Political Parties and Electoral Landscapes

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Abstract

We study the relationship between voters' preferences and the composition of party platforms in two-party democratic elections with adaptive parties. In the model, a political party locally adapts a platform on an electoral landscape. The electoral landscape is determined by the preferences of voters and the opposition party's platform. We find that adaptive parties tend to adopt moderate platforms regardless of voters' preferences. We explore how, by varying the distribution of voters' preferences, we can alter the landscape's ruggedness. Greater ruggedness lessens a party's ability to respond to voters' preferences. In other words, landscape ruggedness tempers the responsiveness of parties.

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Introduction

An enduring concern of democratic theory is the extent to which electoral processes encourage candidates or political parties to respond to voters' preferences. Spatial election theories illuminate why parties alter their platforms to appeal to voters. Office-seeking parties try to take policy positions that are as "close" to voters' preferences as possible. Many spatial models assume parties have sufficient information to recognize and the ability to respond to voters' preferences. These models suggest that in a two-party system, efforts to attract votes leads parties to advocate moderate platforms (Downs, 1957; Calvert, 1985).

Yet formal political theory has not entirely succeeded in explaining how changes in voters' preference distributions influence party behavior. Downs (1957, 140), referring to his single dimensional spatial model, claims "the distribution of voters is a crucial determinant molding a nation's political life...[and] major changes in it are among the most important political events possible." He asserts that unimodal preference distributions lead parties to adopt similar or identical platforms, while bimodal distributions lead parties to adopt dramatically different platforms (p. 118). However, with more than one issue dimension, two-party systems have single-point equilibria only if voters are distributed symmetrically (Plott, 1967). If voters are distributed asymmetrically, equilibrium sets, such as the top-cycle, uncovered, or minmax sets, can be large, or even encompass the whole space. ¹ Indeed, only McKelvey (1986) has formalized a connection between preference distributions and the size of equilibrium sets.²
Both party platforms and the distribution of voters' preferences change over time. Moreover, these movements may go hand in hand, which bodes well for the idea of democratic responsiveness (Nie, Verba, and Petrocik, 1976; Sundquist, 1968, Part II; Phillips, 1990). But if parties cannot adapt quickly enough to keep pace with voters, or if parties have little electoral incentive to respond to changes among voters, then election outcomes may not reflect voters' preferences. For these reasons, we believe the rate at which parties change their platforms may be significant in evaluating electoral democracy.

We consider a spatial model of two-party competition where parties are modelled as adaptive agents competing for votes in a multidimensional issue space. Parties respond to popularity polls by incrementally adapting their platforms. Our model explores the ability of parties, in various electoral environments, to find winning platforms. We evaluate winning platforms according to measures of distance, ideological consistency, and social utility.

Our model addresses two substantive questions: How do parties adapt to voters who are concentrated in regions of the issue space? How do parties adapt to voters who become more or less consistent in their ideology? In our model, voters' preferences help to determine the parties' adaptive environment, or what we refer to as the electoral landscape. We discover relationships between the distribution of voters' preferences and the nature of party competition.

Adaptive Parties

Standard formal theory relies on the assumption of rational political actors. As an alternative, we approximate the behavior of parties using artificial adaptive agents (AAA).
This sort of computational modelling, as advocated by Holland and Miller (1991), has recently been applied to biology (Kaufman, 1989), economics (Marimon, McGrattan, and Sargent 1989, Arifovic 1989) and political science (Kollman, Miller, and Page 1992). Such models assist in exploring systems of well-defined agents in a replicable environment; any state of the system is fully recoverable. Inductive hypotheses can be generated, developed, and tested in a matter of moments. Finally, while they can be modelled with great flexibility, individuals, firms, governments, or organizations in these models behave in logically consistent patterns.³

Using AAA models, researchers can explore the relationship between optimization and adaptation. Following Kollman, Miller and Page (1992), we compare various types of adaptive parties and search for generic behavioral patterns. By employing search algorithms of known strengths and weaknesses, we can test hypotheses about the underlying adaptive environment.

