PART II

Public choice in a direct democracy

CHAPTER 4

The choice of voting rule

> Decision by majorities is as much an expedient as lighting by gas.
>
> William Gladstone

> There are two general rules. First, the more grave and important the questions discussed, the nearer should the opinion that is to prevail approach to unanimity. Second, the more the matter in hand calls for speed, the smaller the prescribed difference in the number of votes may be allowed to become: when an immediate decision has to be reached, a majority of one should suffice.
>
> Jean-Jacques Rousseau

This and the next four chapters explore the properties of various voting rules. These rules can be thought of as governing the polity itself, as when decisions are made in a town meeting or by referendum, or an assembly, or a committee of representatives of the citizenry. Following Black (1958), we shall often refer to "committee decisions" as being the outcomes of the voting process. It should be kept in mind, however, that the word "committee" is employed in this wider sense, and can imply a committee of the entire polity voting, as in a referendum. When a committee of representatives is implied, the results can be strictly related only to the preferences of the representatives themselves. The relationship between citizen and representative preferences is taken up later.

4.1 The unanimity rule

Since all can benefit from the provision of a public good, the obvious voting rule for providing it would seem to be unanimous consent. Wicksell (1896) was the first to link the potential for all to benefit from collective action to the unanimity rule. The unanimity rule, coupled with the proposal that each public good be financed by a separate tax, constituted Wicksell's "new principle" of taxation. To see how the procedure might work, consider a world with two persons and one public good. Each person has a given initial income, Y_A and Y_B, and a utility function defined over the public and private goods, $U_A(X_A, G)$ and $U_B(X_B, G)$, where X is the private good and G the public good. The public good is to be financed by a tax of t on individual A, and $(1 - t)$ on individual B. Figure 4.1 depicts individual A's indifference curves between the private and public good. Let the prices of the private and public good be such that if A had to pay for all of the public good ($t = 1$), A's budget constraint

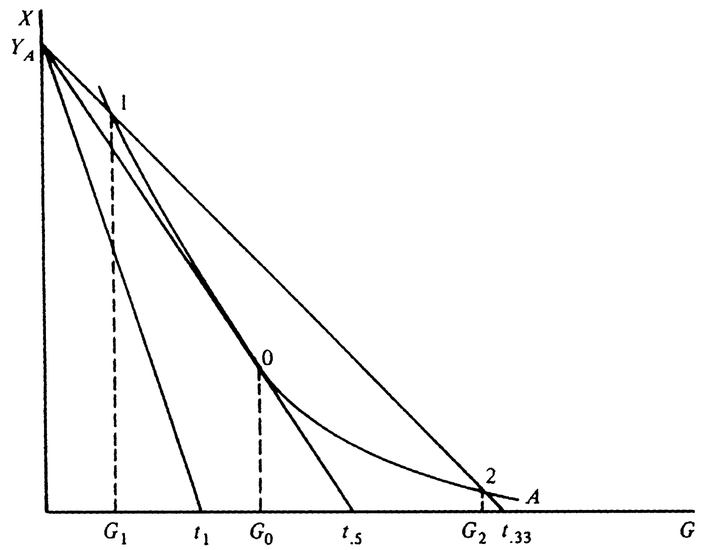

Figure 4.1. Optimal quantities for a voter at different tax prices.

line would be $Y_A t_1$. If A must pay only half of the cost of the public good, his budget constraint line would be $Y_A t_{.5}$, and so on. With a tax share of 0.5 A's optimal choice for a quantity of public good would be G_0. Note, however, that the tax–public good combinations $(t_{.33}, G_1)$ and $(t_{.33}, G_2)$ are on the same indifference curve as $(t_{.5}, G_0)$, and that one could calculate an infinite number of tax–public good quantity combinations from Figure 4.1 that lie upon indifference curve A. It is thus possible to map indifference curve A into a public good–tax space (Johansen, 1963).

Figure 4.2 depicts such a mapping. Points 0, 1, and 2 in Figure 4.2 correspond to points 0, 1, and 2 in Figure 4.1. Indifference curve A in Figure 4.2 is a mapping from the corresponding curve of Figure 4.1.

