MEASURING STATE POSTSECONDARY GOVERNANCE:
DEVELOPING A NEW CONTINUUM OF CENTRALIZATION

by

THOMAS AUSTIN LACY, JR.

(Under the Direction of James C. Hearn)

ABSTRACT

In the U.S., all 50 states have some form of postsecondary governance structure, yet there exists substantial variation in the powers and authority these entities have over their public postsecondary institutions. In studying and characterizing these structural differences, postsecondary education researchers and policymakers have relied on the typology of “planning agency,” “coordinating board,” and “consolidated governing board,” a typology that has persisted largely unchanged since 1965. In utilizing this typology in empirical studies, researchers have consistently found that governance structures influence various policy outcomes. However, despite the usefulness of these categories, many have suggested that the typology does not capture the true heterogeneity between boards, theorizing that postsecondary governance structures lie on a continuum of centralization. This study addresses the shortcomings of the current typology through the use of a Bayesian latent variable model to place all states on a continuum of centralization. To measure this, the model uses 19 indicators, incorporating the existing typology and qualitative case studies as informed priors. Over the 25 year time period of 1985-2009, 25 qualitative pieces of information are systematically integrated into the measurement model. This new measure of centralization is then used in a predictive model that tests factors that influence states’ movements along this continuum of centralization.
Though previous research finds political indicators as the primary influence on changes in state postsecondary governance, a predictive model using the refined measure suggests that, beyond politics, changes in state appropriations to higher education and changing state wealth are additional indicators that correlate importantly with changes in centralization. Taken as a whole, this study may point analysts towards new directions in a longstanding research tradition.

INDEX WORDS: U.S. higher education, states, governance, measurement, centralization Bayesian data analysis
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by

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>iv</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>vii</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>viii</td>
</tr>
<tr>
<td>CHAPTER</td>
<td></td>
</tr>
<tr>
<td>1 INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Overview of the study</td>
<td>6</td>
</tr>
<tr>
<td>2 IDENTIFICATION OF THE PROBLEM</td>
<td>8</td>
</tr>
<tr>
<td>Postsecondary governance structures</td>
<td>9</td>
</tr>
<tr>
<td>Governance restructuring</td>
<td>15</td>
</tr>
<tr>
<td>Governance effects</td>
<td>23</td>
</tr>
<tr>
<td>The disconnect</td>
<td>30</td>
</tr>
<tr>
<td>3 CONCEPTUAL FRAMEWORK</td>
<td>32</td>
</tr>
<tr>
<td>A continuum of centralization</td>
<td>34</td>
</tr>
<tr>
<td>Bayesian theory</td>
<td>43</td>
</tr>
<tr>
<td>Predicting governance change</td>
<td>48</td>
</tr>
<tr>
<td>4 DATA AND RESEARCH METHODS</td>
<td>59</td>
</tr>
<tr>
<td>The measurement model</td>
<td>60</td>
</tr>
<tr>
<td>The predictive model</td>
<td>69</td>
</tr>
<tr>
<td>5 FINDINGS</td>
<td>76</td>
</tr>
<tr>
<td>Results from the measurement model</td>
<td>76</td>
</tr>
<tr>
<td>Table</td>
<td>Title</td>
</tr>
<tr>
<td>-------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>Indicators of governance centralization</td>
</tr>
<tr>
<td>2</td>
<td>Variable Descriptions and Sources</td>
</tr>
<tr>
<td>3</td>
<td>Descriptive Statistics for indicators in the measurement model, 1985 &amp; 2009</td>
</tr>
<tr>
<td>4</td>
<td>State governance structures, 1985</td>
</tr>
<tr>
<td>5</td>
<td>States moving categories in the typology</td>
</tr>
<tr>
<td>6</td>
<td>States experiencing within governance change</td>
</tr>
<tr>
<td>7</td>
<td>Descriptive statistics for variables in the predictive model, 1986 &amp; 2007</td>
</tr>
<tr>
<td>8</td>
<td>Intercorrelations of variables in the predictive model</td>
</tr>
<tr>
<td>9</td>
<td>Results from the measure of centralization, 1985 &amp; 2009</td>
</tr>
<tr>
<td>10</td>
<td>Results from the predictive models for change in centralization</td>
</tr>
<tr>
<td>11</td>
<td>Effect of Republican governor on change in centralization at different levels of gubernatorial power</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1</td>
<td>The existing typology and a continuum</td>
<td>35</td>
</tr>
<tr>
<td>Figure 2</td>
<td>Centralization, 1985</td>
<td>81</td>
</tr>
<tr>
<td>Figure 3</td>
<td>Centralization, 1986</td>
<td>81</td>
</tr>
<tr>
<td>Figure 4</td>
<td>Centralization, 1987</td>
<td>82</td>
</tr>
<tr>
<td>Figure 5</td>
<td>Centralization, 1988</td>
<td>82</td>
</tr>
<tr>
<td>Figure 6</td>
<td>Centralization, 1989</td>
<td>83</td>
</tr>
<tr>
<td>Figure 7</td>
<td>Centralization, 1990</td>
<td>83</td>
</tr>
<tr>
<td>Figure 8</td>
<td>Centralization, 1991</td>
<td>84</td>
</tr>
<tr>
<td>Figure 9</td>
<td>Centralization, 1992</td>
<td>84</td>
</tr>
<tr>
<td>Figure 10</td>
<td>Centralization, 1993</td>
<td>85</td>
</tr>
<tr>
<td>Figure 11</td>
<td>Centralization, 1994</td>
<td>85</td>
</tr>
<tr>
<td>Figure 12</td>
<td>Centralization, 1995</td>
<td>86</td>
</tr>
<tr>
<td>Figure 13</td>
<td>Centralization, 1996</td>
<td>86</td>
</tr>
<tr>
<td>Figure 14</td>
<td>Centralization, 1997</td>
<td>87</td>
</tr>
<tr>
<td>Figure 15</td>
<td>Centralization, 1998</td>
<td>87</td>
</tr>
<tr>
<td>Figure 16</td>
<td>Centralization, 1999</td>
<td>88</td>
</tr>
<tr>
<td>Figure 17</td>
<td>Centralization, 2000</td>
<td>88</td>
</tr>
<tr>
<td>Figure 18</td>
<td>Centralization, 2001</td>
<td>89</td>
</tr>
<tr>
<td>Figure 19</td>
<td>Centralization, 2002</td>
<td>89</td>
</tr>
<tr>
<td>Figure 20</td>
<td>Centralization, 2003</td>
<td>90</td>
</tr>
</tbody>
</table>
Figure 21: Centralization, 2004 .....................................................................................................90
Figure 22: Centralization, 2005 .....................................................................................................91
Figure 23: Centralization, 2006 .....................................................................................................91
Figure 24: Centralization, 2007 .....................................................................................................92
Figure 25: Centralization, 2008 .....................................................................................................92
Figure 26: Centralization, 2009 .....................................................................................................93
Figure 27: Chloropleth maps of state centralization 1985-1996....................................................95
Figure 28: Chloropleth maps of state centralization 1997-2009....................................................96
Figure 29: Effect of Republican governor on change in centralization at different levels of
gubernatorial power .....................................................................................................................102
Figure 30: Comparison of the typology and the continuum, 2009 ..............................................117
Amendment X of the Constitution of the United States reads, “The powers not delegated to the United States by the Constitution, nor prohibited by it to the states, are reserved to the states respectively, or to the people.” When coupled with the Constitution’s omission of education, states assume the primary responsibility for all levels of public education. While the federal government has intervened into this sector, it has been unable to dictate the specific forms states use for the governance and management of public higher education. As a result, states have a wide array of arrangements through which they govern their public postsecondary systems, with some allowing for a high degree of institutional autonomy and others employing large, powerful, centralized structures in an effort to increase system-wide coordination. Prior to the mid 19th Century, all institutions possessed formal autonomy in their states, which changed with Nevada’s adoption of the first state wide governance structure in 1864 (Berdahl, 1971; McGuinness, 1997). In response to the growing complexity of postsecondary education, the 20th Century saw the proliferation of state-wide governance agencies. By the 1950s the number of states with formal governance structures increased to 22, with all states having some formal arrangement by 1974 (Berdahl, 1971; McGuinness, 1997).\footnote{This is shortly after the 1972 amendments to the Higher Education Act which sought to incentivize states to create governance structures (Thelin, 2004 pp.338-340). Not included in this is the state of Wyoming whose small higher education system has long had \textit{de facto} coordination which in practice is similar to the function of many state-wide coordinating agencies.}

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As state governance became the norm, descriptions of the differences between structures moved from the simplified dichotomy of institutional autonomy and state control to typologies of the different structures that indicated varying degrees of centralization. While the overall historical trend was the movement from campus to state control, states have altered their governance structures, with some choosing to decentralize existing structures. As a result, the current landscape of state governance has great variation ranging from highly decentralized systems that privileging campus autonomy (e.g. Michigan and Delaware) to states that vest a significant amount of decision making and authority within a single entity (e.g. Montana and North Dakota).

As a result of this heterogeneity between states, governance arrangements are at the center of state-level postsecondary education scholarship. Despite being a fundamental component of analysis, characterizations of governance arrangements either focus on changes within a particular state or rely on the effects of these structures on various policy outcomes, using a long standing and largely unchanged taxonomy in statistical models. James Gilbert Paltridge’s 1965 article “Organizational forms which characterize statewide coordination of public higher education” is the origin of the taxonomy of governance structures, an endeavor later continued by Robert Berdahl in the 1970s and Aims McGuinness throughout the 1980s and 90s. These qualitative characterizations describe a state as having a planning agency, coordinating board, or consolidated governing board, with planning agencies as the most decentralized structures and consolidated governing boards as the most centralized.\(^2\) While there have been marginal alterations in the 40 years since Paltridge’s seminal work, his original

\(^2\) Both Berdahl and McGuinness describe differences that exist within the category of coordinating board. Nonetheless, the term coordinating board has garnered wide spread use and application by researchers.
schema persists with little change.\(^3\) Despite this, all existing measures result in some description that ranges from loose coordination to centralized control and, recognizing the limits of this approach, both those who updated and outlined the taxonomies and researchers studying governance have observed that there are differences within these broad categories.

In describing the taxonomy’s limitation, higher education scholars often speculate of the presence of an underlying, latent continuum of centralization that may characterize the heterogeneity within the larger set of governance structures, which, by definition, points towards the existence of within category differences.\(^4\) Despite the many assertions that governance structures inhabit a continuum, to my knowledge, there is no research that systematically places all 50 states on a continuum of centralization, much less across time, causing researchers to continue to employ the qualitative typologies in all studies, be they qualitative or quantitative.\(^5\) The dissonance between description and instrumental use of the typology can muddle inference obtained in empirical studies of state higher education policy; the variance exists, but remains unmeasured. Hypothetically, it may be that some states in the middle, coordinating board category, have levels of centralization closer to that of consolidated governing boards while others’ levels are closer to that of planning agencies, a misidentification that could lead to inferential problems when describing governance’s effect on policies. Further, this issue limits research on governance change to cases in which full restructuring or policy initiated changes occurred, ignoring less easily identifiable changes, agency centered changes or other, more

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\(^3\) Arguably, the study of state structures could be characterized as an expansion of qualifying footnotes, which in itself implies that the simplicity of a typology is inadequate.

\(^4\) See, for example, Hearn and Griswold (1994); McLendon, Heller, and Young (2005); McLendon and Ness (2003); and Hearn, McLendon, and Lacy (2009).

\(^5\) Studies that utilize some form of a continuum are the work of Volkwein (1986, 1987, with Malik 1997) and Richardson, Bracco, Callan, and Finney (1999), though none of these are consistent efforts across all states and/or through time. Volkwein focuses not on the state level, but on the effect of campus autonomy on various outcomes. Richardson et al. (1999) place states along a continuum, but provide no description as to what drove their decisions and limits their study to only a handful of cases at a single point in time. Arguably Richardson et al.’s use of continuum is more speculative than operational, see, for example Richardson et al. (1999), pp18-21.
marginal alterations. This creates the problematic situation where changes in governance structures are exclusively observed as changes in policy, obscuring alterations in organizational structures that occur through learning and adaptation.

The impact of this cannot be overstated. As recent research has found politics to be central to reform in postsecondary governance structures (Leslie and Novak, 2003; McLendon, 2003b; McLendon and Ness, 2003; McLendon, Deaton, and Hearn, 2007; Mills, 2007; Leslie and Berdahl, 2008), the influence of politics may result from excluding observed changes to those initiated by policy, a selective process where one should expect to consistently find politics and power at the center of change. That is, the political will required to enact broad, revolutionary change is greater than that required to marginally centralize or decentralize existing structures and, even if the policy centered changes result in minor changes in levels of centralization or decentralization, their policy origins make them the domain of politics. This is in contrast to changes that may result through learning and adaptation, changes that are subtle and do not command the attention of governors and legislators. Another limitation of focusing on policy initiated change is that it forces researchers to understand governance reform as a qualitative, often binary, occurrence. This causes difficulty in revealing an understanding of the degree of governance reform, wherein efforts to centralize or decentralize a system can be profoundly different.

While the majority of studies of governance change use theories from the political science and public policy literatures, these unsurprisingly focus on the politics and policy process. However, governance structures are also organizations, enabling one to utilize theories from the organizational literature. For example, Mintzberg and Westley (1992), describe organizational change as being revolutionary, piecemeal, focused, or isolated. Revolutionary
change, stems from the higher levels (culturally and structurally) affecting the entire organizational entity, which is contrasted with focused and isolated change that only affects alterations at a specific level (Mintzberg and Westley, 1992). As opposed to theories of the policy process that draw from the organizational literature’s “garbage can models of thinking” and “bounded rationality” (e.g. Kingdon, 1994; True, Jones, and Baumgartner, 2007), this conception of organizational change is strategic. I propose that it is possible for state postsecondary governance change to be both and, to “bring the strategy back in” requires a measure that can observe the incremental alterations.

The inconsistency in the existing work’s description and instrumental use of governance is inadequate if the field is to better understand the factors influencing structural change and postsecondary governance’s influence on other educational and policy outcomes. As is often the case with theoretical concepts in the social sciences, there is no direct means to measure the difference in the level of centralization between the two consolidated governing board states. Using Georgia and North Carolina as an example, one could create a list outlining the different powers of the two boards, and uncover differences in the authority of these systems, likely noting that the University System of Georgia has authority over 2-year institutions while the University of North Carolina system does not. While this effort would likely result in a statement such as “Georgia is more centralized than North Carolina,” it neglects to indicate the degree of centralization nor accounts for the other 48 states, much less over any meaningful period of time.

This is but a discrete case and a larger effort would certainly generate a long list of powers and authority for each state in any given year, generating a large amount of data that quickly becomes unmanageable to utilize in a qualitative manner. If one is to gain leverage over the amount of information available, it necessitates the use of statistical techniques. However,
the postsecondary literature is replete with qualitative characterizations of postsecondary governance that continue to inform researchers, data that may be the most important information available. Fortunately, the recent development of techniques pioneered in the fields of statistics, educational testing, and political science can help advance the understanding of state structures while systematically incorporating existing qualitative typologies into a new measure. This study will first rectify the existing taxonomy’s aforementioned limitations through placing states on a continuum of centralization using a Bayesian latent variable model with fully informed priors specified from the existing typology and case studies. After creating this new measure, I will use a predictive model to determine how states’ political, socio-economic, and educational factors influence movement along this continuum.