Rather than being vote-maximizing and fully-informed, our parties are adaptive and dependent on incomplete information. In the real world, parties may have neither the capability nor the incentive to locate the uncovered, top-cycle, or minmax set. Instead, parties may locally adapt from their current platform. There are several reasons to expect this. First, a party may have limited information and foresight, so local adaptation may be the only means of finding winning platforms. Second, a party may be tethered to policy positions for ideological reasons. Third, party members may be repulsed by the opponent's platform, so a party may avoid advocating platforms resembling the opposition party. Finally, voters may be wary of a party which moves across the ideological spectrum quickly.
in search of votes. In a similar model, Kollman, Miller, and Page (1992) show that adaptive parties, despite informational and positioning constraints, advocate moderate platforms of high social utility. As discussed, not only are we concerned with whether adaptive parties adapt moderate platforms, we also want to know whether they adapt moderate platforms quickly, after a few elections, or slowly, after preferences are likely to have changed.  

The Electoral Landscape

A useful way to discuss how parties react to electoral environments is to refer to the "electoral landscape." The electoral landscape signifies the parties' perceptions of vote totals over all possible platforms. Like a geographic landscape, an electoral landscape has points of both high and low elevation. A platform's altitude equals its expected vote total. We assume that parties seek the high ground (in vote totals, not moral rectitude!).

The number of votes a party’s platform receives depends upon its opponent’s platform and voters' preferences. A party’s only information comes from polls of random voters, and a party alters its platform only if it expects the change to improve its vote total. Thus, one could view a party as trying to climb to the highest elevation possible, subject to constraints on how far it may travel and information about the elevation of neighboring peaks. Adaptive parties walking on rugged, multi-peaked landscapes may well get trapped in areas of relatively low elevation.

The notion of an electoral landscape is implicit in rational choice models of elections. An optimizing party scans the entire landscape and selects the platform of highest elevation.
In rational choice models, ruggedness of paths to the optimal platform is irrelevant. In our model, where parties locally adapt, ruggedness matters.

The Model

Following standard spatial models, our voters have perfect information about parties' platforms. Each voter attaches an integer valued strength and ideal position to each issue, where strength measures the issue's relative importance to the voter. A voter considers an issue irrelevant if the voter's strength is equal to zero on that issue. The ideal position denotes the voter's preferred position. Thus, an integer valued vector of length $2n$ (where $n$ equals the number of issues) fully characterizes a voter's preferences.

There are $k$ positions on each issue $\{0,1,\ldots,k-1\}$ and $s$ strengths $\{0,1,\ldots,s-1\}$. In the findings presented below, $n = 10$, $k = 9$, and $s = 3.5$. The utility to a voter from a party's platform, $y \in \{0,\ldots,k-1\}^n$, equals the negative of the squared weighted Euclidean distance, with weights determined by strengths. Let $s_{ji}$ denote the $j$th voter’s strength on the $i$th issue, and $x_{ji}$ denote the voter’s ideal point. We can then write a voter’s utility from platform $y$ as:

$$u_j(y) = -\sum_{i=1}^{n} s_{ji} (x_{ji} - y_i)^2$$

A voter casts a ballot for the party whose platform generates the higher utility, and the party obtaining the most votes wins the election.

An electoral sequence begins with the creation of two randomly assigned initial party platforms. These are referred to as party ideal points. One party is arbitrarily chosen to be
the incumbent, whose platform remains fixed during the first election. During the campaign prior to each election, the challenger party tests platform variations using polls of randomly selected voters. After this polling, the challenger party chooses the platform which maximizes its expected vote total. The parties then compete for election with the winning party becoming the fixed incumbent. The losing party then becomes the challenger and undertakes polls in order to determine a winning platform. Often parties fail to locate winning platforms after the finite campaign. If so, the incumbent remains, and the challenger begins adapting anew. We monitor this process through several elections.

Parties adapt to polling information using either a genetic algorithm, multi-step hill climbing, or random search, three benchmark methods of adaptive search. A genetic algorithm is a population based adaptive search algorithm which mimics evolutionary learning. Platforms are reproduced based on their relative performances, and portions of the surviving platforms may be exchanged with other members of the population using a crossover operator. A mutation operator also alters platforms. Multi-step hill climbing begins by testing a neighboring platform. If the tested platform outperforms the current platform, it becomes the new status quo. Random search tosses out multiple platforms in a neighborhood of its current platform and chooses the best one. At a metaphorical level, our genetic algorithm represents parties which evolve a candidate during a series of competitions, our multi-step hill climbing represents parties which fine tune their previous candidate, and our random search represents parties which choose the best from among volunteers.

