supply the good publicly, for reasons parallel to those discussed earlier in other contexts. The first is that it may not be desirable on *efficiency* grounds to use prices to govern the usage of a commodity. The effects of charging

[1] It should be noted that the term "exclusion" is being used in a slightly different sense from, for example, that employed by Musgrave. He refers to the exclusion principle as indicating that 'a person "is excluded from the enjoyment of any particular commodity or service unless he is willing to pay the stipulated price" (1959, p. 9). This however reflects a *choice* about the method by which the good is to be allocated. Our definition relates solely to the technical possibilities.

depend on (1) the conditions of demand and (2) the conditions on which the good can be supplied *to an additional individual.* If the demand is highly inelastic, then pricing has little effect on usage. In the extreme case, if demand is completely inelastic, there is no efficiency loss from not charging for the commodity (although there may be other arguments, such as raising revenue, as we have seen). Many places do not charge for the quantity of water used, because it is judged that the benefits for metering would be relatively small, demands not being very elastic, and insufficient to warrant the installation of metering devices. (There may also be external economies in consumption—at least, that was an important historical reason for public provision.)

Standard discussions tend in effect to focus on the second aspect—that usage by one person does not reduce the amount that others can consume. In other words, the cost of supplying a fixed quantity to another *individual* is zero. Examples typically given include television programmes (my listening to a TV programme transmitted over the airwaves does not detract from others listening); information (my knowing something does not detract from others knowing the same thing); and national defence. These are extreme cases, and are referred to as *pure* public goods, where "each individual's consumption of such a good leads to no subtraction from any other individual's consumption" (Samuelson, 1954, p. 387). More generally, there is a range of commodities that have the property that an increase in one person's consumption (keeping aggregate expenditure on the commodity constant) may not decrease the consumption of other people by the same amount. If one person travels on a little-used highway, the benefits of the road to others are reduced only slightly.

On this view, private goods are at one extreme of a spectrum, where an increase of one unit in the consumption by Mr X reduces the consumption available to others by one unit; and pure public goods at the other extreme, where an increase in Mr X's consumption leads to no reduction for others. These polar cases are sometimes characterized in the following way. Let $X_i^h$ be the consumption by household $h$ of the $i$th commodity. Then for private goods,

$$\sum_h X_i^h = X_i \tag{16-1}$$

where $X_i$ is the aggregate supply. In contrast, for a pure public good,

$$X_i^h = X_i \quad \text{all } h \tag{16-2}$$

It may be noted that this assumes no *free disposal.* For many public goods, such as defence, this may not be an unreasonable assumption; on the other hand, for goods such as television, free disposal is possible, and (16-2) should be replaced by

$$X_i^h \leqslant X_i \quad \text{all } h \tag{16-2'}$$

The intermediate cases are somewhat harder to characterize, and various approaches have been suggested in the literature. One is to write the consumption possibility frontier for the economy as being for good $i$:

$$\chi(X_i^1, \ldots, X_i^h, \ldots, X_i^H, X_i) = 0 \tag{16-3}$$

with

$$\frac{\partial \chi}{\partial X_i^h} = 0 \quad \text{(for all } h\text{) for pure public goods,}$$

$$\frac{\partial \chi / \partial X_i^h}{\partial \chi / \partial X_i^k} = 1 \quad \text{(for all } h, k\text{) for pure private goods}$$

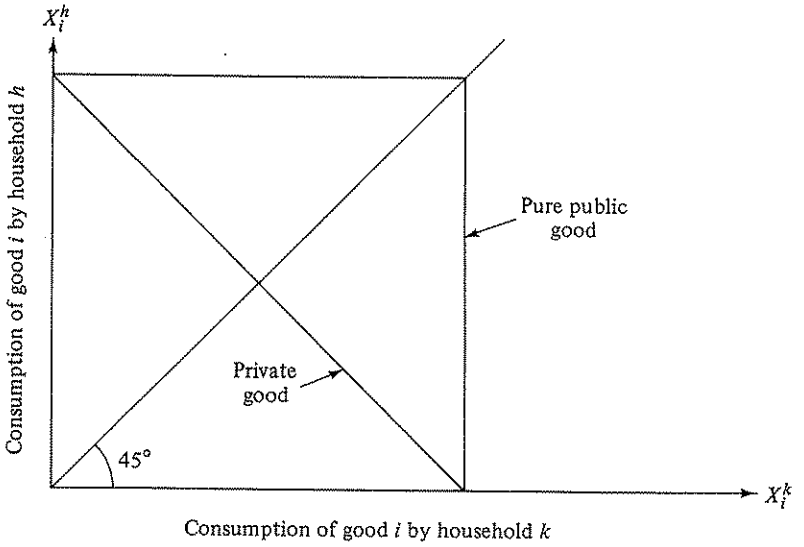


**Figure 16-1** Public and private goods.

These are illustrated in Fig. 16-1 and the reader is invited to consider how intermediate cases can be handled. An alternative approach is in terms of consumption externalities (as discussed in Lecture 14), and this has been developed by Samuelson (1969). In this case the purchase of good $i$ by household $h$ may enter the utility function of other individuals.

In both cases, we have a problem of defining what it is that is being consumed, and how it is to be measured. For instance, for television and radio broadcasts, the obvious unit to measure consumption is "programmes listened to". In this case, the first approach seems more natural. On the

other hand, if individuals privately purchase protective services (e.g., police guards), utility may be a function of the level of "safety" in the community, which may be a function of the aggregate expenditure on protective services, as well as on the private level of protection. Individuals, in providing protection for themselves (and thus lowering the return to crime), are providing a public good (safety), and the consumption externalities representation seems natural. This problem can however be reformulated in terms of our first approach, although one must be careful how this is done. For instance, if $P$ represents the total number of policemen available, and $P^h$ represents the number of policemen assigned to ("consumed by") the household $h$, then $\Sigma_h P^h = P$, and police appear to be a private good, yielding consumption externalities. If however what is consumed (negatively) is the expected number of crimes suffered by household $h$, denoted by $C^h$, then we have a consumption possibilities curve

$$\chi(C^1, \ldots, C^h, \ldots, C_1^H; P) = 0 \tag{16-4}$$

where an increase in the number of policemen reduces the crimes committed.

