

FIGURE 7.1 Individual's Choice of "Most Preferred" Level of Government Expenditures
 The individual's most preferred level of government expenditures occurs at the tangency between the budget constraint and the indifference curve. With proportional taxation, individuals with lower incomes face a lower tax price (flatter budget constraint), as shown in panel A. The income and substitution effects work in opposite directions, so that it is ambiguous whether the most preferred level of government expenditure is higher or lower. With uniform taxation, as shown in panel B, all individuals face the same tax price, so there is only an income effect. Rich individuals prefer higher levels of expenditure. (In this example, the rich and poor are assumed to have the same indifference curves (preferences); they differ only with respect to the budget constraints.)

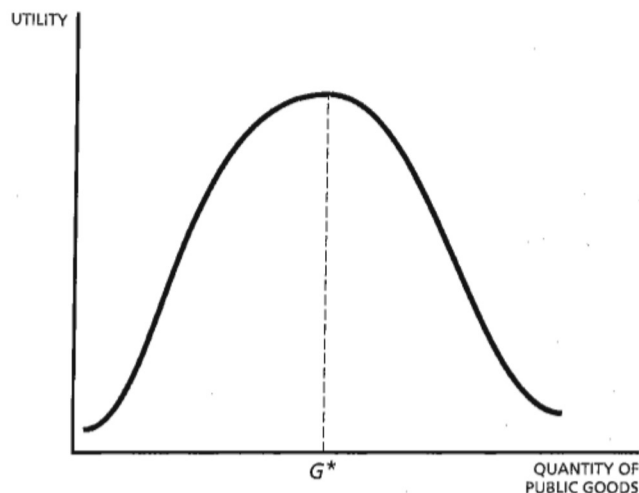


FIGURE 7.2 Utility Depends on Level of Government Expenditure Utility is maximized at the point of tangency between the indifference curve and the budget constraint. The further away the actual level of expenditures from the preferred level of expenditures, G^* , the lower the level of utility.

they demand less public as well as private goods. The net effect is ambiguous. Figure 7.1A illustrates the case where the substitution effect (lower tax price) dominates the income effect, and so the poorer individual does prefer a higher level of public goods than the richer person.

With uniform taxation, there is only an income effect, so high-income individuals will prefer higher levels of public expenditure (Figure 7.1B); with progressive income taxation, lower-income individuals will face a lower tax price than with proportional taxation, so their preferred level of expenditures will be even higher than with proportional taxation.

Figure 7.2 shows how utility depends on the level of government expenditures. The individual's most preferred level of expenditures occurs at G^* , but utility is maximized under a budget constraint, at the point of tangency with the indifference curve. The further away the actual level of expenditures is from the preferred level of expenditures, G^* , the lower the level of utility.

Figure 7.3 shows the relationship between the level of utility and the level of public goods expenditure for three different groups—the rich, the poor, and the “middle,” assuming a particular tax system. Each has its own preferred outcome, and utility decreases both as expenditures deviate above or below that level. For expenditures above, the marginal benefits of increased public expenditure are less than the marginal costs the individual bears in additional tax payments, while the converse holds for expenditures below the preferred level.

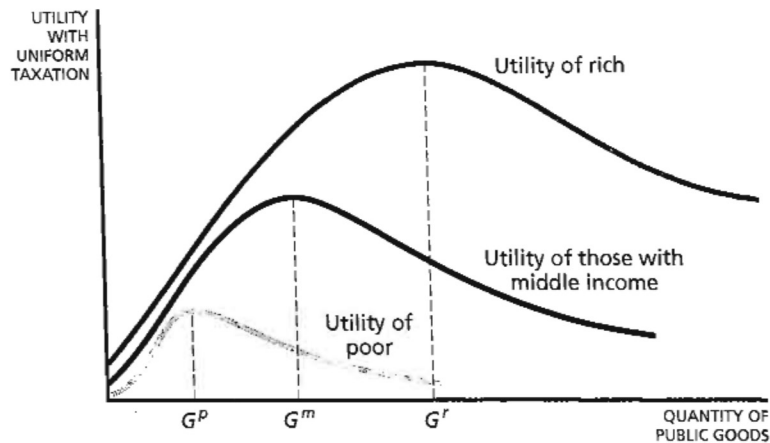


FIGURE 7.3 Utility as a Function of G . The figure reflects the preferences of three groups in the population, the poor, the middle class, and the rich. In this example, the rich prefer higher levels of expenditure to the middle class, who prefer higher levels than the poor.

THE PROBLEM OF AGGREGATING PREFERENCES

In the private market, the firm does not have to balance the claims and interests of one group against those of another. If an individual is willing to pay a price for the commodity that exceeds the marginal cost of production, it pays for the firm to sell the commodity to the individual. Decisions are made on an individual basis. In the public sector, on the other hand, decisions are made collectively—when a politician votes to increase expenditure on some public good, it is not as if he has to pay for the good himself. His vote is intended to represent the interests of his constituents, but their opinions are not likely to

CENTRAL PROBLEMS OF PUBLIC CHOICE

Preference Revelation:

- Ascertaining the desired level of public goods of each individual

Aggregating Preferences:

- Different individuals have different preferred levels of public expenditure.
- Preferred level depends both on individual's income and tax system.
- Other things being equal, rich typically prefer higher levels.
- But cost of increased public expenditure may be higher for rich.

be unanimous. Some individuals would like more military spending, others less. Some individuals would like more expenditures on welfare, others less.

The problem of reconciling differences arises whenever there must be a collective decision. Popular political discussions often refer to what “the people” want. But since different people want different things, how, out of these divergent views, can a social decision be made? In a dictatorship, the answer is easy: the dictator’s preferences dominate. But there is no such easy resolution in a democracy. A number of different voting rules have been suggested, among them unanimity voting, simple majority voting, and two-thirds majority voting. Of these, perhaps the most widely employed rule for decision making in a democracy is simple majority voting.

**MAJORITY VOTING AND
THE VOTING PARADOX**

We all know how majority voting works. Suppose you and two friends are trying to decide whether to go to a movie or a basketball game. You take a vote: if the movie gets two votes, you go to the movie; if the basketball game gets two votes, you go to the game. But sometimes majority voting does not lead to such a clear outcome when there are more than two alternatives. A majority voting equilibrium requires that there is one alternative which can win a majority in a contest against *any* alternative. As early as the eighteenth century, the famous French philosopher Condorcet noted that *there may not exist any majority voting equilibrium*. The problem may be seen in the following simple example, where there are three voters and three alternatives, denoted A, B, and C. A could be going to a movie, B to a basketball game, C renting a video; or A could be spending more money on health care for children, B reducing the deficit, C cutting taxes.

Voter 1 prefers A to B to C.

Voter 2 prefers C to A to B.

Voter 3 prefers B to C to A.

Assume we vote on A versus B. Voters 1 and 2 vote for A, so A wins. Now we vote on A versus C. Voters 2 and 3 prefer C to A, so C wins. It appears that C should be the social choice. C wins against A, which wins against B. But let us now have a direct confrontation between C and B. Both Voter 1 and Voter 3 prefer B to C. This is referred to as the **voting paradox**, or the paradox of cyclical voting. There is no clear winner. B beats C and C beats A but A beats B. Assume we began by saying we were going to first vote on B versus C, and put the winner against A. B beats C, and then A beats B. But just to check that we had made the right decision (A), we decide to put A against C. C beats A. So we think C is the winner. But then we check that by challenging C with B. B beats C—which was our original vote. B again appears to be the winner. But just to check, we again challenge it with A. A again beats B, as we knew from our earlier vote. The voting process goes on and on.

Often, to avoid these voting cycles, democracies organize their decision making as a sequence of votes, for instance, A against B, and the winner of that vote will be put against C, with the final determination depending on the outcome of that vote, with no further contests. In that case, it may be very important to control the agenda, the order in which the votes occur.

