The Median Voter Model

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1. Introduction: On the Necessity of Models

Models have always been used to describe political systems and public policies because the reality of politics is too complex to be completely described in all its detail by any historical narrative or mathematical characterization. Both the domains of future possibilities and past realizations are complex and multifaceted. A candidate running for high office may espouse a particular position during a political campaign. That policy may reflect his or her current assessment of voter interests, his or her practical interest in a larger tax base, aspirations for an outstanding historical reputation, and the advice of his expert advisors. Other relevant factors would determine why he or she regards particular outcomes to be important, including the candidate's wealth, health, internalized norms with respect to policy of interest and honesty, past lessons learned by fellow candidates, teachers, priests, and parents, and past promises made to those who were important gate keepers during one's political career, and past epiphanies about the nature of all those factors and their interplay. Once in office, a representative may use various strategies for negotiating with other representatives to try and advance various combinations of his or her interests and those of the voters and interest groups that brought him or her to office. Each of these factors may have been set in motion by other causal factors including constitutional procedures, the personalities of fellow representatives, regional culture, and their polity's founding mythology.

It is for such reasons that a single politician's diaries may fill dozens of volumes; yet still remain incomplete.

Interest-Based Models

To explain even a single candidate's espoused policies in a single election, some simplifications are always required. Some factors are (and must be) deemed of greater consequence than others. Both historical narratives and mathematical models thus focus on a small subset of the huge range of factors that have influenced the course of governance in the past and are likely to do so in the future. One obvious simplification is to focus only on proximate causes, the last and most

influential factors in the chain of causality that produce the choice settings and choices about which an author or model-builder is most interested in.

For example, interest-based models of political behavior often focus on the choice of strategies during elections for high offices and assume that candidates for high office want to win the electoral contests in which they participate. They also assume that various combinations of a candidate's policy positions (platforms) and character influence voter decisions about whom to vote for. Since a candidate's character is the product of a genetics and a lifetime of experience, it may be assumed to be constant during a particular election, which implies that a candidate's espoused policy positions is the most relevant factor in his or her electoral campaign. These, then, must largely be adopted with their electoral consequences in mind.

In rational choice models of policy determination, it is also assumed that both candidates and voters are forward looking and attempt to anticipate the consequences of the policies espoused. Additional informational assumptions are normally made about the facts and theories in the minds of both candidates and voters at the times that decisions are made. Most rational choice models assume that each voter and representative a has sufficient understanding of policies to form unbiased expectations about the consequences of those policies. Such persons may occasionally make mistakes, but do not make systematic errors. Given that assumption, it can be said that most of the public policies in place at a given time are there "on purpose," as products of intent, as consequences of candidate efforts to win the office of interest.

The focus on proximate causes allows most of the histories of candidates, voters, and political systems to be ignored, which eliminates the need to recount all of human history or biological evolution before getting on with the narrative or analysis. A person's current interests determine their current choices—even though those interests were formed over many decades. Insofar as adult "interests" are quite stable, these assumptions also imply that the past behavior of voters and elected officials can be used to predict their future behavior.

Such assumptions have long grounded "interest" based analyses of politics undertaken with historical narratives. Even mythic political actors were often said to have behaved in ways that are consistent with interest-based explanations.

Mathematical models of interest-based political behavior far are more recent. The use of mathematical models of political actors began a little over two centuries ago with the work of Borda

(1784), Condorcet (1785). It was extended by several contribution a century later as with the models of Dodgson (1884) and Hotelling (1929). However, mathematical models of politics were not widely used until the middle of the twentieth century. The usefulness of such models was reappraised after World War II, and a great snowball of research emerged based on mathematical and geometric models during the second half of the twentieth century (Mueller, 1976; Congleton, 2018).

Thus, it is only a slight exaggeration to say that the rational-choice-based modelling of elections and democratic public policy began with the work of Black (1948) and Downs (1957) and that most extensions of that work were developed by the scholars that produced the public choice and social choice literatures.

2. Spatial Voters, Majority Rule, and the Median Voter Theorems

The most widely used of the models developed is the spatial voting model. Spatial voter models assume that each voter has a political ideal point—an ideal vector of government policies— and that when offered a choice between any two alternatives, each voter favors the one "closest" to his or her ideal point. The term "closest" is subject to various interpretations and alternative metrics, but it is most frequently interpreted geometrically, as the Euclidian distance from the alternatives being evaluated to the voter's ideal point.