The third set of reasons for public provision relates to distributional objectives. This may stem either from a general distributional goal, for example embodied in a social welfare function, or from principles of specific egalitarianism as discussed in Lecture 11. Thus, distributional reasons are probably the primary rationale for the public provision of education—either because it reduces inequality of endowments, or because access to at least a minimum level of education is an objective in itself. This may be put another way. As in earlier Lectures, we may derive for each commodity an optimal nonlinear price function. For certain goods, that function may have the characteristic that no price is charged for consumption below a specified minimum.

We have tried to bring out some of the features that characterize goods that may be publicly provided. In determining whether or not they are supplied in this way, the various factors are likely to be of differing importance. In Table 16-1 we have listed some of the goods that are commonly, but not necessarily universally, publicly provided. In each case, one can ask whether exclusion is feasible (at reasonable cost), what are the properties of demand, what are the costs of supplying to the individual, and whether there are likely to be distributional arguments. For the first six, we have suggested our own judgement; the reader may like to consider how far he agrees, and to complete the remainder.

In what follows, we concentrate particularly on the cases that are at the extreme ends of the spectrum for the cost of individual supply. In Sections 16-2 and 16-3, we consider the provision of pure public goods; in 16-4 we take the opposite extreme of publicly provided private goods. These sections are concerned with the arguments regarding the optimum level of

**Table 16-1 Characteristics of publicly supplied goods**

| | Costly exclusion ? | Demand irresponsive ? | Low cost of individual supply ? | Distributional arguments ? |
|---|---|---|---|---|
| National defence | Yes | Yes | Yes | |
| Roads and bridges | Yes | | Yes ? | |
| TV and radio | Yes ? | | Yes | |
| Education | | | | Yes |
| Water | | Yes | | Yes ? |
| Police | Yes | | Yes | Yes |
| Medical care | | | | |
| Fire protection | | | | |
| Legal system—criminal cases | | | | |
| —civil cases | | | | |
| Sewerage and rubbish | | | | |
| National parks | | | | |

provision, and—in the case of publicly provided private goods—its allocation among individuals, on the assumption that the government has full information about individual preferences and endowments. The actual procedures by which public spending decisions may be effected, and preferences revealed, are the subject of Sections 16-5 and 16-6.

## 16-2 OPTIMUM PROVISION OF PURE PUBLIC GOODS—EFFICIENCY

In this section we consider the optimum level of provision of a single, pure public good, consumed in quantity $G$ by everyone. There is an aggregate production relationship:

$$F(\mathbf{X}, G) = 0 \tag{16-5}$$

where $\mathbf{X}$ denotes the vector of total private good production.

### First-Best Allocation

The government of a fully controlled economy is assumed to choose the level of $G$, and the allocation of private goods $\mathbf{X}^h$ to household $h$ (where $h = 1, \ldots, H$) to maximize an individualistic social welfare function.[2] If the

[2] The modern general equilibrium treatment of the optimum provision of public goods dates from Samuelson (1954); he has returned to the subject in Samuelson (1955, 1958b, 1969).

individual utility function is $U^h(\mathbf{X}^h, G)$, then the social welfare function may be written as

$$\Psi[U^1, \ldots, U^h, \ldots, U^H] \tag{16-6}$$

where $\Psi$ is assumed to be a twice differentiable, concave function and to be increasing in all arguments. If we form the Lagrangean

$$\mathscr{L} = \Psi - \lambda F(\mathbf{X}, G) \tag{16-7}$$

the first-order conditions are

$$\frac{\partial \mathscr{L}}{\partial X_i^h} = \Psi_h U_i^h - \lambda F_i = 0 \quad \text{for all } i, h \tag{16-8a}$$

$$\frac{\partial \mathscr{L}}{\partial G} = \sum_h \Psi_h U_G^h - \lambda F_G = 0 \tag{16-8b}$$

The condition (16-8a) yields the standard first-best welfare conditions (equality of marginal rates of substitution and transformation). The new condition is (16-8b).

From (16-8a) we can see that $\Psi_h U_i^h = \lambda F_i$ (i.e., the left-hand side is the same for all $h$). We can then divide the $h$th term in the sum on the left-hand side of (16-8b) by $\Psi_h U_i^h$, giving

$$\sum_h (U_G^h / U_i^h) = F_G / F_i \quad \text{for all } i \tag{16-9}$$

This is the basic condition for the optimum supply of public goods: *the sum of the marginal rates of substitution* between the public good (and some private good) must equal the marginal rate of transformation ($\Sigma MRS = MRT$). There is a clear intuitive interpretation of these conditions for a full optimum. The marginal benefit of an extra unit of a public good is the benefit that person 1 gets, plus the benefit that person 2 gets, etc. In contrast, an extra unit of a private good is *either* given to person 1 *or* given to person 2.