We want to know how parties, in their efforts to attract votes in changing environments, move about the issue space. At the completion of each election, we record
several measures which indicate how parties move and whether parties adopt platforms which
in a broad sense respond to the preferences of voters.

Over the series of elections, we trace the trajectory of winning party platforms on the
following measures:

Distance from Ideal equals the Euclidean distance of a winning party's platform from its
original platform prior to the first election.

Distance from Median equals the Euclidean distance between the winning party's platform
and a hypothetical platform consisting of the median position on all issues.

Separation equals the Euclidean distance between the winning party and the losing party.

Consistency equals

$$\text{consistency}(x) = 1 - \frac{\text{var}(x)}{\text{Maxvar}}$$

where var(x) is the variance of the positions in the platform x, and Maxvar equals the highest
possible platform variance (a platform alternately taking positions 0 and 8). Consistency
always lies on the unit interval and varies inversely with the variance in the platform's
positions. A platform with no variance has a consistency equal to one.

Centrality of a platform y equals

$$\text{centrality}(y) = \frac{\sum_{j=1}^{V} u_j(\text{median})}{\sum_{j=1}^{V} u_j(y)}$$

where V equal the number of voters. This normalization sets centrality(median) = 1, though
we attach no normative significance to the median itself as an outcome. Higher centrality

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means that the platform is closer to the weighted center of voters’ preferences. Centralities close to 1 represent strong utilitarian outcomes. Note, however, that centralities across different distributions of voters’ preferences cannot be compared directly because each preference distribution generates a distinct centrality distribution.

Ruggedness equals the percentage of one dimensional interior local maxima and minima. A platform has a one-dimensional maximum (minimum) on an issue at position k if both positions k+1 and k-1 obtain lower (higher) vote totals. More ruggedness should lead to slower adaptation. 6

Preference Distributions

We alter voters’ preferences by correlating voters’ ideal positions on different issues and by correlating an issue’s strength and position. The first type of correlation alters what we call an ideology. Voters can have uniform ideologies, which means they have independent (across issues), uniformly distributed ideal positions, or voters can have consistent ideologies, where ideal positions on issues are correlated. To create consistent preferences, we randomly assign an ideal base position to each voter and require that all ideal positions on other issues lie within one position of the base. For example, if the base for a voter is 3, then all ideal positions lie in the set {2, 3, 4}. 7

The second type of correlation, between strengths and ideal positions, may be independent, centrist, or extremist. With independent preferences, a voter’s strengths on issues are independent of preferences over policies. If a voter attaches greater strengths to issues on which the voter prefers moderate positions, that voter has centrist preferences. If
the voter attaches greater strengths to issues on which extreme positions are preferred, that voter has extremist preferences.

To illustrate, consider the case of nine positions per issue \{0,1,...,8\}, and three strengths \{0,1,2\}. Centrist voters assign high strengths (s=2) to issues with ideal positions \{3,4,5\}, low strength (s=1) to issues with ideal positions in \{1,2,6,7\}, and no strength (s=0) to issues with ideal positions \{0,8\}. In extremist preference distributions, voters attach greatest strength to issues on which they have extreme ideal positions. Issues with ideal positions in \{0,1,7,8\}, receive high strength (s=2), issues in \{2,3,5,6\} receive low strength (s=1), and an issue with ideal position \{4\} is considered by the voter to be irrelevant (s=0).

Since there are two types of ideologies and three types of strength-ideal position correlations (see Table), we consider six possible distributions of voter preferences.

place Table 1 about here

**Intuition**

The distribution of voters’ preferences together with the incumbent’s platform determine the challenger’s electoral landscape. Parties’ local choices depend on whether the distribution of voters’ strengths is centrist, extremist, or independent, and whether voters are ideologically consistent or uniform.