To illustrate some properties of majority rule when voters are all spatial voters consider the following table of elections. It illustrates a series of votes by friends attempting to choose a restaurant for lunch. The first column of Table 1 lists the alternative restaurants voted on, the next three list the votes cast by each of the three friends, and the last column the restaurant that obtains majority support in each of the votes undertaken. Al is assumed to prefer restaurants where the average meal costs $4.00, not because of that price, but because that price characterizes the restaurant's ambiance, service, and quality of food. Similarly, Bob prefers a restaurant where the average meal costs $9.00 and Cathy another restaurant where the average lunch costs $13.00—again, not because of the price but because she prefers more ambiance, better service, and more complex foods than her two friends and/or has more time for lunch than her friends.

As spatial voters, each person votes for the restaurant that is closest in overall quality to his or her ideal. The first illustrates a vote between Al and Cathy's ideal restaurants. Al votes for the $4 restaurant since it closest to his or her ideal (indeed it is ideal), Bob votes for the $13 dollar restaurant because it is closer to his ideal than the $4 restaurant (although far from ideal for him), and Cathy votes for the $13 restaurant because it is closer to her ideal point (indeed it is ideal for

her). The outcome is the $13 dollar restaurant, because the thirteen-dollar restaurant receives a majority of the votes (here two of the three votes). The other rows illustrate a series of votes among other alternative nearby restaurants.

Table 1: Votes Between Friends for a Lunch Restaurant				
Options	Al ($4.00)	Bob ($9.00)	Cathy ($13.00)	Outcome
$4 vs $13	$4	$13	$13	$13
$13 vs $6	$6	$6	$13	$6
$6 vs $11	$6	$11	$11	$11
$11 vs $8	$8	$8	$11	$8
$8 vs $9	$8	$9	$9	$9
$9 vs $10	$9	$9	$10	$9
$9 vs $9.50	$9	$9	$9.50	$9

Examine carefully the first four elections or referenda. Notice Bob's pattern of voting is exactly the same as the pattern of outcomes, although this is not true for the other voters. These first four outcomes characterize the **weak form of the median voter theorem**: when there are two alternatives, the voters are all spatial voters, and a median voter exists, the median voter always votes with the majority. Bob is the median voter; his ideal point is the median of the distribution of voter ideal points. There are exactly the same number of voters preferring more expensive restaurants as prefer less expensive restaurants than Bob (here just 1 of each type of voter). The same results would occur for larger groups of voters as long as there is an odd number of voters and Bob remains the median voter. (If Bob is indifferent between two alternatives because they are the same distance from his ideal point, he'll toss a coin to decide, and the coin toss will determine his vote and the outcome.)

The last three rows illustrate the **strong form of the median voter theorem**. When the median voter's ideal point is one of the two options voted on, it always wins. In such cases, the use of majority rule decision making implies that the median voter gets his or her ideal point. (The median voter's ideal point is sometimes called the Condorcet winner, because Condorcet demonstrated that a particular policy may be majority preferred to all the others that are feasible.)

The strong form of the median voter theorem generally requires institutional support to emerge. It does not happen automatically; whereas the weak form holds in all cases in which a median voter exists and two issues at a time are voted over. In the vote series illustrated, the winner of the previous round always became one of the alternatives voted on in the next round. (This

would be the case, for example, if the winner of the previous round became the incumbent or status quo ante for the next vote.) Once the median voter's ideal emerges as an outcome, it is majority preferred in all subsequent votes unless the median voter's ideal point changes—as might occur when his or her tastes or information about the alternative changes. No alternative can defeat the median voter's ideal, but every other alternative can be defeated by the median voter's ideal point. Under this institution, the median voter's ideal point is the unique majoritarian equilibrium.

Another institutional setting that has an equilibrium at the median voter's ideal point was discovered by Downs (1957). In elector contests between two candidates for office (or two political parties) who are both pragmatic vote maximizers, there is a tendency for candidate positions to converge on the median voter's ideal point—if voters are spatial voters and a median voter exists. Figure 1 can be used to illustrate the logic of Down's analysis.