The solution may be illustrated diagrammatically for the case where there are two individuals and two goods ($X$ = private good, $G$ = pure public good). Figure 16-2 shows in the upper part the indifference curves for citizen I and the production constraint $AB$. Suppose we fix citizen I on the indifference curve $U^I$. The possibilities for citizen II are shown in the lower part of Fig. 16-2 by $CD$ (the difference between $AB$ and $U^I$). Clearly, Pareto efficiency requires the marginal rate of substitution of the second individual be equal to the slope of the curve $CD$ (i.e., at point $E$). But this is just the difference between the marginal rate of transformation (the slope of the production possibilities schedule) and the marginal rate of substitution of the first individual (the slope of his indifference curve). Thus, we have

$$MRS^{II} = MRT - MRS^I$$

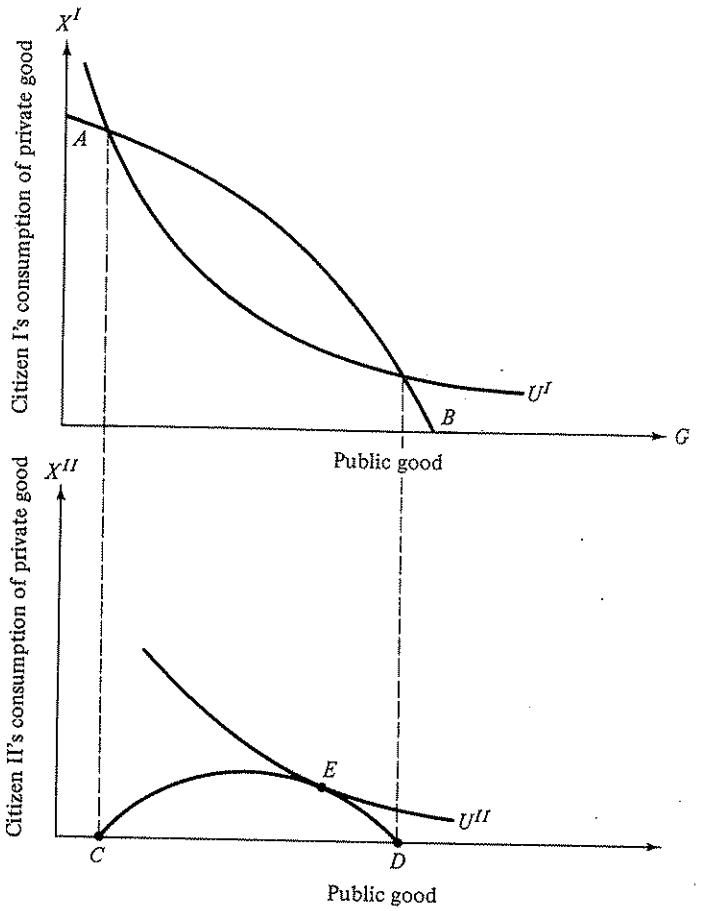


**Figure 16-2** Optimum provision of public goods—two-person example.

i.e.,

$$MRS^I + MRS^{II} = MRT$$

the sum of the marginal rates of substitution must equal the marginal rate of transformation.[3]

[3] As recognized by Samuelson (1954), his treatment was a general equilibrium version of the earlier partial equilibrium analysis of Lindahl (1919) and Bowen (1943). In that case, the "total demand" is found by adding up the demand curves; but unlike private goods, where we add horizontally (the total demand at a given price), for public goods we add vertically (the total amount that all individuals are willing to pay for the given amount of the public good).

The analysis so far has been conducted in terms of a fully controlled economy. It is however equivalent to the situation in a competitive economy where the government is able to levy first-best lump-sum taxes, both to finance the expenditure and to redistribute income. As in earlier Lectures, we need to ask what happens when first-best taxation is not possible. In the remainder of this section, we consider the efficiency aspects, taking for this purpose the case where individuals are all identical; in the next section, we take up the issue of redistribution.

## Financing of Public Goods by Distortionary Taxation

When the public expenditure is financed by taxes that generate an excess burden, it appears likely on intuitive grounds that the rule of equating $\Sigma MRS$ with $MRT$ will lead to too high a level of spending. As it was put by Pigou,

> The raising of an additional £ of revenue... inflicts indirect damage on the taxpayers as a body over and above the loss they suffer in actual money payment. Where there is indirect damage, it ought to be added to the direct loss of satisfaction involved in the withdrawal of the marginal unit of resources by taxation, before this is balanced against the satisfaction yielded by the marginal expenditure. [Pigou, 1947, pp. 33–4]

Pigou's intuitive argument is not, however, necessarily correct.

In order to explore this, let us take the case of two private goods—consumption ($X$) and labour ($L$)—and one public good. We take leisure (=minus labour) as the *numeraire*, and denote the producer price of the consumption good by $p$, that of the public good by $p_G$. For convenience, we assume a linear production constraint:

$$p\sum_h X^h + p_G G = \sum_h L^h \tag{16-10}$$

If all individuals are identical, and are treated identically, this can be written

$$pHX + p_G G = HL \tag{16-11}$$

(where $X, L$ now denote the *individual* level of consumption).

In order to examine the effect of different methods of financing, we assume that the public good is financed partly by a uniform lump-sum tax $T$ on all individuals and partly by a specific tax at rate $t$ on the consumption good. The individual budget constraint is therefore (there is no profit income)

$$(p+t)X = L - T \tag{16-12}$$

and the first-order conditions for individual utility maximization,

$$U_X = \alpha(p+t) \tag{16-13a}$$

$$(-U_L) = \alpha \tag{16-13b}$$

where $\alpha$ denotes the private marginal utility of income. From these we can derive the individual demand and labour supply functions of $p$, $t$, $T$, and $G$.

The government aims to maximize welfare measured by $HU$, subject to the production constraint. The Lagrangean can therefore be written:

$$\mathscr{L} = HU(X, L, G) - \lambda(pHX + p_G G - HL) \tag{16-14}$$

The necessary conditions for optimality involve

$$\frac{\partial \mathscr{L}}{\partial G} = HU_G - \lambda\left(pH\frac{\partial X}{\partial G} + p_G - H\frac{\partial L}{\partial G}\right) = 0 \tag{16-15}$$

From this it follows that government expenditure should be carried to the point where:[4]

$$\frac{HU_G}{\alpha} = \frac{\lambda}{\alpha}\left(p_G - tH\frac{\partial X}{\partial G}\right) \tag{16-16}$$

The left-hand side represents the sum of the marginal rates of substitution between $G$ and the *numeraire* good (leisure), while on the right-hand side $p_G$ corresponds to the marginal rate of transformation.