RANK-ORDER VOTING FAILS "INDEPENDENCE OF IRRELEVANT ALTERNATIVES"

John and Jim prefer a swimming pool to a library to a tennis court.

Tom prefers a tennis court to a swimming pool to a library.

Lucy and Jill prefer a tennis court to a swimming pool to a library.

Majority voting: Three prefer a tennis court to a swimming pool.

Three prefer a tennis court to a library.

Five prefer a swimming pool to a library.

TENNIS COURT WINS.

Rank order (lowest sum of ranks wins): Tennis nine; swimming pool eight; library thirteen.

SWIMMING POOL WINS.

Rank order in choice between tennis court and swimming pool (library not an option): Tennis seven; swimming pool eight.

TENNIS COURT WINS.

Adding "irrelevant choice"—library—alters outcome.

For instance, as just depicted, we know that A would defeat B, and C would defeat A, so C would be the decision. But suppose instead we structured the election as first a contest between B and C, and then the winner of that contest against A. A would win that election. Finally, suppose we structured the election as first a contest between A and C, and the winner of that election against B. Then clearly B would win. Thus the winner of each of these elections is determined solely by the order in which the pair-wise comparisons were made.

Note, too, that if individuals realize there is going to be a particular sequence of votes, they may wish to vote strategically. That is, in the first round of the vote, Voter 1 may not vote her true preferences on, say, A versus B, but think through the *consequences* of that for the eventual equilibrium. She may vote for B, even though she would prefer A, knowing that in a contest between C and B, B will win, while in a contest between A and C, C might win. Since she prefers B to C, she votes initially for B.

This analysis leads to two questions. First, are there voting rules that will ensure a determinate outcome for any vote? Second, are there any circumstances under which simple majority voting will yield a determinate outcome? We take up these two questions in the next two sections. It

**ARROW'S
IMPOSSIBILITY
THEOREM**

turns out that the voting paradox cannot be resolved through voting rules, but there are indeed circumstances in which majority voting yields clear decisions.

An endless cycle of voting is clearly an unsatisfactory state of affairs. It is natural to ask, then, whether there is any other political mechanism, any other set of rules for making social decisions, that eliminates this problem. An ideal political mechanism should have four characteristics:

1 *Transitivity*. If the rule shows that A is preferred to B, and B is preferred to C, then A should be preferred to C. As we have seen, simple majority voting lacks this essential property. Without this property, we can get into cyclical voting.

2 *Nondictatorial choice*. There is a simple way of avoiding voting cycles: give all decision-making powers to a dictator. As long as the dictator has consistent preferences, then there will never be a voting cycle. But in a democratic society, a meaningful political mechanism must ensure that the outcomes do not simply reflect the preferences of a single individual.

3 *Independence of irrelevant alternatives*. The outcome should be independent of irrelevant alternatives; that is, if we have to make a choice between, say, a swimming pool and a tennis court, the outcome should not depend on whether there is a third alternative (such as a new library).

4 *Unrestricted domain*. The mechanism must work no matter what the set of preferences and no matter what the range of alternatives over which choices are to be made.

In looking for a system that would satisfy all four of these properties, a number of alternative rules were examined, but each fails one or more of the requirements. For instance, *rank-order voting* (in which individuals rank the alternatives, the ranks assigned by all individuals are added together, and the alternative with the lowest score wins) does not satisfy the “independence of irrelevant alternatives” criterion.

The quest for an ideal system came to an end with the findings of Nobel laureate Kenneth Arrow of Stanford. He showed that there was no rule that would satisfy all of the desired characteristics. This theorem is referred to as **Arrow's impossibility theorem**.³

Arrow's impossibility theorem has one further interesting and important implication. We often hear expressions such as: “The government seems to be acting in an inconsistent manner . . .,” or “Why doesn't the gov-

³ Kenneth Arrow, *Social Choice and Individual Values*, 2nd ed. (New York: Wiley, 1963).

ernment determine its priorities and then act upon them?" This language personifies the government, treats the government as if it were an individual. Language is important: although we all know that the government is not a single individual, speaking of it as if it were frequently leads us to think of it in such facile terms. We come to expect that government should act consistently like a rational individual. But Arrow's impossibility theorem suggests that, unless some individual is granted dictatorial powers, the government should not be expected to act with the same degree of consistency and rationality as an individual.

In the earlier example in which there was no majority voting equilibrium, we saw the importance of control of the agenda. We also saw that it can be beneficial for individuals to vote strategically, that is, to vote not according to their true preferences, but to take into account how the outcome of the current vote will affect the final outcome. Just as Arrow established that there does not exist any way of adding together the preferences of different individuals to satisfy all of the desired characteristics of a choice mechanism, it has been shown that there does not, in general, exist any voting system⁴ in which individuals will always vote their true preferences.

**SINGLE-PEAKED
PREFERENCES AND THE
EXISTENCE OF A
MAJORITY VOTING
EQUILIBRIUM**

Though Arrow's impossibility theorem shows that there is no voting rule which *always* satisfies the desirable properties of a social choice mechanism described earlier, there are some conditions under which the simple system of majority voting yields a determinate outcome.

Figure 7.3 showed the level of utility as a function of the level of expenditure on public goods. There, each individual has a single peak to his preference profile. This property of **single-peakedness** is enough to guarantee the existence of a majority voting equilibrium. Note that the peak need not be "interior" but may lie on the "end," so that preferences such as those in Figure 7.4A are also consistent with single-peakedness.

On the other hand, preferences such as those illustrated in Figure 7.4C are not consistent with single-peakedness. Both 0 and G_1 are (local) peaks. Unfortunately, such examples arise naturally in considering many public choice problems.

For instance, consider the problem of an individual's attitudes toward expenditures on public education. If the level of expenditure on public education is below a certain minimum level, a rich individual may prefer sending his children to private schools. If he does this, any increase in expenditure on public schools simply increases his taxes; he gets no direct benefits. Thus his utility decreases with government expenditures up to a critical level at which he decides to send his children to public school. For increases beyond that level, he derives some benefit. Of course, beyond some point,

⁴ A voting system is any set of voting rules by which a group of individuals tries to reach a decision—for instance, by dropping from consideration the alternative with the lowest number of votes or by giving individuals several votes and allowing them to assign as many as they like to each alternative.

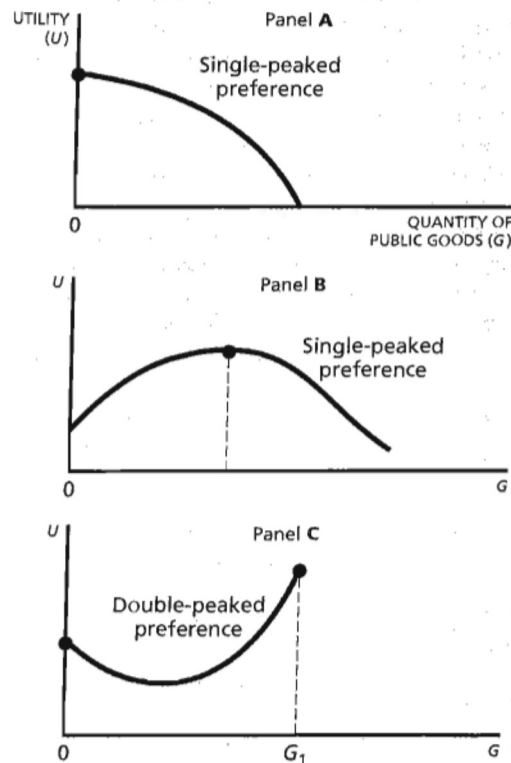


FIGURE 7.4 Single-Peaked and Double-Peaked Preferences With single-peaked preferences (panels A and B), there always exists a majority voting equilibrium. Without single-peakedness (panel C), there may not exist a majority voting equilibrium.

the increases in taxes more than offset the benefits. For this individual, a high level of expenditure is preferred to no expenditure, but no expenditure is preferred to an intermediate level of expenditure. There may be no majority voting equilibrium in this case.