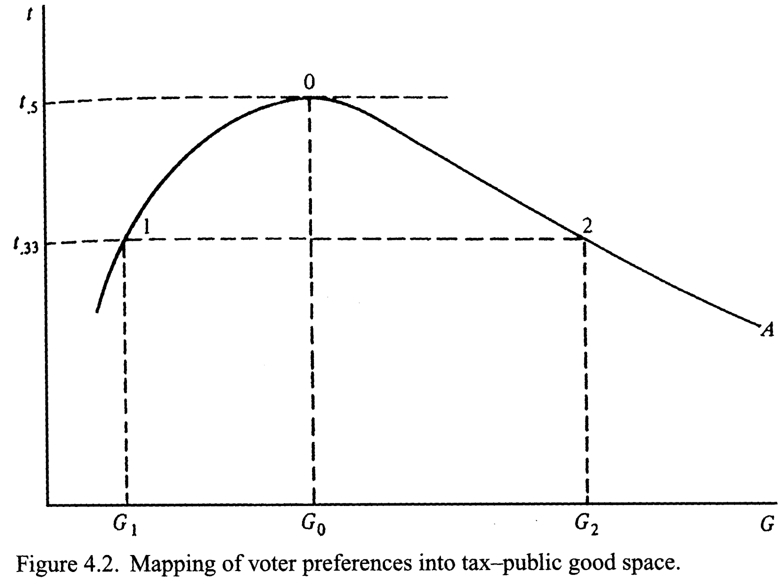

Figure 4.2. Mapping of voter preferences into tax–public good space.

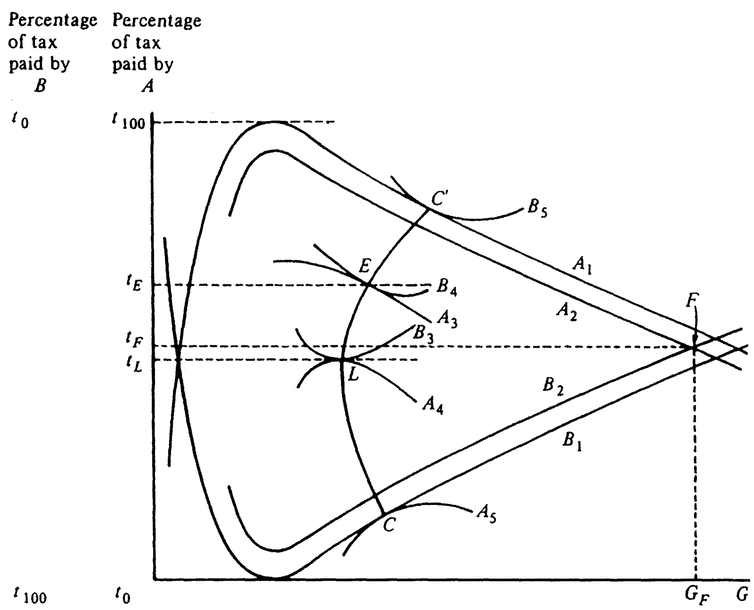

Figure 4.3. Contract curve in public good–tax space.

To map all points from Figure 4.1 into public good–tax space, we redefine each individual's utility function in terms of G and t alone. From the budget constraint, we obtain

$$\begin{aligned} X_A &= Y_A - tG \\ X_B &= Y_B - (1-t)G. \end{aligned} \tag{4.1}$$

Substituting from (4.1) into each individual's utility function, we obtain the desired utility functions for A and B defined over G and t:

$$\begin{aligned} U_A &= U_A(Y_A - tG, G) \\ U_B &= U_B(Y_B - (1-t)G, G). \end{aligned} \tag{4.2}$$

Figure 4.3 depicts a mapping of selected indifference curves for A and B from public good–private good space into public good–tax space. A's share of the cost of the public good runs from 0, at the bottom of the vertical scale, to 1.0 at the top. B's tax share runs in the opposite direction. Thus, each point in Figure 4.3 represents a set of tax shares sufficient to cover the full cost of the quantity of public good at that point. Each point is on an indifference curve for A, and one for B. Embedded in each point is a quantity of private goods that each individual consumes as implied by his budget constraint (4.1), the quantity of the public good, and his tax share. A_1 and B_1 are the levels of utility, respectively, if each individual acted alone in purchasing the public good, and thus bore 100 percent of its cost.[1] Lower curves for A (higher for B) represent higher utilities. The set of tangency points between A's and B's indifference

[1] To simplify the discussion, we ignore spillovers from one individual's unilateral provision of the public good on the other's utility. One might think of the public good as a bridge across a stream. A_1 and B_1 represent the utilities that each individual can obtain if each builds his own bridge. Within A_1 and B_1 are points of higher utility for both that can be obtained by cooperating and building but one bridge.

curves, CC', represents a contract curve mapping the Pareto-possibility frontier into the public good–tax share space.