From this expression we can see that the existence of indirect taxes modifies the conventional $\Sigma MRS = MRT$ formula in two ways:

1. To the extent that an increase in $G$ leads to an increase in the consumption of taxed goods ($\partial X/\partial G > 0$), this reduces the revenue to be raised (through the term $tH(\partial X/\partial G)$). The right-hand side is therefore lower than with the conventional formula, or vice-versa if $\partial X/\partial G < 0$. If, for example, the provision of a further television channel increases the demand for television sets, and these are subject to an indirect tax, it may be socially optimal to carry provision to a point where the sum of the marginal rates of substitution is less than the marginal rate of transformation, even though the expenditure has to be financed by distortionary taxation.
2. The conventional formula is based on the assumption that raising \$1 extra revenue would have a social cost equal to the marginal utility of income. However, where there are non-lump-sum taxes this is no longer true. The social cost of raising \$1 ($\lambda$) may in fact be greater or less than the private marginal utility of income ($\alpha$).

The intuition behind these results is that the government wishes to set the sum of the marginal rates of substitution equal to the marginal *economic* rate of transformation (as in earlier Lectures). With taxes that are not lump-sum, the marginal economic rate of transformation is in general

[4] Using the fact that $(p+t)\partial X/\partial G = \partial L/\partial G$ obtained from differentiating the individual budget constraint (16-12).

different from the marginal physical rate of transformation. The difference arises from the fact that, when there is distortionary taxation, the changes in taxes required to raise the extra revenue to finance the addition to public expenditure affect the deadweight loss (Stiglitz and Dasgupta, 1971). The relationship between $\lambda$ and $\alpha$ may be seen from the condition for the choice of $t$:

$$\frac{\partial \mathscr{L}}{\partial t} = H\frac{\partial U}{\partial t} - \lambda\left(pH\frac{\partial X}{\partial t} - H\frac{\partial L}{\partial t}\right) = 0 \tag{16-17}$$

Using the fact that $\partial U/\partial t = -\alpha X$, we obtain

$$\alpha X = -\lambda\left(p\frac{\partial X}{\partial t} - \frac{\partial L}{\partial t}\right) = \lambda\left(X + t\frac{\partial X}{\partial t}\right) \equiv \lambda\frac{\partial R}{\partial t} \tag{16-18}$$

(the second step following from differentiating the individual budget constraint). Where $t \neq 0$, we have to allow for the effect on revenue ($R$) of the change in $X$. Substituting into (16-16), we obtain

$$\Sigma MRS = \frac{p_G - tH(\partial X/\partial G)}{1 + (t/X)(\partial X/\partial t)} \tag{16-19}$$

**Exercise 16-1** Carry out the same analysis where there is a tax on wage income and no indirect tax. What differences are there in the results and how can they be explained? (See Atkinson and Stern, 1974.)

## Comparison with Lump-sum Taxation

The analysis so far has considered the effect of non-lump-sum taxation on the $\Sigma MRS = MRT$ *rule*; it is important to emphasize that the results do not tell us anything about the optimum *level* of provision for public goods—whether the optimum provision in the case of distortionary taxation is larger or smaller than where lump-sum taxation can be employed. One cannot in general make deductions from the first-order conditions about the behaviour of the optimum quantities—a point that is often confused. (For example, the form of the first-order conditions depends on the choice of the untaxed good, but this has no implications for the optimum level of $G$.)

In order to investigate how the optimal quantity of the public good may be affected by the method of financing, we assume that the utility function is additively separable between "private utility" $u(X, L)$, and the public good:

$$U = u(X, L) + g(G) \tag{16-20}$$

where $g' > 0$, $g'' < 0$ and $u$ is strictly concave. The government constraint is

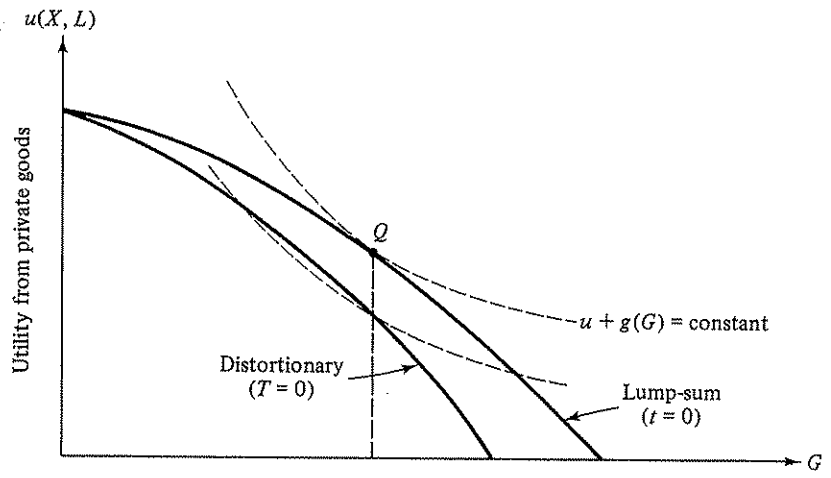


**Figure 16-3** Provision of public goods with distortionary taxation.

given by:[5]

$$H(tX+T) = p_G G \tag{16-21}$$

In the case $t = 0$ (lump-sum financing), we can trace out the transformation curve between $u(X, L)$ and $G$, with slope given by $-\alpha p_G/H$ (see Fig. 16-3).[6] The optimum level of provision is found by maximizing the welfare of a representative individual, which with contours as shown in Fig. 16-3 gives the point $Q$. The concavity of $u$ implies that $\alpha$ is a declining function of lump-sum income, and hence that the frontier is concave to the origin.