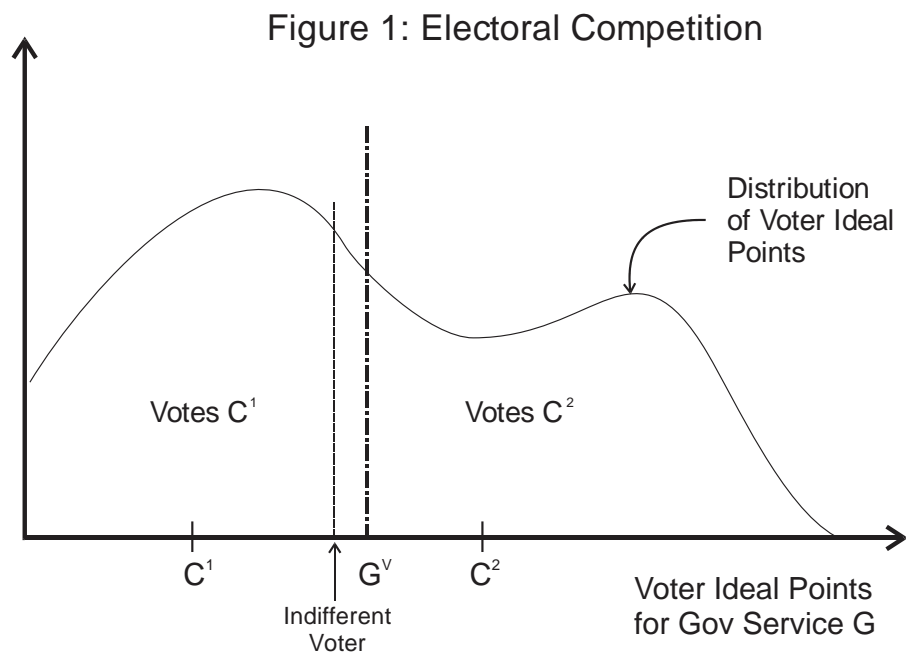
Figure 1: Electoral Competition

Figure 1 characterizes a frequency distribution of voter ideal points (or a density distribution of voter ideal points in cases in which voter ideal points form a continuum). Its bimodal shape is arbitrarily and is used solely for purposes of illustration; any distribution of voter ideal points can be used to illustrate Down's result as long as there is a median voter. The area under the curve between any two points on the horizontal axis is the number of voters with ideal points between those two points. Thus, when the median voter's ideal point is located precisely on the diagram, the areas under the curve to the left and right of the median voter are exactly the same. Note that the median

voter and average voter tend to be different from one another unless the distribution of voter ideal points is symmetrical, as would be the case for a normal distribution. The median voter model is not a "representative voter" model.

Figure 1 illustrates the case in which two candidates have made different promises about the policies they will support if elected (their platforms). C^1 is the platform initially proposed by candidate 1 and C^2 is the platform initially proposed by candidate 2. Being spatial voters, all the voters to the right of candidate C^2 would vote for candidate 2. All the voters to the left of C^1 would voter for candidate 1. Exactly halfway between these two candidate platforms (at $[C^1+C^2]/2$) is the indifferent voter. The indifferent voter(s) is exactly the same distance from each candidate's announced (and believed) platform. He, she, or they would simply flip a coin to determine which candidate to vote for. All the voters to the left of the indifferent voter votes for candidate 1 and all to the right voter for candidate 2 because their ideal points are closer to those candidates than to the other. As drawn, candidate 2 would win this election given the platforms the two candidates have adopted. Candidate 2 receives the half of the vote to the right of the median voter plus the voters between the median voter and indifferent voter. Note that the weak form of the median voter theorem thus holds. The alternative closest to the median voter's ideal point wins the election. In Figure 1, candidate 2's platform is closer to the median voter's ideal point than is candidate 1 and would win the election.

The weak form of the median voter theorem implies that if candidate 1 wants to win the election, he or she should move closer to the median voter than candidate 2. If candidate 1 shifts his or her platform to towards the middle far enough, the indifferent voter will be to the right of the median voter's ideal platform, and candidate 1 will win the election. Because that is true for both candidates, there is a tendency for both platforms to shift toward the median ideal point during an electoral contest. The only Nash equilibrium to this electoral contest occurs when full convergence has taken place, and both candidates espouse platforms that are identical to the median voter's ideal point. At the Nash equilibrium, neither candidate can increase their vote share by changing their platforms, and the strong form of the median voter theorem holds.

