Tax shares and government spending in a median voter model

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1. Introduction

The median voter model has provided a fertile environment for the econ-
omic analysis of political processes. Originally suggested by Hotelling
(1929), it was developed by Bowen (1943), Black (1958), and Downs (1957)
into a powerful model for evaluating decision-making under majority rule.
The median voter model concludes that the median voter's most preferred
outcome will be selected in a majority rule decision-making process. Using
a median voter model greatly simplifies the economic analysis of majority
rule decisions, because it allows the analyst to focus attention on the
preferences of a single individual – the median voter – rather than on the
entire population.[1] In general, the median voter model assumes tax shares
to be given in its analysis. This assumption is quite reasonable in the case
of state and local governments, where most revenues are raised through
sales taxes and property taxes. At the federal level, however, tax shares ap-
pear as a part of political platforms, and the manipulation of tax shares
through changes in progressivity, loopholes, writeoffs, and deductions is
common. The purpose of this paper is to analyze the effects of including tax
shares as a part of a candidate's platform within a median voter model.

In Downs' depiction of the median voter model, two candidates with plat-
forms on opposite sides of the median compete for the median voter's vote
by moving their platforms toward the median. If tax shares can be included
in the platforms, another method of competition would be to offer the me-
dian voter, and perhaps other voters, lower tax shares in an effort to win
votes. Within the single dimensioned median voter model, a voter with a
downward sloping demand curve for government output would demand a
larger quantity of government output in response to the offer of lower taxes.
Thus, if party platforms do try to win the votes of the marginal voters by
lowering tax shares, the voters being sought will demand more government,
and will find their positions moving toward the platform offering more total
government spending. In this way, the inclusion of tax shares in party plat-
forms will tend to increase the size of government.[2]

A simple case can illustrate this point. Assume that at a given tax price the median voter prefers qauantity Q_M of a homogeneous good, government spending. Two parties are competing in an election. One offers output Q_L below Q_M and another offers Q_H above Q_M such that the median voter is indifferent between Q_L and Q_H. Downsian competition will find the platforms moving toward and converging on Q_M. Assume that instead of the Downsian process, the parties continue to offer Q_L and Q_H, but attempt to win the median vote by lowering the median voter's tax price. As the median voter's tax price declines, the voter's quantity demanded moves from Q_M toward Q_H. Thus, if both platforms offer equal reductions in tax shares, the median voter will now prefer Q_H to Q_L. This illustrates the bias in favor of larger government spending when tax shares can be included as a part of a political platform. The bias is simply the result of the fact that demand curves slope downward. By offering a lower price to try to win the median vote, the quantity of government demanded by the median voter increases.

This simple illustration shows that when tax shares can be included as an element in political platforms, parties will manipulate tax shares to try to win votes. Lowering the tax shares of pivotal voters generates a bias toward larger government. This bias is the motivating force in the model of the following section, which uses a median voter model to illustrate the bias toward larger government that results from including tax shares in party platforms.

2. The model

Government output in this model is a homogeneous good, and two parties are competing for election by majority rule by offering platforms that include the quantity of government to be produced and tax shares to be paid by each voter. Quantities of government will be represented by q, and tax prices by t. There are $n = 2m - 1$ voters, and m is the median voter. Each voter has a downward sloping demand curve for government, $D_i(q)$, such that the demand curves may be ranked from low to high demands, and the demand curves do not intersect. The two parties offer quantities Q_L and Q_H in their respective platforms such that $Q_L < Q_H$.

To set up a standard median voter model, it is assumed initially that $t = MC/n$, where MC is the marginal cost of government output, and that at tax price t the median voter is indifferent between Q_L and Q_H. In the Downsian model, political competition would occur through parties moving their platforms toward the median until they converge on Q_M, the median voter's most preferred level of output, with tax shares given. In the present model, however, parties will adjust their tax shares to try to win votes. To focus on the effects of changing tax shares, Q_L and Q_H will be given in this section

as the quantities such that the median voter will be indifferent between Q_L and Q_H at tax price t. The following section will relax this requirement to allow Q_L and Q_H to vary.