Throughout this section, we confine discussion to a ten issue, nine position issue space with 2501 voters, and sample polls of 151 randomly sampled voters. Two dimensional projections can provide intuition for the formation of a multi-dimensional electoral landscape.
In Figure 1, the fixed incumbent party (I) lies in the upper left corner of the projection onto issues one and two, and the adaptive challenger party (C) begins in the lower right. We have also included a voter (V) whose ideal point, projected onto the first two issues, lies below and to the right of I. On the other eight issues, V's ideal point may be nearer to one party's platform, or it may be equidistant from the two parties' platforms. Suppose first that V's ideal point is equidistant from both parties on the other eight issues. If the challenger party locates inside the middle ellipse (denoted by 0) on issues one and two, then it receives V's vote. Otherwise, V votes for the incumbent.

If V's ideal point is nearer to the incumbent's platform on the other eight issues, then in order to win V's vote, the challenger party must be even closer to V's ideal point on the first two issues. For example, the challenger needs to locate inside of the inner ellipse (denoted by -). Finally, if V's ideal point is closer to the challenger's platform on the other eight issues, then the challenger needs only locate inside of the outer ellipse (+) to win V's vote.

Place Figure 1 Here

Suppose V prefers the challenger party on the other eight issues, and that any platform adaptation on issues one and two which moves the challenger into the interior of (+) yields V's vote for the challenger. Using similar diagrams we could draw an ellipse for each of the 2500 other voters, in the interior of which the challenger party obtains a vote. In simplest terms, the goal of the challenger party is to locate a platform which lies in the
interiors of as many ellipses as possible. In an electoral landscape, the elevation of a platform equals the percentage of voters' ellipses in which the platform lies. Figure 2 shows a three dimensional landscape formed by a sample of 151 voters with independent preferences, a uniform ideology, and an arbitrarily positioned incumbent. The elevation at the point (2,4) represents the percentage of the vote received by the challenger party if it advocates position two on the first issue, four on the second issue, and retains the rest of its platform. The concentration of high elevation platforms near the center illustrates the moderating influence of democratic selection in two-party settings; moving towards the center wins votes.

Place Figure 2 Here

Results

In this section, we expand upon the concept of an electoral landscape to derive predictions about parties' behavior, and we test these predictions using computer simulations. Different preference distributions produce distinctive types of electoral landscapes and thus different rates of convergence.

We ran elections for all six types of preference distributions. The most fundamental finding is that adaptive parties tend to move toward moderate positions regardless of the distribution of voters' preferences. For all landscapes, adaptive parties with information limited to polls of sample voters moved to regions of high social utility. In
every case, by the fourth election winning parties moved within the top 1% of all platforms as measured by centrality.

However, a tendency to move toward regions of high social utility does not imply that parties will converge to identical platforms. Parties in our model maintain some distance from each other and from the median positions, suggesting that parties in the real world, to the extent they are adaptive, may have distinct platforms and noncentrist policy positions even though they are encouraged by poll results to become more moderate.

To demonstrate the abilities of the different algorithms to adapt on rugged landscapes, Figure 3 shows Distance from Ideal for a uniform independent distribution and for the three search algorithms. Genetic algorithms are promoted by many researchers largely because they perform well in nonlinear landscapes (Holland 1975). For rugged landscapes, multi-step hill climbing does not adapt as well as genetic search because it can easily get stuck at local optima. Finally, random search is slower than the other two in simple environments, but it performs nearly as well as hill climbing in complex environments because it can "jump" over low points on a rugged landscape.

To indicate robustness, for the remainder of this paper we shall report results from parties using the least able search technique on extremely rugged landscapes, multi-step hill climbing. We shall show that party behavior varies according to the distribution of voters' preferences when parties use hill climbing algorithms. Our data confirm that the same kind
of differences are manifest with parties using genetic algorithms and random search.

Heretofore, unless otherwise indicated, all measures reported to show differences between two or more types of preference distributions are statistically significant with \( p < .05 \).