Of course, just as the law of one price never perfectly holds in microeconomics, one rarely observes such perfect convergence in competitive elections. Instead of identical platforms, the result is often one in which the platforms are similar moderate middle-of-the-road affairs. When substantial convergence occurs, one could easily imagine the two candidates or leaders of the

dominant parties swapping many of their prepared policy speeches, and that their listeners would rarely be surprised by their preferred candidate's "new" positions. Of course, each candidate's reading of their rival's speech would reflect his or her own speaking style, which would tend to affect how voters interpret the words spoken, but the words spoken are often very similar.

Such convergence does not always happen, because not all candidates are pragmatist in the sense posited by Downs, and because policy differences may affect turnout. Nonetheless, elections are often "close," and it is usually the case that "moderate" candidates and parties win elections—all of which are implications of the Downsian (1957) model of competitive elections.

3. The Median Voter Model of Policy Formation

The above models of electoral outcomes serve as the foundation for median voter models of policy formation in democracies. Both the illustrating examples imply that the strong from of the median voter theorem tends to emerge as an electoral equilibrium under institutions commonly used for referenda and national elections. In such cases, one can represent public policies as if they were chosen by a single person, namely the median voter. Changes in policies—insofar as they are consequences of electoral pressures--reflect changes in the median voter's idea policy, such as would occur if the median voter's income or age changes or if the relative price of government and private services change.

Note that the median model is not a "representative agent" model of the sort often used in micro and macro-economics, where an "average" person is used to illustrate how relative prices or macroeconomic policies affect individuals. Rather, it is an implication of rational voters and candidate competition in elections in which voters have sufficient information about the policies being voted on to favor the policy or candidate that is closest to their ideals. If elections matter—e.g. largely determine the policies chosen by elected representatives—then the median voter model can serve as at least a first approximation of policy formation in democracies, because election-based public policies tend to converge on median voter's ideal.

The median-voter model and its various predictions have been subjected to numerous statistical tests, and it has generally provided a plausible explanation for the course of major public policies in all well-functioning democracies. As a model, it necessarily leaves out much that may influence policy, but that is true of all political analysis. A good deal of statistical evidence suggests that it does a surprisingly good job of accounting for the broad outline of public policies and their changes through time.

The following subsections illustrate how a median voter model of policy choice can be developed and discusses how it may be estimated.

A Median Voter Model of Environmental Regulations

Consider a rational voter's interest in policies that tend to increase environmental quality. Suppose that environmental quality, E, rises with the stringency of the environmental regulations, R, adopted, and the level of economic development at the time a regulatory decision is to be made, Y^0. However, more stringent regulations tend to reduce future economic development, Y_t. National income in the future tends to be reduced as regulations become more stringent, but nonetheless tends to increase through time because of increases in capital stocks and scientific and technological innovation (assuming the regulations are not excessive). Future national income thus varies with the income level at the time the regulations are adopted and the stringency of the regulations, $Y_t = y(Y^0, R, t)$. In that case, environmental quality in the future can be written as $E_t = e(R, Y_t)$ or $E_t = e(R, y(Y^0, R, t))$. Assume that a voter's income is a constant fraction, s_i, of national income, $Y^i = s_i\, y(Y^0, R, t)$.

To simplify, it is assumed that voter interests are generally similar and that utility in period t increases with the personal income and environmental quality realized in that period. Voters experience the same level of environmental quality but differ in their personal income because of differences in human capital or natural capacities. The median voter in this case will be the voter with median income, whose share of national income is denoted as v. Substituting into the median voter's utility function produces the following characterization of the median voter's expected utility over planning horizon, T.

$$U = \int_0^T u(vy(Y^0, R, t), e(R, y(Y^0, R, t)))dt \tag{1}$$

Differentiating with respect to R allows the median voter's ideal environmental quality to be characterized.

$$U_R = \int_0^T [vU_Y Y_R + U_E (E_R + E_Y Y_R)]\, dt = 0 \tag{2}$$

The subscripts are partial derivatives of the variables subscripted. The integral of the first term can be thought of as the present value of the marginal cost of more stringent environmental regulations and of the second term as the present value of the marginal benefit of those regulations. The median voter's ideal level of regulatory stringency is the one, R^*, that equates his or her present discounted

value of reductions in personal income (material comfort) to the present discounted value of the increases in environmental quality over his or her planning horizon, as required to satisfy equation 2.