**Overview of the study**

Following the introduction, the second chapter identifies the problem of measuring state governance through detailing the historical depiction of these structures, studies of governance reform, and the literature detailing these structures’ effects on policy outcomes. Together these illustrate the importance of governance to the state-level postsecondary literature, the limitations of the predominant typology, and the disconnect between its use and the description of a continuum of centralization. Chapter three provides the conceptual framework, providing a theoretical justification for measuring governance on a continuum and introduces the epistemological motivation for using Bayesian analysis to generate a latent variable. This chapter will conclude by providing the hypotheses for the variables used in the predictive model, drawing from McLendon et al.’s (2007) article that uses event history analysis to study governance reform. Chapter four provides the specific methods used for the analyses and
descriptive statistics for variables used in the modeling and the fifth chapter presents the results from the measurement and predictive models. Following this will be the conclusion, which reviews the study and its implications for theory, research, and policy.
Chapter 2

IDENTIFICATION OF THE PROBLEM

This chapter begins by detailing the historical study of higher education governance in the United States. Over time, many have sought to distinguish the types of arrangements states use to govern their public postsecondary education systems, yet despite the efforts of numerous researchers and policymakers, these characterizations almost exclusively follow the familiar typology of planning agency, coordinating board, and consolidated governing board. Following the discussion of governance, will be an overview of the literature on governance restructuring. Predominantly using theories of the policy process and approached through case-study analyses, this strand of research offers explanations as to the forces that compelled states choose to alter their governance structures and provide narratives that detail the process of change. Taken as a whole, in these studies the tension is between an understanding of governance reform as an incremental, adaptive process and as an irrational battleground for political struggles. Next, I detail the growing body of literature on the effects of postsecondary governance arrangements. Recently, many state-level higher education researchers have begun to utilize advanced statistical techniques to ascertain the influence of these structures on state appropriations, tuition levels, and the adoption of various policies, studies that have contributed to the understanding of the policy effects of state postsecondary governance. Finally, I briefly discuss the disconnect between the literature’s hypothesized “continuum of centralization” and researchers’ instrumental use of the typology.
Postsecondary governance structures

The publication of the diametrically opposed works of Glenny’s *Autonomy of Public Colleges* and Moos and Rourke’s *The Campus and the State* marked 1959 as a watershed year for studies of state postsecondary governance (Hearn and McLendon, forthcoming). A product of their time, these works addressed the potential effects the nascent state governance structures could have on system efficiency and the autonomy of public institutions. For Glenny, several changes would inevitably lead states towards greater coordination of their public colleges and universities. He saw that the increasing complexity of institutions of higher education, the growing size of state governments, and the rapidly expanding financial investments in postsecondary education as contributing to the need for a change in state-level governance. From 11 state case studies, Glenny came to view the decentralized, voluntary coordination agencies as the most ineffective and more centralized coordination as a governance form best positioned to attend to health of the system as a whole. Still, he acknowledged that this would be challenging, observing that both coordinating and consolidated governing boards found difficulty in differentiating between their roles of state agency and institutional advocacy, with the explicit legal powers of the state agency role only partially delineating a board’s responsibilities.

In contrast to Glenny, Moos and Rourke (1959) believed in “the efficiency of freedom,” where they argue that autonomy from the state is essential in fostering postsecondary institutions’ mission to enhance, create, and disseminate knowledge. They go on to assert that “a tightly co-ordinated [sic] system of higher education can leach quality and originality out of state

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6 Voluntary coordination was Glenny’s term for the most decentralized state systems, which at the time had even fewer powers than contemporary advisory/planning agencies.
colleges and universities,” noting that some of the finer institutions emerged in a the context of a complete lack of state coordination (p. 226). In discussing the “limits of centralization,” Moos and Rourke similarly do not lack conviction on the danger posed by increased coordination.

No factor has contributed more to recent stress in the relationship between state and higher education than the widespread belief that centralized control over all state activity cheapens the cost while improving the services that are provided to the public. (Moos and Rourke, 1959, p.319)

Arguments for autonomy or centralized, state control would continue throughout the 20th Century, without much resolution. In 1965 James Paltridge furthered the conception of state postsecondary governance with his work “Organizational forms which characterize statewide coordination of public higher education.” In this, he devised a taxonomy which classified all states into different types of governance arrangements, tracing their changes from 1940 to 1965. In his classification scheme, Paltridge identified five types of state governance. Two of the types he identified (“no coordinating organization” and a voluntary, inter-institutional coordination) eventually disappeared from the state governance landscape, but the other three governance types – consolidated governing board, governing-coordinating board, and advisory/regulatory boards – defined and cemented the conception of state postsecondary governance. Using reports gathered at different points in time, Paltridge was able to move beyond the previous characterizations which only focused on a handful of states, giving higher education researchers and policymakers the first, comprehensive study of statewide governance structures. In his analysis Paltridge confirmed that, in general, states were moving towards a greater degree of coordination, attributing this change to the sharp growth in enrollments and institutional complexity.

Perhaps inspired by the 1972 amendments to the Higher Education Act, in the 1970s researchers returned to the study of statewide postsecondary governance. Specifically, Sections
1202 and 1203 called for states to maintain or create postsecondary education commissions and begin statewide planning for higher education (McKinney, 1974). While the financial incentives provided by Section 1203 would not be allocated until 1974, by then, 43 states had established some form of postsecondary governance structure. Though these changes were in response to the federal government’s coercion and different from the previous, voluntary adoption of governance structures, they continued the general trend away from voluntary coordination towards increased centralization. In this policy context, The Journal of Higher Education published papers from “The Invitational Seminar on Restructuring College and University Organization and Governance.” Like the perspectives of Glenny and Moos and Rourke a decade before, the debate between centralization and decentralization was framed as the conflict between campus autonomy and state control (e.g. Clark, 1971; Peterson, 1971). Again, proponents of centralization argued that increased coordination would ameliorate the management difficulties brought on by recent massification and increases in federal and state funds, while opponents cited the fear that decreased campus autonomy and governmental intrusion into faculty matters would adversely affect the core functions of institutions (Ikenberry, 1971).

Of the 1970s research on state governance, none had as lasting impact as Robert Berdahl’s 1971 book Statewide Coordination in Higher Education. Like Glenny, Berdahl also used a case study approach, documenting governance patterns in 19 states. From his studies, Berdahl believed that coordinating boards would come to be the preferred government arrangement and had the greatest potential for success. Despite the rich characterizations from the case studies, Berdahl’s most long-lasting contribution is the adaptation of Paltridge’s typology, identifying the governance arrangements for all 50 states, expanding it beyond the
categories of no state agency, voluntary association, advisory/regulatory board, coordinating board, and consolidated governing board, further detailing the differences within the broader classification of coordinating boards. To Berdahl, the coordinating board category consisted of three types: institutional majority with advisory powers, public majority with advisory powers, and public majority with regulatory powers. This deeper parsing of the coordinating board category demonstrated the heterogeneity that existed within a single category of the typology. As the first comprehensive depiction of state governance structures since Paltridge’s work, Berdahl’s typology has served as the predominant construct, giving researchers an understanding of the antecedents of current governance arrangements and a picture of governance issues in the 1970s (Hearn and McLendon, forthcoming). 7

Berdahl’s other contributions are the incorporation of the distinctions between *de jure* and *de facto* and substantive and procedural autonomy into the higher education literature. While the legal powers for governing structures are easily understood, in many cases these structures may not exercise all of the powers formally bestowed upon them; the *de facto* use of these *de jure* powers may fluctuate over time. In contrast, some governance structures may utilize powers that are not explicitly codified in law. By distinguishing between substantive and procedural autonomy, Berdahl referred to the degree to which states are able to dictate institutional goals (substantive authority) and the extent to which states are able to dictate the means by which the goals are achieved (procedural autonomy). These developments should caution researchers that, though structural differences may be noted and identified, the means through which higher education is managed in a state is not consistent within structural types or even consistent within a given state structure from year to year.

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7 This work’s influence has been so profound that many researchers misidentify Berdahl as the origin of the typology.
Aims McGuinness’ work throughout the 1980s and 1990s represents the most consistent effort to categorize state governance structures. As a consultant for the Education Commission of the States, McGuinness’ *State Postsecondary Structures Sourcebooks* not only indicated the type of governance arrangements employed by the states, but chronicled the particular powers and authorities of the various state boards, offered narrative profiles, and discussed state efforts at governance restructuring and reform. While the intended audience for these handbooks was state policymakers, when coupled with Berdahl’s work in the previous decade, this continuous project enabled higher education researchers to track changes in governance across time.

During the period of McGuinness’ work, many states attempted to alter their existing governance arrangements. To McGuiness, the reform of these structures stemmed from two broad categories: changes in the external policy environment and what he termed “perennial issues” (McGuinness, 1997, 2005). Noting that specific changes in the external environment vary by state, McGuinness broadly categorized these as changes in the political environment, changes in attitudes towards postsecondary education, the rise of accountability movements, and changes in technology. The perennial issues were states’ perceived needs for efficiency and coordination among public institutions and the desire to insulate state lawmakers from institutional lobbying (McGuinness, 1997). While these perennial issues recall previous decades’ rhetoric surrounding centralization, McGuinness’ recognition of politics influence on governance change would come to influence later researchers’ preoccupation with the influence of political actors on governance reform.

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8 Specifically he lists: duplication of graduate and professional programs, conflict between institutions, legislative reaction to institutional lobbying, challenges in transfer and articulation, proposals to close institutions or alter their missions, inadequate coordination across sectors, concerns for the board’s effectiveness, and proposals for “superboards” (McGuinness, 1997, pp.31-33)
The work of Richard Richardson, the most recent effort at characterizing state postsecondary governance, slightly deviates from the typology in its description of the types of structures. Abandoning the planning agency, coordinating board, and consolidated governing board typology, Richardson identifies states as having segmented, unified, or federal systems (Richardson, Bracco, Callan, and Finney, 1999; Richardson and Martinez, 2009). Segmented systems lack an effective state agency and use multiple governing boards for one or more institution, unified systems have a single board, and federal systems use a single state-level entity but divide powers and responsibilities between state and institutional boards (Richardson et al., 1999). Richardson and a team of researchers from the National Center for Public Policy and Higher Education conducted case-studies of Michigan, California, New York, Florida, Georgia, Texas, and Illinois, finding that state systems interact with a state policy market role in shaping the function of higher education in the state. In defining the state policy market role, Richardson et al. list four types: providing resources, regulating, consumer advocacy, and steering. These policies roles lie on a continuum, where states with the providing resources role subsidize higher education and are the least market-like. The steering role, on the other hand, involves the most forceful use of the market through the aggressive use of privates, contracts, vouchers, and appropriations targeted to specific degrees (Richardson et al., 1999, pp.14-15). By coupling these two governance positions together, states could either have a “match” in their postsecondary policies or not (Richardson et al., 1999). Ten years after this effort, Richardson and Martinez (2009) would complement this work by examining the interaction between governance structures and policies in New Mexico, California, South Dakota, New York and New Jersey. In this, they list five broad categories that distinguish state postsecondary education.

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9 This framework was also utilized by Martinez (2002) to study the effect of governance structure on policymaking in South Dakota.
governance: Statewide Planning, Statewide Coordination and Regulation, Self-Governing Public IHEs, Use of the Private Sector, and Extensive Two-Year Colleges. While this represents somewhat of a departure from the typology, Richardson and his team’s methodological approach prohibits them from giving a comprehensive picture of all 50 states, much less across time. Further, if this strand of work had classified all 50 states, it would be highly correlated with the predominant typology; from the limited sample all unified systems are consolidated governing boards.

Despite the growing interest in state-level postsecondary research, the understanding of state-level governance is becoming fractured. Some states, such as Florida’s recent, highly publicized restructuring no longer neatly fit in the typology. On one hand, the recent work of Richardson departs from the typology. On the other, the Association for Governing Boards and various state compacts’ (e.g. the Southern Regional Education Board) websites continue to maintain databases that identify states’ structures using the typology. ¹⁰ Perhaps most indicative is the Education Commission of the State’s Postsecondary Governance Database which has, in part, abandoned the convenient typology in favor of a narrative approach to state governance. While it is still used by postsecondary researchers, as the body of literature on state governance grows and new governance forms arise, the 45 year old typology may be beginning to show its age.

**Governance restructuring**

The description of state governance structures has largely been the providence of policymakers and national associations. In contrast, postsecondary education researchers have focused on the causes and processes of governance reform. This research predominantly utilizes

¹⁰ McGuinness’ most recent update was in 2002.
a case study approach, applying the techniques of document analysis and interviews to gain insight into what spurs states to alter their governance arrangements. From this literature emerges an understanding of governance reform as a policy process, generating a series of narratives concerning the political and contextual factors that contribute to and create the environment for postsecondary governance reform.

Throughout the 20th Century the overall trend in postsecondary governance change was from campus autonomy towards increased centralized control. However, once established some states have taken action to alter their existing structures. In the early 1980s, state postsecondary governance structures were confronted with arguments for both decentralization and centralization (Millard, 1980). At this time, decentralization was understood as states adopting the federal government’s policy of supporting students as opposed to institutions, utilizing the market as a regulatory force. Yet despite this trend at the federal level, Millard saw potential for centralization to occur as state governments and officials may force their public postsecondary systems to respond to increasing calls for accountability from state governments.

Less equivocal than Millard are the writings of Terrence MacTaggart, a former chancellor of the University of Maine and Minnesota State University systems. Writing in the 1990s, MacTaggart believed the higher education was in danger of experiencing increased government intervention, predicting that in the near future, postsecondary governance reform would manifest as a shift to more centralized, authoritarian control (1996, 1998). While at the time, a popular trend in governance reform was a shift towards Reinventing Government style decentralization, MacTaggart asserted that in public postsecondary education politicians lack the
appropriate incentives for this type of change, inevitably forcing states towards increased regulation and centralized control of public postsecondary governance.\footnote{This refers to the widely discussed 1992 book by Osborne and Gaebler, \textit{Reinventing Government: How the Entrepreneurial Spirit is Transforming the Public Sector}, which argues for the use of market based incentives to increase efficiency in the public sector.}

In the research literature, Olivas’ 1984 study of the creation of Ohio’s governance structure in the previous decade is an early case study examining the policy process behind governance reform within a state. In this analysis, Olivas utilizes an agenda setting framework to describe governance change as a process of incrementalism. He found that the eventual shape and powers of the Ohio Board of Regents was the result of a slow process, involving conflict, negotiation, and the bounded rationality of actors which proceeded along a predictable and inevitable path. In this view of governance, the eventual structure originated from insiders and higher education stakeholders before moving to the macro-policy level which determined the eventual arrangement (Olivas, 1984). Later, researchers would come to criticize Olivas’ explanation of governance reform as an incremental process, favoring theories that describe policy change as a partially irrational process, where politics and policy entrepreneurs are at the center of changes in postsecondary governance (McLendon 2003a, 2003b; McLendon and Ness, 2003). Despite these contentions, by integrating theories from the policymaking literature into his study of governance change, Olivas’ recognition of political constituents’ role in the process marked a departure from previous research.

Using surveys, Marcus (1997) examined 49 restructuring proposals that occurred in 29 states during the period of 1989 to 1994. From these surveys, he indicated that reforms in the 1980s were predominantly in the direction of centralization, the 1990s were marked by states attempts at decentralizing public postsecondary governance. In explaining the emergence of the reform initiatives, his respondents reported that state economic conditions and budgetary powers
were the driving factors of proposed change. However, his findings revealed that the enactment governance restructuring had no consistent rhetoric attached to the centralization/decentralization argument, with the espoused needs of cost containment and accountability the impetuses for both types of reform (Marcus, 1997). In analyzing which proposals led to enactment, these rhetorical variables were found to have no predictive power, with only proposals initiated by the existing state board having statistical significance, which indicates that these structures were important actors in the reform processes. Synthesizing the different analyses of the data, Marcus observed that in addition to the logical solutions that centralization and decentralization provide, power and a state board’s ability to mediate struggles between institutions and elected officials could buffer higher education from undesired change. Though not a predominant element of his analysis, Marcus prefigured later work on postsecondary policy diffusion (e.g. Doyle, 2006; McLendon et al., 2006; McLendon et al., 2007), suggesting that states’ restructuring efforts tended to conform to types of structures that were predominant in the region.