Let us now consider the case of the indirect tax, with $T = 0$. The level of private utility is given by

$$u^{**}(G) = \max_L u\left(\frac{L}{p+t}, L\right) \tag{16-22}$$

and the government budget constraint

$$HtX = p_G G \tag{16-23}$$

[5] This can be obtained by summing the individual budget constraints $(p+t)HX = HL - HT$ and subtracting the aggregate production constraint (16-11).

[6] Define

$$u^*(G) = \max_L u[(L - p_G G/H)/p, L]$$

then

$$\frac{du^*}{dG} = -\alpha p_G/H$$

The slope of the transformation frontier is therefore

$$\frac{du^{**}}{dG} = \frac{-Xu_X}{p+t}\frac{dt}{dG} = -\alpha\left(\frac{p_G}{H}\right)\frac{1}{1+(d\log X/d\log t)} \qquad (16\text{-}24)$$

This frontier is illustrated by the curve nearer the origin in Fig. 16-3, although it should be noted that there is no necessary reason why it should be concave.

Optimality again requires a tangency between the social welfare function and the transformation curve. The slope of the social welfare function is $-g'$ and is a function simply of $G$. If the distortionary tax transformation curve is steeper than the no-distortionary tax transformation curve, then this implies that at the level of $G$ that was optimal with lump-sum taxation, the distortionary transformation curve cuts the indifference curve from below; i.e., optimality requires a smaller level of production of public goods. This situation is illustrated in Fig. 16-3. However, while "on average" the distortionary curve is steeper, and hence there may be a presumption that expenditure will be reduced, it is not necessarily so and global results cannot be deduced. At the same time, sufficient conditions can be given for the level of $G$ with indirect taxation to be lower than that with lump-sum taxation, for example, for small levels of $t$ and $G$. (N.B.: the transformation frontiers have identical slope at $G = 0$.) It is also possible to establish that a small reduction in the possibilities for lump-sum taxation from the first-best optimum ($t = 0$) leads to a fall in the optimum quantity of the public good (Atkinson and Stern, 1974, p. 124).

**Exercise 16-2** For the Cobb–Douglas utility function

$$u(X,L) = a\log X + (1-a)\log(1-L) \qquad (16\text{-}25)$$

describe the transformation frontiers with $t = 0$ and $T = 0$. What conclusions can be drawn about the optimum quantity of $G$ in the two situations?

## 16-3 OPTIMUM PROVISION OF PURE PUBLIC GOODS—DISTRIBUTION

In this section we examine how the conditions for the optimum supply of public goods are influenced by distributional considerations, paying particular attention to situations in which there are restrictions on the set of feasible taxes.

### Redistribution and Non-Distortionary Taxation

In the previous section we derived the first-best allocation rule $\Sigma MRS = MRT$, where the optimum could be attained by the use of lump-

spending than the voting equilibrium where the government has no distributional preferences. What difference does it make if the public good is financed by a proportional tax on income? (See Stiglitz, 1974a.)

The analysis just given should be treated simply as a counter-example to the proposition that majority voting leads to a level of government spending that is below (conversely above) the social optimum. The example shows that there is no presumption either way. In order to reach more positive conclusions, it is necessary to specify more fully the political machinery and procedures lying behind public spending decisions. This would need to take account of the conditions that ensure a determinate outcome, and the role played by legislators and bureaucrats in addition to that of voters.

## Lindahl Equilibrium

The inefficiency of the Nash equilibrium arises because each consumer is faced with a price equal to that of the public good, whereas some of the benefit accrues to others. By analogy with the case of consumption externalities, we can seek therefore a set of corrective subsidies, which will in general have to vary across individuals—we need "personalized" prices. This procedure was discussed by Samuelson (1969) as a "pseudo-demand algorithm" to calculate the optimal level of public goods supply, but was proposed as an actual allocation process by Lindahl (1919).

The essence of the Lindahl procedure is that individuals "demand" a total quantity of public goods on the basis of a specified distribution of the tax burden (see Johansen, 1965, Ch. 6). Thus each individual faces a tax *share* $\tau^h$ of the expenditure, where $\Sigma_h \tau^h = 1$, and these tax shares perform the function of personalized prices, referred to as "Lindahl prices". An equilibrium is a set of Lindahl prices such that at those prices everyone demands the same level of each public good. In the case of a single public and a single private good, individual $h$ maximizes

$$U^h(M^h - \tau^h p_G G, G) \tag{16-63}$$

so that the first-order condition is

$$MRS^h = \frac{U^h_G}{U^h_X} = \tau^h p_G \tag{16-64}$$

Summing over $h$, we obtain

$$\sum_h MRS^h = p_G \sum_h \tau^h = p_G \tag{16-65}$$

The Lindahl equilibrium satisfies the necessary condition for a Pareto-efficient supply of public goods in a full optimum.

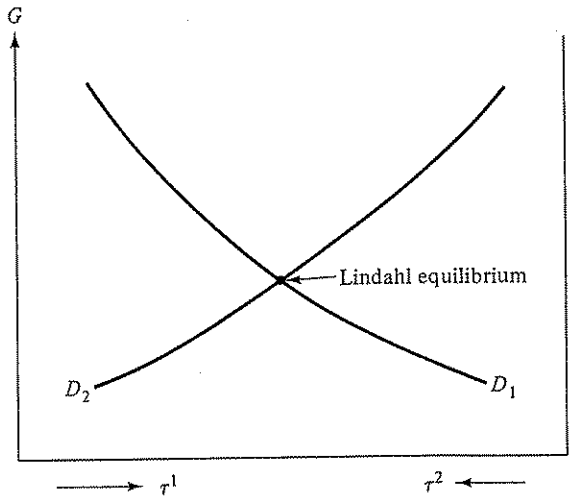


**Figure 16-5** Lindahl equilibrium: two-person example.

The Lindahl equilibrium is illustrated in Fig. 16-5 for the case where there are two (types of) individuals. The share of the first is denoted by $\tau^1$ and the demand is shown by $D_1$; the share of the second is given by $1-\tau^1$ and the demand is shown by $D_2$. The intersection is the Lindahl equilibrium.