To see that each point on CC' is a Pareto-efficient allocation, take the total differentials of each individual's utility function with respect to t and G, holding the initial incomes (Y_A, Y_B) constant:

$$\begin{aligned} \Delta U_A &= \frac{\partial U_A}{\partial X}(-t)dG + \frac{\partial U_A}{\partial G}dG + \frac{\partial U_A}{\partial X}(-G)dt \\ \Delta U_B &= \frac{\partial U_B}{\partial X}(-1+t)dG + \frac{\partial U_B}{\partial G}dG + \frac{\partial U_B}{\partial X}(G)dt. \end{aligned} \tag{4.3}$$

Setting the total change in utility for each individual equal to zero, we can solve for the slope of each individual's indifference curve:

$$\begin{aligned} \left(\frac{dt}{dG}\right)^A &= \frac{\partial U_A/\partial G - t\partial U_A/\partial X}{G(\partial U_A/\partial X)} \\ \left(\frac{dt}{dG}\right)^B &= -\frac{\partial U_B/\partial G - (1-t)\partial U_B/\partial X}{G(\partial U_B/\partial X)}. \end{aligned} \tag{4.4}$$

Equating the slopes of the two indifference curves, we obtain the Samuelsonian condition for Pareto efficiency (1954):

$$\frac{\partial U_A/\partial G}{\partial U_A/\partial X} + \frac{\partial U_B/\partial G}{\partial U_B/\partial X} = 1. \tag{4.5}$$

Now consider the following public choice process. An impartial observer proposes both a pair of tax shares, t_F and $(1 - t_F)$, and a quantity of the public good, G_F. If the combination falls within the eye formed by A_1 and B_1, both individuals prefer this proposal to share the cost of the public good to having to provide all of the public good themselves. Both will vote for it, if they vote sincerely. F now becomes the status quo decision and new tax share–quantity pairs are proposed.[2] When a combination falling within the eye formed by A_2 and B_2 is hit upon, it is unanimously preferred to F. It now becomes the status quo and the process is continued until a point on CC', like E, is obtained. Once this occurs, no new proposal will be unanimously preferred, that is, can make both individuals better off, and the social choice has been, unanimously, made.

Note that for the tax shares inherent in the allocation E, each individual's optimal quantity of public good differs from the quantity of the public good selected. A prefers less of the public good, B prefers more. Given the tax shares t_E and $(1 - t_E)$, therefore, each is being "coerced" into consuming a quantity of the public good that differs from his most preferred quantity (Breton, 1974, pp. 56–66). This form of coercion can be avoided under a slightly different variant of the voting procedure

[2] Of course, the rule for selecting a new tax share or a new public good–tax share combination in the procedure described above must be carefully specified to ensure convergence to the Pareto frontier. For specifics on the characteristics of these rules, the reader is referred to the literature on Walrasian-type processes for revealing preferences on public goods as reviewed by Tulkens (1978).

(Escarraz, 1967; Slutsky, 1979). Suppose, for an initially chosen set of tax shares t and $(1 - t)$, that voters must compare all pairs of public good quantities, and a given quantity is chosen only if it is unanimously preferred to all others. This will occur only if the two individuals' indifference curves are tangent to the tax line from t at the same point. If no such quantity of public good is found for this initially chosen t, a new t is chosen and the process repeated. This continues until a t is found at which all individuals vote for the same quantity of public good against all others. In Figure 4.3, this occurs at L for tax shares t_L and $(1 - t_L)$. L is the Lindahl equilibrium.