In 2003, McLendon and Ness recreated Marcus’ original survey for the years of 1995 to 2000, supplementing the original instrument with questions that focused on the politics role in efforts of governance restructuring. In the years of their study, they found 24 governance reform initiatives, with 15 resulting in enactment. While the total number of initiatives is half that of the earlier study, during this time initiatives had a nominally larger passage rate (63% in McLendon and Ness (2003) and 55% in Marcus, (1997)). Additionally, the results of McLendon and Ness’ survey found little evidence of an economic impetus for restructuring, instead, their results highlighted the role played by policy entrepreneurs in governance reform, which they attribute to different economic climates in the two studies’ time periods.
A handful of studies discuss give insight into Illinois’ 1995 decentralization of its postsecondary governance structure (Richardson et al., 1999; Van Der Silk, 2001; McLendon, 2003b). In a comprehensive study of this reform, Van Der Silk (2001) used a case-study approach, finding that universities were not involved in the agenda setting, but rather politicians initiated the changes that would take place. Policy consensus among higher education stakeholders at the university level, individual political ambitions, and a policy entrepreneur’s ability to manipulate the images kept the Illinois Board of Higher Education from maintaining their authority resulting in the devolution of power and authority to the campus level.

Contributing to the understanding of the phenomenon of governance restructuring, Van Der Silk applied theories from the political science and public policy literatures which describe the role of agenda setting in the policy making process. Specifically she adapted the work of Jones (1995) on agendas role in federal policy, Kingdon’s (1984) multiple-streams theory, and Baumgartner and Jones’ (1991, 1993) punctuated equilibrium theory. Of these three complementary theories, punctuated equilibrium’s ability to account for rapid change after long periods of stasis and venue shopping best described the changes experienced in Illinois.

In the early 2000s, researcher Michael McLendon produced a series of articles on state higher education governance reform. In a piece that is part literature review and part theoretical, McLendon (2003a) followed the work of Van Der Silk, proposing three theories of the policy process through which one might study governance reform. Like Van Der Silk he identified Kingdon’s multiple streams theory and Baumgartner and Jones’ punctuated-equilibrium theory, but also speculated that the policy adoption and diffusion theory may apply to cases of postsecondary governance reform. While for time theories of policy adoption and diffusion had been applied for some time in the political science literature (e.g. Walker, 1969; Gray, 1973),
McLendon advocated for the most recent developments by Berry and Berry (1990, 1992) that utilize large state-level databases and the regression technique of Event History Analysis to study governance reform. In later research, McLendon would go on to apply these frameworks finding politics consistently at the center of governance reform (2003b; 2007 (with Deaton and Hearn)).

Despite the overall historical trend of states centralizing their public postsecondary education systems, research on governance reform in the last decade predominantly focused on efforts of decentralization. While in the 1990s and 2000s, states both centralized and decentralized their postsecondary governance structures, the policy rhetoric of New Public Management created a charged and politicized realm for studying the latter. McLendon (2003b) notes four forms of decentralization that occurred in the 1980s and 90s: flexibility legislation, disaggregating governance systems, a public-private approach, and a weakening approach. Utilizing case-study methodology, he tested the incrementalism and Multiple Stream theories in Arkansas, Hawaii, and Illinois’ decentralization efforts. As Kingdon’s work primarily focused on policymaking at the federal level, the author adapted it, conceiving of a field of Campus-State conflict that was imbedded in a state governmental system, which in turn is imbedded in a national and regional macro-system. Rather than finding support for incremental policy making, these three cases best conformed to Kingdon’s multiple streams theory, suggesting that decentralization may be the result of a less rationale and more serendipitous policy environment. McLendon’s (2003a, 2003b) departure from the prevailing theory of incrementalism, shaped following studies of governance reform, placing politics and policy entrepreneurs at the center. These ensuing studies continued to apply Kingdon’s theory,

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12 For an overview of Berry and Berry’s approach to policy adoption and diffusion, see Berry and Berry (2007).
13 The weakening approach involves replacing an existing structure with one that is less powerful.
which has come to displace incrementalism as the predominant explanation of governance reform.

Leslie and Novak (2003) also used case studies, examining restructuring in Minnesota, Kentucky, New Jersey, Maryland, and Florida. Also borrowing theories from the political science and public policy fields, they too found politics to be at the center of debates on restructuring, though in some cases of restructuring actual policy change was made in order to accomplish certain instrumental goals. Rather than a purely political process, they suggest that reform is a result of an interaction between politics and instrumental goals. Though unstated by the authors, this belief does is not outside explanations provided by multiple streams theory, where the problem stream does not exclude instrumental goals. For example, they describe the interaction as “governors and legislators constantly [playing] the levers available to them as they seek to achieve both the control of the governmental apparatus and their own party objectives” (Leslie and Novak, 2003, p.117).

Mills (2007) used document analysis and interviews in his case study of Florida’s widely publicized governance restructuring in the early 2000s. While not deviating far from the use of multiple streams and punctuated-equilibrium theories, Mills found three distinct narratives for Florida’s policy change which he refers to as “The Press Story,” “The Executive Control Story,” and “The Blue Ribbon Committee Story.” Though there are some similarities across these narratives, they also differ, with some stressing the exercise of political power and others viewing the process as rational problem. Notably, the competing narratives both share and differ in indicating what constituted certain streams in Kingdon’s model.
Leslie and Berdahl (2008) examined the quasi-privatization of Virginia’s more prestigious public colleges and universities, finding support for the “garbage can model.” Burdens from excessive regulation – the problem - were coupled with the solution of charter status for the most prestigious institutions. That is, while initially calls for changes came from the University of Virginia, Virginia Polytechnic Institute and State University, and the College of William and Mary, which were all hampered by regulation, after entering the policymaking sphere, the resulting structure required institutions to exchange substantive autonomy for an increase in procedural autonomy.

While the previous studies outlined all take a qualitative approach to governance restructurung, McLendon et al. (2007) is the sole quantitative analysis of governance change. Using event history analysis, they used a single categorical variable for “any governance restructuring” as the dependent variable, testing the influence of various political, social, and economic indicators on this outcome. The “political instability hypothesis,” their core research question was confirmed, with the findings indicating that a change in the party controlling the state legislature and change in Republican legislative membership positively influence governance reform while a governor’s tenure negatively influences reform. Surprisingly, gross state product, tuition, and enrollment indicators were shown to have no effect, suggesting that reform of governance structures is more political than a means to attenuate perceived problems.

Taken as a whole, research on the causes of governance reform provides strong evidence that these changes are primarily, if not exclusively, the result of the exercise of political will and opportunity. When coupled with the literature on governance structures, and the rationales for different arrangements, one is left with a cynical interpretation of the landscape state higher

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14 The “garbage can model” is how these authors refer to Kingdon’s Multiple Streams Theory. Kingdon adapted his theory from Cohen and March’s (1986) theory they developed to characterize decision making in higher education.
education governance. As the next section will detail, research suggests that these structures can have an impact on states’ postsecondary policy environment which, in light of their genesis as products of the political process, causes one to question the rationality of the policies and business of public postsecondary education.

**Governance effects**

In addition to research into governance change and restructuring, there exists a growing body of literature examining the impact of governance structures at both the institutional and state level. Beyond classifying states in the typology, the early literature on governance effects engaged in the challenging operation of evaluating the effectiveness of statewide boards. For example, in 1971, Berdahl outlined the myriad problems in evaluating statewide boards cautioning that individuals and the informal powers of state agencies may be the most influential aspects of state higher education governance, making a systematic evaluation of board effectiveness challenging, if not impossible. While this and similar efforts endeavored to give recommendations as to the ideal governance arrangement, these works were largely prescriptive, reflecting both their intended policy audience and the naivety of the time in regards to state politics. As the postsecondary research community grew, researchers shied away from the difficult task of determining board effectiveness, instead focusing on state governance’s effectiveness on other policy outcomes. However, unlike the research on governance reform, these studies predominantly utilize parametric statistical methods, incorporating the typology into their models through the use of dummy variables for governance structures.

Volkwein’s (1986, 1987, 1997 (with Malik)) work represents the most consistent research into the campus level effects of state postsecondary governance. Using factor analysis,
Volkwein (1986) created variables for the institutions’ degree of “flexibility” in financial and administrative categories, finding no effect of these variables on measures of faculty quality, undergraduate quality, governmental grants, and endowments. Using the same techniques, Volkwein and Malik (1997) again found no impact of state regulations on faculty undergraduate quality, however, one set of results showed state size to negatively influence the degree of financial flexibility given to campuses.

Focusing on tuition at the state level, Hearn, Griswold, and Marine (1996) viewed high tuition as a product of the innovation of high tuition/high aid policies, hypothesizing, because of their greater analytic capacity and ability to influence policy, more centralized governance arrangements would lead to higher tuition in state public institutions. The findings indicated the opposite, revealing that states with planning agencies and strong coordinating boards predicted higher tuition (Hearn et al., 1996). The authors found the decentralization finding confusing, but explained the strong coordinating board effect as a product of these institutions’ close ties to legislatures.

Returning to the institutional effects of governance arrangements, Lowry (2001) used cross-sectional data for 407 institutions in 1995, finding a different set of results from Volkwein’s earlier work. In Lowry’s study, campuses in coordinating board states spent fewer dollars on the categories of instruction, student services, and academic support and tended to charge less for tuition. Lowry’s interpretation of these findings is that politics, manifested through state agencies’ control of institutions, yields the results that reflect the interests of politicians rather than institutions.

15 The one exception is that he found greater degrees of academic flexibility positively affected endowments and gifts.
Using time-series cross-sectional [TSCS] data, Nicholson-Crotty and Meier (2003) investigated the effect of governance at the state level. This extended previous work by investigating the effects of the interaction governance structure and political variables. Though they found no partisan effects on total cost, tuition, or state appropriations, they uncovered a complex pattern in the interaction between ideological variables and legislative professionalism. The authors fail to interpret these interactions, suggesting that these relationships may point to an even more complex phenomenon which would call for even more complex specifications (i.e. three and four way interactions). Despite the authors’ reluctance to interpret their findings, one variable interaction with structure is consistently meaningful across all three models: legislative professionalism.\(^\text{16}\)

A couple of recent studies, all using similar specifications, have found conflicting evidence of the influence of state postsecondary governance structures on state appropriations to higher education. In an analysis for the years 1984 to 2002, McLendon, Hearn, and Mokher (2009) found no support for the influence of governance on state appropriations, instead finding that a cluster of political variables, a young population, and enrollment in different sectors predicted this variable. Conversely, using the same dependent variable, but for the time period of 1976 to 2004, Tandberg (2010a) found that having a consolidated governing board decreased state appropriations to higher education. In a continuation of this research, Tandberg (2010b) used the same dependent variable, but interacted the indicator for consolidated governing board with several political variables. This resulted in a constellation of findings that, when taken as a whole, suggests that postsecondary governance, when interacted with other variables, has a “conditioning effect” on a state’s political landscape.

\(^\text{16}\) Others include citizen ideology for tuition and citizen and governmental ideology for appropriations.
Though the specifications of governance structure differ, one of the common dependent variables across these studies, tuition, was consistently shown to be decrease with centralized coordination. The effect of governance on higher education appropriations is, however, mixed, with some studies providing evidence that centralized, consolidated governing boards may predict decreases in this indicator as well while others fail to identify any influence for governance structures. These findings point towards a conception of centralized systems as a mechanism that buffers institutions’ tuitions from spiraling upwards, while at the same time decreasing state-level appropriations. While not explicitly stated by the authors, this recalls some of the persistent arguments for increased centralization: low cost and increased efficiency.

Beyond the influence of postsecondary governance on finance indicators, other research looks at the factors influencing states’ adoptions of postsecondary educational policies. In most cases these studies employ some indicator for governance structure in their models.\(^\text{17}\) While many of these studies fail to reject the null hypothesis of “no governance effect,” others find support that governance structures do influence states’ adoptions of higher education policies.\(^\text{18}\)

Using a cross-sectional approach, Hearn and Griswold (1994) examined the influence of governance structure on an array of policy innovations, offering the core hypotheses of “Higher levels of centralization will be associated with higher levels of innovation in postsecondary policy” and “Empowered state coordinating boards will be associated with higher levels of innovation in postsecondary policy than consolidated governing boards, even though both are at the more centralized end of the continuum of state-level governance arrangements” (Hearn and Griswold, 1994, p. 168). The development of these hypotheses suggests that levels of

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\(^{17}\) One notable exception is Doyle’s 2006 study of the adoption of broad based merit aid programs.

\(^{18}\) This section is limited to the adoption literature that has findings for the influence of structure. Because of the nature of NHST, it is inappropriate to assign null effects the value of “zero.” For further discussion of this and other problems associated with the NHST paradigm see Gill, 1999.
centralization influences policy innovation, but the relationship is not necessarily linear. In explaining this relationship, the authors theorize that powerful coordinating boards possess both the necessary power to enact policy and exert their will and maintain a modicum of connection to institutional interests. The findings provide support for both hypotheses in the context of assessment requirements, but failed to find governance’s influence in the categories of finance and teacher education policy innovation (Hearn and Griswold, 1994). This may suggest that governance’s influence is felt more in academic matters and less in the allocative arenas. Merging all policy innovations together, the authors found consolidated governing boards to influence the total number of innovations. Interpreting the findings together, the authors indicate that stronger governance structures have the greatest influence on innovation, but acknowledge that while centralization may produce innovation, an “innovative impulse or context in a state” could also lead to innovation (Hearn and Griswold, 1994, p. 185).

Extending the previous work of Hearn to TSCS data, McLendon et al. (2005) used a dummy variable for planning agencies and weak coordinating boards, finding mild support for the negative influence of these less centralized structures on states’ adoptions of financing innovations. They interpreted this finding as support for the overall thesis that governance structure affects the adoption of certain polices, noting an inconsistency between their findings and those of Hearn and Griswold (1994). As the authors suggest this may be a product of the TSCS approach, but also argue for increased research into governance effects.\textsuperscript{19} When coupled together, these two findings point to centralization’s complex and non-linear influence on policy adoption and innovation.

\textsuperscript{19} Also notable about this piece is that it marks the first systematic incorporation of the theory of policy diffusion in the higher education literature.
Continuing with this research agenda McLendon, Hearn, and others continued to examine the influence of governance on policy adoption. With a refinement in their methodological approach and the inclusion of new indicators culled from the political science literature, these works began to uncover additional governance effects, yet across these studies no clear and consistent pattern emerged. Consolidated governing boards were found to negatively influence the probability that states would adopt performance funding policies and to positively influence the adoption of performance budgeting (McLendon et al., 2006). The authors explain this finding by suggesting that consolidated governing boards operate as academic cartels, preferring the less stringent accountability policies in order to demonstrate some effort towards this issue while simultaneously protecting their interests and those of their predominant stakeholders. Mokher and McLendon (2009) found that consolidated governing boards positively impacted states’ adoptions of dual enrollment policies, interpreting the finding as the higher levels of coordination and analytic capacity inherent in these centralized systems was necessary in fostering these policies across statewide institutions.

In contrast, coordinating boards were shown to positively influence a state’s adoption of “eminent scholars” economic development policies (Hearn, McLendon, and Lacy, 2009). In the case of this policy, the authors argue that coordinating boards are better positioned than their more centralized counterparts to simultaneously advocate for both the economic and institutional sectors of the states.

Taken as a whole, these studies suggest that governance structure has a role and effect on higher education policy adoption. However, beyond the assertion that “governance matters,” it is difficult to draw systematic conclusions as to how centralization affects policymaking. As outlined above, the authors select many different specifications of governance, using different
combinations of the typology. While on one hand this gives flexibility in crafting the specification to the particular research question, the alternative specifications create difficulty in synthesizing the results. It may be that, like the assertion of Nicholson-Crotty and Meier (2003), state postsecondary governance interacts with other measures of state analytical capacity (i.e. legislative professionalism), or it may simply be that the categorical indicators mask and absorb the true governance effects.