Although preferences for a *single* public good (with no private good option, unlike education) are usually single-peaked, when we have to rank choices involving more than one public good, those rankings are seldom single-peaked.⁵ To obtain single-peakedness, we have to restrict ourselves to voting on one issue at a time.⁶

⁵ See G. Kramer, "On a Class of Equilibrium Conditions for Majority Rule," *Econometrica* 41 (1973): 285-97.

⁶ See S. Slutsky, "A Voting Model for the Allocation of Public Goods: Existence of an Equilibrium," *Journal of Economic Theory* 11 (1975): 292-304.

TABLE 7.1
Alternative Tax
Schedules

PAID IN TAXES	FRACTION OF INCOME		
	A	B	C
Poor	20%	18%	17%
Middle	20%	18%	21%
Rich	20%	23%	22%

Equally important, for most distribution issues there will not be a majority voting equilibrium.⁷ This can be seen most clearly in considering the structure of income taxation. Suppose we are voting between three income tax schedules that are designed to raise the same amount of revenue. For simplicity, we assume there are three groups of individuals with equal numbers: the poor, the middle class, and the rich—and that they vote in solid blocks. The three tax schedules are denoted as A, B, and C in Table 7.1. Tax schedule A is strictly proportional; it takes the same fraction of income from each individual. The poor and the middle class then get together and propose tax schedule B. This reduces the taxes they pay but taxes the rich much more heavily. Clearly, tax schedule B will win a majority over A. Now the rich propose to the poor: “Since you are more needy, why don’t we lower your taxes somewhat more; at the same time, we’ll adjust the tax schedule at the upper end, to reduce the inequities associated with excessive taxation.” Thus they propose tax schedule C, which, relative to B, lowers the taxes on low and high income and raises them on middle income, so that now both the middle- and upper-income individuals pay a larger proportion of their income in taxes than do the poor. Clearly, tax schedule C wins a majority over B. Now, however, the middle class proposes going back to straight proportional taxation. Since both the upper- and middle-income individuals prefer schedule A, A defeats C. We again get a cyclical pattern of voting.⁸

THE MEDIAN VOTER

When preferences are single-peaked, we asserted that there is a well-defined majority voting equilibrium. What does it look like? And how does it correspond to the *Pareto efficient* equilibrium that we described in the previous chapter?

⁷ See D. K. Foley, “Resource Allocation and the Public Sector,” *Yale Economic Essays* 7 (1967): 45–98.

⁸ If we restrict the set of tax schedules over which voting occurs to, for instance, tax schedules with an exemption level and a fixed marginal tax rate (these are called flat-rate tax schedules), there may be a majority voting equilibrium. See T. Romer, “Individual Welfare, Majority Voting, and the Properties of a Linear Income Tax,” *Journal of Public Economics* 4 (1975): 163–85.

TABLE 7.2
Preferred Levels
of Expenditure
on Public Goods

Lucy	Tom	Jim	John	Jill
\$600	\$800	\$1000	\$1200	\$1400
Jim is median voter				

When preferences are single-peaked, we can rank individuals by their preferred levels of, say, expenditure on the public good, from the individual who prefers the least to the individual who prefers the most. The *median* individual is the individual such that half prefer less and half prefer more than he does. In Table 7.2 Jim is the median voter. *The outcome of majority voting corresponds to the preferences of the median voter.* In this case, it is Jim's preferred level, \$1000, that wins. The reason is simple: if any level of expenditure below \$1000 is voted on against \$1000, Jim plus all of those who want more than \$1000 vote for \$1000; since Jim is the median voter, a majority cast their vote for \$1000. If any level of expenditure above \$1000 is voted on against \$1000, Jim and all of those who want less than \$1000 vote for \$1000. Again, \$1000 wins.

**THE INEFFICIENCY OF
THE MAJORITY VOTING
EQUILIBRIUM**

Since the median voter determines the level of expenditure on public goods, to ascertain whether there is too much or too little expenditure we need only examine how he votes, and contrast that with the conditions for efficiency discussed in Chapter 6. The median individual is assumed to compare only the benefits he receives with the costs that he bears. His benefits are lower than total social benefits (which includes all the benefits that accrue to others), but so are his costs. Whether there is too much or too little expenditure on public goods thus depends on whether his share of total (marginal) costs is less than or greater than his share of total (marginal) benefits.

For a wide variety of public goods, with proportional or progressive taxation majority voting will result in an oversupply of public goods. To see this, assume there are N individuals. With uniform taxation, the tax price for each individual would be $1/N$; with proportional taxation, it would be $Y_m/\bar{Y}N$, where Y_m is the income of the median voter and \bar{Y} is average income; and with progressive taxation, the tax price would be still lower. With a symmetric distribution of income, as illustrated in panel A of Figure 7.5, the income of the median individual equals the average income, that is, $Y_m = \bar{Y}$; but in fact, most income distributions are skewed, as in panel B. There are a few very rich individuals which increase the average income. As a result, average income exceeds the income of the median individual, $Y_m < \bar{Y}$, so that with proportional taxation the tax price is even less than $1/N$.

The question, then, is what fraction of the total marginal benefits accrues to the median voter. If the marginal benefits are uniform, then the median voter gets $1/N$ of the total marginal benefits, so that with uniform

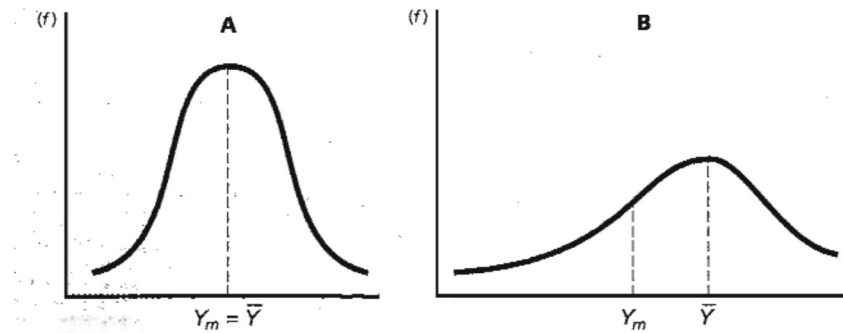


FIGURE 7.5 **Income Distributions** Panel A shows a symmetric income distribution; the median income, Y_m , equals the average income, \bar{Y} . Panel B shows a skewed income distribution more typical of the United States. Because there are a few very rich individuals, the average income exceeds the median income.

taxation the median voter would get $1/N$ th of the total social benefits and bear $1/N$ th of the total costs. Therefore he would vote for an efficient level of expenditure. But with proportional or progressive taxation, his share of the cost would be smaller than his share of the benefits, and he would vote for excessive expenditures—that is, for a level of expenditure where the sum of the marginal benefits is less than the total marginal cost to society.

Some forms of public expenditures are actually enjoyed disproportionately by the poor: in many cities the rich may make less use of public parks, for instance, because they have large yards of their own. According to the median voter theory, there is an especially large tendency for an oversupply of such goods. In many cases, it is difficult to ascertain the balance: the median voter gets a smaller share of the benefits and bears a smaller share of the costs.

In the examples discussed so far, the median voter corresponds to the voter with the median income. This is often, but not necessarily, the case. Higher-income individuals normally demand more of all goods, including public goods, *if they face the same prices*; but the tax price faced by higher-income individuals is typically higher, so that in some cases, very high income individuals may actually prefer lower levels of public expenditures on certain goods than do middle-income individuals.

