An Evolutionary Theory of Democracy :
Dynamic Evolutionary Models of American Party Competition
with an Empirical Application to the Case of Abortion Policy
from 1972-2010

by

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Dissertation submitted in partial fulfillment of
the requirements for the degree of Doctor
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ABSTRACT

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Abstract

In this dissertation, I challenge the unitary-actor assumption of contemporary theoretical models of American politics and re-conceptualize party competition as an evolutionary process. I begin by discussing the assumptions of Darwin's theory and their applicability to American party competition. Building on these assumptions, I then develop a formal evolutionary model of party competition that I test against empirical data regarding the two parties' shifting stances on abortion policy from 1972-2010.

Chapter 2 presents several single-party models that focus on explaining the conditions that must hold for parties to emerge as populations in an evolutionary sense. I show that only when candidates experience common selection pressures will population dynamics arise.

Chapter 3 extends this model to two-party competition wherein population dynamics are sustained by inter-party competition for votes and intra-party competition for activist resources. Two-party competition provides the necessary selection pressures needed to foster the emergence of coherent and distinct party populations. However, this will only be the case when: (1) party resources are valuable for winning elections, (2) the distribution of party resources are biased towards ideologically extreme candidates, and (3) parties have sufficient resources.

In Chapter 4, I extend the model to a multi-dimensional setting. Previous theoretical work on multi-dimensional party dynamics has been divided between (1)

analytical models that provide *stable equilibria* results and (2) qualitative theories that seek to explain the *dynamic process* of party change. In this chapter, I present a formalized model that makes precise predictions regarding *both* the environmental conditions that lead to locally stable policy positions and the dynamic process that occurs as the parties drift from one stable configuration to another in response to changing environmental conditions.

Finally, in Chapter 5, I apply my model to the case of abortion policy in the United States from 1972-2010. Using data from public opinion surveys and Congressional roll-call votes, I show that party polarization on abortion was driven by changing activist preferences and that this shift occurred almost entirely as the result of incumbent replacement. These results support my ecological party model and demonstrate its ability to account for the kinds of gradual party movements – driven by incumbent replacement – that characterize many important historical shifts in party platforms.

Contents

List of Tables

List of Figures

xiii

Acknowledgements

Any research project of this magnitude is necessarily a collective enterprise. This is especially true for any dissertation project. This work represents not only my own intellectual efforts but also advice, guidance, financial support, and hand holding from a large number of friends and mentors. I am certain that I have forgotten the assistance of several important people. To any individuals or institutions that I am omitting in these acknowledgements, please accept my apologies.

In addition to those already mentioned, many individuals have offered substantial comments on parts of this work. These include Mike Brady, Robi Ragan, Melanie Freeze, Christopher Desante, Alan Wiseman, Mik Laver, Sunshine Hillygus, Justin Valasek, Bill Keech, and Steve Haptonstahl. David Sparks helped me with my figures. Frank Orlando and Aaron King offered me significant support in parsing roll calls. I also received valuable feedback from commentators and participants at several professional conferences and seminars. Portions of this dissertation were presented at the PIPC Seminar Series, the Graduate Student Colloquium, the Triangle Political Methods Meeting, Duke's Political Behavior Seminar, and the Annual Meetings of the Midwest Political Science Association, the American Political Science Association, and the Society for Public Choice. I also presented parts of this work to audiences at New York University, Washington University in St. Louis, Yale, Penn State, Stanford, and the University of Houston. Finally, my fellow students at Duke University have all provided me with support and feedback over the years. However, I would be remiss in failing to note the extensive feedback and advice I have received from Brendan Nyhan, who has been an unfailing friend and colleague. No other person on earth has spent more time and energy on this project besides myself.

My parents have always provided me with love, wisdom, and guidance. I am especially grateful to the other Dr. Montgomery. I may be one of the few Ph.D. students on earth who still sends drafts to his mother for feedback. I am so thankful that she has been there to patiently offer her experience and advice these past six years. Finally, my greatest depth of gratitude is to my wife, Lisa S. Hoppenjans, who is my best friend, my love, my inspiration, and my copy editor. Lisa, it is an honor to dedicate this dissertation, with my deepest love, to you. The most important event in my life was being selected by you.

Introduction

There is a fundamental tension at the heart of research on American political parties. Dominant theories of party positioning conceptualize parties as unitary actors. The basic Downsian framework, for instance, "in effect .... treats each party as though it were a single person" (Downs 1957, p 26). This single-actor assumption is also implicit in classic studies of party dynamics (e.g., Sundquist 1983) that discuss the strategies that parties choose in response to societal changes as if there were individuals or committees making decisions.

This portrait runs counter to decades of research on collective action (Olson 1965) and American parties (Aldrich 1995; Cox and McCubbins 2005). Absent strong hierarchical institutions, groups of individuals do not have preferences in any meaningful sense, and it is inappropriate to just assume that groups can act in concert to achieve common goals. This is especially true for the heterogeneous candidates who gather under party labels in the American setting, where formal party organizations and

leaders are comparatively weak.[1]

Unlike many modern democracies, political parties appear nowhere in the American constitution. The framers provided parties with no special role and gave party leaders no special powers. Indeed, from a comparative perspective one of the most unique characteristics of American party institutions are their high levels of *decentralization*, the *lack of organizational* structures, and the *lack of unitary control* that party leadership has over the actions and statements of candidates who run for office under the party banner.

Yet, the unitary-actor conceit remains viable due to its ability to explain important historical phenomena. American political history consists of recurring patterns of social change and strategic party adaptation (c.f., Sundquist 1983; Aldrich 1995; Brewer and Stonecash 2008). Demographic or ideological shifts in the electorate are followed by so-called "realignments" at the elite level that reflect these changes. For instance, growing discontent amongst socially conservative Catholics and southern Evangelicals in the early 1960s and 1970s opened new opportunities for Republicans to expand their coalition. Republicans then changed their policy stance and emphasis on social issues, leading to the incorporation of these groups into the Republican base. In other words, the collections of elected officials and candidates who make up the two political parties are often homogenous, coordinated, and seemingly

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[1] Although there is evidence that party institutions do have some influence over the electoral strategies of candidates (e.g., Grynaviski 2010), American party institutions are simply not strong enough to justify the unitary-actor assumption of existing models (Aldrich 1995). The international relations literature addresses some specific circumstances under which a unitary-actor assumption is allowable even given diverse preferences amongst collections of decision-makers (Achen 1988, 1995; Downs and Rocke 1990; Cederman 1994). However, as argued by Hug (1999), these circumstances are unlikely to obtain in most international interactions, much less in long-running intra-party disputes. Decisions by parties are usually multi-dimensional, involve multiple levels or organization, and are taken over lengthy periods of time. Tomahawk missiles may not be recalled due to intransitivities in preference sets, but policy positions are far more easily reversed as new options are proposed and chosen. Moreover, there is no evidence that parties have either stable mechanisms for aggregating preferences (or *any* institutions for aggregating preferences) or stable preference profiles within its membership that would be necessary to treat diverse groups as unitary-actors in the long run.

strategic. Despited notable intraparty controversies, these populations of diverse individuals have remained consistent and coherent to the extent that it is virtually impossible to conceptualize American political history except through lens of party competition. Any proposed replacement of the unitary-actor theories should offer an equally compelling explanation for such seemingly strategic historical sequences.

Throughout this dissertation, I argue that a model of party dynamics based on explicitly neo-Darwinian logic offers a compelling explanation for these empirical patterns, while eliminating the overly simplistic unitary-actor assumption. My central argument is that an ecological party model can explain these seemingly strategic shifts in party positions based on more realistic and micro-level assumptions for how *populations* of individual candidates gradually adapt to changes in the electoral environment despite a lack of centralized leadership. Moreover, the model makes predictions more consonant with empirical evidence about the importance of intraparty competition, changes in the underlying political environment that lead to party position change, and the mechanisms through which this change is achieved.

Importing evolutionary models into political science may seem like an overly-ambitious project. It challenges basic assumptions and methodologies of economics-inspired models of campaigns and elections that have dominated the discipline for decades. To stand as a viable alternative, the evolutionary approach must (1) account for the empirical regularities already explained by research in the economics tradition, and (2) offer important new insights into the workings of democracy that are unanticipated or inexplicable from within the traditional paradigm.

That is a tall order, and I should be up front in stating that I neither try nor succeed at achieving such broad goals in this dissertation. My aim here is far narrower. I consider this work to be a "proof of concept" for the concrete application of evolutionary theory to political science topics. As I have discovered, it is one thing to argue that political competition is "something like" an evolutionary process

(e.g., Carmines and Stimson 1989; Axelrod 1984; Kollman, Miller and Page 1998), and quite another to specify an actual theoretical model based on evolutionary assumptions and test its predictions against empirical data. To achieve the latter, it is necessary to deal with a number of theoretical, methodological, and philosophical obstacles. There are basic roadblocks that stand in the way of moving beyond using evolutionary theory as a source for metaphor towards applying its principles in scientific theory-building. In specifying and testing evolutionary models of party competition, I am covering some untrodden ground, and it is necessary to move forward deliberately and cautiously. Taking this first step is difficult enough, and I see no reason to make broader claims about the superiority of evolutionary models or wild-eyed calls for a change in paradigms.

My focus in this dissertation is to lay a basic theoretical foundation for approaching the topic of party competition from an evolutionary perspective. Building on this foundation, I gradually construct a theoretical edifice of increasing complexity and (I hope) verisimilitude. I begin with models with only one party and one policy dimension and build towards models of two-party competition in a multi-dimensional space. Along the way, I highlight some of the differences between my theory and the unitary-actor Downsian models that dominate the political science literature. I then test some of the predictions and assumptions of this final model against empirical evidence regarding the changing positions of the parties on the issue of abortion from 1972-2010. Finally, in several appendices I examine possible extensions of the evolutionary modeling framework.

Note that my primary aim is to build up a theoretical edifice rather than to undermine the economics-inspired theories of politics that have contributed so much to our understanding of American politics. Although I borrow heavily from specific rational-choice models, I do not give priority to comparing and contrasting my specific results with those from that vast body of work. I do this for two reasons. First,

4

my goal is not to prove that unitary-actor rational-choice models are "wrong," but rather that models based on evolutionary principles can make a contribution to the literature. This does require that I point out some gaps in the literature that my models fill, but does not require that I dedicate pages to attacking the entire rational-choice literature. Second, merely summarizing, much less critiquing and comparing, the hundreds of models of party competition now in the literature would be a dissertation by itself. The literature is too broad to constitute a meaningful baseline for comparison. Only when I present my final model in Chapter 4 do I turn to the task of comparing my results to the narrower class of models and theories of two-party competition in a multi-dimensional space. These constitute a more compact and meaningful baseline with which I can compare my theoretical results.

In Chapter 1, I begin by asking whether it is even appropriate to model political competition as an evolutionary system. I discuss the basic assumptions and moving parts of evolutionary theory and re-conceptualize them in political terms. This requires defining important terms such as traits, populations, selection, and fitness. In this chapter, I pay special attention to how these can be defined in terms of political parties and party competition and how evolutionary models might contribute to that literature.

In Chapter 2, I begin my theory-building by focusing on the conditions under which it is appropriate to think of parties as populations in an evolutionary sense. I show that it is only when candidates experience sufficiently similar selection pressures that population behavior emerges. Moreover, I suggest that these common pressures may arise from the party labels or banners under which all party members run.

In Chapter 3, I extend the basic model to include two parties. In addition, I add party activists who, I argue, serve as the basis for the intra-party competition necessary for population dynamics to arise. It is the simultaneous intra-party competition for activist resources mixed with inter-party competition for votes that jointly set the

stage for the emergence of two distinct populations of candidates. In this chapter, I also give considerable attention to the appropriate methods of characterizing the predictions of dynamic evolutionary models.

In Chapter 4, I extend the model further to a multi-dimensional setting with a specific focus on the dynamical process through which parties move between equilibria positions over time. Previous theoretical work on party dynamics has been divided between (1) analytical models that provide *stable equilibria* results and (2) qualitative theories that seek to explain the *dynamic process* of party change. In this chapter, I present a formalized model that makes precise predictions regarding *both* the environmental conditions that lead to locally stable policy positions in a multi-dimensional space and the dynamic process that occurs as the parties drift from one stable configuration to another in response to changing environmental conditions. Thus, the model connects the formal literature on party positioning to the body of rich historical and empirical work on party dynamics.

In Chapter 5, I apply these theoretical results to the case of abortion policy in the United States from 1972-2010. Using data from public opinion surveys and Congressional roll-call votes, I show that party polarization on abortion was driven by changing activist preferences and that this shift occurred almost entirely as the result of incumbent replacement. These results support my ecological party model and demonstrate its ability to account for the kinds of gradual party movements – driven by incumbent replacement – that characterize many important historical shifts in party platforms.

Finally, the appendices include several possible extensions of the model, including allowing for: individually adaptive candidates (Appendix B), path dependency in the formation of ideologies or platforms (Appendix C), and the endogenous creation of party institutions that promote cooperative behavior amongst members (Appendix D). While these models are complete, they are less well studied and are, in any case,

not necessary to the main argument of the dissertation. However, they do provide some evidence for the promise of the evolutionary approach to addressing additional topics of interest in the field of political science.

1

Can Evolutionary Theory Be Applied to Party Competition?

The purpose of this chapter is to provide a detailed justification for applying evolutionary theory to the study of party competition in the United States. Before moving on to presenting and validating a specific model, it is worthwhile to pause to consider the appropriateness of the basic assumptions of evolutionary theory. What are these assumptions? Are they meaningful in the context of political party competition? Moreover, what added insights can we hope to discover from evolutionary models?

In this chapter, I show how the study of political parties is an appropriate domain for the application of evolutionary theory. To this end, I aim to complete three interwoven tasks. The first is to lay out the fundamental tenants and concepts of evolutionary theory. These include variation, selection, replication, interaction, fitness, and population. The second task is to translate these concepts and assumptions into a meaningful representation of political party competition. This is the subject of Section 1.1.

Section 1.2 goes onto argue that there are significant benefits – both concep-

tual and theoretical – to thinking of party competition in evolutionary terms. The particular focus of this section is to contrast the evolutionary approach with the unitary-actor rational-choice models of political competition that originated in Anthony Downs' *An Economic Theory of Democracy* (1957). To preview my argument, evolutionary models are better able to account for the facts that: (1) changes in the positions advocated by political parties take place at the population rather than the individual candidate level; (2) parties rarely function in a state of equilibrium but must adjust constantly to a swiftly changing political environment; (3) candidates do not have complete and ordered preferences over all possible platforms; (4) there exist significant intraparty differences in the preferred policy positions of the parties and there are no centralized institutions to (perfectly) resolve conflicts.

1.1 Can the study of politics be an evolutionary science?

Recent years have witnessed the flourishing of evolutionary ideas in the social sciences. Scholars from fields as diverse as economics (Nelson and Winter 1982), cultural anthropology (Boyd and Richerson 1985), sociology (Carroll and Hannan 1989), business organizations (Kogut and Zander 2003), psychology (Campbell 1969), and linguistics (Chomsky 2002) have embraced evolutionary concepts and models from biology to explain important phenomena within their own discipline. This adoption of evolution now goes far beyond acknowledging the natural world as a convenient source of metaphors and involves building concrete – often mathematically derived – models of dynamic processes. Indeed, these scholars are not engaged in simple arbitrage from the natural sciences, but often veer away from the conventions of biology to build new models that, while founded on the basic principles of Darwin's logic, are nonetheless novel and subject-specific. They incorporate features of the real world phenomena under consideration and often add assumptions that are meaningless to biologists.

With only a few notable exceptions, however, political science has rarely drawn deeply from the well of Darwinian theory. A handful of prominent works have used evolutionary concepts as a source of organic metaphors (e.g., Carmines and Stimson 1989; Kollman, Miller and Page 1998; de Marchi 1999), and a few recent scholars have drawn more directly on evolutionary theory in studies of the genetic origins of individual political behavior (e.g., Fowler, Baker and Dawes 2008). However, I am aware of only two scholarly efforts that develop explicitly evolutionary models that go beyond metaphor and onto adapting evolutionary theory for application to political science topics. The first stems from the collaboration of political scientist Robert Axelrod and biologist W.D. Hamilton in their famous 1981 paper published in the prestigious journal *Science* (c.f., Axelrod and Hamilton 1981; Axelrod 1984, 1986). This work uses the methodology of evolutionary game theory to explain how patterns of cooperative behavior might emerge spontaneously in the context of repeated interactions. The second is the research of Virginia Gray and David Lowery into populations of interest groups (c.f., Lowery and Gray 1995; Gray and Lowery 2000). This work directly borrows results from formal models of population ecology to explain how environmental conditions shape the relative frequency of interest groups in particular policy areas.

Given the tendency in political science to borrow insights and theoretical approaches from the natural sciences, the relative lack of cross-fertilization from biology into the discipline is surprising. However, there are several strong reasons that evolutionary approaches have met resistance. Knight (1992), for instance, draws the following conclusion from a review of evolutionary explanations of social institutions. "There are ... two weaknesses in this approach: (1) the conceptual confusion in the elaboration of the mechanism of selection and (2) the lack of sufficiently detailed empirical evidence to support the theory" (Knight 1992, p. 94). This criticism echoes Edith Penrose's (1952) warnings regarding biological analogies. "The chief danger of

carrying sweeping analogies very far is that the problems they are designed to illuminate become framed in such a special way that significant matters are ... obscured" (Penrose 1952, p. 804).

More generally, there are two broad concerns regarding evolutionary models. First, serious theorists are correctly antagonistic towards treating analogies and metaphors as equivalent to concrete theories of politics. It is not enough to simply state that political competition is "like" an evolutionary process. Such a claim immediately opens a number of questions that require serious consideration and greater specificity. What are the units of selection? How are units replicated? How is variation generated or maintained?

Second, references to biological or "organic" models are often confusing because it is not clear how the specific mechanisms of biological reproduction and natural selection translate into political systems. Chromosomes, DNA, enzymes, sexual reproduction, heterozygosity, and the like have no clear referents in the political world. To the extent that these trappings of biological processes are unnecessarily conflated with Darwinian logic, they prevent theorists from appropriately altering existing biological models to speak directly to the salient features of the political world we are hoping to explain.

The theoretical approach I use in the following chapters moves away from the dominant paradigm of rational-choice models of party competition and re-conceptualizes it as an evolutionary process. In Section 1.2, I suggest several relative advantages of this approach. However, it is appropriate to first ask if there is any substantively meaningful way to frame political competition as an evolutionary process. In the remainder of the current section, therefore, I describe the the assumptions of evolutionary theory. I then unpack them and interpret them in the context American party competition. My hope is that confronting these issues explicitly may help overcome some basic objections to the subsequent modeling efforts and will serve to

address some of the previously noted objections to applying evolutionary theory to the study of social institutions (e.g., Knight 1992).

1.1.1 Evolution without biology

While most people are exposed to the theory of evolution in introductory science courses, almost every reader is likely to hold a slightly different view of what is meant by the terms "evolution" or "Darwinian selection." Indeed, many forests have been consumed as biologists themselves debate the meaning of central terms including evolution, species, and fitness. Nonetheless, the past several decades have witnessed a growing consensus around the variation-selection model of evolutionary processes that I present here (Metcalfe 2005).

To begin with, there is nothing inherently biological about evolutionary theory. Darwin's theory in its broadest form is not a description of particular biological process, but a logical conclusion from a set of specific assumptions (Dennett 1996). DNA, Mendelian inheritance, sexual reproduction, and the like are the *process* of biological evolution. But Darwin's theory is the *logic* of evolution, and it requires no genes, proteins, or chromosomes to work. Indeed, it took over 40 years after Darwin first published *The Origin of the Species* until its biological mechanisms, first discovered by Mendel, were uncovered by the scientific community. But Darwin's logic was so compelling – explaining much of what had previously been unexplainable – that it was almost instantly adopted by biologists despite its total lack of foundation in any known chemical or biological process.

Stripped of biological detritus, Darwin's logic can be stated as: (1) a population of agents have variation in fixed traits, behavioral patterns, or tendencies; (2) these fixed traits, behaviors, or tendencies can be transferred to other agents either through reproduction or emulation; and (3) this relative rate of perpetuation is partially determined by these traits' usefulness in adapting the agent to its environment

12

(Dennett 1996). An alternative summary of these ideas breaks down evolutionary logic into three basic principles (Metcalfe 2005).

> These are: the principle of variation, that members of a relevant population vary with respect to at least one characteristic with selective significance; the principle of heredity, that there exist copying mechanisms to ensure continuity over time in the form and behavior of entities in the population; and the principle of selection, that the characteristics of some entities are better adapted to prevailing evolutionary pressures and, consequently, these entities increase in numerical significance relative to less well-adapted entities. (Metcalfe 2005, p. 394).

Are these assumptions appropriate to the study of political competition? To answer in the affirmative, a number of the terms used above need clearer definitions for the political context. What is the relevant population and what are the characteristics or traits under discussion? In what sense are traits or characteristics inherited? What is the unit of selection, and what determines a unit's probability of replication? How is variation in the population maintained, and how do "new" characteristics or traits arise? The remainder of this section takes up these issues in the particular context of American party competition.

1.1.2 *Relevant traits and units of selection*

A commonly cited shortcoming of evolutionary explanations of social phenomena is the lack of specificity in the unit of selection. For instance, F.A. Hayek's writings on social evolution often seem to imply that selection occurs at the level of societies despite his broader commitment to methodological individualism (Hayek 1988, 1967; Hodgson 1999). Carmines and Stimson (1989) foster confusion in their *Issue Evolution* theory by constantly discussing changes in the population of elected officials, but insisting that their true units of selection are the issues themselves.

It seems natural to begin by treating the individual candidate as the unit of selection, and many of the theoretical results presented in subsequent chapters stick

with this characterization. However the central concern in the study of party dynamics is not understanding which particular candidates survive. Rather, the focus is explaining changes in the policy positions (or party platforms) that the candidates in each party advocate over time (e.g., Sundquist 1983; Carmines and Stimson 1989; Brewer and Stonecash 2008; Karol 2009). In other words, we care about the relative frequency of specific policy platforms held within the population of candidates constituting each party. This suggests that the appropriate unit of selection is the bundle of policies advocated by particular candidates, or their position in some theoretical policy space.[1] Thus, the traits or characteristics that we are concerned with are candidates' policy positions rather than the candidates themselves. In a multidimensional policy space, a particular unit of selection will be a vector that describes some point in the space. This vector is some bundle of policies that are relevant in the specified selection process.[2]

1.1.3 Candidates and populations

If these bundles or vectors are the units of selection, who or what is doing the selecting? There are actually several answers to this question depending on how much relative agency we assign to political candidates and the electorate. First, we could assume that candidates have fixed positions in the policy space. Under

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[1] It is possible to instead consider that the units of selection are "strategies" or heuristic responses to given political environments. These strategies might consist of a series of if-then rules concerning what policies a candidate should advocate given specific environmental conditions (e.g., "if the economy is suffering, then advocate for tax cuts"). Although I am sympathetic to this conceptualization, it adds considerable complications to both the presentation of an evolutionary theory and the implied theoretical models. Given the state of evolutionary modeling in the discipline, it is helpful to begin with a simpler variant. My presentation implicitly assumes that a given candidate's heuristic is invariante to environmental conditions.

[2] Note, however, that it is not necessary to stick with this restrictive definition for units of selection. It is also possible to add non-policy elements to this bundle or vector. Any strategy or pattern of behavior can be included. These are characterized as any stable habit, tendency, or behavioral pattern. This is what Nelson and Winter (1982) refer to as the "collectivity of routines." For instance, in Appendix D I introduce a dichotomous indicator that controls whether a candidate will choose to support particular institutional arrangements once in office.

this assumption candidates are equivalent to our units of selection, and it is solely through the electoral process that selection occurs. It will be candidates themselves who are selected based on their location in the policy space through the mechanism of elections. Thus, adaption takes place strictly at the population level as candidates located in one area of the policy space become relatively more or less numerous.

Second, we might assume that elections are irrelevant, but that the candidates themselves can choose a policy position based on some criteria. For instance, an agent might choose amongst several possible policy positions. Thus, the candidates themselves are adapting to their environment by selecting amongst a population of possible policy positions based on some criterion (e.g., vote maximization). A usual restriction here is that we assume that candidates are engaged in some "boundedly rational" method of selection rather than maximizing expected utility (Metcalfe 2005). In this second case, adaption takes place strictly at the within-individual level as candidates shift their location in the policy space.

Finally, we might allow that both of the above processes are happening simultaneously. That is, candidates are being selected through an electoral process but are also themselves choosing amongst many possible policy platforms. This form of learning has typically been referred to as "Lamarckian."[3]

Note the distinction here between (1) candidates and (2) the positions that a candidate represents at any given time. This echoes the distinction in biology between organisms and genes (Dawkins 1976). In many areas of evolutionary biology, we assume that selection takes place at the level of the organism. Genes that favor the rates of survival and replication of itself can usually be assumed to also improve the fitness of the organism. However, there are many circumstances when this assumption is not appropriate. These are "selfish genes" that work to improve their

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[3] Note that there are reasons to doubt whether this characterization is valid in the context of evolutionary *social* systems (Hodgson and Knudsen 2006).

own frequency, but which can actually undermine the fitness of the organism. A particular important instance of this class of phenomenon is the evolution of cooperative behaviors in populations of organisms (Axelrod and Hamilton 1981). In these cases, behaviors not beneficial to any particular organism may propagate through a population.

A more general framework for understanding this difference is to delineate between the "replicators" and "interactors" (Dawkins 1982; Metcalfe 2005). Replicators are the unit that is reproduced and propagated within a fixed population or to new generations over time. Hull (1988) defines an interactor as "an entity that interacts as a cohesive whole with its environment in such a way that this interaction causes replication to be differential" (Hull 1988, p 408). In the case of biology, the replicator is the gene while the interactor is (usually) the organism. In the case of political competition, the policy positions of the candidate are the replicators while the candidates themselves are the interactors.

Given these definitions, the focus of analysis for both theoretical and empirical work should be on shifts in the relative frequencies of particular policies in populations of candidates. The next step, therefore, is to define a population. It is tempting to think of populations as species. Although such a definition is plausible, it likely to be more confusing that helpful. To begin with, there is still no widely shared definition of species even though it is a fundamental concept to the discipline fo biology.[4] In practice, the natural world does not provide clear delineations between distinct species or populations. The difficulties inherent in specifying a universal definition are demonstrated by the fact that significant portions of many species' genomes do not come from direct ancestors of the same species. For instance, a recent study estimated that 8% of the human genome originated from invading viruses (Masayuki

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[4] Despite the title of his famous work, Darwin himself provides no useful definition of species. In fact, his theory was partly inspired by the nearly imperceptible gradations in the phenotype of supposedly unique species that he observed during his travels in *H.M.S. Beagle* (Weiner 1994).

et al. 2010). As another example, over a third of all plant species are hypothesized to have arisen from hybrid crossings. In political terms, defining parties as species would imply that members of Congress that switch parties are trading species. Given the complex relationships between organisms in real-world ecosystems, providing a clear definition of species has proven to be difficult and no consensus has been reached. For these reasons, *it is not correct to think of parties as species.*

Nonetheless, significant progress has been built on simplifying assumptions about populations that are appropriate to the substantive question under consideration. If "species" is not a useful construct for theory-building, what constitutes a population? In general, populations are the class of interactors who are subject to common selection pressures and who are interdependent for survival. In the case of political competition, I argue that *populations are the collection of candidates who share a common party label* (Aldrich 1995). For instance, in the study of party dynamics, we care about the relative frequency of pro-choice and pro-life Democrats over time. The inclusion of the "party label" in the above definition is necessary because it implies that there is some degree of linked fate amongst candidates who run under the same party banner. That is, an assumption of this approach is that the general reputation of the party label affects the success of all candidates running under the banner (Aldrich 1995; Grynaviski 2010; Hinich and Munger 1996). Without the implied mutuality of the label, it is difficult, if not impossible, to specify a meaningful definition of a population. Each individual candidate would represent her own "population."[5]

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[5] It might also be possible to conceive of each electoral district as containing its own population of candidates, and it is the mutual conflict for votes in that district that defines the relevant population. However, this definition dispenses with parties and does not provide any meaningful improvement over the traditional Downsian approach.

1.1.4 Selection, fitness, and hierarchy

I have suggested that the evolutionary approach to party competition seeks to explain the changes in the relative frequency of policy platforms or strategies within a population of candidates sharing a party label. If this is the phenomenon we are seeking to explain, what are the mechanisms that drive these changes? The answer is selection, but this term by itself may not provide any clarification. Many people understand selection to be the differential birth and death among organisms who are more or less "fit." However, this is an inadequate representation of selection, as it merely describes *sorting* (differential birth and death among varying organisms within a population) of individuals based on each individual's fitness (Vrba and Gould 1986). This is not *selection* as understood by either Darwin nor modern evolutionary biology.

In part, the confusion surrounding the term selection can be attributed to the oft quoted phrase from Herbert Spencer – "survival of the fittest" – which is both misleading and tautological. The phrase is misleading in that it implies that: (1) fitness is some fixed trait or characteristic of an agent or entity; and, (2) fitness plays some causal role in the evolutionary process. Instead, fitness is a caused attribute of an agent that derives from the interaction of an agent's characteristics and elements in its environment (including other agents in the population). Fitness itself is not a trait of any particular agent nor of the environment. Rather, it is a conditional statement. The probability of an entity surviving (or reproducing) is conditioned on some variant characteristic of the entity and the environment. Thus, there is no sense in which an entity is by itself "more fit" (Michod 1999; Metcalfe 2005).

Selection, therefore, cannot be defined as the differential birth and death among individuals based on relative fitness. Selection is the process through which the fitness of an individual is determined and sorting of individuals is caused.

A helpful distinction to make in this discussion is between sorting and selection (Vrba and Gould 1986). Sorting is a simple description of a differential rates of success among some individuals, while selection is the causal process that leads to this sorting.

> In a selection process the growth rates of different entities are mutually determined by the interaction between members of the population in a specific environment. Mutual determination is the key; the fitness of any one entity is a function not only of its own characteristics and behavior but of the characteristics and behavior of all its rivals in the population (Metcalfe 2005, p. 412).[6]

As first noted by Vrba and Gould (1986), this distinction is easily overlooked when considering selection on a single level. For instance, if selection pressure is working in favor of candidates who take policy positions closer to the median voter, it is difficult to see the difference between sorting and selection based on spatial proximity. However, if selection is working at multiple levels within a hierarchy – replicator, interactors, and populations – there is no longer an easy link between natural selection and the sorting at a single level.

Consider the example, which is developed in Chapter 2, that selection pressures are working to favor the positions of candidates who are closer to the mean policy position of all candidates in the parties (i.e., deviance from the party banner is punished). This clearly leads to sorting, but not in the simplistic way described above. Selection is working to enforce an emergent property of the population (the population mean), which may change in response to factors such as random drift or aspects in the environment that respond to shifts in the emergent features of the population rather than directly to traits of individual candidates.

This is why it is so important to clearly define the population such that there is

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[6] Note that this emphasis on the mutuality of the population echoes the broader literature on complex adaptive systems. Holland and Miller (1991), for instance, define complex adaptive systems as, "a complex system containing adaptive agents, networked so that the environment of each adaptive agent includes all other agents in the system" (Holland and Miller 1991, p. 365).

a strong element of mutual determination. It is the structured interaction of agents in the institutional setting of electoral competition under a shared party banner that truly distinguishes a simple sorting model (e.g., Schelling 1978) from selection-based evolution. Moreover, it is the mutually deterministic aspect of selection that fosters the creation of emergent traits at higher levels, such as cooperative norms or social institutions.

1.1.5   Variation and replication

To summarize the discussion so far, we can characterize an evolutionary political process as selection operating on a population of individual candidates with differential traits sharing a common label leading to changes in the relative frequency of particular policy platforms or strategies within that population. However, a full theoretical statement must also account for the sources of this variation. Variation is the fuel of the evolutionary engine, but the process consumes its own fuel. Over time, selection works to reduce the amount of variation as the relative frequency of certain traits increase and others disappear.

It is in the creation of variation that the analogy between social and biological systems is most problematic. Biology has developed an array of mechanisms to explain how variation in a population is maintained, including Mendelian inheritance, dominance, sexual reproduction, crossing, radiation, and random errors during mitosis. However, these explanations are deeply ingrained in the specific chemical processes underlying biological evolution. They relate to the particular processes through which DNA is replicated, maintained, and passed to future generations. These processes are not clearly analogous to social processes, and efforts to transplant them directly often seem unmotivated and difficult to interpret. An example is provided in Kollman, Miller, and Page's (1992, 1998) work on adaptive political parties. The authors consider the possibilities that parties may work as a genetic algorithm:

A genetic algorithm begins with a randomly generated population of plat-forms similar to the party's existing platform. These platforms are then selectively reproduced, biased towards those that fare better against the incumbent party's platform. A random subset of the reproduced plat-forms then undergo an exchange of sequences of positions (crossover) and arbitrary changes on some positions (mutation). The platforms are then tested against the incumbent's platform and a new cycle of repro-duction and modification is begun. Each application of the algorithm is referred to as a generation, and the number of generations corresponds to two units of campaign length (Kollman, Miller and Page 1998, p. 144).

Although this characterization provides all of the elements of a variation-selection evolutionary system, the real world referents for the process of reproduction and variation maintenance (c.f., crossover and mutation) are vague and difficult to inter-pret.[7]

A better approach is provided by researchers in the fields of behavioral economics (e.g., Simon 1955, 1985, 1995), evolutionary economics (e.g., Nelson and Winter 1982; Dopfer and Potts 2004; Metcalfe 2005), and research stemming from the influ-ential work of Donald Campbell (1969). Each of these bodies of research argues that agents do not have the information necessary to construct optimal strategies, or even to construct preferences as defined in the rational choice approach. The response set is vast, and no single agent can be expected to understand the consequences of all possible actions. From this perspective we can conceive of candidates as agents who develop routines, habits, and heuristics through which new policy positions are generated, implemented, and evaluated (see also Ensley, de Marchi and Munger 2007; Ensley, Tofias and de Marchi 2009). Since the *ex ante* consequences of these choices are unknown all such routines can be conceptualized as "blind-variation-and-selective-retention processes" (Campbell 1969; Simonton 1999).

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[7] Kollman, Miller and Page (1998) merely state that: "The genetic algorithm approximates ... a political party undergoing internal debate over policy positions. Candidates borrow ideas from each other and win or lose primaries based on how they match up against the incumbent. Occasionally an activist introduces a new idea" (Kollman, Miller and Page 1998, p. 144).

In this view, variation in the policy positions within a population of candidates is generated via one of two mechanisms: new candidates enter the population who differ from existing candidates in the policy positions they advocate; or, existing candidates alter their stances to find some "better" (however evaluated) positions. But where, exactly, do these innovations come from? It is one thing to say that new innovations arise by chance (in the sense that their consequences are *ex ante* unpredictable), but "one should know the probability-generating function for the chance events" (Metcalfe 2005, p. 419). In particular, the evolutionary approach restricts these probability generating functions in two ways. First, it assumes that all candidates do not choose identical policy position. Such a system would immediately destroy all heterogeneity and the evolutionary process would end. Second, it assumes that candidates do not choose new positions completely at random. Rather, new policies must in some way be constrained – either by behavioral tendencies or institutional arrangements – to be more similar to existing members in the population than would be predicted by chance alone.

I argue that there are three plausible mechanisms that generate new candidate positions in ways that meet the above criteria. First, primary elections and primary voters work to screen out candidates taking positions too dissimilar from the current population, but which may nonetheless differ significantly as innovative candidates forward new ideas (Snyder and Ting 2002). A second mechanism, and the one I incorporate most fully into the models in the following chapters, is the view forwarded by Alchian (1950), Hayek (1988), Denzau and North (1994) and other scholars that, in an arena as complex and stochastic as politics, extreme uncertainty about the future consequences of current decisions is the dominant feature of the environment (c.f., Kollman, Miller and Page 1992; de Marchi 2005; Ensley, de Marchi and Munger 2007). In such an environment, candidates may choose to imitate (with some degree of error) the strategies of successful candidates in their own party rather than to

attempt to find an optimal policy platform by themselves. Indeed, imitation may be a superior strategy relative to discovering an optimal response when information is costly to obtain (Conlisk 1980). Third, in Appendix B I briefly consider the possibility that existing candidates may not have fixed stances but may choose random positions in the policy space near their current position.

Each of these ways of conceptualizing replication with variance is incomplete and does not provide candidates with the degree of agency that many readers would prefer. Indeed, the simplifying assumptions regarding how new candidates are generated in an evolutionary system may be the least satisfying aspect of the approach. These assumptions certainly represent the greatest departure from the dominant rational choice paradigm. On the other hand, they seem more plausible than the wholesale transplantation of inappropriate biological mechanisms (e.g., crossing and sexual reproduction). They are also no more removed from reality than the assumptions of complete, ordered, and transitive preferences assumed in Downsian models.

In the end, the usefulness of these different assumptions – and the entire evolutionary approach – rests not in the plausibility of the assumptions but in the theory's ability to provide theoretical insight and to explain important empirical phenomena. In the next section, I therefore turn to the specific theoretical and empirical issues I hope to address using the evolutionary framework.

1.2   Party competition as an evolutionary process

In the previous section, I provided a detailed account of the assumptions needed to describe American party competition as an evolutionary system. The basic framework I have laid out is unusual for political science. It also requires the addition of considerable complexity relative to Downsian models. What, if anything, offsets these costs?

I believe that the benefits of applying the evolutionary framework to the study

of party competition is that it is able to explain more about the real world and has greater verisimilitude with the actual political world than traditional approaches. It is important, therefore, to specify some of the often overlooked shortcomings of the traditional framework that the evolutionary approach overcomes. In this section, I discuss four motivating facts about American politics that justify moving beyond the traditional Downsian model: (1) ideological movement of political parties takes place at the population rather than the individual level; (2) traditional models provide little insight into the dynamic mechanisms parties use as they move in the policy space in response to changes in the electoral environment; (3) candidates (and particularly challengers) do not appear to choose optimal platforms; (4) traditional models ignore the collective action dilemmas inherent in decentralized parties and present under-specified explanation for the emergence and maintenance of strong party institutions.

1.2.1 Population rather than individual adaptation

Evidence based on comprehensive sets of roll calls show that candidates (or at least members of Congress) almost never significantly change their stances, but rather "die in their ideological boots" (Poole and Rosenthal 2007; Poole 2007; Lott and Reed 1989; Bronars and Lott 1997; Bender and Lott 1996). The rigidity of incumbents appears to be true amongst members even as they approach retirement, decide to run for higher office, face a new constituency after redistricting, or even after moving to statewide office (Poole and Rosenthal 2007; Poole 2007; Grofman, Griffin and Berry 1995; Lee, Moretti and Butler 2004). Although other scholars have found limited evidence of individual adaptation amongst politicians (e.g., Jenkins 2000; Kousser, Lewis and Masket 2008; Snyder and Ting 2003; Crespin 2010), as Poole notes, "What the evidence here suggests is that [adaptive] changes ... are second and third order effects. They are trees or even the bark on the trees in the forest of stability" (Poole 2007, p 449). To be perfectly clear, the preponderance of the

scholarly literature has concluded that individual members of Congress do not adapt their ideological platforms *even if their electoral environment changes.*

These empirical regularities demand the development of theoretical models capable of explaining party change premised on the notion of individual member rigidity. As Poole and Rosenthal note:

> An immediate implication of this spatial stability from the post-Reconstruction period of the nineteenth century until the present ..., is that changes in Congressional voting patterns must occur almost entirely through the process of *replacement* of retiring or defeated legislators with new blood. Politically, selection should be far more important than adaptation (Poole and Rosenthal 2007, p 79).

To the extent that the two political parties – or the population of elected officials who constitute American political parties – move in the ideological space, it is almost exclusively through selection rather than adaptation. If this is the empirical reality, the traditional Downsian approach is open to criticism for focusing too much on individual candidate adaptation rather than adaptation at the population level.

Note that this an empirical rather than a theoretical claim. There are multiple reasons why individual candidates may remain fixed in the policy space. They may have beliefs about what constitutes good government and act solely based on those beliefs. They may have stable "induced preferences" or mental models about what issue positions to advocate and what strategies to follow in order to win an election (e.g., Poole 2007; Ensley, de Marchi and Munger 2007). It might also be that the dis-utility for appearing to be a "flip-flopper" exceeds the expected value of adapting (e.g., Canes-Wrone and Shotts 2007; Hinich and Munger 1996).[8] Whatever the reason, however, so long as individual candidates and incumbents remain fixed in the space, changes in the position of the populations in a party must be the result

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[8] There is some evidence that candidates do alter their policy positions when seeking the nomination for President. There are many famous examples, for instance, of pro-life Democrats moving significantly in the pro-choice direction once they take aim at the Presidency. However, as I show in Chapter 5, these appear to be exceptions that prove the rule.

of adaptation at the population rather than the individual level. That is, aggregate changes in the policy positions of the parties must be explained via the mechanism of selection and replacement rather than individual adaptation.

1.2.2 Combining why and how

Modern rational choice models of party competition focus on finding the conditions under which particular equilibrium positions will obtain. The focus is on explaining the static positions the parties will choose given a fixed environment. Thus, they provide strong theoretical insight into *why* parties choose a particular position and what changes in the political environment lead parties to change their location in the space.

However, rational choice accounts provide little insight into *how* the parties arrive at these equilibrium locations, nor through what process parties adjust in response to changes in the political environment. These accounts provide *ad hoc*, and often unspecified, mechanisms through which the candidates in each party population coordinate upon a new position (de Marchi 2005).[9] This is especially true in a multidimensional setting when multiple equilibria are possible (c.f., Aldrich 1983*b*; Schofield 2004), or when the equilibrium outcome depends on the past history of endogenous parameters leading to path dependence (Noel 2007; Metcalfe 2005). This shortcoming is particularly unfortunate given that so much of the substantive literature on party positioning has focused on the *dynamics* of parties (c.f., Aldrich 1995; Brewer

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[9] One could argue that a Downsian party will simply adjust its policy position in response to shifts in the underlying parameter space. There are two fundamental problems with this. First, this is no real explanation and is simply a restatement of the assumption that the parties will behave rationally. This argument implies that the political system is *always* in a state of equilibrium, and changes in the position of the parties are always determined by changes in exogenous parameters. Thus, it continues to explain the why of party dynamics while giving no meaningful insight into the *how*. Second, if there are discontinuous jumps in the parameter space, we should observe instantaneous jumps in the positions of the parties. Historically, however, parties have usually adjusted gradually to significant political shocks over the course of multiple election cycles (Mayhew 2002; Carmines and Stimson 1989; Sundquist 1983).

and Stonecash 2008; Burnham 1970; Carmines and Stimson 1989; Karol 2009; Key 1955; Poole and Rosenthal 2007; Sundquist 1983).

One of the key advantages of the evolutionary approach is that it provides a concrete model explaining both the *how* and the *why* of party movement. The models discussed in the subsequent chapters are able to precisely specify the environmental conditions that lead to particular equilibrium outcomes. Once obtained, selection works to reinforce these outcomes. However, the model also provides a concrete explanation for how the parties will move between equilibria when the underlying environmental conditions change. Moreover, it can provide clear predictions about the position and trajectory of the parties even when the underlying environmental conditions are in a constant state of flux and the system never settles into a long-term steady-state. Replicator dynamic models are open ended in that they make predictions about how current populations will adjust in a particular direction given the current composition of the population and the current state of the environment (Metcalfe 2005).

1.2.3 *Candidates choose policy platforms similar to co-partisans*

The Downsian framework makes strong assumptions about how much information is available to candidates. Given the fact that incumbent candidates appear to adapt very little to changing electoral environments, it is difficult to understand from the traditional rational choice viewpoint why challengers so seldom are able to offer policy platforms that can defeat incumbents (Ensley, de Marchi and Munger 2007; Kollman, Miller and Page 1992).

In fact, there is surprisingly little evidence to justify the assumption or conclusion that candidates are either willing or able to anticipate or provide optimal policy alternatives (Ansolabehere, Snyder and Stewart 2001; Ensley, Tofias and de Marchi 2009). Rather, the available evidence shows that even successful candidates for office

take positions closer ideologically to own-party candidates from across the nation rather than to any other population (e.g., the voters in their own district). For instance, Bafumi and Herron (2009) show that new candidates who win elections are at best marginally closer to the ideal points of the median voters and are much more similar to own-party candidates in other districts. And Ansolabehere and colleagues (2001) show that, for most of the history of the United States, when congressional seats change hands between parties the new member is much more similar to their co-partisan members of Congress than to the ideological position of their districts' voters. Of particular importance, they show that unsuccessful challengers frequently offer policy positions *farther* from the district median than the incumbent – a finding that is difficult to explain from the traditional Downsian perspective without significant adjustments to the model. In its totality, therefore, the empirical evidence leads us to conclude that candidates for Congress are either unable or unwilling to adopt their policy positions similar to their district voters but instead offer positions similar to co-partisans.

It is possible that these extreme positions *are* optimal given additional constraints such as primaries. In any case, numerous scholars have shown that members of Congress are not notably representative of the preferences of their own constituents, and have more in common with co-partisans than with district voters.[10] This empirical regularity should be a feature of any accurate model of political competition.

1.2.4 Endogenous party institutions

Models in the Downsian tradition do not adequately reflect the fundamental group nature of candidate-centered political competition. As noted above, it is inappro-

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[10] Clear examples of empirical findings that U.S. Congressmen better represent the interests of partisans than the median voters in their districts include: Ansolabehere, Snyder and Stewart (2001); Bishin (2000); Brady, Han and Pope (2007); Crespin, Gold and Rohde (2006); Markus (1974); Moon (2004); Shapiro et al. (1990); Gerber and Lewis (2004); Levitt (1996).

priate to speak of American parties as having either preferences or strategies. The notion that any party leader can determine the policy-positions of own-party candidates is, at best, a flawed analogy and may be remarkably misleading in the American setting. In particular, this reified conceptualization of parties simply assumes away intra-party negotiations, issues of label-maintenance and adverse selection, and outright internal conflicts that in many eras constitute the primary characteristic of the political landscape (Aldrich 1995; Sundquist 1983). In practice, American political parties are composed of a collection of individual candidates who face heterogeneous electoral environments. Despite differing individual incentives, parties share a common label and must work jointly to pass legislation, both of which are the basis of an ongoing collective action dilemma (Aldrich 1995; Cox and McCubbins 2005; Snyder and Ting 2002, 2003). Ignoring these facts limits the ability of existing models to encapsulate the dynamics of intra- and inter-party conflict, or even to adequately represent the basic dilemmas facing candidates and party leaders in American politics.

Can evolutionary theory provide a better answer? I believe it can, but it is necessary to closely examine Darwinian logic to see why. The power of Darwin's theory *in its simplest form* is that it ensures an outcome at both the individual and population level. If we assume sufficient variation, constant selection, and some unbiased method of transference, then we can conclude that any trait or tendency that is beneficial will become relatively more common throughout the population over time (Dawkins 1976). In fact, if we assume sufficient time, variation, and selection pressures, the algorithm guarantees an *optimal* solution. Thus, populations will respond to changes in the environment as if some rational agent were directing their choices towards a best response.

This basic result undergirds Alchian's (1950) famous argument that evolutionary logic provides a justification for why firms move towards optimal responses despite

considerable uncertainty. "Like the biologist, the economist predicts the effects of environmental changes on the surviving class of living organisms" (Alchian 1950, p. 221). Milton Friedman (1953) extended this further by framing 'natural selection' as a basis for assuming that agents act 'as if' they maximize utility, even though such assumptions seem implausible (Hodgson 1999). This logic is also apparent in F.A. Hayek's writings on cultural evolution.

Such reasoning may lead some readers to question the usefulness of this enterprise. If evolutionary processes always lead to optimal outcomes, a model that conceives of parties as atomistic utility-maximizing agents with perfect information will provide identical predictions. What is the purpose of adding the considerable complexity of re-framing politics as an evolutionary process to arrive at identical conclusions?

In reality the conclusion that evolution will lead to optimal outcomes at the population level is highly contingent. As first argued by Nelson and Winter (1982), an evolutionary system will only lead to this result under the assumption of linear and constant selection. Conversely, it assumes there is a complete lack of what biologists term "frequency dependence" (Michod 1999). That is, it assumes that selection pressures do not change in response to changes in the aggregate population.

This is a critical point because an assumption of constant selection is only appropriate if there are no conflicts among lower-level units (Michod 1999). Constant selection is equivalent to assuming that there are no collective action dilemmas and that the interests of all members of a population are identical. If this is not the case, then new mechanisms must evolve to overcome collective action dilemmas at the lower level before efficient outcomes at the population levels can be expected to obtain. Echoing many scholars of social institutions, biologist Richard Michod argues, "[W]e need to identify those mechanisms and structures that serve to align the interests of the component parts with the interests of the group.... The evolution of conflict mediation is necessary for adaption at the new level." Without such reso-

lution, populations may not only fail to arrive at optimal outcomes but may actually converge on global minima or anything in between (Abrams, Matsuda and Harada 1993).

Biologists have identified three specific ways through which the problems of frequency selection can be overcome: kinship (e.g., relatedness), group structure (e.g., chromosomes or cell walls), and conflict mediation (e.g., repeated interaction or social hierarchy) (Michod 1999). Each of these mechanisms corresponds with important areas of research in political parties and social institutions more generally. In particular, much has been made of the role of repeated interaction in fostering strong party institutions (e.g., Axelrod 1984) or the development of behavioral patterns that reward leaders for enforcing group norms (Cox and McCubbins 1993). However, the evolutionary approach makes it more tractable to directly include the development of endogenous party institutions that foster cooperative behavior into analytical models of party competition. That is, it can provide a direct link between the environmental conditions in the electorate and the development of strong party institutions in the electoral and legislative arenas.

For instance, a basic fact of politics in the American setting is the strong linkage between intra-party homogeneity, inter-party polarization or heterogeneity, and the emergence of institutions designed to strengthen the role of parties and party leaders (e.g., positive agenda control). In their theory of *Conditional Party Government* (CPG), Rohde (1991) and Aldrich and Rohde (2001) show that there is a strong positive correlation between the polarization of parties, their internal homogeneity, and the development of strong party-based institutions and norms. However, the theoretical justification for this observed empirical phenomenon has remained contentious and under-specified. Even models that take seriously issues of collective action and adverse selection (e.g., Snyder and Ting 2003; Cox and McCubbins 1993) simply *assume* that party discipline mechanisms exist and can be implemented rather than

deriving conditions under which these mechanisms might arise endogenously.

1.3 Conclusion

In this chapter, I have attempted to provide a detailed discussion of what it would mean to build a theory of party competition in Darwinian terms. Seeking to move beyond metaphor or the rote transfer of ideas from biology, I define and clarify the crucial concepts of Darwin's ideas in political terms. These include: units of selection, population, fitness, selection, variation, replication, replicators, and interactors. I have also suggested a number of areas in the literature on political parties that might be improved with evolutionary models. These include: macro-level adaptation at the population rather than the individual level and a richer class of models for explaining the development of party institutions

I argue that the evolutionary approach promises to provide a new method for explaining the dynamics of party positioning. It is the endless competition of politicians seeking lengthy careers in politics while facing the constant pressure of impending elections that shapes America's political parties. It is the need to face the electorate as an individual candidate while still reaping the consequences of a shared party label that facilitates the emergence of party institutions.

However, the discussion in this chapter has been extremely broad. It is the view of a theory from 50,000 feet. The utility of the evolutionary approach to party competition cannot truly be evaluated from this lofty perspective. Rather, it is in the close-up examination of specific models designed to address particular aspects of the political world that the relative value of this framework can be tested. Thus far I have provided a bare foundation of premises. The questions that remain are what kind of theoretical edifice can I build on that foundation, and what can it teach us about the political world? This is the task I turn to in the following chapters.

2

Parties as Populations: Single-Party Evolutionary Models

[A]n American party should be thought of not as a rational organism with some kind of collective brain making coherent strategic judgments, but as a terrain to be fought over, conquered, and controlled first by one element, then by another.

– James L. Sundquist (1983, p 328).

As many more individuals of each species are born than can possibly survive; and as, consequently, there is frequently recurring struggle for existence, it follows that any being, if it vary however slightly in any manner profitable to itself ... will have a better chance of surviving, and thus be *naturally selected*.

– Charles Darwin (2004, p 14).

2.1   Introduction

The national conventions of 1964 witnessed two intra-party conflicts of historic import. In Atlantic City, the scheduled events of the Democratic convention were overshadowed by heated controversies over the credentialing of the Mississippi Freedom Democratic Party delegates. Civil rights advocates organized this alternative slate to oppose the strictly segregated institutional delegation. In San Francisco,

traditional Republican forces lead by Nelson Rockefeller fought a valiant rear-guard action to stall or derail the nomination of Barry Goldwater, the choice of the more radical elements of the Republican base.

Although dramatic, the events of 1964 are not singular. The controversies on display at these conventions are merely cogent examples of the ceaseless struggles that have taken place within the parties since their inception. On questions ranging from the national bank, to slavery, to monetary policy, to Medicare coverage, to Civil Rights, battles have raged within the parties over fundamental questions. What does it mean to be a Democrat or Republican? What, if anything, does it say about a candidate who runs as a Democrat versus a Republican? What are the policy positions that should be promoted by the party leadership and by party institutions? These intra-party conflicts and controversies are central to a complete understanding of American history. Indeed, as indicated by James L. Sundquist in the passage above, they are essential to an adequate theoretical treatment of American political parties.

Hampered by the single-agent assumption of the classic Downsian model that "treats each party as though it were a single person," the vast formal literature on party positioning offers little insight into intra-party strife (Downs 1957, p 26). Certainly these conflicts seldom play a central role in theoretical treatments. Indeed, the vast majority of models simply assume that no conflicts exist or else that they are inconsequential.[1] What is the relationship between intra- and inter-party conflict? How do the institutions designed to solve internal conflicts affect party positioning? How are party labels maintained, and what mechanisms serve to alleviate adverse selection, or the watering down of meaningful party reputations? Only a handful of scholars, discussed below, approach these issues from the traditional

[1] As I discuss below, there are notable exceptions including Cox and McCubbins (1993), Aldrich (1995), Hinich and Munger (1996), Snyder and Ting (2002), Grynaviski (2010), and the seldom cited later chapters of Downs (1957).

Downsian framework. Instead, conventional models have ignored intra-party conflict and focused exclusively on the environmental factors external to parties (e.g., voter preferences, uncertainty, etc.) that determine party behavior and positioning.

In contrast, intra-party conflict is at the very center of a Darwinian model of party politics. It is Darwin's "struggle for existence" within and between populations that drives evolution at all levels. Indeed, conflict between individuals is a defining characteristic of a population. To understand this, it is important to note that, to contemporary scholars, one of the primary theoretical contributions of Darwin's theory is not in explaining change (or "evolution") but rather in explaining stability (Dennett 1996).[2] What Darwin's theory reveals is why *distinct* species exist and how they are maintained through competition. It is the commonly experienced and mutually determined struggle for survival of individuals – both against the environment and each other – that define population and brings about clear delineations.

In this chapter, I present four simple models based on evolutionary principles that explore the assumptions necessary to treat collections of candidates as populations. The focus is on explicating the environmental conditions and institutional configurations that are sufficient to change a mob of individual candidates facing unique electoral environments into a coherent population in the Darwinian sense.

As discussed in Chapter 1, populations are generally defined as a class of interactors subject to common selection pressures who are *interdependent* for survival. I have argued that, in the world of political competition, an important source of this interdependency is that all individuals in the party share a common label or reputation. The four models covered in this chapter serve to elucidate this argument and explain in detail how intra-party conflict and competition is essential to

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[2] Chaos, in both politics and the natural sciences, requires no explanation. Both the second law of thermodynamics and the so-called 'chaos theorems' (McKelvey 1976, 1979; Schofield 1978) serve to explain instability and change.

an evolutionary theory of parties.

To preview the results below, the models show that – absent any institutional structures – collections of individual candidates will only behave like a population if they compete in identical electoral districts. If there is heterogeneity in the policy positions preferred by voters in each candidates' district, then a simple evolutionary model will *not* lead collections of candidates to behave as a population. These theoretical results are covered in Sections 2.2 and 2.3.

I then turn to exploring two possible institutional mechanisms – drawn from the broader literature on American parties – through which district heterogeneity might be overcome to foster population behavior. In Section 2.4, I examine the possibility that parties might use some form of "label maintenance" to punish individual candidates who stray too far from the rest of their co-partisans in the policy space. The model shows that, although these mechanisms do lead sets of individuals to behave as a coherent population under certain circumstances, the equilibria outcomes are unpredictable and highly sensitive to initial conditions in ways inconsistent with American political history. Finally, in Section 2.5, I turn to the idea that there may be some some exogenous actor or group of individuals (e.g., party activists in the sense of Aldrich and McGinnis (1989)) who foster population behavior by rewarding individuals who take particular policy stances. This framework also leads to population behavior in the face of heterogenous electoral districts, but leaves unanswered the question of where these external actors come from and why they favor certain policy positions. In subsequent chapters, therefore, I extend the model to consider two party competition where activist coalitions form endogenously to favor specific policy positions.

2.2 Homogenous electoral districts with constant selection

To begin this discussion, it is useful to clarify what I mean by mean by *party*. Although there are many definitions in the literature, most fall into one of three camps. First, scholars who envision parties to be "factions" within the electorate hone in on shifting coalitions of voters (e.g., Key 1964; Eldersveld 1964; Burnham 1970). Second, other research defines parties as collections of elites seeking to advance a specific ideological goal. These scholars examine changes in the "ideologies" or values parties advocate (e.g., Wittman 1977; Gerring 2001). I join a third body of scholars in defining parties as groups of individuals working under a shared label to win office (e.g., Schattschneider 1960; Schlesinger 1986; Sundquist 1983; Aldrich 1995). My focus, therefore, is the policies proposed and legislated by candidates and incumbents who share a common party label.

In addition, there are two methodological issues that are worth addressing before moving onto the details of the model. First, throughout this chapter I make a number of strong simplifying assumptions. These include the assumptions that: (1) there is only one political party, (2) there is a single policy dimension, and (3) political institutions arise exogenously. These restrictions are dramatic and seem to undermine my prior argument that an evolutionary approach to the study of party competition is more flexible and realistic. However, in later chapters I eliminate these restrictions and consider a more general class of two-party evolutionary models set in a multi-dimensional policy-space. I begin with these extreme simplifying assumptions both to home in on the specific arguments of this chapter and to build a foundation for more complex models in later chapters.

Second, throughout this chapter I will be using computational methods to explore my models' predictions.[3] At this early stage, this is not strictly necessary as a

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[3] The models for this chapter were written for R.

number of the models presented here are likely to have analytical solutions. I use the computational approach because it is more in keeping with the methodology that must be used in later chapters due to the increasing complexity of the models. Thus, I am able to build a vocabulary of methods and results that I can refer back to in subsequent chapters.

In this section, I begin with a simple model in which candidates in a single party exist in electoral districts with identical voter preferences. Later, I will show that this represents a special case of a more general class of models. In Section 2.2.1, I present the details of the base model. In Section 2.2.2, I then present results from a large number of model simulations.

2.2.1 Model details

In this base model there are two "types" of actors: candidates and voters. There is a single median voter located in each of n_d electoral districts. Voter j has an ideal point, x_j, in a 1-dimensional policy space $\mathcal{X} \equiv \mathbb{R}^1$. This main dimension represents the set of policy stances that are linked in the minds of voters and constitute the main "liberal-conservative" axis of American politics (Hinich and Munger 1996). For the moment, I assume that $x_j = M \; \forall \; j \in [1, 2, \ldots, n_d]$. In words, the location of the median voters in every district is located at the single point M and all districts are identical. The utility function of voter j for candidate k who has a position in the policy space y_k is $U_{jk}(x_j, y_k) = -\|x_i - y_k\|^2$, where $\|.\|$ is the simple Euclidean norm.

Candidates in the model do not have utility and are not individually adaptive. This can be interpreted to mean: (1) they have beliefs about what constitutes good government and act solely based on those beliefs; (2) they have stable "induced preferences" or mental models about what issue positions to advocate in order to win elections (e.g., Poole 2007; Ensley, de Marchi and Munger 2007; Denzau and North 1994); or (3) that the dis-utility for appearing to be a "flip-flopper" exceeds

the expected utility of adapting (e.g., Canes-Wrone and Shotts 2007; Hinich and Munger 1996). The assumption that candidates do not move is somewhat stylized and extreme, but it has some strong empirical support, as is discussed in Chapters 1 and 5.

Each candidate, k, has a position in the policy space $y_k \in \mathcal{Y} \equiv \mathbb{R}^1$, and there are n_d candidates (one for each district). To begin the simulations, I assume that the candidates are distributed according to the normal distribution, $y_k \sim N(\mu_c, \sigma_c^2)$.

In every iteration of the model (i.e., each election), all candidates stand for election and voters calculate their utility for the candidate in their respective districts. Candidates in the bottom S^{th} percentile "lose" the election and are removed from the model. That is, the candidates who are least preferred by the median voter in their own district are eliminated. For convenience, I refer to this as candidates experiencing "selection pressure" of strength S.

