Working Paper No. 299

The Public Commodities Problem

by
Karl Widerquist
Jerome Levy Economics Institute

March 2000

Thanks to David Levy, Frances Spring, L. Randall Wray, Ajit Zacharias, Marc-André Pigeon, Jamee K. Moudud, S Jay Levy, Lynndee Kemmet, Stephanie Bell, and the staff of the Levy Forecasting Center.

When it becomes necessary to do a thing the whole heart and soul should go into the measure.
-Thomas Paine

If you're gon'a love me, love me right.
-Jerry Lee Lewis

Things that are not worth doing, are not worth doing well.
-Harry Johnson

One person's public good is another's public bad and so, perhaps, the public goods problem could be more generally described as the public *commodities* problem,[1] in which disagreement about the basic goal of a spending program complicates the decision of how much to spend to achieve that goal. Although public goods spending is a continuous variable, it often has a binary goal such as win a war, deter crime, provide transportation, or reduce poverty. To decide how much spending is necessary, society must answer both a normative and a positive question: Normatively, should the government adopt the goal of this spending program? Positively, given this spending program's goal, what is the optimal level of spending?[2] If the answer to the first question is yes, it may be desirable that the actual level of spending be set at the level that would be optimal given that goal, but spending may not be set at that level. This paper uses the median voter theorem to demonstrate that those who do not believe the government should pursue the goal and those who believe that the government can achieve the goal with relatively less spending can form a coalition to keep spending at a level below which most supporters (and possibly most citizens) believe is objectively the optimal amount of spending. Thus, even if voters have rational expectations about the amount necessary to achieve a goal, disagreement about whether or not to pursue the goal can cause underfunding bias.

The median voter theorem has been used as a tool to examine the level of spending on public goods since developed and refined by Bowen (1944) and Black (1958) based on the original work by Hotelling (1929). It can be stated rather simply: on one dimensional issue, about which voters have single-peaked preferences, the median voter's position cannot lose under simple majority rule.[3] As long as all citizens vote, this result is strategy proof and holds true for any distribution of preferences (Mueller 1989, Ching 1997). There has been considerable discussion about if and when the median voter theorem holds, and if representatives' actions reflect the opinions of the median voter.[4] But that debate is not important for this paper, the problems in this paper can exist whether representatives vote according to their own ideology or their constituents' wishes.

The median voter theorem can explain why nearly everyone can be dissatisfied with the level of spending passed by majority vote, but it offers the positive result that at least the outcome is right in the middle of the population; for every person who thinks there is too much spending there is another person who thinks there is too little. Most if not all of the literature on the median voter theorem does not seem to address the difference between a theory that half of the population believes spending is less than it should be and half of the population believes spending is more than it should be; and a theory that implies that half of the population thinks that spending is more than would be optimal given the project's goal and half thinks spending is less than optimal given the projects goal. One might be tempted to believe that one implies the other, but the intent of this paper is to show that it does not. From a positive standpoint, more of the population will believe the project is underfunded than believe it is overfunded, even though from a normative standpoint half believe it is overfunded and half believe it is underfunded.

This paper is organized as follows. The first section discusses how differences of opinion about whether the goal of a project, even if acceptable, can lead to underfunding. The second section examines under what conditions this problem will occur and discusses how much underfunding it can cause. The third section discusses some of the implications of these findings. The final section concludes.

THE PROBLEM

The normative question (should the government adopt the goal of this spending program?) has a binary distribution of preferences as shown in Figure 1. Either a voter views the goal positively or negatively; that is, either a voter is a supporter or an opponent of the basic goal of the program. Supporters of a government spending project agree with its goal, view it as a public good, and favor some positive amount of spending on it, although they may disagree about how much spending is optimal. Opponents always prefer less spending to more, because they believe that the goal of the proposed project has negative value. That is, they view the project as a public bad rather than a public good. They prefer no spending at all on the project and, in fact, may be willing to spend money to keep the goal from being achieved.[5]

Assume that voters' opinions on the positive question (if this is the government's goal, what would be the optimal level of spending?) approximately follow a normal distribution as shown in Figure 2. The median of this distribution cannot be called the median voter because there is no vote solely on this positive issue, and if there were such a vote, it would be unlikely that people would reveal their preferences honestly. This median is simply the median opinion on the objective question of how much spending would be necessary if the government were to pursue this goal.