Median voter theory says that to understand collective choices, we should focus our attention on the median voter and how a particular policy affects him. Consider what the median voter theory says about support for, and consequences of, abolishing the deductibility of state and local income and property taxes for purposes of the federal income tax, a proposal which is frequently raised in the context of tax reform. Most individuals do not itemize; that is, in calculating their taxable income, they subtract a “standard deduction” rather than listing all the allowable deductions, including

local and state taxes. Accordingly, they would be unaffected directly, though the increased federal revenue, which could be used to reduce the deficit or taxes, would be a benefit. Thus, the median voter should support this reform. Yet it has been repeatedly defeated—suggesting that there are other considerations that go into determining outcomes in political processes, as we note later in this chapter.

One of the worries of state governors has been that if state taxes are made non-deductible, the “tax price” for state expenditures will go up. Now, in effect, the federal government subsidizes the state. If a New York voter who pays 28 percent of his income to the federal government in income taxes pays \$1000 more in state taxes, and he can deduct that expenditure from his income, his federal tax liability goes down by \$280, and the *net cost* to him is only \$720. With a higher tax price, demand for state-provided goods and services would normally be expected to decrease. The median voter theory says “not to worry”: since the median voter in the state does not itemize, tax deductibility has no effect on the level of state-provided goods and services.

**THE TWO-PARTY
SYSTEM AND THE
MEDIAN VOTER**

We noted earlier that an elected representative bears a negligible fraction of the costs of, and receives a negligible fraction of the benefits from, an increase in government expenditure. What can economic theory say about how he should vote? A natural supposition is that the politician wishes to stay in office and that, accordingly, he wishes to maximize his votes, given the position taken by his rival. A vote-maximizing voting strategy can easily be defined as follows: Assume there are two parties, “R” and “D.” Party R takes the position of Party D as given. Focusing on a single issue, the level of expenditure, denote by G_R the position of Party R (that is, the level of public expenditure advocated by the party) and by G_D the position of Party D. For each value of G_D there is an optimal (i.e., vote-maximizing) position for G_R .

Under the hypothesis that each party seeks to maximize its vote given the position of its rival, what will each party do? Let G_m be the preferred level of expenditure of the median voter. Suppose Party D chooses $G_D > G_m$. Then if Party R takes a position between G_m and G_D , it will get all the voters who prefer an expenditure level less than or equal to G_m , and some who prefer slightly more. Thus Party R gets over 50 percent of the votes and wins. In response, Party D will choose a position, G_D' , between G_m and G_R , which wins against G_R . But then Party R chooses a position, G_R' , between G_D' and G_m . The process continues until both parties stand for the same position: that of the median voter (G_m). (See Figure 7.6.)

This result is consistent with the widely observed allegation that with our two-party system voters get no choice: both parties take a “middle-of-the-road” position. This is precisely what the theory predicts.⁹

⁹ This general theory is due to Harold Hotelling, a pioneer in mathematical economics who taught at Columbia and North Carolina State Universities. See H. Hotelling, “Stability in Competition,” *Economic Journal* 39 (March 1929): 41–57.

SOCIAL CHOICE THEORY

The hypothesis that government actions can be explained as the outcome of individuals' acting rationally in their own self-interest, in response to the political "rules of the game," is a central tenet of social choice theory. James Buchanan, currently at George Mason University, received a Nobel Prize in 1986 for his pioneering work in this area. In this view, designing the rules of the game—the constitution—is critical. An important part of the rules of the game is the imposition of constraints on government (such as limits on deficit financing). Without some form of constraints, the incentive of the majority to redistribute income in their favor, away from the minority, or of special interest groups to try to induce elected representatives to act in *their* interests, rather than in the general interest, is too great to be resisted.

Even acts of Congress which seem to go against the special interest groups appear in a different light when viewed from this perspective. Consider the 1986 tax reform, which attempted to strip out of the tax law many of the favorable provisions which special interest groups had succeeded in putting in. Professor Buchanan argues that this action should be viewed from the self-interest of Congress: the tax system had become so overladen with special provisions that the cost of granting further special benefits was rising sharply. The tax reform enabled Congress to start with a clean slate: there was now greater opportunity for introducing *new* special benefits. The greater

There are, however, some important limitations of the theory that need to be borne in mind. First, we noted earlier that in general, there may not exist a majority voting equilibrium. There does if individuals have single-peaked preferences. In the present context, this requires that we should be



FIGURE 7.6 **Two-Party System** If both parties in a two-party system try to maximize their votes, taking the position of the rival as fixed, in equilibrium both parties will adopt the position of the median voter.

opportunity for Congress to dispense special favors was of immense benefit to Congressmen.*

One issue addressed by Nobel laureate Gary Becker, of Chicago and Stanford Universities, is how to explain the seemingly disproportionate influence of certain small interest groups. Farmers, though they constitute less than 2 percent of Americans, have succeeded in getting huge subsidies from the federal government. The answer Becker suggests is that with small groups, the free rider problem that we encountered in Chapter 6 is smaller. "Bribing" representatives to support one's special interest is a public good: all wheat farmers benefit from a wheat subsidy; all steel or car producers benefit from trade barriers that keep out less expensive foreign steel or cars. The smaller the group, the easier it is to persuade all members to contribute to the cost of lobbying. Each of these programs has losers—and not only are the losers far more numerous, but their aggregate losses exceed the benefits of the special interest groups. But each of the losers loses a little. Opposing the special interest groups is also a public good, and each opponent has an incentive to be a free rider.

*James M. Buchanan, "Tax Reform as Political Choice," *Journal of Economic Perspectives* 1 (summer 1987), pp. 29–35.

able to arrange issues along a single dimension—for example, conservative–liberal. If, however, there are a variety of dimensions—some individuals are liberal on some issues and conservative on others—then the median voter is not well defined, and there may be no equilibrium to the political process.

Secondly, we have ignored questions of participation in the political process. There are, for instance, costs associated with becoming informed and voting. These costs are sufficiently great relative to the perceived benefits that slight changes in the weather, making it slightly less pleasant to go outside to vote, have significant effects on voter participation. In particular, voters whose preferences are near the median have little incentive to be active politically, particularly if they believe that the political process will reflect their preferences anyway. Thus, it may be in the interests of those who are more extreme to attempt to pull their party away from the center. This tendency for greater political activism at the extremes may partially offset the median-directed tendencies noted earlier.

MAJORITY VOTING

Proposal which gets a majority against all other wins

WHEN MAJORITY VOTING EQUILIBRIUM EXISTS, REFLECTS PREFERENCES OF MEDIAN VOTER

- In two-party system, both parties will converge to position of median voter.
- Majority voting equilibrium is not in general Pareto efficient.

MAJORITY VOTING EQUILIBRIUM MAY NOT EXIST

- Proposal A defeats B, C defeats A, but B defeats C.
- Majority voting equilibrium exists if preferences are single peaked.

ARROWS IMPOSSIBILITY THEOREM: THERE DOES NOT EXIST AN ALTERNATIVE VOTING MECHANISM THAT AVOIDS PROBLEMS OF MAJORITY VOTING (AND SATISFIES CERTAIN OTHER DESIRED PROPERTIES).

ALTERNATIVES FOR DETERMINING PUBLIC GOODS EXPENDITURES

We have identified several major problems with the most commonly employed way of making collective decisions, majority voting: there may not be a determinate outcome; even when there is, it may not be efficient; and voters may vote strategically, not revealing their true preferences. Even if there is no ideal system, are there perhaps systems that resolve one or the other of these problems? Economists have looked for such alternative systems.

LINDAHL EQUILIBRIUM

The most famous is called the Lindahl solution, after the great Swedish economist Erik Lindahl, who first proposed it in 1919.¹⁰ He was looking for a system that would yield efficiency; he paid little attention to the other problems listed earlier. Lindahl's system attempts to mimic, as far as possible, the way that the market works in providing private goods. Remember, market equilibrium for private goods is described by the intersection of the demand and supply curves. All individuals face the same price. The sum of the quantities they demand is equal to the sum of the quantities supplied by firms.