Once the losing candidates have been removed, the party is re-populated back to size n_d (there is always one candidate assigned to each district). A discussed in Chapter 1, there are many possible ways to model how candidate recruitment and re-population might occur. However, since this is a first foray into modeling parties as an evolutionary system, I assume the simplest. New candidates choose at random[4] one of the surviving incumbents from the previous election. They adopt this incumbent's policy stance, y_k, with some random error, ϱ. Thus, a new candidate, k', will adopt the point $y_{k'} = y_k + \varrho$. The errors, ϱ, are *iid* uniform on the interval $[-\rho, \rho]$. Note that this means that the "screening parameter," ρ, represents the ability of the party to exclude new candidates who are too dissimilar from current incumbents. As Snyder and Ting (2002) note, "A party might ... give candidates a test of 'ideological correctness,' and only nominate candidates who pass the test" (Snyder and Ting 2002, p 95).

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[4] This is sampling with replacement.

As discussed in Chapter 1, the assumption that political candidates from the same party offer similar policy platforms has strong empirical support (c.f., Bafumi and Herron 2010; Ansolabehere, Snyder and Stewart 2001). The specific approach used here to conceptualize candidate replacement can be justified in at least three ways. First, there is evidence that parties do take an active role in recruiting like-minded candidates to run for office (Kazee and Thornberry 1990; Monroe 2001). These recruits are not mirror images of incumbent office holders, but they are more similar to members of their own party than otherwise. Second, there are a number of institutions and norms that facilitate the transference of incumbent positions to new candidates. These include consultants who are shared by multiple co-partisan candidates (Nyhan and Montgomery 2010), reliance on party organizations or party-affiliated think-tanks for coherent issue platforms (Rich 2004), and informal mechanisms that work to promote policy consistency within parties (Masket 2009; Monroe 2001; Noel 2007).

Finally, the notion that agents borrow strategies or "mental models" from other agents in an environment with high levels of uncertainty has a long tradition in political economy. In elections with multiple agents and strategic complementarities, uncertainty about the relationship between policy stances and electoral outcomes will be high and serve to promote mimicry. In particular, if the optimal response of agents depends not only on the decisions of individual opponents, but also on the decisions of *all* co-partisan candidates, best-response functions will be complex at

best, and in many cases the problem will be intractable (de Marchi 2005).[5] Alchian (1950), Denzau and North (1994), Hinich and Munger (1996), Conlisk (1980), Nelson and Winter (1982), and others have argued that in such an environment the best alternative will be to borrow strategies from other agents whose goals resemble one's own. Under this kind of extreme uncertainty, "all individual rationality, motivation, and foresight will be temporarily abandoned in order to concentrate upon the ability of the environment to *adopt* 'appropriate' survivors even in the absence of any adaptive behavior" (Alchian 1950, p 214).

For convenience, Table 2.1 lists the model parameters and their interpretation. After the agents are initialized, the model repeats the following sequence.

1. Voters evaluate the candidate in their district.

2. The candidates in the bottom S percentile (those candidates farthest from the voters in their district) are eliminated.

3. New candidates enter the system and mimic (with some level of imprecision) the position of surviving incumbents.

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[5] This is a serious and often overlooked problem in all existing models of party competition with multiple candidates. In traditional economic-based models there is considerable ambiguity in predicted outcomes unless there are either very few or very many agents (Miller and Page 2007). For obvious reasons, this is hugely problematic in the context of Congressional elections. Traditional approaches have been to either ignore strategic complementarities (treating each race as distinct and separate, or, worse, assuming that each agent's best response is invariant to the other players' actions) or to assume that agents have perfect information about the preferences and best responses of all other agents (common knowledge or common priors). Without these extremely strict and improbable assumptions, agents will generally fail to coordinate onto single equilibrium and predictions are impossible.

Carlsson and van Damme (1993) develop the "global game" framework by showing that equilibria can exist in such games under specific assumptions if there exist institutions to restrict the amount of noise. Conceivably such an approach could be applied to a multi-candidate models of political competition, but I am aware of no extant model from this framework.

Table 2.1: Model parameters and interpretations for the single-party model

Parameters for models in Section 2.2

Symbol	Interpretation and meaning
M	The position of the median voter in all electoral districts
n_d	The number of districts and candidates
μ_c, σ_c	The mean and standard deviation of the distribution of the initial distribution of candidates
ρ	The "screening parameter" indicating the amount of error that occurs when new candidates enter and mimic the position of some existing own-party candidates
S	The percentage of candidates that are eliminated each iteration

Parameters for models in Section 2.3

Symbol	Interpretation and meaning
a, b	The minimum and maximum of the interval in the policy space where district medians are located

Parameters for models in Sections 2.4 and 2.5

Symbol	Interpretation and meaning
β	The "party discipline" parameter in determining the degree of bias in the distribution of party resources. Higher values indicate greater discipline.
κ	The "resource weighting" controlling how much voters weigh resources versus spatial proximity in determining their votes. Higher values indicate a greater weight towards resources.
γ	The "party resources" parameter indicating the total budget of resources available to the party per district.
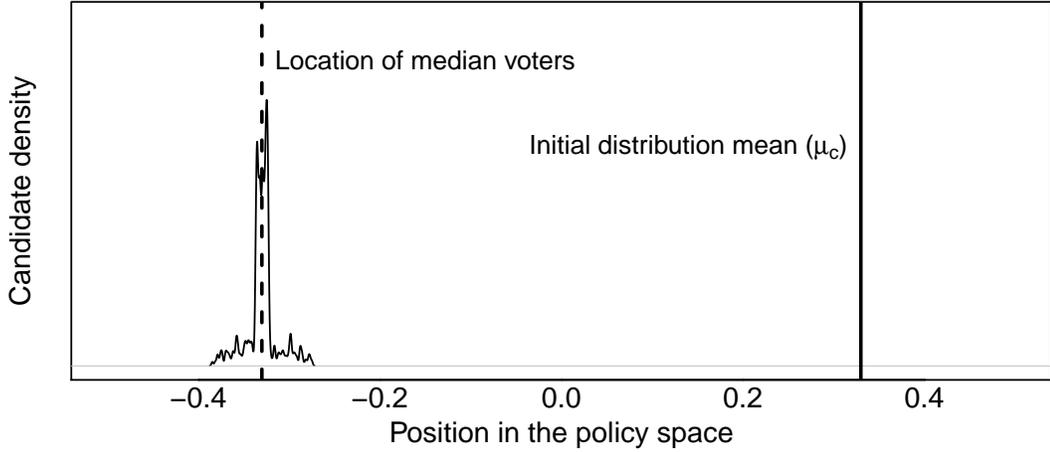
FIGURE 2.1: Exemplar distribution of candidates after 20 elections. The parameter settings used are $n_d = 435$, $\rho = .05$, $\mu_c = 0.33$, $\sigma_c = 1$, $M = -0.33$ and $S = 0.33$.

2.2.2 Simulations and results

To understand the behavior of the model, it is helpful to begin with a single model output. Figure 2.1 shows the distribution of candidate positions after 20 iterations (i.e., 20 elections). The initial distribution of the 435 candidates was $N(0.33, 1)$ while the positions of the median voters were set to $M = -0.33$. The other parameters were set to $\rho = .05$ and $S = 0.33$, meaning that one third of the candidates were eliminated in each iteration. The solid black line in Figure 2.1 shows the population mean after the model was initiated ($\mu_c = 0.33$), while the dotted vertical line shows the location of the median voters ($M = -0.33$). Figure 2.1 shows that even after only 20 elections, candidates converge to the position of the median voters.

With this single example in mind, I now turn to a broader sweep of the possible parameter space. In all of the simulations that follow, I fix the position of the median voters to be $M = -0.33$. The other parameter values I considered are as follows: $S = (.01, .05, .1, .33, .5, .75)$, $\rho = (.01, .05, .1, .25)$, $\mu_c = (-.33, 0, .33, .5)$, $\sigma_c = (.25, .5, 1, 2)$, and $n_d = (100, 435)$. I also consider the results after varying number elections. I looked at results after 10, 25, 50, and 100 cycles. I ran the model

43

five times at each parameter setting for a total of 15,360 simulations representing 710,400 election cycles.

Standard practice in the field of theoretical biology is to focus on the means and variances of the populations, and this is quite sufficient for the limited task of this chapter (Michod 1999). Figure 2.2 shows the distribution of final population means and standard deviations for all of the simulations. Figure 2.2a shows that, in the vast majority of cases, the final population mean is extremely close to that of the median voter. On the other hand, Figure 2.2b shows that, although the populations are usually quite homogenous, there are some parameter settings for which there remains substantial within-party variation.

(a) Population means across all simulations

(b) Population standard deviations across all simulations
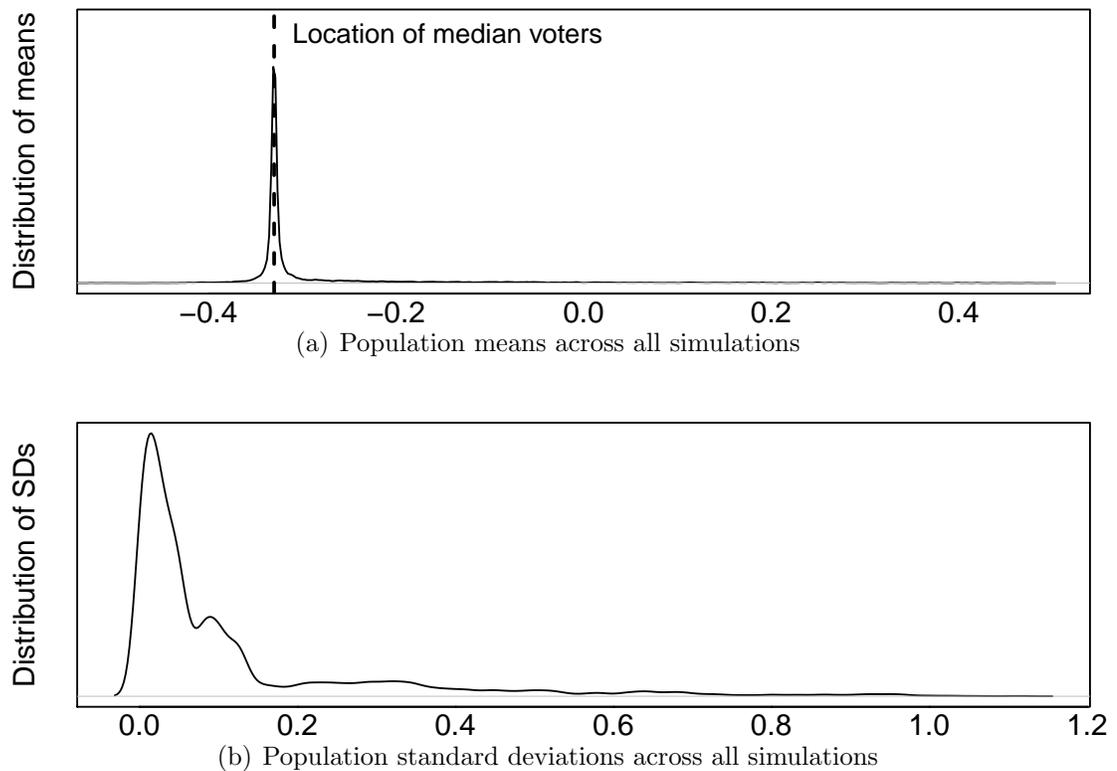
FIGURE 2.2: Means and standard deviations of the final candidate populations in the basic model

The collection of candidates in this model do appear to behave as a population

in the evolutionary sense. This makes perfect sense since *all* individuals experience identical selection pressures. There is a strong degree of mutuality as candidates seek to out-do each other in proximity to the median voters that are identically positioned across all districts. This generates the necessary "struggle for existence" among individuals to create a population.

Nonetheless, this is not uniformly the case. There are some significant variations in the model outputs depending on the parameter settings. Figure 2.3a shows the relationship between specific model parameters and the deviance of the final population mean from the median voters.[6] The upper-left panel shows that, as we might expect, final population means are farther from the median voters when the initial population means (μ_c) are more distant. Likewise, the lower-left panel shows that deviations of final population means from the median voters decreases as a function of the selection pressures. In addition, the lower-right panel shows that convergence to the median voter is far more complete given a larger number of election cycles.

All of these results are fairly intuitive and fall out directly from the basics of Darwinian logic. A final finding, however, is somewhat less obvious but worth noting. The top-right panel of Figure 2.3a shows that there is slightly negative relationship between the deviations from the median voter and the initial amount of variance that exists in the candidate population. As I mentioned in Chapter 1, variation in a population is the fuel of the evolutionary process. This result simply shows that by providing more fuel the population will adapt more quickly and completely.

Of more interest are the parameters that determine the degree of population homogeneity. Figure 2.3b show the relationship between several key parameters and population heterogeneity (measured as standard deviations in the final population). The figure shows that there is a positive relationship between the final population variance and both the initial population variance (σ_c^2) and the "screening parameter"

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[6] The deviance is equal to $|\bar{y} - M|$.
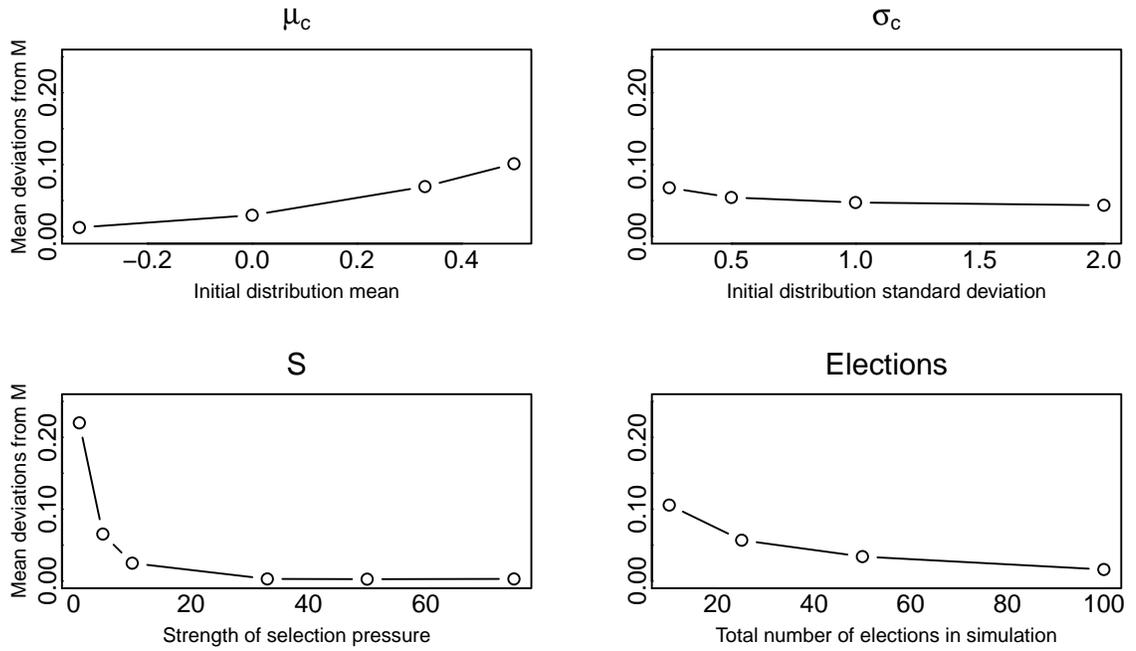
45

(a) Population means across all simulations
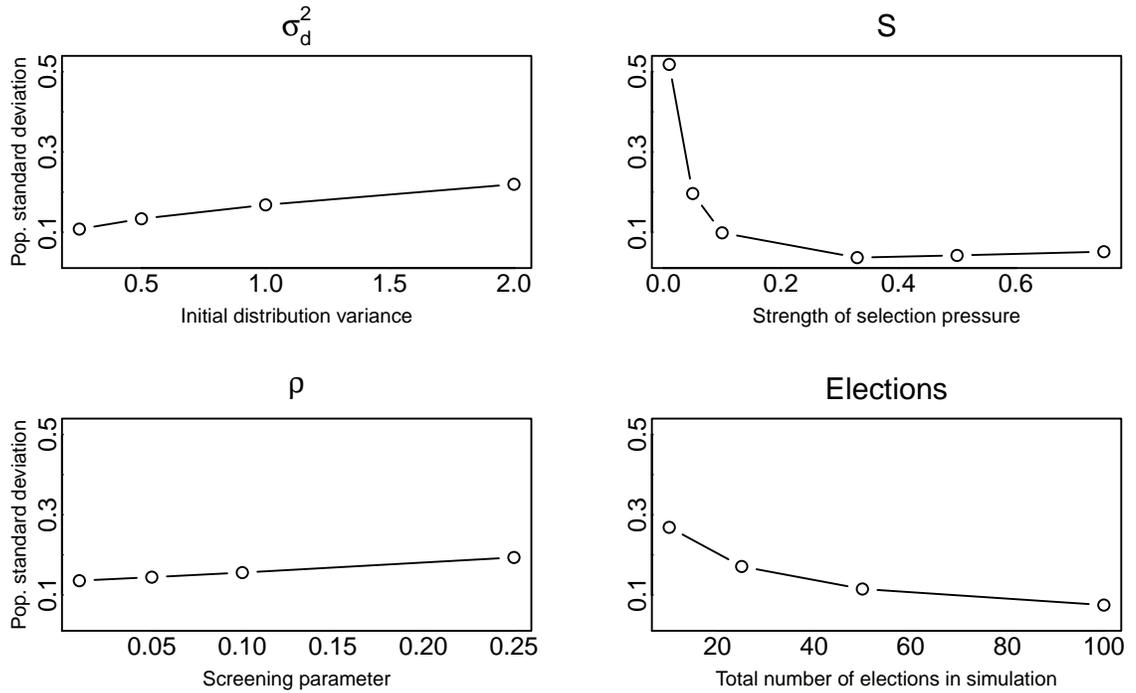
(b) Population standard deviations across all simulations

FIGURE 2.3: Model parameters and final population means and standard deviations

46

(ρ) that controls how much error in mimicry occurs as new candidates are recruited. Furthermore, both the number of elections and the strength of the selection pressure (S) are negatively related to final population variance.[7]

The collection of candidates in this mode appears to behave as a population. The candidate population converges quickly to the position of the median voters. Indeed, given sufficiently strong selection pressures and time, this result is guaranteed. This echoes the findings of Kollman, Miller and Page (1992, 1998), de Marchi (1999), Laver (2005) and others who have used genetic algorithms and their close relatives to represent political parties. However, the setup I propose lays bare one of the strong implicit assumptions of these prior models, and indeed all models premised on the unitary-actor conceit. Is it realistic to assume that all candidates face identical electoral environments? What are the consequences of relaxing this assumption? As I show in Section 2.3, the result of allowing for heterogenous districts completely unravels the results shown so far.

2.3   Heterogenous districts

In the model so far, I have made the very strong assumption that candidates face identical electoral districts. I now examine the consequence of relaxing this assumption. To do this, I extend the model to include a *distribution* of median voters between electoral districts.[8]   I then re-run the above simulations and analyze the impact of adding between-district heterogeneity.

Recall from above, that voter j is the median voter for district j and has an

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[7] The slight upward slope in the relationship between S and population variance for high values of S is an artifact of my simulation procedure. These statistics were calculated on a full population of candidates, thus a final round of replication with error was completed. Higher values of S thus lead to slightly higher values of population variance as more random error has been introduced as more new candidates are generated.

[8] As I am assuming that the median voter controls the outcome of the election, this does not refer to within-district heterogeneity or complexity in the sense of de Marchi (1999) or Ensley, de Marchi and Munger (2007).

ideal point, x_j, in a 1-dimensional policy space. In the initial model, I assumed that the median voters in all districts are located at an identical position M. That is, $x_j = M \; \forall \; j \in [1, 2, \ldots, n_d]$. I now change this assumption so that the median voters will be distributed uniformly on the interval $[a, b]$. Thus, $x_j \sim Uniform(a, b)$, where a is the most extreme district on the left or "liberal" side and b represents the most extreme position to the right. This implies that the results discussed in Section 2.2 represent a special case of this more general model where $a = b = M$.

It is again helpful to consider a single simulation. Figure 2.4 shows the distribution of candidate positions after 20 elections. I use identical parameter settings as in Figure 2.1 except that I now assume that the distribution of the 435 median voters is uniform on the interval $[a = -.5, b = .5]$. The curve shows the distribution of the candidates, while the ticks at the bottom show the locations of the median voters in the districts. Figure 2.4 shows that the candidate population is distributed very widely in the policy space. Indeed, in examining multiple simulations of this model it is apparent that a diffuse distribution is the model's only prediction. Unlike the results in Section 2.2, selection in this model does *not* lead the population towards any particular point in the policy space. Rather, the population ends up distributed virtually uniformly across the interval $[a, b]$ as candidates become ever closer to their respective district medians. After only 20 elections, the average distance between candidates and their respective medians is 0.13 and the median distance is 0.08. After 200 elections, the average distance is 0.13 and the median is 0.04.

How general is this example simulation? I conducted a second simulation experiment identical to those analyzed in Section 2.2, but now drawing median voters from the interval $[a = -.5, b = .5]$.[9] The task is again to examine the final popula-

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[9] The other parameter values I considered are as follows: $S = (.01, .05, .1, .33, .5, .75)$, $\rho = (.01, .05, .1, .25)$, $\mu_c = (-.1, 0, .33, .5)$, $\sigma_c = (.25, .5, 1, 2)$, and $n_d = (100, 435)$. I also consider the results after varying the number elections. I looked at results after 25, 50, and 100 cycles. I again ran the model five times at each parameter setting for a total of 11,520 simulations.
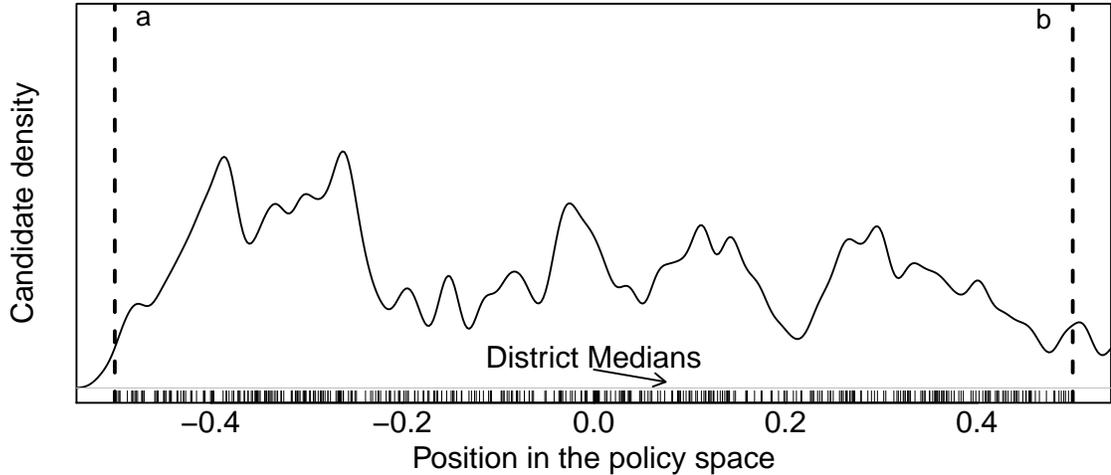
FIGURE 2.4: Exemplar distribution of candidates after 20 elections with heterogeneous electoral districts. The parameter settings used are $a = -0.5$, $b = 0.5$, $n_d = 435$, $\rho = .05$, $\mu_c = 0.33$, $\sigma_c = 1$, and $S = 0.33$.

tion means and standard deviations. Since the intuition is that the populations will be essentially uniform on the interval $[a, b]$, it is useful to have a meaningful benchmark. A proper comparison would be theoretical distribution of means and standard deviations predicted by n_d draws taken multiple times from the $Uniform(a, b)$ distribution.

Figure 2.5 shows the population means and standard deviations for all simulations. The solid line represents the observed results from the model simulations, while the dashed lines show the distribution we would expect if the populations were a simple uniform draw. Figure 2.5 shows that (with only a few outliers) the model simulations approach a random draw.[10] The collection of candidates in this second simulation experiment *do not* behave as a population. All individuals experience selection pressures unique to themselves. Only in the trivial sense that all candidates

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[10] I have also conducted analyses of the relationship between the exogenous parameter and population means and variances as shown in Figure 2.3. The results are largely the same as those reported above, with the exception that all of the correlations are considerably smaller. For instance, there *is* somewhat less variance in the population when S is higher, but the correlation between S and population variance is significantly diminished. In any case, the limited substantive point of this section does not require the presentation of the full results.
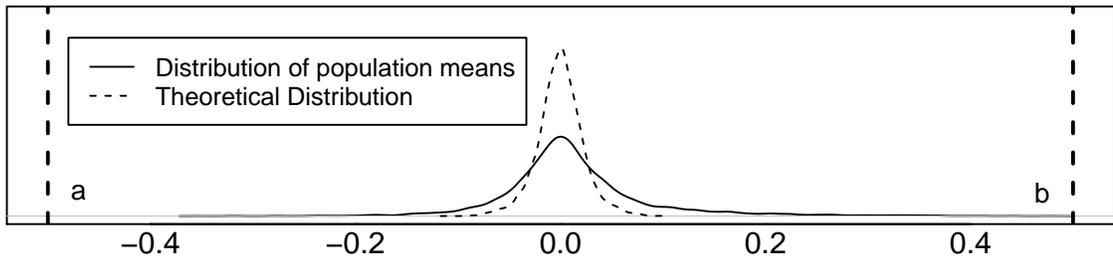
49

(a) Population means across all simulations
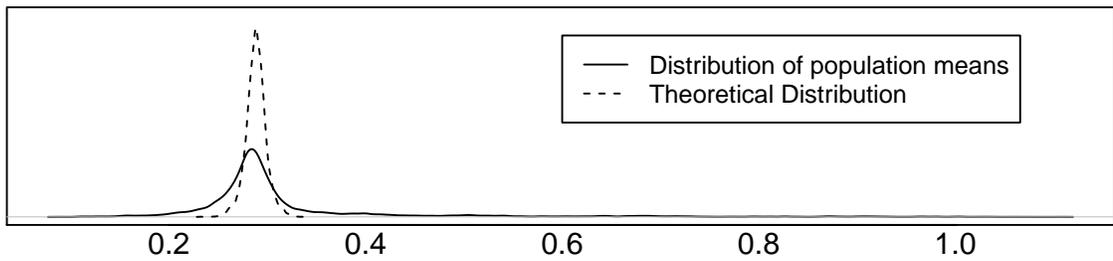
(b) Population standard deviations across all simulations

FIGURE 2.5: Means and standard deviations of the final candidate populations with heterogeneous districts

experience selection pressure towards the region $[a, b]$ (as opposed to the entire real line) is there any mutuality in this population.

From a substantive perspective, this result is very unsatisfying. Empirical research shows both that (1) there *is* considerable heterogeneity in the policy positions of voters across districts (e.g., Bafumi and Herron 2010), and (2) that only in rare historical eras have candidates in the two major parties taken diffuse positions across the policy space (Poole and Rosenthal 2007). Rather, through much of American history, the parties have been remarkably polarized and internally homogenous despite significant heterogeneity in the preferences of voters in their home districts (McCarty, Poole and Rosenthal 2005; Ansolabehere, Snyder and Stewart 2001). Clearly,

additional structure is needed to account for these facts (i.e., heterogeneous electoral districts and high-rates of party homogeneity) within this evolutionary model. In the following two sections, I examine two possible mechanisms suggested by the literature on parties through which collections of candidates may act as a population: *label maintenance* and *exogenous actors*.

2.4 Label maintenance and frequency dependent selection

In Sections 2.2 and 2.3, I demonstrated that a simple evolutionary model of political parties does not automatically lead to population behavior in an evolutionary sense. In the context of heterogeneous electoral districts, a simple evolutionary model will *not* lead the parties to develop into an adaptive population. In the remainder of this chapter, I show how the addition of party institutions can facilitate population behavior in the face of diffuse electoral districts.

In this section, I consider a model in which party institutions work to preserve a meaningful party label. A common proposal in the literature on American parties is that they provide a useful political brand for candidates who run under a shared label. Prominent books and papers contend that these brands (1) serve as valuable information short-cuts for voters and (2) help candidates win elections by providing a mechanism to credibly commit to specific policy stances. The earliest proponent of such arguments was actually Downs (1957) himself, although the later chapters in which these arguments appeared subsequently received scant attention (Hinich and Munger 1996). More recent work in this literature has advanced our understanding of how labels might be created, sustained, and used in the electoral and legislative arenas (e.g., Aldrich 1995; Ashworth and Bueno de Mesquita 2008; Cox and McCubbins 1993, 2005; Grynaviski 2010; Hinich and Munger 1996; Kiewiet and McCubbins 1991; Snyder and Ting 2002)

In all of this work, strong party ideological commitments or meaningful labels are

framed as public goods for all co-partisan candidates. The brand, label, or ideological reputation of the party are valuable to the *group* because they provide information to voters about each candidate's stance and increase their odds of victory. Like all public goods that serve to overcome information asymmetries, the party label is vulnerable to two threats: adverse selection and moral hazard. In the first case, the party label may be damaged or watered down by the participation of candidates who do not sufficiently toe the party line. The party brand may become diluted and voters come to the conclusion that the party banner is a meaningless symbol without content. In the case of moral hazard, candidates may run under the party banner (perhaps in all good faith), but then fail to deliver on their promises.

Numerous papers have examined the institutional structures that serve to overcome these twin difficulties. For instance, Cox and McCubbins (1993, 2005) argue that party leaders are given special privileges in exchange for preserving the party brand. Snyder and Ting (2002) hypothesize a party screening mechanism used to impose high costs on members whose private ideal points are too distant from the party label. Aldrich (1995) argues that sufficiently strong deviations are punished by both the formal leadership in Congress and by party activists who deny valuable resources to deviants.

In this section, I specify a stylized version of label maintenance that broadly (if imprecisely) encompasses all of these proposed institutional solutions to problems surrounding party labels. My purpose here is to show that, in the context of an evolutionary party model, any label maintenance institution implicitly provides the mutuality and "struggle for existence" necessary for the creation of population behavior. Institutions sufficiently strong to overcome problems of adverse selection and moral hazard create intra-party selection pressures sufficiently strong to counter the pull of diffuse median voters.

However, as I show below, the mere preservation of a party label predicts only

that population dynamics begin. It shows that, given sufficiently strong party institutions, the parties will converge to some point in the policy space. However, it does not provide useful predictions for *where* in the policy space the parties will converge. That is, the population does not become adaptive at the emergent party level, but rather settles at unpredictable points in the policy space determined by initial conditions. I provide the details of the model in Section 2.4.1, and turn to simulation results in Section 2.4.2.

2.4.1 An evolutionary model of label maintenance

In addition to voters and candidates, in this new variant of the model I add an *institutional party* that is not itself and agent, but rather a feature of the environment that is determined exogenously. This contrasts with "the party," which I define to be a collection of individual candidates who share a common label.

As before, there are are n_d voters divided evenly into n_d electoral districts. Voters have ideal points distributed $x_j \sim Uniform(a, b)$. Following the traditional framework, voters are assumed to have utility over policy. In addition, however, voters prefer candidates with greater "valence" advantage (c.f., Groseclose 2001; Schofield 2004; Serra 2010). Similarly to models studied by Norman Schofield and his colleagues (e.g., Miller and Schofield 2003; Schofield, Miller and Martin 2003; Schofield 2004; Schofield and Sened 2006, 2005; Schofield and Miller 2007; Miller and Schofield 2008), I assume that this valence advantage is endogenously determined from within the model. Each candidates' valence advantage is assumed to be a function of the party "resources" provided by the the institutional party. These resources are provided to candidates to reward conformity to the party label. Conceptually this may include financial contributions, prestigious committee assignments, particularistic policy benefits, and any other resources at the disposal of the institutional party (c.f., Aldrich 1995; Cox and McCubbins 1993; Parker 2008). Thus, valence may be

accurately described in this model as whatever electoral benefits candidates gain from the party organization.

The utility of voter j for candidate k who has a position in the policy space, y_k, and resources ν_k is given by:

$$U_{jk}(x_j, y_k, \nu_k) = \kappa\nu_k - (1 - \kappa)\|x_j - y_k\|^2 \tag{2.1}$$

where $\kappa \in [0, 1]$ is a "*resource weighting*" constant indicating the relative weight of policy and party resources in voters' utility.

The processes of elections and candidate replacement work the same as described in Section 2.3. The only remaining task is to operationalize a mechanism through which a party label is enforced. I assume that the party signal represents the aggregate position of all the candidates who share a common label. Thus, the party signal for all n_d candidates in the party is denoted $\bar{y} = \frac{1}{n_d}\sum_k y_k \forall k \in [1, 2, \ldots, n_d]$.[11]

Given the above definitions, the issue of label maintenance can be stated as follows. If the institutional party has an exogenously determined budget of party resources, γ, how are these resources to be distributed amongst the candidates? I follow Aldrich and McGinnis (1989), Snyder and Ting (2002), and Cox and McCubbins (1993, 2005) in assuming that the institutional party constructs a distributional mechanism that is biased towards enforcing the party signal, $\bar{y}$. Thus, the institutional party allocates resources as a function of each candidate's distance in the policy space from the party signal. The degree of bias in the distribution of γ can be interpreted as the degree of "party discipline," and is denoted by the parameter β.

Let the *distance* between the party signal and candidate k be given by:

$$d_k = \|y_k - \bar{y}\|^2. \tag{2.2}$$

---

[11] Snyder and Ting (2002) make a similar assumption about the operationalization of the party label.

The total amount of resources (or valence), ν_k, given to candidate k is defined by

$$\nu_k = n_d \gamma \frac{\lambda_k}{\sum_k \lambda_k},$$ (2.3)

where

$$\lambda_k(d_k, \beta) = (1 + d_k)^{-\beta},$$ (2.4)

and $\beta \in [0, \infty)$ represents the extent of party discipline. Note that this formulation indicates that the model presented in Section 2.3 is a special case of this more general model where either $\beta = 0$ or $\kappa = 0$.

This distribution mechanism deserves some additional motivation. Specifying an apparatus for the intra-party dispersion of resources is necessarily complex. The amount of resources any candidate, k, receives depends not only on k's location in the policy space, but also the position of *every other co-partisan.* A policy stance that is very beneficial in one election can quickly become inadequate as a candidate's co-partisans drift towards the mean position ($\bar{y}$). Thus, it is necessary to specify a functional form that normalizes the distribution based on the current positions of *all* candidates in the party. Finally, the functional form I have chosen effectively punishes defection for even small amounts of deviation.[12] Figure 2.6 illustrates the relationship between candidate positions and λ_k for different settings of β as predicted by Equation 2.4.

Together, these assumptions provide the mutual determination necessary for the collection of candidates to behave as a coherent population. In particular, the institutional configuration I have specified – enforcement of an endogenously determined party label – implies that the system will experience 'frequency-dependent' or 'density-dependent selection'. That is, the optimal location in the policy space

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[12] The addition of the scalar 1 is necessary to prevent an inflection point at one.
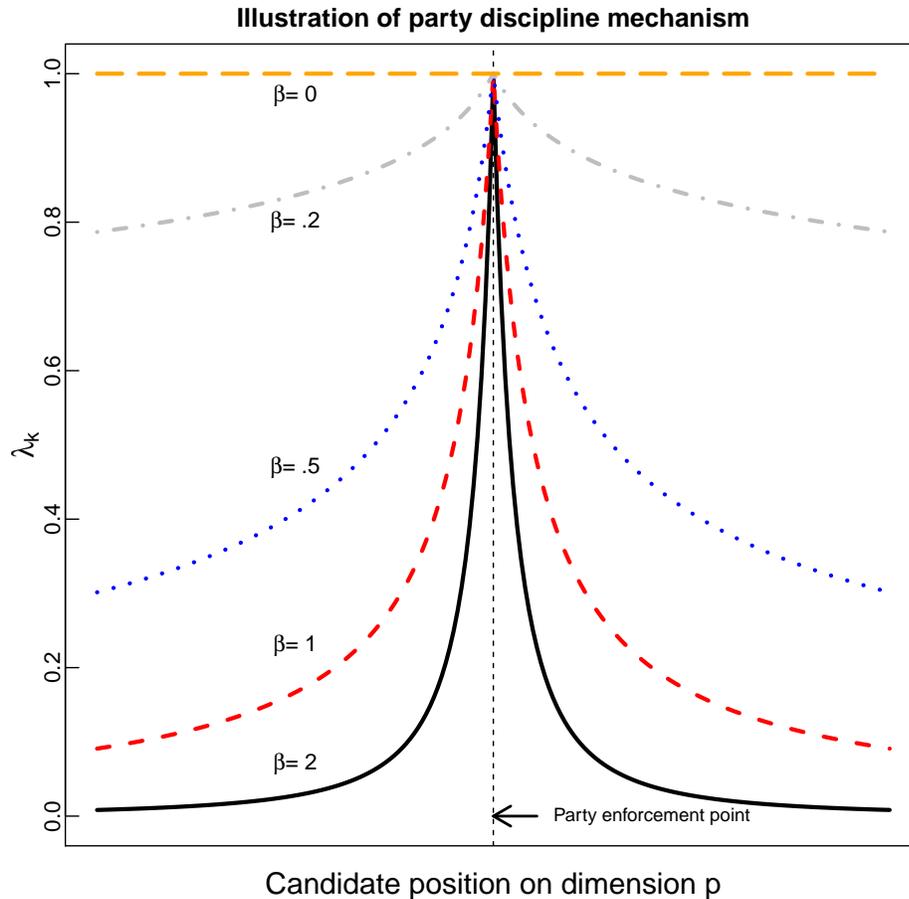
FIGURE 2.6: Relationship between candidate positioning and party resources for different levels of party discipline. The lines show the value of λ_k that will result for different candidate positions for five different values of the party discipline parameter β. The figure illustrates that being farther from the party signal leads to fewer party resources, and that this relationship is increased for higher values of β.

for any particular candidate depends not only on the environment (as it does under constant selection in Section 2.2) but also on the positions of every other member of the party. As I show in the next section, the result of this setup leads to high levels of path dependence, or what Michod (1999) refers to as "the survival of the first."[13]

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[13] The outcome is "phat-dependent" by the definitions provided in Page (2006).

2.4.2 Simulation results

To illustrate the dynamics of the model, I begin with a single simulation where the parameter values serve to maximize both the degree of candidate homogeneity and the long-term impact of initial conditions. In particular, I set the initial distribution of candidates to $\mu_c = 0.4$ and $\sigma_c = 0.1$. I also set the party discipline parameter, party resources parameters, resource weighting parameter, and selection pressure parameters relatively high ($\beta = 1$, $\gamma = 435$, $\kappa = .5$, and $S = 0.75$ respectively).[14] Table 2.1 provides a listing of parameters and their meanings.

Figure 2.7 shows the distribution of candidates after 100 elections as well as the position of the median voters in each district. The solid vertical line shows the mean position of candidates in the initial phases of the simulation (μ_c). The figure shows that the final distribution of candidates is significantly biased towards the initial mean position and that the population is quite homogenous. In this simulation, the final mean is $\bar{y} = 0.38$ and the standard deviation 0.04. Thus, the candidates are clustered around a central point, and this position is stable for any plausible number of iterations.

Compared to the example simulations shown in Figures 2.1 and 2.4, this is a dramatic difference. The candidates are not being drawn towards the position of voters, as in Section 2.2, nor are they spread diffusely across the policy space $[a, b]$ as in Section 2.3. Instead, the population congeals near the position of the initial population mean μ_c.

What exactly is happening? The answer is that there are competing selection pressures stemming from voters on the one hand and party institutions designed to maintain the party label on the other. If there were no benefit for being closer to the party mean (e.g., $\kappa = 0$), the simulation results would be the same as those reported

[14] The remaining parameter settings are: $\rho = 0.05$, $a = -0.5$, $b = 0.5$.
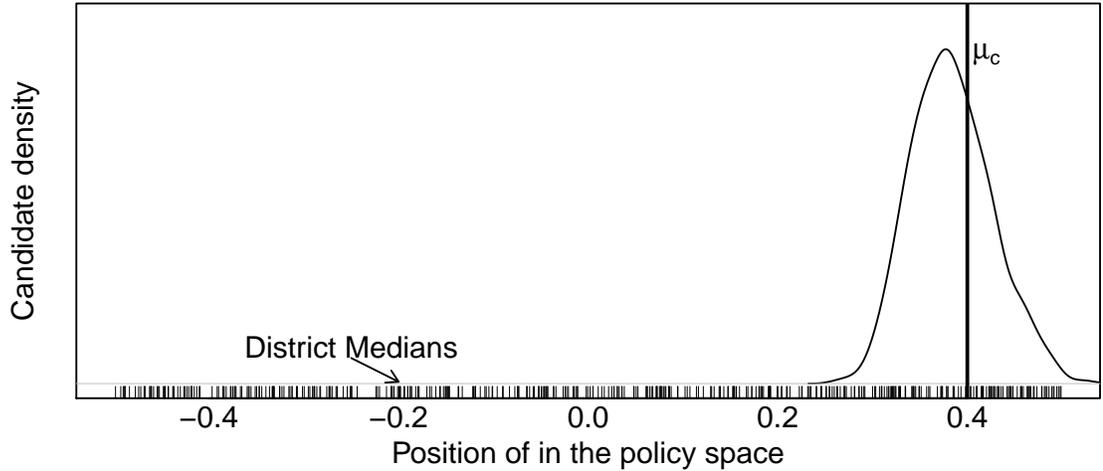
FIGURE 2.7: Exemplar distribution of candidates after 20 elections with hetero-geneous electoral districts. The parameter settings used are $n_d = 435$, $\rho = .05$, $\mu_c = 0.4$, $\sigma_c = 0.1$, $S = 0.75$, $\beta = 1$, $\gamma = 435$, $\kappa = 0.5$, $a = -0.5$, $b = 0.5$.

in Section 2.3. If, on the other hand, there was no benefit for a candidate being close to their district median (e.g., $\kappa = 1$), then the initial mean of the population would be self-sustaining and would never change.

If *both* pressures are extant simultaneously, we get results similar to Figure 2.7. In the initial phases, the selection pressure pulls the population mean towards the center distribution of median voters ($\frac{a+b}{2} = 0$). However, this drift is eventually halted. This is because the selection pressure exerted by the party pressure *depends on the distribution of other candidates*. The more the population becomes tightly clustered near the population mean, the more it becomes true that *only* those candidates near the mean will receive any significant party resources and survive to the next round. This serves to reinforce the position of the current party mean (wherever it may be at that time), and the system stabilizes. Party resources allow the parties to locate much farther from their district medians. The mean distance between candidates and their respective median is 0.32 and the median is 0.28. The location of the population mean when this congealing occurs will depend on the initial distribution

58

of candidates, the strength of the selection pressure towards the party mean, and random drift in the initial stages of the simulation.

To explore this model more fully, I conducted a larger number of simulations for various values of σ_c, S, ρ, β, γ, κ.[15] To limit the parameter space somewhat, I set $\mu_c = -0.4$, $n_d = 435$, $a = -0.5$, and $b = .5$ for all simulations and ran each model for only 50 elections. I ran the model five times for each parameter setting, leading to 90,000 total simulations.

Note that the initial mean position of the candidate population is *always* set at $\mu_d = -0.4$. Thus, we would expect the final population mean to be closer to the point -0.4 for simulations with strong party institutions that quickly stabilize the system. In these cases, we would expect the overall variance of the final populations to also be smaller as the enforcement of the party label leads to more homogenous party populations. On the other hand, we would expect the mean to be closer to zero and the variance to be much higher when the enforcement of party labels is weak. To put this a bit more formally, if (1) voters care about these resources (i.e., κ is high), (2) there are sufficient resources to make a difference (i.e., γ is high), and (3) there is some degree of bias in the distribution of resources toward the party mean (i.e., β is high), then we are likely to observe concentrated distributions near the population mean that is itself sensitive to initial conditions.

Figure 2.8 shows the basic results from the large set of simulations. Figure 2.8a shows the distribution of population means, while Figure 2.8b shows the distribution of population variances. Just as in Figure 2.5, the dashed lines show the baseline distribution of population means and variances we would expect if the candidate population was being drawn from the uniform distribution $[a, b]$. Figure 2.8 shows that the distribution of population means and variances differs significantly from

---

[15] I ran the model searching the parameter space including: $S = (0.05, 0.1, 0.33, 0.5, 0.75)$, $\rho = (0.01, .033, 0.05, 0.1)$, $\beta = (0, .5, 1, 2, 3, 5)$, $\gamma = (0, 108, 217, 435, 642, 1305)$, $\kappa = (0, .25, .5, .75, .9)$, and $\sigma_c = (.25, .5, 1, 2, 3)$.

the baseline across simulation runs. Moreover, the figure clearly shows that (in the vast majority of runs) there is significantly *less* population variance than we would expect by chance. That is, for many parameter settings the collection of candidates is behaving as a population
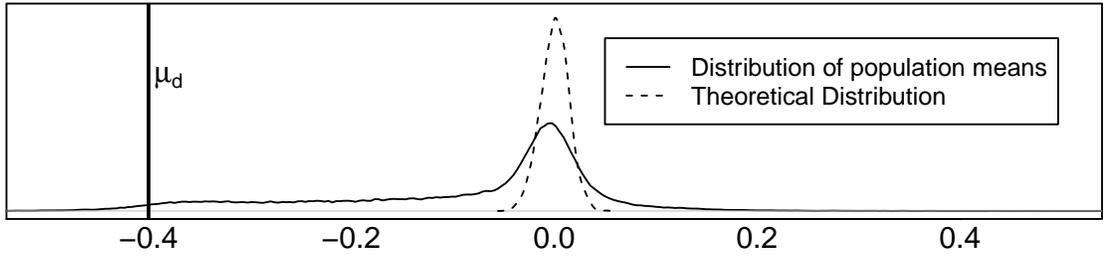
(a) Population means across all simulations
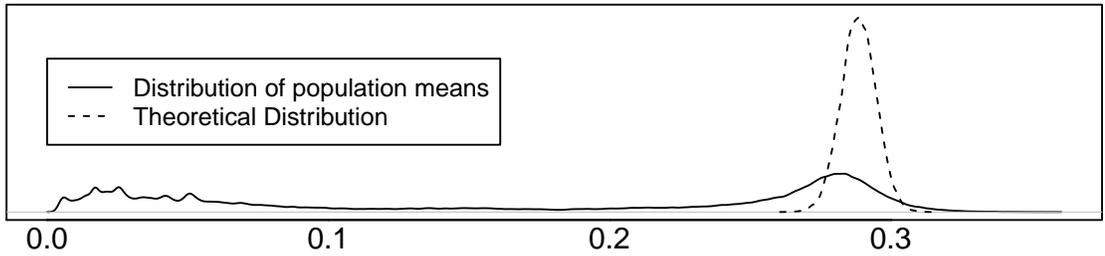
(b) Population standard deviations across all simulations

FIGURE 2.8: Means and standard deviations of the candidate populations at the end of the label enforcement simulation.

Obviously, neither the means nor variances of the final candidate populations are constant across parameter settings. Indeed, there are clear relationships between parameter values and population means and variances. Specifically, parameter values that facilitate stricter enforcement of the party signal lead to increased sensitivity to initial conditions. Within the context of *this* simulation experiment, this means that we should observe population means closer to the value $\mu_c = -0.4$ and farther from the center of the distribution of median voters at 0. Thus, in this set of simulations,

β, κ, γ, and S are all negatively associated with the final population mean $\bar{y}$. In addition, there is a negative relationship between these same parameters and population variance as they also facilitate stricter enforcement of the party signal and more within-party homogeneity. Support for both of these claims in the simulated data is shown in Figure 2.9.

2.5   Party principals and party principles

Thus far I have shown that it is possible to think of parties as populations under two separate conditions. First, population behavior may occur if all candidates represent identical electoral districts. In such a model, the party moves swiftly to the location of the exogenously determined position of the median voters. However, this assumption is extremely unrealistic and the introduction of between-district heterogeneity virtually eliminates population behavior. Second, population dynamics may arise if there are party institutions that serve to enforce the population mean and maintain the party brand. The problem with this approach, however, is that there is a strong degree of path-dependency, and the model's predictions depend almost entirely on the initial conditions. The very parameters that serve to encourage the formation of homogenous political parties – thus maintaining the value of the party label – also serve to increase the sensitivity of the model to initial conditions.

In this final section, I present a model that may be the best of both worlds. The model does not assume homogenous electoral districts, but neither does it assume that party institutions seek to enforce some randomly determined policy position. Rather, following Adams, Merrill and Grofman (2005), Aldrich (1983b,a, 1995), Hinich and Munger (1996), Roemer (2001), Wittman (1977), Wiseman (2006), and many others, I assume that party institutions serve to enforce the exogenously determined preferences of some actor or set of actors. This may represent the ideological preferences of a party boss or party principal (e.g., Wiseman 2006) or the
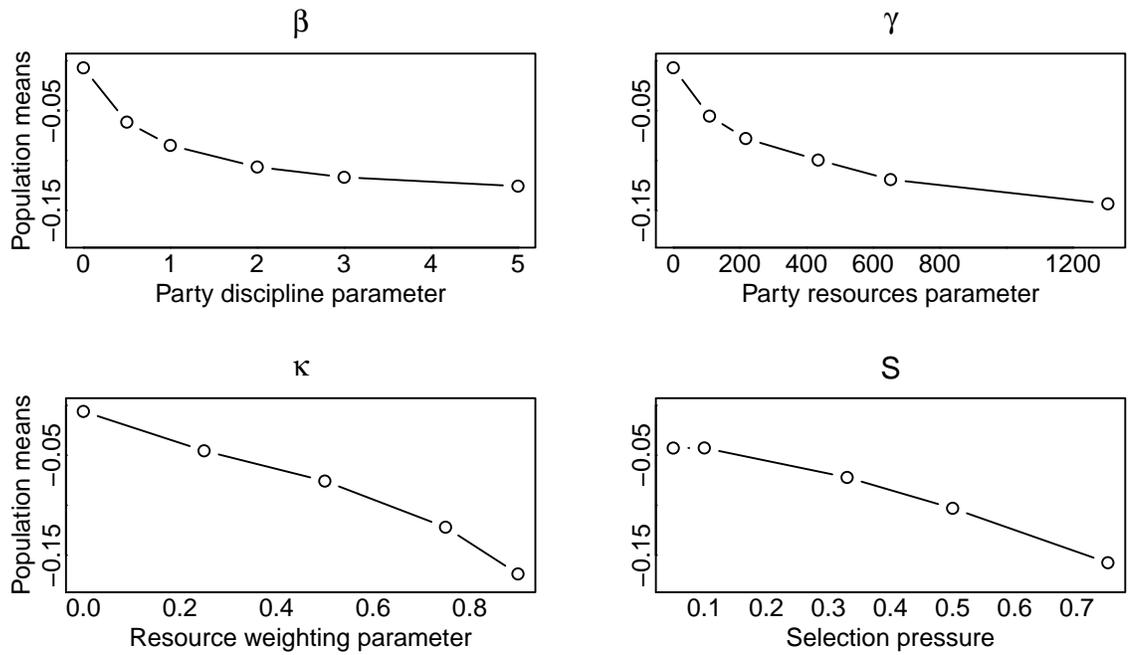
(a) Population means
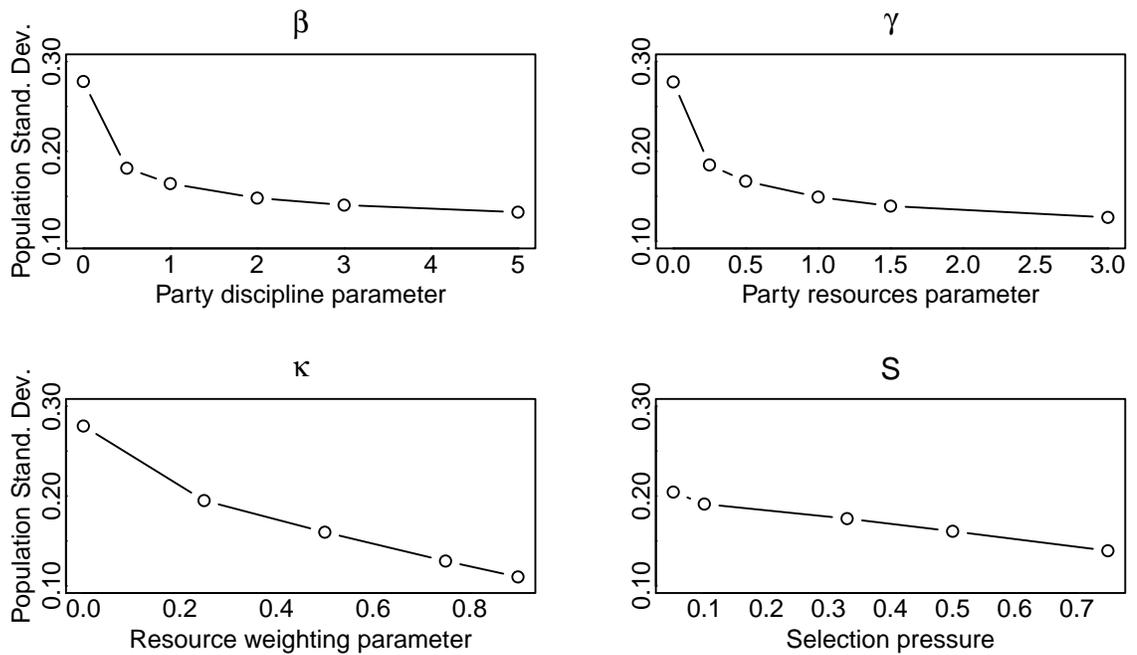
(b) Population standard deviations

FIGURE 2.9: Parameters and population means and SD's for label maintenance model

point agreed to in intra-party negotiations (e.g., Roemer 2001). However, the dominant interpretation in the literature is that this point represents the preferences of ideologically-motivated activists who tend to be more extreme than the median voters.[16]

Whatever the substantive interpretation, the new assumption of this model is that the party works to enforce *not* the endogenously determined party mean, which leads to path-dependent outcomes, but rather some exogenously determined (and constant) position in the policy space. Specifically, we can specify some party enforcement point $E \in \mathbb{R}^1$. The institutional parties follow the same method of distributing party resources as discussed in Section 2.4, but I alter how the distance (d_k) is calculated for each candidate in Equation 2.2. In this variant, I simply replace Equation 2.2 with $d_k = \|y_k - E\|^2$. Thus, party institutions work to favor individuals who are closer to the enforcement point, E, rather than the party mean or party label, $\bar{y}$.

This can be seen in the exemplar simulation shown in Figure 2.10. Here I use the identical parameter settings as in Figure 2.7 above, but with the party enforcement point set to $E = -0.4$. The figure shows that the candidate population swiftly converges to E rather than to either the position of the median voters or the initial distribution mean μ_c. Likewise, parameter settings that promote party discipline and strong party cohesion do not lead to increased levels of path-dependence, but rather to swift convergence to the point $E = -0.4$.

In general, when party institutions are sufficiently strong we will observe homogenous party populations that converge on E. To show this, I conducted a final set of simulations searching the parameter space identical to that considered in Section

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[16] I provide additional discussion of party activists in the two-party extension of the model in the next chapter.
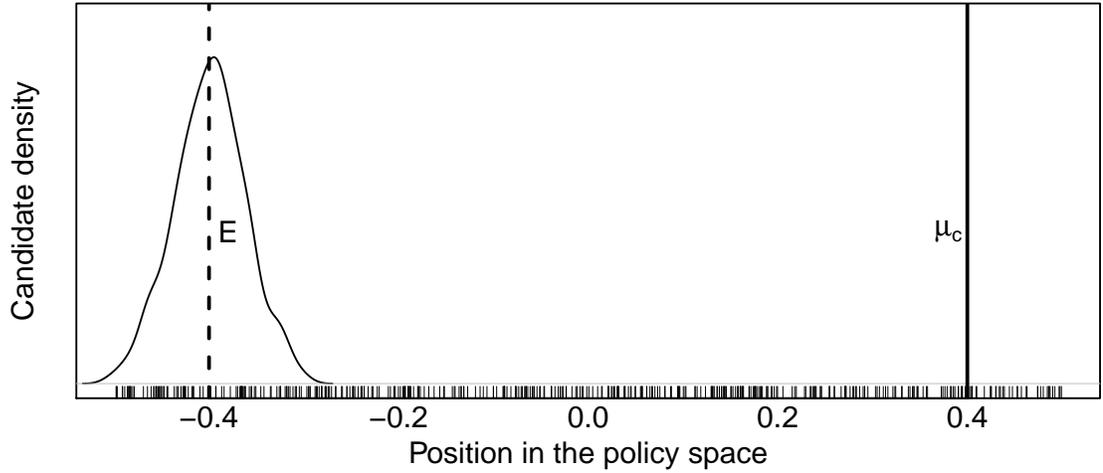
FIGURE 2.10: Exemplar distribution of candidates after 100 elections with an exogenously determined party enforcement point. The parameter settings used are $E = -0.4$, $n_d = 435$, $\rho = .05$, $\mu_c = 0.4$, $\sigma_c = 0.1$, $S = 0.75$, $\beta = 2$, $\gamma = 435$, $\kappa = 0.5$, $a = -0.5$, $b = 0.5$.

2.4.[17] In these simulations, although the initial population mean is $\mu_d = -0.4$, the point in the policy space rewarded by the party is located at $E = 0.4$.

Given the basic logic of this final model, the expectation is that β, γ, κ, and S should have a positive relationship with the population mean. Higher values of these parameters aid enforcement of the enforcement point, E, and overcome both the initial distribution of candidates and the selection pressure exerted by voters. Figure 2.11a shows this to be true. However, just as in Section 2.4.2, there should be a negative relationship between these parameters and intra-party heterogeneity. This is demonstrated in Figure 2.11b.

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[17] This includes: $S = (0.05, 0.1, 0.33, 0.5, 0.75)$, $\rho = (0.01, .033, 0.05, 0.1)$, $\beta = (0, .5, 1, 2, 3, 5)$, $\gamma = (0, 108, 217, 435, 642, 1305)$, $\kappa = (0, .25, .5, .75, .9)$, and $\sigma_d^2 = (.25, .5, 1, 2, 3)$. I again limit the parameter space by setting $\mu_d = -0.4$, $n_d = 435$, $a = -0.5$, and $b = .5$ for all simulations and running each model for only 50 elections in each case. I ran the model five times for each parameter setting, leading to a total of 90,000 total simulations.
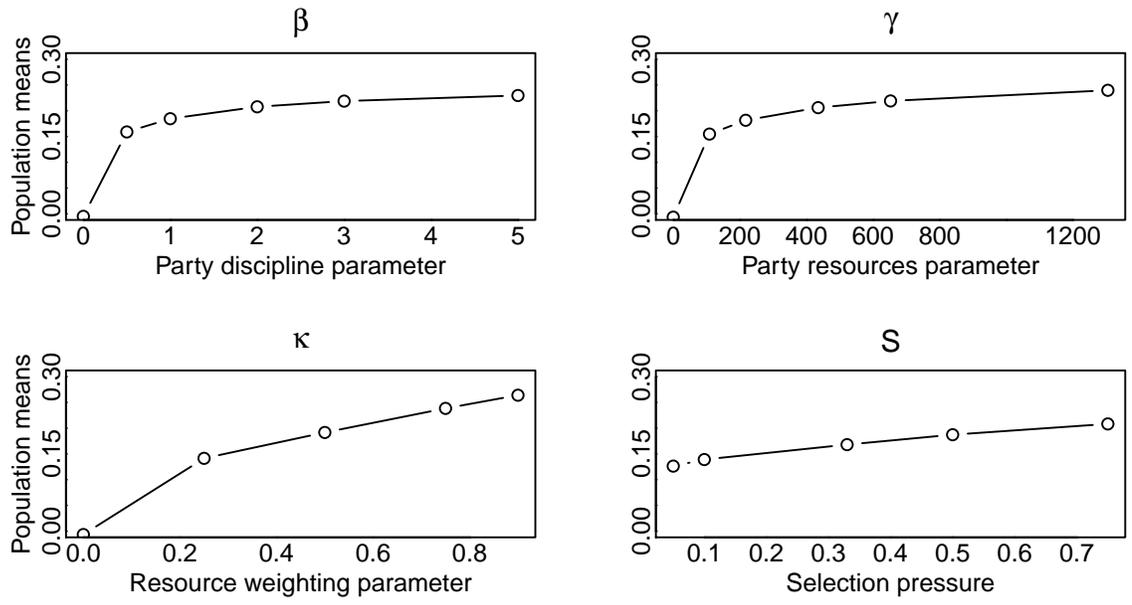
(a) Population means
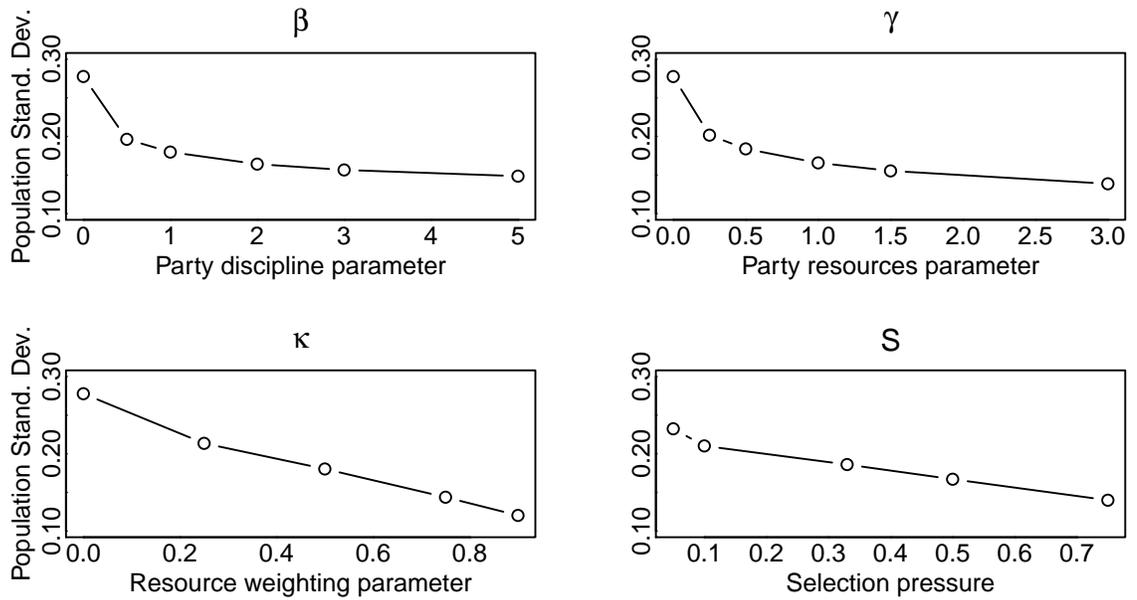
(b) Population standard deviations

FIGURE 2.11: Parameters and population means and SD's for the exogenous party enforcement point model

2.6 Conclusion

In this chapter I aimed to accomplish two interwoven tasks. First, I explored the conditions under which collections of candidates who share a common party label might usefully be described as a population in an evolutionary sense. I have shown that one way that this can be accomplished is by assuming that all individual candidates face identical electoral pressures and compete in identical electoral districts. This is the implicit assumption of past scholarship that has conceived of parties as an evolutionary system of "genetic algorithm." However, in the absence of this strict homogeneity assumption, additional institutional structure is necessary. In particular, I have shown that institutions designed to either enforce the party signal (the mean position of current candidates) or some exogenously determined enforcement point leads to population behavior. It is only in the presence of institutions that foster intra-party competition for resources that population dynamics exist.