Salience

Figure 4 depicts the formation of a landscape given extremist preferences. Voter 1's (V1) ideal position is moderate on issue two and extreme on issue one. It follows that V1 places more weight on issue one as represented by the tall, thin indifference ellipses. Voter 2 (V2), who prefers a moderate position on issue one and an extreme position on issue two, attaches more weight to issue two. Voter 3 (V3), who prefers generally moderate positions on both issues, has indifference ellipses which are circular.\(^\text{10}\) As before, for each voter, the outer (respectively, inner) ellipse correspond to the challenger party's platform being nearer (further) to the voter's ideal point than the incumbent's platform on the other eight issues. And the middle ellipse corresponds to both parties' platforms being equidistant from the voter's ideal point on the other eight issues. In Figure 4, even if both V1 and V2 prefer the challenger on the other eight issues, the incumbent is likely to win their votes.

Therefore, in an extremist landscape, it should be difficult for the challenger to win voters with ideal points in the regions around V1 and V2 using local adaptation. Similarly,
voters with ideal points in the lower right should be difficult for the challenger to lose. Potential voters won through adaptation by the challenger are only those near the center. Since relatively few voters determine the outcome, extremist landscapes will have gentler slopes. Gentler slopes imply increased ruggedness because of noise from random polls. For instance, a small positive slope may not be recognizable given sampling effects. However, the regularity of peaks (because indifference curves for voters in the same region look the same) moderates the ruggedness. To demonstrate, Figure 5 shows a landscape formed by extremist preferences and a well-positioned incumbent (after five elections).

Place Figure 5 Here

As in Figure 2, the platforms of highest elevation are near the center. Both landscapes appear to have similar ruggedness; locating a monotonically increasing path from the edges to the center regions requires some effort.

Centrist preferences imply that the indifference ellipses for voters 1 and 2 rotate by ninety degrees (Figure 6). Voter 1 now attaches greater strength to issue two, and Voter 2 attaches greater strength to issue one.

Place Figure 6 Here

If neither the challenger nor the incumbent has an advantage on the other eight issues, then the challenger can obtain votes from both V1 and V2 by a slight adaptation towards the
center. In centrist environments, compared with extremist environments, more voters are up
for grabs, creating stronger incentives for moving towards the center. Therefore, centrist
preferences should form less rugged landscapes, with smooth paths leading to the elevated
region and quick adaptive convergence.

Finally, independent preferences create indifference ellipses which may be oriented in
either direction. Unlike either centrist or extreme preferences, two voters with identical ideal
points may attach different strengths to issues. Also, there may be isolated peaks in a
landscape formed by independent preferences. The regularity of the extremist and centrist
cases is absent.

A discussion of landscape formation is aided by distinguishing between two types of
voters, Type X and Type +. We classify a voter as Type X if the voter’s ideal positions on
issues one and two are approximately equal distance from the center. For example, the
positions (6,6), (3,5) and (0,8) would be classified as Type X. In both extremist and
centrist environments, Type X voters have circular indifference curves. However, with
independent preferences they have arbitrarily elliptical indifference curves. Type X voters
therefore tend to make independent landscapes more rugged than either centrist or extremist.

Type + voters prefer positions on issues one and two which differ in their distance
from the center, such as (4,8) and (1,3). Voters V1 and V2 in Figures 3 and 5 are type +
voters, and as discussed, they create smooth landscapes with centrist preferences, and rugged
landscapes with extremist preferences. For independent preferences, the lack of regularity
creates ruggedness.
Combining the effects of both types of voters, independent and extremist landscapes should be more rugged than centrist landscapes. Our intuitive comparison between independent and extremist landscapes is indeterminate. Figures 7 and 8 support these intuitions. A greater percentage of local maxima and minima in Figure 7 implies a more rugged landscape. Figure 8 indicates that centrist preferences lead parties to adapt moderate platforms quickly. As expected, extremist and independent preferences create more ruggedness than centrist preferences. The comparison between independent and extremist preferences, though not statistically significant, suggests that independent preferences lead to more ruggedness.

Place Figures 7 and 8 about Here

Ideology

We also want to consider how ideology (consistency of ideal positions across issues) affects electoral landscapes. With ideologically consistent voters in two dimensions, voters' ideal points are distributed as a swath starting in the lower left corner and extending to the upper right. Again, for an arbitrary incumbent, a tested platform in the direction of the center should lead to more votes, while one further away should lead to fewer. Therefore, landscapes formed by ideologically consistent voters should also have peaks near the median.