¹⁰ E. Lindahl, "Positive Lösung, Die Gerechtigkeit der Besteuerung," translated as "Just Taxation—A Positive Solution" in *Classics in the Theory of Public Finance*, ed. R. A. Musgrave and A. T. Peacock (New York: St. Martin's Press, 1958).

One of the ways we can characterize the efficient level of public goods is as the intersection of the "collective" demand curve (formed by adding vertically each individual's demand curve) with the supply curve. The demand curves are generated by asking the individual how much of the public good he would demand if he were to pay so much for each unit produced; that is, in Figure 7.7A if the first individual faced a tax price of, say, p_1 , he would demand G^* .

The Lindahl equilibrium is illustrated in Figure 7.7C. We add vertically the demand curves for Individuals 1 and 2 illustrated in Figure 7.7A and 7.7B, obtaining the collective demand. The Lindahl equilibrium occurs at the intersection of this curve with the supply curve. Price, along the supply curve, measures the marginal cost of production. p_1 measures the first individual's marginal benefit (marginal willingness to pay for an additional unit of government expenditure) at G^* , and what he has to pay, and p_2 measures the same thing for the second individual. At G^* , the sum of the marginal benefits (the total marginal willingness to pay) just equals the marginal cost. The Lindahl equilibrium is thus a set of tax prices (the amount each individual has to pay if one more unit of the public good is produced) adding up to the marginal cost of production, such that, given those tax prices, every individual prefers the same level of expenditures, G^* . Since at the Lindahl equilibrium the sum of the marginal benefits equals the marginal cost, the Lindahl equilibrium is Pareto efficient.

We noted earlier, however, that there were in fact a whole range of Pareto efficient resource allocations, with one individual better off in some, another better off in others. Almost by definition, there cannot be unanimity about which, among these points, is preferred. The Lindahl equilibrium picks one of the Pareto efficient points; but individuals who are disadvantaged by this particular Pareto efficient point will not agree to the use of this mechanism for determining the allocation of public goods; indeed, they would prefer Pareto inefficient allocations so long as the level of utility they obtain is higher.

The most telling criticism of the Lindahl solution is that *individuals do not have an incentive to tell the truth because their tax price increases as their stated demand does*. That is, the higher their stated demand (given the demand statements of others), the higher the equilibrium expenditures on public goods will be. Higher expenditures on public goods necessitate, of course, higher equilibrium tax prices. The demand curves that are used in the Lindahl analysis were drawn under the hypothesis that individuals face a given tax price; they believe that nothing they say will alter what they have to pay per unit of public expenditure. But if they understand the Lindahl mechanism, they will realize that what they say does alter what they have to pay per unit of public expenditure, and thus they will not truthfully reveal their demands.

Let us briefly review the two sets of processes by which collective decisions concerning public goods could be determined, majority voting and the Lindahl equilibrium. Voting, as we have seen, may not yield an equilibrium, and when it does, it is in general not Pareto efficient. We saw earlier that there existed no democratic mechanism which fully resolved the problem of

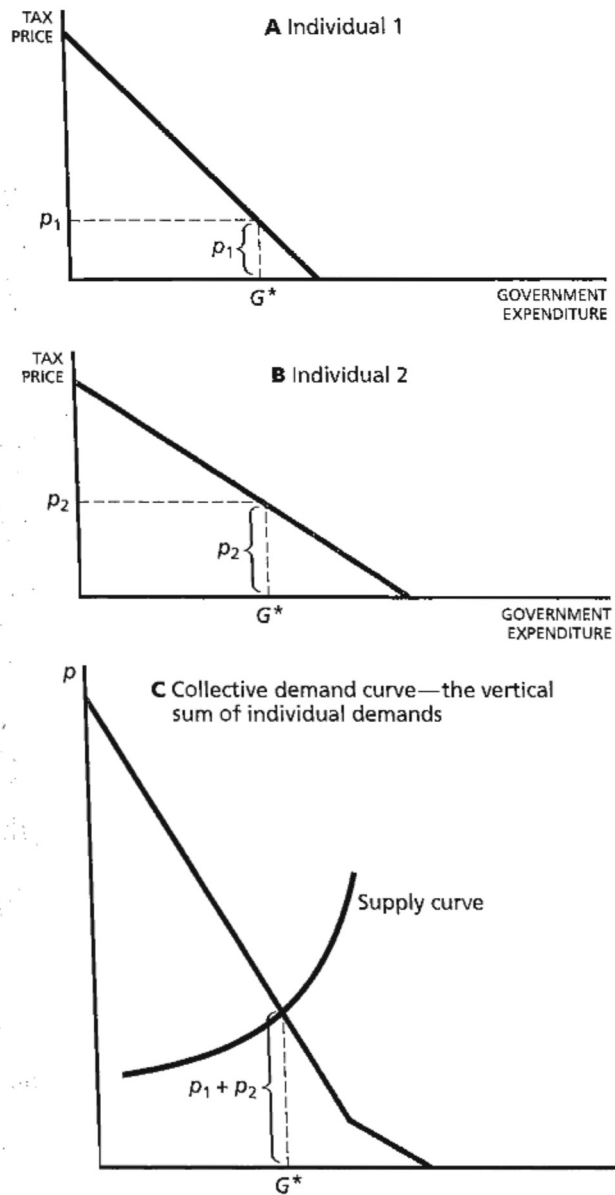


FIGURE 7.7 Lindahl Equilibrium Panels A and B show the demand curves for public goods; demand depends on the tax price faced by the individual. In panel C the two demand curves are added *vertically*, that is, at each level of government expenditures, the tax prices of Individuals 1 and 2 are added together. The Lindahl equilibrium is the level of expenditures G^* at which the collective demand curve thus constructed intersects the supply curve. At the intersection, the sum of the tax prices equals the supply price.

COMPARISON OF PUBLIC CHOICE MECHANISMS

Majority voting

- Equilibrium may not exist
- When equilibrium exists, not in general Pareto efficient

Lindahl equilibrium

- Equilibrium always exists
 - Equilibrium always Pareto efficient
 - Individuals do not have incentive for truthful revelation of preferences
-

the nonexistence of a voting equilibrium. The Lindahl equilibrium will be efficient, but individuals do not have an incentive to be honest in providing the information required to implement it. The next natural question is, are there more general plausible ways of organizing collective decision-making which yield efficient outcomes, which do not have the problems we have encountered in the case of majority voting and the Lindahl equilibrium? Though economists have devised complicated schemes that have *some* desirable properties, or that may work in *some* circumstances, it appears that there is no *perfect solution* to the problem of collective decision-making in democratic societies. The appendix to this chapter describes one scheme which, while it induces individuals to reveal honestly their preferences, has other problems which perhaps explain why it is not commonly used.

POLITICS AND ECONOMICS

The preceding discussion of the political process differs markedly from the kind of analysis one might typically find in a political science course. There, one might discuss the roles of special interest groups and political institutions. A full discussion of the relationship between economic theories of the political process and other theories of the political process would take us beyond the scope of this book. In the following pages, we touch on some economic interpretations of certain political phenomena.

WHY DO INDIVIDUALS VOTE?

In many elections voter participation rates are low, and are sensitive to such chance occurrences as changes in the weather. The reason for this, as we have noted, is that the benefits of voting for the individual are low—there is little chance of one person affecting the outcome. The alternatives may differ so little that the outcome is inconsequential, and, though the costs of voting are relatively low, they are not low in relation to the benefits. Indeed, in a fully rational calculation, no one would vote: the probability that an in-

dividual's vote would make a difference to the outcome (since in most cases the individual cares only about whether her candidate wins or loses, not the magnitude of the win or loss) is essentially zero. Yet individuals do vote.¹¹

This paradox is resolved, in a somewhat tautological manner, simply by assuming that individuals get utility out of voting, or more generally, out of participation in the political process. More to the point, considerable time and energy are devoted to inculcating into our children notions of civic responsibility, and among these civic responsibilities is the responsibility to be an informed voter.