However, in the broader context of this thesis, this chapter serves the additional purpose of laying a foundation of a basic vocabulary and structure for modeling American party competition as an evolutionary system. Thus far the model is restricted to a single political party and a single policy dimension. Moreover, in the exogenous party enforcement model, the current framework provides little insight into where these enforcement points might come from and how they might change over time. This is a serious inadequacy given my prior claims that evolutionary models are particularly useful in the context of studying party dynamics.

In the following chapters I relax these assumptions and develop a more general model. In Chapter 3, I extend the enforcement-point model to encompass two-party competition. I then endogenize the location of the enforcement point by the addition party activists in the sense of Aldrich (1995) and Schofield (2004). In Chapter 4, I then consider the behavior of the model in multiple dimensions, with particular

attention to how and why parties might alter their positions in a higher-dimensional space. I conclude, in Chapter 5, with an empirical application to the case of abortion politics in the late 20th century.

3

Candidates, Activists, and the Parties: One-Dimensional Evolutionary Models of Two-Party Competition

Many cases are on record showing how complex and unexpected are the checks and relations between ... beings, which have to struggle together in the same country.

– Charles Darwin (2004, 67)

3.1   Introduction

The main thesis of this dissertation is that theoretical models based on evolutionary principles can explain the seemingly strategic macro-level behavior of political parties based on micro-foundations more consonant with reality than traditional unitary-actor rational choice models. Model predictions rest not on the assumption that parties are directed by unitary rational agents, but rather upon the premise that selection acting at the candidate level leads to adaptive behavior at the emergent population level.

However, the theoretical models discussed in Chapter 2 are too far removed from actual American party competition. Although these simple models serve the limited

purpose of explaining the conditions under which selection pressures lead collections of candidates congeal into emergent populations, they lack basic features of American politics. This both prevents empirical validation and defeats any justification based on claims of greater realism. This chapter, therefore, serves as another stepping stone towards building a satisfying theoretical model capable of illuminating and explaining important real-world phenomena.

In this chapter, I extend the model to incorporate two critical facets of American politics. First, the models in Chapter 2 lack inter-party competition. In those models, candidates win or lose based only on relative intra-party performance. That is, I exogenously introduce selection pressure and assume that the worst-performing candidates are culled by some unspecified mechanism. In reality, candidate selection is the result of competition between members of (at least) two distinct parties. Representing this aspect of reality requires revising the model to (1) introduce additional parties and (2) amend the model's assumptions regarding selection. This is the task of Section 3.2.

Second, the models in Chapter 2 demonstrate that population behavior will only emerge in the presence of institutions designed to enforce specific points in the policy space. In particular, I show that homogenous party populations are likely to emerge when institutions reward candidates who take positions near some exogenously determined point in the policy space. In my previous discussion, I suggested that these enforcement points might be the policy positions most pleasing to supportive party activist. However, the models simply assume the existence of both an activists base and party resources. That is, there is no direct linkage between the positions that party populations take and the behavior of activists. In Section 3.3, therefore, I extend the two-party model to include party activists, drawing on previous theoretical work by Aldrich and McGinnis (1989) and Schofield (2004).

To preview the results below, the extended models show that two-party compe-

tition provides the necessary selection pressures needed to foster the emergence of coherent and distinct party populations. However, this will only be the case when: (1) party resources are valuable for winning elections; (2) the distribution of party resources are sufficiently biased; and (3) parties have sufficient resources. In the model discussed in Section 3.3, these resources must come from party activists. However, population dynamics will still result in the activist model so long as the activists themselves have sufficient resources.

For both of the models below, I present the results of extensive simulation studies. This includes the presentation of results from exemplar simulations as well as discussion of the relationship between exogenously determined parameters and model outputs. As part of these analyses, I examine the stability, sensitivity, and replicablity of the models. Do the models make similar predictions across multiple simulations (using the identical parameter settings)? Do model outputs vary considerably over time within a single simulation? Section 3.2.2 includes a detailed discussion of the methodological issues inherent in characterizing outputs in this non-deterministic model. I find that it is relatively straightforward to characterizing the model outputs in a precise way, although some care is needed in parameterizing outputs. I give significant space to these issues in this chapter both because they are important for demonstrating the usefulness of the evolutionary modeling paradigm and because the stability results shown below are applicable to the multi-dimensional model discussed in the next chapter.

It is important to note that the purpose of this chapter is to continue the gradual accumulation of theoretical results within this class of evolutionary models. My goal is to build yet another layer in my modeling edifice, with the penultimate theoretical statements to be made in the next chapters. Thus, the aims of the chapter are internal to this dissertation, and I do not seek to compare the results below to existing single-dimensional models of two-party competition. Nor do I intend this

chapter to constitute yet another contribution to the now bloated literature on party polarization in a single-dimensional setting (c.f, Grofman 2004). I leave discussion of the relative contributions of the evolutionary approach to Chapters 4 and 5.

3.2   A simple two-party evolutionary model of party competition

In this section, I alter the models presented in Chapter 2 to incorporate inter- as well as intra-party competition. The model is sufficiently different from those presented earlier to justify outlining the model's details in their entirety. This is the task of Section 3.2.1. However, for the sake of brevity, I provide little theoretical or empirical motivation for some of the the more unusual assumptions (e.g., stable candidate positions and the mechanisms of candidate recruitment). More detailed justifications for these assumptions are available in Chapters 1 and 2. In Section 3.2.2, I present simulation results from the two-party model.

3.2.1   Model details

Voters. As before, the model contains two types of agents – candidates and voters. There are n_d median voters divided evenly into n_d electoral districts whose ideal points $x_j \in \mathcal{X} \equiv [-a, a]$ are distributed uniformly across the interval $[-a, a]$. Voters' utility for candidates are determined both by the positions of candidates in the policy space and the amount of resources they can bring to bear on the elections (i.e., endogenous "valence"). The utility of voter j for candidate k in party Θ who has a position in the policy space y_k^θ and resources ν_k^θ is $U_{jk}^\theta(x_j, y_k^\theta, \nu_k^\theta) = \kappa\nu_k^\theta - (1 - \kappa)\|x_j - y_k^\theta\|^2$, where $\kappa \in [0, 1]$ is the "resource weighting" constant and $\|.\|$ is the usual Euclidean norm.

   Candidates. As this is explicitly a model of American party competition, I assume there are two parties denoted Θ and Ψ. There are n_d candidates in each party (one for each district), and the position of candidate k from party Θ in the policy space

is $y_k^\theta \in \mathcal{Y} \equiv \mathbb{R}^1$. To begin the simulations, I assume that candidates are distributed randomly according to the normal distribution, $y_k \sim N(0, \sigma_c^2)$.

Elections and retirement. In every iteration of the model, voters evaluate the candidate from each party standing for election in their particular district. The least-preferred candidate in each district is removed and the most-preferred candidate becomes the incumbent for that district (and maintains her affiliation with that district in future iterations). In addition, r percent of incumbents in each election cycle are chosen at random for retirement.[1] Thus, I term r the "random retirement" parameter. Since the logic of my model prioritizes the *replacement* of candidate populations, I think it is important to allow for candidate replacement that occurs for non-political reasons. Elected officials may die, get arrested, have affairs, or otherwise leave office for reasons totally unrelated to their policies. Karol (2009) notes that retirement rates in the House are almost never below 5% for either party in any year.[2]

Candidate repopulation. Once the candidates and retirees are removed, each party is re-populated back to size n_d such that there is again one candidate from each party in each district. New candidates, k', take the policy-positions of a randomly selected own-party incumbent, k, with some random error ϱ. Thus, $y_{k'}^\theta = y_k^\theta + \varrho_k$, where $\varrho \overset{iid}{\sim} Uniform(-\rho, \rho)$.[3]

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[1] For convenience in the simulations, there is no random retirement within parties where the total number of incumbents is less than rn_d.

[2] As will be seen, this parameter plays almost no role in determining important model outputs. Nonetheless, it does speed "convergence." In any case, it is an easy facet of reality to include in the model.

[3] In some instances (very early in the simulation) one of the parties may lose every election and effectively become extinct. In these cases I restart the extinct population as a normal distribution around the party's enforcement point with variance 0.1. That is, if party Θ goes extinct, the entire population is regenerated as $y_k^\theta \sim N(E^\theta, 0.1)$. In all of the analyses below, I have calculated estimates excluding simulations with extinction events and could detect no substantial differences. In no cases that I have examined have extinctions occurred after the "burn-in" period of 1,000 iterations.

Institutional parties. As before, institutional parties serve to enforce an exogenously determined point in the policy space that I assume is preferred by some party principal or party activists. For the moment, I assume that these points are located symmetrically around zero (this assumption is relaxed in the next section). Thus, the "party enforcement parameter" for the two parties is defined by $E \equiv E^\theta = -E^\psi$. Likewise, I assume that the parties each have an exogenously determined budget of resources to allocate amongst candidates that is assumed (for the moment) to be equal. That is, $\gamma \equiv \gamma^\theta = \gamma^\psi$. Let $d_k^\theta = \|y_k^\theta - E^\theta\|^2$ be the squared distance between candidate k and the party enforcement point. The amount of party resources allocated to candidate k is then equal to $\nu_k^\theta = n_d \gamma^\theta \frac{\lambda_k^\theta}{\sum_k \lambda_k^\theta}$, where $\lambda_k^\theta(d_k^\theta, \beta) = (1 + d_k^\theta)^{-\beta}$, and $\beta \in [0, \infty)$ is the "party discipline" parameter.

Simulation sequence. For convenience, Table 3.1 lists the model parameters and their interpretation. After the agents are initialized, the model repeats the following sequence.

1. Institutional parties distribute resources.

2. Voters evaluate the candidate in their district.

3. The least-preferred candidate in each district is removed.

4. r% of incumbents are randomly selected to retire.

5. New candidates enter the system and mimic (with some level of imprecision) the position of surviving incumbents.

3.2.2 Simulation results

As in Chapter 2, selection pressure from two-party competition leads to emergent population behavior. However, the distribution of candidates is highly dependent

Table 3.1: Model parameters and interpretations for Section 3.2

Symbol	Interpretation and meaning
a	Voters are distributed uniformly across the interval $[-a, a]$.
E	The positions of the party enforcement parameters for the parties are $E \equiv E^\theta = -E^\psi$.
ρ	The "screening parameter" indicating the amount of error that occurs when new candidates enter and mimic the position of some existing own-party candidates with higher values indicating less screening.
β	The "party discipline" parameter in determining the degree of bias in the distribution of party resources. Higher values indicate greater discipline.
κ	The "resource weighting" controlling how much voters weight resources versus spatial proximity in determining their votes. Higher values indicate a greater weight towards resources.
γ	The "party resources" parameter indicating the total budget of resources *per district* available to the party.
n_d	This indicates number of districts and candidates.
σ_c	The standard deviation of the distribution of the initial distribution of candidates.
r	The percent of incumbents in each party who are randomly retired in each iteration.

on the parameter settings of the model. The two parties may diverge into highly homogenous groups located near the party enforcement points E^θ and E^ψ. Alternatively, they may become highly diffuse across the interval $[-a, a]$ and virtually indistinguishable from each other. Finally, we may get intermediate outcomes wherein the candidate populations are still distinguishable (i.e., not distributed identically), but

are relatively more heterogenous with their mean positions relatively closer together.

For the purposes of this discussion, I categorize these outcomes as: *divergent-homogenous*, *diffuse-convergent*, and *intermediate*. (Although the model outputs indicate that there is a continuum of outcomes rather than discrete categories, these groupings aid discussion.) Examples of outcomes in each category are displayed in Figure 3.1. Each panel in this figure shows the final distribution of candidate populations after 200 election cycles. Within each of the panels, the model was run five times under identical parameter settings.[4] Thus, the differences within the panels reflect the inherent instability in the predicted distribution of the candidate populations for the various parameter settings.

Figure 3.1a is an example of a divergent-homogenous outcome. For these simulations, I have assumed that there is strong party discipline ($\beta = 2$), that voters care about party resources ($\kappa = .4$), and that each party has significant resources to allocate amongst candidates ($\gamma = 1$).[5] The figure shows that, under these settings, candidate populations are tightly clustered near the enforcement points (E^θ and E^ψ). In addition, the candidate distributions are very similar across runs of the model.

Figure 3.1b shows the other extreme. In these simulations, I assume that voters do not care at all about candidate resources ($\kappa = 0$), which implies that party discipline and party resources are also irrelevant.[6] The figure shows that the populations are distributed uniformly across the distribution of voters. Moreover, the mean candidate position for each party is identically located at zero.

Finally, Figure 3.1c shows an intermediate outcome. In these simulations, I assume that voters care only slightly about candidate resources ($\kappa = 0.2$), party discipline is still rather high ($\beta = 2$), but parties have modest resources to distribute

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[4] A new random seed was selected for each model run.

[5] The remaining parameter settings are $\rho = .05$, $\sigma_c = 3$, $r = 10$, and $n_d = 435$.

[6] The other parameter settings are the same as noted above.
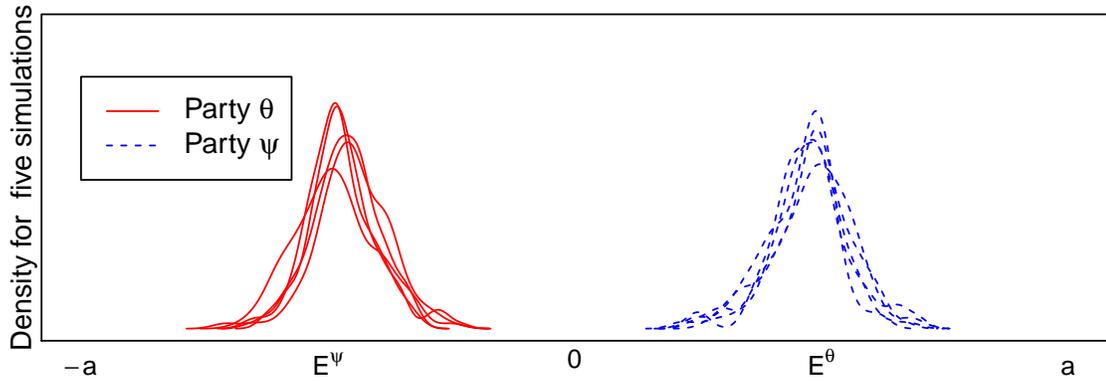
(a) Divergent-homogenous outcome
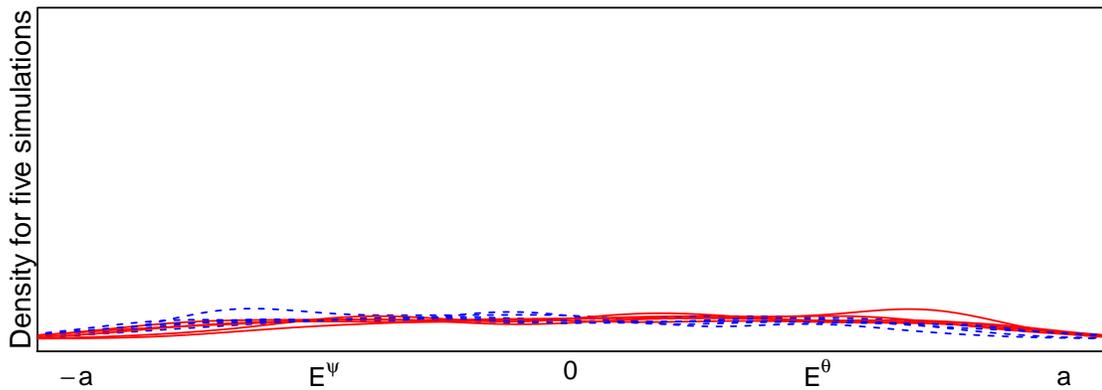
(b) Convergent-diffuse outcome
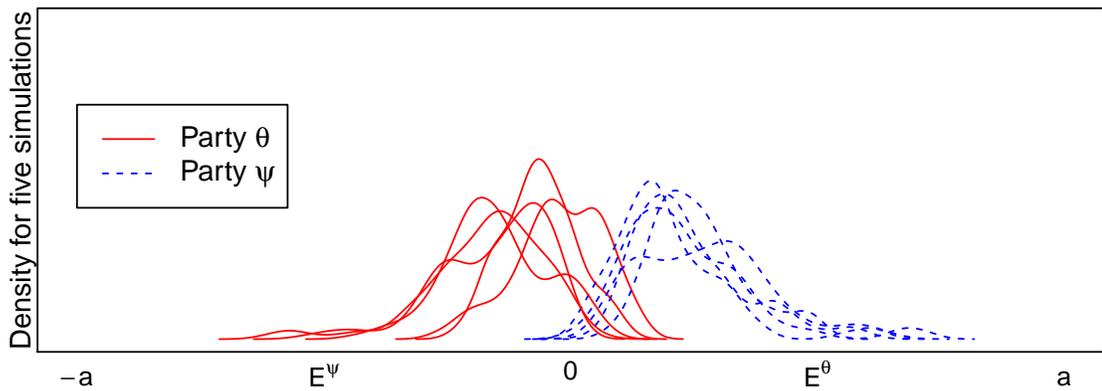
(c) Intermediate outcome

FIGURE 3.1: Example distributions from the simple two-party model after 2,000 elections have elapsed

($\gamma = 0.5$). The plot shows that the predicted candidate distributions are located "in between" the center of the space at zero and the party enforcement points. Moreover,

there is considerable between-simulation variation in the predicted candidate distributions. Each run of the model predicts very different distributions of candidates in each party and different locations for the mean party positions.

Figure 3.1, provides a basic orientation to the model. The next step is to conduct a large number of simulations to characterize the model's predictions. From a substantive point, the primary questions of interest relate to the predicted means and variances of the two candidate populations (i.e., the model outputs) and their association with key parameter settings (i.e., model inputs). For instance, we would like to be able to make generalized statements such as "when parties have more resources they are more homogenous." To accomplish this, I ran the model under a wide variety of parameter settings, and the results will be presented below. However, before embarking on an analysis of these simulations, it is first necessary to discuss the appropriate way to characterize outputs from dynamic models (such as this one). This is the topic of the next sub-sections. I will return to a discussion of the simulated outputs below.

Important concepts for model analysis

My theoretical goal is to characterize the relationship between assumed values of model parameters (e.g., κ, β, or γ) and model outputs of substantive interest. In particular, I am interested in the mean position and intra-party variances of party populations. What changes in parameter values will lead the parties to diverge? What parameters lead to increased (or decreased) levels of within-party homogeneity?

However, it is not immediately obvious how we can characterize outputs in this dynamic model. The predicted distribution of candidates may change dramatically *across* simulation runs (i.e., the results shown in Figure 3.1c). Model predictions may also vary significantly *within* a single simulation (e.g., the mean position of the

parties sometimes varies considerably over time within a single simulation run). How can we characterize model outputs under these circumstances? Offering a precise answer to this question is vital because if we are to make meaningful statements (e.g., "increased party discipline is associated with party divergence") then we must meaningfully define the model's predictions despite instabilities.

Ideally (for the purposes of characterizing theoretical relationships) the variability in a model will follow certain rules that are determined by parameters. For instance, assume that we have some variable, x_i, produced by the the uniform distribution, Uniform$(-a, a)$. In this example, the uniform distribution is our model, a is the model input, and x_i is the model output of interest. We cannot say for certain what the next draw for x_i will be. It is inherently random. But we do know that it will exist somewhere on the interval $[-a, a]$. We also know that if we observe many realizations, $\mathbf{x} = (x_1, \ldots, x_n)$, this collection of observations will have a known mean value, $E(x) = \frac{a-a}{2} = 0$, that is defined by the model parameters. We can also say definitively that the expected value of $\mathbf{x}$ will be higher if the true model was actually Uniform$(-a + 2, a + 2)$. Thus, although there is randomness, we can make clear statements about the relationship between the predicted model outputs ($\mathbf{x}$) and model inputs (a). We cannot make perfect predictions about x_i, but we can make clear statements about the distribution of values x_i will take given specific parameter values.

Of course, in a computational model we will not be able to write down the distribution of possible outcomes. Instead, we will have to simulate from the model many times to gain accurate estimates of the distribution of outcomes likely to occur under specific parameter settings. There are two characteristics inherent in some stochastic dynamic models – both of which are present in the models in this dissertation – that simplify the task of characterizing relationships between model parameters

and outputs through simulation.[7] First, outputs from a dynamic model are easier to characterize if they are *stationary*.[8] Second, outputs from a model are far easier to characterize when the model is also *ergodic*. In the context of this model, we can say the outputs are stationary and ergodic if the long-run expected value of some model output is the same across multiple simulations that have different starting points and across the entire simulation regardless of its length.

How are these model properties helpful for characterizing model outputs? A stationary ergodic model is easier to study because we do not have to worry about running the model multiple times using different initial conditions (e.g., σ_c). Nor do we have to worry about sensitivity to nuisance parameters like the seed used by the computer to generate quasi-random numbers. If we run a model long enough under a given parameter setting, we can recover the full distribution of model outputs associated with that parameter setting. A certain set of outputs will occur with a specific frequency. This Monte Carlo sample characterizes the distribution of model outputs associated with specific parameter settings. For example, we can record the positions of the party means for many iterations in a specific simulation, and this will provide a complete picture of the distribution of predicted means associated with those particular parameter settings.

The next logical question is how we can establish whether this model is stationary and ergodic? Fortunately, this question has been studied extensively in Bayesian statistics, where Markov Chain Monte Carlo (MCMC) methods are used to simulate from probability distributions that cannot be calculated analytically. Below, I use standard diagnostics for convergence and stationarity from the MCMC literature to

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[7] A much more in-depth and technical description of the issues surrounding the characterization of complex dynamic models is provided by Laver and Sargenti (Forthcoming).

[8] Any series of observations is stationary if (1) it has finite variance, (2) the expected values of an observation at any given time period are identical, and (3) the covariance between any two observations x_t and x_s depends only on the difference between those two observations in time $(t-s)$ and does not depend on the particular values of t and s.

illustrate that these properties hold for my theoretical model (Gelman et al. 2004; Gelman and Hill 2006).[9]

Before moving on to model simulations, however, there are two practical points to discuss. First, since the initial positions of the candidates in the model are set exogenously, it may take several iterations for the candidate populations to arrive at their long-run distribution. Standard practice in MCMC analysis is to "burn-in" the simulation by ignoring all outputs produced before the simulations converge to the true distribution. Laver and Sargenti (Forthcoming) pay considerable attention to these issues in their analyses. This is not surprising since many of their models take tens of thousands of iterations to converge. However, as I illustrate below, this is not the case for the model presented above and only a modest number of iterations in each simulation need to be discarded.

Second, in some cases there may be high degrees of autocorrelation that prevent quick and efficient sampling of the long-run distribution of model outputs. For instance, the position of the party means at time t_{100} will tend to be pretty similar to the means at t_{101}. Thus, the model output at t_{101} has not provided us with much additional information about the long-run distribution of the model outputs. The problem of autocorrelation can be overcome simply by either (1) running the model for many iterations or (2) running the model many times using many starting values. I will use both solutions below. However, I note that high levels of autocorrelation are not a serious issue in these models (relative to other dynamic models in the literature). Standard MCMC diagnostics show that, with the exception of some of the more pathological intermediate outcomes, it does not take hundreds of thousands of iterations for the model to provide sufficient information about its predictions.

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[9] These methods do not *guarantee* that the model is stationary and ergodic, but are widely used and are sufficient for my purposes here.

Stability analysis

With these basic concepts in mind, I now turn to analyzing the stability of the model. As the discussion above indicates, there are three basic questions that I must answer. I summarize them and preview my answers as follows:

1. Is the model stationary and ergodic? (*Answer: Yes*)

2. How long must the model run for it to begin sampling from its long-run stationary distribution? (*Answer: Between 50 and 200 iterations*)

3. How long must the model run to adequately explore its long-run stationary distribution? (*Answer: It depends on the outcome category, but is usually less than 10,000 iterations*)

To answer these questions, it is helpful to begin by examining some examples of the long-run behavior of important model outputs. The top left panel of Figure 3.2 shows the dynamic trace of the population mean, $\bar{y}_t^\theta$, of party Θ for a divergent-homogenous outcome. The panel shows the trace-plots from three simulation runs with identical parameter values but different starting distributions and random seeds. The top right panel shows the distributions of $\bar{y}_t^\theta$ for each of the three simulations (after eliminating the first 100 iterations). Intuitively, we can draw three conclusions from these two panels. First, each of the chains appears to quickly converge to nearly identical points in the policy space. There is a very short "burn in" period for which the models are not converged to the long-run stationary distribution. Second, in each chain, the position of the party mean remains stable over a long number of iterations. Finally, there is very little difference between the the long-run distributions covered in each of the three simulations despite different starting values.

More formally, we can calculate the $\hat{R}$ statistic proposed by Gelman and Rubin (1992) to check for convergence of these three simulations. Roughly speaking, this
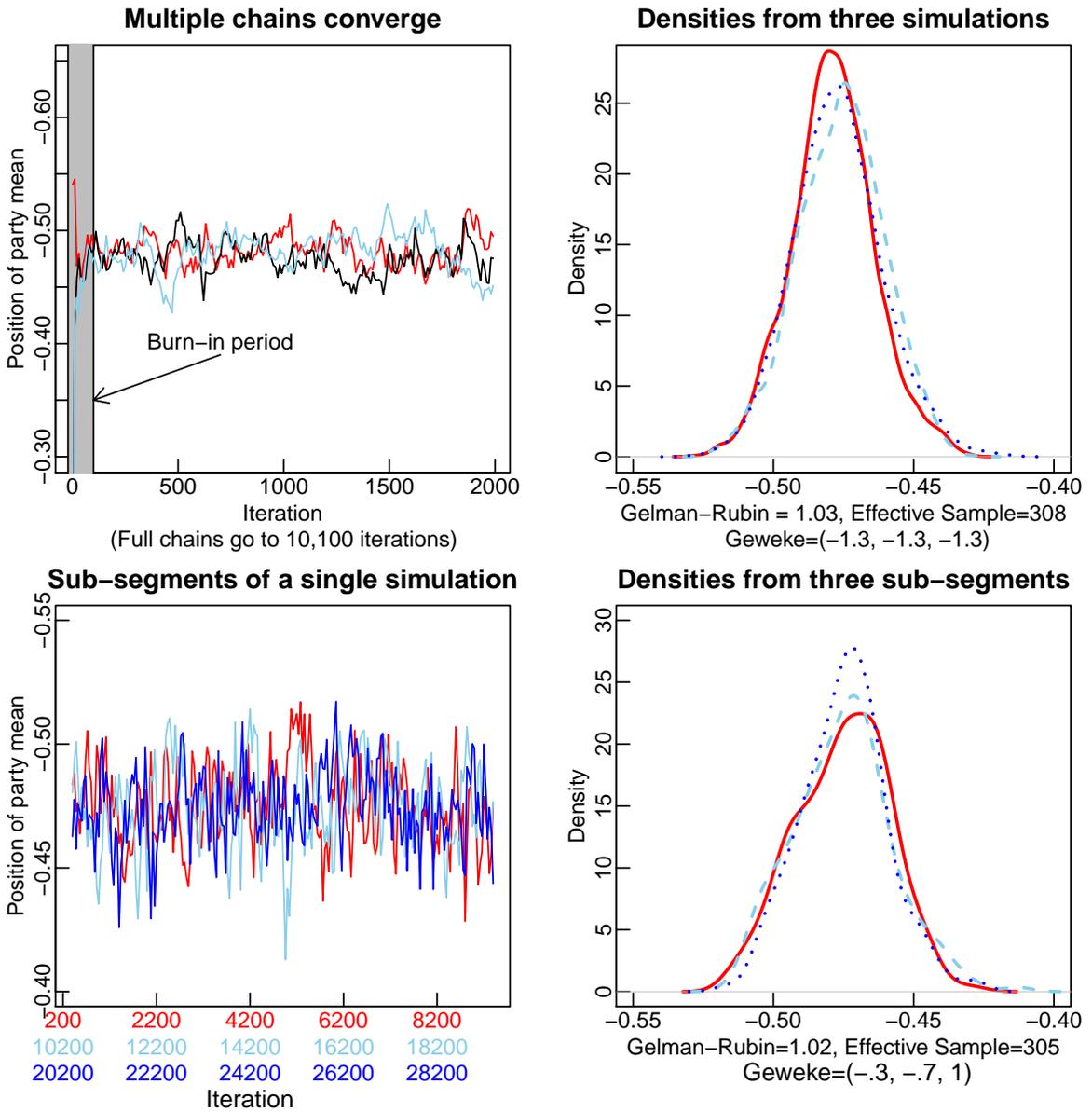
FIGURE 3.2: Long-run behavior of model outputs

statistic will approach 1 when and if the simulations are sampling from identical distributions. Discarding the first 100 iterations, the Gelman-Rubin statistic for these three simulations is 1.03, indicating strong convergence. Allowing the model to run much longer (e.g., 100,000 iterations) results in $\hat{R} = 1.00$. I also calculate the Geweke diagnostic for the difference in the sample means between the first and last

25% of the model outputs from each simulation (Geweke 1992). The diagnostic is a simple z-score, and values below 2 generally indicate a stationary distribution. The Geweke diagnostic statistics for these three chains are -1.3 in all cases. Finally, I calculate the "effective sample size" that estimates the number of truly independent samples included in the simulations after adjusting for autocorrelation (Gelman and Hill 2006). In MCMC analysis, an effective sample size greater than 100 is considered adequate. Here, we have an estimate of approximately $n^{adj} = 308$.[10]

Another way to examine this simulated data is to divide one long simulation run into three discrete sections. If the model output is ergodic and stationary, each of these segments should be roughly equivalent. The bottom-left panel shows the estimated means from a single simulation divided into three time periods $[(t_{200} - t_{9,200}), (t_{10,200} - t_{19,200}), (t_{20,200} - t_{29,200})$. The bottom-right panel shows the distribution of $\bar{y}_t^\theta$ for these periods. We can again calculate the $\hat{R}$ statistic, which in this case is 1.02. In addition, the Geweke diagnostic statistics for these component chains are sufficiently small and the effective sample size is approximately $n^{adj} = 305$.
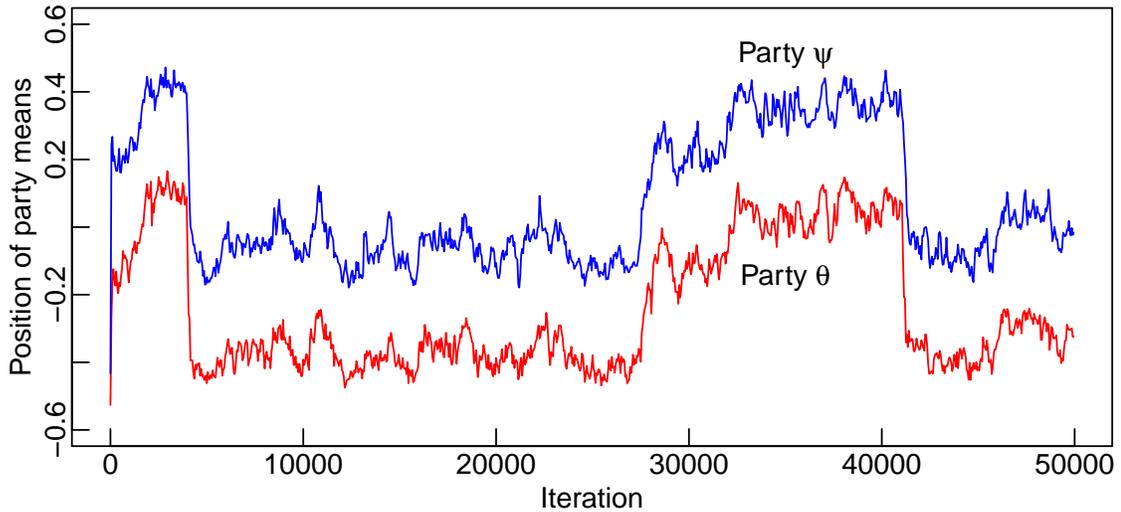
FIGURE 3.3: Position of party means for intermediate models

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[10] All of these calculations were made using the 'coda' package in R.

Judging only from the example in Figure 3.2, it seems that characterizing model outputs (such as party means) would be very straightforward. For each parameter setting, I could run the model for several thousand iterations and record the positions of the various model outputs of interest after discarding the first hundred or so iterations (i.e., the "burn in"). These samples would provide an accurate picture of the distribution of model outputs associated with each parameter setting of the model. However, the model is not so well behaved for particular parameter settings. Figure 3.3 shows the position of the two party means for an intermediate outcome model. The plot displays the output from 50,000 iterations. As can be seen, the position of the two parties is not constant across time. One party tends to locate in the middle of the policy space, while the other locates nearer its enforcement point. However, we cannot say for certain *which* of the two parties will be the centrist party and which will be more extreme. This tends to differ significantly over time (e.g., Figure 3.3) and across multiple runs of the model (e.g., Figure 3.2c). In the *very* long run the distribution of model outputs will converge. However, it takes almost 250,000 iterations to acquire an effective sample size greater than 100 due to the high levels of autocorrelation. Likewise, in several simulations I have examined it takes over 300,000 iterations before we can be assured that that multiple chains have converged.

However, it is possible to reparametrized model outputs in ways that allow for quick and efficient sampling, even in these pathological cases. The key is to choose model outputs that do not depend on accurately forecasting *which* party will be where. For instance, Figure 3.4 shows the model outputs for $|\bar{y}_t^\theta - \bar{y}_t^\psi|$, or the distance between the two party means. Importantly, Figure 3.4 shows simulation outputs from models run under the identical parameter settings as Figure 3.3 discussed above. The top two panels show model outputs for three separate simulations. The bottom two panels show model outputs for three sub-segments of a single long chain. The figure

shows that the reparametrized output behaves well and is easy to sample.
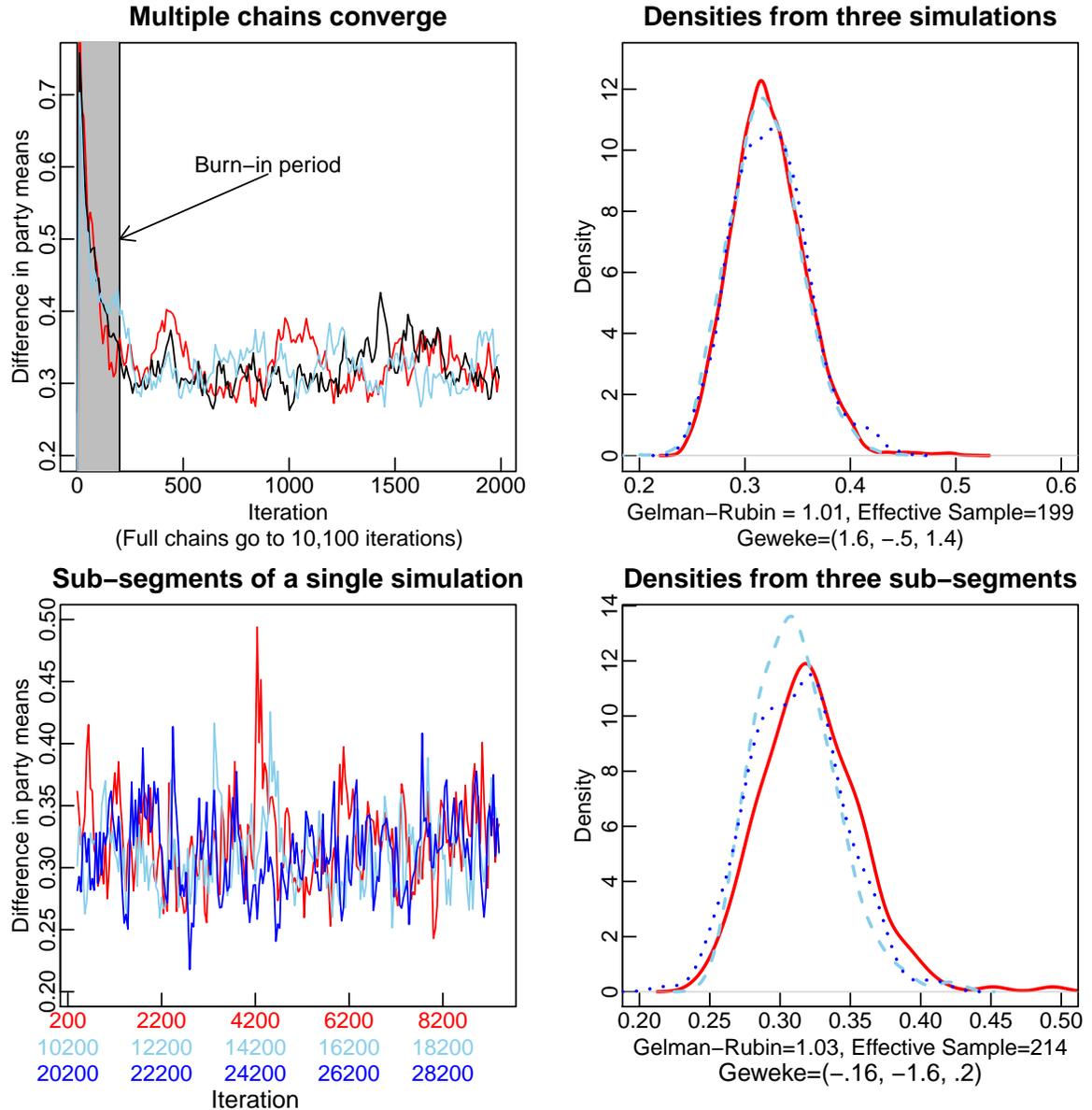
FIGURE 3.4: Long-run behavior of model outputs for intermediate outcomes

Based on the results presented above, as well as many additional analyses of individual models, I use the following procedure to analyze the model. For each parameter setting, I run the model for 10,500 iterations in three separate simulations. After discarding the first 500 iterations from each simulation, this results in 30,000

samples for each possible parameter setting. For computational reasons, I only add an observation to the overall dataset every 50 iterations (i.e., I "thin" by 50). Finally, I record the following model statistics:

1. $\bar{y}^\theta, \bar{y}^\psi$: The means of the two candidate populations

2. $\sigma_y^\theta, \sigma_y^\psi$: The standard deviation of the two candidate populations

3. $|\bar{y}^\theta - \bar{y}^\psi|$: The distance between the two party means

4. $\left((\sigma_y^\theta)^2 + (\sigma_y^\psi)^2\right)^{1/2}$: The total intra-party heterogeneity in the model.

Determinants of model outputs

With all of this behind us, it is finally possible to discuss the relationship between key model parameters and predicted outputs. To limit the size of the parameter space, I fix several parameters either based on empirical reality or because experience showed that they were not crucial for understanding the basic features of this model. In particular, I set the number of districts to $n_d = 435$, I fix the distribution of voters to the unit interval ($a = 1$), and fix the standard deviation of the the starting candidate population to $\sigma_c = 3$. The other parameters I considered were as follows:

- Party discipline parameter (β): $(0, 0.5, 1, 2, 3, 5)$

- Resource utility parameter (κ): $(0, 0.1, 0.3, 0.5, 0.8)$

- Party resource parameter (γ): $(0, .5, 1, 2, 3)$

- Random retirement parameter (r): $(5, 10, 15)$

- Party enforcement parameter ($E \equiv E^\theta = -E^\psi$): $(0.5, 0.75, 1)$

- The screening parameter (ρ): $(0.05, 0.1, 0.2, 0.33)$

In total, this analysis includes 16,200 simulations representing over 160 million iterations.

The first output I examine is party polarization ($|\bar{y}^\theta - \bar{y}^\psi|$). Figure 3.5 shows the mean value of party polarization across all simulations for six different parameters of interest. As can be seen, increased levels of party discipline (β) and increased party resources (γ) are associated with higher rates of polarization. In addition, polarization increases as a function of the degree to which voters care about party resources in determining their vote (κ). Finally, as we might expect, polarization is generally greater in simulations where the enforcement points are set farther apart (E). However, there is only a very modest relationship between polarization and either the "screening parameter" (ρ) and no relationship at all between polarization and the retirement rate.

Next, I turn to my measure of total intra-party heterogeneity, $\left((\sigma_y^\theta)^2 + (\sigma_y^\psi)^2\right)^{1/2}$. Figure 3.6 shows the mean relationship between key model parameters and this output. Both party discipline and party resources are negatively related to intra-party heterogeneity. The same is true for the "resource preference" parameter (κ). All of this indicates that as party institutions facilitate emergent party behavior and party divergence, intra-party homogeneity increases. Unsurprisingly, lower levels of party screening (i.e., increased values of ρ) also lead to more heterogeneous parties as shown by the bottom-left panel of Figure 3.6.

More interestingly, increased values of the party enforcement point ($E \equiv E^\theta = -E^\psi$) lead to higher levels of heterogeneity. Upon closer examination, it is clear that this relationship exists because it is more difficult for the system to arrive at stable divergent-homogenous configurations when the enforcement points are farther from the center of the distribution. Homogeneity tends to increase dramatically when these divergent-homogenous populations are arrived at swiftly and remain entirely stable; thus, more polarized enforcement points slightly increase heterogeneity.
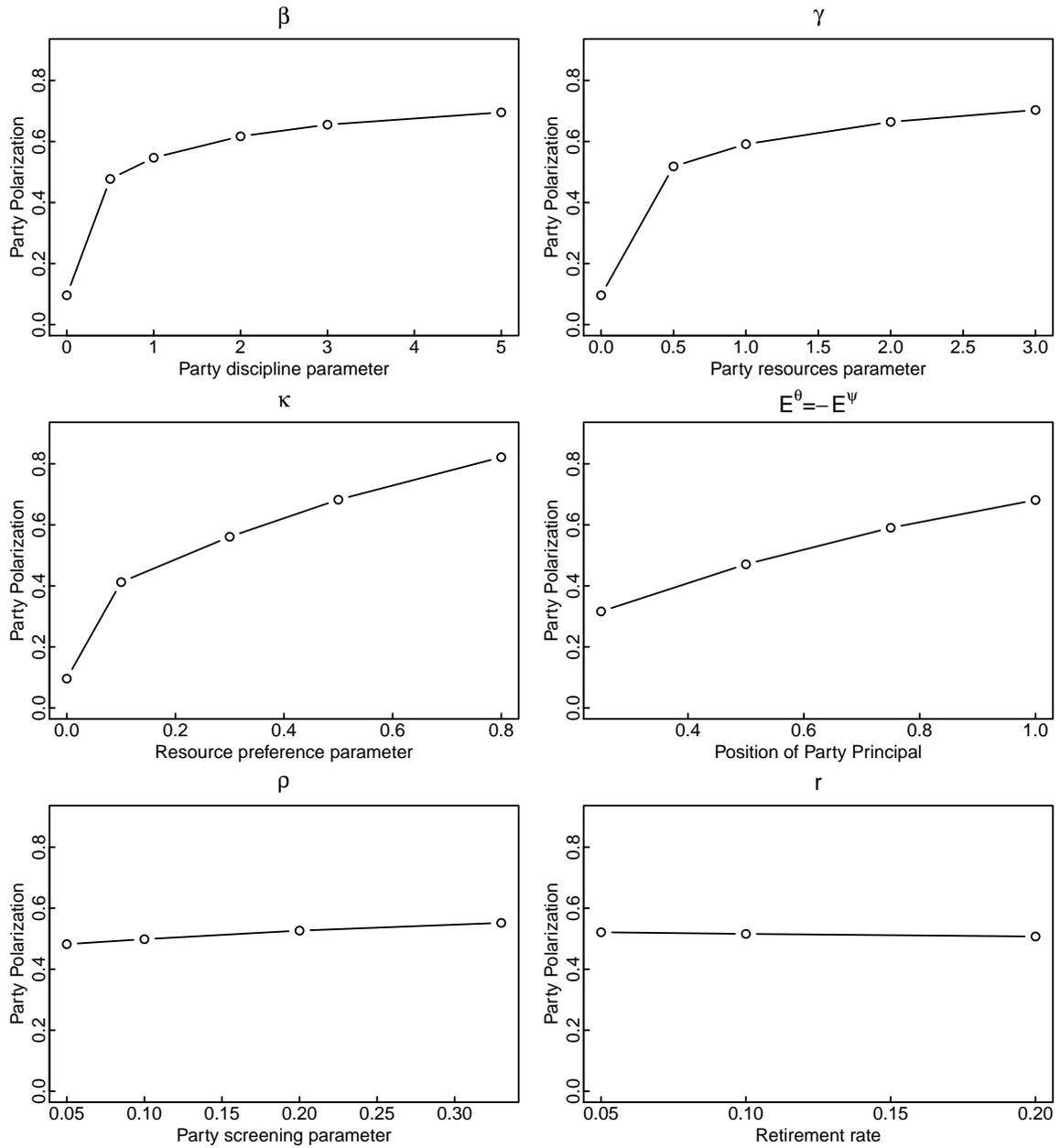
FIGURE 3.5: Key parameters determining party polarization

Higher rates of random retirement are also associated with lower levels of heterogeneity for similar reasons, although the relationship is very slight. Increased random retirement facilitates the rapid convergence to the long-run distribution and fewer deviances by individual candidates who happen to find positions very close to

their individual district median.
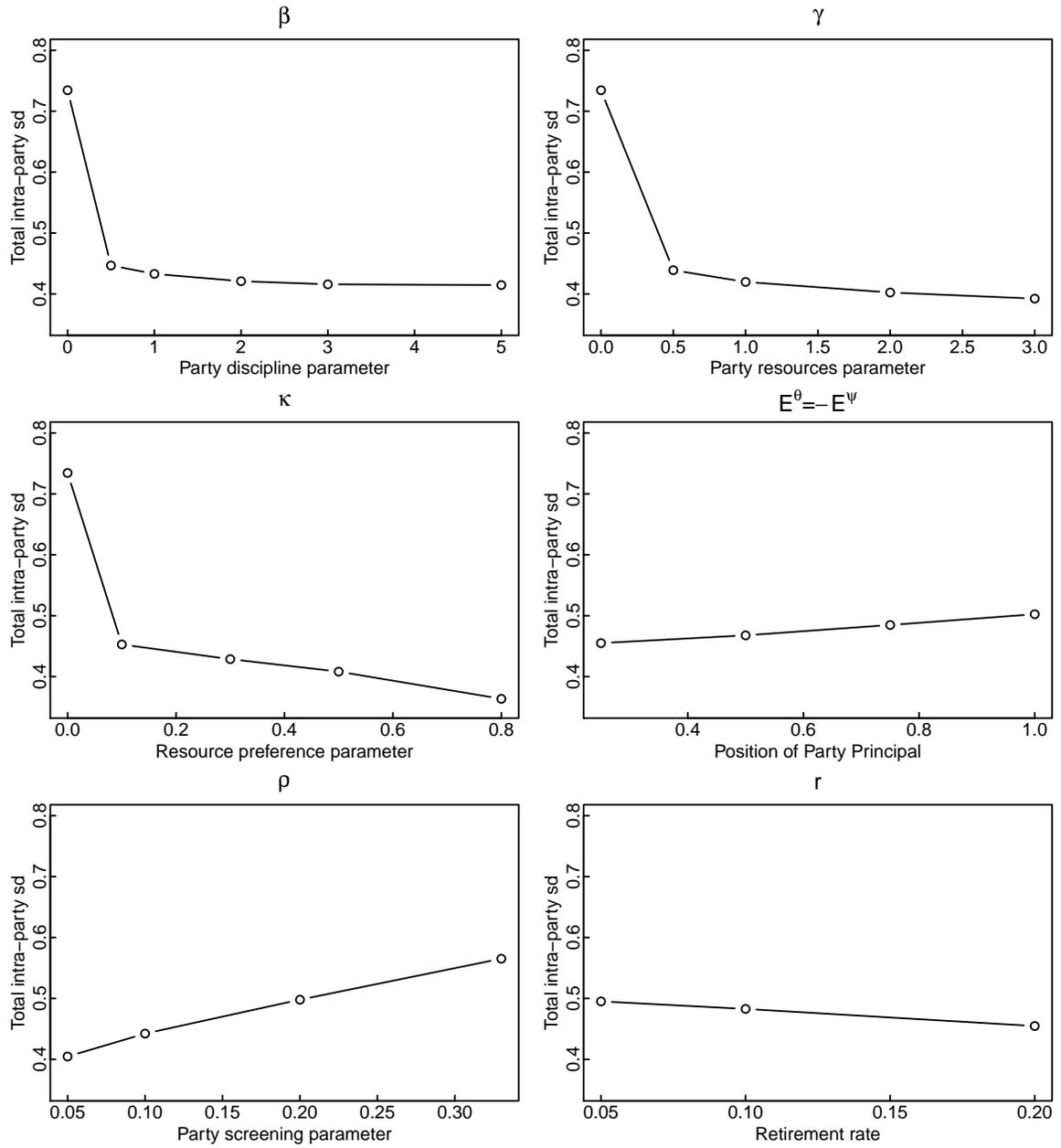
FIGURE 3.6: Key parameters determining total party variance

3.3 Policy-motivated activists and the origins of party resources

The analysis in Section 3.2.2 indicates, in part, that the predicted distribution of the two candiate populations in the policy space is heavily dependent on the enforcement points, (E^θ, E^ψ), and the amount of party resources that parties have to distribute $(\gamma^\theta, \gamma^\psi)$. Thus far, I have assumed that these are exogenously set parameters. The enforcement point represents the preferences of some individual or organized group of individuals who reward candidates taking particular policy positions. However, in the contemporary era of American politics there are many reasons to question the validity of these basic assumptions. In this section, therefore, I extend the above model to endogenize both the positions of the enforcement points and the origins of party resources.

The substantive motivation for extending the model is the incorporation of a crucial type of actor – *policy-motivated activists* – that many scholars believe play a crucial role in contemporary American party politics. In his review of party polarization in the United States, Fiorina (2005) states that:

> [T]here are vastly increased opportunities for Americans to participate in making ... laws. ... The problem is that relatively few people take advantage of those opportunities. Mostly, purists do. ... The problem is that people who care deeply also tend to have extreme views on the issues they care deeply about (Fiorina 2005, p 198-199).

The collective need for party candidates to please these activists is one of the most prominent explanations for the very existence of party institutions. As Aldrich notes:

> One of the tensions facing partisan candidates is the need to solve another collective action problem, that of generating the many activists needed to secure the labor and financial (and other) resources needed to achieve mobilization. This may yield tension, because the best appeal to activists may differ from what would best mobilize voters (Aldrich 1995, p 50).

Thus, to some extent, the very existence of party institutions is hypothesized to result from the need to satisfy the demands of policy-motivated activists. By this same

argument, it is specifically the concern for motivating activists to contribute needed resources that leads collections of candidates to move away from their respective district medians and emerge as distinct populations. "Thus if the party (meaning its resources – the time, effort, money, and such contributed by its activists) is sufficiently important, then the party will pull its nominee away from the overall center and toward the center of the party" (Aldrich 1995, p 191).[11]

In the remainder of this section I extend the the theoretical model described above to include policy-motivated activists. These activists are not inherently associated with a particular party, but rather develop their affiliation endogenously within the model. I assume that the positions that the parties choose to enforce (E^θ, E^ψ) are the mean position of affiliated activists. Moreover, the amount of resources each party has to distribute amongst candidates (γ^θ, γ^θ) depends on the level of participation amongst activists. That is, the party with more activists in any given period will have more resources. The details of the model are presented in Section 3.3.1, and the simulation results are covered in Section 3.3.2.

3.3.1 Model details

I define activists as any individuals or organizations that (1) have resources beyond their own votes that are valuable for winning elections and (2) would be willing to provide those resources to a candidate or party congruent with their policy views. This broad definition encompasses "groups" and issue advocacy organization (e.g., Karol 2009), wealthy backers (e.g., Ferguson 1995), or the more traditional activists studied in the political behavior literature (e.g., Aldrich 1995).

[11] Other works on American parties that prominently feature party activists include: Adams, Merrill and Grofman (2005); Aldrich (1983b,a, 1995); Aldrich and McGinnis (1989); Fiorina (1999, 2005); Hinich and Munger (1996); McCarty, Poole and Rosenthal (2005); Miller and Schofield (2003, 2008); Schofield, Miller and Martin (2003); Schofield (2004); Layman and Carsey (2002); Roemer (2001); Schattschneider (1960); Sundquist (1983); Wildavsky (1965); Wilson (1962) as well as several others.

Following Aldrich (1983a,b), I assume that all activists are only *potentially* active. They decide which party to support and whether to be active in response to the positions the parties take. That is, unlike Schofield (2004) and Adams, Merrill and Grofman (2005), I do not assume the prior existence of affiliated party activists.[12] Rather, these affiliations arise endogenously in the model.

The model assumes that there are n_a activists whose individual positions in the policy space, $z_j \in \mathcal{Z} \equiv [-b, b]$, are distributed evenly on the interval $[-b, b]$. In the simulations, I assume that activists are distributed (weakly) more widely in the policy space than the distribution of district medians ($b \geq a$). However, since voters are the median within each district, this does not necessarily imply that the overall distribution of activists in the space is more diffuse than the general distribution of voters.

Activists respond to the "party signal" rather than the positions of individual candidates. This is very much in keeping with the various presentations of the party signals, brands, or reputations in the literature (c.f., Aldrich 1995; Cox and McCubbins 1993, 2005; Hinich and Munger 1996; Snyder and Ting 2002; Grynaviski 2010). Party activists are assumed to be sufficiently sophisticated and attentive such that their primary motive is not in choosing a specific candidate but in forwarding an agenda through the mechanism of their chosen party (Layman et al. Forthcoming).

As in Chapter 2, the party signal is the aggregate position of all candidates who share the same label, which I operationalize as the mean candidate position (Snyder and Ting 2002). Thus, the party signal for party Θ is denoted $\bar{y}^\theta = \frac{\sum_k y_k}{n_v} \forall k \in [1, \dots, n_v]$.

More formally, activist z_j has an action set $A_j(z_j) = \{\Theta, \Psi, \emptyset\}$. In words, this means that activists may either support party Θ, support party Ψ, or abstain. The

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[12] Schofield (2004) allows that activists may choose whether or not to suport their party. However, they may not choose to switch parties.

utility of activist j for party Θ is

$$U_{j\theta}(z_j, \bar{y}^\theta) = -\text{logit}^{-1}\left(\|z_j - \bar{y}^\theta\|^2\right), \qquad (3.1)$$

The logistic function serves to facilitate activists' abstention due to both alienation and indifference (Aldrich 1983b).

The response function of activists is probabilistic, such that activists are less likely to participate at all if they are more indifferent between the two parties. Specifically,

$$P\left(A_j = \Theta\right) = \left(2|U_{j\theta} - U_{j\psi}| - 1\right) I[U_{j\theta} > U_{j\psi}] \qquad (3.2)$$

where $I[.]$ is the generalized indicator function. Symmetrically,

$$P\left(A_j = \Psi\right) = \left(2|U_{j\theta} - U_{j\psi}| - 1\right) I[U_{j\psi} > U_{j\theta}] \qquad (3.3)$$

and

$$P\left(A_j = \emptyset\right) = 1 - P(A_j = \Theta) - P(A_j = \Psi). \qquad (3.4)$$

As with Aldrich and McGinnis (1989), the model assumes that parties seek to enforce a point in the policy space that will most-please the policy-motivated activists upon whom they rely for winning office. Let $\bar{z}^\theta$ denote the mean position of all activists who are currently affiliated with party Θ. That is, $\bar{z}^\theta = \frac{\sum_j z_j I[A_j = \Theta]}{\sum_j I[A_j = \Theta]}$. Then, for the model described in Section 3.2, we set $E^\theta = \bar{z}^\theta$ and $E^\psi = \bar{z}^\psi$.

A final necessary assumption for the model is to specify how each party's budget $(\gamma^\theta, \gamma^\psi)$ relates to their activist support. The model asumes that the party has greater resources when it has more affiliated activist supporters. The amount of party resources available to party Θ is

$$\gamma^\theta = \tau \left(\frac{\sum_j I[A_j = \Theta]}{n_a} \right). \tag{3.5}$$

The portion of (3.5) in parentheses simply means the percent of all activists currently supporting party Θ. Thus, τ is an exogenously determined constant that is the maximum amount of resources per candidate a party could possess if every activist affiliated with that party.

Table 3.2: Model parameters and interpretations for activist models

Parameters for the model in Section 3.3

Symbol	*Interpretation and meaning*
a, b	Voters are distributed uniformly on the interval $[-a, a]$, while activists are distributed uniformly across $[-b, b]$
ρ	The "screening parameter" indicating the amount of error that occurs when new candidates enter and mimic the position of some existing own-party candidates
β	The "party discipline" parameter in determining the degree of bias in the distribution of party resources. Higher values indicate greater discipline.
κ	The "resource weighting" controlling how much voters weight resources versus spatial proximity in determining their votes. Higher values indicate a greater weight towards resources.
τ	The amount of party resources per candidate that would be available to a party if every activist affiliated with them.
n_a, n_d	The number of activists and districts/candidates, respectively
σ_c	The standard deviation of the distribution of the initial distribution of candidates
r	The percent of incumbents in each party who are randomly retired in each iteration

For convenience, Table 3.2 shows the key exogenous parameters for the activist model. The order of the simulations is as follows.

1. Activists affiliate with one of the parties or abstain.

2. Institutional parties distribute resources.

3. Voters evaluate the candidate in their district.

4. The least-preferred candidate in each district is removed.

5. r% of incumbents are randomly selected to retire.

6. New candidates enter the system and mimic (with some level of imprecision) the position of surviving incumbents.

3.3.2   Simulation results

Although there is a continuum of model outputs, I again use a rough categorization to facilitate discussion. First, there are again *divergent-homogeneous* outcomes. When there are strong party institutions, and when voters care about party resources (κ is large), two homogenous party populations emerge that are located near the mean position of supportive party activists (very near $\frac{-b}{2}$ and $\frac{b}{2}$). Moreover, these outcomes are characterized by relatively high levels of participation by activists. An example of such an outcome is shown in Figure 3.7a. The left panel shows the distribution of the two candidate populations after 2,000 iterations for five simulations of the model under identical parameter settings. The right panel shows the distribution of party activists who are currently affiliated with each of the parties.

Second, the parties may end up in a *convergent-diffuse outcome* when party institutions are very weak or if voters do not care about party resources. Just as in Section 3.2, both the groupings of candidates take diffuse positions across the interval

$[-a, a]$. The mean positions of the two parties are nearly indistinguishable and are located near the center of the space at zero. Not surprisingly, indifference leads to extremely low levels of participation by activists. An example of five simulations from such a model are shown in Figure 3.7b.

Finally, there are *intermediate outcomes*. Note that these differ significantly from the intermediate outcomes discussed in Section 3.2. In this case, the intermediate outcomes result in candidate populations locating somewhere in between the entirely divergent and convergent outcomes discussed above. The parties will tend to be moderately homogenous, but will be located closer both to each other and to the center of the interval $[-a, a]$. Unlike Section 3.2.2, it is impossible for one party to locate at the center while the other is in a position pleasing to their party activists (e.g., Figure 3.3). Candidates that are too moderate will alienate their own activist base and the party will lose valuable resources. Thus, the parties will "balance" and locate symmetrically around zero between their party base and the center of the distribution.

There is another important difference in these simulations relative to those reported in Section 3.2. Since the party enforcement points here are determined endogenously as the mean position of supportive activists ($E^\theta = \bar{z}^\theta$, $E^\psi = \bar{z}^\psi$), there is no way to predict which party will end up on the left and which on the right. That is, party Θ may end up affiliated with activists on the left or right depending on random events in the early stages of the simulation. Thus, while it is possible to predict the positions the parties are likely to take under given parameter settings, it is not possible to say which parties will take those locations.