The outcomes of the two voting procedures just described (E and L) differ in several respects.[3] At L, the marginal rate of substitution of public for private goods for each individual is equal to his tax price:

$$\frac{\partial U_A/\partial G}{\partial U_A/\partial X} = t \qquad \frac{\partial U_B/\partial G}{\partial U_B/\partial X} = (1 - t). \tag{4.6}$$

L is an equilibrium then, in that *all* individuals prefer this quantity of public good to any other, *given each individual's assigned tax price*. E (or any other point reached via the first procedure) is an equilibrium in that at least one individual is worse off by a movement in any direction from this point. Thus, L is preserved as the collective decision through the unanimous *agreement* of all committee members on the quantity of public good to be consumed, *at the given tax prices*; E is preserved via the *veto power* of each individual under the unanimity rule. How compelling these differences are depends on the merits of constraining one's search for the optimum public good quantity to a given set of tax shares (search along a given horizontal line in Figure 4.3). The distribution of utilities at L arrived at under the second process depends only on the initial endowments and individual preferences, and has the (possible) advantage of being independent of the sequence of tax shares proposed, assuming L is unique. The outcome under the first procedure is dependent on the initial endowments, individual utility functions, *and* the specific set and sequence of proposed tax–public good combinations. Although this "path dependence" of the first procedure might be thought undesirable, it has the (possible) advantage of leaving the entire contract curve CC' open to selection. As demonstrated above, all points along CC' are Pareto efficient, and thus cannot be compared without additional criteria. It should be noted in this regard that if a point on CC', say, E, could be selected as most preferred under some set of normative criteria, it could always be reached via the second voting procedure by first redistributing the initial endowments in such a way that L was obtained at the utility levels implied by E (McGuire and Aaron, 1969). However, the informational requirements for such a task are obviously considerable.

We have sketched here only two possible *voting* procedures for reaching the Pareto frontier. Several papers have described Walrasian/tâtonnement procedures for reaching it when public goods are present. These all have a "central planner" or "auctioneer" who gathers information of a certain type from the citizen-voter,

[3] For a detailed discussion of these differences, see Slutsky (1979).

processes the information by a given rule, and then passes a message back to the voters to begin a new round of voting. These procedures can be broadly grouped into those in which the planner calls out tax prices (the ts in the preceeding example), and the citizens respond with quantity information – the process originally described by Erik Lindahl (1919) (see also Malinvaud, 1970–1, sec. 5); and those in which the planner–auctioneer calls out quantities of public goods and the citizens respond with price (marginal rate of substitution) information, as in Malinvaud (1970–1, secs. 3 and 4) and Drèze and de la Vallée Poussin (1971). A crucial part of all of these procedures is the computational rule used to aggregate the messages provided by voters and generate a new set of signals. It is this rule that determines if, and when, and where on the Pareto frontier the process leads. Although there are obviously distributional implications to these rules, they are in general not designed to achieve any specific normative goal. The planner–auctioneer's single end is to achieve a Pareto-efficient allocation of resources. These procedures are all subject to the same important distinction as to whether they allow the entire Pareto frontier to be reached or always lead to an outcome with a given set of conditions, like the Lindahl equilibrium. As such, they also share the other general properties of the unanimity rule.

4.2 Criticisms of the unanimity rule

The unanimity rule is the *only* voting rule certain to lead to Pareto-preferred public good quantities and tax shares, a feature that led Wicksell (1896) and later Buchanan and Tullock (1962) to endorse it. Two main criticisms have been made against it. First, a groping search for a point on the contract curve might take considerable time, particularly in a large community of heterogeneous tastes (Black, 1958, pp. 146–7; Buchanan and Tullock, 1962, ch. 6). The loss in time by members of the community in discovering a set of Pareto-optimal tax shares might outweigh the gains to those who are saved from paying a tax exceeding their benefits from the public good. An individual who was uncertain over whether he would be so "exploited" under a less than unanimity rule might easily prefer such a rule rather than spend the time required to attain full unanimity. The second objection against a unanimity rule is that it encourages strategic behavior.[4] If A knows the maximum share of taxes that B will assume rather than go without the public good, A can force B to point C on the contract curve, by voting against all tax shares greater than t_C. All gains from providing the public good then accrue to A. If B behaves the same, the final outcome is dependent on the bargaining strengths of the two individuals. The same is true of the other equilibria along the contract curve (Musgrave, 1959, pp. 78–80). Bargaining can further delay the attainment of the agreement as each player has to "test" the other's willingness to make concessions.