The general properties of the Lindahl equilibrium have been extensively discussed in the literature. These include the Pareto efficiency referred to above, and the converse of this result that, under certain conditions, every Pareto-efficient allocation can be generated by a Lindahl equilibrium with suitable lump-sum taxes and transfers.[12] A particular question that has received considerable attention is the relationship between Lindahl equilibria and the *core*. An allocation (of goods among individuals) is said to be in the core if no coalition of individuals can together propose an alternative allocation of its *own* resources that makes at least one member better off and no member worse off—they cannot in this sense improve upon the allocation.[13] For a two-good, two-person economy, the core is simply the set of Pareto-efficient points that represent an improvement for both individuals over their no-trade position. It is shown, in the standard

[12] On this, see, for example, Foley (1970). For discussion of the existence of Lindahl equilibria, see Milleron (1972) and Roberts (1974b). Reference should also be made to the planning procedures for public goods, such as those proposed by Malinvaud (1971a, 1971b) and Drèze and de la Vallée Poussin (1971). A useful survey of work in this area is contained in Tulkens (1978).

[13] The reader should note that we have read Shapley (1973) and have resolved not to use the term "blocking".

Edgeworth box diagram, by the points on the contract curve between the indifference curves through the initial endowment.

In an exchange economy with no public goods, complete markets and full information, there are two basic theorems concerning the relationship between the core and the competitive economy:

1. the competitive economy is contained in the core;
2. the core "shrinks" to the competitive economy as the number of traders increases.

The first proposition is trivial. Since the competitive economy represents an improvement for all individuals (or at least no decrease in welfare) relative to the no-trade point, and since the competitive economy is Pareto-efficient, it is clearly contained in the core. The second proposition may be illustrated as follows. Suppose that there are two types of individual, but a large number of each type. The first step is to show that any allocation in the core must be symmetric; i.e., everyone of the same type gets the same consumption bundle.[14] The second step is to show that, if we can replicate the economy by any arbitrary factor, then the only possible core allocations are the competitive equilibria. For this, we need only to consider points on the contract curve. Suppose that we consider a point such as $Q$ in Fig. 16-6, which is not a competitive equilibrium. A line from the initial endowment point to $Q$ intersects at least one of the indifference curves through $Q$, and there exist points such as $P$ where advantageous trades can be made. A group consisting of individuals of type I and II in appropriate ratio can improve on the allocation at $Q$, and replication ensures that this is feasible (with integral numbers of individuals).

When we introduce public goods, the natural parallel results would be for the Lindahl equilibrium to belong to the core, and for the core to shrink to the set of Lindahl equilibria as the number of traders increases. The latter would be particularly significant, since

> one could then argue that, no matter by what system [public] goods actually are allocated, if... we assume that trade and production will take place among agents as long as it is advantageous, then any allocation that actually arose could have been achieved by the Lindahl price mechanism. [Roberts, 1974b, p. 38]

However, although the first result—that any Lindahl equilibrium is in the core—can be demonstrated under certain conditions (Milleron, 1972), the second result does not hold. For instance, Muench (1972) gives an example where the Lindahl equilibrium is unique but the core is very large (see also Milleron, 1972). The reason for this can be seen to lie in the requirement

[14] If not, the "underdogs" can form a coalition. For an exposition, see Hildenbrand and Kirman (1976, Ch. 1) or Varian (1978, p. 181–2).

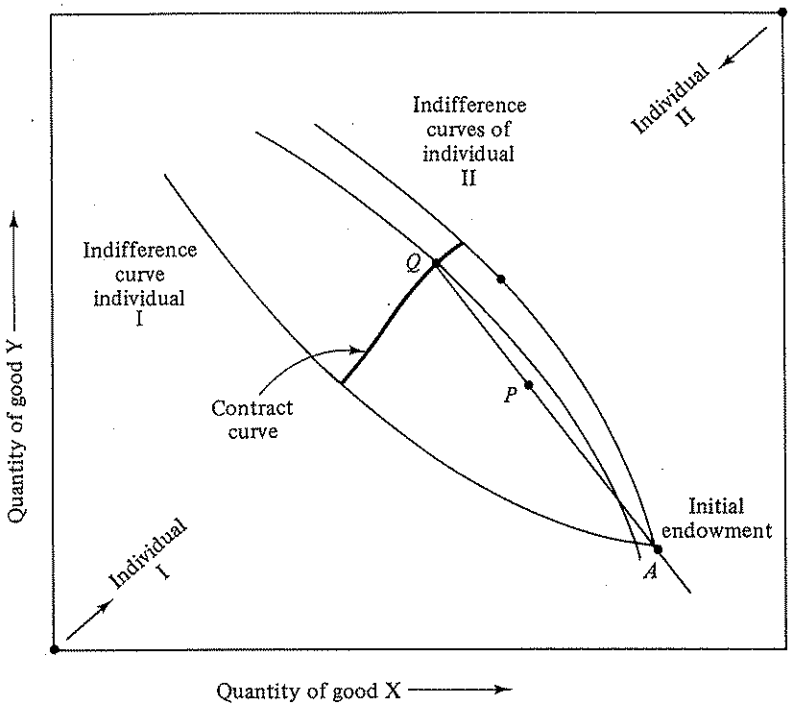


**Figure 16-6** Competitive equilibrium and the core.

that the coalition must be able to make its members better off irrespective of the actions of the remaining group. In the context of public goods, this means that they must be better off even if the remaining individuals decide to produce *no* public goods. It thus becomes difficult for small groups to improve upon the proposed allocation; the core of the economy is likely to be bigger.[15]

Since much of the appeal of the concept of a Lindahl equilibrium stems from the parallel with competitive equilibrium, the results just described reduce the strength of the claims that can be made. We must therefore reconsider either the concept of the core as applied to a public goods economy, or the status of the Lindahl equilibrium. In any event the Lindahl equilibrium is probably best regarded as an analytical benchmark.