The implicit function theorem allows the ideal level of regulatory stringency, R*, to be characterized as a function of the exogenous parameters of the median voter's choice setting—of which there are just three variables that are not determined at the margin by environmental regulation: national income at the moment of choice, Y^0, the median voter's income represented by his or her normal share of national income, v, and his or her planning horizon or anticipated longevity, T.

$$R^* = r(Y^0, v, T) \tag{3}$$

Although regulatory choices take account of future consequences, they may be modified year to year as the base national income, Y^0, changes, the median voter's share of that income, v, changes, or as his or her planning horizon, T, changes. It bears noting that this lean political economy model accounts for the path of environmental quality and national income through time using approximately the same number of variables that macroeconomists tend to focus on—and with fewer arbitrary assumptions about functional forms to this point.

Given a specific functional form for equation 3, the partial derivatives can be estimated using data series for Y^0, v, and T. Such estimates allow the extent to which this model (equation 3) accounts for the time series of environmental regulations through time. And given, such an estimate, it also allows forecasts of future policies to be made given assumptions about the future paths of Y^0, v, and T. Other changes in the choice setting such as changes in voter preferences or beliefs about the effects of regulations on environmental quality would change the functional form of r, which can create problems or estimation. If such changes were frequent, it would increase the difficulty of accurately estimating function r, especially if its functional form changes more or less randomly through time.

The simplicity of the median voter's demand for environmental regulation is partly caused by the assumption that only two variables affect his or her utility, and the use of the standard strictly concave utility functions, as in most microeconomic models of consumer behavior. Other non-economic considerations may also affect political choices, and these can also be incorporated into to the model. For example, the model can be revised to take into account the median voter's

ideological perspective or trust in governmental agents, both of which are likely to affect his or her regulatory preferences.

The same family of models can be used to characterize a wide variety of public policies including those with respect to public education, infrastructure, healthcare, and tax-financed safety net programs.[1]

The Median Voter and the Scope of Governance

The scope of government policies and services can also be characterized using median voter models. For example, given a tax system, one can determine whether a community's median voter is better off with governmental or private provision of a service—whether a pure public or a pure private good. If not, then the service will remain fully private and democratic governments would not (and should not) intervene in such markets. Tax systems affect such choices as do voter ideology and perceptions of the trustworthiness of government officials.

The tax cost faced by a voter for a particular service varies with his or her personal income under contemporary tax systems. In such cases, the identity of the median voter is partly determined by the tax system, because every voter's marginal cost for government services is determined by the tax system. The higher is the marginal cost of a public service, the lower is a voter's demand for a government service or subsidy. Corruption and other sources of inefficiency thus tend to decrease the extent of government services demanded because they increase the marginal cost of government services under a preexisting tax system.

In cases in which tax burdens are largely shifted to persons with above average incomes, richer voters tend to prefer that essentially all private services remain private. The richest residents would in that case pay a higher fraction of the taxes required to finance such services, and thus their marginal tax costs tend to be higher than the market prices of private services. The opposite conclusion is reached by poorer than average voters because their marginal tax costs for governmentalized services tend to be lower than market prices, other things being equal. Median voters tend to have lower than average income, and thus tend to prefer government provision over

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[1] See, for example, Holcombe (1977, 1980, 1989), Gramlich and Rubinfeld (1982), Congleton and Shughart (1990), Breyer and Craig (1997), or Batinti and Congleton (2018) for examples of empirical applications of the median voter model to explain educational, social insurance, and healthcare policies. Congleton et al (2020) provides post-sample tests of the Congleton and Shughart results.

private provision, unless the expected decrease in variety, quality, or increase in production costs (because of a lack of competition) more than offset the effects of progressive taxation. These anticipated costs and quality effects together with the marginal tax rates of the median voter, thus determine the boundary between governmental and private (market) provision of goods and services when it is determined by electoral pressures. The greater these costs are, the fewer services are provided by democratic governments. The smaller they are anticipated to be, the more services are provided.

Note that this conclusion is based on costs and self-interest rather than the technical qualities of the goods and services. It does not matter whether the goods in question are technically pure public goods, club goods, or pure private goods, although in the latter case, economies of scale in provision tend to induce lower tax costs and broader electoral support for government provision of such services.