Combining the two questions would break up the normally distributed population on the positive issue into two populations of supporters and opponents.[6] Supporters' preference functions peak in the positive range, and opponents' preference functions peak in the negative range. The preferences of five voters are displayed in Figure 3a. Voters A and B are opponents; C, D, and E are supporters. Because preference functions are assumed to be single-peaked, only the peaks are shown. Preferences of opponents peak in the negative range, which can be interpreted as the amount that a voter would have to be compensated to be just as well off if this goal were achieved, or as the amount the voter would be willing to spend to prevent this goal from being achieved. The interpretation of a negative preference is not important because spending is restricted to be nonnegative. If a majority of citizens oppose the goal of the program, spending is fixed at zero. The problems discussed in this paper occur when a majority of citizens are supporters, but opponents are able to affect the level of spending. C, D, and E are a majority coalition that can ensure this goal can be pursued, but A, B, and C can form a majority coalition that can ensure that spending will be only M*.

Figure 3b represents a similar situation for a large population; in presents the frequency distribution

of the bliss points of supporters and opponents. The bimodal distribution of the entire population is approximated by two normal distributions. Assume for simplicity that supporters are approximately normally distributed around M^S which is the median, mode, and mean of supporters, and that opponents are approximately normally distributed around M^O, which is the median, mode, and mean of opponents. M* is the population median which is not the population mode and may or may not be the population mean.

The median voter theorem holds regardless of distribution of preferences (Mueller 1989), but when a significant portion of the population opposes the goal, those supporters who favor the least amount of spending have the decisive vote on the level of spending. In figure 3a a coalition of supporters (voters C, D, and E) can assure that some positive level of spending passes. But, a coalition of the two opponents and the least enthusiastic supporter (voters A, B, and C) can limit spending to M*, the population median. This is the electorate's answer to the combined question of how much *should* the government spend to achieve this goal, but what relationship does this have the positive question of what would be the optimal level of spending given the government's goal? If voters have rational expectations, then the best estimate of the optimal amount of spending toward this goal is the level associated with the median supporter (M^S). But as long as some voters are opponents and supporters disagree about the optimal level of spending, the population median will be below the amount associated with the median supporter ($M^* < M^S$). If the median supporter has a rational expectation about needed spending, the median voter (M*) is likely to be a supporter who has underestimated the optimal level of spending.

The opponents (A and B) may agree that M^S would be optimal given the goal of the program, but because they oppose the goal, they have no desire to achieve the optimal level of spending given that goal. A majority coalition of all supporters votes yes to pursue the goal, but a coalition of opponents and relatively less enthusiastic supporters limits spending at a level that most supporters believe is suboptimal given that goal. Thus, it could be that a majority and perhaps a large majority voters, supporters and opponents alike, agree that a less-than-optimal amount of funds are devoted to achieving this project's goal, but spending remains where it is because this majority is split between those who believe this spending is inefficient and should be eliminated, and those who believe the project should be funded more generously.

This result is very different than those derived in much of the public choice literature. Although voters have rational expectations, and the median voter theorem holds, there is a bias toward underfunding government spending programs. When this problem can occur and how much underspending bias it can create is the subject of the next section.

THE EXTENT OF THE PROBLEM

The median voter's position will be in the range that is greater than or equal to zero and less than or equal to the median of supporters (M^S). M* will be less than or equal to M^S and, no matter what the distribution of preferences, the population median cannot be greater than the median of supporters; the bias is solely in the direction of underfunding.

Supporters who prefer less than the median voter can be called "satisfied supporters" in the sense that they believe that spending is equal to or greater than the optimal level, although they may be distinctly unsatisfied with the fact that more is being spent than necessary. Supporters who prefer more spending than the median voter can be called "unsatisfied supporters" in the sense that they believe that spending is less than the optimal level. If all voters are supporters, half of the population are unsatisfied supporters, half are satisfied supporters. In the situation describe in this paper, half of the population are unsatisfied supporters, but only a minority are satisfied supporters. Many or most of those who prefer less spending than the median voter are opponents who prefer no spending at all.

This outcome is substantively different than the case of bimodally distributed preferences when all voters are supporters (Figure 4). In this case the population median voter (M*) lies in between the mode of people who prefer a relatively high amount of spending (M^H) and people who prefer a relatively low amount of spending (M^L), but all voters are supporters in the sense that they all prefer a positive level of spending. In both cases, very few voters want a level of spending close to the amount chosen by the median voter. In both cases, the result holds that half of the population want more spending than the median voter and half want less. But, the proposition that half of the voters think the project has more than optimal spending holds only in the case in which all voters are supporters.