Beyond the literature on governance effects that relies on statistical procedures, some research on governance effects utilizes case-studies and surveys. Nettles and Cole (2001) surveyed all 50 state higher education academic officers, asking them to rank 12 state entities’ influence on the stages of the policy process, including: problem formation, policy formation, policy adoption, policy implementation, and policy evaluation. Of the twelve, state boards ranked second behind campus level leaders in the dimensions of policy formation, policy adoption, and policy evaluation. Taking all five dimensions as a whole, state boards were among the three most influential. The authors’ interpretation is cautious, though when coupled with the extant literature on governance effects, one may interpret these governing agencies as not only actors, but organizations that shape the politics of higher education within a state. In the same series of surveys, Nettles, Cole, and Sharp (1997) juxtaposed governance structures with assessment policies and the use of financial incentives. Their findings indicate that the weak planning agencies were less likely to engage in assessment practices while consolidated governing boards were more likely to participate in these issues. For performance funding policies, they found that states with regulatory coordinating boards were most prone to adopt these financial incentives. Rather than suggest this board type’s role in the adoption of these
policies, they interpreted the results as consolidated governing boards playing a buffering role, insulating institutions from the outside political climate.

Within these broad categories, some states possess separate boards through which they govern their community colleges. In studying the implementation of a community college access initiative in 6 states, Shaw and Bailey (2007) found that, while neither the presence nor absence of these conclusively fostered policy implementation, these structures did manage to shape the process through which states implemented the policies.

Despite this growing literature that uses advanced methodological techniques, few scholars have attempted to evaluate boards and suggest what would be the optimal arrangement for any state. While Glenny, Moos and Rourke, and Berdahl all provided direction, the efforts of Richardson and his colleagues stand alone among recent work, as they approach making recommendations for board structure through identifying certain governance arrangements and policy environments have a “match.”

The disconnect

Despite the long tradition of the study of state governance, there has been little development in the field’s means for distinguishing structures between the states. While Richard Novak, a policy analyst with the Association of Governing Boards, notes that, “the lines between the two types of structures are often murky,” (Novak, 1996, p.18), the operational use of the typology persists and frequently utilizes only part of the governance distinctions indicated by Paltridge, Berdahl, and McGuinness’ work (e.g. the use of a single dummy variable). As Novak continued:
If one were to visualize a “governance continuum”… with consolidation and centralization at one extreme and institutional independence and autonomy at the other, one would see the majority of the states clustered somewhere close to the consolidation or centralization end of the continuum. (Novak, 1996, p.21)

This theory of a governance continuum is echoed by the higher education research community, yet persists as an unresolved theoretical issue. The principle aim of this research is to resolve this disconnect between a theoretical understanding of governance as a continuous construct and the less nuanced typology actually used in most empirical analyses. Questions concerning board effectiveness and the effects of these structures suffer from the use of the simplified typology; absent a refined and unified measure, furthering an understanding of state postsecondary governance will be difficult. However, to appropriately rectify this gap in the literature, one should pay mind to the rich qualitative data on governance structures and efforts at reform.
Chapter 3

CONCEPTUAL FRAMEWORK

Characterizations of state postsecondary governance traditionally are qualitative categorizations of state structures and policy narratives behind efforts at reform and restructuring. This research attempts to rectify the dissonance between the description of a “continuum of centralization” and the instrumental use of the typology of planning agency, coordinating board, and consolidated governing board. The methodological technique used to generate this measure is a Bayesian approach to latent variable modeling. This research addresses a recognized gap in the postsecondary education literature and will have potential utility for researchers and state policymakers alike, contributing not only to the understanding of state governance, but also to the methodological approach of the study of organizations.

The secondary goal of this study is to demonstrate how this new measure may give postsecondary researchers increased leverage over state-level questions. For this demonstration of how the measure may be used, I draw from the “political instability hypothesis” developed by McLendon et al. (2007), augmenting their original specification to test more nuanced hypotheses that test the influence of political, social, and economic factors on movement along the continuum of centralization.

This chapter will first introduce the theoretical underpinnings for the continuum of centralization, identifying specific powers that may be used to adjudicate between the levels of
centralized authority in state governance structures. Next I introduce the Bayesian approach to data analysis, the conceptual framework that drives the study. Because the theoretical underpinnings of Bayesian analysis are central to my conceptual framework and have epistemological ramifications that differ from classical statistical methods, this includes a treatment of topics traditionally discussed in a section devoted to methods. Finally, I identify the specific hypotheses I adapt from McLendon et al. (2007) that I use for the predictive model of changes in state postsecondary governance structures.

To inform the theory of this research I draw from the work of Keith Poole, a political scientist who throughout his career has utilized spatial maps for measures of parliamentary ideology. In declaring his approach, Poole states:

In the notion of theory I include: (1) the technical apparatus of the spatial model; (2) a theory of how legislators make decisions; (3) a theory of belief systems (ideology) that is tied to the assumptions of the model and the theory of decision-making; (4) the computer program that embodies (1), (2), and (3) and actually generates spatial maps; and (5) a substantive understanding of the political system that the parliament is embedded in. All these are necessary for meaning to flow from the spatial map. – (Poole, 2005, p. 4)

I extend this theory of parliamentary ideology to state governance. As the political science literature has moved beyond using party affiliation for a measure of ideology, the same techniques and rationales can be applied to move the understanding of state centralization beyond the qualitative indicators of the typology. The previous chapter covered the field’s understanding of state level higher education governance, yet this theory of centralization attempts to extend our conception of this construct through indicating which identifiable powers and characteristics belie the latent variable of centralization. Save the hypotheses related to the
predictive model, the rest of this section deals with the “Poolian theory.” I do not outline the computer program, which is freely available to all users at the BUGS Project’s website.20

A continuum of centralization

Researchers use many terms to describe changes in state higher education governance, often interchangeably. Decentralization, deregulation, privatization, and autonomy are but a few examples of terms used to describe similar phenomena. For this measure, centralization (or lack thereof) refers to the degree of control and power that the predominant state postsecondary agency has over the public institutions within its borders. These formal, de jure, powers are a limitation since, as Berdahl noted, de facto use of powers may be more pertinent in certain settings. By focusing on the locus of authority and the arena of rules and regulations, this latent dimension is more closely aligned with the traditional typology than alternative concepts of governance that focus on states’ market orientation.

From researchers’ consistent discussion of a continuum and their subsequent utilization of qualitative measurements, I believe that higher education governance structures suffer from a problem where the measure does not match the description; in practice, few researchers distinguish between the true heterogeneity across boards in a manner consistent with their descriptions. When invoking a continuum, yet using a typology, one asserts a latent, continuous variable exits, yet it becomes observed only when particular thresholds are crossed. That is, the categories of the typology are ordered, yet the degrees of centralization within the categories are unobserved. Figure 1 presents a graphic showing the hypothetical centralization variable with the intervals that currently are observed in the typology.

20This study utilized WinBUGS, available at: http://www.mrc-bsu.cam.ac.uk/bugs/
In this framework, the interval between zero and one represents states when they had no formalized governing structure and the interval between one and two states with a planning agency. Moving along this hypothetical continuum, the interval between two and three contains states with coordinating boards and the space between three and four (not pictured) are consolidated governing boards. Theoretically, we may say that currently all states occupy the intervals between 1 and 3.99. Even among highly decentralized states, one could conceive of a change in policy that would shift it further left along the continuum eventually towards a complete absence of the state from its institutions of higher education. Providing a theoretical limit for highly centralized states is more difficult, while there is heterogeneity in the consolidated governing board category, the most centralized state is undetermined. Still, one can theoretically envision a way of organizing state postsecondary governance that is more centralized than that the consolidated governing board category. We would signify this as at least 4, as it would be more centralized than any form for which the existing typology can account. This rationale can then be extended again and again, ergo the use of infinity as the theoretical upper limit of the continuum. That is, while the lower bound of governance – the complete absence of the state from institutions of higher education – is theoretically identifiable, the upper bound of centralization is a theoretical organizational form that can never be known.

While this understanding of the continuum is a theoretical abstraction, a characterization of the continuum is perhaps best understood through examples of differences in centralization of
state postsecondary governance that occur within and across categories of the typology. In 1997
Tennessee and Pennsylvania both had coordinating boards and thus would occupy the interval
between two and three. However, the Tennessee Higher Education Commission has both
program approval authority and consolidated budgeting authority, while Pennsylvania’s has
limited program approval authority for specific programs (e.g. teacher education) and the
authority only to recommend budgets (McGuinness, 1997). When only comparing the two at
this single point in time, one would conclude that Tennessee’s governance structure has more
centralized authority than that of Pennsylvania. To account for this heterogeneity, some
researchers have dichotomized a dummy variable placing “strong coordinating boards” like
Tennessee in the category with consolidated governing boards (e.g. Hearn and Griswold, 1994;
McLendon et al., 2005). This somewhat addresses the differences in the coordinating board
categories, these distinctions are made in an *ad hoc* manner, lacking any consistency across the
state-level postsecondary literature.

Though the coordinating board category likely contains the largest amount of variance in
levels of centralization, consolidated governing boards may also differ in their powers. Again
using McGuiness’ 1997 *State Structures Handbook*, one observes that Montana had a single
board that governs four-year institutions, two-year institutions, and technical schools. In
contrast, Kansas’ consolidated governing board had authority only over four-year institutions. In
this respect, clearly Montana’s governance structure has more *de jure* centralized control, yet,
unlike the few efforts that distinguish coordinating boards, no quantitative research distinguishes
among different consolidated governing boards.

Differentiating among planning agencies, arrangements that have the least amount of
structural authority, is more difficult and requires a deeper parsing of power than general sector
level authority. None of the three planning agency states have program approval authority for any programs as prescribed by statute or as a matter of policy. However, the Vermont Higher Education Council has advisory and recommendation powers for new and existing programs and both four and two year institutions while the Delaware Higher Education Commission has only this advisory authority over existing programs. At the most extreme, the state of Michigan’s Board of Education has only any degree of authority for teacher certification programs or occupational programs receiving funding from the Federal Perkins Act (McGuinness, 1997). In light of this, one might say that Michigan is the most decentralized state in this category and Vermont the most centralized.

Shifting from within category to between category comparisons, Tennessee’s governance structure has some jurisdiction over vocational schools, technical institutes, community colleges, and universities while North Carolina’s predominant postsecondary structure, often acknowledged as among the most centralized of all systems, has no direct authority over the state’s expansive two-year system. While few would likely say that Tennessee is more centralized than North Carolina, conceptually a measure of centralized governance should allow for the possibility that this may be true.

These are only discrete examples, and, if a continuum does indeed exist, then there are theoretically an infinite number of potential arrangements for state higher education governance. While the use of multiple dummy variables that use planning agency as the reference category in part overcomes the limitations, it does not rectify the issue of within category variance. Because few states have planning agencies, researchers frequently measure governance by using a single, dichotomous indicator for consolidated governing board and “other” (e.g. Hearn et al., 2008; 21 One might also use the Michigan Higher Education Assistance Authority, though this agency exists within the Department of the Treasury and has even fewer structural powers than the State Board of Education.)
McLendon et al., 2009; Mokher, 2010; Tandberg, 2010a, 2010b). As mentioned, the challenges this presents is not dissimilar from political scientists who attempt to extend legislative ideology beyond an indicator for Republicans and Democrats. Just as there can be Democrats who are more conservative and Republicans who are more liberal, there are consolidated governing boards that can be more decentralized than others, planning agencies that more centralized than others, and so forth. Perhaps the most compelling limitation of using a dichotomous variable for consolidated governing boards arises from its effect on coordinating board states. Within this category, there are, theoretically, states in which the level of centralization is significantly closer to that of consolidated governing board states and others where the level of centralization is closer to that of planning agency states.

Also arising from the measurement problem are misidentifications of states that may be moving along the continuum, but fail to cross the threshold into the next category. Studies of governance restructuring are not confined to cases in which a state moves from one category to another, in fact, more frequently governance restructuring occurs within a category of the typology.22 These two types of governance reform – moving to a different governance type and simply decentralizing an existing type – may be different, at least in the degree in which a state centralizes or decentralizes. For example, in 1990, both Nebraska and North Dakota centralized their governance systems (Marcus, 1997; McLendon et al., 2007). However, Nebraska moved from a planning agency state to a coordinating board state, while North Dakota centralized its existing consolidated governing board. This centralization effort involved the creation of a new entity, the North Dakota University System, in which the identifiable substantive change was the addition of a chancellor that is appointed by the Board of Higher Education. While which of the

22 See for example, most of the governance reforms identified by Marcus (1997), McLendon and Ness (2003), and McLendon et al. (2007).
two is a greater degree of centralization is an empirical question only answerable by an in depth
comparative case study or the generation of a refined measure, most would indicate that
Nebraska’s governance reform was a more dramatic centralization effort.

To generate a measure, one must first indicate specific indicators that relate to the
construct. Reflecting the literature on governance and the appendices and footnotes in the
reports of McGuinness and Berdahl, I determined 19 indicators that relate to centralized control
and authority that are identifiable across time. The primary rationale used to determine which
powers and authorities were essential was informed by the distinctions these authors used to
adjudicate between coordinating boards, distinctions which proved to also vary in the other
categories of the typology. Table 1 provides a list of the indicators that indicate centralized
authority.
Table 1. Indicators for governance centralization

<table>
<thead>
<tr>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Board for All Public Institutions</td>
</tr>
<tr>
<td>One or Two Boards for All Public Institutions</td>
</tr>
<tr>
<td>Consolidated or aggregated budget</td>
</tr>
<tr>
<td>Budget review and recommendation</td>
</tr>
<tr>
<td>Single board for both 2 and 4-yr governs 2yrs</td>
</tr>
<tr>
<td>Single board for both 2 and 4-yr governs or coordinates 2yrs</td>
</tr>
<tr>
<td>Agency has statutory new program approval for 4-yr</td>
</tr>
<tr>
<td>Agency has statutory new program approval for 2-yr</td>
</tr>
<tr>
<td>Agency has statutory existing program approval for 4-yr</td>
</tr>
<tr>
<td>Agency has statutory existing program approval for 2-yr</td>
</tr>
<tr>
<td>Agency has statutory or policy new program approval for 4-yr</td>
</tr>
<tr>
<td>Agency has statutory or policy new program approval for 2-yr</td>
</tr>
<tr>
<td>Agency has statutory or policy existing program approval for 4-yr</td>
</tr>
<tr>
<td>Agency has statutory, policy, or advisory new program approval for 4-yr</td>
</tr>
<tr>
<td>Agency has statutory, policy, or advisory new program approval for 2-yr</td>
</tr>
<tr>
<td>Agency has statutory, policy, or advisory existing program approval for 4-yr</td>
</tr>
<tr>
<td>Agency has statutory, policy, or advisory existing program approval for 2-yr</td>
</tr>
<tr>
<td>Ratio of public institutions to boards</td>
</tr>
</tbody>
</table>

To illustrate how these identifiable characteristics indicate centralization, I turn to the literature’s distinction of the coordinating board category. The predominant means for distinguishing between coordinating boards is by noting those with or without budget authority and those with or without program approval authority. Clearly, all else being equal, a state that has program approval authority for new and existing programs has more centralized governing authority than one that has approval for only new programs. Similarly, having these powers over all public institutions is evidence of greater central control than a board that only has this authority over 4-year institutions. Despite McGuinness and other’s use of the distinctions of program approval and budgetary authority to adjudicate between coordinating boards, these
differences also exist in the planning agency and consolidated governing board categories. In a departure from the binary program approval authority, I extend this power to encompass its prescription as statutory, policy, or an advisory role, resulting in the indicators above.