Ideology and the Median Voter's Demand for Government Services

Both the normative and positive aspects of an individual's ideology also affect voter demands for services. Positive aspects of ideology affect the anticipated costs of government provision through effects on the anticipated consequences of alternative policies. Normative aspects of ideology affect each voter's assessment of those consequences and thereby the ultimate ranking of the policy possibilities at the time voting takes place. The latter implies that when an ideology or new normative principles is internalized (or an old one revised), voter assessments of the ideal boundary between private and government services changes.[2]

Rational choice models can be extended to take account of such effects, without fundamentally changing the median voter model or its implications for public policies. For example, the environmental model above can incorporate the effects of ideology in several ways. The easiest is simply to posit that ideologies produce theories of the "good" society and, significant" deviations from that ideal tend to make such voters worse off subjectively. In the above model, the relevant indicators of a good society would be environmental ones, in which case existing levels of environmental quality and material comforts would generate systematically lower levels of utility if they differ from those associated with the good society than they would have without those notions.

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[2] In some cases a mere change in vocabulary may do so, as for example the replacement of terms such as public charity or handouts with "entitlements" would tend to make such forms of "social insurance" more likely to be normatively supported.

Such effects can be modelled by adding a term that characterizes the extent of ideological satisfaction from the policies of interest—here environmental regulations as captured by the last term of the utility function below.

$$U = \int_0^T u(vy(Y^0, R, t), e(R, y(Y^0, R, t)), i(E^* - e(R, y(Y^0, R, t)))dt \qquad (1b)$$

Note that this extension of the model adds a new exogenous factor and so changes the voter's demand for environmental regulations:

$$R^* = r(Y^0, v, T, E^*) \qquad\qquad (3b)$$

Incorporating ideological ideals into the model of voter choice does not simply change voter "tastes" it introduces another parameter of the choice setting, namely a voter's normative theories at the time that policies are chosen. In equation 1b, this is effect is modelled by adding a new ideological satisfaction term, which is determined by deviations from the ideological ideal. Changes in that ideal, will change the first order conditions and voter's choices, as characterized by equation 3b.[3]

4. Informational Limits of Voters and the Jury Theorem

The rational voter model can be extended to take other considerations into account as well. For example, an extended median voter model can also take account of the extent of voter knowledge about candidates and policies. Surveys of voter knowledge of candidates and the consequences of public policies suggest that voters may not be able to accurately determine either the politicians or policies most likely to advance their interests. This is largely due to what might be termed "natural" ignorance. We are all borne into the world largely ignorant of all things. Much as learned from our parents, siblings, friends, and teachers as we grow up, but a large residual of ignorance remains.

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[3] In cases in which ideology fully determines their choice (e.g. most voters are ideological zealots), rather than merely influencing it, electoral pressures will favor policies at the median of the electorate's ideological spectrum, which, by definition, would be the position held by "moderate" voters—although their opinions may not be temperate in the sense that the word "moderate" often implies. See Congleton (2020) for a lexicographical model of how such extreme forms of normative internalization affect private behavior and political outcomes. It is quite possible, for example, that the median member of the assembly that selected the French government after the revolution of 1789 may have been quite pleased with all of the bloodshed generated by that government and its immediate successors' policies.

As voters become aware of their own ignorance and of opportunities to reduce it, voters may rationally choose to remain ignorant of many factors that determine their estimates of public policies and their effects on their interests. Their time and attention are scarce resources and the cost of policy relevant information is often high (tax experts often spend much of their adult lives trying to better understand the economic consequences of taxation) and the effects of a single voter on a political outcome is normally very small, which reduces the electoral rationale for investing time and attention in the mastery of public policy. This is not to say that no information is acquired because such information may be relevant for one's investment and locational decision, but it is to say that complete information is unlikely to be acquired by any single voter (or policy expert).

In models that attempt to take account of the informational limits of voters, changes in information are among the factors that can alter a voter's assessment of the best policies. News sources often provide useful information about candidates, their espoused public policies, and the anticipated consequences of those policies. However, much of the information that is freely available tends to be biased in various ways, because it is freely provided in an attempt to persuade voters (or their representatives) to favor particular policies of interest to those disseminating the information. Such persuasive campaigns are undertaken by most candidates, political parties, and interest groups.

New information, whether biased or not, when it is influential may induce voters to change their opinions about the relative merits of public policies or candidates. For example, new information about environmental health risks may change voter assessments of environmental regulations or tax-financed healthcare services. A scandal may cause voters to reassess the character of incumbents or their challengers.

Although much is learned as one becomes more informed (including "facts" and theories that are not entirely true), surveys suggest that persons of voting age know relatively little about their governments and public policies. Indeed, most such surveys imply that voters are unlikely to know enough to select the policies that would most advance their interests. Thus, if policies were determined by the information of the typical or model voter, the resulting policies would be unlikely to advance median voter or general interests, and democratically determined public policies would be unlikely to produce an attractive society. Nonetheless, Western democracies have managed to produce the most attractive societies in human history.