The "bargaining problem" under the unanimity rule is the mirror image of the "incentive problem" in the voluntary provision of a public good. The latter is a direct consequence of the joint supply–nonexclusion properties of a public good. Given

[4] See Black (1958, p. 147), Buchanan and Tullock (1962, ch. 8), Barry (1965, pp. 242–50), and Samuelson (1969).

these properties, each individual has an incentive to understate his preferences and free-ride, since the quantity of public good provided is largely independent of his single message. The literature on voluntary preference revelation procedures has by and large sidestepped this problem by assuming honest preference revelation in spite of the incentives to be dishonest. The strongest analytic result to justify this assumption has been that sincere message transmittal is a minimax strategy; that is, sincere revelation of preferences maximizes the minimum payoff that an individual can obtain (Drèze and de la Vallée Poussin, 1971). But a higher payoff might be obtained through a misrepresentation of preferences, and some individuals can be expected to pursue this more daring option. If to remove this incentive one compels all citizens to vote in favor of a public good quantity–tax share proposal before it is provided, the free-rider problem disappears. Each individual's vote is now essential to the public good's provision. This reversal in the individual's position in the collective decision alters his strategic options. Where an individual might, under a voluntary revelation scheme, gamble on the rest of the group providing an acceptable quantity of the public good without his contributing, under the unanimity rule he might gamble on the group's reducing the size of his contribution rather than risk his continual blocking of the collective outcome. Although the strategy options differ, both solutions to the public good problem are potentially vulnerable to strategic behavior.

Experimental results of Hoffman and Spitzer (1986) and Smith (1977, 1979a,b, 1980) indicate that strategic bargaining on the part of individuals in unanimity rule situations may not be much of a problem. The Hoffman-Spitzer experiments were designed to see whether the ability of individuals to achieve Pareto-optimal allocations in Coase-type externality situations deteriorates as the number of affected parties increases. Since all affected parties had to agree to a bargain before it could be implemented, the experiments essentially tested whether strategic bargaining by individuals would overturn Pareto-optimal allocation proposals under the unanimity rule. Hoffman and Spitzer (1986, p. 151) found that "if anything, efficiency improved with larger groups" (with groups as large as 20 on a side).

Even if strategic behavior does not thwart or indefinitely delay the achievement of a unanimous decision, one might object to the unanimity rule on the grounds that the outcome obtained depends on the bargaining abilities and risk preferences of the individuals (Barry, 1965, p. 249; Samuelson, 1969). Such a criticism implicitly contains the *normative* judgment that the proper distribution of the gains from cooperation *should not* be distributed according to the willingness to bear risks. One can easily counter that they *should*. An individual who votes *against* a given tax share to secure a lower one risks, under a unanimity rule, not having the good provided at all, or if so in a less than optimum quantity. Voting in this manner expresses a low preference for the public good, in much the same way as voting against the tax share does, because it is "truly" greater than the expected benefits. Someone not willing to vote strategically might be said to value the public good higher, and therefore perhaps ought to be charged a higher price for it.

We are clearly in the realm of normative economics here, as we were in comparing points E and L, and need criteria as to how the gains from cooperation *ought* to be shared.[5] Indeed, in a full evaluation of the unanimity rule its normative properties must be considered. Wicksell's advocacy of the unanimity rule was based on its normative properties. The unanimity rule would protect individuals from being coerced by other members of the community, he argued. Wicksell used "coerced" not in the sense employed by Breton, who took it to mean having a different evaluation of the public good *at the margin* from one's tax price, but in the sense of being coerced through a collective decision to pay more for a public good than its benefits are in toto. This argument for the unanimity rule stems directly from Wicksell's view of the collective choice process as one of mutually beneficial voluntary exchange among individuals, as is Buchanan and Tullock's (1962) (see also Buchanan, 1975b). This emphasis on the "voluntary exchange" nature of collective choice underlies the classic essays by both Wicksell and Lindahl and forms an intellectual bond between them, leading in Wicksell's case to the unanimity principle, and in Lindahl's to a set of tax prices equal to each individual's marginal evaluation of the public good. It also explains the reference to "just" taxation in the titles of each of their essays. We shall return to these issues in Chapter 6.