A related point is that, especially for intermediate outcomes, the two parties may occasionally "switch" their location. That is, the party on the left may suddenly become the party on the right. This can occur when the two parties, due to the inherent randomness in their positions, temporarily cross over each other in the

(a) Divergent-homogenous outcome

(b) Convergent-diffuse outcome

(c) Intermediate outcome
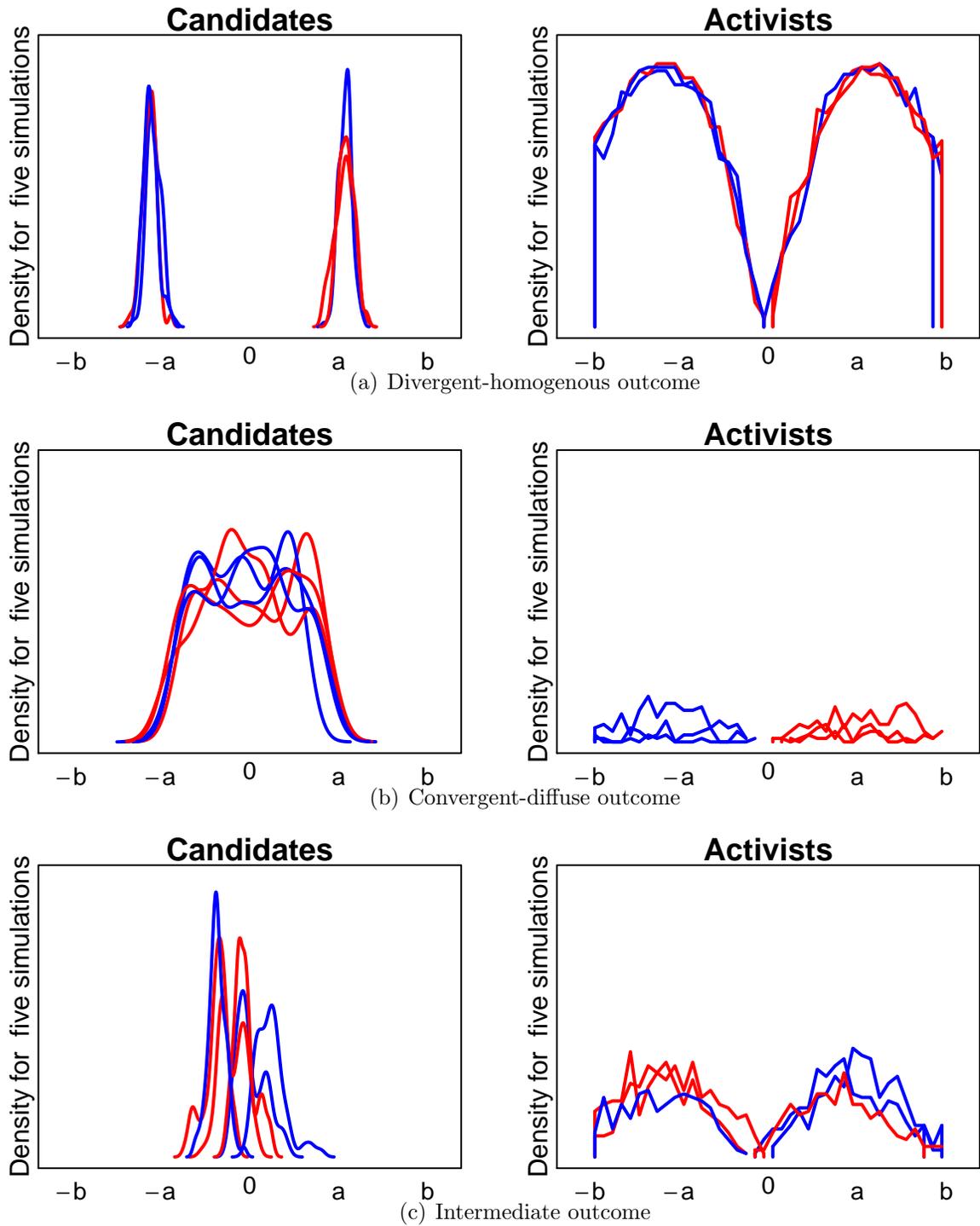
FIGURE 3.7: Example distributions from activist two-party model after 200 elections

space. This results in the instant transference of allegiance of activists from one party to another, and a shift in the location of the enforcement points. An example of this kind of output is shown in Figure 3.8. Thus, as before, I do not focus on model outputs about the position of specific parties (e.g., $\bar{y}^{\theta}$ and $\bar{y}^{\psi}$), but rather on outputs that are not sensitive to this kind of label switching (e.g., $|\bar{y}^{\theta} - \bar{y}^{\psi}|$ or $|\bar{y}^{\theta}|$).
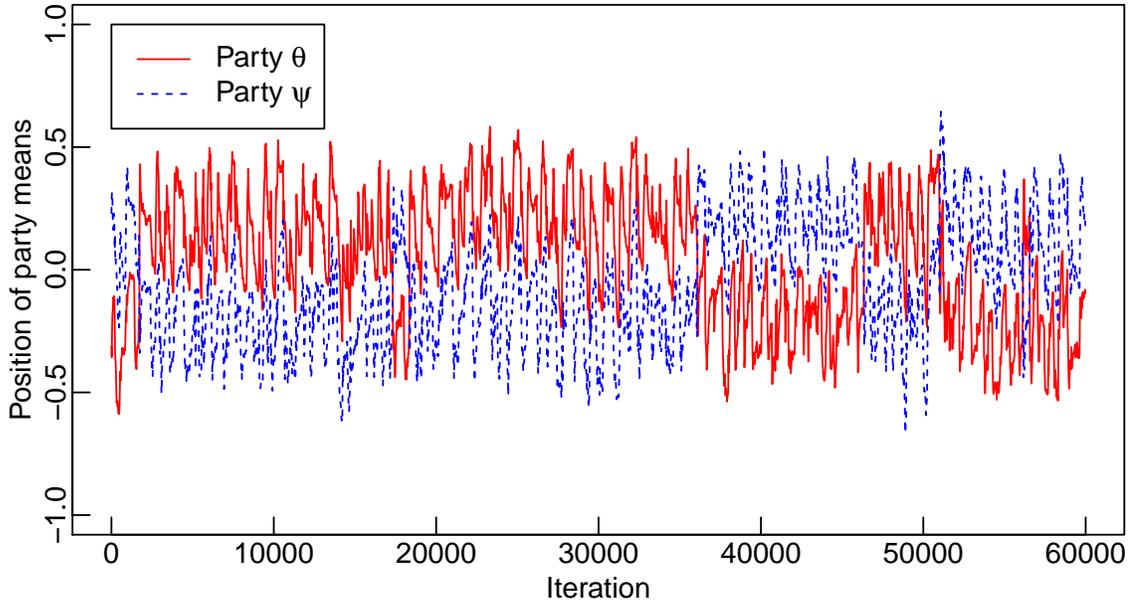
FIGURE 3.8: Example of "flipping" for intermediate outcome

Stability results

Before moving onto a full analysis of the controlling parameters in the activists model, I first briefly analyze its stability. Recalling the discussion of diagnosing models in Section 3.2.2, I conducted analyses on a number of model simulations. These analyses show that (correctly parametrized) model outputs are stationary and ergodic. On the other hand, these models take somewhat longer to converge to their long-run stationary distribution (usually between 100 and 1,000 iterations). Finally, there tends to be somewhat higher levels of autocorrelation, requiring roughly 20,000 iterations to recover sufficiently large numbers of truly independent samples.

For example, the top left panel of Figure 3.9 shows the dynamic trace of the absolute value of the population mean, $|\bar{y}_t^\theta|$, of party Θ for a divergent-homogenous outcome. As before, the panel shows the trace-plots from three simulation runs with identical parameter values but different starting distributions and random seeds. The top right panel shows the distributions of $|\bar{y}_t^\theta|$ for each of the three simulations (after eliminating the first 1,000 iterations). Again, we can safely conclude that the outputs from these three separate models converge to the same long-run distribution. The $\hat{R}$ statistics and Geweke diagnostics reported in Figure 3.9 confirm this intuition. In addition, the bottom two panels of the figure demonstrate that this model output is truly stationary as the distribution from different sub-segments of a single simulation are nearly identical.

Based on the results presented above, as well as many additional analyses of individual models, I use the following procedure to analyze the activist two-party model. For each parameter setting, I run the model for 21,000 iterations in three separate simulations. After discarding the first 1,000 iterations from each simulation, this results in 60,000 samples for each possible parameter setting. For computational reasons, I thin by 100. Finally, I record the following model statistics:

1. $|\bar{y}^\theta|, |\bar{y}^\psi|$: The absolute value of the means of the two candidate populations

2. $\sigma_y^\theta, \sigma_y^\psi$: The standard deviation of the two candidate populations

3. $\left((\sigma_y^\theta)^2 + (\sigma_y^\psi)^2\right)^{1/2}$: The total intra-party heterogeneity in the model.

4. $|\bar{y}^\theta - \bar{y}^\psi|$: The distance between the two party means

5. $|\bar{z}^\theta|, |\bar{z}^\psi|$: The absolute value of the means of activists supporting each of the parties

Multiple chains converge

Absolute value of party mean

Burn–in period

Iteration
(Full chains go to 21,000 iterations)

Densities from three simulations

Density

Gelman–Rubin = 1.01, Effective Sample=151
Geweke=(−.21, −.63, −.35)

Sub–segments of a single simulation

Absolute value of party mean

1500	4500	7500	10500	13500
14500	17500	20500	23500	26500
27500	30500	33500	36500	39500

Iteration

Densities from three sub–segments

Density

Gelman–Rubin=1.02, Effective Sample=102
Geweke=(−1.4, −.81, .31)

FIGURE 3.9: Long-run behavior of activist model outputs

6. $\gamma^\theta, \gamma^\psi$: The party resources available to the two parties, which also records the number of activists affiliated with each party.

Determinants of model outputs

I now turn to exploring the relationship between key model parameters and predicted outputs. To limit the size of the parameter space, I again fix several parameters for identical reasons discussed in Section 3.2.2.[13] In addition, I set $n_a = 4,000$, which is large enough to support stable model outputs, but not so large as to significantly slow computation. The other parameter values explored were as follows:

- Party discipline parameter (β): $(0, 0.5, 0.75, 1, 2, 3, 5)$

- Resource utility parameter (κ): $(0, 0.1, 0.25, 0.4, 0.5, 0.8)$

- Total available resource parameter (τ): $(0, .25, .5, 1, 2, 3, 5, 8)$

- Random retirement parameter (r): $(5, 10, 20)$

- Activist distribution parameter (b): $(1, 2, 3)$

In total, this analysis includes 31,752 simulations representing over 635 million iterations.

Figure 3.10 shows the relationship between key exogenous parameters and party polarization for the activist model. Largely, these results are identical to those described in Section 3.2, with the obvious exception that party resources are no longer determined exogenously. However, the new party resource parameter, τ, is still positively associated with polarization.

There are some differences here from those results reported above. For instance, there is only a weak relationship between the parameter controlling the distribution of activists and polarization, as is seen in the middle-right panel of Figure 3.10. This result is explainable as this parameter is highly interactive with the other parameters.

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[13] Specifically, I set $n_d = 435$, $a = 1$, and $\sigma_c = 3$.

Thus, it takes a higher setting of β to lead to complete party polarization when $b = 3$ relative to when $b = 1$. Thus, the bivariate relationship appears weak.

Figure 3.11 shows that the relationship between exogenous parameters and intra-party heterogeneity is exactly the same as described in Section 3.2.2. Parameter settings that facilitate strong party institutions (i.e., high values of β, τ, and κ and low values of ρ) all lead to greater homogeneity as the party populations look increasingly like the divergent-homogenous outcome shown in Figure 3.7.

Figure 3.12a examines the polarization between the two party activist means $|\bar{z}^{\theta} - \bar{z}^{\psi}|$. The panels show results for a reduced set of simulations where $b = 2$. The plots show that there is a very slightly positive relationship between activist polarization and: party discipline, activist resources, party screening, and voter weighting of party resources. However, these relationships are all relatively weak (note the scale on the y-axis). On the other hand, Figure 3.12b shows that there is a strong relationship between the polarization of activists and the overall distribution. Although this relationship is non-linear, there are generally higher levels of polarization when the underlying activist distribution is more diffuse.

By the logic of the model, I expect that participation rates of activists will be far greater when party polarization is greater. As activists are more likely to participate when they are not indifferent between parties, this is basically a maintained assumption of the model. Thus, it is comforting (if not surprising) that the same paramaters that facilitate candidate polarization facilitate participation rates. This data is shown in the first three panels of Figure 3.13.

3.4   Conclusion

In this chapter, I have extended the evolutionary model of party competition in two important ways. First, I allow for two-party competition. Second, I have added policy-motivated activists, which facilitates the elimination of the assumptions that
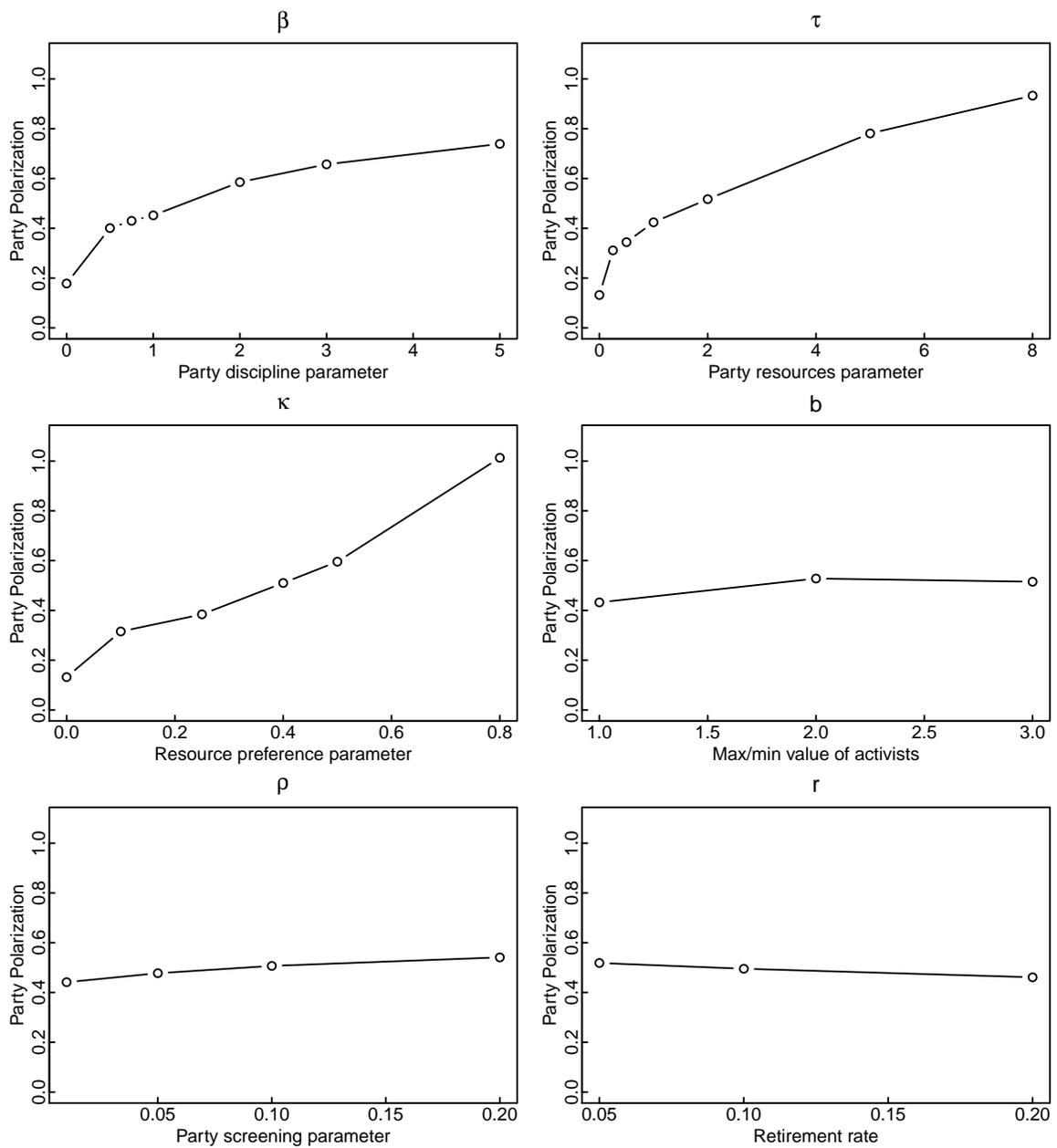
FIGURE 3.10: Key parameters determining party polarization in the activist model
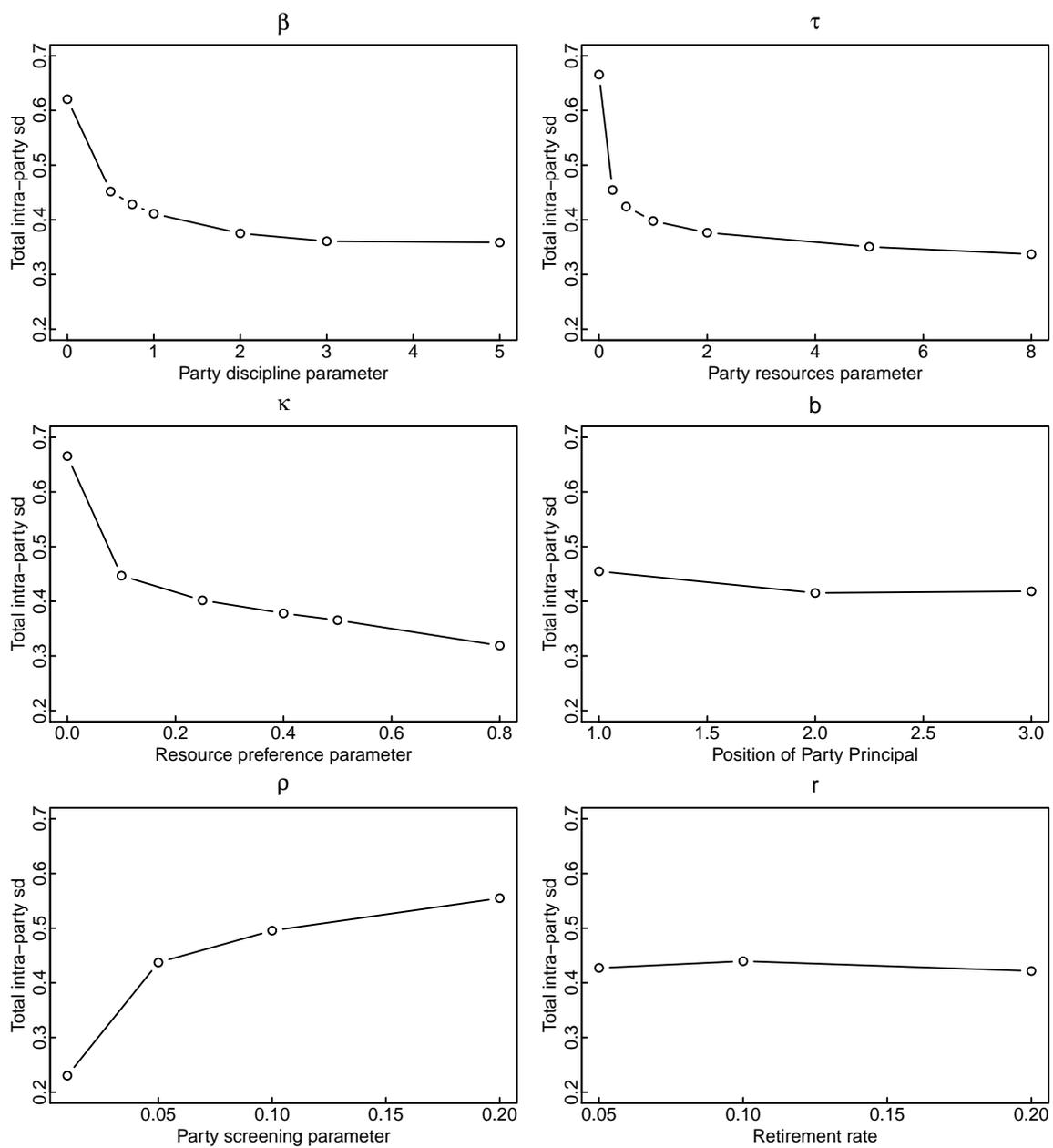
FIGURE 3.11: Key parameters determining intra-party variation in the activist model

party enforcement points and resources are determined exogenously. An additional contribution of this chapter is that it provided evidence that simulations from this class of models are replicable and not overly sensitive to initial conditions. Indeed, it seems clear that these models are stationary and ergodic, which greatly facilitates the process of simulation and analysis.

In general, the results show that divergent-homogenous outcomes are more likely to occur when (1) voters care about party resources, (2) parties are able to gain access to sufficient resources, and (3) when the bias in the distribution of these resources is sufficiently high. Moreover, these divergent-homogenous outcomes are more likely to obtain when party screening is high.

However, the results described above are only marginally interesting on their own. Similar comparative statics exist in other single-dimensional models of party competition. To begin with, there is nothing novel here in providing a model that predicts stable divergent equilibria in a single dimension (c.f., Berger, Munger and Potthoff 2000). Aldrich (1983a) makes similar predictions about the formation of distinct groups of party activists. There are even a handful of models that make similar predictions in a single-dimension setting with multiple candidates in multiple districts (e.g., Snyder and Ting 2002; Callander 2005; Tofias 2010) or in the distribution of resources by party principals to multiple party candidates (e.g., Wiseman 2006). However, the primary purpose of this chapter is not to make a unique contribution to the extensive literature on single-dimension two-party competition, but to lay the groundwork for the multi-dimensional extension in Chapter 4.

In total, this chapter has laid the final foundational layers for building the penultimate model to be presented in Chapter 4 and empirically validated in Chapter 5. Chapter 1 provided the basic justification for using evolutionary logic, and defined several key evolutionary concepts in political terms. Chapter 2 then turned to the initial task of demonstrating what it would mean for collections of candidates shar-

ing a common label to behave as a population in an evolutionary sense. These two chapters provide a skeleton for fleshing out models of party competition based on Darwinian logic.

The current chapter, on the other hand, begins the process of fleshing out the evolutionary approach for more direct application to the political world. Moreover, the stability analyses above provide a basis for my later claims that specific parameter settings can meaningfully be associated with particular model outcomes. In particular, by adding multiple parties and party activists I have now incorporated the final elements of the theoretical story I wish to tell. In Chapter 4, therefore, I extend this model to a multi-dimensional setting with a special focus on the dynamic ways that the party adjusts to exogenous shocks. In Chapter 5, I validate this model by applying it to the case of abortion policy from 1972-2010.
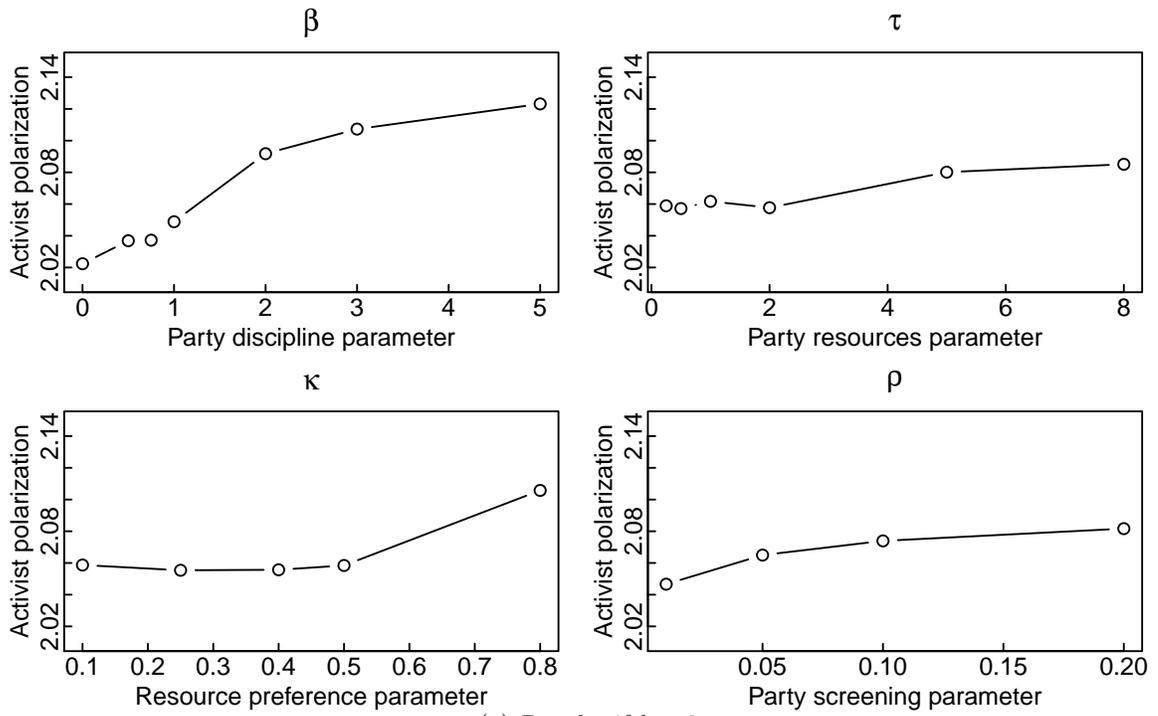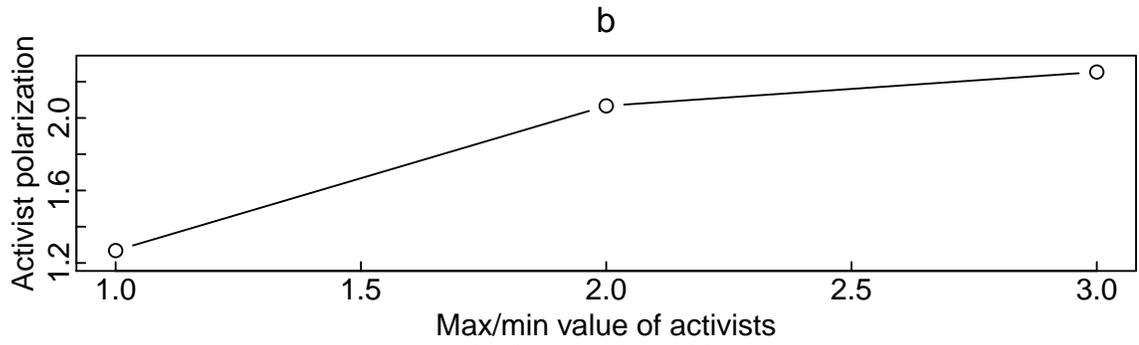
FIGURE 3.12: Key parameters determining the polarization of the activist base. All results here are for simulations where $\kappa \neq 0$ and $\tau \neq 0$.
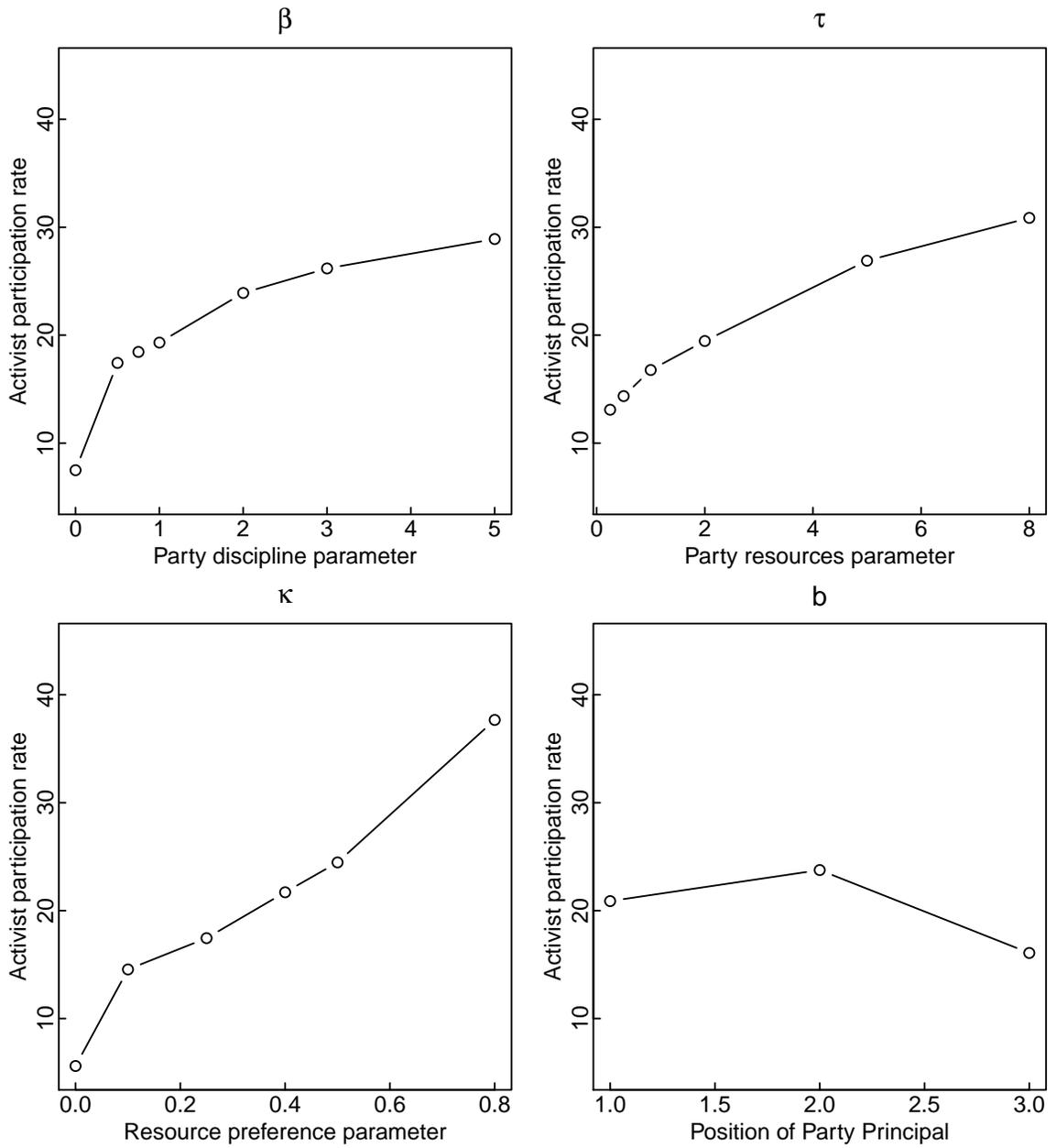
FIGURE 3.13: Key parameters determining the activist participation rate

4

The Why and How of Party Movement: Electoral Selection and the Dynamics of American Party Politics

4.1 Introduction

Scholars of American politics have dedicated tremendous efforts to documenting and explaining when, why, and how political parties change the policy positions they advocate and legislate. We know that sometimes party positions are stable, and sometimes they adapt rapidly. And in some cases, the parties even "switch" positions, such as when the Democratic party of the segregated South became the the party of civil rights.

Explaining how and why parties change their positions is a crucial task for political science. At any given time, some people are well served by the party system. One of the two parties advocates a package of policy proposals that they support, and public discourse focuses on the issues important to them. However, for many other citizens – especially members of socially marginalized groups – there is no major party to voice their concerns or advocate on their behalf. As stated by Schattschnei-

der, "The outcome of the game of politics depends on which of a multitude of possible conflicts gains the dominant position" (Schattschneider 1960, p. 62).

Numerous past studies outline theories to explain party change, yet important unresolved theoretical issues remain. In particular, previous work is divided between models that formally derive predictions about the environmental conditions that encourage shifts in party position (c.f., Aldrich 1983b; Miller and Schofield 2003), and qualitative theories that focus on the process through which the parties alter their positions in the ideological space (e.g, Carmines and Stimson 1989; Layman and Carsey 2002). That is, there are no extant formal models that explicitly account for the dynamic process of party position change when the parties are out of equilibrium.

The purpose of this chapter is to detail a formal representation of party dynamics that makes specific predictions about both the causes of party position change *and* the process through which change occurs. To do so, it draws inspiration from empirical research that emphasizes the critical role that incumbent *replacement*, as opposed to incumbent adaptation, plays in party change (c.f., Adams 1997; Carmines and Stimson 1989; Poole and Rosenthal 2007). The model, therefore, borrows insights from theories in population ecology and the burgeoning field of evolutionary economics (e.g., Alchian 1950; Dopfer and Potts 2004; Metcalfe and Foster 2007; Dopfer and Potts 2008).

The model contributes to the literature on party dynamics in three ways. First, although several prominent scholars suggest that electoral selection (i.e., incumbent replacement) plays a fundamental role in party dynamics, there are no formalized presentations of such a selection-based model.[1] Second, the model can account for additional "types" of party movement that are not predicted by the most prominent formal models of party positioning in a multi-dimensional setting (c.f, Aldrich 1983a;

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[1] However, see Ensley, Tofias and de Marchi (2009), Kollman, Miller and Page (1992), and Kollman, Miller and Page (1998) for models that do draw on evolutionary theory.

Miller and Schofield 2003). In particular, it not only accounts for party movements typically characterized as "conflict displacements" (where the parties diverge on some new issue and converge on all others), but also "conflict extensions" (where the parties diverge on multiple issues simultaneously but at different rates). Finally, the model explains how *populations* of candidates who together share a party label and party institutions might *gradually* shift their positions over time. Thus, the theoretical predictions it generates are more comparable to empirical evidence used in statistical studies of party behavior, such as congressional roll calls and time-series data (c.f., Karol 2009; McCarty, Poole and Rosenthal 2005; Carmines and Stimson 1989).[2]

In the next section, I review the literature on party change with a specific focus on both commonalities and unresolved issues. In Section 4.3, I specify the details of my theoretical model. In Section 4.4, I present the results of several simulation experiments to explore the model's predictions. The model shows that it is changes in the relative importance of issue areas *to activists* that lead to significant party rotations. I show that this may occur either (1) via an exogenous increase in some issue to all activists or (2) through the arrival of a new group of activists with different priorities. Moreover, the model implies that the preferences of voters have a marginal influence over party positions. I conclude with a brief discussion and outline directions for future empirical studies and possible model extensions.

4.2   Issues and commonalities in theories of party rotation

In this section, I briefly review the literature on party rotation. My focus is, first, to identify unresolved issues in the literature and, second, to draw out common features from the diverse perspectives that inform my theoretical model. Before beginning,

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[2] Indeed, by providing a fully specified model of how populations of candidates shift over time, the model may free the literature from its heavy reliance on data from presidential elections (e.g., Burnham 1970; Gerring 2001).

however, it is necessary to clarify what I mean by mean by both the terms "party" and "change." As noted in previous chapters, I define parties not as "factions" or "ideologies" but rather as collections of individual candidates working under a shared label to win office (e.g., Schattschneider 1960; Schlesinger 1986; Sundquist 1983; Aldrich 1995). My focus, therefore, is the policies proposed and legislated by candidates and incumbents within each party. Thus, I do not address mass behavior.

A further conceptual clarification regards the type of "change" I am explaining in the context of past research. Figure 4.1 provides a basic schematic for discussing the literature on party position change using a simple two-dimensional example. Numerous past studies of party dynamics concentrate (often exclusively) on instances when the parties diverge in one policy domain while converging on some other, while holding the overall level of political disagreement constant. Such a movement is depicted in the lower-left corner of Figure 4.1 and is termed "conflict displacement" (Schattschneider 1960). Another body of work focuses on increases or decreases in the absolute distance between the two parties in the policy space without explicitly considering changes in the angle of conflict, denoted θ in Figure 4.1 (e.g., Downs 1957; Fiorina 2005; McCarty, Poole and Rosenthal 2005; Theriault 2008). The upper-right cell depicts an increase in distance (i.e., party polarization). A third possibility is that *both* the angle of conflict and the overall level of polarization may change simultaneously, what Layman and Carsey (2002) term "conflict extension." This is the upper-left cell of Figure 4.1.

A comprehensive model of party dynamics should address all possible party movements. However, the tradition in the literature is to treat these these different "types" separately, and in keeping with existing practice, and for presentational clarity, I focus on movements that involve rotation.[3] Thus, my focus is *not* on polarization (and

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[3] The parameters in this model that determine party polarization are discussed at greater length in Chapter 3.

Does the angle of conflict change?

Does the distance between parties change?

	Yes	No
Yes	Conflict Extension	Polarization
No	Conflict Displacement	Equilibrium

Issue B / Issue A axes with θ markers.

θ represents the angle of conflict
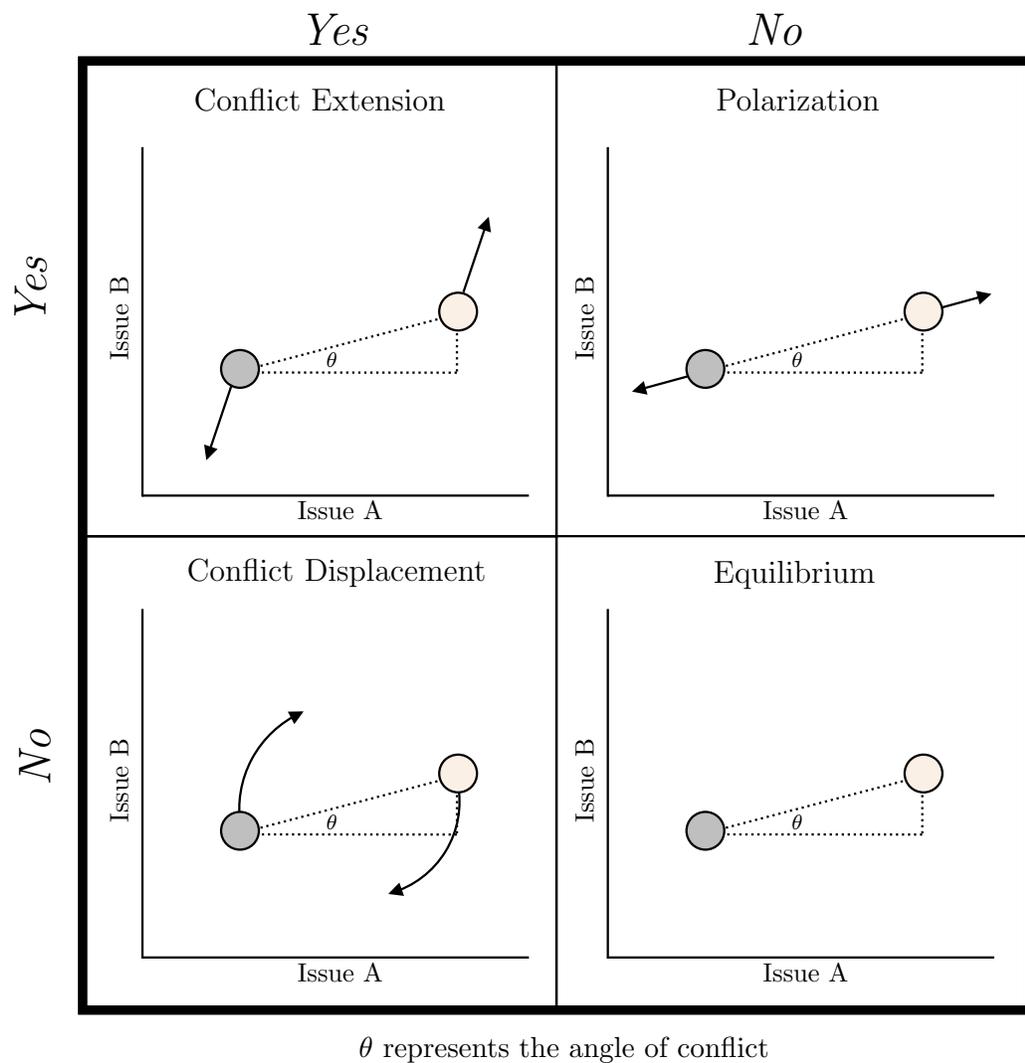
FIGURE 4.1: A conceptual framework for discussing *the literature* on party position change

convergence), but on the ways that parties change their position in multiple policy areas at different rates. In other words, my focus is on the factors that contribute to party rotation in the policy space. Note that this is inherently a multi-dimensional phenomenon, and my work rests firmly in the literature on multi-dimensional policy competition. I therefore do not directly address the many single-dimensional models that explore the conditions under which parties will converge or diverge in a simple left-right space (Downs 1957; Berger, Munger and Potthoff 2000; Grofman 2004).

4.2.1 What we know and don't know about party rotation

I begin this discussion with some motivating evidence. Figure 4.2 shows the average level of polarization for members of Congress on four sets of issues as measured by issue group ratings: civil liberties (ACLU), race (civil rights), abortion, and general ideology (ADA).[4] The top panel shows the level of polarization, defined as the distance between the party means, for each measure over time. The bottom panel shows this same data, adjusted to remove the secular trend in polarization. I do this to emphasize the *relative* rate of polarization in each issue area.

There are three features of this data I wish to emphasize: (1) the parties have polarized on each issue over time; (2) these changes were gradual;[5] and (3) the parties polarized at different rates on the different issues. Note that the parties polarized early in this time series on the civil rights dimension and much later on the issue of abortion. Indeed, adjusted for the overall increased levels of polarization, the parties have actually converged somewhat in the past decade according to the ACLU (civil

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[4] General ideology is represented by the Americans for Democratic Action (ADA) ratings. The civil liberties ratings is from the American Civil Liberties Union (ACLU). The civil rights measure is from the Leadership Conference on Civil Rights. The abortion rating comes from the National Abortion Rights Action League.

[5] Indeed, these changes have been ongoing for far longer than is depicted here. For instance, Carmines and Stimson (1989) argue that party movement on the racial dimension began in the 1950s, and Feinstein and Schickler (2008) argue that this movement began as far back as the early 1940s.

liberties) measure. This indicates that the parties are not just moving farther apart but are *rotating* in the policy space.

Existing work on party dynamics can be broken into two camps, as shown in Table 4.1, based on how this evidence is addressed. On one hand, there is a tradition of rich historical and empirical studies that develop and refine qualitative theories to explain how the parties alter their positions gradually over time in ways consistent with the data (e.g., Sundquist 1983; Carmines and Stimson 1989; Karol 2009). This category also includes Carsey and Layman's work, which provides the only existing theory of conflict extension.

The weaknesses of these qualitative accounts, however, is that they lack the rigor and completeness of a formalized model. For instance, a basic assumption of the issue evolution model is that the "American party system exists in a state of equilibrium" (Carmines and Stimson 1989, p 140). Issue evolution is what occurs out of equilibrium. Yet, Carmines and Stimson are blunt in stating that they "do not know" what mechanisms drive the system towards equilibrium, what preserves the new equilibrium when it is achieved, nor what punctuates it at the "critical moment" when issue evolutions begin.

On the other hand, the few extant formal models that provide equilibria predictions in a multi-dimensional policy space offer little insight into the gradual *process* of party rotation. This is largely a result of the very strong assumption in the Downsian framework that "in effect .... treats each party as though it were a single person" (Downs 1957, p 26). Party rotation is implicitly an instantaneous response to changes in the underlying parameter space. Moreover, *no* available formal models provide a concrete explanation for all the types of party movement (including conflict extensions) shown in Figure 4.1 (Layman et al. Forthcoming).

The goal of this chapter is to detail a more comprehensive theory of party rotation that provides the rigor and specificity of a formal model, but that more directly

Adjusted Interest Group Scores
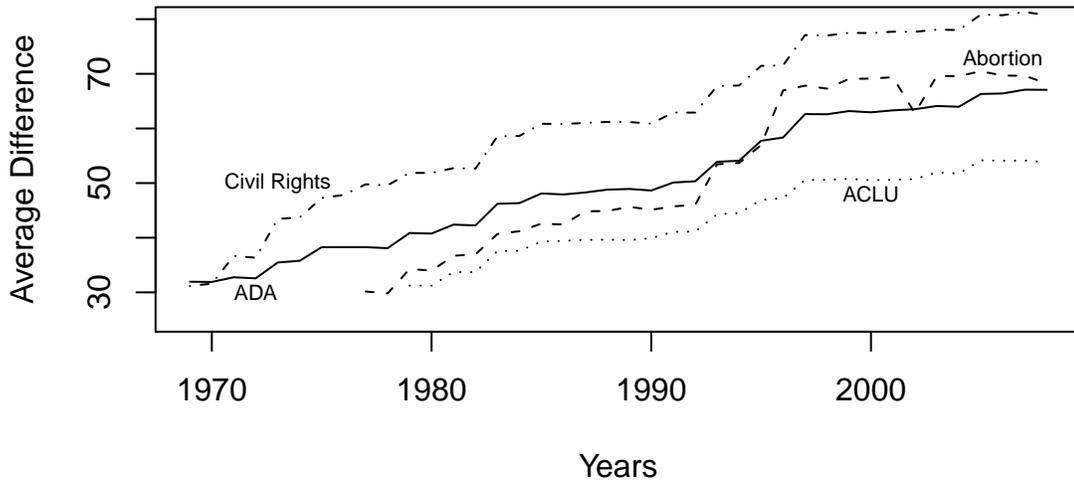
Scores adjusted for time trend
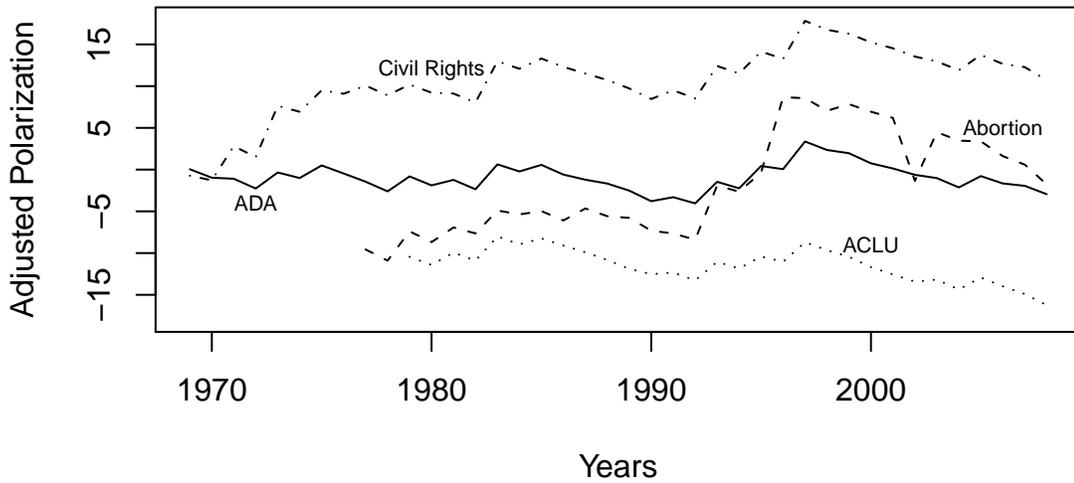
FIGURE 4.2: Adjusted interest group scores on four issue dimensions. Data represents "real" interest group scores (Groseclose, Levitt and Snyder 1999). The top panel shows the difference in the mean adjusted scores between the members of congress in each party. The bottom panel shows this same data adjusted to remove the linear time trend.

116

Table 4.1: Categorization of previous theories of party change with examples

Can it explain:	Theory Type	
	Qualitative Theory	*Formal Models*
Stable Equilibrium?	No	Yes Aldrich (1983a,b) Schofield (2004)
Gradual Change?	Yes Carmines and Stimson (1989) Karol (2009)	No
Conflict Displacement?	Yes Carmines and Stimson (1989) Sundquist (1983)	Yes Aldrich (1983b) Schofield (2004)
Conflict Extensions?	Yes Carsey and Layman (2002a)	No

relates to the real world data on gradual party rotation we seek to explain. But what would such a comprehensive model look like? What specific mechanisms and dynamic processes should be included? I conclude this section by briefly reviewing theories of party dynamics with an eye towards drawing out important commonalities. In the following sections, I then incorporate them into a formal computational evolutionary model.

4.2.2 Why do parties rotate?

The most common answer to this question is that the exogenous introduction of a "new" (or newly salient) political issue leads to rotation (e.g., Schattschneider 1960; Sundquist 1983; Aldrich 1983*b*; MacDonald and Rabinowitz 1987). However, past theoretical treatments have not always been clear regarding what is meant by "new."[6] Nor has it always been clear *to whom* the issue must be important. Carmines

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[6] For instance, Stimson notes that, "no issue is ever new in the stronger sense of never having been thought of before. ... Racial controversies, for example, are older than the country" (Stimson 2004, p 40). He goes on to argue that new issues are newly "politically relevant" in that they come to divide the two parties, but this does not provide us with a clear understanding of what kinds of issues are likely to become relevant nor why only some appear to result in significant party movements.

and Stimson (1989) imply that the decision lies with the voters, while the formal literature has focused on activists, interest groups, and organizations (c.f., Aldrich 1983*b*; Miller and Schofield 2003). Moreover, Aldrich (1983*b*) argues that these new issues become increasingly salient to *all* activists, while Miller and Schofield (2003) and Sundquist (1983) contend that it is the arrival of new activists who weight the new issue more heavily that causes rotation. In my model below, I will consider all of these possibilities.

A second factor central to theories of rotational movements is the role of party activists. Carmines and Stimson (1989) argue that activists serve merely as mediums for information exchange between parties and voters. In this view, voters learn about party positions from activists, but it is the voters who determine which issues will lead to rotation. However, the bulk of the literature on party change places activists in a more critical role. Parties are theorized to alter their positions either to incorporate groups of unaffiliated (potential) activists (e.g., Aldrich 1983*a*; Miller and Schofield 2003; Schattschneider 1960; Sundquist 1983), or to continue to extract resources from currently aligned groups whose preferences are shifting (Aldrich 1995).

4.2.3   How do parties rotate?

Historically, the most prominent mechanism proposed to explain party rotation was the "critical election" (c.f., Key 1955; Burnham 1970; Sundquist 1983), a concept that subsequently received considerable criticism for both its lack of theoretical rigor and empirical validity (c.f., Mayhew 2002; Carmines and Wagner 2006). More recent formal models in this tradition (e.g., Schofield 2004) build on the classical Downsian assumption that the party is adequately conceptualized as a single decision-maker who can alter the party's position at will. However, although theoretically stronger, these studies focus on presidential elections and provide little insight into the more gradual shifts in party positions observed in Congress and other lower-level offices.

A second, and more promising, mechanism proposed for explaining party rotation is the replacement of elected officials over time (Carmines and Stimson 1981, 1989; Poole and Rosenthal 2007; Brewer and Stonecash 2008). In particular, the issue evolution theory posits an almost Darwinian process of party dynamics through the gradual accumulation of small changes driven by selection. While Carmines and Stimson "choose not to" formulate their argument in explicit Darwinian terms (Carmines and Stimson 1989, p 15), other studies are less reticent. Explaining the divergence of the two parties on the issue of abortion, Adams (1997) states:[7]

> Once abortion was thrust into the public spotlight ... some legislators were advantaged by their position on abortion and others were disadvantaged. Suppose that ... pro-life Republicans were slightly more likely to win election than pro-choice Republicans, and pro-choice Democrats were more likely to win than pro-life Democrats, all else being equal. ... Such a difference could be so small as to be unrecognizable, even by the candidates themselves. But when accumulated over nearly 470 House and Senate seats up for election every two years, and then compounded across elections, the effect could be like interest in a savings account, growing larger every year. (Adams 1997, pp 726-727).

4.3   A model of party movement via electoral selection

> First, the party system is dynamic, not static. Second, it is multidimensional not unidimensional.... Any generalization about political party behavior that does not take these variables into account is to that extent invalid. Sundquist (1983, pp 322-323)

In this section, I incorporate the insights from the literature on party rotation into a formal computational model of party competition. In reviewing the literature, it seems plain that any comprehensive theoretical treatment that adequately encapsulates the insights of existing qualitative theories and historical accounts of party change should meet three criteria. First, the model must be set in a multi-

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[7] In addition, Gerring (2001), Theriault (2006), and Karol (2009) argue that party movement is characterized by *both* individual adaptation and incumbent replacement. I return to this issue in Appendix B.

dimensional policy space. Second, it should provide both a prediction for where equilibria (or steady-states) will exist and an explanation of how parties get from here to there through time when equilibria are "punctuated." Finally, these predicted positions must be divergent. Or, at a minimum, an adequate model must be able to accommodate the *possibility* of stable divergence as the entire concept of party rotation only makes sense if the parties have diverged on at least one issue.

However, as scholars in the formal modeling literature have long shown, developing a model with strong micro-foundations that meet these criteria is in no way straightforward. To begin with, providing any theoretical results that predict *stable*, divergent, equilibria in a multi-dimensional policy space is something that political science has struggled with for decades. Indeed, only a handful of scholars have succeeded, with most of them coming in the past few years.[8] In addition, the political science discipline has focused very little on developing concrete micro-level models of system dynamics (de Marchi 2005). Finally, the entire Downsian framework that undergirds most analytical models of elections does not easily incorporate the concepts of multiple constituencies and multiple candidates (Austen-Smith 1987).[9]

The model I propose differs from previous efforts by drawing inspiration from theoretical models of population ecology. Similar to the logic forwarded by Adams (1997) above, I theorize politics to be a Darwinian process fought out between two populations of candidates. Thus, the political system represents an ecological system dominated by selection.[10]

However, the model also builds on the class of Downsian models of two-party

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[8] Models that have succeeded in this task include Adams, Merrill and Grofman (2005), Roemer (2001), Aldrich and McGinnis (1989), Hinich and Munger (1996), Schofield and Sened (2005), and Peress (2005).

[9] Callander (2005) and Tofias (2010) provide brief discussions of the few models that explicitly handle elections with multiple constituencies.

[10] Among the many scholars who make similar arguments regarding the importance of selection in party competition are de Marchi (1999), Kollman, Miller and Page (1992, 1998), Ensley, Tofias and de Marchi (2009), Poole and Rosenthal (2007), Poole (2007), and Lee, Moretti and Butler (2004).

competition first proposed in Aldrich (1983*b,a*) and further elaborated in Aldrich and McGinnis (1989), Schofield (2004), and Miller and Schofield (2003).[11] I include three "types:" *candidates, voters*, and *activists*. Unlike these previous models, however, there is also an *institutional party* that is not itself an agent, but rather is an institution whose activities are determined exogenously.[12] This contrasts with "the party," which I define to be the collection of individual candidates who share a common label.

4.3.1 Voters

There are n_v voters in each of n_d districts. Thus, the model includes $n_v \times n_d$ voters divided evenly into n_d districts.[13] The inclusion of multiple voters in each district is important in a multi-dimensional setting as we cannot simply assume that there will be a voter who is the median in all directions.

Voters have ideal points, $\mathbf{X}_j = (x_1, x_2, \ldots, x_p)$ in a p-dimensional policy space $\mathcal{X} \in \mathbb{R}^p$. These dimensions represent any specific issue or cluster of issues that are conceptually linked in the minds of voters and activists. The model is able to accommodate multiple dimensions, although the simulations I present below include only four.[14] Voter preferences within district d are distributed randomly $\mathrm{N}(\boldsymbol{\mu}_d, \sigma_v^2 \mathbf{I})$. These district means, $\boldsymbol{\mu}_d$, are themselves distributed according to the multivariate normal

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[11] The model was written in NetLogo v4.1 and is available on my website.

[12] In Appendix D, I consider a variant of this model where the behavior of the institutional party is determined endogenously. However, the addition of endogenous institutions adds considerable complexity to the analysis, and I therefore plan to present these results in future papers.

[13] For computational reasons, the simulations I report include relatively small values of n_v (e.g., 50). However, there are no notable differences in the behavior of the model with larger numbers of voters. Readers may interpret these voters to be "representative" of broader constituencies with similar preferences. Indeed, virtually all other research on models with multiple constituencies makes the even more extreme assumption that districts are fully represented by their district medians (e.g., Callander 2005)

[14] The model's equilibrium results, however, become increasingly fragile as the number of *salient* dimensions increase. The results discussed below hold for the modest number (e.g, $p \leq 6$) typical to studies of party rotation.

121

distribution N($\mathbf{0}$,$\sigma_d^2\mathbf{I}$), implying that the overall distribution of voter preferences is $\mathbf{X}_j \sim N\left(\mathbf{0}, (\sigma_d^2 + \sigma_v^2)\mathbf{I}\right)$.

I assume that voters not have preference over the policy positions of candidates *and* prefer candidates with a greater "valence" advantage (c.f., Groseclose 2001; Schofield 2004; Wiseman 2006). The motivation for this assumption is discussed at greater length in Chapter 2. Valence in this model represents whatever electoral benefits candidates gain from party resources, and I will sometimes use the term "resources" in the discussion below.

In keeping with the empirical literature discussed above, I assume that there is significant heterogeneity within the electorate in the relative importance individuals place on each issue dimension.[15] Let $w_{ij} \in [0,1]$ represent the saliency (or importance) of dimension i to voter j such that $\sum_{i=1}^{i=p} w_{ij} = 1$. Voter saliency weights are distributed $\mathbf{W}_j \sim Dirichlet(\delta_1, \delta_2, \ldots, \delta_p)$, which means that δ_i represents the *average* saliency of dimension i amongst voters.[16]

The utility function of the voter j for candidate k who has a position in the policy space $\mathbf{Y}_k$ and resources ν_k is given by

$$U_{jk}(\mathbf{X}_j, \mathbf{Y}_k, \nu_k) = \kappa\nu_k - (1 - \kappa)\left(|\mathbf{X}_j - \mathbf{Y}_k|^T \mathbf{W}_j |\mathbf{X}_j - \mathbf{Y}_k|\right), \qquad (4.1)$$

where $\kappa \in [0,1]$ is a constant indicating the relative weight of party resources and policy in voters' utility. Voters always cast their votes for their most-preferred candidate.

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[15] Kollman, Miller and Page (1992, 1998) and de Marchi (1999) make similar assumptions regarding heterogeneous saliency weights.

[16] The Dirichlet distribution is convenient in that it produces a random vector of outcomes that always sum to unity.

4.3.2 Candidates

For reasons discussed in Chapters 1 and 2, the model assumes that candidates do not have utility and are not individually adaptive. As this is explicitly a model of American elections, I assume that there are two parties denoted Θ and Ψ. Candidates take a policy stance at point $\mathbf{Y}_k$. In the initial phase of the simulation, the n_d candidates from each party are distributed $\mathbf{Y} \sim N(\mathbf{0}, \sigma_d^2 \mathbf{I})$, the same distribution as the district means specified in Section 4.3.1.[17]

In each iteration, candidates that gain the most votes become the incumbent for their district. Candidates that lose the election are removed. If there is a tie, the election is determined randomly. After each election, both parties are re-populated back to size n_d. That is, there is always one candidate from each party running in each district.

It is possible to imagine many ways that candidate recruitment or re-population might be specified. However, as this is a first foray into modeling elections as an evolutionary process, I chose the simplest approach. New candidates choose at random one of the surviving incumbents from the previous election who is of their own party. They adopt this incumbent's policy stance, $\mathbf{Y}_k$, with some random error. Thus a new candidate, k', will adopt the point $\mathbf{Y}_{k'} = (y_{k1} + \varrho_{1k'}, y_{k2} + \varrho_{2k'}, \ldots, y_{kp} + \varrho_{pk'})$. The errors, $\varrho_{ik'}$, are *iid* uniform on the interval $[-\rho, \rho]$. Thus, as in previous chapters, ρ represents the ability of the party to "screen" new candidates who are too dissimilar to current incumbents. High values indicate poor screening, while low values indicate

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[17] Model results do not appear to depend heavily on the initial distribution, so long as they are spread randomly and are reasonably diffuse.

stringent levels of screening.[18]

4.3.3 Party activists

The model assumes that there are n_a activists in each district whose preferences are distributed $\mathbf{Z_j} \sim N(\boldsymbol{\mu}_d, \sigma_v^2 \mathbf{I})$ (the same distribution as voters discussed in Section 4.3.1). As in Chapter 3, activists base their decisions on the "party signal" rather than on each individual candidate's position.

The party signal represents the aggregate position of all the candidates who share the same label, which I assume is represented by the mean incumbent position. Thus, the party signal for all N winning candidates in party Θ can be denoted $\bar{\mathbf{Y}}^\theta = (\bar{y}_1^\theta, \bar{y}_2^\theta, \dots, \bar{y}_p^\theta)$, where $\bar{y}_i^\theta = \frac{\sum_k y_{ik}}{N}$ for all k *incumbents* in party Θ. Let $a_{ij} \in [0,1]$ represent the saliency of dimension i for activist j and $\mathbf{A}_j \sim Dirichlet(\alpha_1, \alpha_2, \dots, \alpha_p)$. Thus, α_i represents the average saliency of dimension i to activists. The utility of activist j for party Θ is therefore

$$U_{j\theta}(\mathbf{Z}_j, \bar{\mathbf{Y}}^\theta) = -\text{Logit}^{-1}\left(|\mathbf{Z}_j - \bar{\mathbf{Y}}^\theta|^T \mathbf{A}_j |\mathbf{Z}_j - \bar{\mathbf{Y}}^\theta|\right). \tag{4.2}$$

Activist z_j has an action set $A_j(z_j) = \{\Theta, \Psi, \emptyset\}$, and

$$P\left(A_j = \Theta\right) = \left(2|U_{j\theta} - U_{j\psi}| - 1\right) I[U_{j\theta} > U_{j\psi}] \tag{4.3}$$

$$P\left(A_j = \Psi\right) = \left(2|U_{j\theta} - U_{j\psi}| - 1\right) I[U_{j\psi} > U_{j\theta}] \tag{4.4}$$

$$P\left(A_j = \emptyset\right) = 1 - P(A_j = \Theta) - P(A_j = \Psi), \tag{4.5}$$

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[18] Since the logic of my model deals largely with the *replacement* of candidate populations, I also allow for candidate replacements that occur for reasons outside of the model. Karol (2009) notes that retirement rates in the House are almost never below 5% for either party in any given year. Moreover, in the more extensive simulations conducted in Chapter 3, I found that the rate of random retirement had little impact on model outputs for reasonable settings. I therefore include an additional parameter, r, which indicates the percentage of incumbents who are randomly assigned to retire. This parameter plays no role in determining equilibria locations. In all models below, it is set to the suggested value of 5% and will not be discussed further.

where $I[.]$ is the generalized indicator function. Substantively, this means that while activists will always support their favorite candidate *if* they affiliate, they may not always participate. Specifically, activists are more likely to affiliate when they are not indifferent between the two parties.