How is this possible if voters are largely ignorant of public policies and electoral politics determine public policies? One possible explanation for the success of democratic public policy is another implication of the median voter model referred to as Condorcet's Jury Theorem. Condorcet's (1785) analysis suggests that the middle or moderate members of a jury tend to have more accurate assessments of the guilt or innocence of a person under trial than the extreme jurors. When applied to large scale elections, the same logic implies that moderate voters—including the median voter—tend to have more accurate assessments of the policies that advance their interests than more extreme voters—even though they have no more information than any of the other voters. In effect, the median voter is a median estimator of the merits of policies options, which are very likely to be accurate assessments.

To illustrate how Condorcet's jury theorem works in an electoral setting, suppose that voters all have exactly the same interests, but have different estimates of the policies that would best advance their interests because they have different information (and likely not very much of it). If one arranges such voters according to their estimated ideal policies from high to low, a distribution like that of figure 1 may be characterized—although statistics implies that it is more likely to resemble a normal distribution than the bimodal one drawn. The median voter is, in this case, determined by the median of the distribution of voter estimates.

It turns out that the median estimate provides a very accurate (low variance) estimate of the voter assessment most likely to correctly characterize "good" policy, as long as voters have enough information so that (most) individual estimates are unbiased. Since, it does not require very much information for an estimate to be unbiased—just two independently selected data points are sufficient to make an unbiased (but quite inaccurate) estimate of a linear relationship—the median estimate generated by a large sample of voters tends to identify the policy that most likely advances voter interests. If the distribution of estimates resembles a normal distribution, the result is a maximum likelihood estimate, given the assumed similarity of voter interests. When both interests and information vary and a large number of voters are near the median, the median voter's conclusions about the best policy is the approximately the one that is most likely to advance the interests of moderate voters (rather than all voters). In either case, the voter at the median is generated by a much larger sample size than available to any single voter, and therefore is a far more accurate estimate of the policies that are likely to advance voter interests, than any single voter's estimate can be.

This property of median voter outcomes is very likely to account for much of the relative success of democracies, despite conclusive survey evidence of voter ignorance. Fortunately, it often does not take very much information for the median voter's assessment to accurately identify his or her interests.[4]

5. Relevance of the Median Voter Model When a Median Voter Does Not Exist

The main weakness of models that predict median voter outcomes is that many distributions of voter policy preferences do not have a median. Without a median, obviously, there can be no median voter outcome. In multidimensional policy spaces, a good deal of symmetry is required for a median voter to exist (Plott, 1967). In the absence of sufficient symmetry, an electoral equilibrium is unlikely to exist (the cyclic majority problem). Moreover, this problem is not just associated with "odd" or unlikely distributions of voter preferences, but with every policy area in which distributional issues are central to the policy choice. These include choices among tax systems and formulae for allocating all services that are not pure public goods.

To illustrate the cyclic majority problem, suppose that a fund, F, for financing local mass transit is to be distributed among three equally sized towns with their own mass transit systems. Suppose further that an allocation to one of the towns provides benefits only the voters the community obtaining the funding. The distribution of benefits can be characterized as (A, B, C). An equal division of funds among the three towns would be (.33F, .33F, .33F). Note that if the residents of each town have equal representation in the legislature making the allocation, this division would be majority dominated by an unequal one such as (.40F, .40F, .20F) because two of the three groups (towns) benefit more from that division than the equal one. That one in turn is dominated by distributions such as (.55F, .20F, .25F), which are still more unequal, because again two of the three groups benefit from the more uneven distribution. Perhaps surprisingly, the original division dominates the last division. A majority cycle exists.

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[4] For simulations that illustrate some of these properties see Congleton (2007). For more on the theory of Condorcet's Jury theorem and variations of that theory, see Grofman et al (1983). The jury theorem requires more data tends when many tradeoffs (dimensions) than are relevant for policy assessments. Congleton (2007) shows that the jury theorem fails to operate if only a few voters have collected at least a bit of full-dimensioned data.

There are endless possibilities for majoritarian cycles in every case in which costs or benefits are to be distributed among different groups, towns, or regions. There is no electoral equilibrium in such cases. There is no Condorcet winner—no policy that is majority preferred to all others.