Generating a single measure for state postsecondary governance poses several challenges. First, states that have multiple boards or a “system of systems” pose a challenge to both the typology and the coding of the indicators listed above. Second, a relatively recent trend in state governance is the creation of state-wide “superboards” that oversee all levels of education. Currently, the literature is unclear as to the relative level of centralization these states have when compared to the existing typology. In an effort to overcome these two challenges I focus all indicators on the board that has responsibility for 4-year institutions and include the indicator “One or Two boards for all public institutions.” This indicator is able to distinguish the states that have adopted “Superboards” and account for most states with a “system of systems.” Lastly, the only continuous indicator, “Ratio of Public Boards to Institutions,” reflects a type of governance change observed in the literature which is an explicit removal or addition of discrete powers and authority. The most studied example of this is Illinois’ 1995 decentralization, in which before and after the reform, Illinois remained in the category of coordinating board. The reform disbanded two multi-campus governing boards, replacing them with campus level boards (Van Der Silk, 2001; McLendon, 2003b). This type of governance reform involves the devolving of authority from the state to a local level of control. In contrast, I suggest that a consolidated governing board state like Georgia, which has authority over 36 institutions, possesses a greater degree of centralized authority than one responsible for a handful on institutions. Beyond the literature’s recognition of this as decentralization, this “dispersion of authority” may also reflect the rhetoric of “New Public Management” that found favor in governments throughout the
period of the study. To align this indicator with the others, where a larger number is equivalent to “greater centralization,” this indicator is subtracted from 1.

These data come from McGuinness’ State Postsecondary Education Structures Sourcebooks, the websites of the Education Commission of the States, state legislative agencies, the Association of Governing Boards, the Southern Regional Educational Board, the Western Interstate Commission for Higher Education, and the State Higher Education Executive Officers. I complement these with case studies that describe governance change within particular states. I was able to confirm most indicators from multiple, reliable, secondary sources. However, it should be noted that even in the broader characterization of governance types, there is much disagreement in the literature and this data collection effort undoubtedly is prone to the same, subjective judgments.

Depending on the specific research question, researchers articulate state postsecondary governance as either an organizational attribute of states or policy. As an organizational attribute, postsecondary governance is a quality or characteristic that, in part, describes states’ higher education landscapes, while research focusing on governance reform describes change in governance as a policy. This dual nature of postsecondary governance points to a larger question regarding the nature of policies as a whole. In an attempt to extend this thought, I argue that many, if not all policies can be considered continuous variables whose latent state is not qualitatively observable. As this work comes to understand governance as a continuous variable, one will allow for postsecondary governance as both policy and organizational attribute, allowing one to see the effect of the former on the latter.
**Bayesian theory**

The 19 indicators listed above, for all 50 states, over a period of 25 years will result in 23,750 unique state-year qualitative indicators related to the centralization of postsecondary governance. Beyond this, from reports and the literature on governance reform detailed in Chapter 2 I have detailed qualitative information about years in which states centralized or decentralized their postsecondary governance structure. To gain leverage over this large amount of qualitative data necessitates the use of a method that can systematically incorporate all information. Typically researchers get leverage over large amounts of data through statistical analyses, however, the classical approach to probability is ill suited for the incorporation of qualitative data, causing these techniques to be sub-optimal for my data and research question. Thus, to utilize all pieces of data I will use the subjective probability of Bayesian data analysis which, through conceiving of probability as subjective, enables one to introduce the qualitative data into statistical modeling. As a result, an essential part of the conceptual framework that underpins this question is the epistemological and technical advantages provided by the Bayesian approach.

Rev. Thomas Bayes’ 1764 posthumous publication “Essays towards solving a problem in the doctrine of chances” is the origin of the Bayesian paradigm. Most social scientists use the classical or frequentist approach which draws from games of chance to generate statements of the relative frequency of outcomes and conceptualize a theory of probability (Jackman, 2009). In contrast, the Bayesian approach explicitly makes statements about prior beliefs which then are conditioned on data. To accomplish this, one combines the prior and the data to form the posterior, from which one draws inferences. This is known as “subjective probability” since a

23 Concurrently, similar ideas were being developed by Laplace which appeared in his 1774 essay “Mémoire sur la probabilité des causes par les évènements.”
24 For the rest of this study, the traditional or classical approach will be referred to as the frequentist approach.
statement about the degree of belief of some outcome is made before observing the data. The following equation is the operationalization of this statement.

\[
P(A|B) = \frac{P(B|A)P(A)}{P(B)}
\]

In the case for continuous parameters, which will be used in this study, the following equation is more frequently used:

\[
p(A|B) \propto p(A)p(B|A)
\]

Which is stated as: the probability of A given B is proportional to the probability of A times the probability B given A, in which A is the prior belief and B a given set of data. Before discussing the parametric implementation of this notion of this probability belief, I detail a hypothetical example of this type of “inverse” or “subjective” probability. Suppose that you are tested positive for a disease, but wish to know the true probability of actually having the disease. If it is known that 10% of the population have the disease and that the test is 95% accurate, one has two probabilistic pieces of information to aid in this calculation. While a frequentist would likely say there is a 95% chance that you have the disease, we apply Bayes’ rule through the following equations:

\[
p(Disease|Pos\ Test) = \frac{p(Disease)p(Pos\ Test|Disease)}{p(Disease)p(Pos\ Test|Disease) + p(No\ Disease)p(Pos\ Test|No\ Disease)}
\]

\[
0.679 \approx \frac{0.10 \cdot 0.95}{0.10 \cdot 0.95 + 0.90 \cdot 0.05}
\]
As illustrated here, the ability to incorporate both pieces of information into the estimate yields a much lower and more accurate probability than the frequentist alternatives. If we are to extend this to social science, through theory and previous studies, researchers often have some knowledge or belief about a phenomenon prior to estimation. The conventions of literature reviews and hypothesis testing underscore this a priori belief, yet through employing frequentist models, researchers methodologically assert that nothing is known about the values that their statistical models estimate. Drawing from the recent work of political methodologists, I argue that the Bayesian approach is best suited to social science questions in which one has a large amount of qualitative data available, and is perhaps essential when all that is known is from qualitative studies. While traditional regression estimates are testing hypotheses, latent variable models attempt to measure phenomena that the literature purports to exist. Thus, it is rare to ever have a latent variable without prior information.

To extend Bayes’ rule to the estimation of model parameters, we write the following equation:

\[ \pi(\theta | X) \propto p(\theta)L(\theta | X) \]

with \( \pi \) representing the posterior distribution, \( p \) some prior belief about the quantities in question, \( L \) the likelihood function, \( \theta \) the parameters of interest, and \( X \) the data. The likelihood function is equivalent to a frequentist Generalized Linear Model, yet it differs in that one makes probabilistic statements about the value of \( \theta \) in the priors, including both point estimations and a measure of uncertainty (i.e. variance), surrounding these beliefs (Congdon, 2001; Gill, 2008). A consequence of this formulation is that, typically, models using a Bayesian approach are
difficult, if not impossible, to maximize.\textsuperscript{25} To overcome this maximization problem, Bayesians use Markov-Chain Monte Carlo [MCMC], frequently employing thousands of simulations that sample from the posterior distribution. The Markovian property of the chains dictates that the successive quantity is dependent only on the previous value, which is what enables one to have confidence in this sampling technique (Gill, 2008). Thus, over time the chain will result in draws from the parameter space that reflect the quantities of interest (i.e. means and variances). Because maximization is not an issue, a researcher can define complex models that traditional methods are unable to solve.

For some time, Bayesians sought the ironic search of “empirical,” non-informed priors (e.g. Jeffreys, 1961).\textsuperscript{26} While many researchers use uninformed priors to take advantage of Bayesian estimation’s flexibility, the use of \textit{informed priors} has recently gained traction in the political science field. The use of these types of priors recognizes that there often exists scientific evidence on the event in question before a researcher begins his model building process (Gill, 2008). Informed priors can take many forms, drawing from the existing literature, expert interviews, or even intuition on the part of the researcher. While the degree of formality varies across informed priors, they all serve to explicitly incorporate previous scientific research into a statistical model. Western and Jackman (1994) utilize two existing studies to create informed priors for a study of union density in twenty European countries, enabling them to overcome the asymptotic and autocorrelation limitations of the previous works. Gill and Walker (2005) used structured interviews to generate informed priors when studying factors influencing trust in the Nicaraguan judicial system. Their study generates three distinct sets of priors, each drawn from

\textsuperscript{25} An exception to this statement occurs in simple models using conjugate priors. In social science questions, it is difficult to exploit conjugacy as it is rare that the conjugate distribution to one’s GLM is the conceptual distribution for the prior.

\textsuperscript{26} The educational literature, at times, utilizes “empirical Bayes” in its frequent utilization of Multi-Level Modeling (Raudenbush and Bryk, 2002).
different ideological groups. They then run separate models to show the influence of the different ideologically based priors on survey data. Bakker (2009) uses surveys of experts to generate priors for a spatial model determining the ideological position of European political parties. These “ideal points” are then used to predict ensuing ideological statements made in party manifestos.

Clearly, the use of informed priors is a different epistemological statement from what is made in the frequentist approach. While in predictive models this practice is understandable, in latent variable models where the literature often asserts a quality to exist, something must, by definition, be known. Extending this to state governance structures, Chapter 2 outlined the breadth of literature on postsecondary governance. To disregard this knowledge would be dismissing what is perhaps the most important information of these structures. Ironically, this epistemological argument most closely resembles that of traditional qualitative researchers in the social sciences.

Beyond the flexibility generated from the ability to use priors, Bayesian estimation possesses other qualities that should appeal to social scientists. While frequentists assert that $\beta$ is a fixed element and data are random, the Bayesian approach inverts this relationship, treating $\beta$ as a random variable (that we sample using MCMC) and data as fixed. Due to the high cost and difficulty in collecting data, social scientists often have one realization. Moreover, researchers of comparative state politics by definition have one realization of data. History is fixed.27 While frequentist counterarguments may say that this data is a random realization from history, this implies that history has its own sampling distribution which, at this point, is unknown.

27 For example, the probability that Georgia adopted a broad based merit aid program in 1993 is 1.0.
While factor analysis and Simultaneous Equation Modeling are frequentist means for generating latent variables from observed indicators, a Bayesian approach gives researchers added flexibility. In the political science literature, the most frequent use of these measurement models are in studies of parliamentary, legislative, and court ideology (e.g. Clinton, Jackman, and Rivers, 2004a; 2004b). In this use, two ideologically different senators are placed at opposite ends of the latent variable. For example, in studies of the U.S. Senate, Jesse Helms is placed at the right and Ted Kennedy is placed at the left.

Through using this approach, I will be able to exploit the existing typology and instances in which the literature indicates governance centralization and decentralization. This adds to the variables collected as I believe that the typology is useful, and possibly more informative than the individual indicators. By combining them, I will produce a measure that leverages the data available and the decades of study of state postsecondary governance.

**Predicting governance change**

Shifting from the theoretical underpinnings of the measure outlined in the previous section to a use of the measure, this section introduces the theoretical framework that informs the model predicting governance change. The purpose of including this model is to demonstrate how the new measure may be utilized and give researchers a new tool with which to investigate hypotheses related to state postsecondary governance. As it is not the principal focus of the study, those who wish to further understand the theoretical underpinnings of this specification

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28 In the Higher Education literature, Doyle (2010) used this technique to measure senator’s ideological positions in relation to postsecondary education issue.
are advised to visit McLendon et al.’s 2007 piece “The enactment of reforms in state governance of higher education: Testing the political instability hypothesis.” In this “re-testing of the political instability hypothesis” I include several additional hypotheses not found in McLendon et al.’s study which are discussed at greater length.

To specify the dependent variable I subtract each state’s centralization measure at time $t - 1$ from time $t$. This allows one to assess not only if change occurred, but to what degree it occurred. To estimate this, I turn to the literature, which indicates two, broad factors that influence governance change: a state’s desire to better manage its public institutions and the state’s political climate. To test the management hypothesis I identify several factors that indicate changing complexity, cost, and investment in a state’s postsecondary education system. These indicators may be understood as barometers of “the health” of a state’s public postsecondary education. For the political variables I first draw upon the political instability hypothesis, which draws from McGuinness’ (1997) explanation of governance change in the 1990s and was later specified and tested by McLendon et al. (2007). McGuinness hypothesized that the influx of new political leaders in this time period led to state level leadership that sought to alter their predecessor’s actions in the 1960s and 1970s. To operationalize this, McLendon et al. focus on the changing partisan balance in state legislatures and gubernatorial tenure. Beyond this, I foresee other political factors that may influence this change, notably the changing ideological climate of a state’s citizens and the interaction between gubernatorial party and a governor’s powers.

McLendon et al. (2007) specified their dependent variable as a dichotomous indicator for “any change,” which necessitated using hypotheses that neglect movements toward
centralization and decentralization. Using this new measure enables me to test directional movement associated with the political instability hypotheses, allowing for a deeper understanding of not only what predicts change, but what predicts what type of change. As a result, I attach directional hypotheses to the political variables. However, because the rhetoric for centralization and decentralization says that both are beneficial for a state’s public system, some indicators for the postsecondary climate receive a two-tailed hypothesis. This is specified because the indicators suggest that a state’s system is not optimal, yet one cannot determine if centralization or decentralization will ameliorate the problem. I also wish to test the influence of additional indicators, namely the interaction between governor’s party and his institutional power, on governance change. The following hypotheses reflect the factors believed to influence postsecondary governance change.

Hypothesis 1: States in which Republicans recently gained control of the legislature will decentralize their postsecondary governance structures.

Hypothesis 2: States in which Democrats recently gained control of the legislature will centralize their postsecondary governance structures.

Hypotheses 1 and 2 are partisan variants of the political instability hypothesis, which McLendon et al. (2007) found to positively influence any governance reform. To inform the specific directional hypotheses, I associate centralization with greater state control and decentralization with the relaxed, devolved theory of New Public Management. This dichotomy is frequently

29 Consequently I am unable to test all hypotheses associated with the political instability hypothesis. Notably, I omit a hypothesis for gubernatorial tenure for which the directional change is unclear.
aligned with partisan ideology, with Democrats favoring the former and Republicans the latter. As per the political instability hypothesis, once a party claims power, it will seek to enact their policy preference.

Hypothesis 3: *States in which Republican legislative membership recently increased will decentralize their postsecondary governance structures.*

Beyond legislative take-over, I wish to account for changing partisan balance. While Hypotheses 1 and 2 represent a change in control, this hypothesis centers on states where Republican representation is increasing or, alternatively, Democratic representation is decreasing. Following McLendon et al. (2007), this draws from the principal-agent logic of policy making, where the changing principals will scrutinize the existing programs and policies of the previous principals; rather than simply manage the existing state structures, the new, Republican, principals will seek to enact their preferences.

Hypothesis 4: *States with powerful Republican governors will decentralize their postsecondary governance structures.*

While most governors are typically Republican or Democrat, these executives differ in the formal powers they possess and consequently their ability to influence the policy process. Partisanship and these institutional powers do not operate independently, thus, I propose that powerful Republican governors will be able to decentralize their state structure, aligning it with
their party’s policy preferences. In contrast, I expect weak Republican governors to not have the necessary influence to enact their desired change.

*Hypothesis 5: States in which the citizenry is becoming more ideologically liberal will centralize their postsecondary governance structures.*

Beyond political representation, states’ citizens vary in their ideological position. The citizenry is an important element to states’ ideological orientation and, after considering partisanship, will influence a state’s policy preferences. Reflecting the Republican and Democratic ideological divide, states’ with more ideologically liberal citizens will favor more structural, bureaucratic control.30

*Hypothesis 7: States in which tuition is increasing will centralize their postsecondary governance structure.*

Increasing tuition in public postsecondary education is an often lamented issue, with many noting its outpacing of inflation (IHEP, 1999). If tuition is increasing, then states may seek to alter their governance arrangement in order to better manage this upward spiral, which is predominantly driven by institutions. Thus, if state tuition is increasing, then states will centralize their governance structures to better control this cost.

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30 Here, “liberal” refers to contemporary ideological, “leftism” and not the classical form of liberalism.
Hypothesis 8: States in which enrollment is increasing will centralize their postsecondary governance structures.

