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A model of majority voting and growth in government expenditure

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1. Introduction

This paper develops a simple graphical model to explain the relationship between majority voting and government growth. The government provides two or more public goods, and the levels of output of those public goods are determined through majority voting.

Well-known results of Plott (1967), Kramer (1973), McKelvey (1976) and others indicate that majority voting equilibria generally don't exist in models with two or more public goods. But if choices can be restricted to straight line subsets of the set of all possible bundles of public goods, majority voting equilibria will exist on the lines, under standard conditions. (See Slutsky, 1977.) In this paper, voter choice is always restricted to straight lines, and the lines are determined by an agenda-setting government.

The agenda-setting government follows this guiding light: at each stage of the game, it maximizes total expenditure. That is, each time an election is held, the government chooses a linear subspace of the choice space, and given that agenda, voters determine a majority voting equilibrium bundle of public goods. That equilibrium has a price tag associated with it. The government chooses the straight line so as to maximize the resulting price tag.

McKelvey (1976) establishes that any point in a multi-dimensional choice space can be reached from any other point by an appropriately chosen sequence of majority votes. That is, if the government wants to reach any high-price x^*, and if the starting point is at x^0, there exist alternatives x^1, x^2. x^3, ..., x^n, such that x^1 defeats x^0 in a majority vote; x^2 defeats x^1 in a majority vote; ...; x^n defeats x^{n-1} in a majority vote, and x^* defeats x^n in a majority vote. So a government that sets the agenda can, in theory, get to any place it wants, according to McKelvey. However, the sequence

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$x^1, \ldots, x^n$ will generally oscillate wildly, in the sense that the distance between x^k and x^{k+1} will increase as k increases, *and* in the sense that the price tag associated with x^k, or the total expenditure level associated with x_k, will swing wildly up and down. Empirical evidence suggests that there aren't wild oscillations in total public expenditure. There is steady growth. The model in this paper produces steady growth.

In this paper I assume the agendas that government sets are straight lines. The agendas can't be 'fatter' than lines, for if they were, majority voting equilibria would not exist. They can't be curved lines, for it they were, majority voting equilibria might not exist. Making agendas pairs of points, as in Romer and Rosenthal (1978), is unnecessarily restrictive. The straightline agenda approach is similar to what is done in Denzau and Mackay (1976, 1980), Mackay and Weaver (1979, 1980), and others.

What is real-world example of a straight-line agenda? Suppose the publicly-provided goods are defense (x_1) and social expenditure (x_2). Suppose the Reagan Administration wants to raise defense and cut social expenditure. It might propose to Congress that social expenditure be traded off against defense in a certain ratio, say \$1.00 of social expenditure for \$1.25 of defense. That is, cut social expenditure \$1.00 for each \$1.25 increase in defense. Then it is in effect proposing a line in an x_1/x_2 diagram with slope -1.25. Or, as an alternative example, suppose a committee chairman in a legislature is fashioning an appropriations bill that funds two projects x_1 and x_2. He might propose changing next year's appropriations from this year's levels by increasing both in certain proportions – e.g., let x_1 rise twice as much as x_2; or by decreasing both in certain proportions; or by trading off one against the other – e.g., for each \$1.00 rise in x_1 cut x_2 by 80¢. In the first case he is proposing a straight-line agent with slope .5; in the third he is proposing a straight-line agenda with slope $-.8$.

I also assume that at each stage of the process, the government (myopicly) maximizes total expenditure. So in this respect the paper follows the line of a number of authors, including, for instance, Niskanen (1971, 1975), Romer and Rosenthal (1978), Denzau and Mackay (1976, 1980), Mackay (1980) and Mackay and Weaver (1980). However, some people don't believe that government behavior ought to be modelled this way. There is some question about whether people in government want to see total expenditure grow. My feeling is that it's plausible to assume that bureaucrats get pecuniary and nonpecuniary benefits when their budgets rise. There is also some question about whether government has the power to set restrictive agendas. Why can't the voters vote on the agendas themselves? I think we can safely conclude that something must be controlling the agenda process, for if there were no controls on the process we would see a lot more instability than we do see. We would see the voting chaos that the Plott, Kramer and McKelvey results imply.

Obviously, the assumption that government sets agendas so as to maximize expenditure is not meant to be taken as literal truth. Clearly government has multiple actors with conflicting motives. Clearly government does not formally propose linear subspaces as voting agendas. The assumption should be evaluated by examining its implications. If the model succeeds in explaining growth in government, then the underlying premise should be tentatively accepted as a useful hypothesis.

This paper differs from other papers on agenda-setting budget-maximizing governments because it emphasizes the dynamics. The agenda-setting, voting process is repeated time after time. So this paper provides some insight into one of the major economic phenomena of the 20th century: the persistent growth of government expenditure.

The table below shows total government expenditure by Federal, state, and local governments in the United States; GNP; and government expenditure as a percent of GNP (Source: *Economic Report of the President*, February 1983, Tables B–1 and B–75).