To determine which platform a voter will prefer, the consumer's surplus for each platform is calculated, where the ith voter's consumer's surplus for tax price t^* and quantity q^* is calculated as

$$CS_i(t^*, q^*) = \int_0^{q^*} D_i(q)\,dq - t^* \cdot q^*. \tag{1}$$

The voter will choose the platform that yields the highest consumer surplus. At tax price t,

$$CS_m(t, Q_L) = CS_m(t, Q_H) \tag{2}$$

by assumption, and with Q_L and Q_H given, the parties will try to win a majority by adjusting tax shares. The party offering Q_L is at a disadvantage since at lower tax prices, the quantities demanded move toward Q_H. Since taxes cannot fall below zero, the best offer the party offering Q_L can make the median voter is to give the voter Q_L free. There will be some tax price t_m^* such that

$$CS_m(0, Q_L) = CS_m(t_m^*, Q_H). \tag{3}$$

Substituting,

$$\int_0^{Q_L} D_m(q)\,dq = \int_0^{Q_H} D_m(q)\,dq - t_m^* \cdot Q_H, \tag{4}$$

and solving for t_m^*,

$$t_m^* = \left(\int_{Q_L}^{Q_H} D_m(q)\,dq\right)/Q_H. \tag{5}$$

Since both the numerator and denominator of equation (5) are positive,

$$t_m^* > 0. \tag{6}$$

In other words, there is some positive tax price t_m^* that would make the median voter indifferent between Q_H at t_m^* and Q_L given free. By choosing a tax price slightly below t_m^*, the party offering Q_H can always win the median vote.

Now consider the voter $m+1$, just beyond the median. Again, the best

the party offering Q_L can do is offer Q_L free so, as above, there is a tax price t^*_{m+1} such that

$$CS_{m+1} (0, Q_L) = CS_{m+1} (t^*_{m+1}, Q_H), \tag{7}$$

Solving for t^*_{m+1} as above,

$$t^*_{m+1} = (\int_{Q_L}^{Q_H} D_{m+1}(q)\,dq)/Q_H \tag{8}$$

Since by assumption $D_{m+1}(q) > D_m(q)$ for all q,

$$t^*_{m+1} > t^*_m. \tag{9}$$

This same process could be carried out for voters $m+2$, $m+3$ ... n, to generate an increasing sequence of tax prices

$$t^*_m < t^*_{m+1} < \ldots < t^*_{n-1} < t^*_n, \tag{10}$$

at which a majority of the voters m ... n would be indifferent between Q_H at those tax prices and Q_L free. Thus, the party offering Q_H could guarantee itself a majority of the votes by offering tax prices slightly below those in expression (10) to those voters. There is no possible counter offer by the other party that could defeat the platform of Q_H, so when tax shares can be included in a party's platform, Q_H will be produced, and government will be larger than the Q_M that would be produced in the median voter model.

The reduced tax shares for voters $m, \ldots, n$ will have to be financed by increasing the taxes of voters $1, \ldots, m-1$, which is a consideration that has not been mentioned until now. The reason it does not have to be considered in determining the winning strategy of the high demand party is that in a majority rule system, only a majority of the votes need be captured to win an election. Since there is a strategy by which the high demand party can defeat any platform offered by the low demand group, the high demand party does not need to concern itself with the welfare of the minority.[3]

To summarize the results of this section, two parties propose platforms within a Downsian median voter model such that one party's platform would produce more government than most preferred by the median and the other would produce less. The median voter is indifferent between the two platforms. In the Downsian model, parties adjust their platforms to converge on the median, and end up producing the median voter's preference. Q_M. In this model, the parties compete for voters by adjusting the tax shares of individuals, but (for ideological reasons, perhaps) do not adjust the quantity of government they propose. When this happens, the party pro-

posing larger government can always find a platform such that it can defeat the other party, so that party's platform, Q_H, will be produced.

Note that nothing has been said about the distance of Q_H from Q_M except that at the initial tax shares the median voter is indifferent between Q_L and Q_H. The implication is that if a party favoring small government arises that makes a commitment to a very low Q_L, the resulting platform of Q_H that can beat Q_L will be greater than if Q_L were closer to the median.[4] This suggests a reason why it is difficult for any politician who favors smaller government to actually produce a politically viable alternative for lower government spending.