The same considerations imply that when the individual votes, she may not act in the narrowly self-interested manner that we have assumed in our discussion so far. Individuals may support representatives who vote for closing some loophole in the income tax system because it would result in a more equitable distribution of the tax burden, even though their personal tax liability might thereby be increased.

ELECTIONS AND SPECIAL INTEREST GROUPS

The political models we have discussed thus far have assumed that all individuals are well informed about the consequences of all alternatives under consideration, that all individuals vote, and that they cast their votes on the basis of the implications that each alternative has for their own (private) welfare.

There are many who believe that this does not provide an adequate description of the political process. Although constitutionally each person has one vote, some votes seem more effective than others. The outcome of the political process, in this view, reflects the political power of special interest groups.

Assessing the validity of these views is beyond the scope of this chapter. Instead we will focus on a more narrow set of questions: What can economic theory say about the kinds of interest groups that are likely to be effective? And how can we reconcile the effectiveness of special interest groups with the fact that each individual does, in the United States, have only one vote?

The answer to these questions is related to our discussion in the previous chapter of the public interest as a public good. We saw there that the efficient management of the public sector was a public good. Similarly, when others choose elected officials who are competent and who reflect values similar to our own, we benefit as well. This may reduce our incentive to become informed voters, and encourage us instead to "free ride."

At the same time, we should note that the free rider problem may not be as serious in small groups as it is in large. It is easier to form an interest group of a small number of steel producers to attempt to persuade Congress to restrict steel imports than it is to form an interest group of the large number of steel users who would be adversely affected by such restrictions. Each of the producers has more to gain than each of the consumers has to

¹¹ In U.S. presidential elections since 1932, between 49 percent and 63 percent of the voting age population has voted. In elections of U.S. representatives to Congress, participation has been somewhat lower (33 percent to 59 percent) (*Statistical Abstract of the United States, 1997*, p. 289). In local school board elections, often less than 10 percent of the eligible voters vote.

lose, though the aggregate gains of producers may, in fact, be less than the aggregate losses to consumers.

Trade unions, recognizing the nature of the free rider problem, have long sought closed shops, in which all workers must support the activities the union believes to be in their collective interests. Once they have this power, they can attempt to use it not only at the bargaining table but also in the political arena, where they act as a special interest group.

THE POWER OF SPECIAL INTEREST GROUPS

How are interest groups able to exercise power? There appear to be at least three mechanisms. First, as we noted before, individuals have little incentive to vote or to become informed concerning the issues. Interest groups can attempt to lower the costs of voting and information, particularly for those voters who are likely to support them. They do so by making information (obviously, that supporting their own views) readily available; and they often assist directly by providing transportation, child care, and so on, on polling day.

Secondly, we noted the difficulty that politicians have in obtaining information about the preferences of their constituents. There is no simple demand-revealing mechanism for public goods, as there is for private goods. Interest groups attempt to provide such information. Politicians may lack the technical information required to make informed political decisions—for example, they may not know the consequences of continued imports of cheap foreign cars or clothing. Interest groups are a primary source of information, and it is through providing information that they often exercise influence.

The third mechanism is through direct and indirect bribery of the politician. Direct bribery does not occur often, at least in most jurisdictions in the United States. (Presumably, this may not be due to the purity of our politicians so much as to the costs associated with being caught.) But indirect bribery is important: special interest groups provide financial and other forms of support for politicians who support their interests; this support is viewed to be essential in running a successful political campaign.

There has been increasing recognition of the power of contributions, reaching a crescendo after the 1996 elections, in which the President was accused of “selling” nights in the Lincoln bedroom and seats on Air Force One in return for large contributions. But in spite of rhetorical support for campaign finance reform from both parties, Congress has failed to pass legislation.

THE ALTRUISTIC POLITICIAN?

An alternative view holds that many politicians do not behave in as self-interested a way as we have assumed throughout this chapter. Just as individuals behave altruistically as private citizens, and give to charity, so too do they behave as public citizens, in their capacity as elected officials. In our society considerable status and respect are accorded to public officials and public service. Effective government depends on the quality of these public servants.

However, being disinterested does not suffice to ensure that politicians will make a wise decision: as has been noted, even a well-intentioned public official may have a difficult time ascertaining the preferences of his constituents. Further, even if the electorate would like to chose altruistic repre-

CAMPAIGN REFORM

Behind the power of many special interest groups is the power of money—especially money to support candidates whom they favor. Traditionally, the Democratic Party has had less access to money; and its members have been particularly concerned that the power of money has created an unlevel playing field, where the voices of rich individuals and corporations are heard more clearly than the voices of the poor and middle class. But incumbents of any party, who typically have better access to financial support, are usually less enthusiastic about reform than those trying to get elected. This helps explain in part why Congress has, at least in the past, had only limited enthusiasm for strong reforms.

Some reforms have focused on limiting the amount of money that any organization can give to any candidate. Such reforms typically have been subverted: if a corporation cannot give money directly, it may still encourage its employees to contribute. If they cannot give money to a candidate, they give money to the candidate's party. Even were they restricted in their contributions to his party, they could give

representatives who vote exclusively on principle, attempting to ensure that there is an "efficient" supply of public goods, they face a difficult problem: So long as not all individuals running for office are disinterested, the voters must select between those who are and those who are not. If voters believe that it is better to be a "disinterested" public servant than a selfish politician, then self-interested politicians will all attempt to resemble a disinterested public servant. How are voters to choose among them on the basis of the limited information they normally have available?

There are numerous instances where politicians seem to act "on principle," voting in a way that is inconsistent not only with their own narrowly defined self-interest, but also with the wishes of their voters. They thus risk not getting elected (though often the electorate respects such shows of "independence" and "principle").

While altruistic behavior on the part of politicians is to be preferred to corruption, or even to lesser forms of self-aggrandizement, economists have long worried about the reliability of seemingly altruistic behavior in the pursuit of the common interest. Indeed, it was the seeming capriciousness of the actions taken by political leaders (often allegedly in the public interest) that led Adam Smith to suggest that there was a better way that the public interest might be served: by each individual's pursuing his private interest. Unfortunately, though Adam Smith's invisible hand may work well for most goods, it does not work well for public goods. Still, at least to a limited degree, self-interest on the part of politicians—their desire to get re-elected—serves an important function: it induces them to try to elicit accurately the

money to some group identified with a position of the candidate. If the National Rifle Association were limited in the amount it gave to pro-gun representatives, it could still mount a campaign against their opponents who advocate gun control.

Some critics of campaign reform worry that it will create an unlevel playing field of a different sort. Groups that can mobilize thousands of volunteers and huge letter-writing campaigns, such as senior citizen advocates or labor unions, will still be able to exercise political influence.

There is also a worry that any restrictions on contributions to parties or causes would be in effect a restriction on First Amendment (free speech) rights: in a democracy, individuals should not be restricted in what they say, how they say it, or to whom they say it. Campaign finance mainly goes to support the dissemination of views—though to be sure, questions may be raised at the extent to which a thirty-second spot ad on TV promotes intelligent decision-making.

preferences of their (voting) constituents and to vote for measures that reflect those preferences. It is this form of self-interest that lies behind the analysis of the two-party model presented earlier.

**THE PERSISTENCE OF
INEFFICIENT
EQUILIBRIUM**

In recent years, the prices of commodities—from cars to corn to aluminum to uranium to tomatoes—have been higher as a result of trade restrictions, or the threat of imposition of trade restrictions. When special interest groups manage to impose trade restrictions or to obtain subsidies for themselves, the resulting resource allocations not only violate generally accepted standards of equity and fairness but also are frequently inefficient. There are alternative allocations that could make everyone better off. Why, in the face of this, don't individuals get together and propose one of these Pareto-dominating alternatives, to which, presumably, all would agree? There is no universally agreed-upon answer to this puzzle. Several "partial" answers may be suggestive.