4.3.4   The institutional party and the protection of party reputations

Although the parties themselves in this model consist of populations of candidates, it is still necessary to include some mechanism through which policy positions are coordinated (Aldrich 1995). The purpose of this setup is to accurately reflect the inherent collective action dilemma of party politics. All candidates are motivated to "defect" by taking positions somewhat closer to their district mean and farther from the more extreme policy position that would please activists and optimize party resources. This will be especially true for candidates in moderate or ideologically unfavorable districts (i.e., districts far from the activist base). If a candidate moderates, the logic of the model states that the defection will make the party signal less optimal for garnering activist support. However, the decreased amount of activist support will be dispersed throughout the candidate population. Thus, the party signal is a public good. If defections become common, this will lead to a less optimal party signal, fewer supportive activists, fewer party resources, and less electoral success for *all* party candidates. Only if the institutional party is able to reward non-defecting candidates will this collective action dilemma be averted (Axelrod 1984; Snyder and Ting 2002).

I add four assumptions to the model to accommodate a role for the institutional parties. First, as stated above, the model assumes that activists affiliate with parties based on the collective party signal. Second, the institutional party *may* have resources that are valuable for candidates in winning elections. Specifically, the institutional parties provide candidates with an additional valence advantage. Third,

the institutional parties *may* distribute resources in a biased way so as to reward candidates who are more more loyal. Finally, there is a positive relationship between the amount of resources each party has and the number of activists that support or are affiliated with the party.[19]

Given these assumptions, the issue of rewarding non-defection can be reframed as follows. The institutional parties have a budget constraint, $(\gamma_\theta, \gamma_\psi)$. How would we expect the institutional parties to distribute resources amongst the candidates? As in Chapters 2 and 3, I follow Aldrich and McGinnis (1989), Snyder and Ting (2002), and Cox and McCubbins (1993, 2005) in assuming that the institutional parties construct a distributional mechanism that is biased towards enforcing some point in the policy space that will maximize the party's resources. Thus, the institutional parties allocate resources as a function of each candidate's distance in the policy space from this point. The degree of bias or concavity in the distribution of γ_θ can be interpreted as the degree of "party discipline," denoted β.

In particular, the model assumes that the parties seek to "enforce" a point in the policy space that will please the policy-motivated activists who they rely upon for winning office (Aldrich 1995). Let $\mathbf{Z}_\theta$ denote the mean position of all activists who are currently affiliated with party Θ. Let the *squared distance* between this point and candidate k in party Θ be given by $d_{\theta k} = |\mathbf{Y}_k - \mathbf{Z}_\theta|^T \boldsymbol{\alpha} |\mathbf{Y}_k - \mathbf{Z}_\theta|$.[20] The total amount of resources (or valence), ν_k, given to candidate k is defined by $\nu_k = \gamma_\theta n_d \frac{\lambda_k}{\sum_k \lambda_k}$, where $\lambda_k(d_{\theta k}, \beta) = (1 + d_{\theta k})^{-\beta}$. Again, $\beta \in [0, \infty)$ represents the extent of "party discipline."

A final assumption for the model deals with how each party's budget $(\gamma_\theta, \gamma_\psi)$

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[19] It is also possible to divide activists into individual districts and contribute valence resources directly to party candidates. However, no significant differences were noticed in model behavior for this variant and such a setup comes with significant computational costs.

[20] In this instance, each dimension is weighted according to the average salience of issues to activists ($\boldsymbol{\alpha}$). In addition, in the rare instance (usually in the initial elections) where there are no activists associated with the candidates, the enforcement point is the mean position of the candidates.

relates to their activist support. The model asumes that the party has greater resources when it has more affiliated activist supporters. The amount of party resources available to party Θ is

$$\gamma_\theta = \tau \left(\frac{\sum_j I[A_j = \Theta]}{n_a} \right) \tag{4.6}$$

The portion of (4.6) in parentheses simply means the percent of all activists currently supporting party Θ. Thus, τ is an exogenously determined constant that is the maximum amount of resources per candidate a party could possess if every activist affiliated with that party.

4.3.5   Sequence of the simulations

After the agents are initialized, the model repeats the following sequence. First, the institutional party distributes resources (or valence) amongst all of the candidates.[21] Second, the activists looks at the party "signals" to determine whether or not they will affiliate with one of the parties. Third, voters decide between the candidates based on their relative utilities for each candidate running in their own district. There is one candidate from each party running in each district. The voters' utility is based on (1) the ideological proximity of the two candidates and (2) the resources each candidate is allocated from the institutional party. Fourth, the candidate that wins the election survives and becomes the incumbent for that district while the other candidate is eliminated.[22] Finally, new candidates enter the system and mimic (with some level of imprecision) the strategies of successful own-party candidates. Table 4.2 lists the model parameters and their interpretation.

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[21] In the initial election, the institutional parties have no resources to distribute and therefore do nothing.

[22] Incumbent candidates may retire at this point with probability r.

Table 4.2: Exogenous model parameters

Parameter symbol	Interpretation and meaning
p	The number of dimensions in political competition.
κ	The relative importance of party resources (i.e., valence) to spatial proximity in voter utility functions.
β	The "party discipline" parameter in determining the degree of bias in the distribution of party resources. Higher values indicate greater discipline.
ρ	The "screening parameter" indicating the amount of error that occurs when new candidates enter and mimic the position of some existing own-party candidate.
τ	The maximum amount of resources a party could possess per district if every activist affiliated with that party.
n_d, n_v, n_a	The number of districts, voters-per-district, and activists-per-district.
σ_v, σ_d	The standard deviation of the distribution of ideal points of voters/activists within districts and between districts, respectively.
α, δ	The vector containing the average saliency of each issue-dimension for activists and voters, respectively.

4.4   Simulation outputs

In this section, I conduct a number of simulation experiments using the above model to demonstrate its ability to account for party rotations. However, before we can study how the parties change, it is necessary to first provide some details regarding where parties begin. In other words, we need some understanding regarding the

equilibria positions for parties predicted by the model.[23]

Some readers may object to the use of the term "equilibria" to describe the stable configurations that the model predicts. The simulations show that the party populations are tethered at locations near the mean positions of supportive activists. Moreover, these points of attraction remain fixed across a large number of iterations. Strictly speaking, the party positions are not in equilibrium in that they are not *completely* static, but neither do they move at random through the space. Movements away from these locally stable points of attraction are usually followed by movements back towards these points. In other words, selection pressures constantly push the parties back towards these stable configurations, but temporary deviations are the rule rather than the exception. Some readers may wish to substitute the term "ecologically stable configuration" in place of the term equilibrium in what follows. Due to the cumbersome nature of this language, I have elected to stick with the more familiar terminology.

The basic equilibrium predictions of the model can be summarized as follows:[24]

- As in Chapter 3, the parties will locate at divergent local equilibria so long as (1) activist resources are sufficiently valuable for winning votes; (2) party discipline is sufficiently high; and (3) the total amount of activist resources are sufficiently high. Otherwise, the candidate populations will drift towards the center.

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[23] For presentational clarity, I do not present the kinds of stability analyses conducted in Chapter 3. However, just as before, model outputs here are stationary and ergodic.

[24] I set aside here issues regarding extreme values for certain model parameters that have no empirical referent and that do not illuminate the issue of party rotation. For instance, if the odds of incumbent retirement, r, or the level of error in screening, ρ, are set at extremely high values, no equilibrium will result. Likewise, there are specific combinations of parameter values that result in unstable outcomes that are difficult to characterize. For instance, if the number of dimensions, p, is set very high (e.g., 20) and these dimensions are all equally salient to activists, the parties will tend to drift between the many local equilibria in the space as selection pressure along any dimension at any particular time will be weak.

- The predicted location of the parties is determined by the relative salience of each dimension to activists. *Ceteris paribus*, the parties will diverge along each dimension such that they are further apart for the dimensions with the greatest values of α_i (the average salience of dimension i to activists).

- The model is characterized by multiple local equilibria. Although it predicts that the parties will diverge along salient dimensions, it does not predict how these issues will be "bundled." The number of possible equilibria is equal to $2^{(p-1)}$, where p represents the number of dimensions sufficiently salient to activists to cause divergence. Which of these equilibria will result depends on random events in the early phases of the simulation. For example, in a two-dimensional space (issue A and issue B) there are two possible combinations:$[(High\ A, High\ B), (Low\ A, Low\ B)]$ and $[(Low\ A, High\ B), (High\ A, Low\ B)]$.

- The stability of the parties' positions along each dimension depends primarily on the salience of that dimension to activists. For low salience issues, it is possible that random drift may lead to random "reversals" where the parties flip from one equilibrium position to another, similar to the phenomenon discussed in Chapter 3.

An example of the outcomes produced in the model is provided in Figure 4.3. The figure shows the mean ideological position of the candidates in each party. In this example $\boldsymbol{\alpha} = (.35, .30, .20, .15)$.

The implications of this brief discussion for better understanding party dynamics are straightforward. If one of the factors that determine the location of this equilibrium shifts, then the the party populations will gradually adjust to some new position. In the remainder of this section, I discuss important parameters in the model that predicts rotation.
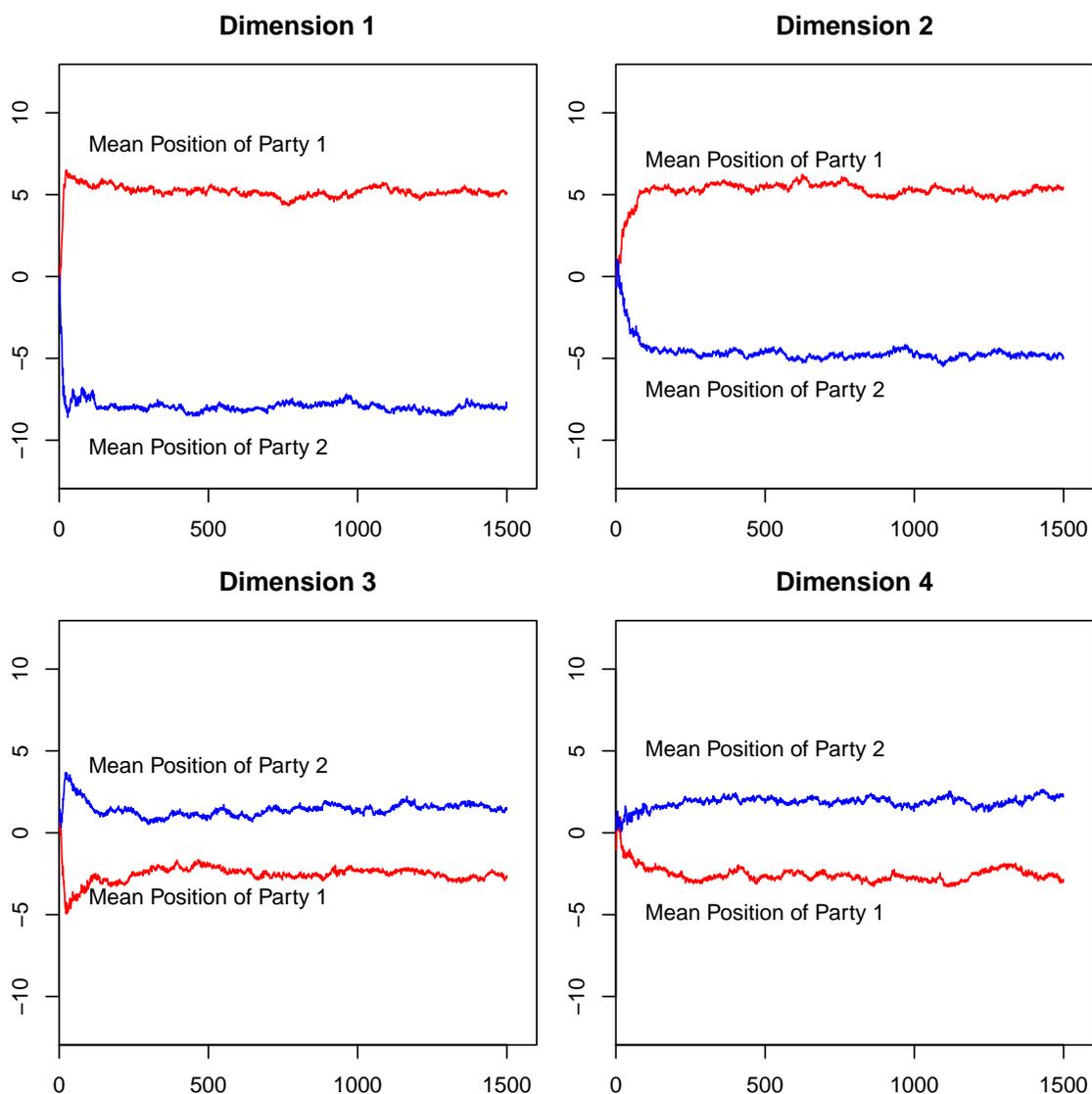
FIGURE 4.3: An example of a stable divergent equilibrium in four dimensions. The solid lines indicate the location of the mean candidate position in each dimension. Average issue salience for this simulation is $\alpha = (.35, .30, .20, .5)$. The other parameter settings are $n_d = 435, n_a = 5, n_v = 30, \beta = 2.25, \tau = 8, \rho = 2, r = 5, p = 4, \delta = (.4, .3, .2, .1), \sigma_v = 150, \sigma_d = 150$.

4.4.1 Explaining rotation

It is now possible to turn to the questions of why and how parties rotate in the policy space. The model reveals that party rotation depends on the salience (or importance) of the different issue dimensions *to activists*. The parties will always drift apart on dimensions that are the most important to the greatest number of potential activist supporters. The logic for this result is discussed below, but I first provide simulation results to illustrate the finding.

To demonstrate this point, I present data from several simulation experiments. In each, I first "burn in" the simulations by running them for 1,000 iterations. In experiment 1, I then increase the salience of dimension four for every activist from the starting value of .10 to increasingly higher values (.30, .40, .50).[25] Substantively, this could represent the increasing importance of an issue dimension resulting from the strategic action of political leaders (Riker 1986), exogenous shocks (e.g., the Great Depression), or from social movements external to the political system (e.g., the Civil Rights Movement). As each individual activist's salience vector, $\mathbf{A}_j$, must sum to unity, this means the relative salience of the other dimensions has decreased.[26] The results of the simulation are shown in Figure 4.4.

Figure 4.4 shows the average distance between the two party means on each of the four dimensions in the model for the 1000 iterations after the sudden shift in activist saliences. The solid lines represent the change in polarization along each dimension when the saliency of dimension four is increased from .10 to .50, the dashed lines represent the predicted shift for an increase from .10 to .40, and the dotted lines

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[25] Computationally this is achieved by taking all activists and incrementing up their individual value for a_4 by 0.001 and then re-normalizing back such that $\sum_i a_{ij} = 1$. This process is repeated until the observed average salience, $\bar{a_{4j}}$, is equal to the target level.

[26] Increasing the salience of a dimension without re-normalizing saliency vectors back to sum to one is equivalent to increasing the the actual size of the policy space. To have a meaningful discussion, it is necessary to either fix the overall size of the policy space, as is typically done in many formal models with assumed policy spaces in a unit square, or to bound the saliency weights.

Dimension 1

Dimension 2

Dimension 3

Dimension 4

Total Polarization

Legend
— α_4 increased from .10 to .50
-- α_4 increased from .10 to .40
··· α_4 increased from .10 to .30

FIGURE 4.4: Experiment 1: Increasing the salience of a dimension for all activists. This figure shows the effect of increasing the salience of dimension 4 for all activists. The plot shows the results after a 1,000 iteration burn-in period at the initial settings. The lines depict the "smoothed" level of polarization (the distance between the party means) for five simulations from the model for each parameter setting. Other parameter settings for these simulations are $\kappa = .35, \delta = (.4, .3, .2, .1), \sigma_d^2 = 200, \sigma_v^2 = 200, \rho = 2.5, r = 5, \tau = 7, \beta = 1.7, n_a = 10, n_v = 20, n_d = 300$.

represent the paths taken for the more modest shift of .10 to .30. First, we can look at what happens on the newly salient issue (i.e., dimension four), which is depicted in the middle right panel of Figure 4.4. It shows that after the external shock is introduced, the parties gradually drift apart on that dimension. The speed and degree to which the two parties separate is a function of the new level of salience. A larger increase in salience leads to a larger level of polarization on that issue and a faster party movement. Looking at the other panels, we can see that the parties converge on the issues that are now *relatively* less salient. However, this level of convergence is very moderate, leading to an overall increase in the level of polarization in the system, as shown in the bottom right panel of Figure 4.4.

Thus, the model shows that when a dimension becomes increasingly salient to activists, the parties will become increasingly divided on that dimension. The logic of rotation in the model is as follows. First, activists place increased weight on a dimension in choosing between the two parties and in their decision to participate at all. Second, either through random drift (in the case when the parties had previously been perfectly converged on that dimension) or because the parties had previously been slightly separated, the two party signals will become distinct along that issue dimension. Third, once some small separation of the two candidate populations has occurred, an iterative process begins leading to increasing divergence along this newly important dimension. Some activists re-sort themselves to affiliate with the party more aligned with themselves along this new dimension. This will be translated through screening (e.g., primaries) and the biased way in which parties distribute resources (i.e., party discipline) into a slightly higher rate of survival for candidates with more extreme positions along this dimension. Finally, over time the process will slow as the added benefit for candidates taking positions more extreme on this dimension begins to equal the cost of taking positions too far from the district means. Meanwhile, an opposite process will occur on the dimensions that have be-

come *relatively* less salient to activists, leading to higher levels of convergence along these (now) less salient dimensions.

Some scholars have suggested that party rotations are not (or are not always) the result of changes in the dimension saliency for *all* activists, but rather that the parties may respond to the introduction of new activist groups who weigh the various policy dimensions differently. Such heterogeneity in activist preferences is especially important in the theory of conflict extension as outlined by Layman and Carsey.

> [W]hen a group motivated by a new set of issues moves into a party (e.g., new Republican activists who are culturally conservative but moderate or liberal on economic issues), it may not place much pressure on the party to soften its stand on older issues because the group does not attach much importance to those issues. Similarly, veteran activists who were attracted into party politics by older issues may not offer much resistance to a party's more extreme positions on newer issues because they do not care much about them (Layman, Carsey and Horowitz 2006, pp 99-100).

Indeed, in his comprehensive study of party rotation on multiple issues, Karol (2009) argues that the introduction of new activists is a defining feature of the various "types" of party rotations. He finds that rotations that result from the changing preferences of current activists are swifter and more dramatic than shifts that occur as the result of the incorporation of new activists.

To explore this possibility, I conduct a second experiment. In experiment 2, I imagine a scenario where the importance of the fourth dimension increases for a *subset* of activists but remains constant for the rest. This might represent either the entrance of a new group of activists or a change in the profile of the activist population due to generational shift.[27] The results for this experiment are shown in Figure 4.5. Again we can see that the average position of the two parties diverges on

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[27] Computationally, this is achieved by choosing an activist at random and increasing the salience of dimension 4 to .70 and re-normalizing. This process is repeated until the average, $\bar{a}_4$, for the entire activist population is equal to the target.

the newly salient issue (dimension 4), while the parties converge on the dimensions that are now less salient.

Thus, the model provides a more concrete theoretical basis for discussing rotations that occur as the result of the growth of the importance of a specific issue throughout the activist base (experiment 1) and the increased importance of an issue due to the arrival of activists with different preference profiles (experiment 2). The simulations predict that, *ceteris paribus*, rotations resulting from the former event will be larger, a prediction exactly parallel to Karol's findings noted above. The underlying logic of rotations that occur for either of these reasons is identical, and it seems reasonable to argue that most significant movements in party positions involved both mechanisms. But it remains true that the model predicts party movements to be larger, faster, and more dramatic as a result of universal changes in issue salience than for rotations resulting from the incorporation of new activists.

4.4.2   Voter salience

So far, I have focused on the dynamic relationship between activists and candidates. One question that remains is: what role do voters play? In another set of simulations, I replicated both of the above experiments for voters (rather than activists) to isolate the relative roles that these two types of agents play in the political system. However, altering the saliency weights for voters (δ) results in no noticeable rotation in the positions that parties take (results not shown).[28]

In other words, the model demonstrates that voters are mere spectators in rotational movements, a finding that is in conflict with portions of the issue evolution model proposed by Carmines and Stimson (1989). The dominance of activist rather than voter preferences in determining rotation results from the fact that it is activists

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[28] Likewise, the other parameters in the model do not affect rotation. Rather, the parameters β, τ, κ, σ_d^2, σ_v^2, *and* ρ only influence the degree of polarization in the system given any specific angle of conflict.

Dimension 1

Dimension 2

Dimension 3

Dimension 4

Total Polarization

Legend
— α_4 increased from .10 to .50
– – α_4 increased from .10 to .40
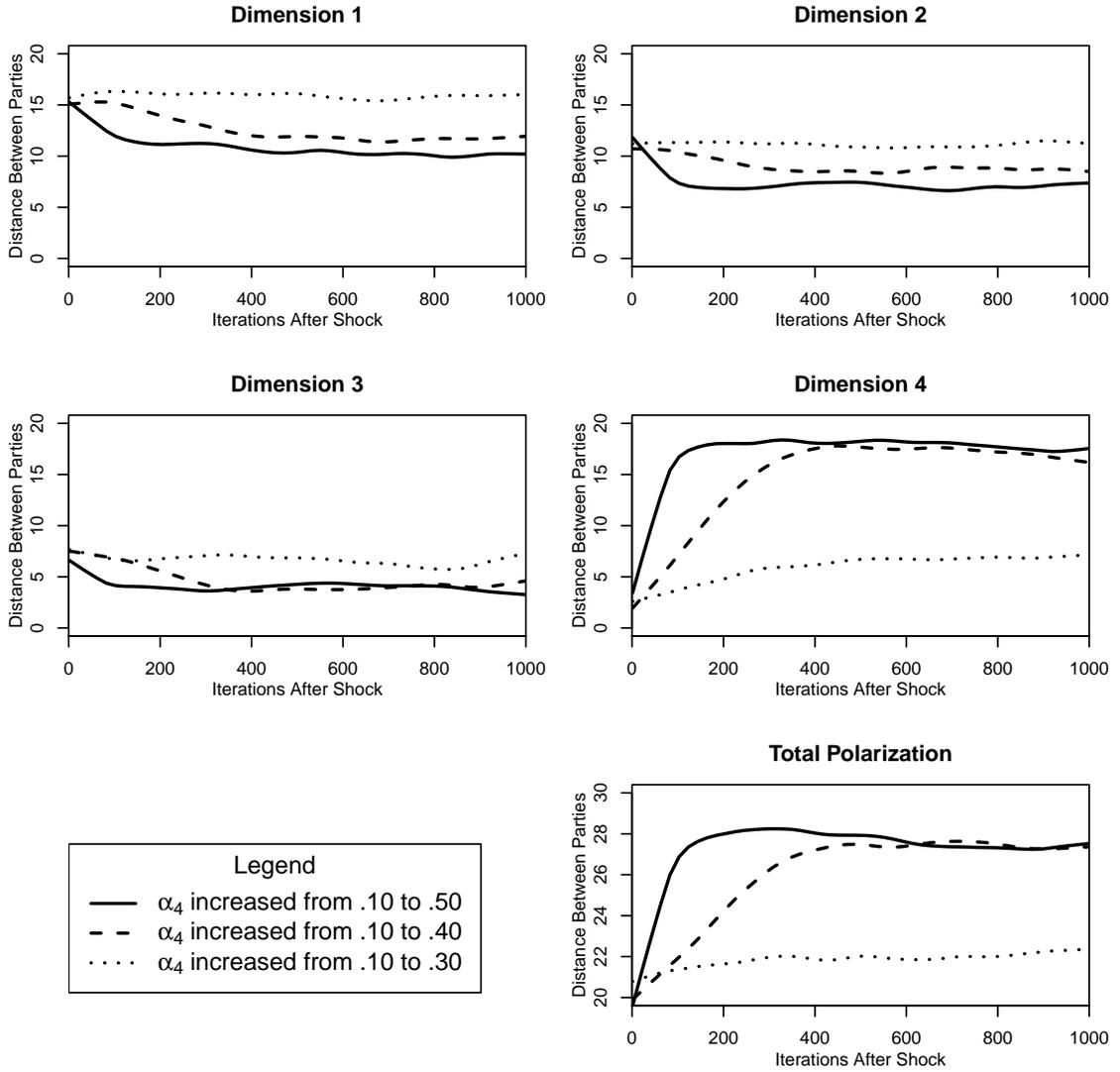···· α_4 increased from .10 to .30
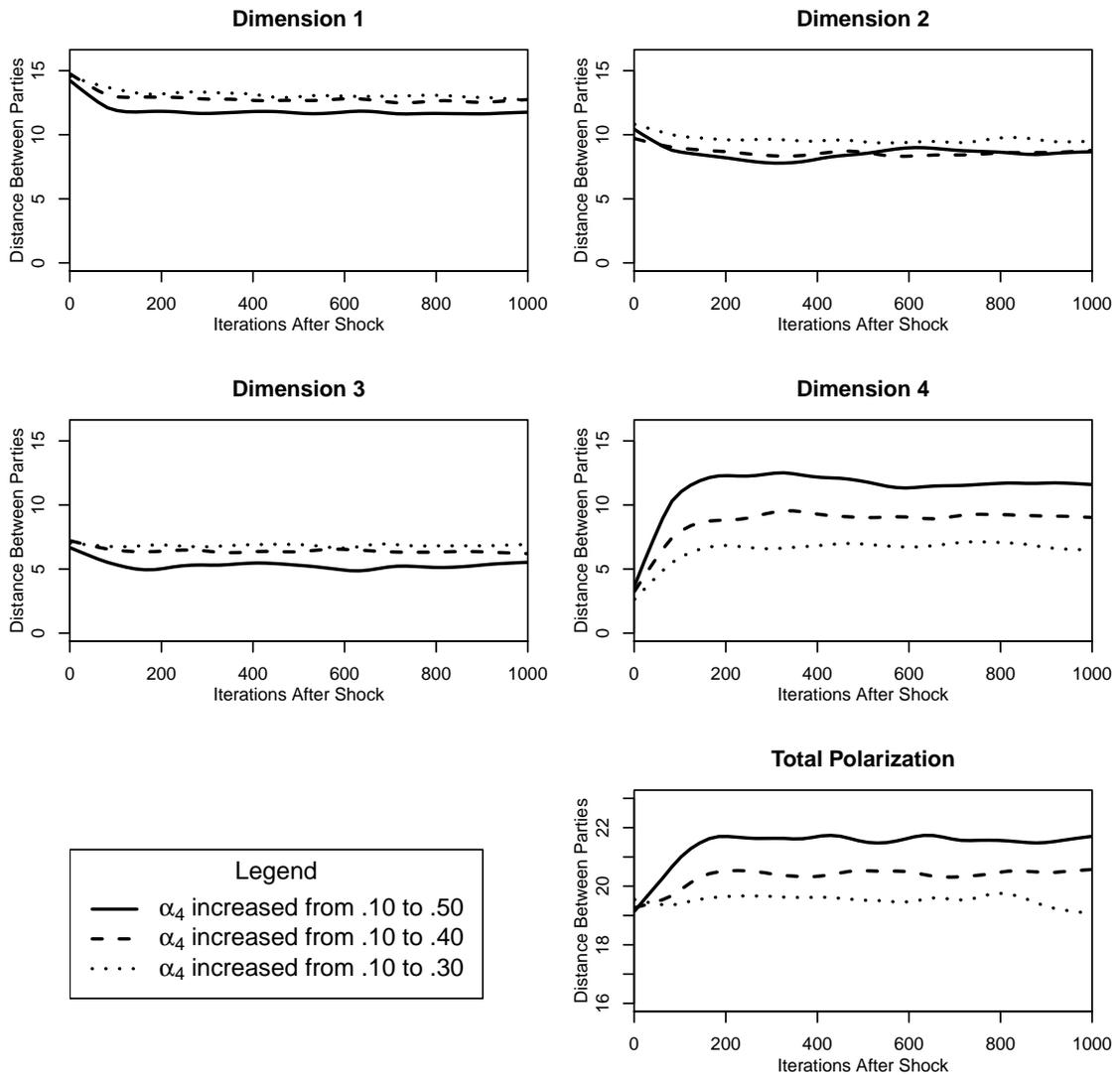
FIGURE 4.5: Experiment 2: Increasing the salience of a dimension for a subset of activists. This figure shows the effect of increasing the salience of dimension 4 for a subset of activists such that the total increase in salience is identical to figure 4.4. The results shown occur after a burn in period of 1,000 iterations. The lines show the "smoothed" positions of the two parties for five simulations from each setting of the model. Additional parameter settings are identical to experiment 1.

137

who provide the stable "base" that structures divergent equilibria. The process of party position change is inherently a discussion of how parties move from one equilibrium location to a new one. In order for voters to play a role in rotation, they must play a role in establishing the equilibrium. Although voters do play a role in determining the overall level of polarization in a given equilibrium (as I discuss below), their preferences are irrelevant in determining the angle of conflict (see Figure 4.1).[29]

To be more precise, voter salience plays a role in determining the level of polarization given any specific configuration of activist saliences ($\boldsymbol{\alpha}$). To demonstrate this point, I conduct an additional simulation experiment. In experiment 3, I begin with the assumption that voter saliences ($\boldsymbol{\delta}$) and activist saliences ($\boldsymbol{\alpha}$) are identical, $\boldsymbol{\delta} = \boldsymbol{\alpha} = (.4, .3, .2, .1)$. After letting the simulation run for 1,000 iterations, I alter the saliences of the dimensions. In one set of simulations, I increase the saliency of dimension four from 0.1 to 0.4 for activists only (solid lines in Figure 4.6). In a second set of simulations, I increase the salience of dimension four for *both* activists and voters (the dotted lines in Figure 4.6).

The figure shows that when the parties diverge on a dimension that is unimportant to voters, the overall level of polarization observed in the system will increase. In other words, the model predicts conflict extension rather than conflict displacement, as depicted in Figure 4.1. When the parties diverge on an issue of no importance to voters, there is little cost associated with taking a more extreme position on that issue and the benefits in terms of resources are large.

Anecdotally, the result seems valid and may provide a stronger basis for the theory of conflict extension proposed by Layman and Carsey. In particular, this result may partially explain why the parties have become so dramatically polarized on various

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[29] The Pythagorean theorem shows that the degree to which parties will differ along any given dimension depends both on the angle and on the total distance. Thus, voters do play some role in determining a party's position along any specific dimension. However, for any given level of polarization voter preferences are irrelevant for determining the angle.
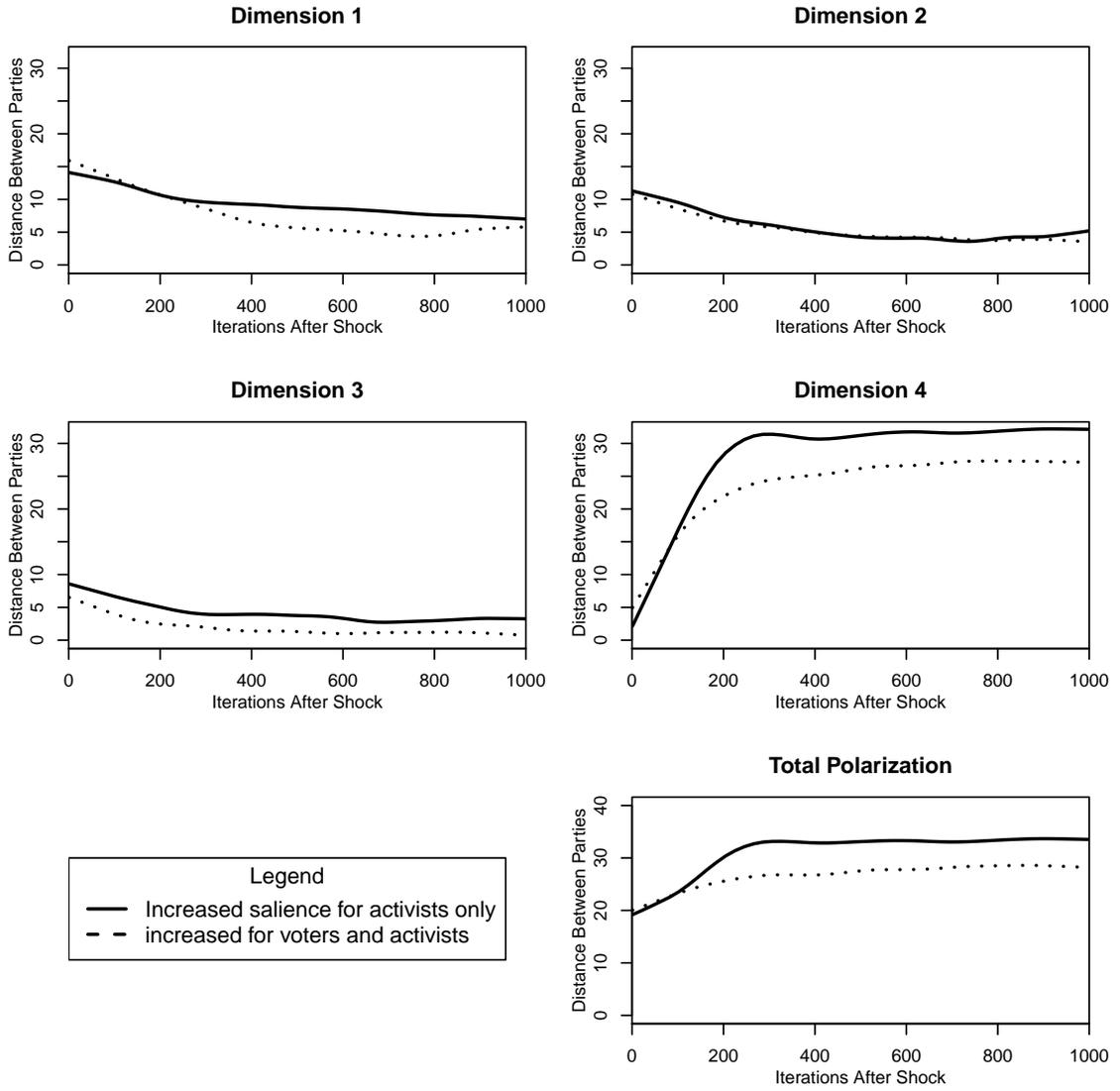
FIGURE 4.6: Experiment 3: Relative issue salience for voters and activists. The solid lines show outputs for 5 runs when α_4 is increased for all activists but δ_4 is held constant. The dotted lines show simulation outputs when the saliency of dimension 4 is increased for all activists and voters.

so-called "social issues," such as abortion, gun control, and gay marriage, that are very important to subsets of the activist base, but which public opinion data shows are of limited import to the mass electorate.

4.4.3 Extension and polarization

Thus far, the simulation results have been conducted while holding all other parameters constant. However, the data depicted in Figure 4.2 indicate that any party rotations in the contemporary era must be taking place in the context of an overall increase in polarization across all dimensions (McCarty, Poole and Rosenthal 2005; Fiorina 2005; Theriault 2008). A detailed examination of the parameters that control the level of polarization in the model is provided in Chapter 3. However, it is useful to briefly show that the model is able to account for rotation in the context of a general increase in party polarization.

Experiment 4 considers the possibility of rotation of the parties in the context of an overall secular increase in polarization. After burning in the model for 1,000 iterations, I alter two parameters. First, I increase the level of preference heterogeneity for all activists ($\sigma_d + \sigma_v$) from 100 to 600. Second, I increase the salience of one of the dimensions (in this case dimension 3) from .25 to .4 for all activists. The results are shown in Figure 4.7. The left panel shows the overall levels of polarization on all four dimensions. There is a strong increase in polarization across all dimensions, and there is certainly no decrease in polarization on any dimension as would be the case for conflict displacement. The right panel shows the level of polarization along each dimension, controlling for the overall secular trend. As can be seen, the parties diverge at different rates along each dimension. In particular, we can see that the parties move much more quickly along dimension three, which has an increased level of importance for activists.
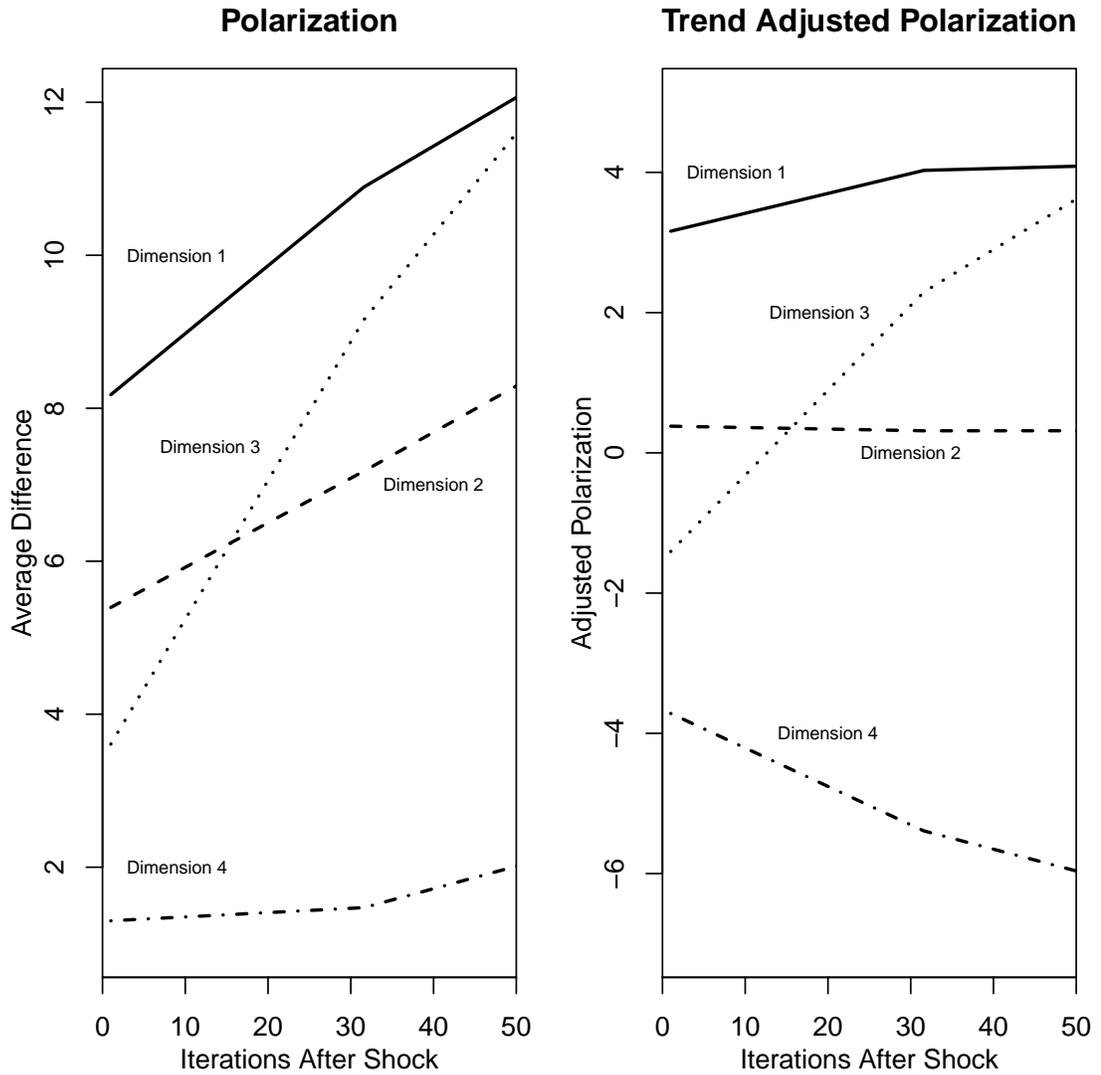
FIGURE 4.7: Experiment 4: Rotation in the context of increased polarization. The lines show the average distance between the two parties for one simulated run of the model. The model was burned in for 1,000 iterations. I then increased the saliency of dimension 3 for all activists, and increased the variance of the activist distribution from 100 to 600. These lines are the 50 iterations following this shock. The left panel shows the raw levels of polarization. The right panel shows the levels of polarization adjusted for the time trend.

4.4.4 Additional discussion

It is worth noting several additional theoretical issues that the simulation results address. First, the model shows that the "newness" of an issue is not as relevant as the importance or salience of the issue in determining rotation. It is crucial to realize that while legitimately new issues will necessarily have increased saliency (Hinich and Munger (2008) argue that new issues should be considered issues that previously had a salience of 0), such events are rare and perhaps even irrelevant. None of the "new" issues that are the focus of the classic realignment literature (e.g., slavery, monetary policy, economic management, civil rights) were new to the political scene at the historical moment when they gained prominence. Likewise, all of the issues that are the focus of more contemporary scholarship (e.g., abortion, gun control, gender issues, trade) have been areas of policy concern since the 18th century. In all of these cases, the changes in the positions of the parties began because these issues gained saliency for a larger share of potential party activists as the result of exogenous events or exogenous shifts in the status quo.

Second, numerous scholars suggest issue typologies to explain why the parties rotate on some new issues and not others. These include distinctions such as "easy" and "hard" (c.f., Carmines and Stimson 1989), "easily dramatized and understood" (Sundquist 1983, p 301), and "ends" and "means" (Stimson 2004). New cross-cutting issues that are easy, easily dramatized, or ends-related are hypothesized to foster party rotation. The above simulations provide some insight into the mechanisms that might underlie differences in the success and duration of party configurations. The ability of a newly salient issue to engender a rotation does not stem from the level of emotional content or the "easiness" of the issue. Rather these outcomes are predicted by the extent to which the issue remains *relatively* salient for a sufficiently *lengthy period of time*, a finding that is not apparent in static models of party competition.

142

If a dimension is salient for a brief moment, there will not be sufficient time for the dynamic process to take effect.

The ability of an issue to structure political competition over a lengthy period of time depends on whether or not it can remain *relatively* salient. Some issues (e.g., the Vietnam War, the Panama Canal) are less able to sustain disagreement because they are resolved (Carmines and Stimson 1989). Other issues lose their relative prominence due to external events. Mayhew (2002) suggests that this may be the reason that the parties failed to rotate during the Progressive Era of the early 20th century, as World War I intervened. Finally, some issues are structurally fused into the political domain due to status quo policies, and they are therefore more likely to remain highly salient for longer periods of time. For instance, questions about the appropriate scope of government intervention in the economy will unquestionably remain a fundamental point of contention between the two parties so long as the federal government controls such a large portion of the U.S. economy. Another example is the issue of slavery, which gained sudden political salience as a result of the acquisition of western territories in the Mexican-American War.

What does this say about the relationship between issue type and rotation? The saliency of an issue may or may not be related to its "easiness" or emotional appeal, but it is difficult to say from existing discussions. If easy or emotional issues are simply an indicator of higher salience, then the model above supports this argument. However, if these issue typologies are meant to imply something beyond increased importance, then additional conceptual clarification is needed regarding how easy or hard issues differ.

Finally, the model provides theoretical insight into the interdependent roles of candidate behavior and activist preferences in fostering rotation. A change in the underlying preference structure of activists is the necessary beginning for party rotation. However, it is the conjunction of this opportunity combined with the slight

143

separation of the two candidate populations that together initialize the dynamic process that is responsible for rotations.

4.5   Conclusion, future directions, and empirical implications

Past research on party rotations has tended to focus one of of two separate questions. First, what factors determine the equilibrium locations of parties, and therefore can explain when equilibrium positions are likely to change? Second, via what mechanism do the parties change their positions on the path from one position to another? In this chapter, I have presented a model of party dynamics that provides a precise formalization with strong micro-foundations and that offers an answer to both of these questions simultaneously.

The model is unique in adopting a Darwinian framework for electoral competition over time. I do this in keeping with previous empirical studies of party position change that have identified incumbent replacement as a crucial mechanism. In this way, the model offers an explicit formalization of previously qualitative theories of party evolution via electoral selection. In addition, the simulated outputs show that the model is able to account for a wider variety of party motions, including conflict extension, than any extant multi-dimensional model in the literature.

There are several advantages to adopting this evolutionary framework. First, it allows us to move away from the extremely strong assumption in existing formal models that: (1) parties can be adequately represented by single utility-maximizing individuals (Downs 1957); (2) candidates running under the same party label in different districts are entirely independent; (3) all candidates are seeking office in perfectly identical electoral districts; or (4) voters care only about party labels and not at all about individual candidate positions (Snyder and Ting 2002).

Second, past theoretical treatments of party dynamics in a multi-dimensional setting have been forced to either assume that activist affiliations arise exogenously

(i.e., independent of party or candidate behavior), that activists affiliate with one of the parties based only on the position of other activists rather than party or candidate behavior, or both (Aldrich and McGinnis 1989; Schofield 2004; Adams, Merrill and Grofman 2005; Roemer 2001). The model presented above, however, shows how activist affiliation and party positioning may interact dynamically over time in a gradual process that leads to locally stable party positions. In order to loosen this assumption, however, it is necessary to also consider the role that institutional parties must play in screening new candidates and biasing resources towards incumbents and challengers who take positions more pleasing to the activist base. This adds a layer of complexity to the model, but my hope is that it is compensated by increased verisimilitude.

Third, by more explicitly modeling the *process* of party position change as it occurs through the changing positions of populations of candidates and incumbents, the model's theoretical predictions are more consonant with the kinds of empirical data typical to studies of party dynamics. Although significant attention has been given to the role of presidential campaigns and elections in party position change, many of the most empirically rigorous approaches perforce rely on data about the behavior members of Congress, governors, and others. Providing a concrete model for how populations of candidates may "drift" over time in response to pressures in their environment may facilitate more rigorous empirical testing and allow us to move a step further away from treating our theories as distant analogies for the processes we seek to explain.

As this chapter concludes the development of my theoretical model, I conclude with a few words about potential paths forward. First, although I have argued that the model presented above provides important insights into real-world political dynamics broadly speaking, the extent to which it is an adequate representation of the reality is an empirical question. To begin with, the model rests on the somewhat

unusual assumption that replacement of candidates rather than strategic responsiveness drives party change. However, its accuracy remains an open empirical debate that deserves continued attention (Theriault 2006; Karol 2009; Poole and Rosenthal 2007; Poole 2007).

In addition, the model makes several predictions that may serve as a guide for future studies. First, it re-emphasizes the critical role that issue salience plays in determining party positioning. Of particular import is the salience of different issues to party activists or those who might be induced to become party activists. However, there is little consensus within the public opinion literature on how to measure issue importance, and what research does exist has primarily focused on explaining public opinion and political behavior rather than on party positioning. A closely related point is that the model makes the somewhat unusual prediction that, *ceteris paribus*, the parties should be increasingly convergent on issues that are most important to voters. In other words, it predicts that the parties should be the most divergent on issues that are important to activists but about which non-active voters are indifferent. If it is possible to develop a metric of issue saliency for voters and activists, this prediction should be tested.

There are also a number of possible theoretical extensions to this model. One of the best features of the agent-based approach is that it is possible to add ever-increasing levels of detail to any given model in order to better capture the phenomenon of interest. However, this is also one of the worst features of the agent-based approach, as it can lead to the inclusion of an ever-expanding list of increasingly poorly understood parameters (de Marchi 2005). Nonetheless, there are a few areas of research where this model may provide additional insight.

First, I have given little space in this chapter to analyses of voters. This is because voters play only a minimal role in determining either the orientation or the scope of political conflict. However, dynamic trends in public opinion and mass behavior

146

are themselves topics of considerable scholarly interest. Further simulation work may reveal valuable insights and testable predictions regarding shifts in public opinion and patterns of turnout. In particular, future extensions might model and parameterize the dynamic interaction between candidate positioning and partisan identification (Erikson, MacKuen and Stimson 2002; Green, Palmquist and Schickler 2002).

Second, like virtually all other formal models of elections, I have assumed fairly regularly shaped distributions of voters and activists. Questions remain regarding the generalizability of these results and their sensitivity to these distributional assumptions. However, the model is sufficiently flexible that these assumptions can easily be relaxed (e.g, de Marchi 1999). One point of particular interest would be to explore the results of unequal distributions of activist resources in the ideological space. We have a great deal of evidence to suggest that socioeconomic status is positively associated with both participation and ideological conservatism. To the extent that activists appear to have a disproportionate influence over party positions, this would suggest that varying the distribution of resources may bias electoral outcomes (Bartels 2008).

Finally, in my treatment of the institutional parties, I have purposefully abstracted away from a detailed consideration of how parties serve to both screen new challengers and bias resource distributions. Further extensions of the model might include specific hypothesized mechanisms such as primaries (Stimson 2004), informal organizations and networks (Masket 2009), and the distribution of particularistic goods and lucrative leadership posts towards more "loyal" incumbents and challengers.

5

An Ecological Theory of Party Movement: Activist Resources, Incumbent Replacement, and the Dynamics of Abortion Politics in the United States

5.1 Introduction

The value of the unitary-actor conceit of the Downsian model is its ability to explain important historical phenomena. Numerous scholars have documented that American political history consists of recurring patterns of social change and strategic party adaptation (c.f. Sundquist 1983; Aldrich 1995; Brewer and Stonecash 2008). Changes in the preferences or composition of the electorate are followed by changes at the elite level (often termed "re-alignments") that appear to be rational responses.

In this chapter, I argue that the theoretical models of party dynamics presented in previous chapters provide a compelling explanation for these empirical patterns, while building upon more realistic micro-level assumptions. Using evidence from the long-running public controversy on national abortion policy, I show how this ecological party model provides a better explanation for the kinds of macro-level

changes in party positioning that are the focus of the traditional "realignment" literature. However, the model is based on more realistic micro-level assumptions for how *populations* of individual candidates gradually adapt to changes in the electoral environment despite a lack of centralized leadership.

My ecological party model states that the policy positions parties take will reflect the issues most important to their activist bases. Intra-party competition for activist resources ensures that candidates who reflect the interests of party activists will be more electorally viable. Inter-party competition ensures that candidate populations will drift to the points in the policy space that maximize activist participation. It is the shifting compositions of the activist base, therefore, that lead to party position change. If the question is, "*Why* do parties change their position in the policy space?," my answer is activists.

Moreover, the specific mechanism for this process is far removed from the implausible unitary-actor assumption and more consonant with available data. The ecological party model states that candidates who take policy stances favored by the current activist base will be rewarded with more resources and slightly advantaged in competitive elections. Those candidates who take the wrong stance, or who are located in unfavorable districts, will lose. If the question is, "*How* do parties change their position over time?," my answer is incumbent replacement.[1]

In Chapter 4, I present the formalized ecological party model for a multi-dimensional setting. Here, I provide evidence demonstrating the empirical validity of this model by focusing on one specific issue – national abortion policy. Drawing upon extensive data sources on incumbents, activists, and voters, I test the extent to which my model is consonant with the dynamics of party positioning on the abortion issue in the 1972-2010 period. I focus on four specific claims.

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[1] As I discuss below, I do not claim that incumbents *never* change their stance on important issues. However, as I demonstrate, such individual shifts empirically account for only a small amount of party movement (c.f., Poole 2007).

First, the model predicts that changes in the affiliation and attitudes of policy-motivated activists are the engine that drives party dynamics. In the 1960s and early 1970s, activists on both sides of the abortion issue began to sort themselves into the two parties based on the newly salient issue of abortion policy. This led to *slightly* higher rates of success for pro-choice Democrats and pro-life Republicans, which in turn encouraged more sorting of activists into the parties based on the abortion issue. It is the repetition of this cyclical process over time that leads to party position change. Second, the ecological model implies that although incumbents will be somewhat representative of the opinions of their districts' voters, they will be far *more* representative of their activist base over time. I show in Section 5.4.1 that both of these expectations are supported by the data.

Third, the ecological model assumes that the vast majority of party change should occur *not* through the process of strategic adaptation by individual candidates (as is assumed in virtually all other theoretical models) but by the gradual replacement of pro-choice Republicans and pro-life Democrats. Finally, this replacement should be accompanied by district sorting. Districts with relatively extreme positions on abortion should become increasingly represented by only one party. In Section 5.4.2, I provide evidence supporting these latter claims.

In the next section, I briefly review the literature on American party dynamics, and then provide some intuition into the ecological party model. I also provide exemplar simulations from the model and specify my empirical expectations. To test these hypotheses, I use estimates of public opinion on abortion at both the national and state level, the ideal points of incumbent office holders on abortion policy, and measures of activist attitudes. In Section 5.3, I describe my data sources and measurement strategy. The core of my empirical analysis is in Section 5.4. However, before moving onto the data, I will first provide more context as to how my ecological party model fits into the wider literature on American party dynamics.

In the next section, I briefly discuss the major features of my model with an emphasis on how it differs from previous approaches and thus contributes to our understanding of American party dynamics.

Before moving on, however, I emphasize that both my theoretical model and my empirical expectations assume that political competition occurs in a multi-dimensional policy space. My goal is *not* to explain party polarization in general terms (Fiorina 2005; McCarty, Poole and Rosenthal 2005; Theriault 2008), but rather to explain how and why the parties have diverged in a specific policy area. As I show below, I understand the party shift on abortion policy to be an example of what Layman and Carsey (2002) term "conflict extension." The parties have polarized on the abortion issue while at the same time continuing to disagree on more traditional policy areas such as taxation and government spending.

5.2   Theories of party position change

In seeking to explain party dynamics, the first question must be: why do parties change their positions over time? One answer forwarded in past research is that parties move in response to the exogenous introduction of "new" (or newly salient) political issues (e.g., Schattschneider 1960; Sundquist 1983; Aldrich 1983*b*; MacDonald and Rabinowitz 1987). For instance, Sundquist's first generalization states that "a realignment has its origins in the rise of a new political issue (or cluster of related issues)" (1983, p. 298). However, as discussed in Chapter 4, previous studies have not always been clear regarding what is meant by "new" nor *to whom* the issue must be important to spark a party movement. Some theories have emphasized voters (c.f., Carmines and Stimson 1989), while many others have focused on activists (c.f., Aldrich 1995; Miller and Schofield 2003).

Indeed, activists, interest groups, and other political organizations are pivotal in much of the literature on party dynamics. Parties are theorized to alter their

positions either to (1) incorporate groups of unaffiliated potential activists (e.g., Aldrich 1983*a*; Fiorina 1999; Karol 2009; Miller and Schofield 2003; Schattschneider 1960; Sundquist 1983), or (2) to continue to extract resources from currently affiliated groups and individuals that are themselves shifting their preferences (Aldrich 1995; Karol 2009).

If these are the principal reasons forwarded to explain party movement, *how* would we expect such movements to occur? One proposed mechanism in the literature is the "critical election" (c.f., Key 1955; Burnham 1970; Sundquist 1983). Indeed, despite considerable criticism for both its theoretical rigor and empirical validity (c.f., Mayhew 2002; Carmines and Wagner 2006), the critical elections paradigm continues to gain adherents and generate new research.[2]

A second proposed mechanism for party change is the replacement of elected officials over time. Referring to historical shifts in the policy positions of parties, Poole and Rosenthal conclude that "changes in preferences must occur almost entirely through the process of replacing retiring or defeated legislators" (2007, p.79). The issue evolution theory likewise posits an *almost* Darwinian process of party dynamics through population replacement (Carmines and Stimson 1981, 1989). However, as I noted in Chapter 4, Carmines and Stimson "choose not to" formulate their argument in explicit Darwinian terms (Carmines and Stimson 1989, p 15). Finally, replacement is also central to recent accounts of "secular realignment." For instance, in explaining the rise of polarization since the mid-20th century, Brewer and Stonecash state, "As realignment unfolded, ... moderates were eventually replaced by liberal Democrats or more conservative Republicans, and the divisiveness within the party declined" (2008, p 28).

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[2] See, for instance, Jones, Kim and Startz (2009), Norpoth and Rusk (2007), and Bowler, Nicholson and Segura (2006).

5.2.1 *The ecological party model*

The ecological party model fills an important gap in this literature. Previous research is divided between models that formally derive predictions about the environmental conditions that encourage shifts in party position (c.f., Aldrich 1983b; Miller and Schofield 2003), and qualitative theories that focus on the *process* through which change occurs (c.f., Carmines and Stimson 1989; Layman and Carsey 2002; Brewer and Stonecash 2008).

The qualitative theories are more consonant with the gradual, replacement-driven position changes seen in the data. Their weakness is that they lack the rigor and completeness of a formalized model (Aldrich 2003). As noted in Chapter 4, a basic assumption of issue evolution is that the "American party system exists in a state of equilibrium" (Carmines and Stimson 1989, p 140). Yet, Carmines and Stimson are candid in stating that they "do not know" what mechanisms drive the system towards equilibrium, what preserves the new equilibrium when it is achieved, nor what punctuates it at the "critical moment" when issue evolutions begin. Likewise, the realignment literature (e.g., Sundquist 1983) conceptualizes party change as something that happens intermittently between periods of "normal politics," a concept that implies, but does not explain, a steady-state equilibrium.

The advantage of existing formal models, on the other hand, is that they carefully derive the conditions under which strategic parties are likely to alter their policy positions. They provide clear predictions (usually involving changes activist coalitions or preferences) for when we should expect parties to move. However, the underlying single-actor assumptions of these models are problematic in the American setting. Moreover, they require that party movement result from the adaptation of strategic individuals, something that is not borne out by the data.

In the end, there is no extant model that predicts the seemingly strategic macro-

level shifts in party positioning that are so central to the study of party dynamics that also draws its empirical expectations from a micro-level theory consistent with established facts about *how* the process of party change actually works. The model I outline in Chapter 4 fills in this gap by borrowing insights from theoretical evolutionary biology and population ecology. It provides specific equilibria conditions, and thus predicts what changes in the environment will lead to party position changes. Unlike traditional Downsian models, however, it specifies that these equilibria will be obtained and sustained through the gradual process of electoral selection acting upon populations rather than than the strategic thinking of single individuals. In addition, my model specifies a specific mechanism through which parties will move from one equilibrium to another in a manner consistent with existing data.[3]

The logic of the model is as follows. In order to win or retain elected office, candidates need to strike a compromise between motivating the activist base and pleasing the mean voter position in their districts. Candidates too far in the policy space from their activist base will lose valuable electoral resources to more aligned co-partisan candidates. Activists, and the party institutions they control, do not reward defection (Aldrich 1995; Cox and McCubbins 2005). These resources (which we can interpret as time, money, or other assistance to campaigns) help candidates persuade voters and win. To be perfectly clear, *candidates face intra-party selection pressures* to take policy stances pleasing to the activist base.

On the other hand, candidates who take positions too far from the mean voter in

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[3] It is important to emphasize again that I am far from the first scholar to draw on theories from evolutionary biology and population ecology in the social sciences. Evolutionary economics research draws on work dating back to Schumpeter and has generated an expanding amount of scholarship based on evolutionary concepts (e.g., Dopfer and Potts 2008). In political science, the most notable examples are Lowery and Gray (1995) and Gray and Lowery (2000), who explicitly draw on population ecology theory in the study of interest group populations. Likewise, scholars such as Axelrod (1984), Kollman, Miller and Page (1998), de Marchi (1999), Munger (2008), and Holland and Miller (1991) draw deeply on evolutionary concepts and models. These issues are discussed at greater length in Chapter 1.

their district are disadvantaged in inter-party competition (Downs 1957). That is, *they face inter-party selection pressures* to take policy stances pleasing to the mean voter in their district. Candidates that take policy stances that correctly balance these competing interests are the ones most likely to survive, fill important positions in party organizations, and facilitate the recruitment of like-minded candidates to run in other offices.

The party populations, therefore, exist in an environment heavily influenced by the location of the activist base. Activists provide the resources, and intra-party competition for these resources prevents the convergence of the parties to the center of the policy space. Activists, in turn, are only willing to support a party when they perceive a difference between their aggregate stances in the policy space – the party "signal" (Cox and McCubbins 2005; Grynaviski 2010). When the parties are not clearly distinguishable on issues important to activists, policy-motivated activists will be indifferent and less likely to participate (Aldrich 1983*b*). The net result of these factors is that, under specific conditions, the two parties will always diverge on any political issue that is important to a significant number of activists.[4]

This is the explanation for how equilibria are maintained through selection pressures. But how do the party populations evolve when the electoral environment changes? Party position change occurs in four steps. First, activists place increased weight on a dimension in choosing between the two parties. Second, either through random events (Carmines and Stimson 1989) or because the parties were already slightly polarized on the new issue (Noel 2007), the two party signals (the mean position of candidates in each party) become distinguishable along this newly salient

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[4] This will only occur when: (1) activist resources are sufficiently valuable for winning election, (2) new candidates (perhaps to win primary elections) choose policy stances sufficiently similar to current incumbents, (3) activists possess a significant amount of resources, and (4) there are institutional mechanisms in place that bias the distribution of party resources towards candidates more aligned with the activist base. Otherwise, the parties will converge to the center of the policy space. I assume here that these conditions are met.

issue dimension.

Third, once some small separation of the two candidate populations occurs, an iterative process begins leading to increasing divergence on this newly important policy area. Some (but not necessarily all) activists re-sort themselves to affiliate with the party more aligned with themselves along this new dimension, thus shifting the position of the party bases. This will be translated into a slightly higher rate of survival for candidates with more extreme positions on the newly salient issue. Finally, the process will slow as the added survival benefit for candidates taking more extreme positions on the issue begins to equal the costs of taking positions too far from the district mean voter.