3. Downsian competition

Up to this point, parties have been constrained to maintain the level of government spending proposed in their original platforms. This restriction has served two purposes. First, it has illustrated the case when parties maintain their initial ideological position on the level of government rather than modify their ideological positions. Second, it clearly shows the bias toward larger government that results when tax shares can be included in a platform in a democracy. Having established this much, the present section will drop the restriction and allow parties to modify the quantity of government in their platforms, subject only to the constraint that the quantities do not cross, so that the party initially offering Q_L cannot at a later time offer more government than the other party. This constraint allows Q_L and Q_H to vary, but restricts them so that $Q_L \le Q_H$. This scenario allows Downsian political competition, so that parties can move their platforms to converge toward a determinate equilibrium.

A determinate equilibrium platform can be found within this model if there is some Q_H^* such that $D_m(Q_H^*) = 0$, or in other words, if there is some level of government Q_H^* beyond which the median voter will receive no additional utility for additional government. In this case the party offering Q_H could pursue a strategy similar to the strategy in the previous section, and offer voters $m, \ldots n$ tax prices of zero and set $Q_H = Q_H^*$, meaning that all voters below m would pay tax shares of $(n \cdot t)/(m - 1)$ each. In order for the median voter to be indifferent between this platform and some offer by the other party of t_L and Q_L,

$$\int_0^{Q_L} D_m(q)\,dq \; - \; t_L Q_L \; = \; \int_0^{Q_H^*} D_m(q)\,dq, \tag{11}$$

which means

$$t_L Q_L = \int_{Q_H^*}^{Q_L} D_m(q)\,dq. \tag{12}$$

Since $Q_L \le Q_H^*$, the right side of equation (12) will be less than zero except when $Q_L = Q_H^*$. Therefore, the best that the competing party can do is to propose $Q_L = Q_H^*$ and offer $t_L = 0$ to the median voter in order to have a chance to tie the election. Thus, when tax shares can be included in party platforms in a median voter model, the Downsian equilibrium level of government spending is that level which produces a marginal value of government equal to zero for the median voter. This amount will be significantly greater than the equilibrium amount in a median voter model without variable tax shares. This level of government will be called Q^* for future notational clarity.

4. Discussion

The results of this model illustrate an extreme case where it is feasible to reduce the tax prices of some voters to zero, at the discretion of the majority party. In reality, the majority party does not have nearly that much discretion over the tax shares of voters. In the typical democracy, even a minority party is likely to be able to defeat tax proposals that differ significantly from the status quo. But although a majority party does not have complete discretion over tax shares, it does have some discretion, and to that extent, government spending will be biased upward when tax shares are included in party platforms.

The possibility of cycles within the model deserves some mention.[5] The framework of the model provides for a single dimensioned government good, but by including tax shares as a variable, a second dimension is added, leading to the possibility of cycles.[6] In the initial model, where Q_L and Q_H were given, the cycles were prevented by the restriction that tax shares could not go below zero percent of the total tax burden.[7] This restriction seems reasonable, even though it would be logically possible to assign an individual a negative share of the total tax burden. In the model where Q_L and Q_H were allowed to vary, cycles were prevented by the restriction $Q_L \le Q_H$. Again, it seems reasonable that the party favoring lower government expenditures would not jump over the other party's platform to offer higher expenditures than the other party. However, if these platform switches can take place, there will be a platform $(Q', t_1, t_2, \ldots, t_n)$ such $Q' > Q^*$ that could defeat Q^*, and there will also be a $Q'' < Q^*$ that could beat Q'. Therefore, cycles are possible without the restriction $Q_L \le Q_H$.

There is still something unique about Q^*, though. This quantity offered with the appropriate tax shares, cannot be beaten by any platform offering less than Q^*. Only larger levels can defeat it. However, any other Q can be

defeated by larger or smaller levels of government. These details of the model will affect the ultimate outcome of the model, or even whether there is a determinate equilibrium. The details of the model should not obscure the basic conclusion that the ability to include tax shares in political platforms will produce a bias toward larger government.

5. Summary

When tax shares can be included in political platforms, there will be a bias toward more government spending. This bias is the result of the fact that demand curves slope downward. Political parties can compete for votes by offering pivotal voters lower tax shares, but when they do, a lower price per unit of government will cause the quantity demanded to rise. This yields an advantage to platforms promising more government.