It should be noted that the results in this paper rely on the median voter theorem's assumption that voters have single-peaked preferences. One could imagine someone who preferred zero spending to any positive level but would rather see the project funded optimally than partially. If so he would have a second peak to his preference function as voter A in Figure 4. Such a distribution of preferences could lead to cycling (see Mueller 1989), but that is not the focus of this paper. The problem here is a stable, but not necessarily desirable, equilibrium.

This sort of a financing problem is more likely the larger the minority of opponents and the larger the disagreement among supporters about the optimal level of spending. If the majority of voters are opponents, spending is zero and no public commodities problem exists. If all voters are supporters the population median is identical to the median of supporters, and no public commodities problem exists. Even with a slim majority of supporters, as long as all supports agree on the same amount of spending, the population median will equal the median of supporters and no public commodities problem exists. If, however, there is significant disagreement among supporters about the optimal level of spending and a significant minority of opponents, the difference between the median of supporters and the population median can be substantial.

Table 1 summarizes the difference between the median of supporters (M^S) and the population median (M*) for selected percentages of support, assuming supporters are approximately normally distributed around M^S, and opponents are approximately normally distributed around M^O as in figure 3b.[7] The first column shows the percentage of the population who are supporters (the percentage of the population with preferences that peak to the positive range). The second column shows (M^S—M*) the difference between the median of supports (M^S) and the population median (M*) in standard deviations of the distribution of supporters. The third column shows the percentage of the population who are satisfied supporters (the area under the curve between 0 and M*). The fourth column shows the satisfied supporters as a percentage of supporters. As always in the median voter theorem, 50 percent of the population are unsatisfied supporters (the area under the curve above M*), so long as more than 50 percent of the population are supporters. If less than 50 percent are supporters, spending is zero.

Table 1Satisfaction of Median of Supporting Voters and Population Median for Selected Percentages of Support

Supporters (percent of total population)	M^S-M*	Satisfied supporters (percent of total population)	Satisfied supporters (percent of supporters)
100	0	50	50
90	0.14	40	44
80	0.32	30	38
75	0.44	25	33
70	0.57	20	29
65	0.74	15	23
60	0.96	10	17
58	1.09	8	14
56	1.25	6	11
54	1.45	4	7
52	1.77	2	4
51	2.06	1	2
less than 50	-	0	0

Source: Author's calculations from standard math table.

Figure 6 graphs the figures given in selected rows of Table 1. In 6a, all voters are supporters, 50 percent are satisfied and 50 percent are unsatisfied. In 6b, 75 percent of voters are supporters, but only 25 percent of all voters are satisfied supporters, and the population median is 0.44 standard deviations[8] below the median of supporters. In 6c, 60 percent of voters are supporters, but only 10 percent of voters are satisfied supporters. Only 17 percent of supporters believe the program is funded adequately, and the population median is 0.96 standard deviations below the median of supporters. In 6d, only a 51 percent majority are supporters. Only 1 percent of voters, and 2 percent of supporters are satisfied supporters, and the amount of spending actually approved is more than two standard deviations below the level the median supporter believes is optimal. In 6e, the majority of voters are opponents, spending is set at zero, and the public commodities problem disappears.

The table and graphs reveal that the public commodities problem can be quite significant: Even with a three-fifths majority support, spending is nearly one standard deviation below the amount that the median supporter believes is optimal, and only one-tenth of the total population both support the program and believe it is optimally or more than optimally funded. This is quite different from the usual interpretation of the median voter theorem in which half of the population believes spending is above the optimal level and half believes it below the optimal level. It is crucial to realize that if this is the case the position of the median voter does not depend solely on what voters believe is the optimal level of spending, but also on the portion of voters who support the goal. The position of the median voter can change without anyone changing their opinion about the optimal level of spending, if a significant portion of voters switch their opinions from support to opposition or vice versa.

HISTORICAL EXAMPLES

Historical examples of the public commodities problem may have included the spending cuts undertaken during the Reagan administrations, the death penalty, and the Vietnam War. World War II could be an example of a case in which the public commodities problem did not apply. The Second World War had overwhelming support, and nearly all supporters agreed that a high level of spending was necessary to achieve the goal of winning the war. Thus, the difference between the median supporter and the population median was insignificant or nonexistent. Hardly anyone could argue that spending on defense during World War II was less than optimal. In the case of the Vietnam War, however, the United States was divided between supporters and opponents of military involvement and supporters themselves were divided between those supporting limited and larger involvement. Just as this theory predicts, the country stuck to a strategy of limited involvement even after it became apparent to many that this strategy would not achieve its goal. Few believed limited involvement would work, but there was not enough support for either greater involvement or a complete pullout. Today there is wide agreement that the level of U.S. involvement in Vietnam was wrong, but the question of whether more or less involvement would have been desirable is still controversial.