First, as we have already seen, the public interest is a public good. Since the efforts to maintain a good government must come from private individuals, there will be an undersupply of this (as any other) privately provided public good.

Secondly, many of the distributive implications of public programs undertaken at the behest of special interest groups are far from obvious—and this is deliberately so. It is unlikely, for instance, that the American voters would deliberately vote to transfer resources (give a public gift) to *rich* rice farmers. For these individuals to receive a transfer at the public expense, they must be included in a broader-scale program, of which they appear to

be almost accidental beneficiaries. Thus, rich rice farmers become advocates of federal aid to rice farmers, singling out, in their public rhetoric, the benefits that would accrue to poor rice farmers from such a program. A Pareto improvement might, for instance, entail giving each rice farmer a fixed sum, which would leave him free to move into some other occupation where his productivity might be higher. Although such direct grants could be structured to make everyone better off, they would expose the true distributive implications of the program—that is, that most of the benefits accrue not to poor rice farmers, but to rich ones. Since the likely result would be weakened political support for subsidies to rice farmers, this Pareto improvement would not receive the backing of rich rice farmers.

REVIEW AND PRACTICE

SUMMARY

1 Collective decision-making, such as determining the level of public goods, differs from standard decision-making within a household in two important ways: First, there is a problem of eliciting preferences. If the amount that individuals have to pay depends on their statements, they may tend to understate their true preferences. If the amount that individuals have to pay does not depend at all on their statements, they may tend to overstate their true preferences.

Second, there is a problem of resolving differences in preferences: how much should be provided, if different individuals desire that the government should, for instance, spend different levels on providing public goods?

2 Majority voting is the simplest way by which such differences are resolved. Unfortunately, there may not exist a majority voting equilibrium.

3 Arrow's impossibility theorem demonstrates the impossibility of finding an alternative, nondictatorial political mechanism that resolves this problem of majority voting and that satisfies certain other properties that one would desire of any political mechanism (such as independence of irrelevant alternatives).

4 The majority voting equilibrium exists if preferences are single-peaked.

5 Preferences for a single public good will usually be single-peaked. Preferences will not be single-peaked if:

- a** there is more than one public good, and the vote is taken over packages, rather than over a single good at a time;
- b** voting is over a publicly provided private good, for which there exists a private alternative, such as education;
- c** voting is over distributional questions, such as the structure of the income tax schedule.

6 The majority voting equilibrium, when it exists, reflects the preferences of the median voter.

7 In a two-party system, there will be a convergence of positions of the two parties toward that of the median voter.

8 The majority voting equilibrium does not, in general, result in an efficient supply of public goods; there may be either an undersupply or an oversupply.

9 The Lindahl equilibrium is the level of public goods provision in which the sum of the tax prices equals the marginal cost of production. While the Lindahl equilibrium is Pareto efficient, there is no incentive for individuals to tell the truth concerning their preferences.

10 In many elections, voter participation is low. In fact, economists are puzzled why individuals bother to vote at all, since the expected private benefit—given the low probability that they affect the outcome—is typically less than the private cost.

11 Special interest groups often exercise strong influences over the outcome of political processes.

KEY CONCEPTS

Preference revelation	Single-peaked preferences
Aggregating preferences	Median voter
Voting paradox	Lindahl equilibrium
Arrow's impossibility theorem	

**QUESTIONS
AND PROBLEMS**

1 Assume that some individual's marginal valuation of public goods increases. What does this do to the Pareto efficient level of public expenditures? If this individual is not the median individual, what will happen in a two-party system to the equilibrium level of expenditure on public goods? If the equilibrium was originally Pareto efficient, will it still be?

2 Assume that all individuals have identical preferences but some individuals are wealthier than others. Assume there is a single public good and a single private good.

- Show diagrammatically how you derive the demand curve for the public good, as a function of the tax price charged the individual.
- Assume that the demand function is of the form

$$G = kY/p,$$

where k is a constant (less than 1), Y is income, and p is the tax price. This says that when income doubles the demand for public goods doubles, but when the tax price doubles the demand is cut in half. If

the tax price is proportional to the individual's income (as with proportional taxation), how will demand for public goods differ among those with different incomes?

3 Assume instead there is uniform taxation, so that all individuals face the same tax price. Recall that along each individual's demand curve, the price equals the marginal rate of substitution. Thus,

$$\text{MRS} = p = kY/G,$$

the marginal rate of substitution is proportional to income. Assume that income is symmetrically distributed, so that mean income equals the median. Explain why the majority voting equilibrium will be Pareto efficient. Now assume that income is not symmetrically distributed, but rather is skewed toward higher incomes, as in Figure 7.5B. Will the majority voting equilibrium still be efficient? Will there be an under- or oversupply of public goods?

4 Demand curves are said to be *income elastic* if the demand for the good increases more than proportionately with income. For instance, with the demand curve

$$G = kY^2/p$$

the demand for public goods increases with the *square* of income. Draw the marginal rate of substitution as a function of income (for a fixed level of expenditure on public goods). Assume income is symmetrically distributed. What is the relationship between the average value of the marginal rate of substitution and the marginal rate of substitution of the median individual? What does this imply about the equilibrium supply of public goods under majority voting with uniform taxation?

5 In the text, we suggested that for well-off individuals, with uniform taxation, preferences for education were not single-peaked. Why might preferences for local parks and for urban public transportation systems (buses and subways) also not be single-peaked?

6 Is the median voter always the voter with the median income? Give examples.

7 How might the majority voting model be used to explain the growth of government expenditures?

- a Should changes in median or average income better explain increases in the demand for government services?
- b What should be the effect of an increase in the costs of producing public good caused by government inefficiency? Would it make a difference if the increase in cost is a result of government paying above-market wages (wages higher than those paid comparable

workers in the private sector)? (Does your answer to the last question depend on whether the median voter is a government employee?)

- c Why might you expect that if income per capita remains the same but the number of individuals in the economy increases, the demand for public goods would increase?

8 One popular voting scheme is rank-order voting, where individuals assign a rank (1, 2, 3) to the possible alternatives; the assigned ranks are then added up, and the alternative with the lowest sum wins. Consider a choice among four alternative ways of spending public funds (a library, a ski slope, a swimming pool, a garbage dump). Can you construct an example in which the outcome (the most preferred alternative) is, say, a library, if the vote is among the first three alternatives, while the outcome is a ski slope if the vote is among all four alternatives? This voting scheme thus violates the principle that the chosen outcome should be independent of irrelevant outcomes (the garbage dump was not chosen in either situation).

9 Median voter theory says that to predict changes in collective decision-making, one should focus on the median voter. Between 1973 and 1993, average incomes in the United States increased, while the income of the median family remained roughly stagnant. (Since then, the median income has increased slightly, but not enough to erase the increased gap of the previous two decades.) How might an economist focusing on median voter behavior and an economist focusing on average incomes differ in their predictions concerning changes in the level and composition of public expenditures?

APPENDIX

NEW PREFERENCE-REVELATION MECHANISMS

This appendix describes a simple procedure which induces individuals to reveal truthfully their demands, provided there is no collusion among individuals. Everyone is asked to give his demand curve for public goods, just as in the Lindahl equilibrium. As before, the equilibrium will be at the intersection of the collective demand (formed by adding vertically the demand curves of each individual) and the supply curve. For simplicity, we assume that the marginal cost of production of the public good is constant, so the supply curve is horizontal. But now, there is a different rule for determining the individual's tax liability.