To understand the model a bit better, it is helpful to look at some example simulations. I begin by examining the aggregate patterns. Figure 5.1 shows a simulated example of of two parties dynamically responding to the introduction of a newly salient issue. The figure shows the mean position of incumbents, activists, and supportive voters (i.e., those voters who supported the party in the current election) for the hypothetical "red" and "blue" parties. In the initial period, I exogenously increase the salience of this dimension for a subset of activists. Substantively, this represents the introduction of new groups who care deeply about a specific policy area. This subset of activists care greatly about this issue, while many others care more deeply about other issue areas (Layman et al. Forthcoming). This "punctuates" the previously existing equilibrium and the parties begin to adapt.

After the initial election, three interconnected processes occur. First, activists begin to sort themselves into parties that agree with them on the new issue and gradually polarize. Second, the candidate populations in each party drift apart on this issue as more extreme candidates win a disproportionate share of resources from polarized activists. Thus, as is shown in the bottom panel of Figure 5.1, the candidate populations move apart. Finally, as the parties move farther and farther apart on

156

this dimension, voters also polarize on the new issue (Fiorina 2005).

The most important aspect of the figure is that *it is the activists who lead the way.* The model predicts, in the words of Carsey and Layman, that activists are "the mainspring of party polarization" (2006, p. 96). In more thorough simulation experiments, I show that it is *only* the polarization of activists in the model that can lead to polarization (Chapter 4). This is my first hypothesis.

> *Hypothesis 1: The polarization of candidate populations should follow the polarization of activists.*

It is important to emphasize that in this simulation, the distribution of preferences of voters and activists remain completely unchanged. No voter, activist, or candidate changes their stance. Only the candidate *populations* move over time. However, the partisan affiliation and level of participation of voters and activists do change in response to this party adaptation. Indeed, as stated above, it is this sorting of activists that is the underlying source of party polarization on the new issue. Moreover, as argued by Fiorina (2005), as the candidate populations polarize this polarization will also be reflected in voter behavior as choices become more stark. The sorting of candidates, activists, and voters during the process of party movement is shown in Figure 5.2.

One important feature of Figure 5.2 is that, except in the initial stages when polarization has just begun, candidate populations will be far more representative of activists' preferences than of the opinions of their districts' voters. This leads to my second hypothesis.

> *Hypothesis 2: Members of Congress should be more responsive to the preferences of party activists than to district voters throughout the party movement.*

The above hypotheses are primarily focused on the "why" of party movement. However, the model also makes predictions regarding the "how." First, candidates
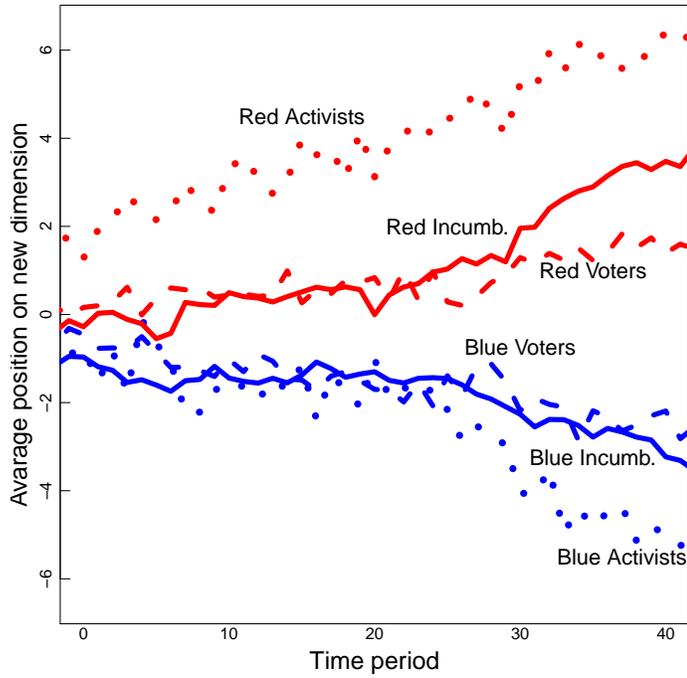
(a) Mean positions of voters, activists, and candidates on a newly salient dimension
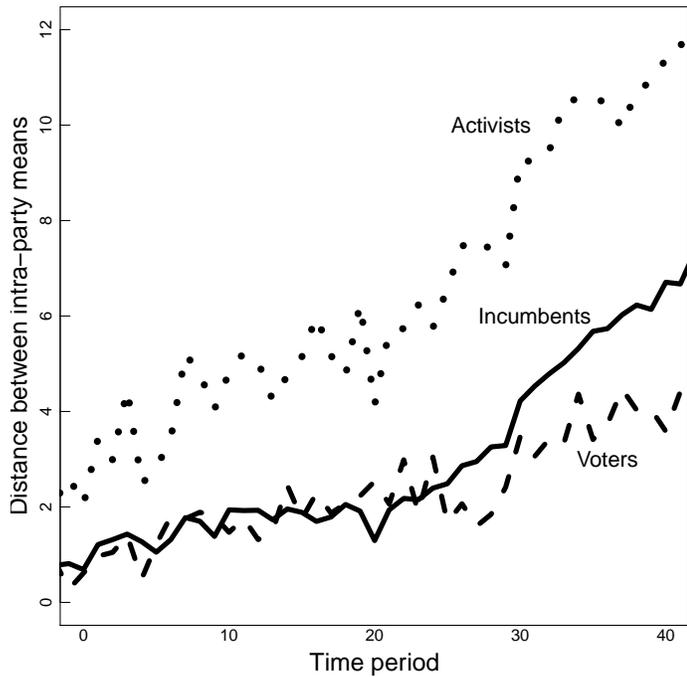
(b) Polarization of activists, incumbents, and voters on the newly salient dimension

FIGURE 5.1: Simulated aggregate patterns from an example of the ecological party model. In this simulation, the salience of this dimension is increased exogenously at time period zero. The parties, led by the activists, then gradually polarize.

158
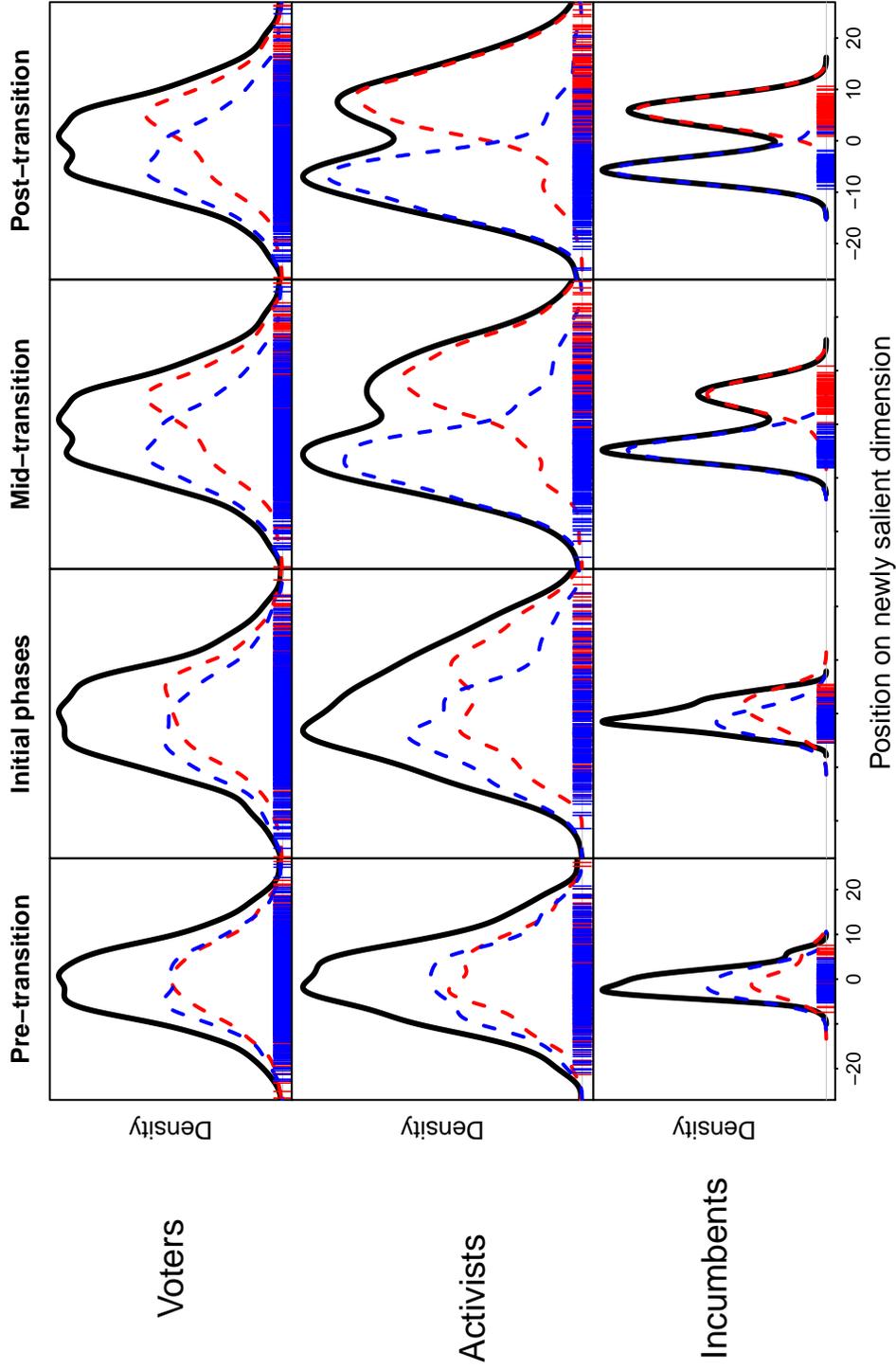
FIGURE 5.2: Distributions of incumbents, activists, and voters in four stages of party movement. Data are from an exemplar simulation of party movement depicted in Figure 5.1. The solid black lines show the aggregate distributions, and the dashed lines show the distributions within each party.

competing in districts that are far (in terms of the policy space) from their party's activists are significantly less likely to win. They are not able to take positions sufficiently close to the voters in their district while still taking a position pleasing to their activist base. Therefore, as the parties rotate in the policy space, incumbent candidates become "sorted" into the districts that are ideologically aligned with their activist base on the new issue. An example of this phenomenon is shown in Figure 5.3. The upper left panel shows the configuration of incumbent preferences and district means before the rotation begins, and each subsequent panel shows their position farther into the rotation process.

This sorting of incumbents into aligned electoral districts leads to a form of "leap frog" representation, where the overall relationship between district preferences and incumbent behavior is very high, but the within-party relationship is weak (Bafumi and Herron 2010). In Figure 5.3, the simple regression line between mean district opinion and incumbent position is shown by the thick black line. Comparing the slope of the line across the four panels shows that the relationship increases over time. However, the dotted colored lines show the within-party relationships between mean district opinion and incumbent preferences. The within-party relationship between district opinion and incumbent positioning actually decreases over time as the parties become increasingly homogeneous. This seeming contradiction arises because "red" candidates (shown as circles) become uncompetitive in districts in the negative range on the new issue, while the reverse is true for "blue" candidates (shown as triangles). This leads to my third empirical prediction.

> *Hypothesis 3: Party movement should result in the "sorting" of candidates into electoral districts more ideologically aligned with their party base.*

Finally, it is a maintained *assumption* of the model that candidate populations will move over time via the mechanism of electoral selection. Although there might be
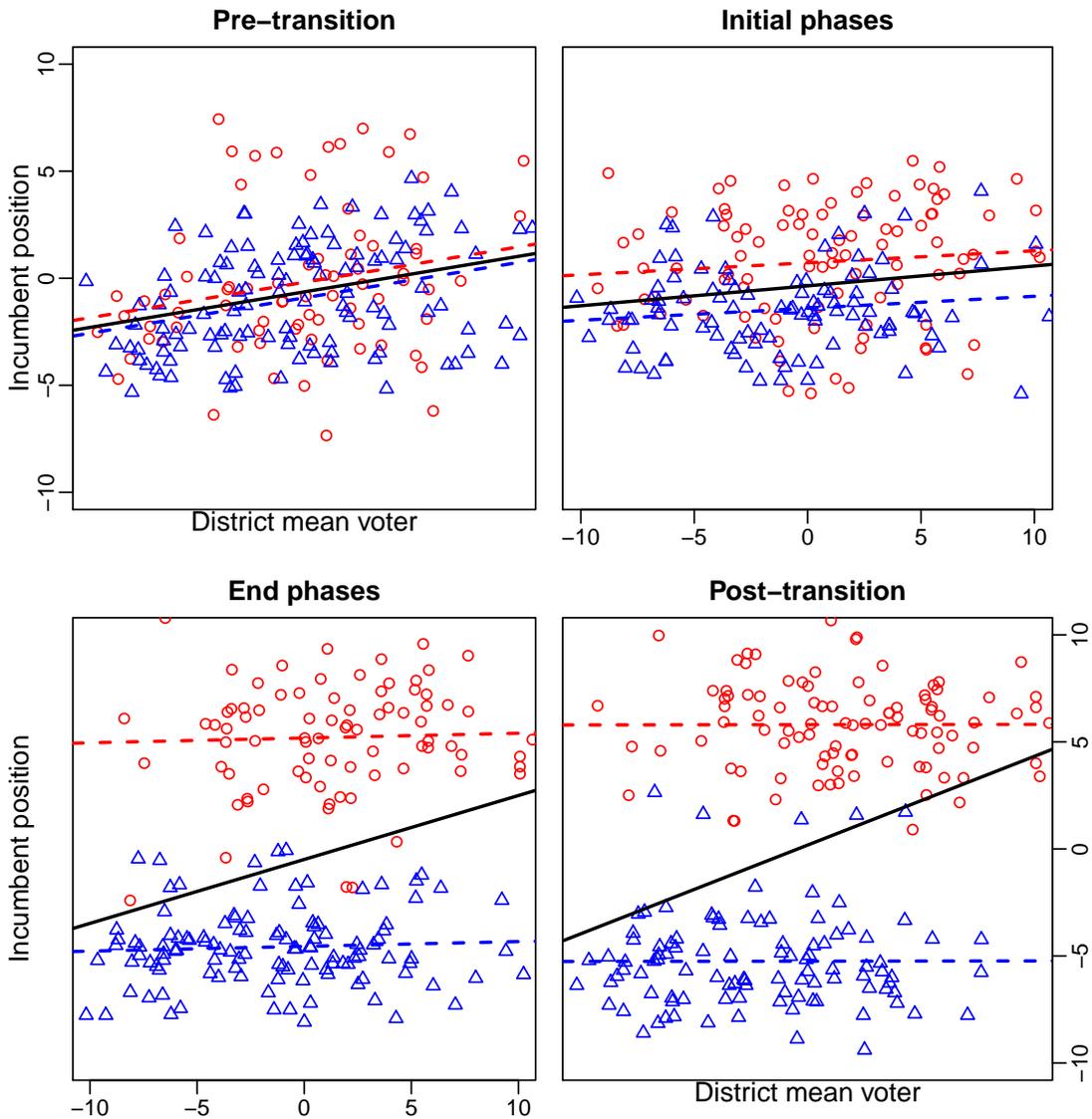
FIGURE 5.3: Ideological position of incumbents and mean voters in four periods. Data are from an exemplar simulation of party movement. The solid black lines show the linear relationship between incumbent positioning and mean district opinion. The dotted lines show the within-party linear relationship between incumbent preferences and mean district preferences.

some specific instances of individual candidates altering their policy stance over time, the preponderance of party movement should be a result of incumbent replacement rather than individual adaptation.

> *Hypothesis 4: Party movement resulting from candidate replacement should be greater than population change resulting from individual adaptation.*

5.2.2   Discussion

This theory differs from previous models of party dynamics in three important ways. First, the model places strategic policy-motivated activists and the resources they offer to candidates at the very center of the political process. It is the changing priorities and attitudes of these activists that structure when and why parties will shift their ideological positions.

Second, the model posits that changes in party positioning occur *not* via the mechanism of strategic adaptation but through candidate replacement. Thus, unlike Downsian models that predict instant responses by strategic candidates and parties to changed underlying conditions, the model predicts the parties will often adjust slowly over time in response to basic changes in the electoral environment far in the past. In this way, the ecological party model is much more consistent with the findings that members of Congress rarely alter the policy positions they advocate, but rather "die in their ideological boots" (Poole 2007).

Third, while several of the above predictions have been anticipated in part by previous scholars, the ecological party model is unique in its ability to unify this collection of empirical regularities into a coherent and internally consistent whole. For instance, activists are emphasized by Layman and Carsey (2002) in their theory of conflict extension as well as by Aldrich (1983*a*), Aldrich (1983*b*), Aldrich (1995), Miller and Schofield (2003), and Adams, Merrill and Grofman (2005). In addition, this argument has been previewed by several scholars focused on polarization more

162

generally. For instance, Fiorina (2005) posits in his concluding essay that one of the driving forces behind polarization is that "the people who participate are ... those who care intensely about some issue or some complex of issues" and that "the problem is that people who care deeply also tend to have extreme views on the issues they care deeply about" (p 199). As just mentioned, another body of scholars has provided evidence to support the notion that party movement (at least in Congress) is largely the result of population replacement (e.g. Poole and Rosenthal 2007; Poole 2007; Lott and Reed 1989; Bronars and Lott 1997; Bender and Lott 1996).

However, no previous work, at either a theoretical or empirical level, has unified these phenomena. As I state above, the ecological party model is a story of resources and survival. Populations of candidates drift apart on "new" policy dimensions in response to the polarization of activists via the mechanism of electoral selection. Thus, it is the primacy of activists combined with the primacy of population replacement that is the model's contribution. To test the validity of this story, it is necessary to re-examine available data in a new way to ensure that the coherent story offered by the model matches the evidence regarding the "how" and "why" of party movement in the historical record.

5.2.3 Case selection

The long-running controversy on abortion policy in the United States is an ideal setting for testing my model. To begin with, abortion policies are important. Abortion raises normative questions regarding the appropriate scope of state action, the boundaries of personal privacy, and the meaning of personhood itself. Federal law controls not only which abortion procedures are legal but also the ability of many women to access abortion services. Current laws affect federal employees, residents of the District of Columbia, federal prisoners, Peace Corps volunteers, Native Americans, military personnel and their families, Medicaid recipients, and foreign nationals

receiving aid from both U.S. and U.N. agencies.

Abortion politics is important to American politics in a more general sense. Few issues in American politics have exhibited such a pervasive tendency to "leak" into seemingly unrelated policy debates (Ainsworth and Hall Forthcoming). Debate over abortion has erupted during consideration of bills on health care, the Legal Services Corporation, bankruptcy reform, defense spending, foreign relations with China, the National Institutes of Health, United Nations funding, government employee compensation, federal prisons and many other areas of government activity.

The abortion issue also presents several theoretical puzzles to scholars of party position change. Democrats and Republicans at all levels have polarized dramatically on the issue. However, there has been no concomitant shift in public opinion as we might expect from existing theories such as issue evolution (Carmines and Stimson 1989) or secular realignment (Brewer and Stonecash 2008). Although there has been a very modest degree of polarization by party identifiers, opinion on abortion has been static for decades. Moreover, individual abortion opinion is perhaps the most stable attitude there is (Freeze and Montgomery 2010). If abortion attitudes at both the macro and micro levels have remained unchanged, then why have the parties altered their positions so drastically? Before turning to these questions it is necessary to discuss the data I use to answer them.

5.3   Data and measures

To demonstrate the validity of my model, I gathered measures of: (1) ideal points of members of Congress, (2) preferences of voters at both the national and state level, and (3) the preferences of the activists for each party. In this section, I provide an overview of the data sources and measurement techniques used in the analyses below. Since several scholars have raised important concerns over the appropriate method for estimating dynamic measures of the policy positions of individual members of

164

Congress, I focus much more extensively on this measure (e.g., Herron 2004). A detailed description of my statistical techniques and a complete listing of the survey items included in these analyses are provided in the Appendix.

5.3.1 Measures of incumbent behavior

Like previous scholars of party dynamics, I rely on congressional roll-call data to measure the policy positions of incumbents (Carmines and Stimson 1989; Adams 1997; Karol 2009). Although roll calls do not encapsulate all the activities of incumbents, what happens in Congress is nonetheless important for establishing the reputations of individual members and the parties. I identified a comprehensive list of abortion-related roll calls.[5] I include 475 roll calls from the 91st[6] to the 110th Congress where more than 5% of members disagreed with the majority opinion. For convenience, I coded all roll calls such that a one is a vote in the pro-life direction.[7] Great care is required in constructing estimates of individual member preferences that are comparable across time (Herron 2004). It is easy to show that applying any statistical technique across multiple congresses without consideration of potential changes to the meaning of underlying latent scales can lead to estimates that have "no known interpretation" (Herron 2004, p.182).

Previous research on party dynamics on single issue areas rely almost exclusively on one of two approaches for measuring member preferences. First, most previous research uses additive scales (e.g., Adams 1997; Carmines and Stimson 1989; Karol

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[5] I included all roll calls identified by Adams (1997) and Karol (2009). I also consulted the issue codings provided by the Policy Agenda's Project, David Rohde's PIPC roll-call dataset, and Poole and Rosenthal's issue codings available on the Vote View website. Finally, I reviewed CQ summaries in the abortion issue area to identify additional votes. I include all roll calls related to the treatment and legal status of the human embryo or fetus. Therefore, the dataset includes votes on fetal-tissue research, human cloning, and embryonic stem-cell funding.

[6] There are very few roll calls in the 91st and 92nd Congresses. Therefore, most of the analyses below will focus on somewhat later periods.

[7] However, the three-parameter IRT model used below allows the data to speak for itself as to whether a 'yea' vote on each roll call should be coded as pro-choice or pro-life.

2009; Layman et al. Forthcoming). Member scores are calculated as the number of pro-life votes divided by the number of total votes cast. This approach assumes that, first, all roll calls are equally informative about members' abortion attitudes and, second, that there are no year-to-year differences in the underlying agenda. Second, some studies rely on adjusted interest group ratings as provided by Groseclose (1999) (e.g. Shipan and Lowry 2001). Here again, the underlying assumption is that the latent distribution for the entire chamber and the policy agenda remains fixed.[8]

I calculate estimates for members' ideal-points on abortion policy by fitting an item response theory (IRT) measurement model to this data (c.f., Jackman 2001). In this case, I estimate a three-parameter variant denoted:

$$\Pr(y_{ivt} = 1) = \Phi(\alpha_v \theta_{it} - \kappa_v) \tag{5.1}$$

where y_{ivt} denotes the vote of member i at time t on vote v. The "ability" parameter (θ_{it}) denotes each individual's tendency to vote in the pro-life direction, and is therefore the estimate of member i's ideal point at time t.[9]

This basic model is adequate for generating estimates of stable member preferences in a single chamber. However, as noted by Poole (2005) and Bailey (2007), additional assumptions are needed to generate estimates that can span multiple institutions (e.g., the House and Senate) and multiple time-periods while still retaining a comparable scale.

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[8] In addition, it is not clear that these scores have been generated by the interest groups using consistent methods or metrics for the past four decades. From a scientific standpoint, it is desirable to generate unbiased estimates from available evidence rather than rely on the black-box of historical interest-group scores.

[9] The "difficulty" parameter (κ_v) indicates the extremity of the cut-point for roll call v. High values indicate that only extreme pro-life members will vote yea. Finally, the "discrimination" parameter (α_v) indicates the extent to which roll call v cleanly delineates more pro-choice and pro-life members. Values close to zero indicate that all members are equally likely to vote yea regardless of their underlying preference. Meanwhile, high positive or low negative values indicate that the roll call sharply divides members based on their underlying position on abortion. A visual display of the IRT models for two example roll calls is provided in the Appendix.

My solution is to identify multiple "bridge" observations (Bailey 2007). I identify 55 roll calls that I assume have identical difficulty and discrimination parameters in both the House and the Senate. These include, for example, conference reports and veto-overrides.[10] In addition, I identify multiple instances when either the House or Senate voted repeatedly on the same proposal in multiple time periods. In these cases, the same proposed policy change and the same underlying status quo are set against each other in two roll calls in two time periods. For example, in each Congress from the 104th-109th, Democratic members of the House proposed an amendment to defense appropriations bills to remove restrictions on abortion access for military personnel and their families posted in overseas bases. The restriction was never removed, and the basic underlying language of the amendments remained relatively static.

Using these bridges, I generate estimates of member ideal points in five distinct periods.[11] These periods were chosen to reflect fundamental shifts in the political environment (e.g., changes in the incumbent president or control of Congress) and significant shifts in the agenda and strategies of both pro-life and pro-choice groups. In addition, I chose these periods to ensure both a sufficiency of within-period roll calls and bridge observations. The periods are the Nixon-Ford-Carter administra-

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[10] In addition, I assume that members who switch chambers do not alter their position immediately. This assumption is commonly deployed for estimating ideal-points across chambers. However, given that I assume members can change their preferences over time in general, the assumption is not strong as it might first appear. In addition, there is reason to believe that the behavior of House members expecting to seek a position in the Senate may shift well before their actual transfer. So my approach ameliorates the need to identify the period when we would expect ambitious House members to begin to change their behavior in anticipation of a run for the Senate.

[11] Two alternative approaches would be to follow Poole and Rosenthal (2007) and Bailey (2007) in assuming that member preferences move in a linear or quadratic fashion over time. Alternatively, approaches such as Martin and Quinn (2002) place less structured priors linking observations over time. However, as one of my main claims is that replacement rather than individual adaptation accounts for party dynamics, I chose the method that was most likely to capture any individual-level preference change while still maintaining over-time comparability. In addition, I am not confident that the roll-call dataset on abortion is sufficiently large to generate unbiased estimates with these methods. In future work, I hope to compare these alternative methods for correctly recovering dynamic ideal points. A fuller discussion of these issues is presented in Appendix A.

tions (1972-1980), the Reagan administration (1981-1988), the George H.W. Bush and early Clinton administrations (1989-1994), the post-1994 Clinton administration (1995-2000), and the George W. Bush administration (2001-2008).[12]

My measurement strategy represents a significant improvement to the most commonly applied method for studying party dynamics on single issues. First, past estimates relied on relatively small numbers of roll calls. For instance, ideological estimates for members of the U.S. House from 1984-1987 were calculated by Adams (1997) using only six total roll calls for the entire period. By adding significantly to the universe of roll calls and pooling information across chambers and time-periods, my estimates are far less dependent on individual votes.

Second, previous analyses rest on the strong assumption that there are no year-to-year differences in the underlying agenda. Figure 5.4 shows the importance of questioning this assumption. The plot shows the average difficulty parameters in the roll-call record over time, and shows that the agenda is *not* stable. For instance, the difficulty parameters moved increasingly in the negative direction from the 104th-108th Congresses as issues like the partial birth abortion ban and the Unborn Victims of Violence Act dominated the agenda. From the 108th-110th Congresses, on the other hand, the agenda was dominated by stem cell research.[13]

Finally, the traditional approaches tend to over-estimate the degree of extremity in member preference. This can be seen in Figure 5.5, which compares the distribution of the additive and IRT measures. The figure shows the skewed distribution of

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[12] I categorize the early Clinton administration with the George H.W. Bush administration partly to distinguish it from the sequence of roll calls that occurred after the Republican takeover of Congress beginning in 1995. However, this also reflects an understanding of a generally pro-choice drift in both public opinion and congressional action throughout the 1989-1994 period. These years are dominated by Democratic efforts to roll back the restrictive policies put in place in the 1970s and early 1980s

[13] In each case, just as dominant theories of Congress would lead us to expect (Rohde 1991; Cox and McCubbins 2005), the agenda shifted such that roll calls divided the minority party but united the majority membership.
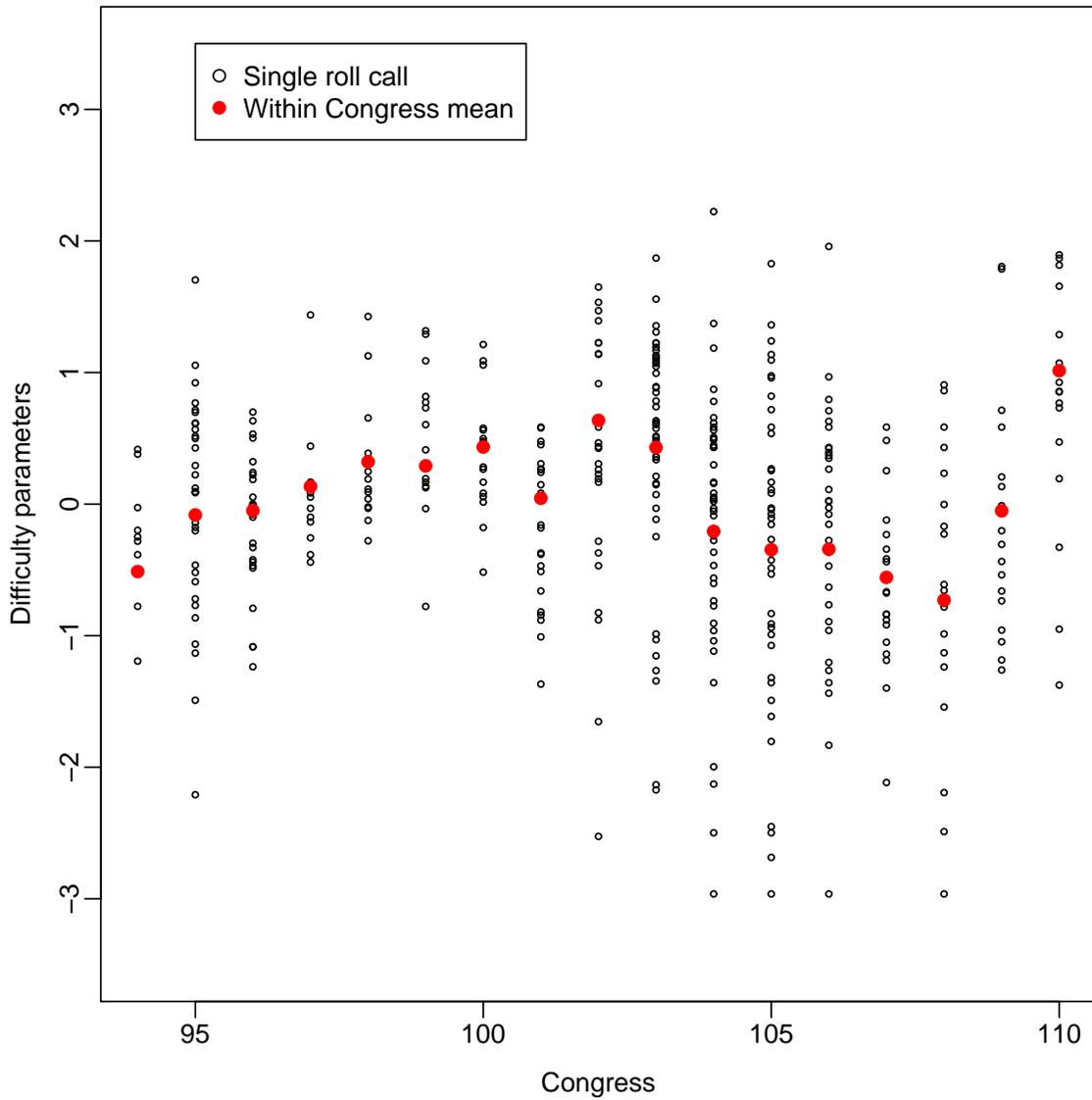
FIGURE 5.4: Agenda instability: The estimates of the difficulty parameters (κ in equation 1) for all roll calls in the dataset by Congress.

the additive scale relative to the IRT measure.

5.3.2 Voter and activist opinion

I use four separate data sources to explore mass-level opinion: the General Social Survey (GSS), the American National Elections Study (ANES) time-series, the Gallup

Simple Additive Scale   **Item Response Theory Estimates**
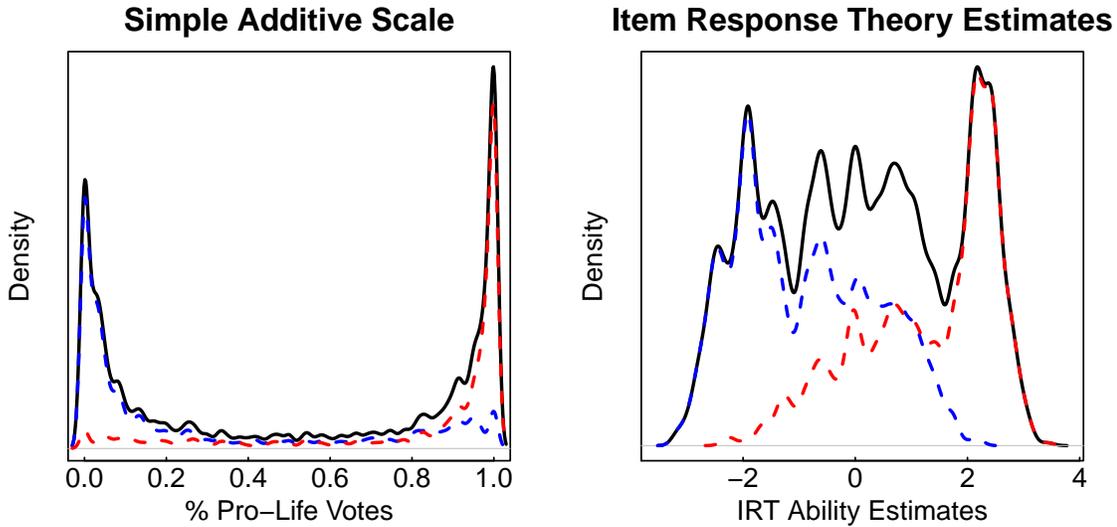
FIGURE 5.5: Comparing IRT and additive measure of member preferences

Poll, and the 1988-1990-1992 ANES Senate Panel Study.[14] I chose the GSS and Gallup survey because they have asked identically worded abortion items since the early 1970s. I use the ANES Senate study because the sampling frame was specifically designed to provide accurate estimates of state-level public opinion.[15] The questions I used from each of these sources as well as my measurement models are described in the Appendix.

My handling of the ANES time-series data requires more discussion. From 1972-1980 the American National Election Study (ANES) asked respondents to choose one of four statements that best agreed with their view on abortion: i) Abortion should never be permitted; ii) Abortion should only be permitted when the life and

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[14] This analysis is far from the first to use these data sources. For additional analysis of this data see Adams (1997), Fiorina (2005), Carmines and Woods (2002), Stimson (2004), and Layman et al. (Forthcoming).

[15] In future work, I hope to construct dynamic estimates of state opinion using the post-stratification techniques advocated by Park, Gelman and Bafumi (2006) as well as Lax and Phillips (2009). However, as is discussed more below, abortion opinion is remarkably stable at both the state and national levels, and there is little evidence to suggest that such a dynamic measure will markedly alter the results below.

health of the woman is in danger; iii) Abortion should be permitted when, due to personal reasons, a woman would have difficulty caring for the child; iv) Abortion should never be forbidden. After 1980 the question was altered somewhat to focus on specific situations when abortion should be *legal*.[16] Fortunately, the ANES included both questions on the 1980 survey, and it is possible to use these observations as a link between the items.

This method of bridging across the shifts in wording also facilitates the measurement of activist opinions. I rely on three separate data sources. First, following Carmines and Woods (2002) and Layman et al. (Forthcoming), I look at responses to abortion questions on the National Presidential Delegates Surveys.[17] The full question wording for these surveys is provided in the Appendix. However, with some slight variations, the 1972-1988 surveys used the pre-1980 ANES question described above. The 1992 and 2000 surveys use the post-1980 ANES question wording. A second data source for "high-level" activists is surveys of financial donors to the presidential candidates in each party conducted in 2000 and 2004. These surveys included the current ANES abortion item.

My final data source is the ANES time-series discussed above. I use this data to estimate the abortion opinion of "low-level" party activists. I define these as individuals who are in the top 10 percentile in rates of political participation (as measured by the standard ANES participation battery) who also identified moderately or strongly with one of the two main parties.[18]

Thus, all these data sources include one of the two ANES abortion questions

[16] The exact wording for the current question is shown in the Appendix.

[17] The 1972, 1980, 1984, 1988, and 1992 surveys were downloaded from the ICPSR website. The 2000 survey was kindly shared with me by Tom Carsey. The 1980 survey also included a mail survey of delegates to the 1976 convention, and I use these responses to estimate the 1976 data points. There was no survey in 1996, and in all subsequent analyses, I interpolate the 1996 data point as the average of the 1992 and 2000 estimates. See Layman et al. (Forthcoming) for a similar approach. The full question wordings and statistical methods are in the Appendix.

[18] The questions and method used to identify high-level participants are listed in the Appendix.

discussed above. In order to generate comparable estimates of abortion opinion, I again use the 1980 ANES to bridge across the two question formats. I am then able to estimate a time series of high-level activist opinion (delegates and donors) and low-level activist opinion (those identified in the ANES).

5.4 Results

With these measures in hand, I can now test the validity of my theoretical model. First, in what sense have the parties changed their positions on abortion over time? Like many so-called "social issues" in the contemporary era, abortion is clearly an example of conflict extension (Layman and Carsey 2002; Layman et al. Forthcoming). Since the issue first appeared in the congressional roll-call record in the early 1970s, the parties have moved farther apart on the issue. However, this has not been accompanied by party convergence in other areas.

This rotation in the policy space is shown in Figure 5.6, which plots my estimates of senators' abortion opinion against their DW-Nominate scores for four different congresses in this era (Poole and Rosenthal 2007). Nominate scores are a broad measure of a member's ideological disposition and are based on their entire roll-call history. We can interpret them to represent a member's position on the traditional left-right ideological scale. Figure 5.6 shows that the party populations have polarized on both issue dimensions simultaneously, but that the shift was more substantial on abortion.

Figure 5.7 provides a more comprehensive history of party movement on the abortion issue from the 94th to the 110th Congress. The figure shows standard boxplots of abortion positions by party for all members. Over time, the parties gradually diverged while becoming more internally homogeneous on abortion policy.

This polarization does not reflect a change in the overall distribution of possible ideal-points but a "sorting" of all Republicans to the pro-life (positive) side of the

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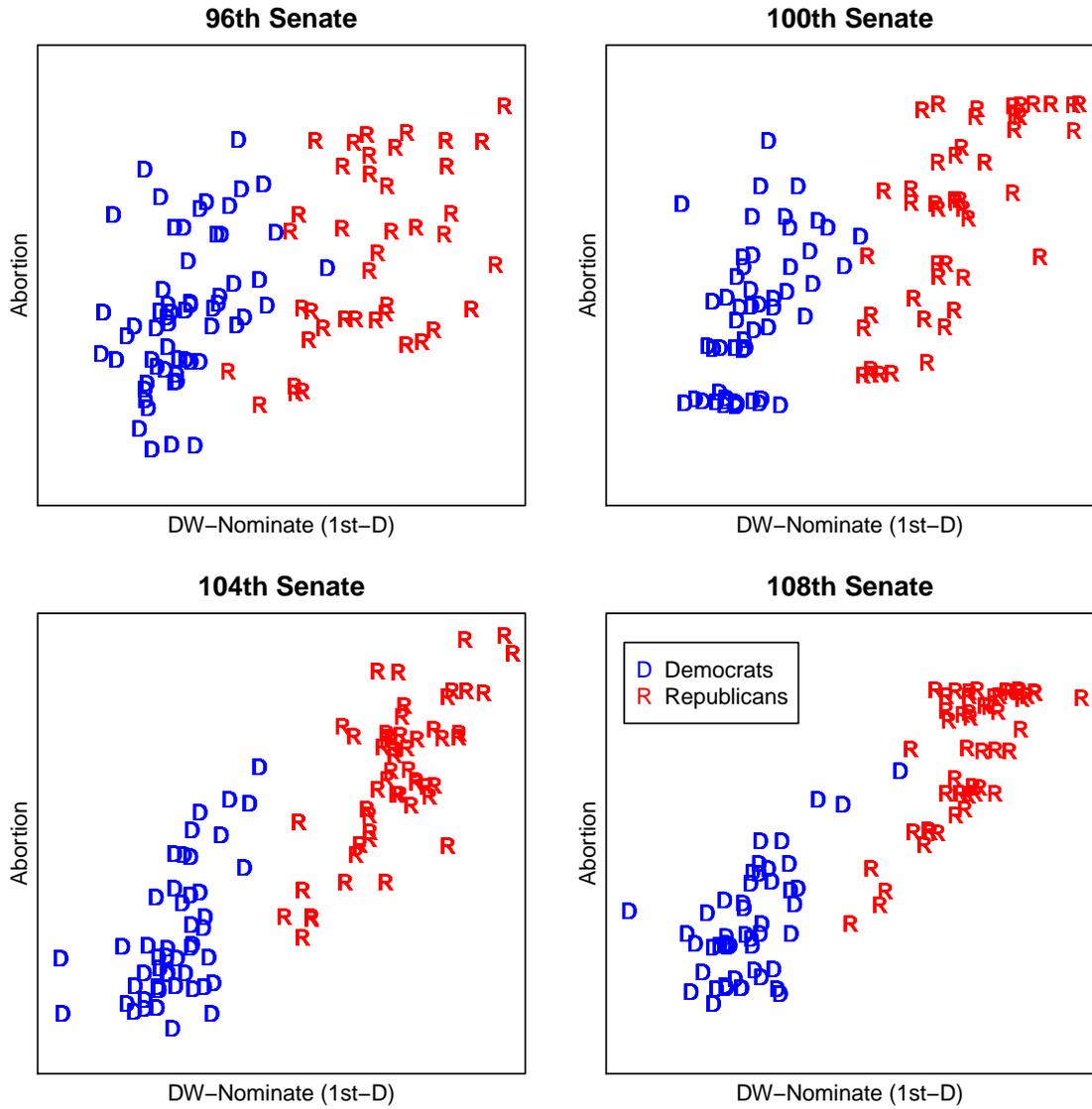
FIGURE 5.6: Ideal point estimates on abortion and general "liberal-conservative" dimensions in the U.S. Senate

scale and of Democrats to the pro-choice (negative) side.

How and why did this rotation in the policy space occur? As shown in Figure 5.8, the answer clearly has little to do with changes in the attitudes of voters. In all three time-series, public opinion on abortion has remained flat. There is some evidence that party identifiers polarized slightly. However, this polarization is very

Congressional abortion preferences by party (94th–110th Congress)
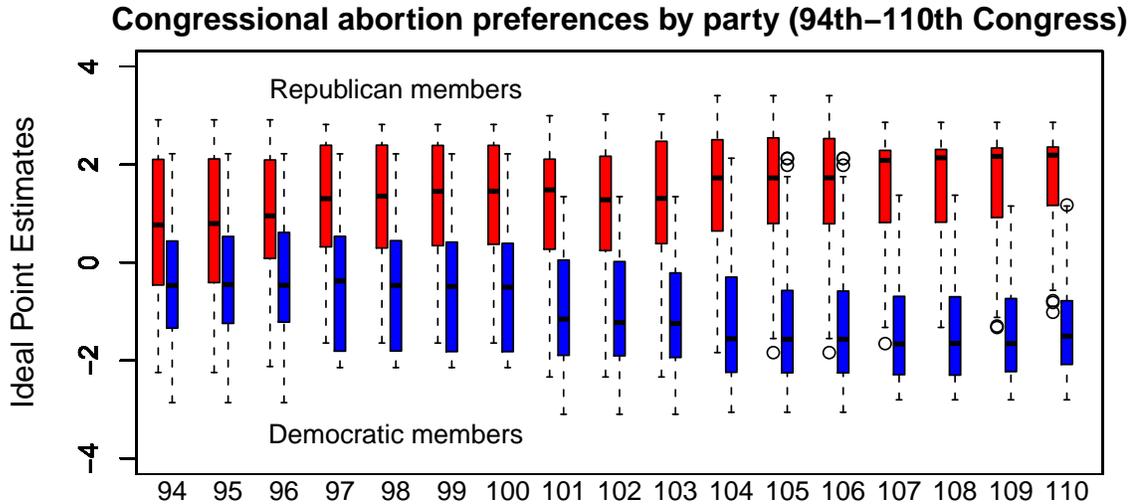
FIGURE 5.7: Polarization of incumbents on abortion policy. For each Congress, this plot shows the distribution of member preferences in each party. The distributions are summarized by traditional 'box-and-whisker plots.' The plot shows that the parties have diverged significantly, and that they have become more homogenous on the abortion issue.

modest relative to the overall scale. The dashed lines in each panel show the cut-point estimates for different response categories. Thus, the top left panel of Figure A.1 shows that Republican identifiers are not more likely to oppose abortion under even one additional circumstance than Democrats.

What then is driving the parties apart on abortion over this era? Moreover, how is this change occurring? The ecological theory of parties states that: (H1) the changing priorities and preferences of the party-activist base should be the instigating force driving party movement; (H2) throughout this transition, members should be more responsive to the preferences of activists; (H3) incumbents will become increasingly sorted into districts ideologically aligned with their party's activists base; and (H4) this movement should primarily occur through the mechanism of replacement. I now turn to examining the evidence for these claims.
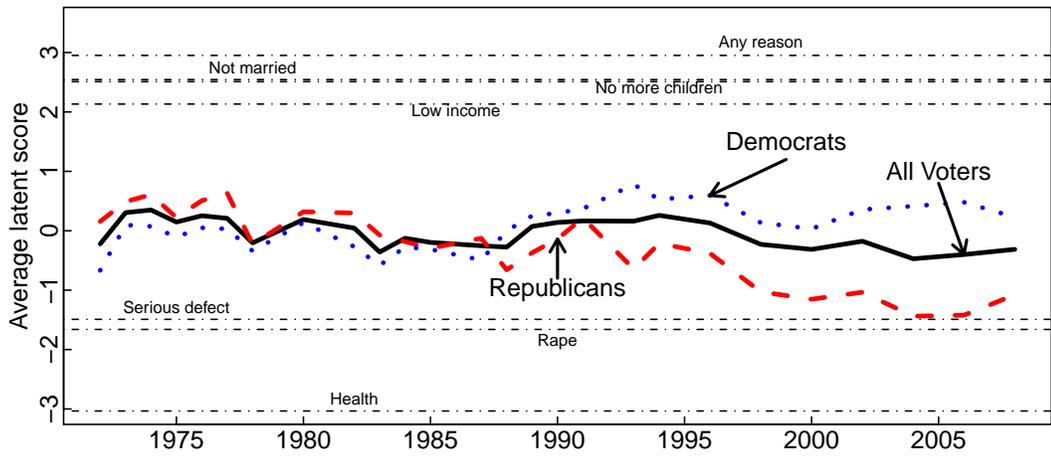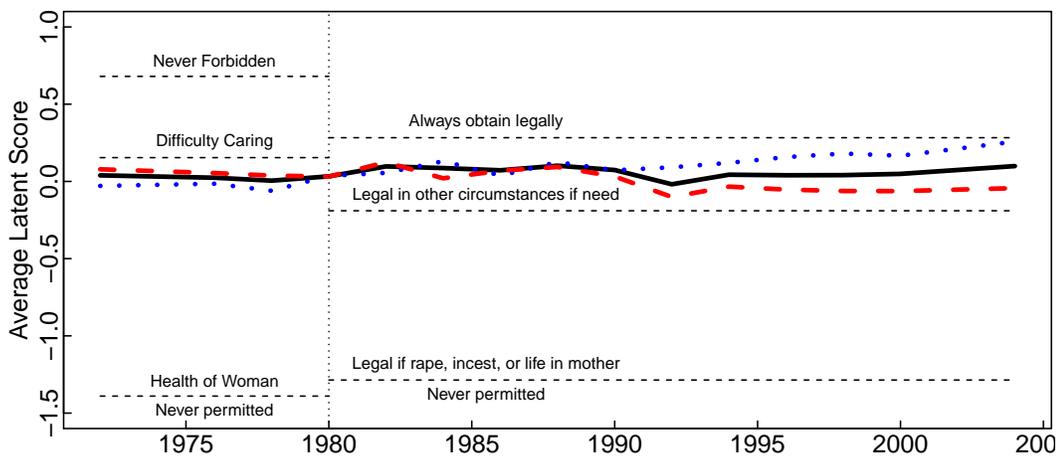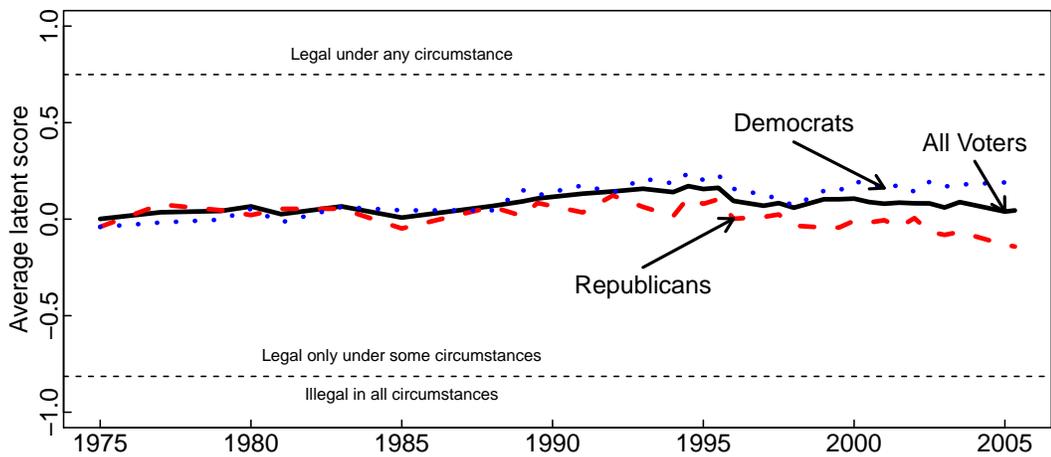
FIGURE 5.8: Latent abortion opinion by year and party from three data sources. Additional information on question wordings and measurement models are provided in Appendix A.

The ecological theory of parties states that the parties should gradually diverge on issues that become important to subsets of their activist base. Thus, the issue does not need to be "new," as has been argued by some previous scholars (Carmines and Stimson 1989; Sundquist 1983). Rather the issue needs to be newly important to an increasing number of activists.

The history of the abortion issue fits these expectations well. Abortion has been a subject of public controversy in America since the early days of party competition. Although there is no evidence that the issue ever came to the floor of Congress until the early 1970s, abortion politics was at least a century old at the time *Roe v Wade* was decided (e.g., Beisel and Kay 2004; Caron 2008; Mooney and Lee 1995). Abortion was not, as is sometimes portrayed, a "new" issue thrust onto the public stage by the court in the early 1970s. Rather, the decision is part of a much wider context that contributed to the increasing prominence of the abortion issue (Rosenberg 1991; Greenhouse and Siegel 2010).[19] Contributing factors included changes in medical technology, shifting attitudes amongst medical professionals, the revelation that the widely-used morning sickness medication thalidomide led to birth defects, increasing rates of pre-marital sexual activity, and a tremendous expansion of the national government into the provision of health care for women of child-bearing age with the passage of Medicaid (Caron 2008).

Politically, abortion first became an issue at the state level as pro-choice groups worked to overturn restrictions on a state-by-state basis. In other words, it was an important issue to many activists well before it leaped onto the national stage. Indeed, as is shown in Figure 5.9, by the time the issue appeared on the national agenda, activists and members of Congress had already begun to diverge. This

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[19] Recall that the alliterative epithet attached to McGovern during the 1972 election, "amnesty, abortion, and acid," pre-dated Roe by several months.

early rate of divergence amongst activists and incumbents is a first indication of the extent to which the positions of the parties is largely shaped by the attitudes of activists. Figure 5.9 shows the levels of polarization for members of Congress, delegates, donors, campaign activists, and party identifiers from 1972 to 2004.[20] Visually, the time-series for high-level activists trends much more closely with the rates of polarization of members of Congress.

With this data, I can explicitly test hypothesis 1: *The polarization of candidate populations and voters should follow the polarization of activists.* Although there are are relatively few data points to work with, it is still possible to conduct a basic Granger causality test.[21] I fit error-corrected Granger models.[22] The test involves fitting a full model $(y_t - y_{t-1}) = y_{t-1} + (x_t - x_{t-1}) + x_{t-1}$, and the reduced model is $(y_t - y_{t-1}) = y_{t-1}$. We compare the fits of these two models using a standard F-test to see if x is an important predictor of y. We can also fit the reverse models $(x_t - x_{t-1}) = x_{t-1} + (y_t - y_{t-1}) + y_{t-1}$ and $(x_t - x_{t-1}) = x_{t-1}$ and calculate the appropriate F-tests. If the results show that x affects y (i.e., $x \rightarrow y$), but that there is no evidence for the reverse relationship $(y \rightarrow x)$ then we can say that x "Granger causes" y.

I tested for Granger causality between the four time-series shown in Figure 5.9. The relevant F-statistics are shown in Table 5.1. The first column of this table shows that only the high-level activist time-series (delegates and donors) "causes" changes in incumbent positions $(F = 16.18)$. Moreover, the second column shows that the reverse, that incumbent polarization Granger caused activist divergence, is

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[20] Because all of these estimates are based on the two ANES question-wordings, activists and partisans are on the same scale. It is not possible to put members of Congress on the same scale with voters and activists with currently available data.

[21] Layman et al. (Forthcoming) conduct a similar analysis. Although their measurement techniques differ markedly from those I use here, their results are consistent.

[22] I restrict this analysis to a first-order Granger test due to the small number of observations I have to work with. I also conducted an uncorrected Granger test, which is presented in the Appendix. The findings are entirely consistent with those shown here.
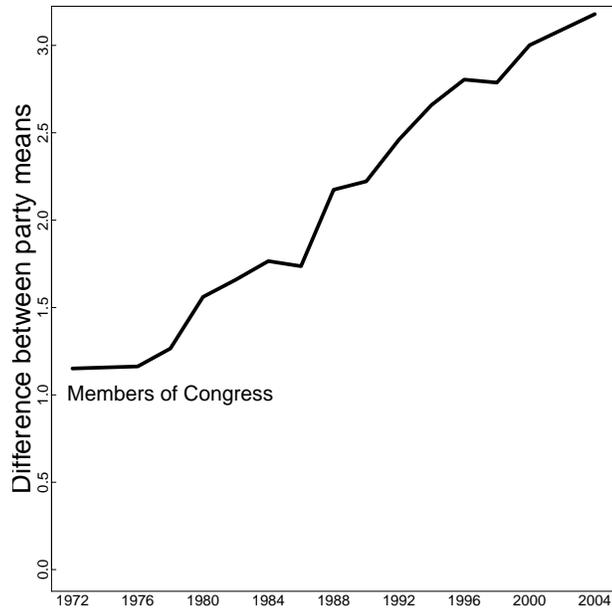
(a) Divergence of parties in Congress over time
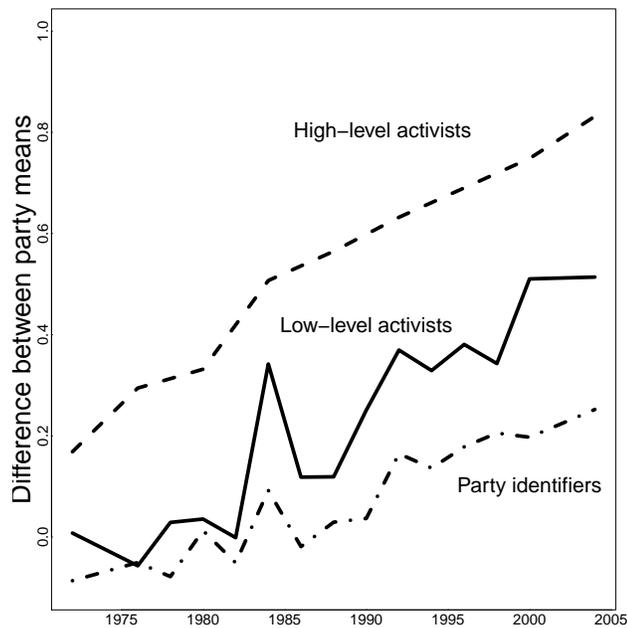
(b) Difference between party means for voters and activists

FIGURE 5.9: Aggregate patterns of incumbents, activists and voters on abortion

not supported by the data ($F = 2.3$).

One plausible alternative hypothesis is that these findings have nothing to do with

Table 5.1: F-statistics for error correction Granger models

	→ Congress	→HL activists	→ LL activists	→ Identifiers
Congress →		2.3 (0.216)	8.84 (0.006)	15.05 (0.001)
HL activists →	16.18 (0.012)		25.65 (0.005)	8.32 (0.038)
LL activists →	0.27 (0.767)	8.5 (0.036)		19.34 (0)
Identifiers →	0.98 (0.407)	5.1 (0.079)	19.94 (0)	

P-values are in parentheses. Models including data from the delegates time series include only presidential years and have only 9 observations. All others include 15 observations. The full model is $\Delta Y = Y_{t-1} + \Delta X + X_{t-1}$. The reduced models are $\Delta Y = Y_{t-1}$.

abortion *per se*, but are rather an artifact of the overall secular increase in polarization in Congress. To test this theory, I conduct an identical Granger causality test using W-Nominate scores rather than my measure of member preferences on abortion. This represents the time-trend in overall polarization rather than polarization on abortion policy. The results of this analysis are shown in Table 5.2.

If the results I discussed in Table 5.1 are indeed mere artifacts, we would expect to see identical patterns. However, the results in Table 5.2 show a very different pattern. Looking at the first column, it appears that there is a strong (and reciprocal) relationship between polarization in Congress and among low-level activists and party identifiers. Indeed, there is no evidence that polarization of high-level activists on abortion is related at all to overall party polarization as measured by W-Nominate.

Thus, the data support my theory at the aggregate level (although given the small sample sizes we should be cautious). However, the advantage of the ecological party

Table 5.2: F-statistics for error correction Granger models using W-Nominate

	→Congress	→ HL activists	→LL activists	→Identifiers
Congress →		0.49	7.61	26.12
		(0.645)	(0.01)	(0)
HL activists →	1.89		26.8	6.64
	(0.265)		(0.005)	(0.054)
LL activists →	2.8	10.42		19.56
	(0.108)	(0.026)		(0)
Identifiers →	7.54	5.51	20.45	
	(0.01)	(0.071)	(0)	

Main cells are F-statistics. P-values are in parentheses. Models including data from the delegates time series include only presidential years and have only 9 observations. All others include 15 observations. The full model is $\Delta Y = Y_{t-1} + \Delta X + X_{t-1}$. The reduced model is $\Delta Y = Y_{t-1}$.

model is that it does not simply rely on these aggregate time-series. It also makes predictions regarding the changing micro-level relationships we expect to observe.

My second hypothesis is that *members of Congress should be more responsive to the preferences of party activists than to voters*. To test this hypothesis I fit three relatively simple OLS regressions predicting the abortion ideal-points of U.S. senators in the 95th-109th Congresses.[23] In the first model, I include my measure of state abortion opinion and my estimate of high-level activist opinion for each party. In model 2, I add a dummy indicator for membership in the Republican party. All three variables are re-scaled to have a maximum value of 1 and a minimum value of 0 to ease comparison. The results of these two models are presented in the first two columns of Table 5.3. They show that, even controlling for party affiliation, activist opinion is far more correlated with senator behavior than state-level opinion, although senators are responsive to both constituencies.

There are two related concerns with these results. First, my measure of state-level opinion is static. Second, since my measure of activist opinion is the only element

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[23] Senators who retired early in the 1970s only voted on a handful of abortion votes before retirement. Likewise, new senators in the 110th Congress cast only a few abortion votes. I therefore restrict myself to the 95th-109th Congresses to reduce bias induced by missing data.