The death penalty exists in most U.S. states, but in most of those states legal barriers exist so that only a few prisoners are executed each year. This could be the result of legal roadblocks put up by a coalition of death penalty opponents and the least enthusiastic death penalty supporters. The disagreement among supporters is not about the level of funds needed to achieve the goal, but about extent to which the goal should be achieved.

In 1981, Ronald Reagan came to office promising to eliminate many social programs. He failed to eliminate all but one program, but he succeeded in reducing spending on a wide number of programs to the point that many supporters believed was not nearly enough to continue providing adequate services. If one were to explain this change in the level of spending using the traditional characterization of the median voter theorem, one would say that the entire distribution shifted to the left so that the most voters believed that less spending was necessary to achieve the goals of these programs, although there appeared to be no change in the supporter for the goals of those programs. This interpretation does not fit with the Reagan-era rhetoric of the desire to eliminate government programs. The failure to eliminate spending, but the success with cutting programs is better explained as a public commodities problem: More voters voters became opponents of social programs. The opponents had not become large enough to eliminate those programs, but they were large enough to reduce the size and effectiveness of those programs. Thus, the size of the programs was cut without there necessarily being any change in opinion on the level of spending required to achieve the programs' goals.

IMPLICATIONS

If the median voter theorem holds, and the electorate tends to be polarized into supporters and opponents, government would attempt to achieve many different goals, but fund many programs at suboptimal levels: long lines would appear at government offices, equipment would be poorly maintained, staff would be overworked. In short, the commonly observed government inefficiencies usually blamed on poor management or the lack of market discipline could be the results of too few resources devoted to government projects. What appear to be inefficiencies may merely be a reflection of the disagreement among voters about whether the government should pursue this goal.

Although this problem can be easily recognized, a solution is not easy to find. A large portion of the population will want to find a way to eliminate inefficient spending and a large portion will seek a way to increase spending to the optimal level. One possible solution would be a super-majority rule requiring, perhaps, a three-fifths majority to pass a spending program. This would not eliminate the spending level problem, but would eliminate programs that are least likely to be optimally funded. Better information could help if it allowed supporters to come to a closer agreement about the

optimal level of spending, but such information may not be readily available, and better information will not ensure an agreement.

One partial solution to the spending level problem is a body of elected officials could make mutually beneficial compromises. If a simple vote leads to suboptimal funding, opponents of one initiative who are supporters of another could agree either to fund both optimally or to fund neither. Vote trading is often viewed as a way representatives benefit themselves rather than their constituents, but in this case it could benefit constituents as well. Elected representatives also may have access to better information and may have less disagreement about what is the optimal level of expenditure. But a legislature is not immune to the problems discussed here and is subject to problems of its own.

One also cannot dismiss the possibility that the median voter is right: Perhaps attaining a goal inefficiently is a reasonable compromise for a population that is divided on an issue. However, given that the median voter is an outlier among supporters we cannot expect that he will always be right. If there is perfect information the worst outcome is that the goal will be achieved, but not as efficiently or as completely as most supporters would like. However, if there is imperfect information the public commodities problem can actually prevent the goal from being achieved, which, if nothing else, would be a tremendous waste of resources.

CONCLUSION

This paper has argued that voters tend to become polarized into supporters or opponents of the goal of a public good. The median voter (of the entire population), therefore, tends to be a supporter who prefers less spending than the median supporter. If supporters have rational expectations about the spending necessary to achieve the program's goal, the median supporter will on average be right about the optimal level of spending, and the median voter then will tend to be someone who has underestimated the optimal level. The position of the population median is not determined solely by the perceived costs and benefits of the program, but also by the number of people who support the goal. The larger the minority who opposes the program the farther median voter will be from the median supporter's optimal level of spending. Thus, even if individual voters do not make systematic errors in assessing the optimal level of funding, democratic governments will systematically fund programs at less than optimal levels.

Figure 1: The distribution of preferences on the question of whether the government should pursue a particular goal.