4.3 The optimal majority

When a less than unanimous majority is sufficient to pass an issue, the possibility exists that some individuals will be made worse off via the committee's decision; Wicksell's coercion of the minority can take place. If the issue is of the public good–prisoners' dilemma variety, and there exist reformulations of the issue that could secure unanimous approval, the use of a less-than-unanimity rule can be said to impose a cost on those made worse off by the issue's passage, a cost that could be avoided through the expenditure of the additional time and effort required to redefine the issue so that its passage benefits all. This cost is the difference in utility levels actually secured and those that would have been secured under a full unanimity rule. Buchanan and Tullock were the first to discuss these costs and refer to them as the "external costs" of the decision rule (1962, pp. 63–91; see also Breton, 1974, pp. 145–8).

Were there no costs associated with the unanimity rule itself, it would obviously be the optimal rule, since it minimizes these external decision costs. But the time required to define an issue in such a way as to benefit all may be considerable. In addition to attempting to find a formulation of the proposal benefiting all, time may be required to explain the nature of the benefits of the proposal to some citizens unfamiliar with its merits. On top of these costs must be added the time lost through the strategic maneuvering that might take place as individuals jockey for more favorable positions along the contract curve, as described earlier.

Most observers, including those most favorably disposed toward the unanimity rule like Wicksell and Buchanan and Tullock, have considered these latter costs sufficiently large to warrant abandoning this rule. If all need not agree to a committee decision, what percentage should agree? The preceeding considerations suggest a trade-off between the external costs of having an issue pass against which the

[5] At least two normative proposals for sharing these gains are dependent on the bargaining or risk preferences of the individuals (Nash, 1950; Braithwaite, 1955).

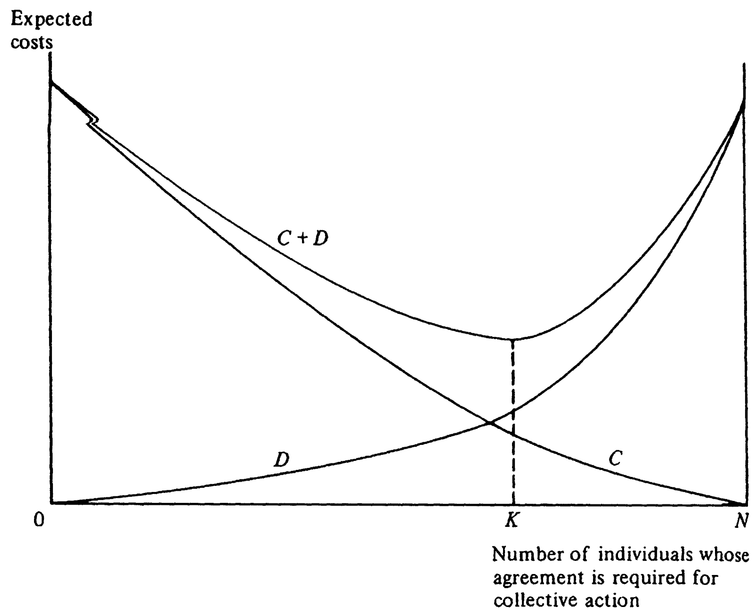

Figure 4.4. Choosing the optimal majority.

individual is opposed, and the costs of time lost through decision making. At the one pole stands unanimity, under which any individual can block any agreement until he has one with which he is satisfied, or which he feels is the best he can obtain. The external decision costs under this rule are zero, but the decision time costs may be infinite. At the other extreme, each individual decides the issue alone. No delays may occur, as with a pure private good decision, but the external costs of allowing each individual to decide unilaterally for the community are again potentially infinitely large.

These various possibilities are depicted in Figure 4.4, which is taken from Buchanan and Tullock (1962, pp. 63–91). The costs of a particular collective decision are presented along the vertical axis; the number of people 0 up to N, the committee size, required to pass the issue are presented along the horizontal axis. Curve C is the external cost function representing the expected loss of utility from the victory of a decision to which an individual is opposed under the committee decision rule. Curve D depicts the decision-time costs of achieving the required majority to pass the issue as a function of the size of the required majority. The optimal majority is the percentage of the committee at which these two sets of costs are together minimized. This occurs at K, where the vertical addition of the two curves reaches a minimum. The optimal majority to pass the issue, given these cost curves, is K/N. At this percentage, the expected gain in utility from redefining a bill to gain one more supporter just equals the expected loss in time from doing so.