Year	Total government expenditure (Billions)	GNP (Billions)	Expenditure as a % of GNP
1929	10.3	103.4	10.0
1940	18.4	100.0	18.4
1950	61.0	286.5	21.3
1960	136.4	506.5	26.9
1970	313.4	992.7	31.6
1980	871.2	2633.1	33.1
1981	985.5	2937.7	33.5
1982	1084.5	3057.5	35.5

The table shows that government expenditure as a proportion of GNP has grown in every decade since 1929, and has continued to grow even during the Reagan presidency. (See Nutter, 1978, for a survey of statistics on growth of government in various countries; Freeman, 1975, and Kendrick, 1955, for statistics on the growth of government in the U.S.; Peacock and Wiseman, 1961, for the growth of government in the U.K.; and Borcherding, 1977a, 1977b, 1982, for useful surveys of explanations of government growth.)

This paper is related to several streams in the growth of government literature. I give a logical foundation to the now unfashionable 'displacement effect' of Peacock and Wiseman (1961). Peacock and Wiseman argue that governments expand during crises, but do not shrink back to their previous sizes when the crises pass. In Section 3.3 below I show why. In Section

3.4 below I show why expansion of the franchise ought to increase the size of governments. In Section 3.5 I show why contraction of the franchise or migration from one jurisdiction to another also ought to cause governments to grow. Of course, this paper is closely related to the various theories of bureaucratic power over spending levels, of Niskanen (1975), Mackay and Weaver (1979, 1980), Romer and Rosenthal (1978, 1980), and others. But the special contribution of this paper in this context is that it makes the story dynamic: Expenditure grows in year 1 because of government's agenda power, but it then grows again in year 2, and in years 3, 4, and so on.

2. The model

Assume there are an odd number of voters. (If the number of voters is even, the substantive results do not change. The difference is that majority voting equilibria would be multiple, rather than unique.) The voters are labeled A, B, C, etc. They vote on levels of expenditure on publicly provided goods (called 'public goods' for short). Their voting is nonstrategic: each voter votes his true preferences. There are two or more public goods. A proposal to be voted on is written $x = (x_1, x_2, \ldots)$, where x_1 represents expenditure on public good 1, x_2 represents expenditure on public good 2, and so on. Total government expenditure associated with x is given by $\sum_i x_i$. Public expenditures are financed by taxes, but the details of the tax mechanism are ignored in this paper. It is assumed that each voter has a most preferred point ('bliss point') in the choice space; for notational convenience we attach the same label to a voter and to his bliss point. For example, A represents person A, and his bliss point $A = (A_1, A_2, \ldots)$.

The utility an individual gets from a proposal x is given by the negative of the squared distance from x to his bliss point. For example, when there are two public goods, A's utility is

$$U_A(x) = -(x_1 - A_1)^2 - (x_2 - A_2)^2.$$

When there are two public goods, an individual's indifference curves are circles around his bliss point; when there are three public goods his indifference surfaces are spheres centered on his bliss point, and so on.

Generally, no true majority voting equilibrium exists (see Plott, 1967; and Kramer, 1973). That is, for any x there exists a y such that the number of people who prefer y to x is greater than the number of people who prefer x to y. However, if the voting is restricted to a straight line ℓ in the public goods space, utility functions are single-peaked on ℓ, and so an agenda-restricted majority voting equilibrium exists.

In this paper I assume the government chooses ℓ. Given any starting point

x^0 and any line ℓ, there is some majority voting equilibrium x, and an associated total government expenditure level $\sum_i x_i$. The government chooses ℓ with one purpose: to maximize $\sum_i x_i$. When the government has chosen ℓ, and a majority voting equilibrium x^1 has been established, x^1 becomes the new starting point, and the process continues. This is a process of government choice of agenda, voting to establish a majority voting equilibrium, repeated government choice of agenda, repeated voting, and so on.

The point x^0 is called the status quo. Usually, I assume the status quo is the origin, that is, $x^0 = 0$. An agenda is determined by a vector $\alpha \neq 0$; the agenda is a line through x^0 with direction α, or the set of points $\{x: x = s\alpha + x^0, s \epsilon R\}$. For any agenda there is a majority voting equilibrium x. The government chooses the first agenda α^0 so as to maximize $\sum_i x_i$. Then the economy moves to the resulting majority voting equilibrium, which is called x^1.

In general, when the economy is at x^k, an agenda is determined by a vector $\alpha \neq 0$; the agenda is the set of points $\{x: x = s\alpha + x^k, s \epsilon R\}$. The government chooses the vector α^k so as to maximize $\sum_i x_i$ for the associated majority voting equilibrium. Then the economy moves to the resulting majority voting equilibrium x^{k+1}.

This agenda setting, voting, agenda setting process will typically never end, but the sequence of x^k's may converge.