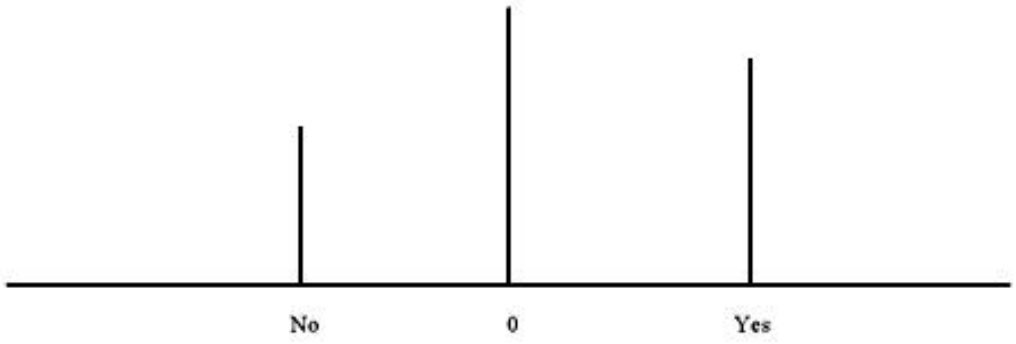


Figure 2: The distribution of voters' opinion on the question of if this was the government's goal, what would be the optimal level of spending?

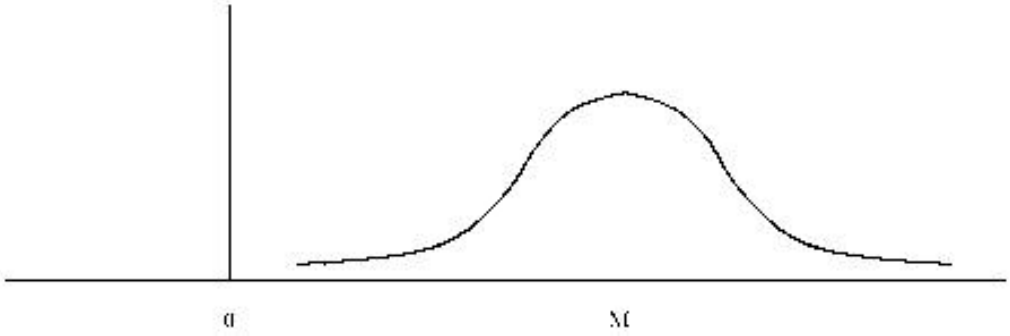


Figure 3a: The preference functions of five citizens, two opponents and three supporters.

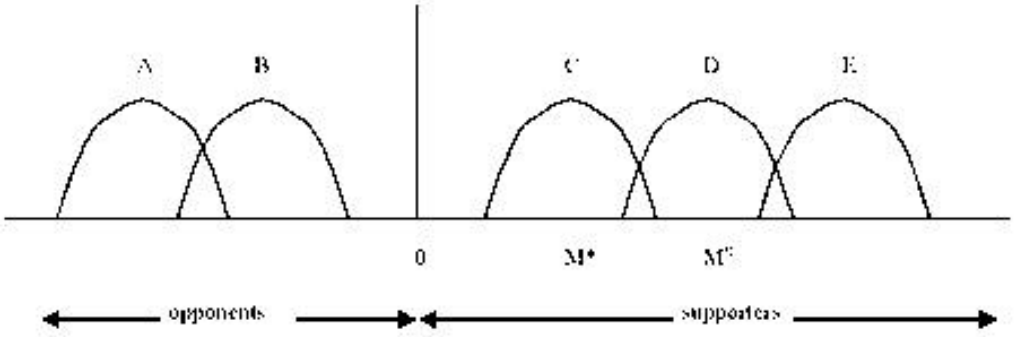


Figure 3b. The frequency distribution

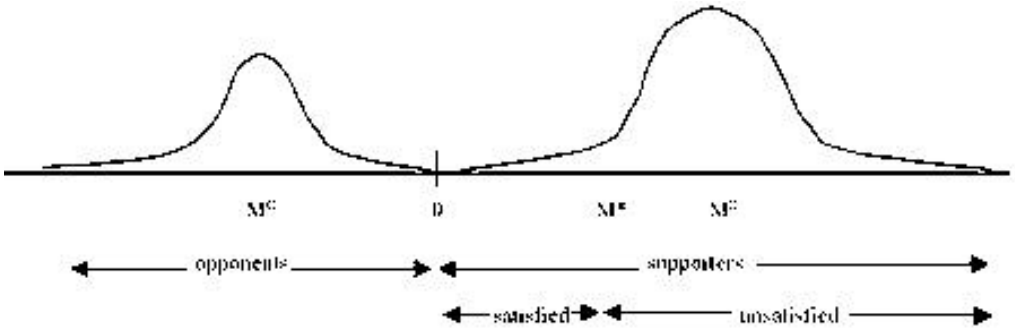


Figure 4: Bimodal distribution in which all voters are supporters.