As states’ enrollment increases, complexity becomes introduced into the public, postsecondary educational system. When many states established their postsecondary governance systems in the 1950s to 1970s, recent massification was frequently cited as the impetus for these changes. Similarly, in this study, I predict that as enrollments increase, states will centralize their systems in an effort to better manage brought on by these increases.

Hypothesis 9: States in which appropriations to higher education are increasing will change their postsecondary governance structures.

Increased state investment in higher education will lead to demands for greater system-wide efficiency; however, unlike increasing enrollments which is closely tied to the efficiencies brought on by bureaucratic and authoritarian controls, the solution for efficiency is less clear. On one hand, centralization is thought to increase efficiency through avoiding unnecessary program duplication, controlled purchasing, and so forth. On the other, during the time of the study, many policy scholars believed that greater efficiencies could be achieved through decentralizing state functions. As a result, I offer a “two-tailed” hypothesis, to account for the possibility that increasing appropriations as compelling a state to either centralize or decentralize its governance structure.
Hypothesis 10: States who experience a larger migration of students outside of their borders will change their postsecondary governance structures.

Part of the rationale for investing in education is to generate an educated citizenry that will remain in state and contribute to a state’s economy. By the time students have reached postsecondary education, states have invested in individuals at the elementary and secondary level. Further, a frequent policy rationale is the belief that the probability of remaining in-state increases when a student attends postsecondary education in a given state. From this, student out-migration may indicate a problem within a state’s public, postsecondary education system. However, the solution of centralization for this given problem is unclear as, like in the case of tuition, both centralization and decentralization can be viewed as panaceas for the ills of postsecondary education, with both suggesting that they contribute to efficiency, resulting in another two-tailed hypothesis.

Hypothesis 11: States with decreasing wealth will decentralize their postsecondary governance structures.

The arguments for decentralization not only center on efficiency potentially gained through devolution of public roles, but also can be viewed as cost saving measures. Maintenance of large, organizational bureaucracies requires a larger share of public funds for their very operation. In the case where state wealth is decreasing, decentralization may be viewed as an opportunity at cutting cost.
Table 2 lists the variables that will be used in the predictive model to test the stated hypotheses, their descriptions, sources, and availability. To account for inflation, all dollar values are indexed to 2007 prior to derivation.
<table>
<thead>
<tr>
<th>Variable Indicator</th>
<th>Description</th>
<th>Source</th>
<th>Data Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Republican takeover of state legislature</td>
<td>Dummy variable (yes=1; no=0) indicating a one year shift from divided or Democrat control of the legislature to unified Republican control</td>
<td>Author’s derivation from Klarner data at SPPQ data archive, Book of the States, Council of State Governments</td>
<td>1961-2009</td>
</tr>
<tr>
<td>Democrat takeover of state legislature</td>
<td>Dummy variable (yes=1; no=0) indicating a one year shift from divided or Republican control of the legislature to unified Democratic control</td>
<td>Author’s derivation from Klarner data at SPPQ data archive, Book of the States, Council of State Governments</td>
<td>1961-2009</td>
</tr>
<tr>
<td>Percent change in Republican legislators</td>
<td>Annual measure in the change in percentage of seats in the state legislature that is Republican.</td>
<td>Author’s derivation from Klarner data at SPPQ data archive, Book of the States, Council of State Governments</td>
<td>1961-2009</td>
</tr>
<tr>
<td>Republican Governor</td>
<td>Dummy variable (yes=1; no=0) indicating whether a state had a Republican governor</td>
<td>Author’s derivation from Klarner data at SPPQ data archive, Book of the States, Council of State Governments, National Governors Association</td>
<td>1960-2009</td>
</tr>
<tr>
<td>Governors institutional powers</td>
<td>Index representing the combined tenure potential, budgetary powers, appointment powers, and veto powers of a governor</td>
<td>Beyle data, at <a href="http://www.unc.edu/~beyle/gubnewpwr.html">http://www.unc.edu/~beyle/gubnewpwr.html</a></td>
<td>1968-2009</td>
</tr>
<tr>
<td>Percent change in citizen ideology</td>
<td>Annual measure of the percent change in the ideology of states’ citizens (higher values correspond to greater ‘liberalism’)</td>
<td>Author’s derivation from Berry data, at <a href="http://www.uky.edu/~rford/stateideology.html">http://www.uky.edu/~rford/stateideology.html</a></td>
<td>1961-2008</td>
</tr>
<tr>
<td>Percent change in tuition at public institutions</td>
<td>Annual measure of the percent increase of in-state tuition at state flagship universities.</td>
<td>Author’s derivation from NCES, Digest of Education Statistics data</td>
<td>1973-2007</td>
</tr>
<tr>
<td>Percent change in enrollment at public enrollment</td>
<td>Annual measure of the percent change in enrollment in public postsecondary education</td>
<td>Author’s derivation from SREB data</td>
<td>1973-2008</td>
</tr>
<tr>
<td>Percent change in state appropriations</td>
<td>Annual measure of the percent change in indexed state and local tax fund appropriations for higher education per $1000 of state personal income</td>
<td>Author’s derivation from Grapevine data</td>
<td>1962-2008</td>
</tr>
<tr>
<td>Out-migration</td>
<td>Percent of a state’s resident freshman who attend postsecondary education outside the state</td>
<td>NCES, Digest of Education Statistics</td>
<td>1975-2008</td>
</tr>
<tr>
<td>Percent change in GSP</td>
<td>Annual measure of the percent change in Gross State Product per capita</td>
<td>Bureau of Economic Analysis</td>
<td>1964-2009</td>
</tr>
</tbody>
</table>
Of these indicators, two, “governor’s institutional powers” and “percent change in citizen ideology,” are drawn from the political science literature and less intuitive in their description, meriting further discussion. The indicator for governor’s institutional powers, which is used to test Hypothesis 4, comes from the research of political scientist Thad Beyle (see Beyle, 1983, 1990, 1995, 1999, 2001, 2004); Beyle publicly provides these data on his personal website. In defining the institutional power of governors, Beyle states:

The institutional powers of the governorship are those powers given the governor by the state constitution, state statutes, and the voters when they vote on constitutions and referenda. In a sense, these powers are the structure into which the governor moves on being elected to office. (Beyle, 1999, p. 209).

This measure is an average of six components: separately elected state officials, tenure potential, appointment powers, budgetary control, veto power, and party control of government. Because the last of these components, party control of government, is manifest in other variables in the model, I recalculated this indicator, removing party control of government and averaging the other five components.

In the political science literature, the measurement of state citizen ideology is a subject of much contention. The cause for the interest in this particular construct stems from the theoretical interest in between state variation in citizens’ placement on a liberal-conservative continuum beyond the bounds of partisan politics. In this study, I use the measure developed by Berry, Ringquist, Fording, and Hanson in their 1998 paper “Measuring citizen and government ideology in the American states, 1960-93.” When compared to other specifications of citizen ideology, this can best be described as a measure of citizens’ ideology viewed through the lens of “policy mood.” To compute this score, Berry et al. first determine district candidate ideology

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31 Beyle does not use all of these components in all years of his measure, though from the mid-1990s on, this has become his standard formula.
32 See Brace, Arceneaux, Johnson, and Ulbig (2007) and Berry, Ringquist, Fording, and Hanson (2007).
through an equation that accounts for interest groups’ ideological ranking for an incumbent candidate, the state average ideological ranking of the challenger’s party, and district level support for the incumbent in comparison to a challenger. For non-election years, Berry et al. estimate the support for a hypothetical challenger using the previous and following elections. These estimates are then used to create an unweighted average each state’s overall citizen ideology score.33

33 For the specifics of this measurement, see the Unpublished supplement to the 1998 article, available at: http://www.uky.edu/~rford/stateideology.html
CHAPTER 4

DATA AND RESEARCH METHODS

The purpose of this study is to use the existing qualitative and descriptive literature to place state postsecondary governance structures on a continuum of centralization and then demonstrate a use of this measure in a predictive model. Previously researchers have quantitatively explored the influences on any discrete change in governance structures and used case study approaches to understand restructuring within a state. In contrast, this study is the first to move beyond the existing typology for all 50 states throughout time and test not only what influences change, but account for what type and degree of change.

The previous section introduced the conceptual underpinnings and motivations for the models, introducing the epistemological implications of the Bayesian statistical paradigm. In this section, I introduce the data for the indicators and the specific Bayesian model and the inclusion of the informative priors and truncation. By using informative priors and truncation, I explicitly incorporate much of the research cited in Chapter 2 into the measurement model described in this chapter. Following the description of the measurement model, I introduce the data used to test the hypotheses of the predictive model.
The measurement model

In the previous chapter, I listed the 19 indicators that are used here to determine states levels of governance and justified their relevance to the construct of centralization. Table 3 presents the means and standard deviations for these indicators in the first and last years of the analysis.

Table 3: Descriptive Statistics for indicators in the measurement model, 1985 & 2009.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>One Board for All Public Institutions</td>
<td>0.28</td>
<td>0.45</td>
<td>0.22</td>
<td>0.42</td>
</tr>
<tr>
<td>One or Two Boards for All Public Institutions</td>
<td>0.44</td>
<td>0.50</td>
<td>0.42</td>
<td>0.50</td>
</tr>
<tr>
<td>Consolidated or aggregated budget</td>
<td>0.60</td>
<td>0.49</td>
<td>0.68</td>
<td>0.47</td>
</tr>
<tr>
<td>Budget review and recommendation</td>
<td>0.88</td>
<td>0.33</td>
<td>0.90</td>
<td>0.30</td>
</tr>
<tr>
<td>Single board for both 2 and 4-yr governs 2yrs</td>
<td>0.28</td>
<td>0.45</td>
<td>0.30</td>
<td>0.46</td>
</tr>
<tr>
<td>Single board for both 2 and 4-yr governs or coordinates 2yrs</td>
<td>0.80</td>
<td>0.40</td>
<td>0.54</td>
<td>0.50</td>
</tr>
<tr>
<td>Agency has stat new program approval for 4-yr</td>
<td>0.76</td>
<td>0.43</td>
<td>0.82</td>
<td>0.39</td>
</tr>
<tr>
<td>Agency has stat new program approval for 2-yr</td>
<td>0.58</td>
<td>0.50</td>
<td>0.62</td>
<td>0.49</td>
</tr>
<tr>
<td>Agency has stat existing program approval for 4-yr</td>
<td>0.52</td>
<td>0.50</td>
<td>0.68</td>
<td>0.47</td>
</tr>
<tr>
<td>Agency has stat existing program approval for 2-yr</td>
<td>0.38</td>
<td>0.49</td>
<td>0.48</td>
<td>0.50</td>
</tr>
<tr>
<td>Agency has stat or policy new program approval for 4-yr</td>
<td>0.82</td>
<td>0.39</td>
<td>0.84</td>
<td>0.37</td>
</tr>
<tr>
<td>Agency has stat or policy new program approval for 2-yr</td>
<td>0.66</td>
<td>0.48</td>
<td>0.70</td>
<td>0.46</td>
</tr>
<tr>
<td>Agency has stat or policy existing program approval for 4-yr</td>
<td>0.60</td>
<td>0.49</td>
<td>0.70</td>
<td>0.46</td>
</tr>
<tr>
<td>Agency has stat or policy existing program approval for 2-yr</td>
<td>0.48</td>
<td>0.50</td>
<td>0.56</td>
<td>0.50</td>
</tr>
<tr>
<td>Agency has stat, policy, or advisory new program approval for 4-yr</td>
<td>0.94</td>
<td>0.24</td>
<td>0.90</td>
<td>0.30</td>
</tr>
<tr>
<td>Agency has stat, policy, or advisory new program approval for 2-yr</td>
<td>0.78</td>
<td>0.42</td>
<td>0.76</td>
<td>0.43</td>
</tr>
<tr>
<td>Agency has stat, policy, or advisory existing program approval for 4-yr</td>
<td>0.86</td>
<td>0.35</td>
<td>0.86</td>
<td>0.35</td>
</tr>
<tr>
<td>Agency has stat, policy, or advisory existing program approval for 2-yr</td>
<td>0.72</td>
<td>0.45</td>
<td>0.72</td>
<td>0.45</td>
</tr>
<tr>
<td>Ratio of public institutions to boards</td>
<td>0.78</td>
<td>0.19</td>
<td>0.74</td>
<td>0.23</td>
</tr>
</tbody>
</table>

With the exception of “ratio of public institutions to boards” all indicators are binary and take the Bernoulli distribution. While additional indicators of state centralization may take other forms,
the following equation represents the equations for the measurement model. Because of the continuous nature of the latent variable, all priors will be specified using the normal distribution. The resulting latent variable model contains all 50 states over a 20 year time period. The following equations represent the latent variable model.

\[
Y_{ijt} \sim \text{Bernoulli}(p_{ijt}, n_{ijt})
\]

\[
Y_{it} \sim \text{Normal}(p_{it}, n_{it})
\]

with the first equation applying to the first 18 indicators and the second the board ratio indicator. In the equations, subscript \( t \) represents the units of time (years), \( Y_{ij} \) represents the number of centralized features a state governance structure \( i \) has on feature \( j \), \( p_{ij} \) is the probability that a governance structure has feature \( j \), and \( n_{ij} \) the total number of centralized/decentralized powers within a state's governance structure. From these equations one can see that, with 50 states, 25 years, and 19 indicators that the model approaches 2000 unknown values. Because MCMC estimation allows one to sample from the posterior, it negates the need to invert the matrix to obtain standard errors, instead summarizing the distribution through means and standard deviations. To address this issue I employ a form of the MCMC, the Gibbs sampler algorithm.

For this study, the existing typology is utilized for initial prior formation, specifically the 1985 State Structures Handbook (McGuinness, 1985). I defend the use of these priors through their consistent use in both quantitative and qualitative research (e.g. McLendon et al., 2005; 

\[34\] This will not prove to be an analytical problem as Bayesian factor analysis is not limited to a single distribution.

\[35\] The second equation lacks a subscript \( j \) because only one of the factors takes the normal distribution.

\[36\] The Gibbs sampler is well suited for models that are highly dimensional. For a technical introduction to Gibbs sampling, see Casella and George, 1992. For further reading on Gibbs sampling in a social science context, see Jackman, 2010, Ch. 5.
McLendon et al. 2006; Hearn et al., 2009). Their inclusion is defensible as many existing studies that test hypotheses surrounding postsecondary governance consistently use the typology to specify their indicators.