In order to picture the process, consider the following: If the economy is at x^k and the agenda is determined by the vector α, individual A's utility will be maximized at the point on the line $\{x: x = s\alpha + x^k, s \epsilon R\}$ that is closest to his bliss point. Allowing α to range over the set of all conceivable (i.e., nonzero) direction vectors generates a locus of most preferred points. This locus is A's offer locus (or offer curve). If there are two publicly provided goods, the offer locus is a circle passing through A and x^k, with center midway between A and x^k. (See MacKay and Weaver, 1979.) If there are three (or more) publicly provided goods, the offer locus is the sphere (hypersphere) passing through A and x^k, with center midway between A and x^k.

The circular offer curves make the geometry of the voting-expenditure process quite simple in the two-dimensional case. Figure 1 illustrates a three-person, two-good example. The status quo is the origin, while A, B, and C are the three bliss points. The circle through A is A's offer locus; the circle through B is B's offer locus; and the circle through C is C's offer locus. An agenda is a straight line from the origin. Generally there are three distinct points other than x^0 where a straight line from the origin cuts the three circles. The middle point is the majority voting equilibrium. The locus of such majority voting equilibria is the wavy line in Figure 1. A budget-maxi-

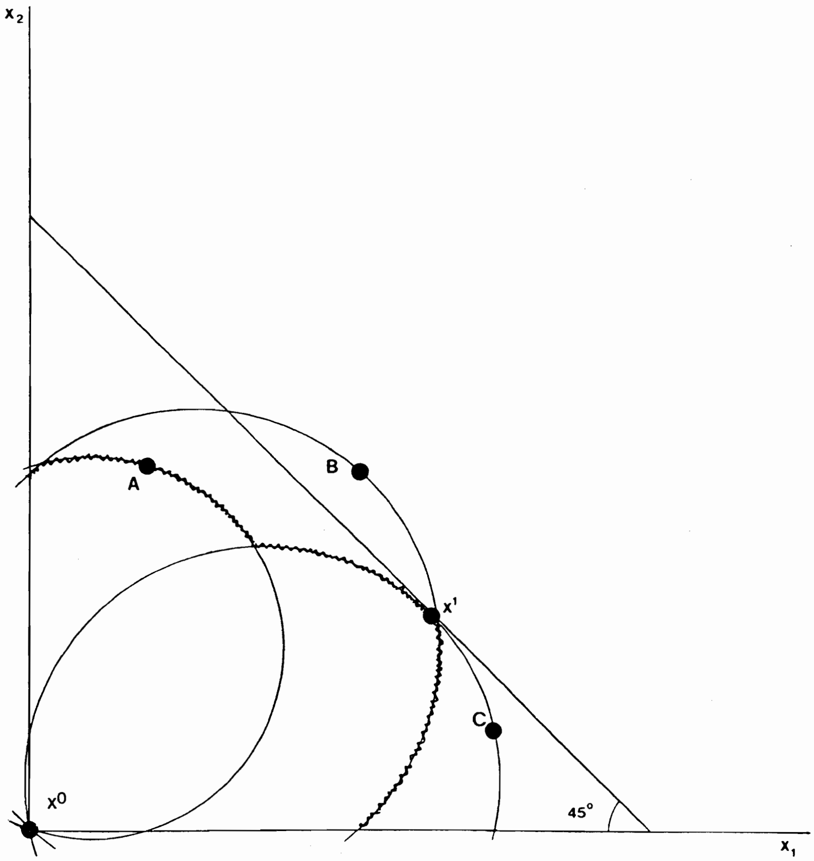

Figure 1.

mizing government wants to maximize $x_1 + x_2$; the way to do this is to choose x^1, where the majority voting equilibria locus touches the 45° line. Therefore, the government sets α^0 proportional to $x^1 - x^0$.

Figure 2 illustrates the next stage of the voting expenditure process, where the move is from x^1 to x^2, and the associated α^1 is proportional to $x^2 - x^1$. Note that x^2 could not be reached in a direct move from the origin; if voters were confronted with the agenda $\{x: x = s\alpha, \alpha = x^2 - 0, s \epsilon R\}$, they would choose a point on the locus of majority voting equilibria shown in Figure 1. Also note that the move from x^1 to x^2 involves an agenda that requires much more growth (or shrinkage) in expenditure on public good 2 than on public good 1.