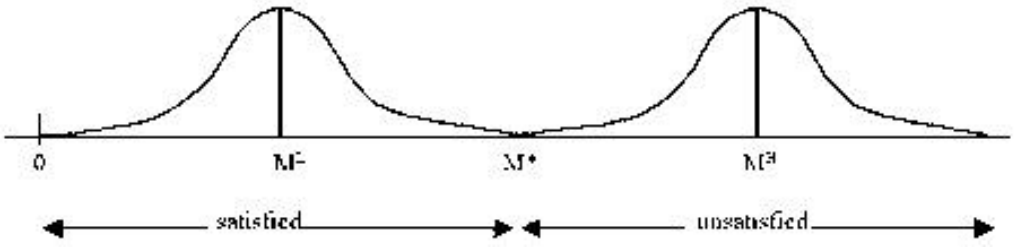


Figure 5. Cycling

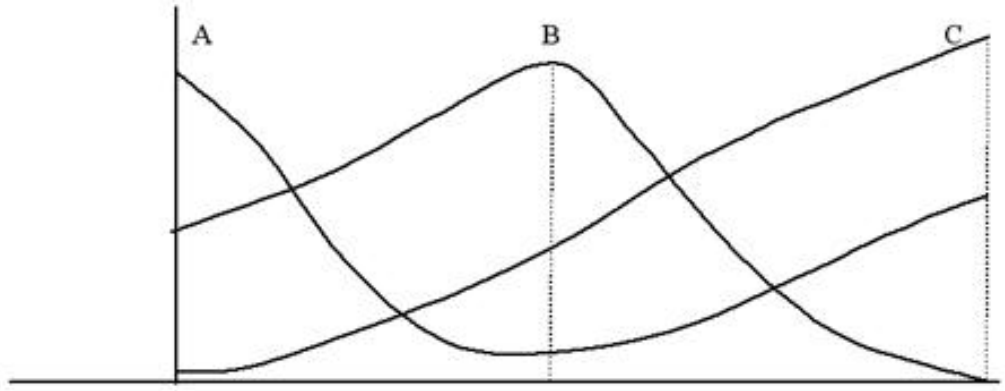
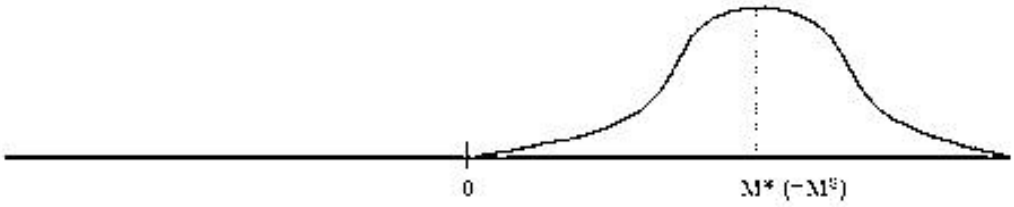
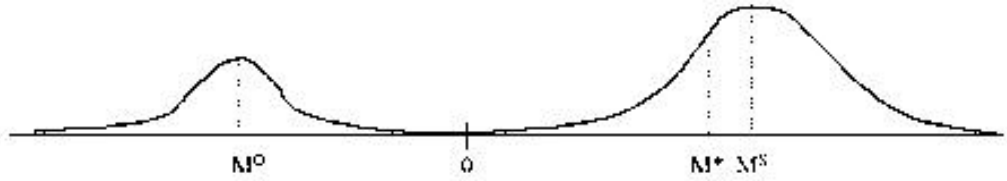


Figure 6: Frequency distribution of preferences for selected portions of supporters.