Table 4 lists the states and their structure in 1985, the first year of the analysis, where advisory planning agencies are the most decentralized structures and consolidated governing boards the most centralized.
Table 4: State Governance Structures 1985

<table>
<thead>
<tr>
<th>State</th>
<th>Governance Structure</th>
<th>State</th>
<th>Governance Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska</td>
<td>Consolidated Governing Board</td>
<td>Montana</td>
<td>Consolidated Governing Board</td>
</tr>
<tr>
<td>Alabama</td>
<td>Coordinating Board</td>
<td>North Carolina</td>
<td>Consolidated Governing Board</td>
</tr>
<tr>
<td>Arkansas</td>
<td>Coordinating Board</td>
<td>North Dakota</td>
<td>Consolidated Governing Board</td>
</tr>
<tr>
<td>Arizona</td>
<td>Consolidated Governing Board</td>
<td>Nebraska</td>
<td>Planning Agency</td>
</tr>
<tr>
<td>California</td>
<td>Coordinating Board</td>
<td>New Hampshire</td>
<td>Coordinating Board</td>
</tr>
<tr>
<td>Colorado</td>
<td>Coordinating Board</td>
<td>New Jersey</td>
<td>Coordinating Board</td>
</tr>
<tr>
<td>Connecticut</td>
<td>Coordinating Board</td>
<td>New Mexico</td>
<td>Coordinating Board</td>
</tr>
<tr>
<td>Delaware</td>
<td>Planning Agency</td>
<td>Nevada</td>
<td>Consolidated Governing Board</td>
</tr>
<tr>
<td>Florida</td>
<td>Consolidated Governing Board</td>
<td>New York</td>
<td>Coordinating Board</td>
</tr>
<tr>
<td>Georgia</td>
<td>Consolidated Governing Board</td>
<td>Ohio</td>
<td>Coordinating Board</td>
</tr>
<tr>
<td>Hawaii</td>
<td>Consolidated Governing Board</td>
<td>Oklahoma</td>
<td>Coordinating Board</td>
</tr>
<tr>
<td>Iowa</td>
<td>Consolidated Governing Board</td>
<td>Oregon</td>
<td>Consolidated Governing Board</td>
</tr>
<tr>
<td>Idaho</td>
<td>Consolidated Governing Board</td>
<td>Pennsylvania</td>
<td>Coordinating Board</td>
</tr>
<tr>
<td>Illinois</td>
<td>Coordinating Board</td>
<td>Rhode Island</td>
<td>Consolidated Governing Board</td>
</tr>
<tr>
<td>Indiana</td>
<td>Coordinating Board</td>
<td>South Carolina</td>
<td>Coordinating Board</td>
</tr>
<tr>
<td>Kansas</td>
<td>Consolidated Governing Board</td>
<td>South Dakota</td>
<td>Consolidated Governing Board</td>
</tr>
<tr>
<td>Kentucky</td>
<td>Coordinating Board</td>
<td>Tennessee</td>
<td>Coordinating Board</td>
</tr>
<tr>
<td>Louisiana</td>
<td>Coordinating Board</td>
<td>Texas</td>
<td>Coordinating Board</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>Coordinating Board</td>
<td>Utah</td>
<td>Consolidated Governing Board</td>
</tr>
<tr>
<td>Maryland</td>
<td>Coordinating Board</td>
<td>Virginia</td>
<td>Coordinating Board</td>
</tr>
<tr>
<td>Maine</td>
<td>Consolidated Governing Board</td>
<td>Vermont</td>
<td>Planning Agency</td>
</tr>
<tr>
<td>Michigan</td>
<td>Planning Agency</td>
<td>Washington</td>
<td>Coordinating Board</td>
</tr>
<tr>
<td>Minnesota</td>
<td>Coordinating Board</td>
<td>Wisconsin</td>
<td>Consolidated Governing Board</td>
</tr>
<tr>
<td>Missouri</td>
<td>Coordinating Board</td>
<td>West Virginia</td>
<td>Consolidated Governing Board</td>
</tr>
<tr>
<td>Mississippi</td>
<td>Consolidated Governing Board</td>
<td>Wyoming</td>
<td>Consolidated Governing Board</td>
</tr>
</tbody>
</table>
Except for the first year in the analysis and instances of complete governance restructuring, the study will use a "random walk prior." A random walk prior takes advantage of the flexibility of Bayesian modeling, using the mean and variance of the latent variable from year $t$ as the prior for year $t+1$. As the model aims improve upon the typology, placing it along the continuum, the estimates produced in the previous year are preferable to simply using the typology for all years. The informed priors enter in the model through the following equation:

$$X_{it} \sim \text{Normal}(\mu_{it}, \sigma^2_{it})$$

Here $\mu_i$ is the value in the McGuinness typology and $\sigma^2_i$ is the variance of the “McGuinness prior.”37 The following equations indicate the priors for the different governance arrangements as identified by McGuinness and adapted for use in this model:

- **Consolidated Governing Board** $X_{i1} \sim \text{Normal}(40_{i1}, 7.65_{i1})
- **Coordinating Board** $X_{i1} \sim \text{Normal}(25_{i1}, 12.76_{i1})
- **Planning Agency** $X_{i1} \sim \text{Normal}(10_{i1}, 7.65_{i1})$

The choice to use a scale that ranges from 10 to 40 was made in an effort to appeal to researchers and policy makers alike. By extending this beyond the more typical -1 to 1 scale, I believe the expansion of the scale will aid researchers and policymakers to better understand the differences and better communicate the differences between states. As there is a complete lack of quantitative information in McGuinness' work, I am forced to specify the variance in an ad hoc manner. As illustrated, smaller variances will be given to the priors for states with advisory/planning agencies and consolidated governing boards and larger variances to states with

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37 The program used for the analysis utilizes the precision, which is the inverse of the variance. Appropriate calculations were made for this conversion.
coordinating boards. The decision to increase the variance around coordinating boards is because of the literature's greater sense of uncertainty in the levels of centralization within the coordinating board category. Taken as a whole, the specification of the variance for these structures reflects my personal degree of uncertainty surrounding the governance structures. After settling on the particular scale, this operation was performed by constructing 95% confidence intervals around the points for the elements of the typology, from which I then converted to a variance. This enabled me to operationalize my belief by constructing the prior so that coordinating boards’ level of centralization extends into both the advisory/planning agency and consolidated governing board levels of the scale, yet restrict any overlap between the consolidated governing board and advisory/planning agency categories. However, because of the large amount of data, the prior predominantly serves to anchor the states and, after conditioning them on the data, results in a measure which is the combination of the typology and the 19 indicators.

Because the use of informative priors is infrequent in higher education research, I offer a metaphor for understanding how these priors function in this measurement model. The mean values (40 for consolidated governing boards, 25 for coordinating boards, and 10 for planning agencies) may each be thought of as an “anchor” for states with those particular boards in the first year of analysis and the variance (7.65 for consolidated governing boards and planning agencies and 12.76 for coordinating boards) is the “length of chain” attached to these anchors. These are then conditioned on the 19 indicators that place them on a specific location on the continuum. It is worth noting that in Bayesian models, as the number of observations approaches infinity, the influence of the priors decreases.

38 This is a metaphor that aims only to provide an intuitive sense of how the priors and the data work in this measurement model. Mathematically, of course, the reality is more complex.
McLendon et al. (2007) identified instances of governance reform from the years 1985-2000. In cases where the board was dissolved and structures moved to a different category of the typology, the prior specification illustrated in the above equations will be employed. All of these changes were verified though the Education Commission of the States, which was also used to determine this type of change for the post-2000 time period. This decision to introduce a new prior is based on the belief that the information from the estimate at $t-1$ contains no better information than the existing typology. Table 5 presents the five instances where states completely restructured their postsecondary governance.

Table 5: States moving categories in the typology

<table>
<thead>
<tr>
<th>Year</th>
<th>State</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>Nebraska</td>
<td>Changed from Planning Agency to Coordinating Board</td>
</tr>
<tr>
<td>1991</td>
<td>Massachusetts</td>
<td>Changed from Consolidated Governing Board to Coordinating Board</td>
</tr>
<tr>
<td>1999</td>
<td>Florida</td>
<td>Changed from Consolidated Governing Board to Superboard</td>
</tr>
<tr>
<td>2000</td>
<td>West Virginia</td>
<td>Changed from Consolidated Governing Board to “Strong” Coordinating Board</td>
</tr>
<tr>
<td>2004</td>
<td>Massachusetts</td>
<td>Changed from Coordinating Board to Superboard</td>
</tr>
</tbody>
</table>

Table 5 illustrates that, in the time of the study, very few states completely restructured in a manner that moves them from one category in the typology to another. Of the 1,200 state-years in which change was possible, these constitute less than half of a percent. This simple, qualitative finding further illustrates the weakness of the typology if it is used to understand governance change. Also of note is that of the five states in this category of governance change, Florida and Massachusetts abandoned their structure and created a “Superboard,” a type of governance structure that does not neatly fit into the typology. Since my conception of
centralization focuses on the state-control of institutions, these “Superboards” were given a prior of 30 with a large variance. Similarly, as identified by the Association of Governing Boards, West Virginia’s restructuring resulted in a “strong coordinating board,” the sole state with this structure as its classification. To account for this distinction, the prior of 30 was also used. In the unique case of Florida, the governance restructuring was a long, lengthy process involving a series of legislation over several years. Because of this, and because of the literature’s lack of consensus on this state’s place in the typology, I employ the random-walk prior, though changes in the indicators used for during these will cause minor movement along the continuum.

As identified by the literature review, states may also centralize and decentralize their governance structure, yet remain in a category of the typology. That is, a state may choose to decentralize its coordinating board, yet it remains classified as a coordinating board. In part, this underscores the existence of a continuum of centralization, and also provides another opportunity for including qualitative information in the model. Here, the prior becomes not only the estimate at time $t-1$, but is also truncated. To accomplish this truncation, I set the cut off prior at the mean estimate at time $t-1 +/- 2$ depending on whether a state centralizes or decentralizes. Through this operation, I am able to incorporate even more of the qualitative literature on governance reform into my measurement model. Table 6 lists the states, years, and the direction of reform.

---

39 This type of truncation is a truncated or censored sampling distribution and should not be confused with models that rectify truncated dependent variables (e.g. tobit).
Table 6: States experiencing within governance change

<table>
<thead>
<tr>
<th>Year</th>
<th>State</th>
<th>Board Type</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987</td>
<td>Texas</td>
<td>Coordinating Board</td>
<td>Centralization</td>
</tr>
<tr>
<td>1988</td>
<td>Maryland</td>
<td>Coordinating Board</td>
<td>Centralization</td>
</tr>
<tr>
<td>1989</td>
<td>Arkansas</td>
<td>Consolidated Governing Board</td>
<td>Centralization</td>
</tr>
<tr>
<td>1989</td>
<td>West Virginia</td>
<td>Consolidated Governing Board</td>
<td>Decentralization</td>
</tr>
<tr>
<td>1990</td>
<td>North Dakota</td>
<td>Consolidated Governing Board</td>
<td>Centralization</td>
</tr>
<tr>
<td>1991</td>
<td>Minnesota</td>
<td>Coordinating Board</td>
<td>Centralization</td>
</tr>
<tr>
<td>1992</td>
<td>Maryland</td>
<td>Coordinating Board</td>
<td>Centralization</td>
</tr>
<tr>
<td>1993</td>
<td>Arizona</td>
<td>Consolidated Governing Board</td>
<td>Decentralization</td>
</tr>
<tr>
<td>1994</td>
<td>Montana</td>
<td>Consolidated Governing Board</td>
<td>Centralization</td>
</tr>
<tr>
<td>1994</td>
<td>New Jersey</td>
<td>Coordinating Board</td>
<td>Decentralization</td>
</tr>
<tr>
<td>1995</td>
<td>Illinois</td>
<td>Coordinating Board</td>
<td>Decentralization</td>
</tr>
<tr>
<td>1997</td>
<td>Arkansas</td>
<td>Coordinating Board</td>
<td>Decentralization</td>
</tr>
<tr>
<td>1997</td>
<td>Kentucky</td>
<td>Coordinating Board</td>
<td>Decentralization</td>
</tr>
<tr>
<td>1997</td>
<td>Maine</td>
<td>Consolidated Governing Board</td>
<td>Centralization</td>
</tr>
<tr>
<td>1998</td>
<td>Hawaii</td>
<td>Consolidated Governing Board</td>
<td>Decentralization</td>
</tr>
<tr>
<td>1999</td>
<td>Kansas</td>
<td>Consolidated Governing Board</td>
<td>Centralization</td>
</tr>
<tr>
<td>2002</td>
<td>Maine</td>
<td>Consolidated Governing Board</td>
<td>Centralization</td>
</tr>
<tr>
<td>2003</td>
<td>Colorado</td>
<td>Coordinating Board</td>
<td>Decentralization</td>
</tr>
<tr>
<td>2005</td>
<td>Virginia</td>
<td>Coordinating Board</td>
<td>Decentralization</td>
</tr>
<tr>
<td>2009</td>
<td>Ohio</td>
<td>Coordinating Board</td>
<td>Centralization</td>
</tr>
</tbody>
</table>

Compared to states that changed position in the typology, the literature reports four times as many centralizing or decentralizing within their category in the typology, though this is still approximately 1.7%. When taken together, Table 5 and Table 6 show that governance reform occurred in approximately 2.1% percent of the state-years. However, in contrast to these changes, of the 22,800 year-indicators in which change can occur, 3.7% showed year-to-year change which suggests that governance may change in a manner that does not result from policy intervention.

In Bayesian models, diagnostics are not as formal as in frequentist statistics. The primary concern for these models is the issue of convergence. In order to obtain correct inference, it is
essential to believe that the Markov chains have correctly sampled from the posterior, giving one
the highest posterior density rather than having oversampled from a local maxima. That is, it is
necessary to provide evidence and ample sampling to ensure that the Markov chains have amply
sampled from the solution. While convergence cannot be proven per se, I run two chains
simultaneously and assess convergence through visual diagnostics of the chains.

The priors and data for the latent variable are not without their assumptions. The first is
that the typology, as is, accurately reflects levels of centralization. Since numerous studies
utilize the typology, this is not of a great concern. As mentioned previously, this measure
attempts to use the 19 indicators to add richness to the familiar categorizations. As these priors
are conditioned on the available data, any misspecification will be addressed by the model.
Appendix A provides the code to run the measurement model, which is easily adaptable to
alternative prior specifications for specific or all states. The second and more powerful
limitation is that the data only represent de jure powers and, as noted by Berdahl and others, de
facto powers may at times have more bearing on the reality of governance. As this study
measures governance over a 25 year time period, it is impossible to even speculate on the de
facto powers of all 50 states. This is a limitation but, as mentioned previously, the developed
construct utilizes measures of uncertainty and produces conservative results.

The predictive model

On account of the continuous nature of the latent variable, the second stage of the
predictive model will utilize the normal distribution. Based on theory, it is difficult to determine
a single estimator. Typical estimators for continuous variables in TSCS data are fixed and random effects estimators. The advantage of random effects estimation is the use of varying slopes, allowing social science researchers to estimate between-unit effects. Fixed effects estimation, by contrast uses varying intercepts, and models within-unit estimates. While the random effects estimator may seem preferable, as mentioned earlier, there is nothing random about this given sample, which causes one to gravitate toward fixed effects. Further, from differencing several variables in the predictive model, a simple, pooled estimation may be preferred. After the estimation, a Hausman test will be conducted to determine the preferred specification. As most states’ governance systems will not change, statistically the Hausman test should prefer the random effect model. However, because of the theoretical sampling issues mentioned, both models will be presented along with the pooled regression. Systematic findings across the two models will confirm the importance of the finding. The following equation represents the fixed effects equation:

\[ \text{Normal}(Y_{it}) = a_t + \beta X_{it} \]

With \( Y_{it} \) is the annual change in the latent variable from the measurement model for state \( i \) at time \( t \), \( a_t \) is the state level, random intercept, \( \beta \) represents the coefficients of interest and \( X_{it} \) is a vector of independent variables for state \( i \) at time \( t \). Alternatively, the random effects model is expressed through the following equation:

\[ \text{Normal}(Y_{it}) = (\alpha + u_t) + \beta X_{it} \]

40 For a discussion of the confusion and problems associated with “fixed vs. random effects” see Gelman and Hill (2007).
41 For a thoughtful discussion on the differences between fixed and random effects, see Gelman and Hill (2007), Chapter 11. For a classical (frequentist) perspective on this issue, see Wooldridge (2006), Chapter 14.
Here, I substitute a single intercept $\alpha$ and $u_i$ which represents the random, heterogeneous slope.

The following equation presents the Hausman test statistic:

$$H_0 = (b_{FE} - \hat{\beta}_{RE})' [V_{FE} - V_{RE}]^{-1} (b_{FE} - \hat{\beta}_{RE})$$

This test produces a $\chi^2$ statistic, with which one tests the Null Hypothesis of constant variance across the models. When one fails to reject the Null Hypothesis, then the random effects model is preferred as no systematic differences occur between the models (Greene, 2008).