[15] The assumption that the cost of the public good is totally independent of the size of the economy may be questioned. For discussion of the question of "returns to group size", and "semi-public goods", see Roberts (1974b).

## 16-6 REVELATION OF PREFERENCES

Throughout the previous sections, we have assumed that the government knows the preferences of individuals (in the analysis of optimum provision of public goods) or (in the voting model) that individuals vote for their "true" preferences. This raises two closely related questions: how can the government learn the preferences of consumers, and how can we be sure that in any actual procedure for determining the provision of public goods, individuals will behave "honestly"? If we start from a presumption that individuals reveal the truth, unless it is in their interest not so to do, then this means examining the incentives for lying or for providing the government with false information.

That the demand for public goods may provide people with such incentives has been recognized for a long time. If the amount an individual has to pay for the public good is related in some way to his "revealed preference", then he has an incentive to understate his demand. As Samuelson expressed it in his classic paper, "it is in the selfish interest of each person to give *false* signals, to pretend to have less interest in a given collective consumption activity than he really has" (1954, pp. 888–9). This is sometimes referred to as the "free-rider problem"; and it arises in a variety of contexts apart from public goods. Unions claim that the reason that all individuals should be required to contribute dues is that there exists a free-rider problem. They provide a collective good (negotiating better terms with the management); and any individual disclaiming interest in the good has the advantage of enjoying the benefit without paying the cost. The general problem is the same as that of incentive compatibility in a (finite) competitive private economy, to which we referred in Lecture 11. In that case, the incentive for individuals to misrepresent their preferences disappears as the economy becomes "large". For public goods, however, the incentives do not improve as the number of people increases (see Roberts, 1976); and in this respect there is indeed a contrast between the allocation of public and private goods.[16]

### Mechanisms for the Revelation of Preferences

A general class of mechanisms can be described as follows. The $h$th individual is asked to report a valuation of public goods, $z^h(G)$. The government announces that the tax shares of the $h$th individual and the

[16] The problem of incentive compatibility may arise quite widely where there is government intervention in the economy. For example, we have seen in Lecture 13 that the first-best redistributive tax may involve utility being a declining function of ability, and that this would give people an incentive to misrepresent their ability.

supply of public goods will be a function of all statements according to some rule:

$$\tau^h = \Gamma^h(\mathbf{z}(G))$$
$$G = \gamma(\mathbf{z}(G)) \tag{16-66}$$

In designing the mechanism, the government may seek to secure properties such as the following:

1. The Nash equilibrium (where everyone takes the announcements of others as given) is Pareto-efficient where each person chooses his announcement to maximize his own welfare.
2. In the Nash equilibrium, everyone reports truthfully their valuation of public goods (for Pareto efficiency this is not necessary; all that is required is that the government can "translate" the announced valuations).
3. Truthful reporting is a dominant strategy (that is, it pays each individual to report $z^h(G)$ accurately regardless of the announcements of others).

There have been a number of attempts to devise mechanisms that have some or all of these properties. The earliest of these mechanisms was that of Vickrey (1961), who developed a procedure for a public marketing agency faced by monopolistic buyers and sellers. He showed that it would be possible to motivate individuals to give correct information by paying them the net increase in the sum of producer and consumer surpluses *of the other persons in the market* that resulted from the supply or demand curve revealed. This procedure was then independently discovered and developed by Clarke (1971, 1972) and Groves (1970, 1973; Groves and Loeb, 1975). (See also the discussion of elicitation functions in Kurz, 1974.)

The procedure may be described in a partial equilibrium model where utility functions are of the form

$$U^h = g^h(G) + M^h \tag{16-67}$$

It is assumed that lump-sum transfers of income $M^h$ can be made freely. The stated valuation function of individual $h$ (note that it is a *function* and not simply a single value) is $z^h(G)$. The level of public provision, $G^*$, is chosen to maximize $\Sigma_h z^h - p_G G$, and individuals are taxed in a lump-sum way according to the schedule

$$p_G G^* - \sum_{i \neq h} z^i(G^*) + \kappa^h(\mathbf{z}^{-\mathbf{h}}) \tag{16-68}$$

where the last term is an arbitrary function of the vector $\mathbf{z}$, excluding $z^h$. The level of individual utility is

$$U = g^h(G^*) - z^h(G^*) + \sum_i z^i - p_G G^* - \kappa^h \tag{16-69}$$

With this procedure, the dominant strategy is for each person to reveal the true marginal valuation. To see this, suppose that his response is a function of $G$ and some variable $\zeta$ (so that we can think of his answer as being represented by the choice of $\zeta$). A variation in $\zeta$ has no direct effect on $U$ (since the terms in $z^h$ in (16-69) cancel); it has an indirect effect via $dG^*/d\zeta$. By the conditions determining the choice of $G^*$, this has no effect on the underlined term in (16-69), and the variation is therefore proportional to $g^h_G - z^h_G$. With the optimal choice of $\zeta$, this is zero, so $z^h(G)$ must equal $g^h(G)$ up to the addition of a constant.[17]

This preference revelation mechanism has therefore certain attractive properties, and Green and Laffont (1977a) have shown that this is the only class of mechanisms such that stating one's true preferences is a dominant strategy and that the outcome is Pareto-efficient. It is however limited, both by the assumptions made and by the fact that the mechanism does not guarantee a balanced budget for the government (on this, see Groves and Ledyard, 1977). It does not allow for collusion between individuals, and *coalition* incentive compatibility raises further issues (see Green and Laffont, 1979). Finally, no equity considerations are allowed for.