The dynamic process that starts in Figures 1 and 2 continues in a sequence of steps. In subsequent steps the agendas require that expenditure on good 2 be increased while expenditure on good 1 is decreased, or *vice versa*. The voters have the choice. When offering this choice the government can appear to be fiscally conservative, since it requires that one program be cut while the other be expanded. But in fact, its goal is always to maximize total expenditure. Figure 3 shows the final equilibrium toward which the process

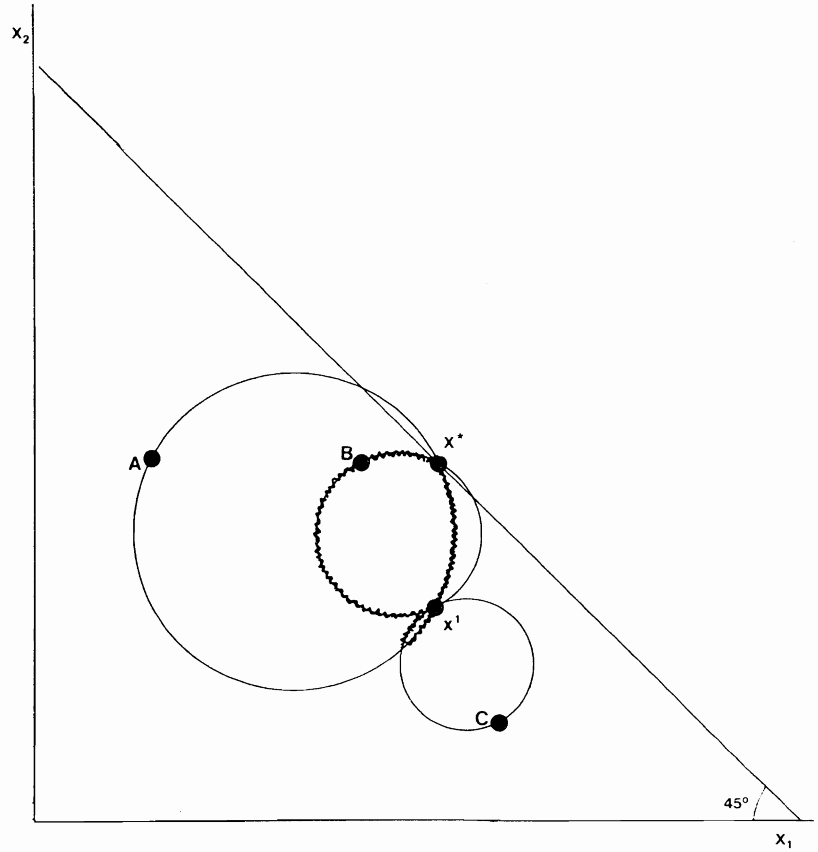

Figure 2.

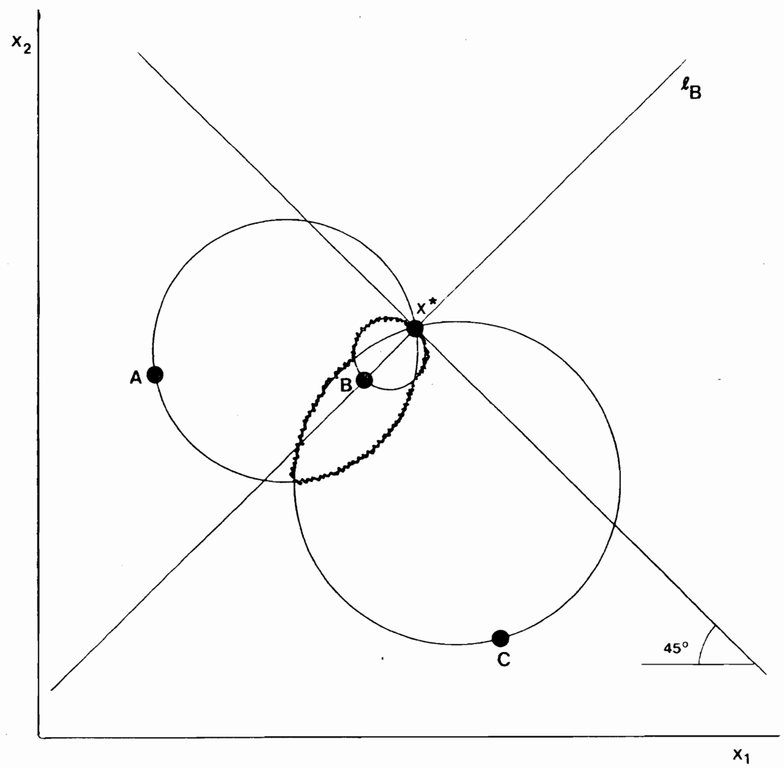

Figure 3.