Since these costs are likely to differ from issue to issue, one does not expect one voting rule to be optimal for all issues. The external costs will vary depending on both the nature of the issues to be decided and the characteristics of the community deciding them. Ceteris paribus, when opinions differ widely or information is scarce, lengthy periods of time may be required to reach a consensus, and if the likely costs to opposing citizens are not too high, relatively small percentages of the community might be required to make a decision. Again, the extreme example here is the pure private good. In contrast, issues for which large losses can occur are likely to require higher majorities (for example, issues pertaining to the Bill of Rights).[6] The larger the community, the greater the number of individuals with similar tastes and, thus, the easier it is likely to be to achieve a consensus among a given *absolute* number of individuals. Thus, an increase in N should shift the curve D rightward and downward. But the fall in costs of achieving a consensus among a given number is unlikely to be fully proportional to the rise in community size. Thus, for issues of a similar type, the optimal *percentage* of the community required to pass an issue K/N is likely to decrease as the community increases in size (Buchanan and Tullock, 1962, pp. 111–16).

Individuals whose tastes differ widely from most others in the community can be expected to favor more inclusive majority rules. Individuals with high opportunity costs of time should favor less inclusive majority rules. Buchanan and Tullock assume that the choice of the optimal majority for each category of issues is made in a constitutional setting in which each individual is uncertain over his future position, tastes, and so on. Therefore, each views the problem in the same way, and a unanimous agreement is achieved as to which less-than-unanimity rule to use for each set of issues. When such a consensus does not exist, the knotty question that must be faced is what majority should be required to decide what majorities are required on all other issues? Having now faced this question, we shall move on.

4.4 A simple majority as the optimal majority

The method of majority rule requires that at least the first whole integer above $N/2$ support an issue before it becomes the committee decision. Nothing we have said so far indicates why $K/N = N/2$ should be the optimal majority for the bulk of a committee's decisions; and yet it is the voting rule of choice across the world from parliamentary assemblies down to the local meeting of the Parent-Teacher Association. As Buchanan and Tullock (1962, p. 81) note, for any one rule, such as the majority rule, to be the optimal majority for a wide class of decisions, there must exist some sort of a kink in one of the cost functions at the point $N/2$, causing the sum of two curves to obtain a minimum in a substantial proportion of the cases at this point.

A possible explanation for a kink in the decision-making cost curve, D, at $N/2$ can be obtained by considering further the internal dynamics of the committee decision process. When less than half of a committee's membership is sufficient to pass an issue, the possibility exists for both the issue A and the issue's converse ($\sim A$) to pass. Thus, a proposal to increase school expenditures by 10 percent might first achieve a winning majority (of, say, 40 percent) and a counterproposal to cut expenditures by 5 percent may also receive a winning majority. The committee could, when less than half of the voters suffice to carry an issue, become deadlocked in an endless series of offsetting proposals absorbing the time and patience of its members. The method of simple majority rule has the smallest possible required majority to pass

[6] In Chapter 26 a more formal and general analysis of the constitutional choice of a voting rule is presented.

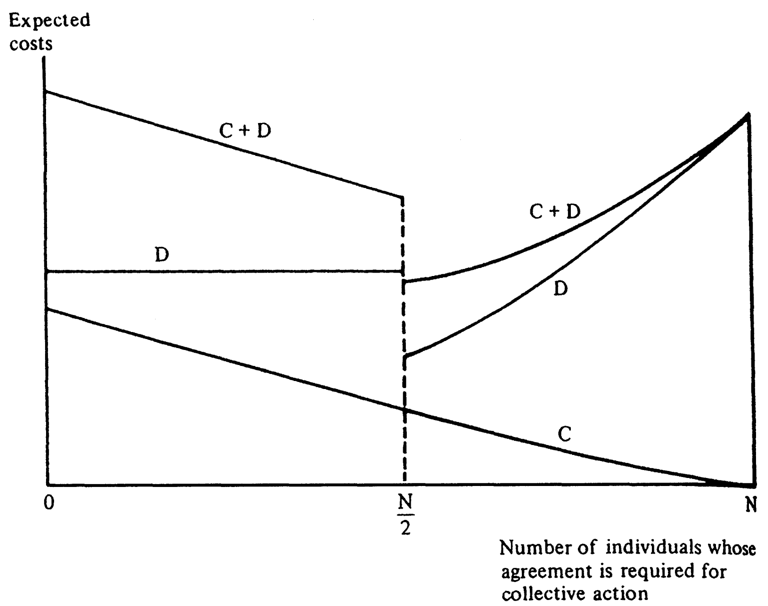

Figure 4.5. Conditions favoring a simple majority as the optimal majority.

an issue, which avoids the possibility of self-contradictory issues simultaneously passing (Reimer, *1951*).