We first add up the demand curves for *all other* individuals (vertically). The collective demand curve of all *others* intersects the supply curve at G_0 in Figure 7.8. This is what the level of public goods would be if the individual said that he got no value out of the public good. He is told that for each unit beyond G_0 that the government produces, he will have to pay the difference between the marginal costs of production and the collective valuation (demand) of all others. If the equilibrium entailed an output of $G_0 + 1$, the

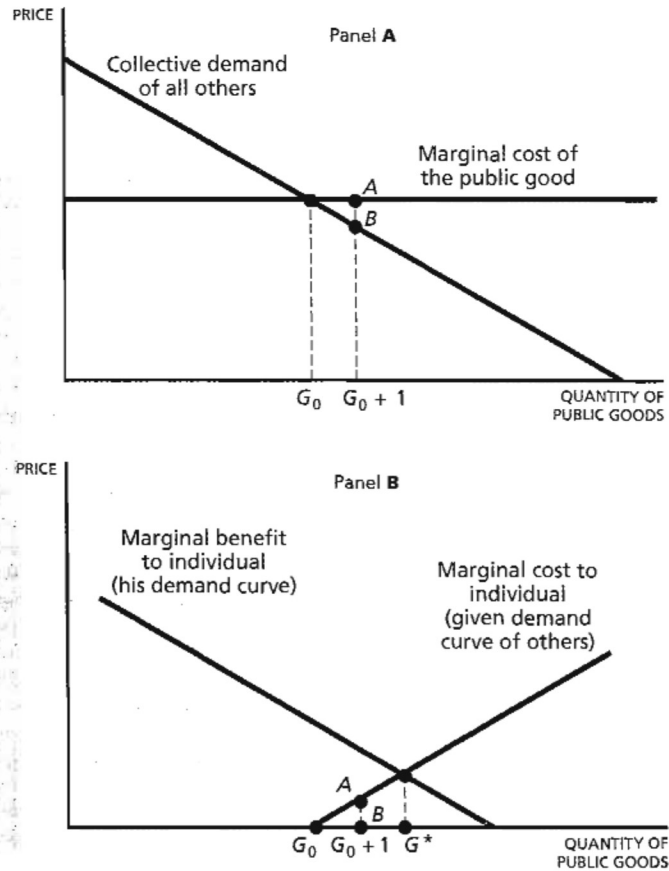


FIGURE 7.8 **New Preference-Revelation Mechanism** Panel A shows the collective demand of all but one individual for the public good (the sum of their marginal valuations) and the marginal cost of production. If the last individual placed no value on the public good, the level of production of the public good would be G_0 , where the sum of the marginal valuations equals the marginal cost. As the level of expenditure increases beyond G_0 , the last individual is required to pay, for each additional unit, the difference between the collective (marginal) valuation of all others and the marginal cost. Thus, if $G_0 + 1$ is produced, he must pay the amount denoted by AB. Panel B shows, at each level of output, the *marginal cost* that the (last) individual must pay for each extra unit of output. Thus, to have the economy go from producing G_0 to producing $G_0 + 1$ requires that he pay AB. Panel B also shows the last individual's marginal valuation of the public good (his demand curve). The individual's most preferred level of expenditure is where his marginal benefit from increased expenditures (given by his demand curve) exactly equals his marginal cost, that is G^* . If the government sets public expenditures at G^* , the individual will be induced to reveal truthfully his demand.

individual would have to pay AB , the distance between the marginal cost curve and the others' collective demand curve.

The individual is in a position to determine the level of public goods simply by his announcement of how much they are valued to him. Clearly, he will try to increase G to the point where the marginal cost to him of increasing G is equal to his marginal benefit. This can be seen in two alternative ways. First, in Figure 7.8B, we have plotted the marginal cost to the individual from each additional unit of production beyond G_0 , given others' demands. Since his marginal cost is the difference between the cost of production and others' demand, the marginal cost of the $G + 1$ st unit is equal to AB . In panel B we have also drawn the individual's demand curve; the individual will wish point G^* to be chosen, where his demand curve intersects his marginal cost curve.

We now show that each individual has an incentive to reveal honestly his demand for public goods, and that the equilibrium is Pareto efficient. To see this, we look at the individual's budget constraint. The individual faces a budget constraint as depicted in Figure 7.9. The extra amount that the individual has to give up for each extra unit of public goods beyond G_0 is the marginal cost minus the others' collective demand (marginal valuation). Thus he sets his marginal rate of substitution equal to the marginal cost minus the others' collective demand, point E in Figure 7.9. It is clear

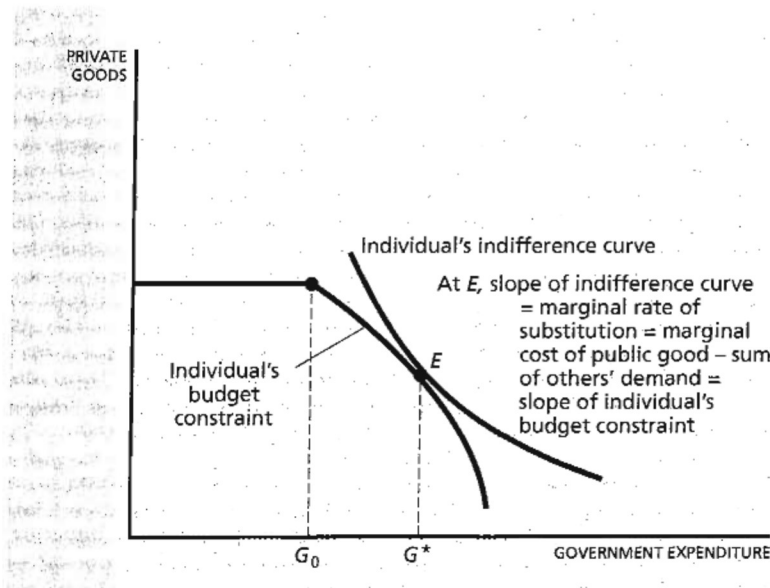


FIGURE 7.9 Choice of Optimal G by Individual If the individual must pay the difference between marginal cost and others' demands, and others have honestly revealed their demands, the level of public goods will be Pareto efficient. From Figure 7.8, the price the individual has to pay for each increment in public goods expenditure increases. That is why the individual's budget constraint has the shape depicted.

that the individual has no incentive to misrepresent his preferences. If he asked for any level of public goods other than G^* he would be worse off.

Assume now that each individual honestly announces his demand curve. Recall that in constructing the demand curve, the tax price for each individual (the slope of his budget constraint) was set equal to the individual's marginal rate of substitution. Hence, when the demand curves are added vertically, the sum of the marginal rates of substitution are just the sum of the tax prices, and at the Pareto efficient allocation that equals the marginal cost (the marginal rate of transformation):

$$MRS_1 + MRS_2 + \dots = MC.$$

In other words, each individual's marginal rate of substitution is equal to the marginal cost of the public good minus the sum of the marginal rates of substitution of others (the sum of their tax prices). For instance, for the first individual,

$$MRS_1 = MC - (MRS_2 + MRS_3 + \dots).$$

But this is exactly the point we described earlier, where the marginal cost to the individual of further increases in government expenditure (which equaled the marginal cost of production minus the sum of others' demand prices at the given quantity) equaled the marginal benefit to the individual (his marginal rate of substitution). We have just shown that by honestly revealing his demand curve, the individual maximizes his own utility, and the allocation of resources to public goods will be Pareto efficient.

In spite of the attention that revelation mechanisms such as the one we have just described have received from economic theorists, there is considerable controversy about their relevance. There are several objections to them, besides their possibly high administrative costs and the fact that they are susceptible to collusion (two individuals could get together, agree to distort what each said, and each be better off).

Like the Lindahl equilibrium we described earlier, these mechanisms ensure that the condition for a Pareto efficient allocation—that the sum of marginal rates of substitution equals the marginal rate of transformation—is satisfied. But some individuals might prefer another, Pareto inefficient allocation that gives them a higher level of utility. Hence, it is not obvious that they would agree to a decision to adopt this mechanism, knowing that they would thereby be disadvantaged. Finally, the mechanisms do not, in general, guarantee a balanced budget. Although the sum of the marginal valuations (marginal rates of substitution) does equal the marginal cost, the total amount paid may well differ from the total costs of the public good.