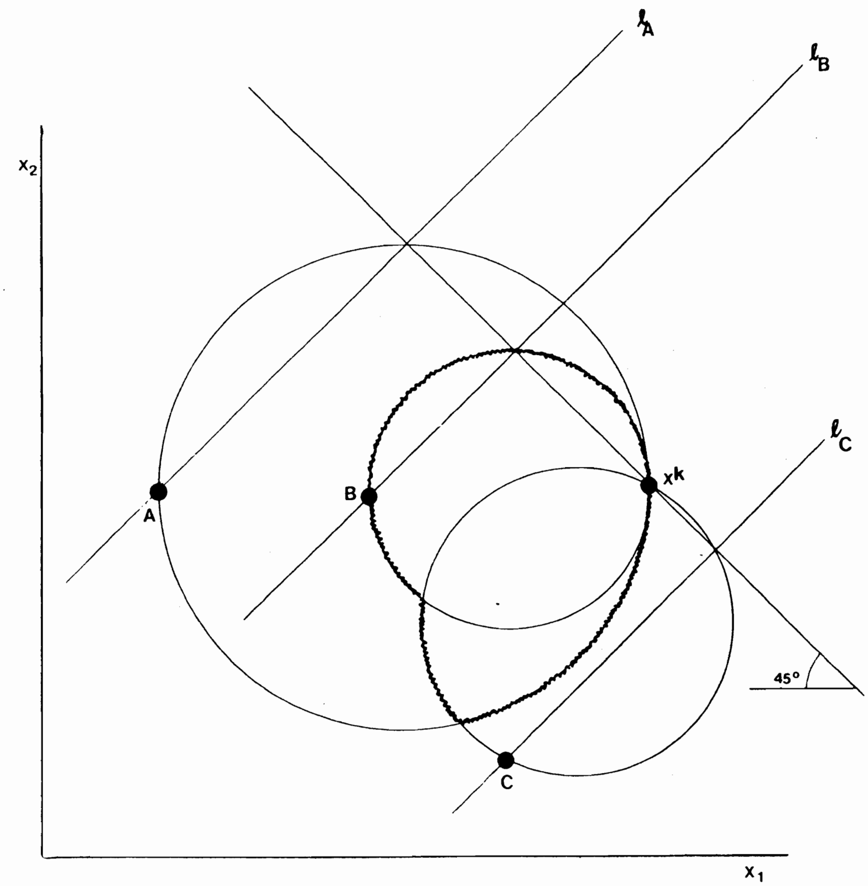

Figure 4.

converges. The line ℓ_B passes through B and has slope 1; its use is explained below.

3. Results

3.1 *Convergence*

The model sketched above raises lots of interesting questions. First, can we predict where the process will lead? The answer in the two-dimensional case is fairly easy. For each individual, draw a line with slope 1 through his bliss point. Assume that these lines are all distinct (so no individual's bliss point is on the line through another's bliss point). One of these lines is in the middle (counting from left to right, or bottom to top). In Figure 4, the line ℓ_B is in the middle.

Now if the process is at x^k and x^k is *not* on ℓ_B, it is clear that an agenda can be found which leads to a majority voting equilibrium with a higher total expenditures level. In Figure 4, the locus of majority voting equilibria passes *above* a line through x^k with slope $= -1$, i.e., an iso-expenditure line. So the process cannot stop at x^k. In fact, the equilibrium to which the process converges must be on ℓ_B.

For any x on ℓ_B and above B, the best agenda the government can choose is the one for which $\alpha = (1,-1)$, and with that agenda, the economy stays at x. This agenda requires that any increase in expenditure on good 1 be financed with equal cuts in expenditure on good 2. Such a point x is a stable point in this process.

When there are three or more public goods, the analysis is more complex. In the case of three goods, it can be shown that at any point x^1 there is an agenda α^k that would produce an increase in total government expenditure. We have some computer examples for which the sequence $\{x^k\}$ does not seem to converge. However, the increment in expenditure

$$\Delta e^k = \sum_i x_i^{k+1} - \sum_i x_i^k$$

always does approach zero. Our computational algorithm, which stops when Δe^k falls below a threshold, does in fact always stop. Whether $\{x^k\}$ always converges, or $\sum_i x_i^k$ converges, are open questions.

3.2 *Shifts of bliss points*

What happens when one person's preferences change, or when several people's preferences change? To answer this question we return to the two-dimensional case.

Consider Figure 3 again. If the voting process starts at the origin, it converges toward a stable equilibrium at x^*. If the bliss points A, B, and C remain fixed, no further move is possible. Now, however, suppose A moves. If A moves to an A' that lies above the line ℓ_B but not above the line through x^* with slope -1, i.e., the iso-expenditure line, person B will remain the crucial median voter, and the equilibrium will not shift. If A moves below ℓ_B or far enough above the iso-expenditure line, then the equilibrium may shift to a new point with a higher total expenditures level. For instance, if A' were at the origin, total expenditure would *rise*.

If A and C move to A' and C' that lie below the iso-expenditure line, with A' above ℓ_B and C' below it, the equilibrium will not shift. However, if A' is below ℓ_B and C' is below it, total expenditure will rise. If A' is above ℓ_B and C' is above it, total expenditure will rise. If both A' and C' move above the iso-expenditure line, total expenditure will rise.

What happens when B alone moves is left to the reader.