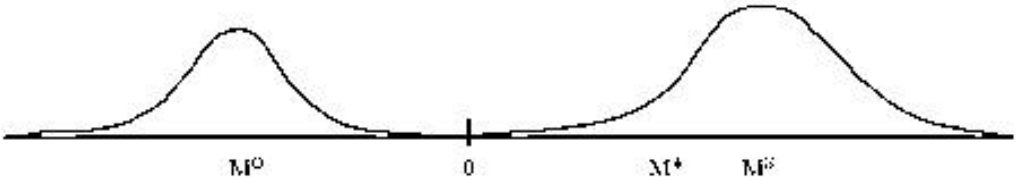
6a: Supporters = 100% of the population; MS = M*



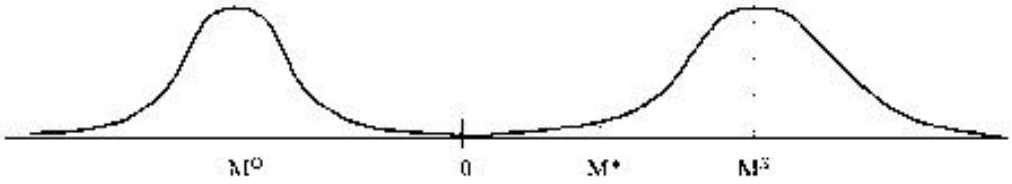
6b: Supporters = 75% of population; MS ‹ M* = 0.44 standard deviations



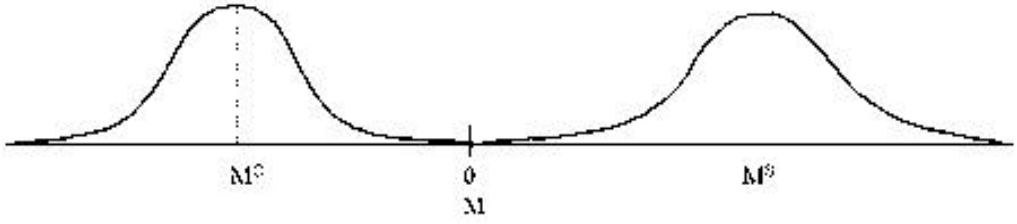
6c: Supporters = 60% of population; MS ‹ M* = 0.96 standard deviations



6d: Supporters = 51% of population; MS ‹ M* = 2.06 standard deviations



6e: Supporters = 49% of population; M* = 0



NOTES

1. A "good" is a commodity of which people prefer more to less. A "bad" is a commodity of which people prefer less to more. The public goods problem is the problem of deciding how much of a public good to produce and how to fund it. The public commodities problem is the public goods problem with the added complication that there is disagreement among citizens about whether or not the public commodity in question is actually a good.
2. It may not be as easy to separate the normative and positive issues as this and there may be some overlap between the two, but for simplicity, this paper treats the two questions as if one were purely normative and the other purely positive, and it treats the normative question is if it were a purely dichotomous choice.
3. This result does not necessarily hold for a multidimensional issue (Plott 1967, Slutsky 1976) or on issues in which voters do not have single peaked preferences (Riker 1961, Enelow and Hinich 1984). The discussion here is restricted to one dimensional issues in which preferences are single-peaked.
4. For a discussion see Holcombe (1989). For criticism of the perspective from which the median voter theorem is drawn see Adams (1991). Empirical tests of the median voter hypothesis have produced conflicting results. Mueller (1989, 189-193) finds that many studies have conclusions that are generally consistent with the median vote theorem, but few that necessarily conclude that it is a better predictor of political outcomes than other models. More recently, Brennan and Hamlin (1996), Poole and Rosenthal (1996), Levitt (1996), and Jung, Kenny, and Lott (1994) find evidence to doubt the median voter hypothesis, but Turnbull and Chang (1998), Congleton and Bennett (1995), Turnbull and Djoundourian (1994), and Cahan and Kaempfer (1992) find evidence to support the median voter hypothesis. Much of the empirical literature on the median voter hypothesis tests wether the median citizen's opinions are reflected in the choices of elected representatives. The answer to this question, however, it not directly relevant for this paper; the problems discussed in this paper are the same whether the voting body is 100 million citizens or 100 senators.
5. Opponents may not necessarily believe that the goal of spending is a public bad. They may believe it simply has not value. Such opponents would always prefer less spending to more, and so their behavior would likely be little different than those who truly oppose the goal. Another individual could be called an opponent if he saw some value to the goal, but did not think the benefit was worth the cost. Such a person is an opponent in the sense that he prefers zero to any positive level of spending, although he is not an opponent of the basic goal of the program. Such a person may have nonsingle-peaked preferences and the outcome of such preferences will be considered but the focus on the current discussion are opponents with single-peaked preferences who prefer less spending to more for any level of spending.
6. At least one study specifically looks at whether it holds on bimodal issue. Medoff, Dennis, and Bishin (1995) find evidence that, on bimodal issues, legislators vote consistently with their ideology rather than with constituent opinion or demographics. This result, however, is most appropriate for issues which are both bimodal and dichotomous. That is, issues that involve a clear yes/no choice. By contrast, the paper focuses on the effect of a yes-or-no choice on the goal of spending affects the continuous variable of the level of spending.
7. As before, M^S is the median, mode, and mean of supporters and M^O is the median, mode, and mean of opponents.
8. Note that in all cases standard deviations refers to the distribution of supporters. The total population is divided into two separate populations, supporters and opponents, which can both be approximated by a normal distribution, but the distribution to which the paper refers when discussing the standard deviation is always the distribution of supporters.