This concept was examined within the framework of a median voter model, and Figure 1 summarizes graphically the main conclusions of the model. In an initial situation, two parties are competing in an election. D_m is the demand curve of the median voter, tax shares are fixed at t for all voters, and the parties propose Q_L and Q_H such that the median voter is indifferent between Q_L and Q_H. In the Downsian model, the party platforms converge on Q_M, most preferred by the median voter, and Q_M is the result of a majority rule election.

If the parties are constrained to keep their platforms at Q_L and Q_H (for ideological reasons, perhaps), but can compete for votes by adjusting tax shares of individual voters, it was shown that the party offering Q_H can always win the election. Thus, there is a bias toward larger government, induced by the downward sloping demand curves of voters. An attempt to win the vote of D_m, for example, moves the median voter's most preferred level of government away from Q_L, toward Q_H. From the initial restriction that the median voter is indifferent between Q_L and Q_H at tax price t, it is apparent that a lower Q_L offered by one party will enable the other party to increase Q_H. This bias toward large government suggests why it is difficult even for politicians who favor smaller government to put together a viable political platforms that will actually reduce government size.

The model was then extended to allow parties to adjust the quantities of government in their platforms, subject to the restriction that $Q_L \leq Q_H$. In this case, the party platforms converge on Q^*, where the marginal value of government spending to the median voter is zero. This is, admittedly, an extreme case, since the majority party does not have an unlimited ability to manipulate tax shares. However, it illustrates once again the bias toward larger government, and shows that Downsian competition leads to a determinate equilibrium level of government spending in excess of Q_M that would be produced when tax shares cannot be manipulated.
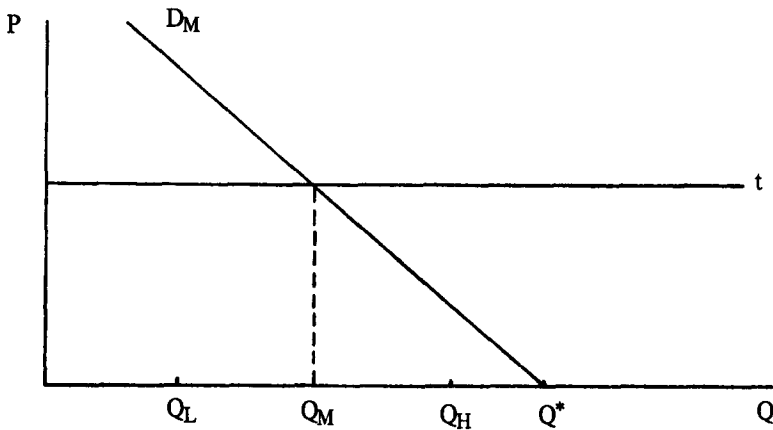
Figure 1.

In summary, when tax shares can be included in political platforms politicians will attempt to win votes by lowering the tax shares of pivotal voters. These lower tax shares cause the quantity of government demanded to increase, and politicians will respond by offering more government. Thus, if tax shares can be included in political platforms, there is a bias toward larger government.

NOTES

1. Empirical studies such as those by Barlow (1970). Bergstrom and Goodman (1973), and Borcherding and Deacon (1972) used the median voter model as a simplifying device for empirical studies, suggesting the general acceptance of the median voter framework at the time these articles were written.
2. See Holcombe (1978) and Holcombe (1983: Ch. 6) for a related model.
3. This point is discussed in detail by Buchanan (1962).
4. There is a similarity here to the concept of the reversion level in models of agenda control. See, for example, Romer and Rosenthal (1978) and Holcombe (1980). The foundations of the agenda control model are different from the present model, however. See Holcombe (1983: Ch. 3) for a discussion of the agenda control model.
5. See Tullock (1982) for a discussion of cycling problems and implications for public choice theory.
6. See McKelvey (1976) for a discussion of cycles in multidimensional issue space. Holcombe (1985) discusses many other models of multidimensional political competition and the attendant cycling problems that can arise.
7. Individuals do receive payments from the government, but in general these come as payments of a certain dollar amount, rather than as a fraction of the total tax bill. Thus, items like transfer payments are not the same as negative tax shares.

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