In general, we have this result: Suppose the process is at a stable equilibrium x^*. *If bliss points shift in any way, total expenditure will rise or stay constant.*

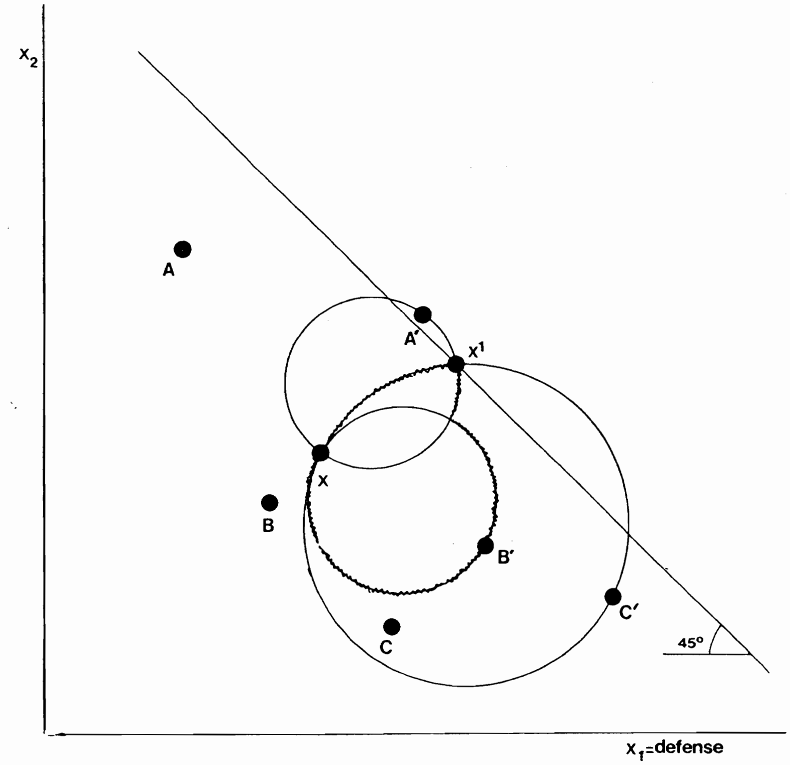

Figure 5.

3.3 *Ratchet effect of a war*

To further illustrate the proposition, we consider in some detail what happens when there is a temporary shift in bliss points due, say, to a war.

Figure 5 shows three pre-shift bliss points A, B, C, and a pre-shift stable equilibrium x^*. The two public goods are x_1, defense, and x_2, other expenditures. A war starts, and all the bliss points move to the right; A moves to A'; B moves to B' and C moves to C'. If the expenditure vector is x^* and the new bliss points are A', B', and C', the new offer locii are the three circles in Figure 5, and the locus of majority voting equilibria is the wavy line. The government sets $\alpha^0 = x^1 - x^*$, and the new majority voting equilibrium is at x^1.

After x^1 is established, the voting is repeated. In Figure 6 the sequence of equilibria x^2, x^3, ... is shown, as well as the stable point x^{**} toward which the sequence converges. Now suppose the economy is at (or very near) x^{**}, and the war ends. Assume A's bliss point moves back to A, B's bliss point moves back to B, and C's bliss point moves back to C. Since the economy is at x^{**}, the new offer locii are three circles, passing through x^{**} and A, B, and C respectively. It follows that the new majority voting equilibrium is $\hat{x}^1$. After $\hat{x}^1$ is established, the next round of voting takes the

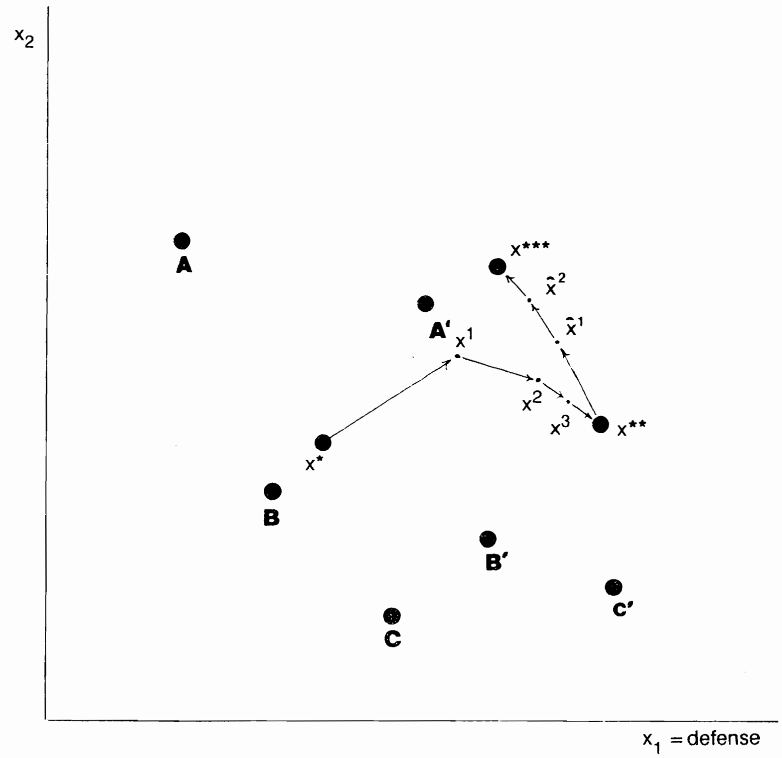

Figure 6.

economy to $\hat{x}^2$, and so on. The process finally converges to a new stable equilibrium x^{***}. Note that the (post-war) x^{***} involves a higher level of total expenditure than the (wartime) x^{**}, and a much higher level of total expenditure than the (pre-war) x^*.