Table 5.3: Predicting senator ideal points (95th-109th Congress)

	Model 1	Model 2	Model 3
Constant	-2.33	-2.25	-1.63
	(0.07)	(0.07)	(0.12)
Mean voter opinion	1.85	1.86	1.77
	(0.10)	(0.10)	(0.10)
Own-party activist opinion	2.98	2.04	0.79
	(0.09)	(0.26)	(0.33)
Party (GOP=1)		0.69	0.72
		(0.18)	(0.18)
Time trend			-0.06
			(0.01)
Party × Trend			0.11
			(0.02)

(n=1,483) Results are from OLS predicting senator ideal points. All variables are standardized to be between 0 and 1.

in these regressions that changes over time; this almost necessitates that it will be significantly related to senator behavior. However, this is not as problematic as it may seem. Scholars of public opinion have long noted that there has been little change in opinion on abortion even at the state or regional levels. For example, Figure 5.10 shows estimates of abortion opinion by census region from 1972-2006. Although the smaller sample sizes in these estimates necessarily result in more noise, the only significant trend in the data is a slight increase in pro-life opinion in the East South Central and West South Central regions. Thus, since public opinion is so stable, the finding that activist opinion is more important than public opinion is not just an artifact of my measure but rather a feature of the real world. The parties are

moving in order to take policy stances on abortion more in line with their partisan base, *not* voters.
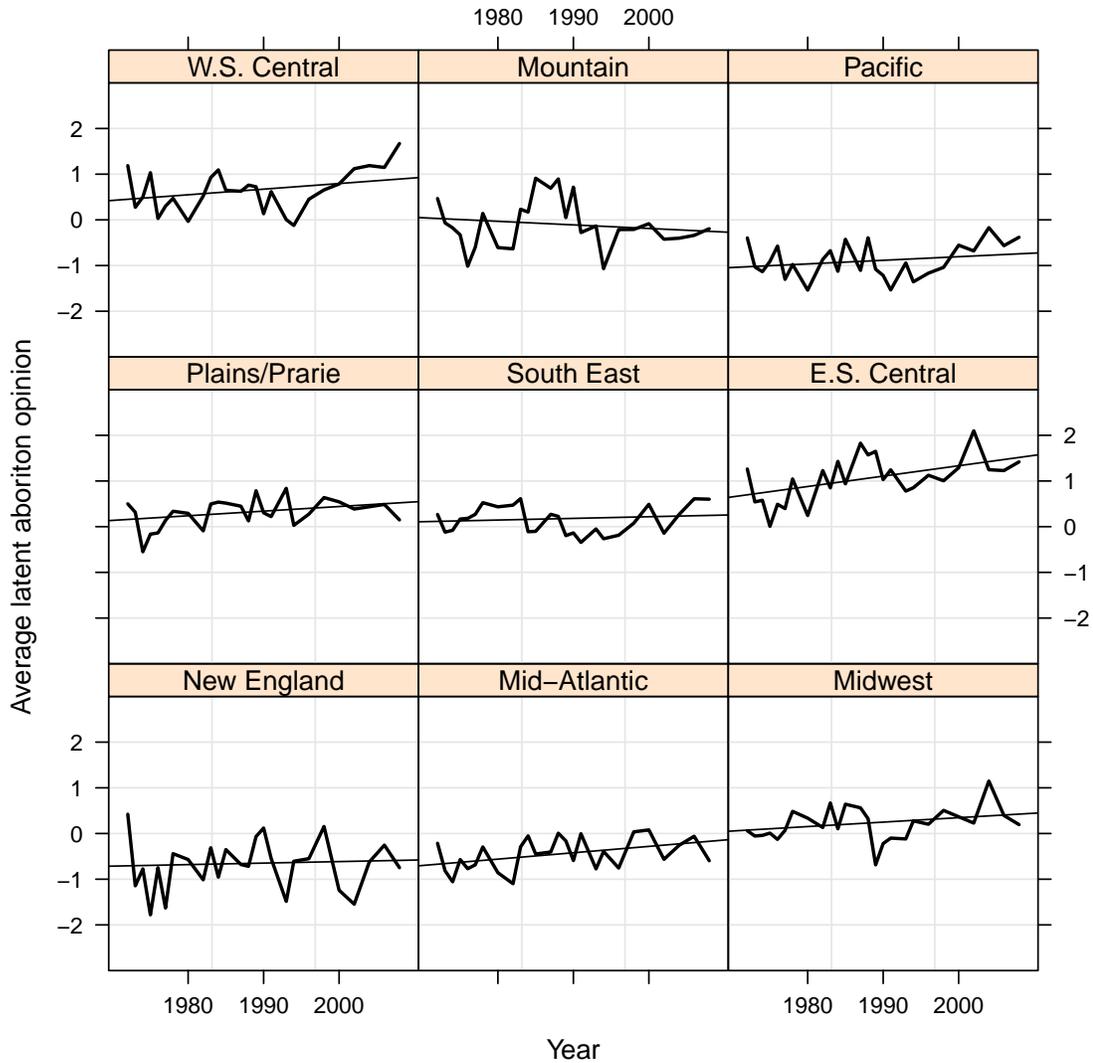
FIGURE 5.10: Dynamic abortion opinion by census region. Estimates for census regions are generated by disaggregating. Source: General Social Survey

To test the robustness of my findings, I fit a third model that includes a linear time-trend and an interaction between this trend and GOP membership. The model tests whether activist opinion is important even factoring out a general linear increase in polarization on abortion resulting from some unknown excluded factor. The results

of this model are shown in the third column of Table 5.3. The estimated relationship between high-level activist opinion and senator behavior is still 0.79 (SE= 0.33) and is strongly significant.

In total, therefore, there is strong evidence to support the theory that changes in the behavior of members of Congress are highly responsive to the preferences of party activists. Activists have the resources needed to win elections, and it is the activists who are leading party polarization on the abortion issue. In the next subsection, I turn to exploring *how* the parties change in response to the shifting composition and preferences of their activist base.

5.4.2 Population replacement

The third hypothesis of the ecological party model is that *party movement should result in the "sorting" of candidates into electoral districts more ideologically aligned with their party base.* In the case of abortion politics, this implies that pro-choice states will increasingly be represented by Democrats, pro-life districts by Republicans, and only those states in the middle of the spectrum will be competitive for both parties. The best way to understand the empirical patterns predicted by the model is to consult Figure 5.3 above.

How do the theoretical expectations generated from the model match up with patterns in the data? Figure 5.11 shows the evidence for the 94th, 98th, 102nd, 106th, and 109th Senates. On the vertical axis are the ideological positions of senators, and on the horizontal axis are state-level estimates on mean voter opinion on abortion policy. The solid black lines in these plots show the estimated linear relationship between state preferences and senator ideal-points. The within-party linear relationships are shown in the dashed lines.

Just as the ecological party model predicts, Figure 5.11 shows that the relationship between mean voter opinion on abortion and senator behavior has increased
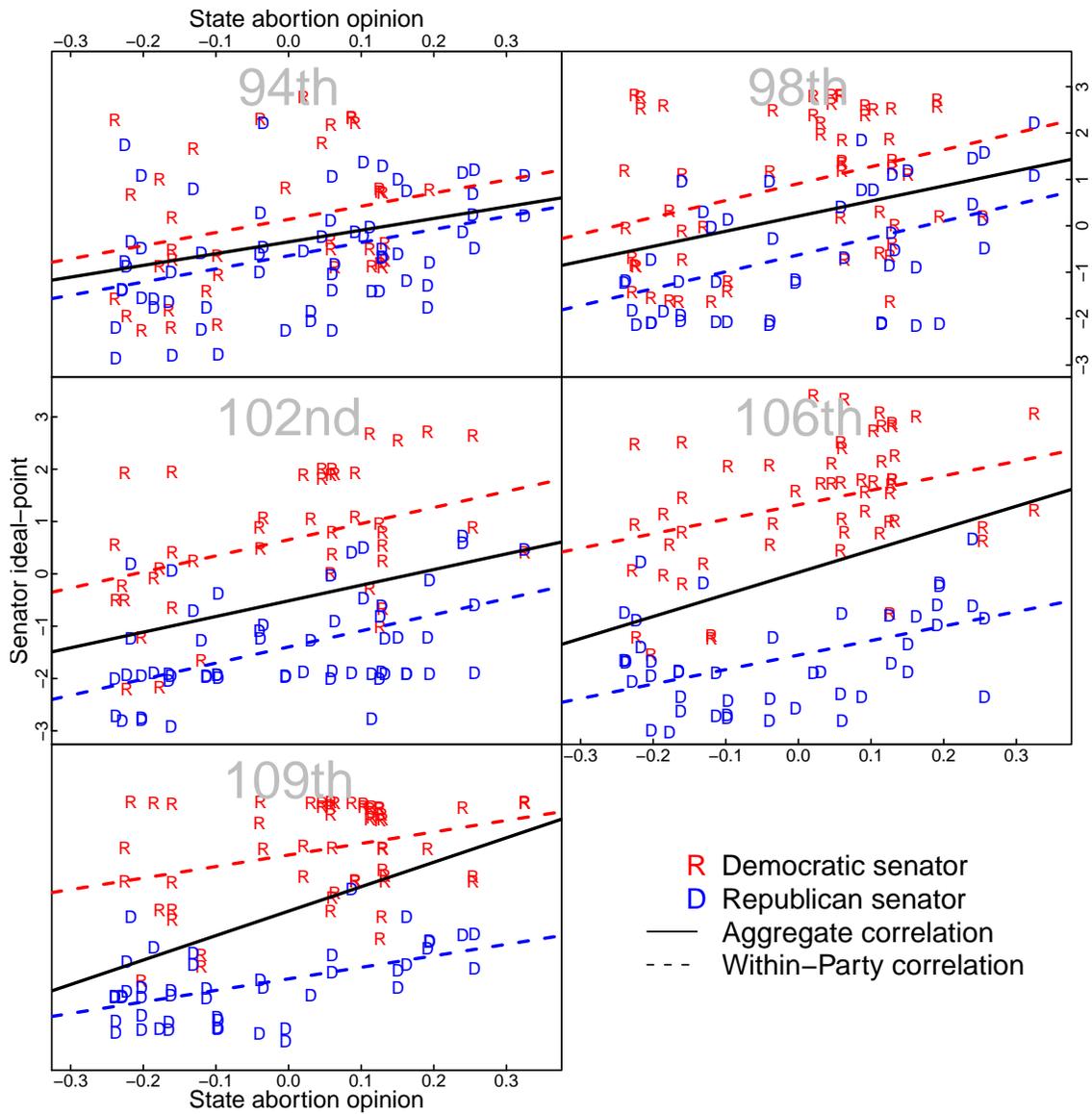
FIGURE 5.11: Sorting on the abortion issue in the Senate. The figure plots the point-estimates for senator's position on abortion against each state's abortion position. The solid black lines show the simple linear relationship between state opinion and senator ideal points. The dotted lines show this relationship controlling for party.

significantly over time. However, when controlling for member party membership, the relationship has decreased. Indeed, in the 109th Senate there is not much intra-party variation on abortion at all. This seemingly contradictory trend is a result of the increased presence of strongly Republican pro-life candidates in pro-life states

and pro-choice Democrats in more pro-choice states. Just as the theory specifies, Figure 5.11 shows that the two parties have come to predominantly represent states whose voters are most aligned with their activist base.

It is important to note that these kinds of patterns are far more difficult to explain in rational-choice accounts of candidate positioning, which treat each campaign as an independent event.[24] This is again the result of thinking of parties and candidates as single unitary actors with little attention paid to the fact that many candidates run under a single party banner in ideologically distinct constituencies.

In the ecological party model, it is the intra-party competition for activist resources mixed with the inter-party competition for votes that leads to the "sorting" patterns just discussed. Candidates competing in districts in disagreement with their party base on abortion are are unable to effectively compete. Taking an ideological position near the district mean will ensure that they get little activist resources. Taking an ideological position too near the base alienates district voters. Meanwhile, their electoral opponent, whose base is more aligned with the mean voter in the district, can please both voters and their activist base. Combined, these forces lead to the patterns we observe in Figure 5.11.

I now turn to my final empirical expectation. Traditional Downsian models suggest that sorting would largely occur as individual members of Congress adapt to the changing electoral environment. For instance, as the Republican base became more pro-life, we would expect individual pro-choice or moderate Republicans to become increasingly pro-life. However, the ecological theory states that the majority of party movement should occur through the mechanism of replacement. Pro-choice or moderate Republicans should be *replaced* by either pro-choice Democrats or pro-life Republicans.

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[24] But see Snyder and Ting (2002), Tofias (2010), Callander (2005), and Wiseman (2006) for some notable exceptions.

The measurement model described in Section 5.3.1 can detect either gradual or significant shifts in member ideal points. For instance, the estimated ideal points for nine members of Congress are shown in Figure 5.12. The figure shows the famous migration of ambitious members of Congress like Dick Gephardt and Dennis Kucinich (both aspirants for their party's presidential nomination) in the pro-choice direction (Karol 2009). Likewise, Arlen Specter gradually moderated his pro-choice stance over the course of his career. However, for many senators, even those taking positions in opposition to their party base like Olympia Snowe and Robert Byrd, the estimates remain remarkably consistent over time.

The question at hand is to what extent the party movement discussed above results from individual adaptation (e.g., Gephardt) versus incumbent replacement. My fourth empirical hypothesis is that *the majority of party movement results from replacement.* To explore this, I use a method suggested by Karol (2009). I generate separate estimates of the positions of the two parties during a given time period using i) members who are present throughout the period, and ii) the population of members who either leave Congress or enter it over this period. Using additive roll-call indexes, Karol (2009) finds that although replacement accounts for the majority of party change, individual adaptation still accounts for almost half of party movement.

Figure 5.13 shows the estimated change in party positions over time for these two sub-populations of members. The dashed lines are estimated using only those members who were in Congress in both the 98th and 106th Congresses.[25] These members account for approximately 21% of the roll-call record in my dataset. The solid lines are estimated using the remainder of the membership in this period.

Visually, the plot shows that the vast majority of party movement results from replacement. The increase in polarization on the abortion issue estimated for constant

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[25] There are virtually no members who were present at both the beginning and end of the entire 92-110th time period. Thus, it is necessary to choose a beginning and end-point for this analysis. The statistical test below, however, removes the dependence on this approach.
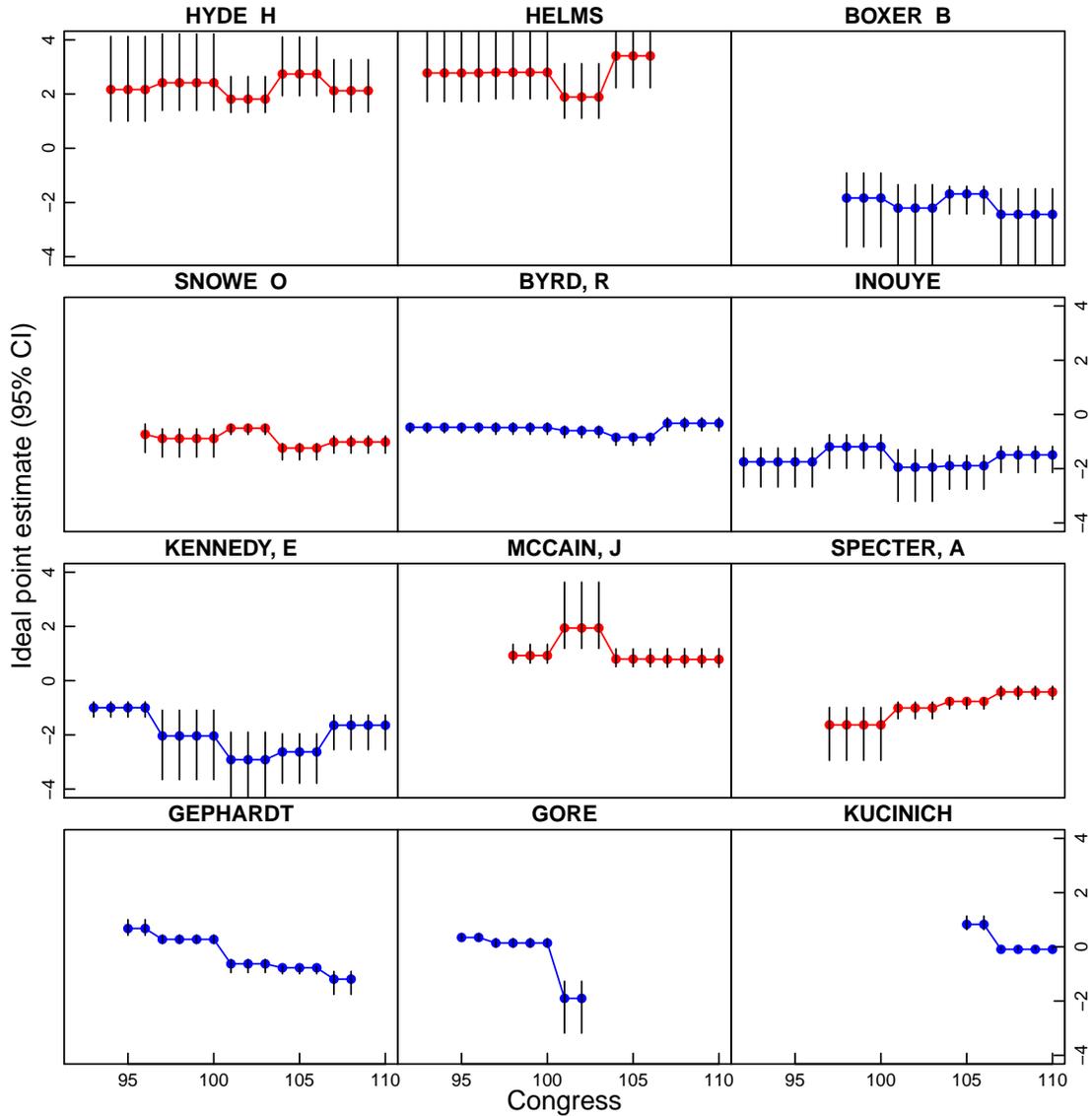
FIGURE 5.12: Point estimates and 95% credible intervals for ideal points for selected individual members of Congress on abortion policy. Estimates are generated separately for five separate periods of Congress.

members is only 10%. This compares with the nearly 100% increase in polarization that occurs through the mechanism of replacement. That is, there was roughly 10 times as much polarization resulting from replacement as there was from individual adaptation.

However, the beginning and end date of this analysis are arbitrary. A more
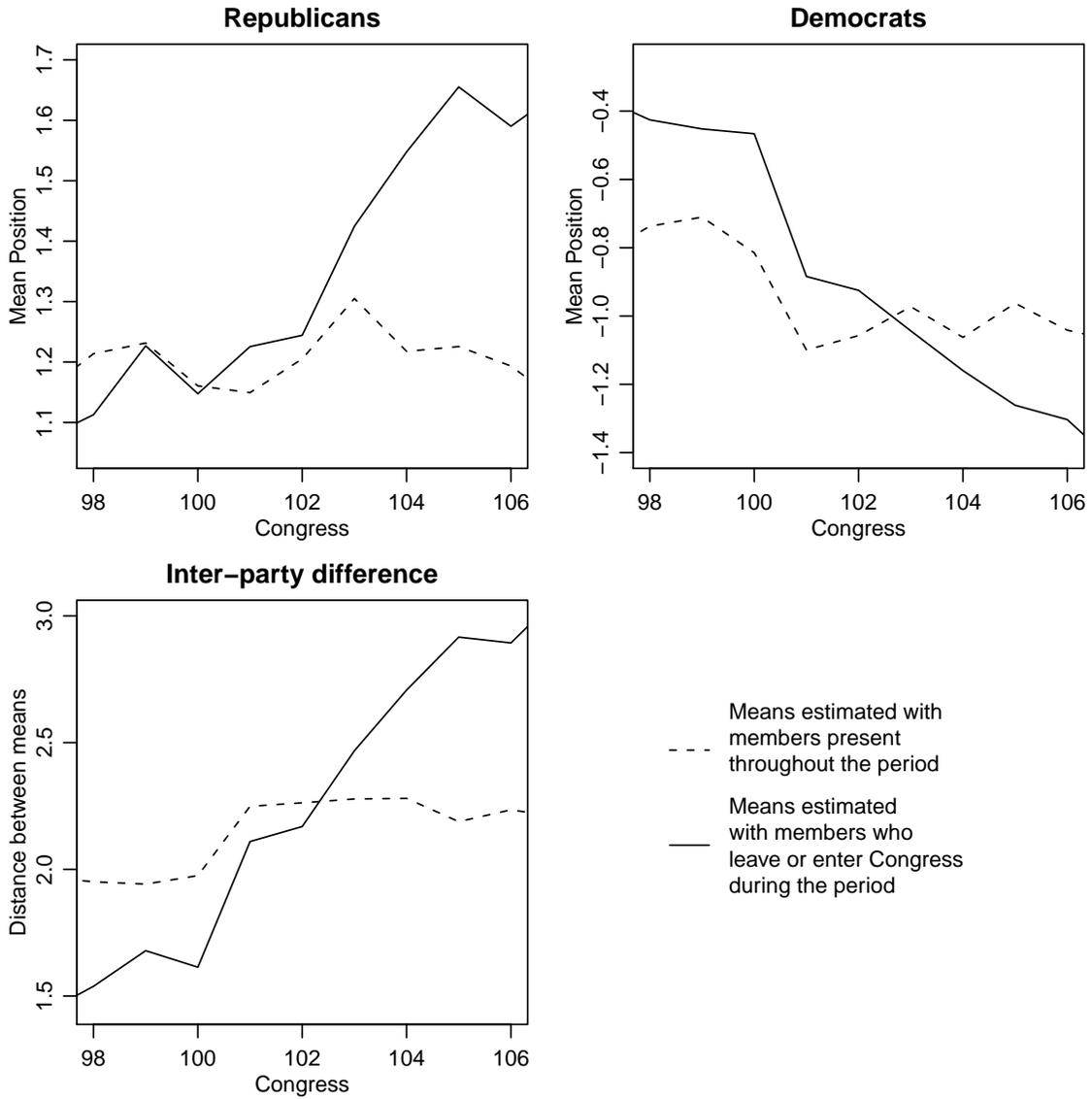
Figure 5.13: Party movement resulting from individual adaptation and population replacement from the 98th to the 106th Congress.

comprehensive analysis would compare the degree to which the parties diverged on abortion as a result of population replacement and adaptation across a number of time intervals. In Figure 5.14, I focus on the amount of change from each of these sources beginning in the 96th, 100th, and 103rd Congresses. These are the congresses just prior to the points where my measurement model allows significant shifts in

individual preferences. Thus, beginning in these years maximizes the chances that individual adaptation rather than replacement will account for more party position change.[26]

Figure 5.14 shows that, with the exception of the moderate movement from the 96th to the 97th Congress, increased party polarization on abortion resulting from population replacement is significantly greater than from individual adaptation. Indeed, beginning in the 103rd Congress there is little evidence of important individual adaptation at all, while there are dramatic shifts occurring through the mechanism of population replacement.

5.5   Conclusion

The controversy surrounding federal abortion policy has always been characterized by emotional and sometimes acrimonious debate. However, in the early years it often featured heated intra-party controversies. Passionate floor debates between Senators Helms (R-NC), Packwood (R-OR), and Brooks (R-MA) in the mid-1970s clearly demonstrated the fact that, although there was always disagreement on the issue, it was not explicitly partisan.

Forty years later all political discussion of abortion policy carries partisan undertones. The polarization on this once bipartisan issue was emphasized again this year during the prolonged public debate on the Patient Protection and Affordable Care Act of 2010. Concern about the bill's implications for abortion policy was a rallying point for both Republican activists and members of Congress. On the other side, the House leadership, bowing to pressure from pro-choice groups, indicated that no explicitly pro-life language would be included in the bill. The party warfare on

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[26] To generate estimates of uncertainty, I re-estimate these differences using 200 draws from the posterior distributions of the ideal-point estimates. The figure shows the point estimate and 95% credible intervals for the estimated change in party position resulting from adaptation and replacement, respectively.

the issue came to a climax during the final debate. Rep. Bart Stupak, a Democrat with a 100% rating from the National Right to Life Committee, was interrupted by a shout of "baby killer" on the House floor while announcing his opposition to a pro-life amendment offered to the bill.[27]

In the aftermath of these events, Rep. Stupak, facing renewed opposition from pro-life *and* pro-choice groups, announced his retirement. In the 2010 midterm elections, Stupak was replaced by a strongly pro-life Republican Dan Benishek. In part, this is because the moderate pro-life stance of the Democratic nominee angered many Democratic faithful (who pledged to spend their resources in other districts) and failed to convince pro-life groups to provide any support.

The political history of abortion politics consists of a myriad of variations on this basic theme. When pro-life Democrats and pro-choice Republicans vacate their seats (for whatever reason), the odds are better than 50% that they are replaced by either a pro-life Republican or pro-choice Democrat. Multiplied by 468 bi-annual elections across four decades, this process has led to ever increasing degrees of party polarization on abortion.

This is the core of the ecological party model. The abortion debate is highly motivating to important constituencies in each party. Individual incumbents who take stands in opposition to their base anger their most likely contributors and campaign workers, and gain only marginal (if any) support from activists on the other side of the issue. Moreover, primaries ensure that candidates "out of step" with their activist base have a more difficult time earning the party nod. The result is a gradual shift in the composition of each party. Finally, the increasing intra-party cohesion on this issue ensures that pro-life Democratic activists and pro-choice Republican activists will have yet another reason to reconsider their party affiliation

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[27] Rep. Randy Neugebauer (R-TX) admitted to making the comment, although he insisted that he had yelled, "it's a baby killer," in reference to the agreement reached between the pro-life members of the Democratic caucus and the White House.

or to drop out of politics altogether. As this cycle repeats, we end up with polarized activists, polarized incumbents, and (eventually) polarized voters.

Although this chapter provides strong evidence that the ecological party model can inform our understanding of party dynamics, further research is required. First, it is unclear if the model generalizes beyond the abortion issue into other policy areas. Karol (2009) provides examples of party movements on issues ranging from immigration and international trade to taxation and gun control. His work challenges the notion that replacement is the driving mechanism of party movement on these issues. Further work is required to test the validity of my model in these areas.

Second, the abortion issue may be unique in the extent to which public opinion at both the aggregate and individual level is so remarkably stable. Further refinements at both a theoretical and empirical level are needed to adequately deal with the possibility that voters and activists may respond dynamically to the positions advocated by party incumbents. Finally, although population replacement may occur for many reasons (retirement, death, scandals, etc.) clearly one of the most important mechanisms must be primary and general elections. Future work might more directly test the implications of the ecological party model on election outcomes, the distribution of activist resources, and on primary contests.
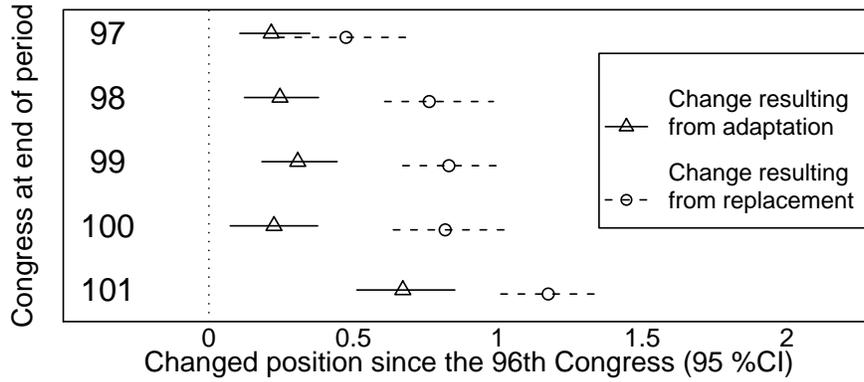
(a) Changes beginning in the 96th Congress
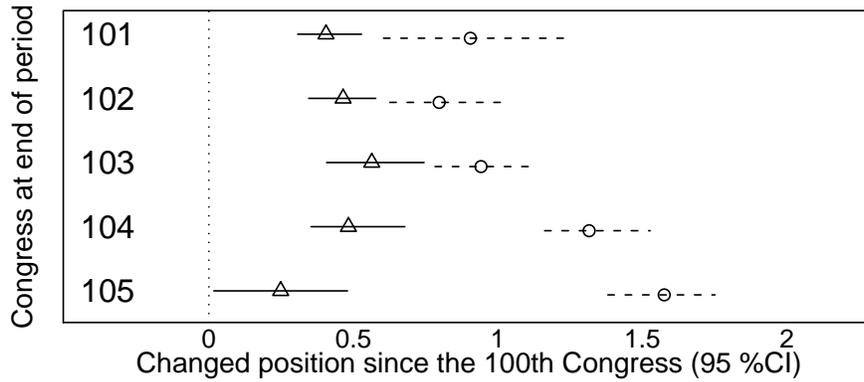
(b) Changes beginning in the 100th Congress
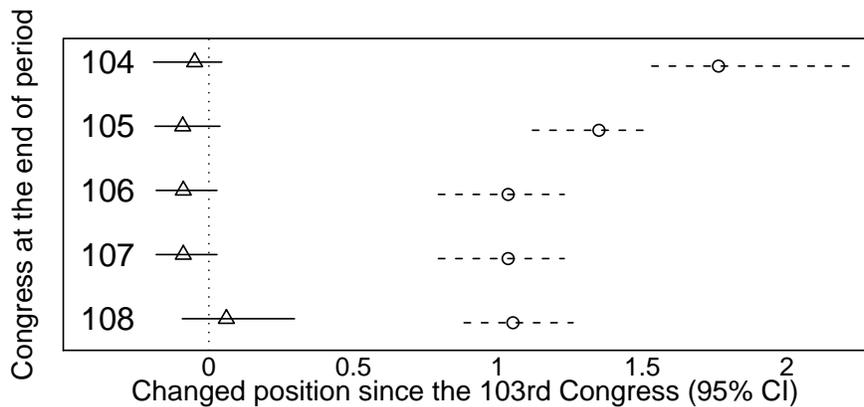
(c) Changes beginning in the 103rd Congress

FIGURE 5.14: Party movement resulting from adaptation and replacement

192

6

Conclusion

Nothing at first can appear more difficult to believe than that the more complex organs and instincts should have been perfected, not by means ... analogous with human reason, but by the accumulation of innumerable slight variations, each good for the individual possessor. Nevertheless, this difficulty, though appearing to our imagination insuperably great, cannot be considered real if we admit the following propositions, namely, – that gradations in the perfection of any organ or instinct ... either do now exist or could have existed, each good of its kind, – that all organs and instincts are ... variable, – and, lastly that there is a struggle for existence leading to the preservation of each profitable deviation of structure or instinct. The truth of these propositions cannot, I think, be disputed.

– Charles Darwin (2004, p 362)

Change has always been slow to come to American parties. The effects of historical catastrophes, institutional reforms, and other political shocks are felt immediately. However, their long-term consequences take many years or even decades to unfold. The mass political parties of the mid-19th century were the result of a long process of gradual development and experimentation whose beginning preceded the U.S. Constitution itself (Aldrich and Grant 1993; Aldrich 1995). The structure and content of partisan competition in the 1960s still echoed and reflected the political

193

calamities of the 1860s (Sundquist 1983; Key 1949). The effect of the institutional reforms of the Progressive era are still unrolling before us today (Sundquist 1983; Aldrich 1995).

Yet, however gradual, party change is an ever-present phenomenon. In politics as in nature, evolution is a continuing process that takes place all around us all the time (Weiner 1994). Elections take place somewhere in the United States on a nearly constant basis, and every election affects (or has the potential to affect) the parties' composition. As I composed the final portions of this dissertation, the abortion issue – ignored for most the Democratic controlled 2006-2010 period – again resurfaced and showed that the parties have continued to evolve on the issue of abortion despite the more prominent role that economic issues assumed in the 2010 elections. The most dramatic evidence of these continued changes came on the May 4th, 2011 vote on the *No Taxpayer Funding for Abortion Act* (H.R. 3). As its name suggest, the bill included sweeping language to permanently ban all direct and indirect federal payments for abortion. Going much farther than past efforts, the bill would even deny tax credits to companies offering employees health insurance which includes abortion coverage (Bendavid 05/04/2011). The bill won unanimous support from house Republicans while receiving only 16 votes from Democrats. It now seems that the abortion issue, once a steadfastly cross-cutting debate, has surpassed even the federal budget in the degree to which it draws strictly party-line support

Parties are in a constant state of flux, but this change is not random. Over time, American political parties have proven to be highly adaptable in a tempestuous and chaotic world. These amazingly successful and long-lived institutions have survived historical calamities and socio-economic upheavals that destroyed many foreign parties, institutions, and even countries. The parties have always changed in ways to ensure their continued existence, and few political observers today foresee their demise.

In this dissertation, I have argued that the gradual adaptive change we observe in American parties can best be explained in Darwinian terms. The parties we observe today are not in a state of equilibria, and there is not reason to believe that they ever have been or ever will be. Nor, as is suggested or assumed by many prominent theoretical accounts, is there any evidence that any centralized leadership or hierarchy is directing party adaptation.

Instead, politics is a process. It is a complex contest fought out not just between two parties, but between thousands of ambitious men and women seeking to advance their various causes and themselves in the electoral arena. Individual candidates better adapted for the current state of affairs are more likely to win, and their success serves both to encourage like-minded candidates to enter the political arena and to motivate ambitious newcomers to adopt their policy stances. Politics is a struggle for existence, and the gradual – seemingly strategic – adaptation of the parties to their ever-changing environment is the simple logical consequence of that struggle. It is through this struggle that the populations of candidates, the organizations they control, and their patterns of interaction (both in the electoral and legislative arenas) adapt.

There are, of course, many potential objections to this evolutionary account. Most of these, however, can be broken into one of two categories. First, there are questions regarding the theoretical validity of an evolutionary theory of party politics. Can we account for party change as an explicitly neo-Darwinian process? What would the necessary assumptions of such a model be, and are they plausible in a political context? What would a model of party change through electoral selection look like, and how can we use such a model to make scientific predictions about the world?

It is my hope that the first four chapters of this dissertation answers, if incompletely, this first category of questions. In Chapter 1, I specified the basic assump-

tions that must hold for Darwin's logic to apply to the political world. I defined the moving parts of evolutionary theory in political terms, and confronted several of the strongest criticisms of applying it to social institutions. Evolutionary theory requires that: (1) individual candidates differ in the policy positions that they advocate in elections and once in office; (2) these differences affect their chances of winning elections; and (3) new candidates for office do not choose their policy positions at random, but instead tend to take positions similar to their co-partisans. These are all of the assumptions necessary for applying Darwin's logic to party competition.

Using these assumptions as a foundation, in Chapters 2-4 I turned to the much more difficult task of building precise models of party competition that have empirical implications relevant to the actual political world. Chapter 2 focused on the conditions that must exist for collections of candidates to emerge as populations in an evolutionary sense. Using three successive models of single-party competition, I showed that it is only when all members of a party experience sufficiently similar selection pressures that population dynamics will arise.

In Chapter 3, I took the next steps in my theoretical development by adding a second party and policy-motivated activists. In detailed analyses of the outputs from these dynamic models I showed that the model predicts the emergence of distinct (i.e., polarized) parties when parties have resources that are valuable for candidates to win elections and institutional arrangements exist to ensure that these resources are distributed in a biased fashion so as to enforce particular policy positions. Finally, in Chapter 4 I added the final layer of complexity by assuming that party competition takes place in a multi-dimensional policy setting. I show how the model can account for both stable equilibria in a multi-dimensional space while also offering an explanation of the dynamic process through which parties change their location when the political environment changes.

Together, these chapters offer some preliminary answers to the theoretical objec-

tions noted above. It *is* possible to build plausible models of party competition from the basic tenants of evolutionary thought. The models in these chapters have proven to be flexible and they encapsulate many of the processes and patterns discussed in the vast literature on party dynamics (c.f., Adams 1997; Brewer and Stonecash 2008; Carmines and Stimson 1989; Layman and Carsey 2002; Sundquist 1983).

This is not to say that this dissertation represents anything like a final statement about the utility of evolutionary theory for explaining political parties or even party position change. Indeed, if anything the models in Chapters 2-4 are simple proofs of concepts for a much wider class of dynamic models that can be built from evolutionary principals to explain complex political phenomenon. As the appendices suggest, there are many directions in which this work might profitably be extended. Yet, carefully building and studying the relatively straight-forward models in Chapters 2-4 are a necessary precursor to such extensions.

A second set of potential objections to the application of Darwin's logic to the political realm is empirical. Is such a theoretical model empirically valid? Even if the model is internally consistent, is this actually the way things work? Do these models capture the historical processes through which major party shifts occurred? More fundamentally, what additional insights about the political world do we gain to compensate for the increased complexity of evolutionary theory relative to dominant rational choice accounts?

These questions are addressed in Chapter 5. I laid out four of the more unusual predictions and assumptions of the model and tested them against real-world data. In this empirical case study, I focused on how the parties have changed their relative position on the issue of abortion from the 1972-2010 period. I find considerable empirical support for two main conclusions: (1) the policy positions of members of congress follow the positions of the activists who provide them with needed electoral resources; and (2) the primary mechanism of party position change is population

197

replacement rather than individual adaptation.

However, even a generous reading of Chapter 5 cannot justify a claim that I have fully answered the empirical objections noted above. There are too many reasons to suspect that there is something unique about the abortion issue. Perhaps these findings will not generalize to other policies domains. In addition, a number of the empirical results I report have been anticipated by other theoretical accounts (although there are none that account for *all* of them).

Significantly more empirical work is needed. First, it is necessary to look beyond the abortion issue. Demonstrating similar findings on issues like welfare policy or Medicaid would significantly allay fears about the generalizability of my findings. Second, there are a number of other relevant empirical regularities suggested or assumed by the model. Specifically, the model claims that party institutions should work to benefit candidates who take positions more pleasing to party activists. Moreover, it specifies that the degree of this bias should be linked in predictable ways with the divergence of the two parties on any particular policy domain. Further study of the ways that party resources are distributed in relation to newly salient issues would not only provide a test of the model's predictions, but provide additional evidence that the specific mechanisms that I hypothesize are actually at work in the world.

Yet, even without additional theoretical and empirical research, the evolutionary approach to party competition has much to offer. Building on a few simple premises, it offers explanations of not only how party populations change their positions on public policy over time, but also how the broader party institutions in the control of elected officials affect and are affected by these changes. The theory promises to explain how changes in the beliefs or preferences of strongly motivated activists may be translated, through the simple process of selection and mimicry, into changes in the stances of candidates, voting patterns in the electorate, the behavior of legislators, and even changes in the political institutions controlled by those legislators. The

theory explains how these may all be linked and does so in a way that matches both our common understanding of the political proces and the empirical historical record.

Appendix A

Survey Data and Statistical Methods

A.1 Survey data

In these appendices, I provide more detailed information on the data sources and statistical techniques used in the main text. I provide information that does not directly contribute to the central arguments of the chapter, but which might be of interest to some readers. In addition, this appendix should provide the details necessary to fully replicate my results.

In Appendix A.1, I list the questions, coding schemes, and statistical techniques used to estimate the preferences of voters and activists. More details about my estimates of member preferences on abortion are provided in Appendix A.2.

A.1.1 General Social Survey

Since 1972, the General Social Survey (GSS) has regularly asked respondents whether pregnant women should be able to obtain a legal abortion in six circumstances. In 1976, a seventh condition ("For any reason") was added. The average national responses from 1972-2006 are shown in Figure A.1.

GSS Abortion Questions

"Please tell me whether or not you think it should be possible for a pregnant woman to obtain a legal abortion if ..."
[Response Categories: Yes (coded 1), No (coded 0), DK/NA (coded missing)]

- The woman wants it for any reason?
- If she is married and does not want any more children?
- If there is a strong chance of serious defect in the baby?
- If the woman's health is seriously endangered by the pregnancy?
- If she is not married and does not want to marry the man?
- If she became pregnant as a result of rape?
- If the family has a very low income and cannot afford any more children?

Using these seven dichotomous answers from the GSS cumulative file, I pooled across all years to estimate latent individual preferences on abortion using a two-variable Rasch model. This model was estimated using the lme4 package in R as outlined by Doran et al. (2007). I can then disaggregate by year and party to generate annual estimates of public opinion and of attitudes amongst party identifiers. I coded leaners as independents, although the results do not change by changing this coding scheme.

GSS Party Identification Question
"Generally speaking, do you usually think of yourself as a Republican, Democrat, Independent, or what?"

- Democrat
- Republican
- Independent

A.1.2   American National Election Study (ANES) Time Series

From 1972-1980 the American National Election Study (ANES) asked respondents to choose one of four statements that best agreed with their view on abortion.
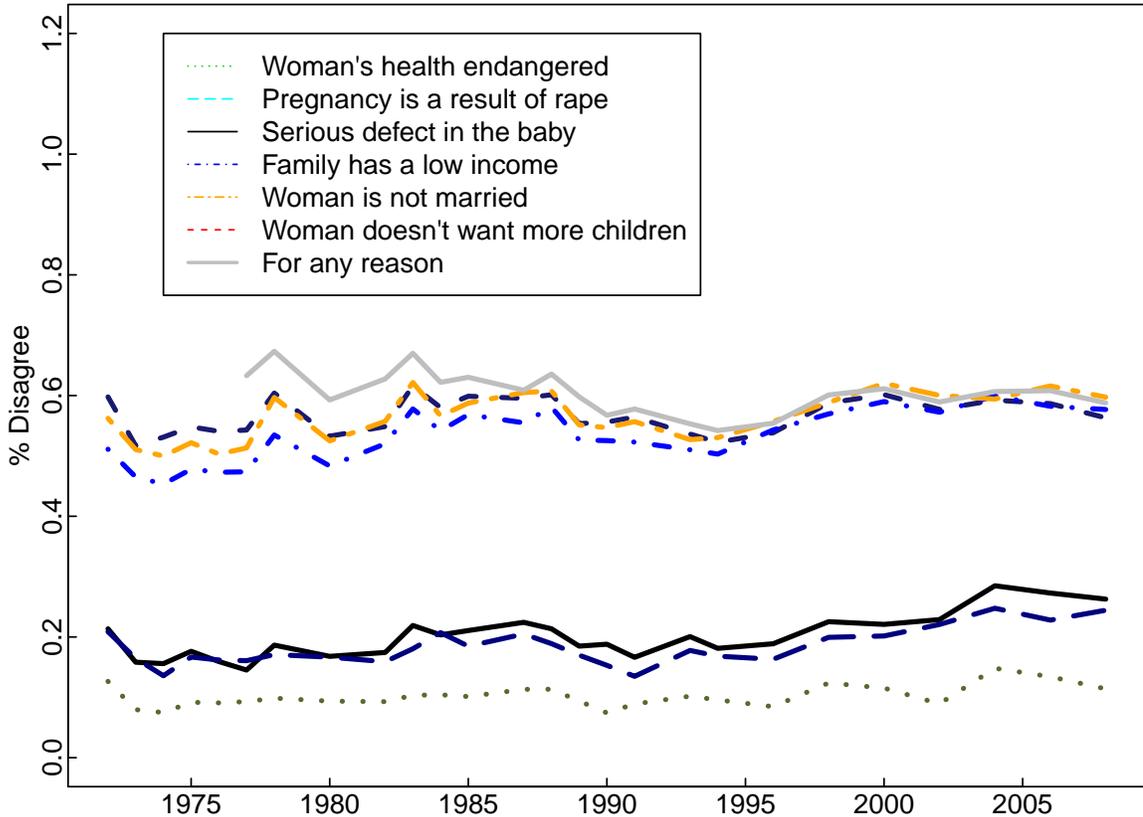
FIGURE A.1: General Social Survey (GSS) measure of public opinion on abortion. Should it be possible for a pregnant woman to obtain a legal abortion, if:

ANES Abortion Questions (1972-1980)
"There has been some discussion about abortion during recent years. Which one of the opinions on this page best agrees with your view? You can just tell me the number of the opinion you choose."

- Abortion should never be permitted.
- Abortion should only be permitted when the life and health of the woman is in danger.
- Abortion should be permitted when, due to personal reasons, a woman would have difficulty caring for the child.
- Abortion should never be forbidden.

Beginning in 1980, the question was altered somewhat to focus on specific situations when abortion should be *legal*.

ANES Abortion Questions (1980-2008) "There has been some discussion about abortion during recent year. I am going to read you a short

list of opinions. Which one of the opinions on this page best agrees with
your view?"

- By law, abortion should never be permitted.
- The law should permit abortion only in case of rape, incest, or when
  the woman's life is in danger.
- The law should permit abortion for reasons other than rape, incest or
  danger to the woman's life, but only after the need for the abortion
  has been clearly established.
- By law a woman should always be able to obtain an abortion as a
  matter of personal choice.

The raw percentage of respondents in each category for this time-series is shown
in Figure A.2. Fortunately, the ANES included *both* question wordings in the 1980
survey. It is possible to use these observations as a link between the two question
wordings, allowing me to create a year-to-year measurement of public opinion using
all the ANES data. Using the 'grm' function in the 'ltm' package in R, I estimate the
latent abortion opinions shown in the main text (Rizopoulos 2006). The separate
estimates for party identifiers are again simply estimated via disaggregating the data.
The party identification question is identical to the one used for the GSS data.

Gallup surveys

A third data source is the Gallup survey, which from 1975 to 2010 has asked the same
abortion question on many of its surveys. I used all Gallup surveys where the entire
survey was provided by Roper iPoll in this period.[1] Figure A.3 show the aggregate
data.

Gallup Survey Abortion Question
"Do you think abortions should be legal under any circumstances, legal
only under some circumstances, or illegal in all circumstances."[2]

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[1] This included the surveys dated 4/75, 12/77, 2/79, 7/80, 5/81, 6/83, 1/85, 9/88, 4/89, 5/91,
1/92, 6/92, 7/92, 3/93, 3/4, 9/94, 2/95, 9/95, 7/96, 9/96, 8/97, 9/97, 1/98, 4/99, 1/00, 4/00, 3/01,
8/01, 2/02, 3/02, 1/03, 10/03, 3/05, 6/05, 11/05, and 7/09.

[2] Later Gallup surveys included the follow-up question for those choosing the middle option: "Do
you think abortion should be legal under most circumstances or only in a few circumstances."
However, I do not include these responses in my analysis.
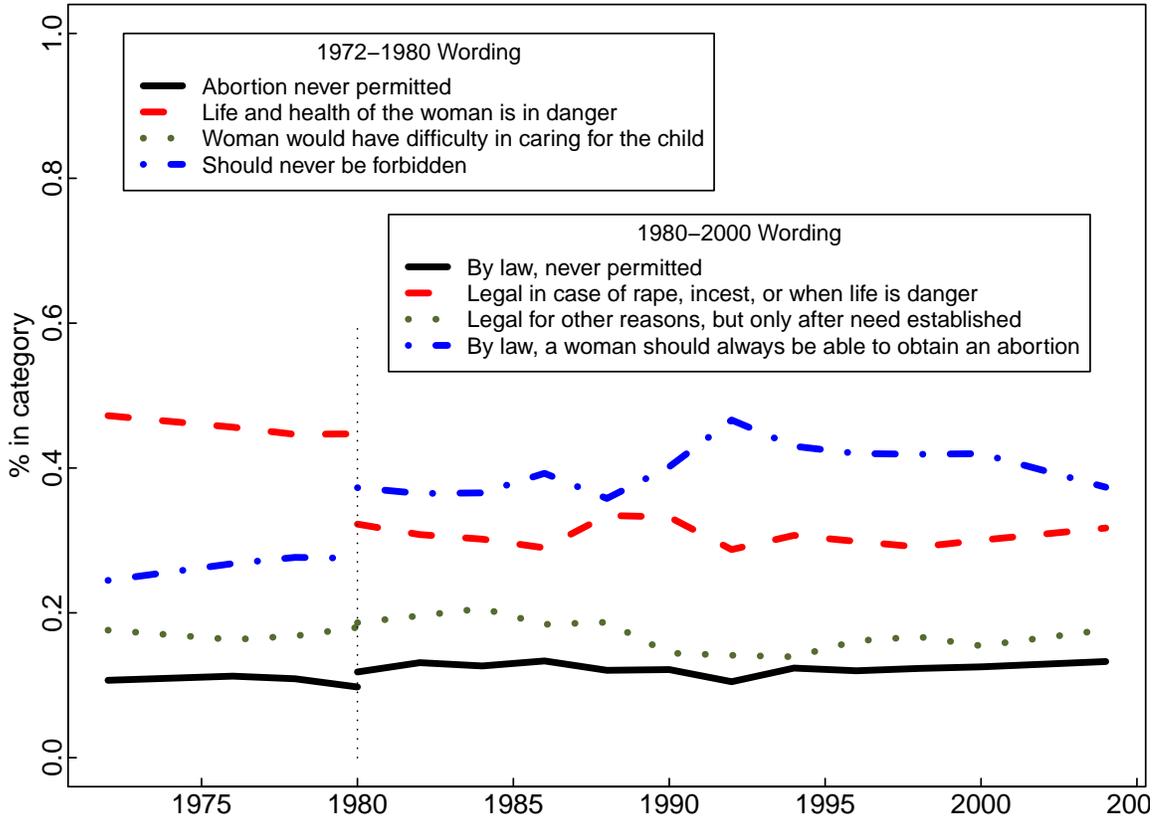
FIGURE A.2: ANES measure of opinion on abortion. Which best agrees with your view?

I estimate the latent public opinion plots shown in the main text using the 'plr' function in the MASS package in R with appropriate survey weights. I estimate an ordered probit model, and then calculate the mean latent abortion opinion for all respondents, Republican identifiers, and Democratic identifiers. I again simply disaggregate to generate the party estimates. To identify partisans I used the first part of the standard Gallup party affiliation question. The 'cut-point' estimates shown on the main plot are then the taken from this model ('zeta' in the notation of the 'polr' function).

Gallup Survey Party Identification Question
"In politics, as of today, do you consider yourself a Republican, Democrat, or Independent."
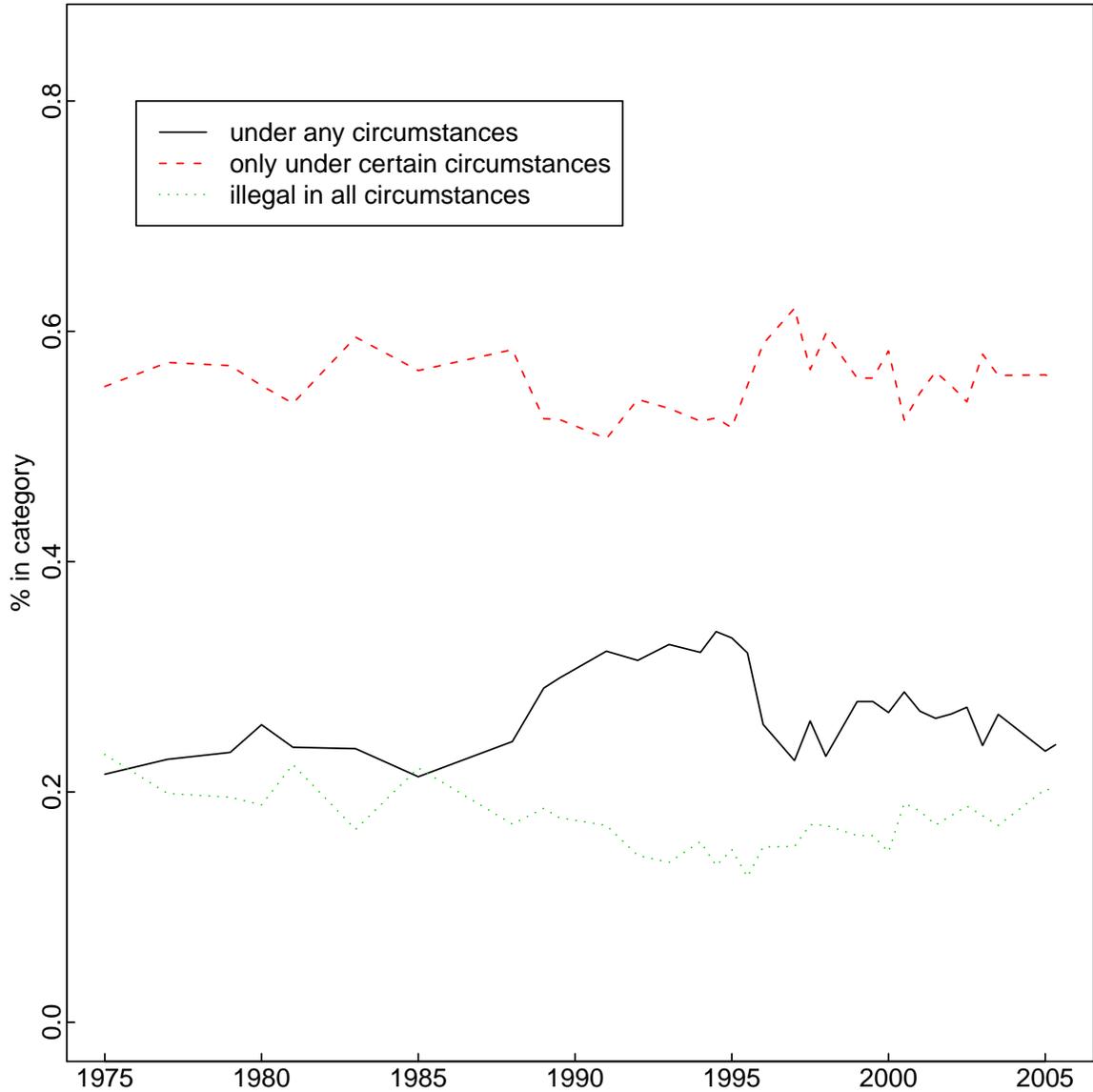
FIGURE A.3: Gallup measure of public opinion on abortion. Do you think abortion should be legal ... ?

ANES 1988-1990-1992 Senate Panel Study

Finally, the 1988-90-92 ANES Senate Panel Study included three abortion-related question. It includes the Gallup item just described as well as two additional items.

ANES Senate Panel Abortion Questions
"Would you favor or oppose a state law that would require parental consent before a teen-ager under 18 could have an abortion?"

[Response options: Favor, Depends, Oppose, Don't know]
"Do you favor/oppose such a law strongly or not strongly?"
[Response options: Strongly, Not Strongly, Don't Know]

"Would you favor or oppose a law in your state that would allow the use of government funds to help pay for the cost of abortion for women who cannot afford them?"
[Response options: Favor, Depends, Oppose, Don't know]
"Do you favor government funding for abortions strongly or not strongly?"
[Response options: Strongly, Not Strongly, Don't Know]

In this data, the sampling frame is explicitly at the state level. I fit a polychotomous IRT measurement model to estimate individual-level abortion opinion and then estimate state-level opinion by disaggregating by state. I again use the 'grm' function in the 'ltm' package in R. The state-level estimates of abortion preferences are shown in Figure A.4.

A.1.3   Low-level activists

I estimated the opinion of low-level activists in each party using ANES time-series data. This dataset includes questions on whether the respondent tried to influence the vote of others, attended a meeting or rally, worked for a party or candidate, displayed a sticker, or donated money to a party or candidate.[3] I fit a simple two-parameter IRT model with this data to estimate individual latent participation scores using the lme4 package in R (Gillion 2010; Doran et al. 2007). The opinions of low-level activists in each party are estimated as the average opinion of party identifiers in the top ten percentile on this latent participation scale.

A.1.4   High-level activists

I used two separate sources to estimate the opinions of high-level activists. First, I used the 1972, 1980, 1984, and 1988, and 1992 surveys of delegates to the national

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[3] The items used are listed in the ANES cumulative file as VCF0717, VCF0718, VCF0719, VCF0720, VCF0721.

State abortion opinion

FIGURE A.4: Estimated abortion opinion by state. Blue colors indicate states with greater pro-choice opinion. Red colors indicates more pro-life opinion. Source: ANES 1988-1990-1992 Senate Panel Survey

presidential nominating conventions downloaded from the ICPSR website. The 2000 survey was kindly shared with me by Tom Carsey. The 1980 survey also included a mail survey of delegates to the 1976 convention, and I use these responses to estimate the 1976 data points. There was also no survey in 1996, and I was forced to interpolate the 1996 data point as the average of the 1992 and 2000 estimates. See Layman et al. (Forthcoming) for a similar approach to dealing with this data. The abortion questions used from the early surveys are listed below. The 1992 and 2000 surveys used the standard current ANES question wording described above.

Presidential Delegate Survey Question on Abortion (1972)
"There has been some discussion about abortion during recent years. Which of the opinions on this card best agrees with your own view."

- Abortion should never be permitted.

- Abortion should be permitted only if the life and health of the woman is in danger.

- If a woman and her doctor agree, she should be able to have a legal abortion.

- Any woman who wants to have an abortion should be able to have one.

- Other (Coded missing)

- Don't Know (Coded missing)

Presidential Delegate Survey Question on Abortion (1976, 1980, 1984, and 1988)
"There has been much discussion about abortion during recent years. Which one of the opinions listed below best agrees with your view?"

- Abortion should never be permitted.

- Abortion should be permitted only if the life and health of the woman is in danger.

- Abortion should be permitted if, due to personal reasons, the woman would have difficulty in caring for the child.

- Abortion should never be forbidden [1988: Abortion should never be prohibited].

A final data source are surveys of financial donors to the presidential candidates in each party conducted in 2000 and and 2004. These surveys include the current form of the ANES abortion question.

For purposes of generating estimates I considered the 1972-1988 delegate surveys to be identical to the pre-1980 ANES wording above despite some minor differences. The 1992, 1996 and 2000 delegate survey were considered to be equivalent to the post-1980 ANES wording. Therefore, to generate comparable estimates of voter and activist opinions, I combined all of the delegate surveys and the ANES time-series data into a single measurement model. I used the 'grm' function to estimate a polychotomous IRT model on this data and then disaggregated to generate estimates of the opinion of low-level activists and high level activists. The final estimates are

shown in Figure A.5. The time series in the main text use the 2004 estimates from the donor surveys, as I do not currently have access to the 2004 delegates survey.
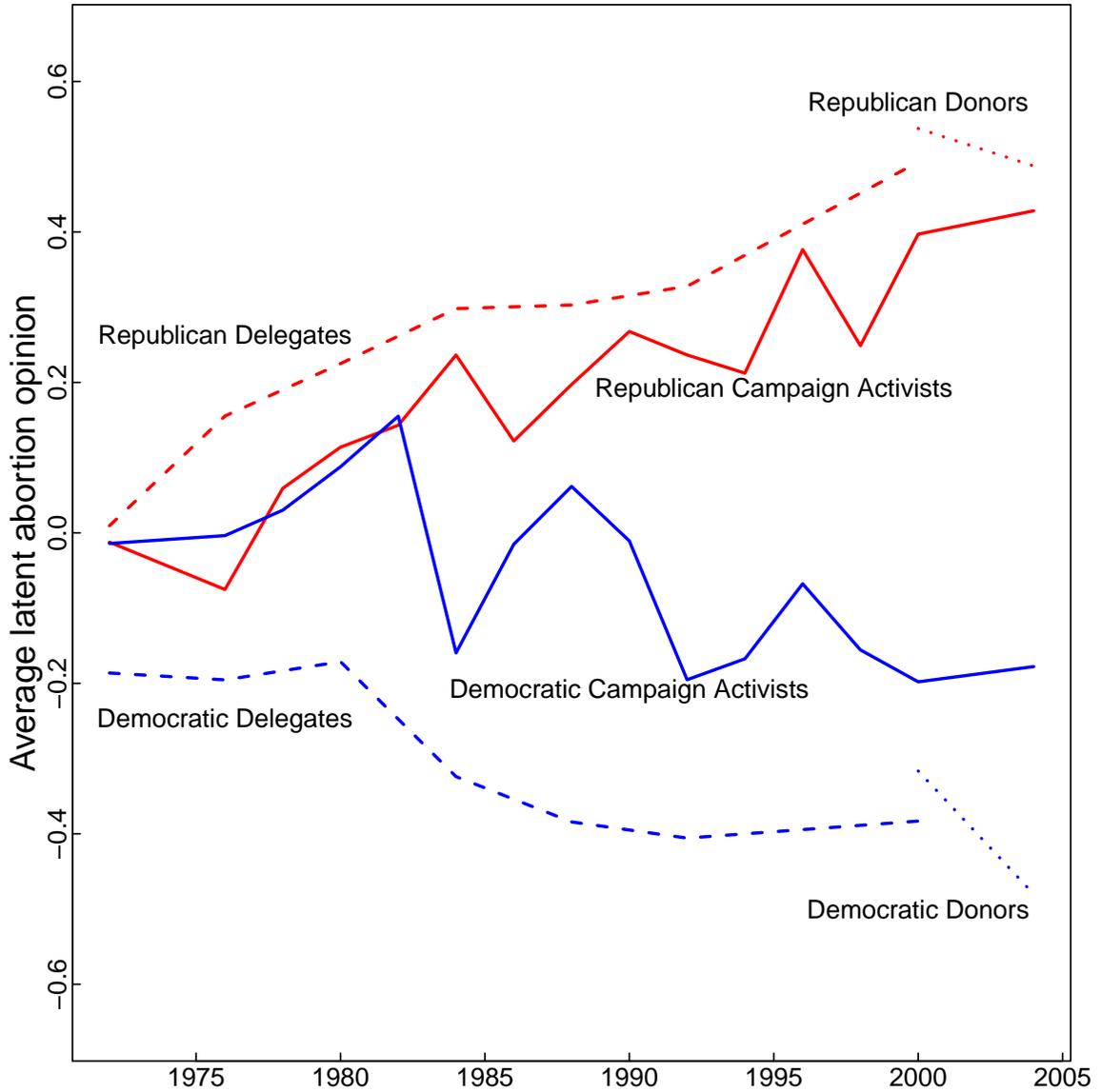
FIGURE A.5: Party activist polarization on abortion. Source: ANES Cumulative File, Party Delegate Surveys, Presidential Donor Surveys

A.2   Roll-call analysis

I calculate estimates for members' ideal-points on abortion policy by fitting an item response theory (IRT) measurement model to my dataset of abortion roll calls (c.f.,

Jackman 2001; Clinton, Jackman and Rivers 2004; Bafumi et al. 2005; Baker and Kim 2004; Fox 2010). In this case, I estimate a three-parameter ogive variant denoted:

$$\Pr(y_{ivt} = 1 | \theta_{it}, \alpha_v, \kappa_v) = \Phi(\alpha_v \theta_{it} - \kappa_v) \tag{A.1}$$

where y_{ivt} denotes the vote of member i at time t on vote v and $\Phi(.)$ denotes the standard normal cumulative distribution. The "ability" parameter (θ_{it}) denotes each individual's tendency to vote in the pro-life direction, and is therefore the estimate of member i's ideal point at time t.

The "difficulty" parameter (κ_v) indicates the extremity of the cut-point for roll call v. High values indicate that only extreme pro-life members will vote yea. Finally, the "discrimination" parameter (α_v) indicates the extent to which roll call v cleanly delineates more pro-choice and pro-life members. Values close to zero indicate that all members are equally likely to vote yea regardless of their underlying preference. Meanwhile, high positive or low negative values indicate that the roll call sharply divides members based on their underlying position on abortion.

A visual example of the model's estimates for two roll calls is provided in Figure A.6. The plot shows the estimated ability parameters for all members of the 105th house who cast votes on these roll calls. Those points plotted at the top are members who voted in the pro-life direction while those at the bottom cast votes in the pro-choice direction. The gray lines in each plot show the estimated probability of voting yea given the discrimination and difficulty parameters estimated by the model for these votes.