For majority rule to be a viable decision rule in such cases, there needs to be either (1) normative or customary support for a particular way of distributing taxes and government funds such as a universality or generality principle (Niou and Ordeshook (1985), Buchanan and Congleton 1998), or (2) political institutions that induce stability by regulating the process through which public policies are adopted (Shepsle and Weingast, 1981). The normative solutions can be illustrated by assuming that all three voting blocs or towns share a normative disposition that supports one of the distributions. In that case, all (or most) voters benefit from policies consistent with their normative theory. That benefit, N, would be added to the benefits associated with normatively ideal allocation of funds, lessor ones to allocation that were close to ideal, an none to allocations that were clearly far from "ideal." For example, if the equal allocation were supported by the community's most commonplace norms, the payoffs for the first allocation become (.33F+N, .33F+N, .33F+N), and N>.17F would be sufficient to make all other possible allocations in the above cycle inferior to the normatively "best" one.

Possible institutional solutions include agenda control by an elected official within the legislature and other procedural rules, such as deciding one policy at a time. In cases in which each policy dimensions has a median voter (which is very likely in non-distributive policy areas, if voters are all spatial voters), making policy decisions with separate committees for each policy area can generate a multi-dimensional policy equilibrium where each policy is at a median voter ideal point, even if there is no overall median voter (e.g. the same median voter in every dimension). Similarly, if the legislature elects an agenda setter that represents either the median of the legislature or of his or her party, the result of that person's agenda control is likely to be approximately that of the median voter of the electorate or of the party that controls the legislature/government. In such cases, the median voter model is relevant even if the overall distribution of voter interests has no median.

For theorists that believe that interest group activity, rather than elections, determine all public policies. Differences between autocracies and democracies would reflect differences in the kinds of interest groups and coalitions of interest groups that can be formed under these systems of government rather than elections, and the median voter results and electoral models would be relevant only to the degree that elections affect the balance of power among interest groups. In this

case, the weak form of the median voter theorem is likely to hold, rather than the strong form. The median voter is likely to prefer the alliance of interest groups that wins the election to the one(s) that lost the election. Contests between two or more such alliances would be unlikely to converge as fully to the median voter's ideal as implied by the Downsian model of representative democracy, but the median voter would still partly determine the policies adopted.

6. Conclusions

If one accepts that hypothesis that the main difference between democracies and authoritarian states is that the policies of a democracy are largely determined by electoral pressures, then focusing on the properties of electoral equilibria provides the best way to understand and predict the public policies of democracies. The median voter equilibria is in many respects the natural one of the ones worked out by public choice theorists, because it rests squarely on the same rational choice model that grounds microeconomic theory. It was the first rational-choice based equilibria to be worked out because it follows from relatively straight-forward game-theoretic models of interactions between candidates and voters.

When elections are open, candidates are more or less honest, and competition for votes is reasonably intense, the Downsian model of representative democracy implies that the median voter gets his or her way on the broad outlines of public policies, because the policy positions of successful candidates and parties tend to converge on the policies most preferred by the median voter. This is true even if the candidates themselves have never heard of the median voter theorems, as long as they adjust their policy promises to increase their vote shares. As a consequence, elections tend to be close—with candidate and vote totals normally within a few percentage points of one another, and relatively moderate candidates and parties normally win elections. Insofar as the winners keep their promises—or at least attempt to—or are interested in reelection, the policies advocated after the election will be those that brought them to high office. Their policies by elected representatives thus tend to be clustered about the ideal points of the median voters of the electoral districts in which they were elected in first-past-the-post electoral systems and about the party platform of the party supported by the median voter in proportional representation systems.

That this clear, but sophisticated, model can account for the broad outlines of public policy within democracies—despite the complexity of electoral competition, voter deliberations, and all the knowledge problems associated with public policy calculations—is the reason that the median voter model continues to attract the attention of scholars. It serves both as a "quick and easy" model of

policy formation that anyone can keep in their head, and it also serves as a useful point of departure for research on extended models that attempt to determine how specific elements of electoral competition affect the characteristics of the persons who are delegated policy making responsibilities in representative democracies.

Indeed, it is quite possible that the complexity and idiosyncratic nature of the other factors that one might take into account are such that their joint effects on public policies are chaotic or random; in which case, the median voter model may well be the best of the systematic explanations that can be devised to account for the policies of well-functioning democratic governments.

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