In Figure 4.5, decision cost and external cost curves have been drawn such that their minimum would lie to the left of $N/2$ were D to continue to decline as it moves leftward from $N/2$. But the D curve is higher to the left of $N/2$ owing to the extra decision costs of having conflicting issues pass. This portion of the D curve has been drawn as a straight line, but it could conceivably be U- or inverted U-shaped to the left of $N/2$. The discontinuity at $N/2$ makes this majority the optimal majority for this committee.[7]

[7] Tullock (1998, pp. 16–17, 93–94) has objected to my rationalization of the universal popularity of the simple majority rule by positing a discontinuity in the decision-costs curve. He cites presidential elections in the United States and parliamentary elections in the United Kingdom as examples of the application of less than majority rules, because U.S. presidents are occasionally elected without receiving a majority of the popular vote, and the party that wins a majority of seats in the British House of Commons almost never receives a majority of the votes cast. But these are examples of *electoral* rules that can convert less than a majority of the popular vote into the victory of a candidate or party. We are concerned here with the choice of a *committee voting rule*. Neither the House of Commons nor either of the two houses of the U.S. Legislature employ a less than 50 percent majority rule, nor am I aware of any committee that does so, nor does Tullock give an example of such a committee. Indeed, if the British Parliament employed, say, a 40 percent majority to pass legislation, then a party that failed to win a majority of the seats in an election would not necessarily "lose" the election. As long as it got more than 40 percent of the seats, it, along with the "winning" party, could pass legislation.

More fundamentally, however, Tullock misses the whole point of the argument. *If* constitutional conventions choose parliamentary voting rules by weighing the external and decision-making costs of each rule, as Buchanan and Tullock first posited, *then* there is *no way* to explain the ubiquitous use of the simple majority rule *without* the existence of a kink or discontinuity in one of the two curves at $K/N = N/2$. If the discontinuity is not in D, then it must be in E.

An alternative way to explain the popularity of the simple majority rule would, of course, be to abandon the kind of cost calculus that Buchanan and Tullock introduced. We shall examine other criteria for choosing the simple majority rule in Chapter 6. In Chapter 26 we integrate the two approaches.

Absent a discontinuity in D, a minimum for $C + D$ only occurs to the left of $N/2$ when the D curve rises more rapidly as it moves to the right than C does moving to the left; that is, decision costs vary much more over the range of committee sizes than do the external costs of collective decision making. $N/2$ is the optimal majority for the committee because of the discontinuity in the D curve. Thus, the choice of $N/2$ as the optimal majority is driven by the shape of the D curve. The method of simple majority rule will be selected as *the* committee decision rule by a committee whose members place a relatively high value on the opportunity costs of time. Were it not for the loss of time involved in having conflicting proposals like A and $\sim A$ pass, the minimal cost majority for the committee would be less than 0.50. The simple majority is optimal because it is the smallest majority one can select and still avoid having conflicting proposals both obtain winning majorities.

Speed is not the majority rule's only property, however. So important is the simple majority rule as a voting procedure that we shall devote most of the next two chapters to discussing its other properties.

Bibliographical notes

Tulkens (1978) presents an excellent review of the literature on tâtonnement procedures for revealing preferences on public goods. Milleron (1972) reviews the literature on public goods more generally.

The seminal discussions of the "voluntary exchange" approaches of Lindahl and Wicksell are by Musgrave (1939) and Buchanan (1949). See also Head (1964).

The relationship between Wicksell's voting theory and the Lindahl equilibrium is taken up by Escarraz (1967), who first described a way in which the Lindahl equilibrium could be reached under a unanimity voting rule. Escarraz argues that the unanimity rule was a necessary assumption underlying Lindahl's belief that the equilibrium would be reached and might have been implied in Lindahl's concept of an "even distribution of political power." Under this interpretation, Lindahl's even distribution of political power, Wicksell's freedom from coercion, the unanimity rule, and a set of tax prices equal to the marginal rates of utility for the public good all become nicely integrated.