There are two effects of consistent voters on landscape ruggedness. First, consistent voters are a subset of Type X voters. Recall that Type X voters with centrist or extremist preferences have roughly circular indifference curves. Type + voters smooth centrist landscapes and make extremist landscapes more rugged. The absence of Type +
voters means that consistent voters form more rugged centrist landscapes and less rugged extremist landscapes.

The effect of consistent voters on independent landscapes is indeterminate. It depends on whether Type X or Type + voters makes the greater contribution to ruggedness.

Second, consistent voters who prefer high (respectively low) positions on issues one and two prefer high (low) positions on the other issues as well. Suppose that after a few elections, the incumbent party's platform takes positions which are higher on average than the challenger party's positions on issues three through ten. Because they have consistent preferences, those voters lying to the upper right on issues one and two generally prefer the incumbent on the other issues, reducing the probability that the challenger can win their votes. Since fewer voters are up for grabs, the result is a gentler slope, and therefore increases ruggedness. If voters have uniform ideologies, they would be as likely to prefer either party on the other eight issues. In short, landscapes formed by ideologically consistent voters should be substantially more rugged for centrist preferences and only slightly more so for extremist and independent preferences. Figure 9 supports this intuition. Differences between consistent and uniform extremist landscapes were not statistically significant.

Place Figure 9 about here

An initial concern regarding consistent voters was whether they compel parties to adapt more consistent platforms. If so, parties would converge down the "swath"; i.e., their consistency would be near 1 as they moved toward the median. In fact, we observe a more
subtle interaction between voters' preferences and party behavior. Parties do not appear to become more consistent when appealing to consistent voters (as measured by consistency (data not shown), but parties do change their behavior.

As Figure 10 shows, party separation does not converge to zero. Parties maintain a level of separation which increases when voters are made consistent. We suspect this is because the swath of voters acts as a drag on parties as they move toward moderate platforms. Adaptation, however, never ceases. In later elections, parties locally search for winning platforms. These searches almost always result in the selection of moderate platforms. Since adaptation in later elections is confined in later elections to moderate platforms, local searches appear less directed and more random.

Place Figures 10 and 11 about here

Other results emerge from the data. For example, we find that adaptive parties cannot always locate winning platforms. The probability of winning decreases with the number of elections, from approximately 100% of the time in the first election down to approximately 25% by the tenth election. Incumbency advantages may be partially a result of the limited abilities of challengers to adapt on landscapes. Traditional spatial theory, in which optimizing parties in multi-dimensional issue spaces can defeat any position, must assume an exogenous incumbency bias in order for the models' predictions to correspond with the reality of advantaged incumbents.

A challenger's (in)ability to win might result either from multiple local peaks or from
a changing percentage of available winning platforms. Our data support the latter; according to our measures, landscapes do not appear to grow significantly more rugged as the number of elections increases and the incumbent's platform improves. Challenger parties succeed less often when incumbents are well-positioned in later elections, and it appears to be a result of fewer winning positions, not because parties do not know which direction to move.

Discussion

To summarize our findings, the ability of parties to locate winning platforms depends on the ruggedness of the electoral landscape. We find that extremist and independent preferences lead to slower party convergence than centrist preferences, and that consistent ideologies lead to slower party convergence especially when preferences are centrist.

The increased ruggedness of landscapes formed by extremist preferences and consistent ideologies may explain some reluctance by contemporary American parties to budge from platform positions. When voters attach greatest strength to those issues on which they take extreme views, for example abortion or gun control in the United States, parties appear to converge slowly to moderate positions. On issues where voters attach more significance to centrist positions, for example Social Security or foreign policy, parties appear to adapt quickly to similar, moderate positions.

Yet even extremist preferences and consistent ideologies lead to parties taking moderate platforms within a few elections. To infer moderate voter preferences from an electoral system with two moderate parties may be a mistake. Political moderation and party
separation in two-party systems might be as much attributable to the structural incentives imposed by the democratic process as to the moderation of voters' preferences.

While extremist preferences and consistent ideologies tend to create more rugged electoral landscapes, convergence results in spatial voting models with adaptive parties seem relatively robust to changes in voters' preference distributions. Our findings tend to support Down's analytical conclusion that in two-party democratic elections, rational parties tend to move toward moderate platforms. For adaptive parties, the rate of that convergence and the separation of parties' platforms are significantly influenced by the landscapes' ruggedness.