This example shows how temporary shifts in preferences produce permanent ratchet effects in government expenditure. Therefore, it formalizes Peacock and Wiseman's (1961) 'displacement effect' arguments.

3.4 *Expansion of the franchise*

What happens when new voters enter an economy that is at a stable equilibrium? In answering this question I continue to focus on the two-dimensional case.

Suppose we start out with the economy illustrated in Figure 4, and suppose we are at a stable equilibrium x^* on ℓ_B. Now assume two more individuals D and E are enfranchised. The new situation is illustrated in Figure 7. Let ℓ_D be the line with slope 1 that passes through D's bliss point, and let ℓ_E be the line with slope 1 that passes through E's bliss point. For analytical simplicity let ℓ_A, ℓ_B, ℓ_C, ℓ_D and ℓ_E all be distinct. Assume that D and E are both 'low spenders,' in the sense that their bliss points lie much closer to the origin than A, B or C. Assume also that the bliss points D and E both lie below ℓ_B.

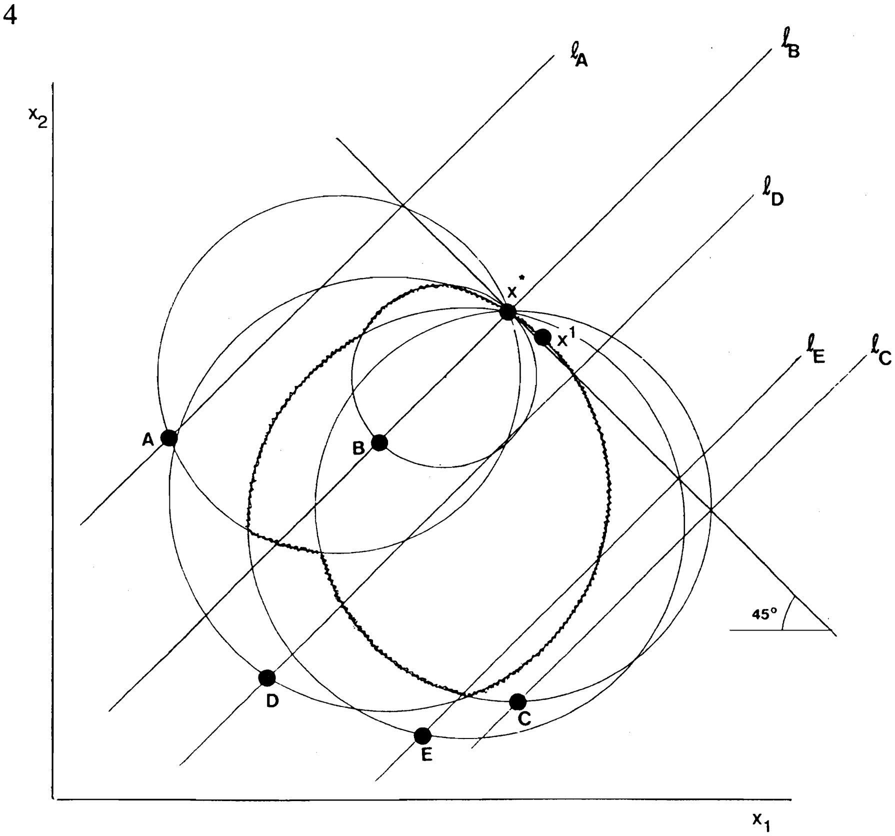

Figure 7.

The new locus of majority voting equilibria is given by the wavy line in Figure 7. x^* no longer maximizes total government expenditure, since an iso-expenditure line cuts through the majority voting equilibria locus. The expenditure maximizing government now sets a new $\alpha^0 = x^1 - x^*$, and the new majority voting equilibrium is x^1. From x^1, the process moves to an x^2, x^3, and so on, and finally converges to a stable equilibrium point on ℓ_D. There are two results: 1) individual D has become the new crucial median voter, and 2) total expenditure has increased.

This example illustrates a general proposition: If the identity of the middle voter changes, total expenditure must rise, even though the newly enfranchised voters have bliss points at low levels of total expenditure. In fact, the reader can check to see that if D and E both have bliss points at the origin – so they both desire *no* public goods whatsoever – when they become enfranchised expenditure must rise!