REFERENCES

Adams, John. 1991. "Surplus, Surplus, Who's Got the Surplus? The Subtractivist Fallacy in Orthodox

Economics." Journal of Economic Issues 25, 1 (March): 187—197.

Black, D. 1958. *The Theory of Committees and Elections* . Cambridge: Cambridge University Press.

Bowen, H. R. 1944. "The Interpretation of Voting in the Allocation of Economic Resources." *Quarterly Journal of Economics* 58 (February): 27—48.

Brennan, Geoffrey, and Alan Hamlin. 1996. "Two Theories of Rational Voting." University of Southampton Discussion Paper in Economics and Econometrics, 9632, July.

Cahan, Steven F., and William H. Kaempfer. 1992. "Industry Income and Congressional Regulatory Legislation: Interest Groups vs. Median Voter." *Economic Inquiry* 30, 1 (January): 47—56.

Ching, Stephen. 1997. "Strategy-Proofness and 'Median Voters.'" *International Journal of Game Theory* 26, 4: 473-490.

Congleton, Roger D., and Randall W. Bennett. 1995. "On the Political Economy of State Highway Expenditures: Some Evidence of the Relative Performance of Alternative Public Choice Models." *Public Choice* 84, 1—2 (July): 1—24.

Comanor, W. S. 1976. "The Median Voter Rule and the Theory of Political Choice." *Journal of Public Economics* 5 (January—February): 169—177.

Enelow, J. M., and M. J. Hinich. 1984. *The Spatial Theory of Voting* . Cambridge: Cambridge University Press.

Holcombe, Randall G. 1989. "The Median Voter Model in Public Choice Theory." *Public Choice* 62, 2 (May): 115—125.

Hotelling, H. 1929. "Stability in Competition." *Economic Journal* 39 (March): 41—57.

Jung, Gi Ryong, Lawrence Kenny, and John R. Lott. 1994. "An Explanation for Why Senators from the Same State Vote Differently So Frequently." *Journal of Public Economics* 54, 1 (May): 65—96.

Levitt, Steven D. 1996. "How Do Senators Vote? Disentangling the Role of Voter Preferences, Party Affiliation, and Senate Ideology." *American Economic Review* 86, 3 (June): 425—441.

Medoff, Marshall H., Christopher Dennis, and Benjamin G. Bishin. 1995. "Bimodal Issues, the Median Voter Model, Legislator's Ideology, and Abortion." *Atlantic Economic Journal* 23, 4 (December): 293-303.

Mueller, Dennis C. 1989. *Public Choice II* . Cambridge: Cambridge University Press.

Plott, Charles R. 1967. "A Notion of Equilibrium and its Possibility Under Majority Rule." *American Economic Review* 57 (September): 787—806.

Poole, Keith T., and Howard Rosenthal. 1996. "Are Legislators Ideologues of the Agents of Constitutents?" *European Economic Review* 40 (April): 707-717.

Riker, William H. 1961. "Voting and the Summation of Preferences: An Interpretive Bibliographical Review of Selected Developments During the Last Decade." *American Political Science Review* 55 (December): 900-911.

Slutsky, S. 1977. "A Voting Model for the Allocation of Public Goods: Existence of an Equilibrium."

Journal of Economic Theory , 14 (April): 299-325.

Turnbull, Geoffrey K., and Chinkun Chang. 1998. "The Median Voter According to GARP." *Southern Economic Journal* 64, 4 (April): 1001—1010.

Turnbull, Geoffrey K., and Salpie S. Djoundourian. 1994. "The Median Voter Hypothesis: Evidence from General Purpose Local Governments." *Public Choice* 81, 3—4 (December): 223—240.