A.2.1 Discussion of dynamic measurement techniques

One of the central claims of my work is that the process of party position change must occur through mechanism of incumbent replacement rather than individual adaptation. This requires that I provide estimates of member preferences that are
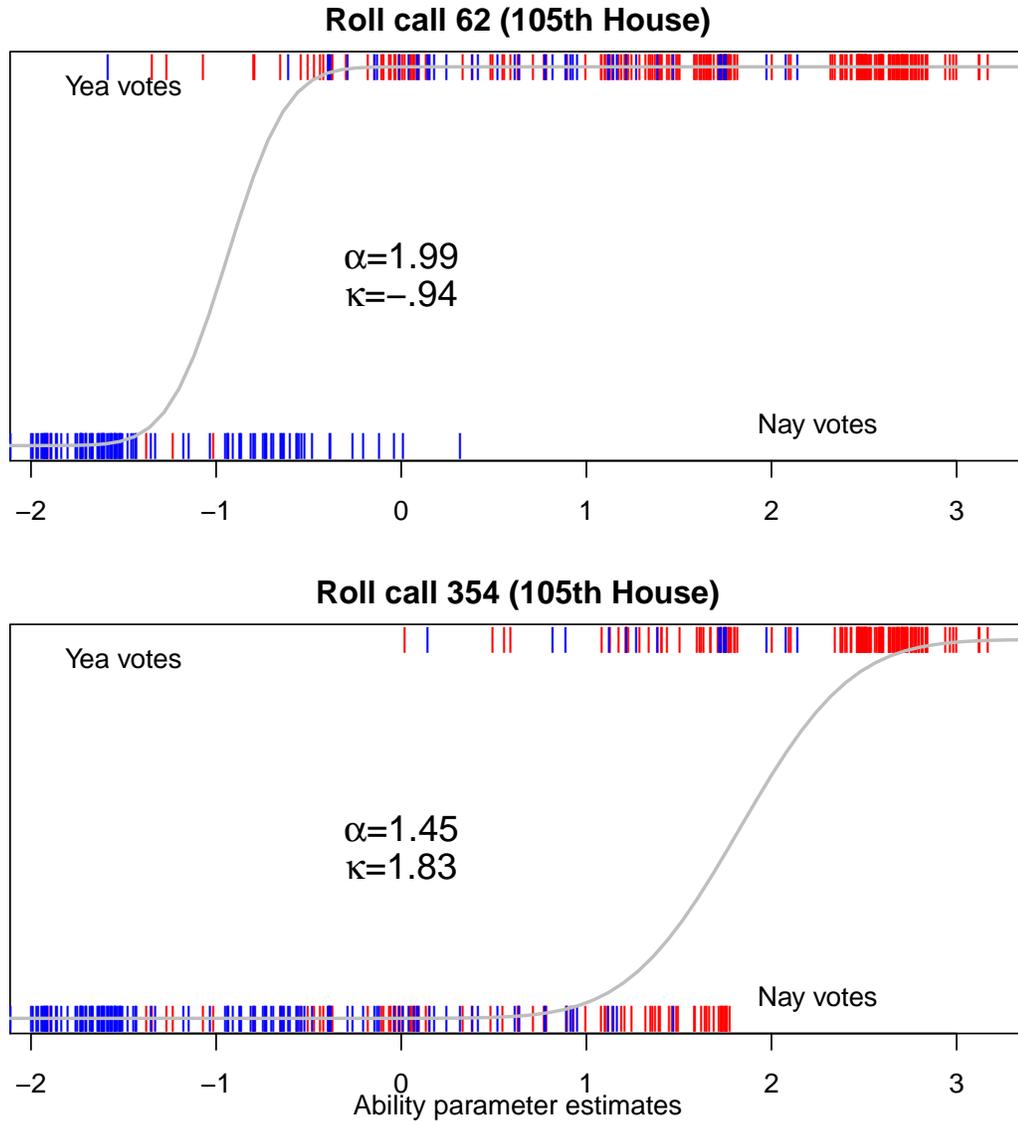
FIGURE A.6: Exemplar estimates of probability curve for two roll-calls. The colored points show the latent ideal point estimates for the legislators divided by whether they voted yea (top) or nay (bottom) on this roll-call. The curved line shows the estimated latent probability of voting yea. RC 62 is a Canady point of order against the Hoyer motion to recommit and report focused on certain aspects of the partial birth abortion ban bill. RC 354 is a Paul amendment on United Nations population program funding.

(1) comparable across chambers, (2) comparable across time, and (3) are not biased by assumptions in the estimation technique towards the incumbent-replacement hypothesis.

Developing techniques to estimate the dynamic preferences of legislators is currently an active area of political methodology research (e.g., Asmussen and Jo 2010; Bailey 2001, 2007; Groseclose, Levitt and Snyder 1999; Poole 2005; Martin and Quinn 2002; Treier 2010b). Each of these proposed methods has its strengths and weaknesses.[4] However, one characteristic of all existing methods is that they rely an assumptions regarding the degree to which (or the way in which) member preferences may change over time. This involves either fixing some legislators' ideal points across distinct time-periods (e.g., Treier 2010b; Poole and Rosenthal 2007) or fixing the ideal-points of actors outside the legislators (e.g., Bonica 2010; Treier 2010a). Other approaches put prior constraints on the future position of members based on their past position (e.g., Martin and Quinn 2002; Bailey 2007; Poole and Rosenthal 2007).

The problem with all of these methods, however, is that they can (1) have difficulty in recovering abrupt shifts in member preferences between periods and (2) have difficulty dealing with universal shifts in members' ideal points (Asmussen and Jo 2010). Finally, all of these methods potentially bias findings in favor of my hypothesis (that member ideal-points are stable), which is not desirable from a scientific standpoint.

The approach I use in the main text has more in common with the approach to estimating member ideal-points used by Clinton and Meirowitz (2001), Clinton and Meirowitz (2003), and Asmussen and Jo (2010). That is, I use prior information about the actual roll calls themselves to generate comparable preferences without placing *any* constraints on the estimated preferences of members. I conducted a detailed study of all available votes on abortion and identified instances when the same status quo was placed against virtually identical proposals. I then constrained the discrimination and difficulty parameters for these votes to be identical between

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[4] Asmussen and Jo (2010) provides an excellent survey of available methods.

periods.

A.2.2   Model specifics

I fit a multilevel IRT model as outlines by Fox and Glas (2001) and Fox (2007, 2010). This more complicated approach is not strictly necessary. However, as I discuss below, this modeling setup is more easily extendible into alternative and more elaborate approaches that I intend to implement in the near future.

The probability of member i in time period t voting in the pro-life direction on roll call v is given by equation A.1 above. At the next level (Level 1), I can add structure for q individual time-varying covariates to this model in the form:

$$\theta_{it} = \beta_0 + \beta_1 x_{1it} + \ldots + \beta_q x_{qit} + \epsilon_{it} \tag{A.2}$$

where $e_{it} \sim N(0, \sigma_\theta^2)$ and the prior distribution for $\boldsymbol{\beta}$ is $N(0, \sigma_\beta^2)$. In the results in the current text, the only individual co-variate I consider is party affiliation. However, it is straight forward to include additional co-variates such as time-period, higher-order polynomial functions of time, or district abortion preferences. The priors and identifying restrictions are discussed in Fox (2007). The model can be estimated using standard Gibbs sampling techniques, and future versions of this appendix will include full conditional posteriors distributions. I ran three chains for 100,000 iterations, and standard diagnostics showed convergence and adequate mixing.

A.2.3   Future extensions

In future work, I hope to significantly extend the basic model above by adding a second level. That is, I wish to add individually varying parameters to the model. First, this involves re-writing equation A.2 as:

$$\theta_{it} = \beta_{0i} + \beta_{1i} x_{1it} + \ldots + \beta_{qi} x_{qit} + \epsilon_{it} \tag{A.3}$$

It is then possible to model (potentially with co-variates $\mathbf{w}$) individually varying parameters at a second level.

$$\beta_{0i} = \gamma_{00} + \gamma_{01}w_{1i} + \ldots + \gamma_{0s}w_{si} + u_{0i} \tag{A.4}$$

$$\beta_{1i} = \gamma_{10} + \gamma_{11}w_{1i} + \ldots + \gamma_{1s}w_{si} + u_{1i} \tag{A.5}$$

$$\vdots \tag{A.6}$$

$$\beta_{qi} = \gamma_{q0} + \gamma_{q1}w_{1i} + \ldots + \gamma_{qs}w_{si} + u_{qi} \tag{A.7}$$

where $\mathbf{u}_j \sim N(0, \mathbf{T})$. This approach would allow me to add the forms of individually varying linear and polynomial time-trends used by Bailey (2007) in a nested fashion. It would also be possible to directly test hypotheses regarding what covariates are likely to lead members to change their preferences more quickly over time *within* the IRT framework. This would provide superior estimates of the relationship between events (e.g., significant redistricting as discussed in Crespin (2010)) on the degree of preference change over time (Fox 2010).

A.3 Simple Granger model

In the main text, I use an error-corrected Granger model. Here, I report the results of the more simple first-order Granger model. The test involves fitting a full model $y_t = y_{t-1} + x_{t-1}$ and a reduced model $y_t = y_{t-1}$ and conducting an F-test for a difference in model fit. I also fit the reverse models ($x_t = x_{t-1} + y_{t-1}$ and $x_t = x_{t-1}$). If the results show that x affects y ($x \to y$), but that there is no evidence for the reverse relationship ($y \to x$) then we can say that x "Granger causes" y. As in the main text, I restrict this analysis to a first-order Granger test due to the small number of observations I have to work with.

The relevant F-statistics for these tests are shown in Table A.1. The first column of this table shows that only the high-level time-series (delegates and donors) leads

to changes in Congressional polarization. Moreover, the second column shows that the reverse is not true. The rate of polarization in Congress does not Granger cause changes in activist opinion.

Table A.1: F-statistics for first-order Granger models

	$\rightarrow$ Congress	$\rightarrow$ HL activists	$\rightarrow$ LL activists	$\rightarrow$ Identifiers
Congress $\rightarrow$		2.97 (0.15)	18.22 (0.00)	30.28 (0.00)
HL activists $\rightarrow$	28.72 (0.00)		8.6 (0.03)	3.72 (0.11)
LL activists $\rightarrow$	0.13 (0.73)	0.17 (0.7)		1.04 (0.33)
Identifiers $\rightarrow$	1.32 (0.28)	1 (0.36)	1.34 (0.27)	

P-values are in parentheses. Models including data from the delegates time series include only presidential years and have only 9 observations. All others include 15 observations. The full model is $Y = Y_{t-1} + X_{t-1}$. The reduced models are $Y = Y_{t-1}$.

Appendix B

Adaptive Candidates and Lamarckian Adaptation

One obvious criticism of the models in the main text is that I assume that candidates themselves cannot adapt to their environment. The parties – the populations of candidates who share a common label – are responsive to changing environmental circumstances. But all of the results above are built on the assumption that the candidates themselves cannot adjust.

One alternative set of assumptions to those I have used above is suggested by David Karol. In his comprehensive review of party position change across a broad array of issue domains, Karol (2009) is particularly critical of using pure Darwinian logic to explain party change. In his detailed analyses of incumbent behavior, he shows that individual candidate adaptation is often as much responsible for party change as incumbent replacement. He argues strongly against the use of Darwinian logic, and instead insists that, "If a biologist can help us here, it is Lamarck rather than Darwin" (Karol 2009, p 188).

Jean-Baptiste Lamarck was an intellectual predecessor to Darwin who built his theory of organic evolution on the notion that animals could not only pass to their

descendants the traits they inherited from their ancestors, but also those obtained over the course of their lives. A blacksmith's son, he argued, is more likely to be large and muscular as a result of the blacksmith's lifestyle and not only as the result of his breeding. Thus, the Lamarckian framework consists of a mixture of individual adaptation and population adaptation.

Here I implement one very simple Lamarckian adaptation model to demonstrate the robustness of the results in the main text. There are obviously many ways we might expect candidates to individually adapt to their environment. Laver (2005) and Kollman, Miller and Page (1992), for instance, review several additional heuristics that could conceivably be used by political elites in an iterative setting. We also might wish to impost some kind of "cost" on search as is suggested by (Munger 2008). However, extending the model to consider a wider array of adaptive algorithm's remains a topic for future research.[1]

Let $\mathbf{Y}_{kt} = (y_{k1t}, y_{k2t}, \ldots, y_{kpt})$ represent the vector of policy positions taken by candidate k at time t. After initially winning an election in time $t = 0$, an incumbent candidate will choose a random movement vector $\mathbf{E}_k = (\epsilon_{k1}, \epsilon_{k2}, \ldots, \epsilon_{kp})$, where $\epsilon_{ki} \sim Uniform(-L, L)$. L represents the maximum possible distance that candidates can move along any dimension. Thus, candidate k's position at time $t = 1$ will be, $\mathbf{Y}_{k1} = (y_{k10} + \epsilon_{k1}, y_{k20} + \epsilon_{k2}, \ldots, y_{kp0} + \epsilon_{kp})$. The heuristic posits that if a candidate garners more votes at time $t = 1$ than she did at time $t = 0$, then she will continue moving in this same direction at time $t = 2$. If, however, she receives fewer votes, she will return to position $\mathbf{Y}_{k0}$ and draw a new movement vector $\mathbf{E}_k$. Just as before, candidates who lose their election are removed. New candidates are recruited as outlined in the main text.

In total, allowing individual adaptation requires the addition of two parameters.

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[1] I will note that no boundedly rational heuristic that I have so far considered has in any way fundamentally altered the results shown in the main text.

Let L represent the maximum distance that a candidate can move along any given dimension between elections, and ξ represent the percentage of candidates who are adaptive.

How does allowing Lamarckian rather than Darwinian adaptation change the model's predictions? The answer is, at least as it relates to explaining party position change, not much. Given that the parties arrive at divergent equilibria points, the identical parameters control the processes of rotation and polarization as were discussed in the main text. The reason is simply that the degree to which the candidates can move is fundamentally bounded by electoral selection. Any movement too far away from the candidate's co-partisans will lead to a loss of all valence advantage and an increased probability of loss. Only if *all* of the candidates moved in some coordinated manner away from the party base (an unlikely situation given the heterogeneity in district preferences) will candidate adaptation unravel the quasi-stable positions of the two parties.

However, there are four important caveats. First, *ceteris paribus*, stable divergent equilibria take longer to materialize and require somewhat higher settings of β, τ, ρ, and κ. Party configurations with modest levels of polarization tend to be less stable. Second, when the parties do diverge to stable equilibria points, the party populations tend to be much more homogeneous. That is, when activist resources are valuable, abundant, and are distributed in a biased manner, the candidates will tend to cluster tightly to maximize their share of party resources. Third, as Karol (2009) suggests, party movements from one equilibrium position to another are accomplished with lower rates of candidate replacement. When candidates are adaptive, their will be some small percentage who "follow" the party to the new position without ever losing an election. However, this is strongly moderated by the value of L. When L is high (e.g., $L = 2$), candidates are in some sense forced to constantly take large steps away from their optimal position and are culled via selection. Only when there

is more gradual individual adaptation is the role of selection substantially reduced. Simulation results supportive of each of these statements are available upon request.

Finally, for modest settings of L and ξ, party adaptation tends to be much *slower* than in the pure Darwinian model variant. To display this, I conduct an experiment showing the rotation of the parties for different settings of L and ξ. After initially allowing the simulation to run for 1,000 iterations, I increase the saliency of dimension 4 for activists.[2] The results are shown in Figure B.1. Here, I display the positions of the two parties on dimension 4 for the various parameter settings[3] As can be seen, the parties are much slower to respond to the changed environment for low values of L and ξ.

This is particularly important, because high values of L are virtually identical to the pure Darwinian model in that selection rather than individual adaptation drives party change. When the candidates themselves are responsible for party movement, it tends to be slower as the candidates are tightly clustered. Thus, there is little variance in the candidate population for the process of "electoral selection" to work upon. To understand this, consider the situation wherein all candidates are located at exactly one identical point. In this case, party resources are distributed uniformly in the population. Since rotation is (in part) a result of the unequal distribution of resources biased towards the activist mean, such a configuration means that neither individual adaptation nor Darwinian selection will have much to "work with" within the candidate populations.

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[2] In the initial phase, I set $\boldsymbol{\alpha} = (.4, .3., 2., 1)$ and then increase the saliency of dimension 4 to 0.4 for all activists.

[3] The simulations represent the average positions of the parties for 5 separate simulations run for each parameter setting.
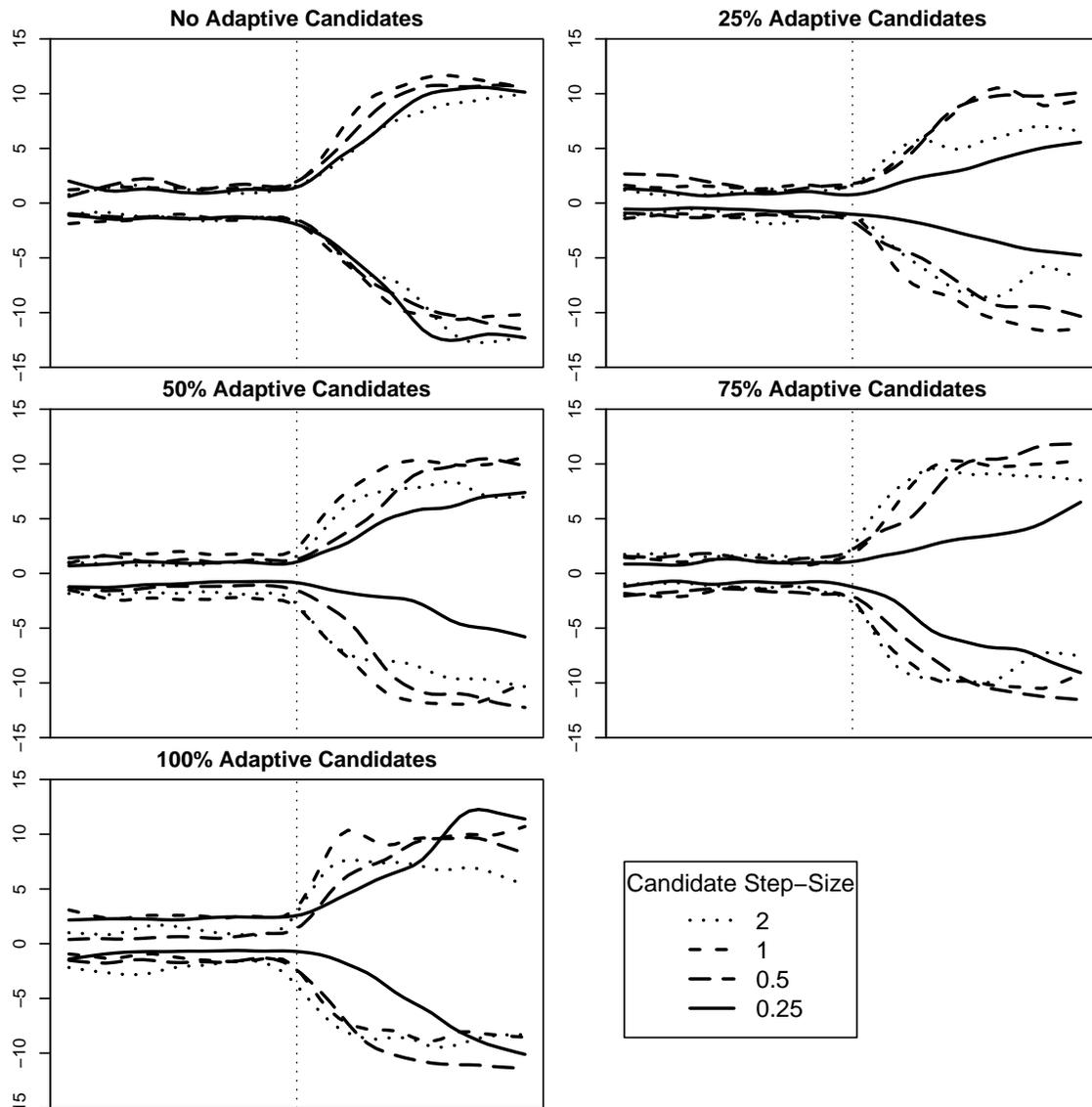
FIGURE B.1: Lamarckian learning: Positions of each party on dimension 4. The figure shows the mean position of the two parties on the fourth dimension. The line-types denote the maximum step-size that a candidate could take in each iteration. The vertical dotted line indicates the point in the simulations where the saliency is increased from .10 to .40. The results are "smoothed" over 5 simulations at each parameter setting. There are 500 iterations depicted on each side of this random shock.

Appendix C

Evolutionary Theory and History-Dependent Politics

> A science can describe either process or outcome or both.... I think political science is now in the stage of emphasizing process very much like biology in the first part of this century (Riker 1980, p. 458).

C.1 Introduction

The literature on "path dependency" was conceived as a response to the Panglossian view of social life wherein all things occur because they represented the best, or at least most efficient, of all possible worlds. In particular, advances in formal models had produced (in some circles) a sort of extreme functionalist determinism, that interprets social systems as maximizing responses to some set of initial conditions. Scholars of path dependence insisted instead that, in essence, "sometimes things just happen" (David 1985). Choices are frequently made without reference to or full understanding of their long-run consequences, and these historical events continue to "matter" in future time periods (Pierson 2000).

In biology, Darwinian theory arose in response to another form of extreme func-

tionalism: the pseudo-scientific theories of creationism that dominated the field in the early 19th century. Darwin's controversial claim was that sometimes things just happen – and the natural world responds. Random mutations or recombinations occur in a population, and evolution proceeds based on whether and how these events have an effect into future generations.

The parallels between theories of path-dependence (or history-dependence) and evolution have not gone unnoticed. Works on history-dependent social processes make frequent reference to evolutionary theory and "organic" change (David 1994). However, political science has, for the most part, restricted itself to analogy and metaphor (c.f., Carmines and Stimson 1989), importing few insights and almost none of the subtler distinctions on display in the contemporary biology literature.

The argument of this appendix is that political science researchers, and particularly scholars of history-dependent processes, would gain a great deal by more fully adopting and adapting the methods of evolutionary theory. As noted by Page (2006), substantive research on history-dependent processes very rarely provide detailed formal theoretical frameworks that are tailored to the historical events and processes that are under consideration. Rather, scholars have often made gestures to stylized ball and urn examples (wherein different colored balls are drawn from an urn and replaced according to a pre-specified rule) that are, at best, distant metaphors. Lamenting the haphazard development of the concept of path dependence over the past decades, Page (2006) notes that:

> In light of the many benefits that formal theoretical frameworks would contribute, we cannot but be surprised by the lack of formal models that describe history-dependent processes. One need only compare the concept of path dependence to that of equilibrium to see how far we have to go. ... By comparison to equilibrium, the concept of path dependence seems almost metaphorical (Page 2006, pp 87 - 88).

Page attempts to ameliorate this situation by masterfully dissecting the concept of

history dependence and categorizing the many senses in which "history matters." My argument, however, is that an alternative course for increasing the number and quality of formal models of history-dependent processes is to better incorporate the insights from a highly scientific field that has long understood that "sometimes things just happen." Evolutionary theory (and replicator dynamic models more generally) come pre-packaged with a host of tools and results that can facilitate the generation of precise history-dependent models designed explicitly for the details and nuances of the case in hand.

The classic mathematical example of a history-dependent process, as provided by Arthur (1994), is the Polya Process.[1] Assume we have an urn that initially contains two balls, one blue, and one white. In each iteration of the process, we remove one ball at random and replace it with two balls of that same color.[2]

There are two aspects of this model that are important to my discussion. First, this model can easily be re-cast in evolutionary terms. Assume we have a population of two individuals. There is only one genetic locus, and two possible genes. One individual has trait A and the other trait a. In each generation, one individual is chosen at random to reproduce asexually.[3] Similar reconstructions can be developed for all variants of these ball and urn examples.

Second, as the above re-framing might reveal, ball-and-urn models are heavily stylized and difficult to relate to most phenomenon (social or biological) to which they are applied. Although there is randomness, there are no mutations. Although there is selection, there is no clear sense as to why these particular parameters have

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[1] The following discussion is based largely on the treatment of Page (2006) and Pierson (2000), who each provide excellent summaries of this logic.

[2] The properties of this model that have drawn the most attention is that i) eventually the ratio of white and blue balls in the urn will reach an equilibrium, ii) that stable ratio could be *anything*, and iii) early draws from the urn have a particularly large effect on the ultimate outcome.

[3] This variant assumes that there is no death. An alternative would be to say that all individuals reproduce asexually and then die, but one individual makes two copies of itself.

been chosen. Why only draw one ball? Why replace it with two? What is the substantive interpretation of any of this anyways? Rather than relying on these simple models, scholars might instead seek to build more specific models – inspired by evolutionary theory – that go beyond metaphor. In the next section, I extend the model presented in Chapter 4 to provide a role for path dependence.

C.2   A model of ideological evolution

As discussed in Chapter 5, in the late 1960's and early 1970's, a number of historical events combined to bring the issue of abortion to national attention (Caron 2008). The relevant question here is what would be our *ex ante* expectations for how the parties would adapt in response to the introduction of this new and highly salient issue? Would they converge to a centrist position? If they polarized, which party would become pro-choice and which pro-life? In other words, how would the abortion issue be "bundled" with the existing stances of the parties? And, more generally, could we have predicted the outcome *ex ante*?

The answers to these question, and others like them, are fundamental to the understanding of the evolution of political ideologies. Moreover, this example parallels many phenomenon of great interest to the social and natural sciences. First, agents in the 1970s were facing an essentially "new" issue that had not previously been considered at the federal level. That is, previous political decisions had been made without forethought into their consequences for the issue of abortion. Second, agents did not exist in a historical vacuum. Candidates had reputations built around policy domains in many related areas that could not be eliminated overnight. Moreover, parties had developed bases of support over many years that could not be ignored.

In this section, I conduct simulations using the model from Chapter 4 to demonstrate its ability to account for history-dependence in party positioning. I begin by briefly re-stating the results of the base model. I then consider a variant that allows

for linkages across issue dimensions in the minds of activists.

C.2.1   Base model results

The basic equilibrium predictions of the model can be summarized as follows:

- The parties will drift towards a local equilibrium so long as (1) activist resources are sufficiently valuable for winning votes ; (2) party discipline is sufficiently high ; and (3) the total amount of activist resources are sufficiently high. Otherwise, the candidate populations will drift towards the center to a stable convergent equilibrium.

- The predicted location of the parties is determined by the relative salience of each dimension to activists. *Ceteris paribus*, the parties will diverge along each dimension such that they are further apart for the dimensions with the greatest values of α_i (the average salience of dimension i to activists).

- The model is characterized by multiple local equilibria. Although it predicts that the parties will diverge along salient dimensions, it does not predict how these issues will be "bundled." The number of possible equilibria are equal to $2^{(p-1)}$, where p represents the number of dimensions sufficiently salient to activists to cause divergence. Which of these equilibria will result depends on random events in the early phases of the simulation.

An example of the outcomes produced in the model is provided in Figure 4.3.

From these basic results we can draw two main conclusions. First, as argued by Carmines and Stimson (1989), the ultimate "bundling" of the issues is determined by early random events in the process. In larger parameter sweeps of this model, we cannot reject the null hypothesis that there is zero correlation between the positions of the parties on the various dimensions. On any particular dimension, things could go either way.

Second, once the parties have reached a certain level of divergence they settle into local basins of attraction. Although these divergent equilibrium are relatively stable for many parameter settings (as is shown in Chapter 4), the model shows high levels of what Setterfield (2009) calls "hysteresis" for low salience policy dimensions. That is, the parties have a tendency to randomly "switch" sides on low salient issues due to random drift.

C.2.2   Multi-dimensional linkages

In my second simulation, I attempt to incorporate the insights of Hinich and Munger (1996) and others that certain issue dimensions may be "linked" in the minds of activists. I alter the basic model described above and introduce each issue dimension sequentially. For this simulation, I set the number of dimensions to $p = 3$.

The order of the simulation is as follows:

- *Setup*: I initialize the simulation by distributing activists in the policy space according to the multidimensional normal distribution, $\mathbf{Z} \sim N(\mu, \sigma_v \mathbf{I})$.

- *Issue 1*: For the first 50 iterations of the model, I set the vector of issue saliences for all voters and activists to $\alpha = \delta = [s_{i1}, 0, 0]$. This is equivalent to assuming a one dimensional policy space for the first fifty iteration.

- *Issue 2*: For the second 50 iterations, I change the saliency vectors to be $\alpha = \delta = [s_{i1}, s_{i2}, 0]$.

- *Issue 3*: For the final 50 iterations, I change the saliency vectors to be the full vector $\alpha = \delta = [s_{i1}, s_{i2}, s_{i3}]$.

I implement three variants of this model. In the first case (the base model), I assume that activist preferences on each dimension are independent. In the second case, I follow Noel (2007) and Hinich and Munger (1996) in assuming that issues

are connected in the minds of activists. That is, preferences of activists are not independent across all dimensions. However, I assume that the level of between-issue correlation is fairly low. Specifically, I assume that $\mu = [0, 0, (.25 \times \mu_1 + .25 \times \mu_2)]$.

In the third instance, I specify a model where the "order" of events matters. Here, I assume that $\mu = [0, 0, .25 \times \mu_1 \times \omega + .25 \times \mu_2]$, where ω is a dummy variable indicating the order in which the issues were made salient. Substantively this might reflect some sort of "framing" effect that results from the different sequencing of events such that the first dimension is only correlated with the third dimension in the minds of activists under one particular ordering.

Under each of these scenarios, I run 100 simulations. Table C.1 shows the results of a logit model where the dependent variable is a dummy variable indicating whether the party (one party is chosen at random) has taken a position on the third dimension that is greater than 0. The independent variables are similar dummies for the party on the other two issues at the point (iteration 100) when the "new" issue is suddenly introduced. In the analysis of the third variant, I also include a dummy variable indicating the order in which these two prior issues they were considered, and an interaction between order and position on dimension 1.

Each column displays the results from one of the three simulation assumptions. As can be seen, this simple modeling approach supports the argument that the positions of the parties in previous eras can affect the positions they take in the future, conditioned on the extent to which (and the manner in which) these issues are correlated in the minds of activists. In column 1, where preferences across dimensions are independent, we can see that the model fails to reject the null hypothesis that the issues are unrelated. In column 2, where activist preferences are correlated across dimensions, we see that the model correctly identifies a positive relationship across time. In column 3, where both previous positions and ordering matter, both the prior states and the order are found to be statistically and substantively significant.

227

Table C.1: Logit models predicting party position on issue 3

	History independent	Multiple-state dependence	Order/state dependence
Intercept	0.065	-1.493	-0.982
	(0.25)	(0.31)	(0.45)
Issue1	-0.095	1.702	0.220
	(0.29)	(0.33)	(0.47)
Issue2	-0.486	1.397	1.826
	(0.29)	(0.33)	(0.51)
Order			-0.612
			(0.34)
Issue1 ×			1.728
Order			(0.50)

Appendix D

Why So Much Cooperation?: The Evolution of Party Institutions in American Elections

In this Appendix, I ask whether it is possible to model the formation of party institutions as an endogenous component of the models presented in Chapters 3 and 4. I find that two factors play the primary roll in determining whether populations of candidates who share a common label can endogenously create and support strong party institutions.

First, the candidates in each population must share a common incentive to cooperate. Following the tradition of many other models of political competition in a multi-dimensional setting, I argue that this common factor is in maintaining a party label pleasing to policy-motivated activists (Aldrich 1983b,a; Aldrich and McGinnis 1989; Miller and Schofield 2003; Roemer 2001). Second, the individual costs associated with supporting strong party institutions must not be too high. If and only if these conditions are met, then populations of candidates will evolve that can build strong party institutions and sustain them despite individual incentives to pursue their own heterogenous interests.

In the rest of this Appendix, I extend the model in Chapter 4 to allow for the endogenous formation of party discipline. In Section D.2, I then conduct a small number of simulation to characterize this model's results.

D.1 Endogenous party institutions and conditional party government

Empirical evidence shows that there is a strong linkage between intra-party homogeneity, inter-party polarization, and the emergence of institutions designed to strengthen the role of parties and party leaders (e.g., positive agenda control). In their theory of *Conditional Party Government* (CPG), Rohde (1991) and Aldrich and Rohde (2001) show that there is a strong positive correlation between the polarization of parties, their internal homogeneity, and the development of strong party-based institutions and norms.

However, the theoretical justification for this observed empirical phenomenon has remained contentious. It is clear that, from a historical standpoint, it is the members of Congress themselves who determine the rules and institutions under which they operate (Rohde 1991). The unresolved issue (perhaps unresolvable in a traditional framework) with CPG is that theoretical justification to explain *why* members of Congress would be willing to support strong party institutions if the resulting outcomes are inferior (from the individual members' perspective) to simple majoritarian institutions remain underspecified. In this section, I extend the model in Chapter 4 to allow for the endogenous formation of party institutions in a 2-dimensional policy space.

D.1.1 On the origin of congressional voting behavior

In Chapter 5, I argue that members' voting records in office can be treated as roughly equivalent to their position in the policy space as discussed in my theoretical models (Chapters 2-4). One of the implicit assumptions of my theoretical approach, there-

fore, is that member voting behavior in Congress is *not* determined solely by the preferences of voters. *Ceteris paribus* individual candidates are rewarded for taking stances closer to the voters in their district. However, in practice such a move towards moderation is likely to irritate (or alienate) supportive policy-motivated activists and reduce overall party resources. Moreover, if party discipline is sufficiently strict, the costs of such of a move in terms of reduced resources will outweigh the benefits.

Thus, member behavior in Congress is determined by some combination of selection pressures originating with voters and selection pressures originating from party activists and party institutions. Given the results of Axelrod and Hamilton (1981) and others, we can anticipate that – when activist resources are sufficiently valuable – selection pressures will work to ensure members are selected who will support institutional arrangements that will prevent members from solely representing their district voters. Instead, as I discuss in Chapter 1, selection pressures will encourage members to cooperate to overcome collective actions problems by creating institutions (e.g., systems of repeated interaction or social hierarchy) to mediate conflict (Michod 1999).

What does this mean about the origins of member behavior? Does the model preclude strategic thinking by members? Am I assuming that members are mere automatons of selection?

The answer to these questions is a qualified no. The model does not posit that members are unable to act strategically (or quasi-strategically in some boundedly-rational manner) to achieve specific goals. However, it does posit that under different political environments, selection will favor members with different goals. When activist and party resources are not valuable, selection will work to select members whose preferred outcomes are more in line with their district voters. When this is not the case, however, selection will favor members whose goals (whether stated or

231

implicit) are more in line with their party's activist base.[1]

D.1.2 Candidates

Each candidate takes a policy stance at point $\mathbf{Y}_k = [y_1, y_2]$. In addition, there are two individual candidate traits associated with party discipline. For candidate k in party Θ, $p_k \in [0, 1]$ represents the candidate's support for strong "party discipline." This is discussed in more detail in Section D.1.3, but can loosely be interpreted to indicate the candidate's support for the biased distribution of party resources towards individuals ideologically close to the party "enforcement point" E_θ.

Candidates also have an additional trait η_k. For candidate k, $\eta_k \in [0, 1]$ represents the candidate's preferences about what point in the policy space the institutional party should attempt to enforce (i.e., her preferred location of E_θ). This is discussed more below, but it can be understood by considering the fact that if η_k is zero for all candidates in party Θ, then party institutions will be used to enforce the party candidate mean (the mean position of all candidates in the party). If η_k takes the value of one for all candidates in party Θ, then party discipline will be used to enforce the average position of party activists.

In addition to their policy stance, candidates also have a "valence" advantage, which is itself a function of the resources given to each candidate by the institutional party (discussed below). For candidate k the valence advantage is denoted ν_k.

Thus, in this two dimensional policy setting, each candidate can be represented by the vector:

$$\mathbf{Y}_k = (y_{1k}, y_{2k}, p_k, \eta_k, \nu_k) \tag{D.1}$$

The first four elements of this vector represent the immutable strategies or traits

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[1] One very plausible scenario here is that many members originate as political activists themselves. Alternatively, they may sort themselves into the party whose base and reputations is most similar to their own (Aldrich and Bianco 1992; Aldrich 1995; Snyder and Ting 2003). An additional source of conformity may be primaries.

of the candidate. These are inherent to the candidate and are transferable to new candidates wishing to copy or mimic the strategies of successful candidates. The final element of this vector, ν_k, is the *endogenous valence* of the candidates and is assigned by the institutional party.

After each election, the candidate populations are re-populated back to size N. That is, there is always one candidate from each party running in each district. New candidates choose at random one of the surviving incumbent candidates from the previous election. They adopt this chosen incumbent's strategy vector, Y_k, with some random error. Thus a new candidate, k', will adopt the strategy vector

$$\mathbf{Y}_{k'} = (y_{1k} + \varrho_{1k'}, y_{2k} + \varrho_{2k'}, p_k + \varrho_{3k'}, \eta_k + \varrho_{4k'}, -). \tag{D.2}$$

The errors, ϱ, are independent and distributed uniformly on the interval $[-\rho, \rho]$.[2]

D.1.3 The institutional party

As in chapter 4, I assume that activists contribute to the parties based on the collective "party signal" each party. Second, I assume that the institutional party must divide up the total amount of resources contributed by the activist base amongst all of the candidates. This sets the conditions for a continual collective action dilemma as all candidates are motivated to "defect" by taking positions somewhat closer to their district mean and farther from the activist base. This will make the party signal less optimal for garnering activist resources, but the decreased amount of activist support will be dispersed throughout the candidate population.

However, as shown by Axelrod (1984), an ecological model that treats strategies as fixed traits may allow the emergence of cooperative behavior amongst agents. Thus, it is possible in my model to explain the emergence of strong party institutions and to study the conditions under which they might emerge.

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[2] Recall that the final element in this vector, ν_k, arises exogenously and is discussed below.

Endogenous party discipline

In order to be more specific it is necessary to operationalize what is meant here by "party discipline." If the institutional parties have a budget constraint, γ_θ , how would we expect the institutional parties to distribute resources amongst the candidates? As I discuss in Chapter 3 and Chapter 4, I assume that the institutional parties distribute activist resources via some kind of function that penalizes distance from the party enforcement point $\mathbf{E}_\theta = [E_{\theta 1}, E_{\theta 2}]$. The degree of "steepness", denoted β, represents party discipline.

In Chapters 3 and 4, I explain in detail how party resources are distributed as a function of β. Given the rules governing the distribution of party resources, two questions remain. First, how is the value of β_θ and β_ψ determined? Second, what point in the policy space, $\mathbf{E}_\theta$ and $\mathbf{E}_\psi$, should the institutional parties attempt to enforce? Unlike previous chapters, I assume that *both* of these values are endogenous to the model and are set by the candidates themselves.

As stated in (D.1) above, each candidate has a trait $p_k \in [0, 1]$ that indicates the extent of the candidates support for strong party institutions. In order to endogenize β_θ, I assume that the candidates in party Θ vote for their preferred level of party discipline thus yielding:

$$\beta_\theta = \frac{\omega \sum_k p_k}{n_d} \tag{D.3}$$

where ω indicates the maximum possible value of β_θ that would arise if all candidates were perfectly supportive of party discipline.

Endogenous enforcement points

Finally, I need to make some assumption about what point $\mathbf{E}_\theta$ the institutional party will attempt to enforce. In previous chapters the assumption was that the enforce-

ment point $\mathbf{E}_\theta$ was identical to the activist mean $\bar{\mathbf{z}}_\theta$. However, it is also possible that candidates may want to use party discipline to enforce their own position.

To allow the enforcement point to emerge endogenously, therefore, I assume that candidates vote on the enforcement point. Their vote is cast for some point on the interval between the candidates own ideal point, $\mathbf{Y}_k$, and the mean party activists' ideal point $\bar{\mathbf{z}}_\theta$. The degree to which each candidate is willing to support the activist point is denoted η_k, such that on dimension i candidate k votes for the point $\eta_k \bar{z}_{i\theta} + (1 - \eta_k)y_{ki}$. It follows that the enforcement point for party Θ will be equal to:

$$E_{\theta i} = \frac{\sum_k \left(\eta_k \bar{z}_{i\theta} + (1 - \eta_k)y_{ki} \right)}{n_d} \tag{D.4}$$

When $\eta_k = 1$ for all k, the enforcement point will always be equal to the party activist ideal point $\bar{\mathbf{z}}_\theta$. When $\eta_k = 0$ for all k, the enforcement point will be equal to the intra-party mean $\bar{\mathbf{Y}}^\theta$.

Costs of supporting party institutions

Finally, it is important to make support for strong party institutions costly. Therefore, I assume that the voters "punish" candidates who support strong party institutions. Specifically, the utility of voter j for candidate k a level of partisan support $p_k \in [0, 1]$ and endogenous valence ν_k can be re-written:

$$U_{jk}(\mathbf{X}_j, \mathbf{Y}_k) = \kappa \nu_k - c p_k - (2 - \kappa - c) \left(|\mathbf{X}_j - \mathbf{Y}_k|^T \mathbf{W}_j |\mathbf{X}_j - \mathbf{Y}_k| \right), \tag{D.5}$$

where $c \in [0, 1]$ is a constant representing the relative weight of this "partisanship" dimension in voters' utility functions.

D.1.4   Sequence of the simulations

It is helpful to return briefly to discuss the exact sequence of the game. First, the activist base for each party looks at the party "signals" and contributes resources. Second, candidates vote to set the values of the party-discipline parameters (β_θ and β_ψ) and the enforcement points (E_θ and E_ψ). Third, the institutional party distribute resources amongst all of the candidates according to these parameter settings. Fourth, the voters decide between the candidates based on their relative utilities for each candidate running in their own district. There is one candidate from each party running in each district. The voters' utility is based on (1) the ideological proximity of the two candidates (2) the degree of support each candidate gives to the institutional party and (3) the valence advantage for each candidate. The valence of each candidate is a function of the resources allocated each candidate by the institutional party in stage 2. The candidate that wins the election survives and becomes the incumbent for that district, and the other candidate is eliminated. Finally, new candidates enter the system and mimic (with some rate of error) the strategies of successful own-party candidates.

D.1.5   Reviewing the parameters

Before examining the results, it may be helpful to briefly review the *new* parameters in the model and their interpretation.

- c: This indicates the relative "cost" associated with a candidate supporting strong party discipline. Specifically, c indicates the relative weight that voters give in evaluating candidates on the "partisanship" dimension relative to policy proximity or valence.

- ω: This indicates the maximum value that can be taken for the party-discipline parameter β when all candidates in a candidate population support strong

236

party-discipline.

For the purposes of this preliminary study I have fixed several parameters that only play rolls at extreme values. In particular, I have fixed $\omega = 10$, $\rho = 0.1$, $n_v = 200$, $n_a = 1,000$, and $n_d = 200$.

It is also necessary to pick starting values for all of the endogenous parameters. In trial simulations, I discovered that the model outputs were particularly sensitive to the degree of partisan support (η_k and p_k) latent in the party populations in the initial stages. In particular, initializing the simulations with extremely low levels (near zero) for η_k and p_k leads to complete convergence and often prevents the emergence of strong party discipline. However, I do not want to bias the simulations by beginning with too high a level of support for strong institutions. I therefore compromised by drawing the initial values for η_k and p_k from the distribution $Uniform[0, 0.1]$. Thus all simulations begin with low (but not zero) levels of η_k and p_k.

D.2   Simulation results

The main focus of this section is to display the properties of the simulation outputs. I find that, in the limit, the parties will either converge to middle of the policy space or diverge to the location of the mean activists. The probability that the parties will diverge is a function of the value of valence in voter utility functions (κ), the costs associated with supporting strong party institutions (c). I also find that the emergence of strong party institutions coincide with the emergence of internally homogenous and polarized parties, while weak party institutions coincide with internally heterogeneous and convergent parties.

D.2.1   Characterizing equilibria outcomes

In this section I describe each equilibrium outcome and discuss the logic for when and how they obtain. Figure D.1 shows model output from an exemplar run of the

model resulting in a convergent equilibrium. The top two panels show position of the two candidate populations on each dimension. The solid lines show the intra-party means and the dashed lines show the 95% coverage intervals. The figure shows that both parties have converged completely to the center of the voter distribution (0.5).

The bottom left panel shows the party-discipline parameter (β) over time. Obviously, the party-discipline parameter is extremely low. In fact, it is nearly as low as it can be given that there is still random variation for new candidates on this parameter. The bottom right panel shows the enforcement points E_θ and E_ψ. Note that the enforcement points remain relatively stable and are very near the mid-point (0.5).

Figure D.2 provides model outputs from a simulation resulting in a divergent equilibrium. The top two panels shows the distribution of the two candidate populations over time on each dimension. Again, the heavy lines indicate the mean position of the candidate populations, while the dashed lines show the 95% coverage intervals. Note that on the first dimension the parties slowly separate over time into two distinct populations. After a number of iterations, the two party populations stabilize to locate at points near the activist mean points. On the second policy dimension, however, the candidate populations remain convergent as the activist means are identical.

The bottom left panel shows the party-discipline parameter (β) over time. Note that the party-discipline parameter immediately increases from it's initial point of .5, and that the population supports relatively high values of β throughout the simulation. The bottom right panel shows the enforcement points E_θ and E_ψ. Note that the enforcement points also drift apart and stabilize near the point where the enforcement points are equivalent to the party activist means.

Candidate Position on 1st Dimension **Candiate Positions on 2nd Dimension**

Party Discipline Parameter **Enforcement Points and Mean Activist Preference**
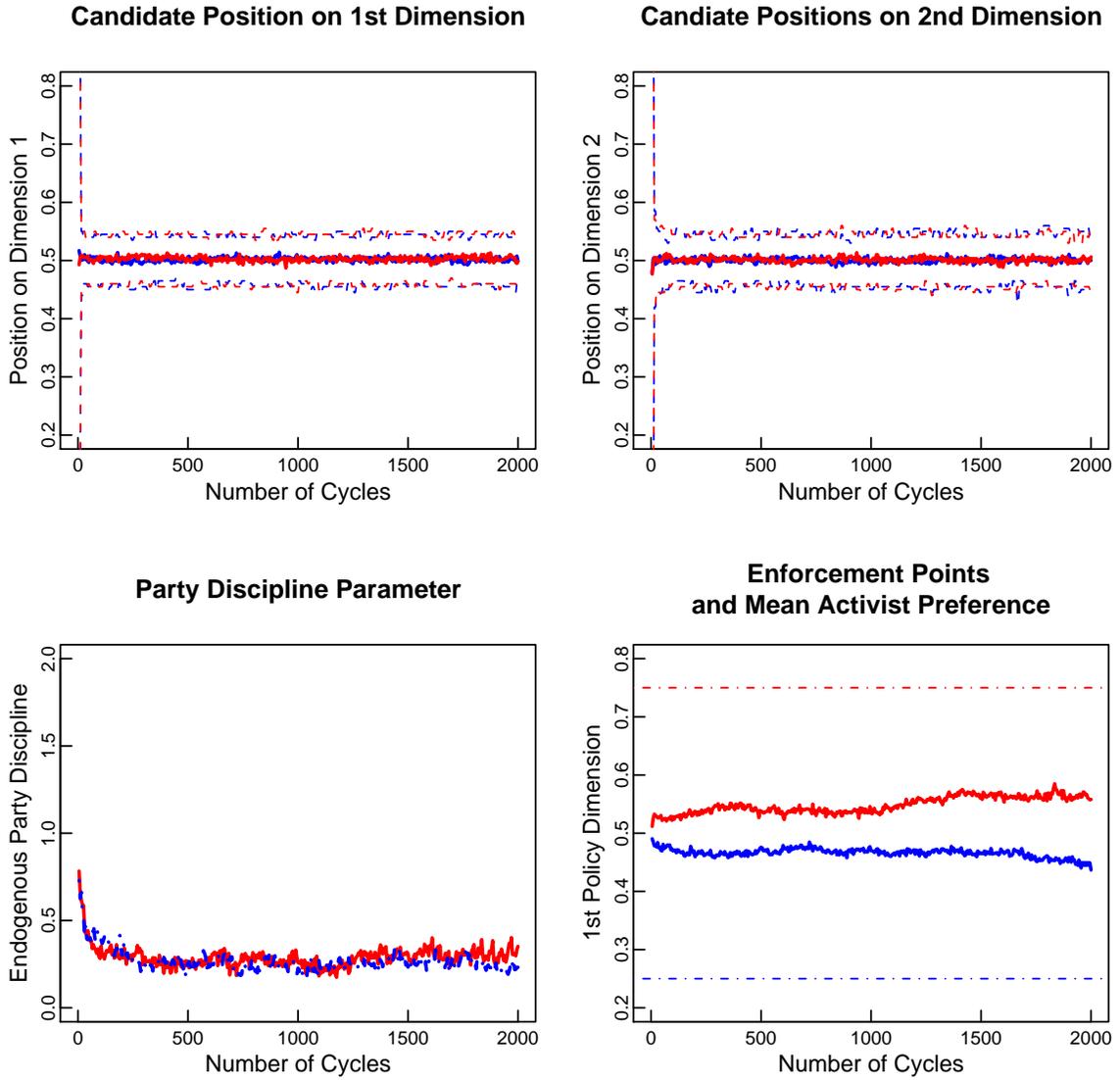
FIGURE D.1: Example simulation outputs for a convergent outcome

D.2.2   Identifying controlling parameters

For this appendix I ran models only over a small subset of the latent parameter space. In each simulation, I ignore the results from the first 5,000 iterations.

For the next 500, iterations I take measurements from the model once every 10 iterations. The results shown here are therefore averages from 50 samples taken from

Candidate Position on 1st Dimension

Candiate Positions on 2nd Dimension

Party Discipline Parameter

**Enforcement Points
and Mean Activist Preference**

FIGURE D.2: Example simulation outputs for a divergent outcome

each of the 930 simulated runs included in this study.[3]

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[3] In addition to the fixed parameter settings mentioned above I used the following parameter setting: $\kappa = (0.05, 0.1, 0.15, 0.25, 0.5), c = (0.05, 0.2, 0.25, 0.5), \alpha_1 = (0.5, 0.75), \delta_1 = (0.25, 0.75), \sigma_d = (0.025, 0.1), r = (0.01, 0.05, 0.1, 0.5)$.

Convergent, divergent, and intermediate outcomes

I focus here on the findings that differ from those discussed in Chapters 3 and 4. The most obvious implication from the model simulations is that the dominant controlling parameters that determine which outcome will obtain is the cost of partisanship c. In fact, for high values of c, divergence is impossible. However, the role of c is moderated by the value of the valence constant (κ).

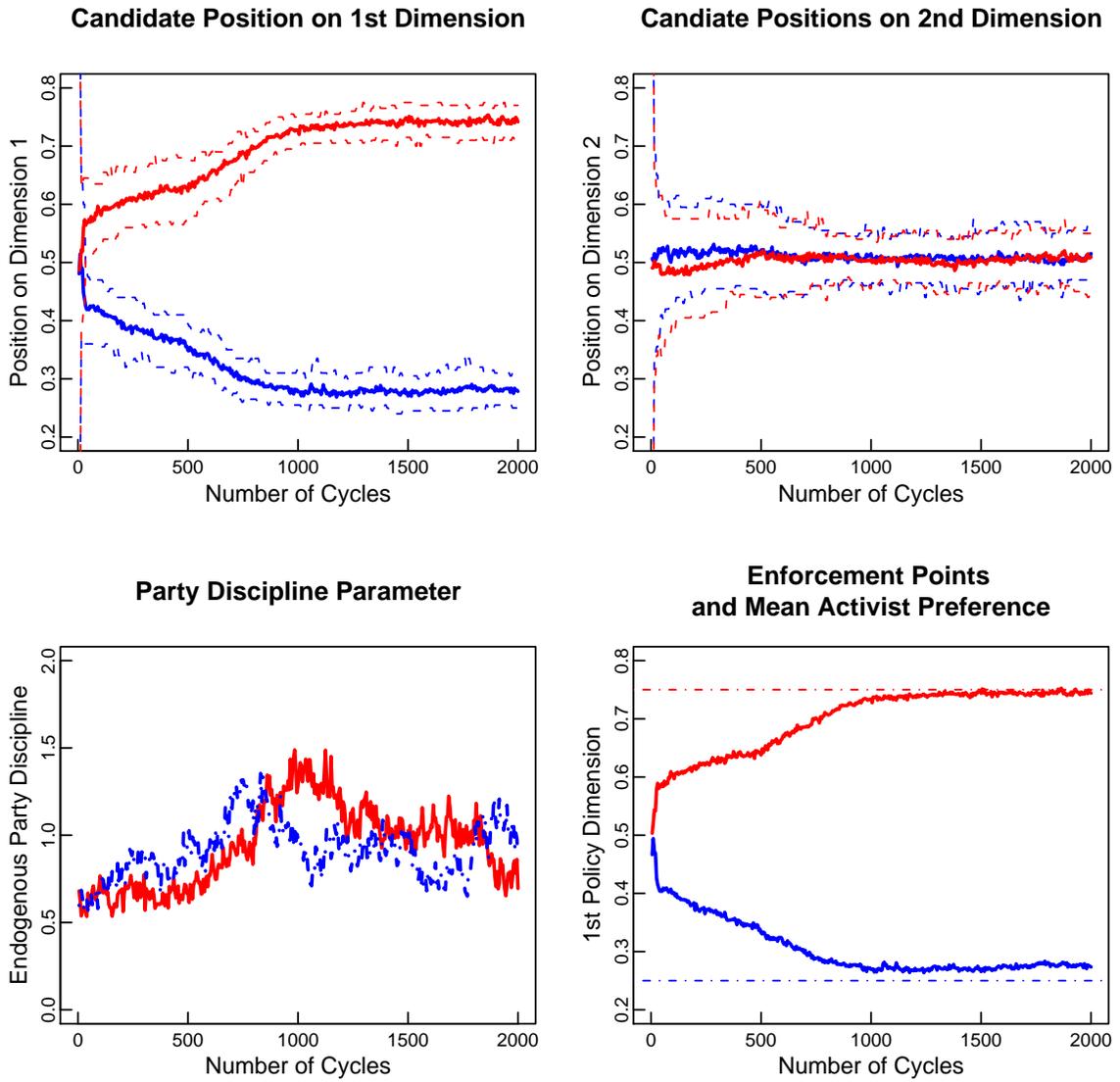> **Claim 1**: The individual candidate costs, c, associated with supporting strong party institutions are negatively associated with divergence.
> **Claim2**: These two parameters are interactive, such that for lower values of c lower values of κ will lead to divergence.

Figure D.3 provides the evidence in support of these claims. Each panel show the distribution of the distance between the intra-party means by κ for a different value of c. Notice first, that in each of these panels κ is positively associated with divergence. Second, note that divergence is less for each value of κ as c increases. Finally, it is obvious that these values are highly interactive.

Second, it is illustrative to simply look at the correlation between the important *endogenous* variables of interest. If the process works as I have argued, then there should be a positive correlation between the distance between the intra-party means, the party-discipline parameters β_{red} and β_{blue}, the amount of activist resources available to each party, and the enforcement point for the party further to the right in the policy space (E_{red}). There should be a negative relationship between all of these variables and the enforcement points for the leftward (blue) party (E_{blue}). Additionally, as β increases we should also anticipate observing higher levels of intra-party homogeneity (smaller 95% coverage intervals). Table D.1 shows that all of these expectations are met, and allows me to make a final claim.

> **Claim 3**: There is a positive relationship between party divergence, intra-party homogeneity, and strong party institutions.
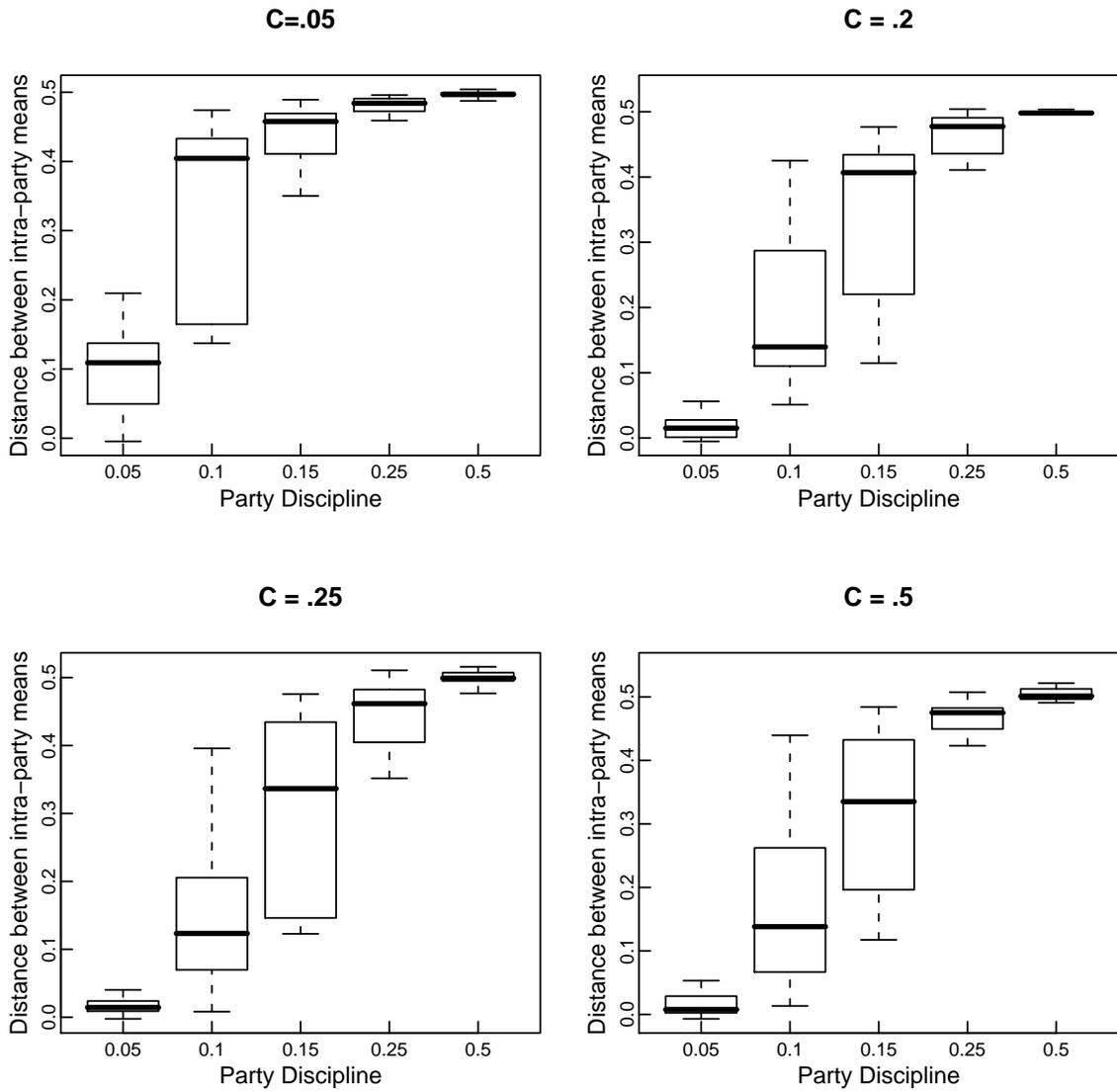
FIGURE D.3: Evidence for Claims 1-2. These boxplots display the distance between the intra-party means for all simulations for different settings of c and κ. The parameters used are listed in footnote 11 with the exception that only simulations where $\sigma_d = 0.1$ are included in this figure.

Table D.1: Evidence for claim 3: Correlations between endogenous parameters

	κ	Dist.	β_{blue}	β_{red}	Res. Red	Res. Blue	E_{red}	E_{blue}	95% CI Reds
Valence constant (κ)	1.00								
Distance Between Party Means	0.76	1.00							
Party Discipline (β_{blue}	0.70	0.65	1.00						
Party Discipline (β_{red})	0.53	0.45	0.64	1.00					
Red Resources	0.73	0.99	0.62	0.41	1.00				
Blue Resources	0.74	0.99	0.62	0.42	1.00	1.00			
Enforcement Point Red (E_{red})	0.59	0.81	0.56	0.38	0.80	0.80	1.00		
Enforcement Point Blue (E_{blue})	−0.61	−0.79	−0.51	−0.37	−0.78	−0.78	−0.70	1.00	
Size of 95% Coverage Interval For Reds on D1	−0.80	−0.94	−0.66	−0.50	−0.93	−0.94	−0.71	0.69	1.00
Size of 95% Coverage Interval For Blues on D1	−0.77	−0.93	−0.66	−0.33	−0.92	−0.92	−0.73	0.67	0.96

Note that only simulations where $\sigma_d = 0.1$ are included in this table.

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Biography

Jacob Michael Montgomery graduated Summa Cum Laude with a Bachelor of Arts degree with Honors in political science and mathematical-economics from Wake Forest University in 2002. He received a M.S. in statistical science from Duke University in 2009. He will complete a Ph.D. in political science at Duke in 2011. He will then be an Assistant Professor of Political Science and Applied Statistics at Washington University in St. Louis in fall 2011.

Jacob has published articles in several journals, including: *Political Behavior*, *Political Analysis*, *The International Journal of Public Opinion Research*, and *Addiction*. Jacob was a National Science Foundation Graduate Research Fellow from 2007–10, and he received an NSF Dissertation Improvement Grant in 2010. He is a recipient of the Robert K. Steel Family Graduate Fellowship, the Robert R. Wilson Graduate Fellowship in American Politics, and the Jaffrey Endowed Fellowship. In 2003 he attended Victoria University in Wellington, New Zealand as part of the Rotary Ambassadorial Scholars program. Jacob was born on May 24, 1980 in Seattle, Washington.