Casual observation suggests that newly enfranchised voters are often very interested in some public goods, and may have bliss points with higher total expenditure levels than established voters. In terms of our example, this would mean D and E would lie above the iso-expenditure line through x^*. If D and E lie on opposite sides of ℓ_B, and so B remains the middle voter, the process will not move away from x^*, and total expenditure will stay constant. However, if D and E both lie on the same side of ℓ_B, the process will move away from x^*, and total expenditure will rise, and may rise very sharply. To see this, the reader can redraw Figure 7, with D and E near the intersection of ℓ_C and the iso-expenditure line.

3.5 *Contraction of the franchise and migration of voters from one jurisdiction to another*

The analysis above clearly suggests that when voters are disenfranchised or leave a jurisdiction the results will be the same as when voters are enfranchised. If the identity of the median voter changes, total expenditure will rise. Otherwise, it will stay the same.

Let us now turn to a numerical example of migration between two jurisdictions. (The equilibria were generated by a computer version of the algorithm described in this paper.)

Low Tax Town Bliss Points	*High Tax Town Bliss Points*
$A = (A_1, A_2) = (9, 11)$	$F = (15, 10)$
$B = (9, 14)$	$G = (13, 13)$
$C = (8, 13)$	$H = (12, 16)$
$D = (10, 12)$	$I = (11, 18)$
$E = (12, 12)$	$J = (11, 12)$

x^k	$\sum_i x_i^k$	x^k	$\sum_i x_i^k$
$x^0 = (0, 0)$	0	$x^0 = (0, 0)$	0
$x^1 = (10.5, 11.5)$	22.0	$x^1 = (13.0, 13.0)$	26.0
$x^2 = (10.7, 12.3)$	23.0	$x^2 = (13.4, 13.2)$	26.6
$x^3 = (10.7, 12.4)$	23.1	$x^3 = (13.1, 13.5)$	26.7

Now suppose individuals G and J migrate from the High Tax Town to the Low Tax Town. The resulting equilibria become:

$x^4 = (10.6, 12.4)$	23.1	$x^4 = (13.2, 13.6)$	26.8
$x^5 = (10.6, 12.5)$	23.1	$x^5 = (13.6, 15.7)$	29.3
		$x^6 = (13.3, 16.4)$	29.7
		$x^7 = (13.2, 16.7)$	29.9
		$x^8 = (13.1, 16.8)$	29.9

The example shows that the migration of G and J to the Low Tax Town results in an increase in total expenditure in the Low Tax Town (although the increase is so small it is hidden by round-off error), and an increase in total expenditure in the High Tax Town. The reader should be aware, however, that the most natural interpretation of expenditure in this model may be *per capita* expenditure, so an out-migration that increases per capita total expenditure might not increase a government's budget.

It has been suggested that one brake on unlimited government growth in the United States is our multiplicity of local governments. For instance, if taxes in Massachusetts get too high, people can move to New Hampshire. Therefore, total government expenditure in the U.S. can't grow as fast as it might grow if we did not have many local taxing and spending authorities. Now it is certainly true that an individual can move to a jurisdiction with lower taxes or expenditures. But the analysis of this paper shows that when individuals move, expenditure will rise in the place they left, and will rise in the place they go! So mobility has the paradoxical effect of causing expenditures of all jurisdictions to rise.

4. Conclusion

In this paper I have developed a mostly new graphical technique for analyzing government expenditure and, particularly, for analyzing how expenditure grows. The analysis assumes that government has the power to set agendas that are straight lines in the space of issues, and that voters choose majority voting equilibria, given these agendas. Government knows individual preferences, and with this knowledge it tailors the agendas so as to maximize the total levels of expenditure of the resulting majority voting equilibria. The process repeats itself, there may be a new agenda and a new vote every year (or whatever period is used), and the process may go on forever. The important results are:

If there are two issues, and if preferences remain constant, the process should converge to a point in the issue space that is stable in the sense that the government's optimum agenda will induce voters to vote down other points allowed by the agenda.

If there are three or more issues, and if preferences remain constant, the sequence of points $\{ x_k \}$ may not converge. However, the increment in total government expenditure Δe^k will approach zero.

If preferences shift, there is a ratchet effect. That is, changes in people's bliss points will generally cause total expenditure to rise, but will never cause it to fall. If bliss points shift out, and then return to their original positions, total expenditure will shift out, and then shift out again.

If new voters are enfranchised, total expenditure levels will either remain the same, or rise. If the new voters have bliss points near the origin, or are 'low spenders,' total expenditure levels will rise slightly. If the new voters have bliss points near the iso-expenditure line through the reigning stable equilibrium, total expenditure may rise very sharply.

If voters are disenfranchised, or leave a jurisdiction, total expenditure levels will either remain the same, or rise. If voters migrate from one jurisdiction to another, total expenditure levels will generally rise in both jurisdictions.

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