## Empirical Significance of Free-Riding

Preference revelation and incentive compatibility is an active area of research. This is undoubtedly a valuable antidote to much of the earlier literature, which, with exceptions such as Samuelson (1954) and Buchanan (1968), has tended to ignore the problem—as in previous sections of this Lecture. On the other hand, there are those who argue that there is little evidence to suggest that the problem of correct revelation of preference has been of empirical significance:

> we have a lot of public goods around, probably more than we would expect on the basis of the theory of the free-rider tendency... and there are also many groups and individuals around who by no means appear to conceal their preferences for public goods. [Johansen, 1977, p. 148]

There are two principal reasons for questioning the importance of the free-rider problem. The first is that honesty may itself be a social norm, rather than simply the outcome of maximizing utility:

> economic theory, in this as well as in some other fields, tends to suggest that people are honest only to the extent that they have economic incentives for being so... the assumption can hardly be true in its most extreme form. [Johansen, 1977, p. 148]

[17] The Clarke procedure has a rather simpler form with the arbitrary functions $\kappa^h$ being replaced by the valuation of public goods to the remaining $H-1$ people, at a level $G^{**}$ chosen to maximize $\Sigma_{i\neq h} z^i(G) - p_G G$. See Tideman and Tullock (1976).

In societies where honesty is a social norm, one would not expect misrepresentation of preferences unless the pay-off to dishonesty reaches a threshold level. Where there is uncertainty about the pay-offs, individuals may feel that the choice of strategy is too complicated or time-consuming and resort to telling the truth: "since I cannot find a way to beat the system, I had just as well tell the truth" (Bohm, 1971, p. 56). The second reason why the revelation of preferences may be less important is that the decision is not made directly by individuals but typically through elected representatives. Johansen argues that in this case misrepresentation is unlikely to pay, either in terms of electoral success or in terms of decisions made by legislative assemblies. This brings us back to some of the issues discussed in Lecture 10.

There have in fact been experimental studies of individual preference revelation under different incentive schemes. For example, Bohm (1972) carried out an experiment at the Swedish Radio-TV Company, where 211 people were asked to express their willingness to pay to see a new programme, not yet shown to the public. They were paid on arrival 50 Kr (approximately $1,0) for taking part, and then asked to specify how much they would contribute to see the programme under a specified payments structure. They were told that the programme would be shown if the total sum stated exceeded the costs (500 Kr). The main results are set out in Table 16-2. Although there are some differences in the means and medians between the different incentive schemes, none of the differences are significant at the 5 per cent level. This experiment is clearly on a small scale, and intended more to assess the feasibility of the method, but it is none the less interesting that so little difference emerges.

**Table 16-2 Experimental evidence on willingness to pay**

| Number of cases | Payment scheme | Amount willing to pay (Kr) Mean | Median |
|---|---|---|---|
| 23 | (I) The amount stated by respondent | 7.61 | 5 |
| 29 | (II) A percentage of the amount stated (so that total collected = total cost) | 8.84 | 7 |
| 29 | (III) One of four possibilities determined by a lottery (with equal probabilities)—designed to represent the case of "uncertainty" | 7.29 | 5 |
| 37 | (IV) Five Kr | 7.73 | 6.50 |
| 39 | (V) Nothing | 8.78 | 7 |

*Source:* Bohm (1972, p. 121).

## Decentralization and Information

The models employed in earlier sections assume that the government knows not only the preferences of the individuals, but also the production possibilities of all firms. In fact, the government does not have at its disposal all the requisite information, nor does it have the ability to solve all the problems of production and allocation simultaneously.

This is one of the main motivations for organizing governments in a decentralized manner, i.e., having branches responsible for different activities or functions. Thus, Musgrave's (1959) division of the branches of government into the stabilization, allocative and distribution branches may be thought of as more than just an analytical device. On the other hand, the sense in which the different branches can carry on their business separately from one another is not made clear in Musgrave (or in most of the subsequent literature), and the conditions under which various schemes of decentralization lead to a full optimum are not spelled out.

This may be illustrated by reference to the provision of public goods. Suppose first that lump-sum taxes may be freely used, and that public spending is decentralized to an agency that has a fixed budget and is instructed to maximize social welfare subject to the budget (public goods being charged for at the producer prices). The agency will then equate the $\Sigma MRS$ to $\lambda MRT$ where $\lambda$ is the multiplier associated with the budget constraint, and if $\lambda$ is chosen correctly the social optimum is reached. (We are ignoring here the problem of revelation of preferences.) Where, however, there are non-lump-sum taxes, we have to allow both for the fact that varying $G$ may affect government revenues and for the distributional effects of public goods. There is then a fundamental interdependence between decisions about the relative quantities supplied of various public goods and the structure of taxation for the finance of these goods. As a consequence, the marginal rate of substitution between two public goods is not in general equal at the optimum to their marginal rate of transformation (the ratio of the producer prices).[18] Moreover, the benefits for public goods need to be weighted according to the social marginal utility of income, and these weights depend on other aspects of distributional policy.

There is therefore a presumption that decentralization will entail certain costs, which have to be balanced against the administrative and informational advantages. The rigorous analysis of this problem, taking account of such factors as the motives of those who administer government programmes and of political power, is clearly a major task. In the next Lecture, we consider one particular form of decentralization—where individuals form local communities for the supply of local public goods.

[18] The conditions under which such decentralization remains possible despite the existence of non-lump-sum taxes has been examined by Lau, Sheshinski and Stiglitz (1978).

## READING

Key references on the optimal provision of public goods are the papers by Samuelson (1954, 1955, 1958b, 1969). A valuable survey of the area is provided by Milleron (1972). On the public provision of private goods, see Arrow (1971a) and the subsequent literature. The discussion of voting on public goods draws on Stiglitz (1974b). A useful review of dynamic processes for the provision of public goods is provided by Tulkens (1978). The revelation of preferences is dealt with in depth by Green and Laffont (1979), and the references contained therein.