Though the notion of adaptive parties competing on an electoral landscape contrasts with the more traditional notion of rational parties optimally locating in an issue space, we view the two approaches as complementary. The robustness of rational actor models can be tested with more flexible AAA modelling techniques. Several intuitions from our model— including the implications of distinguishing between Type X and Type + voters and the slower moderation of parties facing consistent voters—were discovered through an interaction between simulation and model building.
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Notes

1. The top cycle set is the smallest set of platforms such that each member of the set defeats all platforms in its complement. McKelvey (1976) shows that generically, the top cycle set equals the entire issue space. The minmax set consists of those platforms that have the smallest \( m(x) \), where \( m(x) \) equals the maximal number of votes by which they can be defeated. Kramer (1977) shows in a dynamic model, that vote maximizing parties move closer to the minmax set. However, once the incumbent's platform lies in the set, the challenger may move outside the minmax set. The uncovered set is the set of all platforms that are not covered. A platform \( P \) is covered by platform \( Q \) if any platform defeated by \( P \) is also defeated by \( Q \). A rational party would prefer to select a platform from the uncovered set. In all three constructs, the distribution of voters' preferences effects the size of the equilibrium (in this case, the uncovered) set, and the degree of convergence. Incidentally, finding the uncovered set, top cycle set or minmax set is an NP hard problem.

2. The following bound on the uncovered set is due to McKelvey (1986): Define a median
hyperplane to be any hyperplane such that at least half of the voters lie above and at least half lie below the hyperplane. For each platform \( y \), define \( t(y) \) to be the smallest real number such that \( B(y, t(y)) \), a ball centered at \( y \) of radius \( t(y) \), intersects all median hyperplanes. The generalized median, \( y_m \) is the arg min of \( t(y) \) over the set of all platforms. McKelvey shows that \( B(y_m, 4t(y_m)) \) is a bound on the uncovered set.

3. We mean logical consistency in the narrow sense of adherence to a rule and not in the broader sense of satisfying mathematical axioms.

4. In our model, preferences remain fixed throughout.

5. These parameters fall safely within a range for which no qualitative differences in outcomes were observed.

6. Formalizing a notion of ruggedness can prove problematic (Page 1992), and we have chosen perhaps the simplest measure.

7. We also created ideological voters by selecting an initial issue (issue 1) and its ideal position, and then requiring the next issue (issue 2) to have an ideal position within plus or minus one the previous issue's ideal position. Issue 3 then had to be within one of issue 2 and so on. The results for this type of ideological preferences proved indistinguishable from those generated by the consistent ideology described in the paper.

8. In the case where strength on an issue equals zero, the ellipse becomes a line. Similar intuition holds in this case.

9. Only highlights of these data can be provided in this paper. Note that we also considered ideological parties. These parties had lexicographic preferences. Their primary goal was to win election. Their secondary goal was to minimize the distance to their initial platforms, the
platforms randomly assigned to them prior to the first election. For the most part, the findings for ideological parties agree with those for the more ambitious parties described in the text.

10. Strictly speaking, with extremist preferences, issues with idea points exactly in the center receive no strength.

11. On a two dimensional projection, voters lie in an \( X \) or a +.

12. In keeping with our two-dimensional intuition, they are in fact Type I voters.

13. While this will not always happen, it occurs with some regularity.
References


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<th>Salience (strengths on issues)</th>
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Figure 1

Issue 1

Issue 2
Figure 2
Figure 3

Average Distance from Ideal for 50 Trials with Uniform Independent Preferences

Distance from Ideal

Election

- Genetic
- Hill Climbing
- Random
Figure 6
Figure 7

Average Ruggedness for 50 Trials of Hill Climbing Parties and Uniform Preferences

- ▲ Independent
- ● Extremist
- ■ Centrist
Figure 8
Average Distance from Median for 50 Trials of Hill Climbing Parties and Uniform Preferences
Figure 9

Average Distance from Ideal for 50 Trials of Hill Climbing Parties
Figure 10

Average Separation for 50 Trials of Hill Climbing Parties
Figure 11

Consistent Voters

Uniform Voters