Table 7 provides the descriptive statistics for the first and last year of the analysis. From these, one sees little dramatic change across time, which is largely the result of specifying many of the variables as measures of change.
Table 7: Descriptive statistics for variables in the analysis 1986 & 2007 (n=49 states)

<table>
<thead>
<tr>
<th>Variable</th>
<th>1986</th>
<th>Standard Deviation</th>
<th>2007</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Republican take-over of state legislature</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Democratic take-over of state legislature</td>
<td>0.00</td>
<td>0.00</td>
<td>0.06</td>
<td>0.24</td>
</tr>
<tr>
<td>Percent change in Republican legislators</td>
<td>0.00</td>
<td>0.06</td>
<td>-0.07</td>
<td>0.09</td>
</tr>
<tr>
<td>Republican governor</td>
<td>0.33</td>
<td>0.47</td>
<td>0.41</td>
<td>0.50</td>
</tr>
<tr>
<td>Governor's institutional powers</td>
<td>3.79</td>
<td>0.67</td>
<td>3.51</td>
<td>0.45</td>
</tr>
<tr>
<td>Interaction of Republican governor &amp; governor's powers</td>
<td>1.27</td>
<td>1.87</td>
<td>1.36</td>
<td>1.68</td>
</tr>
<tr>
<td>Gubernatorial Tenure</td>
<td>5.31</td>
<td>2.98</td>
<td>3.76</td>
<td>1.87</td>
</tr>
<tr>
<td>Citizen Ideology change</td>
<td>0.07</td>
<td>0.13</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Percent change in in-state tuition at flagship</td>
<td>0.07</td>
<td>0.08</td>
<td>0.03</td>
<td>0.04</td>
</tr>
<tr>
<td>% change in enrollment at public institutions</td>
<td>0.02</td>
<td>0.04</td>
<td>0.02</td>
<td>0.01</td>
</tr>
<tr>
<td>Percent change in state appropriations</td>
<td>-0.04</td>
<td>0.06</td>
<td>-0.02</td>
<td>0.04</td>
</tr>
<tr>
<td>Out-migration</td>
<td>0.19</td>
<td>0.10</td>
<td>0.21</td>
<td>0.11</td>
</tr>
<tr>
<td>Percent change in Gross State Product</td>
<td>0.01</td>
<td>0.07</td>
<td>0.01</td>
<td>0.02</td>
</tr>
</tbody>
</table>

In most years, states do not alter their governance arrangement, thus the dependent variable is centered around zero. This is not surprising since higher education governance structures are institutionalized and experience little change on an annual basis. However, this variable contains some variance, ranging from a minimum of -13.74 to a maximum of .02. In general, across the sample, movement along the continuum was predominantly in the form of decentralization, though there were minor changes in centralization.42

Table 8 gives the intercorrelations of the independent variables used in the analysis. The presence of multicollinearity in regression models can lead to inflated standard errors. Except for the interaction term, which by definition will be correlated with its components, the

---

42 Recall that Nebraska is removed from the analysis. This state experienced a 14.63 change in centralization from 1989 to 1990.
correlations between the variables are surprisingly low, with the -0.23 correlation between “Percent change in tuition” and “Percent change in enrollment” having the highest correlation. Since interactions are typically highly correlated with the main effect terms and the theoretical interlinkages that motivate them point to specific hypotheses, the influence of these variables will not be assessed through the main effects, but rather through tests of the joint significance of these variables. ⁴³

⁴³ For a discussion of the interpretation of interactions in the political science literature, see Brambor, Clark, and Golder, 2006.
Table 8: Intercorrelation of variables used in the predictive model

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in centralization</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rep. take-over of legislature</td>
<td>0.01</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dem. take-over of legislature</td>
<td>0.01</td>
<td>-0.02</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% change Rep. legislators</td>
<td>-0.07</td>
<td>0.02</td>
<td>-0.04</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rep. governor</td>
<td>-0.05</td>
<td>0.02</td>
<td>-0.02</td>
<td>-0.02</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gov. powers</td>
<td>-0.04</td>
<td>-0.02</td>
<td>0.00</td>
<td>-0.08</td>
<td>0.00</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Interaction term</td>
<td>-0.07</td>
<td>0.01</td>
<td>-0.03</td>
<td>-0.05</td>
<td>0.98</td>
<td>0.12</td>
<td>1.00</td>
</tr>
<tr>
<td>Gubernatorial tenure</td>
<td>0.03</td>
<td>-0.03</td>
<td>-0.01</td>
<td>-0.06</td>
<td>0.03</td>
<td>0.11</td>
<td>0.03</td>
</tr>
<tr>
<td>Citizen ideology change</td>
<td>0.05</td>
<td>0.00</td>
<td>0.00</td>
<td>0.28</td>
<td>-0.01</td>
<td>-0.02</td>
<td>-0.01</td>
</tr>
<tr>
<td>% change in tuition</td>
<td>-0.04</td>
<td>0.02</td>
<td>-0.04</td>
<td>0.01</td>
<td>0.02</td>
<td>0.01</td>
<td>-0.01</td>
</tr>
<tr>
<td>% change in enrollment</td>
<td>0.04</td>
<td>-0.04</td>
<td>0.06</td>
<td>-0.09</td>
<td>-0.02</td>
<td>-0.08</td>
<td>-0.05</td>
</tr>
<tr>
<td>% change in appropriations</td>
<td>0.07</td>
<td>-0.03</td>
<td>-0.02</td>
<td>0.02</td>
<td>0.00</td>
<td>-0.01</td>
<td>0.04</td>
</tr>
<tr>
<td>Out-migration</td>
<td>0.02</td>
<td>0.00</td>
<td>0.01</td>
<td>-0.09</td>
<td>0.03</td>
<td>0.00</td>
<td>0.02</td>
</tr>
<tr>
<td>% change in GSP</td>
<td>0.06</td>
<td>-0.03</td>
<td>0.04</td>
<td>0.00</td>
<td>-0.02</td>
<td>0.01</td>
<td>0.04</td>
</tr>
</tbody>
</table>
Table 8 (continued): Intercorrelation of variables used in the predictive model

<table>
<thead>
<tr>
<th>Gov. tenure</th>
<th>Citizen ideology change</th>
<th>% change tuition</th>
<th>% change enrollment</th>
<th>% change appropriations</th>
<th>Out-migration</th>
<th>% change GSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gov. tenure</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Citizen ideology change</td>
<td>-0.03</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% change tuition</td>
<td>0.00</td>
<td>0.02</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% change enrollment</td>
<td>-0.04</td>
<td>0.08</td>
<td>-0.23</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% change appropriations</td>
<td>0.05</td>
<td>0.03</td>
<td>0.00</td>
<td>0.03</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Out-migration</td>
<td>0.01</td>
<td>-0.03</td>
<td>0.05</td>
<td>0.00</td>
<td>0.05</td>
<td>1.00</td>
</tr>
<tr>
<td>% change GSP</td>
<td>0.00</td>
<td>-0.04</td>
<td>-0.04</td>
<td>-0.14</td>
<td>0.21</td>
<td>0.05</td>
</tr>
</tbody>
</table>
CHAPTER 5

FINDINGS

This chapter is presented in two parts, with the first focusing on the measurement model and the second the application of the measurement in the predictive model. In an effort to present the results from the measurement model in a manner that is efficient, yet provides one the ability to draw comparisons between states, the results will primarily use graphical displays of the measure. First, I provide a table with the measure and standard deviations for all states in the first and last years of the analysis, serving to provide a numerical context for the following figures. Next I draw spatial maps that show the placement of all states for every year in the analysis, giving states’ placement on the continuum of centralization. Following this, I provide chloropleth maps that show the geographic “patchwork of centralization.” The predictive model is presented in a more traditional manner with a table of coefficients and their associated standard errors. While the purpose of this was to illustrate the use of the typology, I offer interpretations of the findings, comparing them with those of McLendon et al. (2007).

Results from the measurement model

For the measurement model, I used the “slice sampler” sampling algorithm for two MCMC chains, with an initial burn-in of 10,000 simulations. I then ran the chains for 500,000 iterations each, storing every tenth iteration. The need to store every tenth iteration was a result from preliminary diagnostics which indicated autocorrelation in the chains’ series. To further
address this correlation I used an over-relax form of MCMC which generates multiple samples per iteration and then selects for time $t+1$ a value that is negatively correlated with that of time $t$. This results in 50,000 samples from each chain for a total of 100,000 samples of the posterior distribution. Diagnostics of the chains showed mixing, ensuring they have converged. Table 9 presents the mean posterior estimates and associated standard deviations for the first and last year of the model.

Table 9: Results from the measure of centralization 1985 & 2009

<table>
<thead>
<tr>
<th>State</th>
<th>1985 Mean</th>
<th>1985 Standard Deviation</th>
<th>2009 Mean</th>
<th>2009 Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska</td>
<td>38.58</td>
<td>7.44</td>
<td>38.50</td>
<td>8.05</td>
</tr>
<tr>
<td>Alabama</td>
<td>24.03</td>
<td>9.98</td>
<td>24.03</td>
<td>10.20</td>
</tr>
<tr>
<td>Arkansas</td>
<td>24.34</td>
<td>10.05</td>
<td>24.40</td>
<td>10.49</td>
</tr>
<tr>
<td>Arizona</td>
<td>42.22</td>
<td>7.79</td>
<td>42.47</td>
<td>8.29</td>
</tr>
<tr>
<td>California</td>
<td>12.81</td>
<td>14.85</td>
<td>12.53</td>
<td>15.18</td>
</tr>
<tr>
<td>Colorado</td>
<td>17.87</td>
<td>13.38</td>
<td>17.68</td>
<td>13.73</td>
</tr>
<tr>
<td>Connecticut</td>
<td>28.19</td>
<td>10.87</td>
<td>28.28</td>
<td>11.21</td>
</tr>
<tr>
<td>Delaware</td>
<td>10.13</td>
<td>7.23</td>
<td>10.02</td>
<td>7.73</td>
</tr>
<tr>
<td>Florida</td>
<td>39.87</td>
<td>7.15</td>
<td>29.99</td>
<td>1.77</td>
</tr>
<tr>
<td>Georgia</td>
<td>39.47</td>
<td>7.22</td>
<td>39.53</td>
<td>7.76</td>
</tr>
<tr>
<td>Hawaii</td>
<td>38.22</td>
<td>7.69</td>
<td>38.03</td>
<td>8.19</td>
</tr>
<tr>
<td>Iowa</td>
<td>39.68</td>
<td>6.79</td>
<td>39.73</td>
<td>7.28</td>
</tr>
<tr>
<td>Idaho</td>
<td>39.72</td>
<td>7.83</td>
<td>39.68</td>
<td>8.30</td>
</tr>
<tr>
<td>Illinois</td>
<td>20.28</td>
<td>10.48</td>
<td>20.09</td>
<td>10.69</td>
</tr>
<tr>
<td>Indiana</td>
<td>17.02</td>
<td>15.88</td>
<td>16.81</td>
<td>16.34</td>
</tr>
<tr>
<td>Kansas</td>
<td>38.80</td>
<td>7.52</td>
<td>38.67</td>
<td>8.00</td>
</tr>
<tr>
<td>Kentucky</td>
<td>17.95</td>
<td>13.03</td>
<td>17.72</td>
<td>13.41</td>
</tr>
<tr>
<td>Louisiana</td>
<td>17.84</td>
<td>11.94</td>
<td>17.67</td>
<td>12.10</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>38.75</td>
<td>7.11</td>
<td>30.09</td>
<td>12.01</td>
</tr>
<tr>
<td>Maryland</td>
<td>17.94</td>
<td>9.40</td>
<td>17.73</td>
<td>9.52</td>
</tr>
<tr>
<td>Maine</td>
<td>35.35</td>
<td>7.30</td>
<td>35.04</td>
<td>7.75</td>
</tr>
<tr>
<td>Michigan</td>
<td>9.05</td>
<td>7.46</td>
<td>9.13</td>
<td>8.04</td>
</tr>
<tr>
<td>Minnesota</td>
<td>25.46</td>
<td>13.30</td>
<td>25.54</td>
<td>13.53</td>
</tr>
<tr>
<td>Missouri</td>
<td>18.59</td>
<td>13.09</td>
<td>18.38</td>
<td>13.38</td>
</tr>
</tbody>
</table>
Table 9 (continued) : Results from the measure of centralization 1985 & 2009

<table>
<thead>
<tr>
<th>State</th>
<th>1985</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard</td>
</tr>
<tr>
<td></td>
<td>Deviation</td>
<td></td>
</tr>
<tr>
<td>Mississippi</td>
<td>39.12</td>
<td>8.56</td>
</tr>
<tr>
<td>Montana</td>
<td>40.10</td>
<td>6.35</td>
</tr>
<tr>
<td>North Carolina</td>
<td>38.78</td>
<td>8.24</td>
</tr>
<tr>
<td>North Dakota</td>
<td>37.01</td>
<td>6.10</td>
</tr>
<tr>
<td>Nebraska</td>
<td>10.36</td>
<td>8.01</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>31.48</td>
<td>9.80</td>
</tr>
<tr>
<td>New Jersey</td>
<td>22.09</td>
<td>12.34</td>
</tr>
<tr>
<td>New Mexico</td>
<td>26.34</td>
<td>10.81</td>
</tr>
<tr>
<td>Nevada</td>
<td>38.99</td>
<td>7.16</td>
</tr>
<tr>
<td>New York</td>
<td>18.29</td>
<td>16.57</td>
</tr>
<tr>
<td>Ohio</td>
<td>25.30</td>
<td>14.07</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>25.36</td>
<td>8.76</td>
</tr>
<tr>
<td>Oregon</td>
<td>38.07</td>
<td>8.05</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>17.56</td>
<td>12.47</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>37.80</td>
<td>8.48</td>
</tr>
<tr>
<td>South Carolina</td>
<td>24.48</td>
<td>11.84</td>
</tr>
<tr>
<td>South Dakota</td>
<td>37.95</td>
<td>7.58</td>
</tr>
<tr>
<td>Tennessee</td>
<td>24.29</td>
<td>13.06</td>
</tr>
<tr>
<td>Texas</td>
<td>20.31</td>
<td>8.66</td>
</tr>
<tr>
<td>Utah</td>
<td>39.16</td>
<td>6.06</td>
</tr>
<tr>
<td>Virginia</td>
<td>13.68</td>
<td>10.52</td>
</tr>
<tr>
<td>Vermont</td>
<td>11.34</td>
<td>6.14</td>
</tr>
<tr>
<td>Washington</td>
<td>25.01</td>
<td>12.46</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>37.11</td>
<td>6.94</td>
</tr>
<tr>
<td>West Virginia</td>
<td>41.18</td>
<td>6.47</td>
</tr>
<tr>
<td>Wyoming</td>
<td>40.27</td>
<td>7.14</td>
</tr>
</tbody>
</table>

From the means, the model does succeed in placing the states along a continuum. In 1985, the range for the consolidated governing board types is from 35.35 (Maine) to 42.22 (Arizona), the range for coordinating boards is 12.81 (California) to 31.48 (New Hampshire), and planning agencies range from 9.05 (Michigan) to 11.34 (Vermont). The large spread within the
coordinating board category reflects the significant amount of heterogeneity within this classification. As within coordinating board differences is the most frequently dissected in the literature (i.e. coordinating boards with program approval or budgetary authority), this is not unexpected. Conversely, the spread among the planning agencies is quite small. Because in 1985 there were only four states with this type of governance arrangement, their clustering is expected as all four have few powers that distinguish themselves from one another.

Consolidated governing boards, on the other hand, are in between the clustering of the planning agency and coordinating board category. In part attributable to the greater number of states in this category, there is greater variation among the different consolidated governing boards than planning agencies yet less than within the coordinating board category.

In the measure, Michigan is the most decentralized state and Arizona the most centralized. Michigan is often given as an example of a decentralized system, which the model confirms. In contrast, postsecondary governance in Arizona is an understudied state and its placement as the most centralized system is somewhat surprising. The consolidated governing board category yields other surprising findings. Notably, Wisconsin is often regarded as one of the most centralized systems, yet the model shows it to be one of the most decentralized states within the consolidated governing board category.

As shown in Table 9, the coordinating board category has a larger variance the planning agency and consolidated governing board categories. On one hand, this reflects the larger variance given on the prior for the first year of the analysis. However, not all coordinating boards have extremely large standard deviations. In understanding the model’s uncertainty, I draw attention to California and New York. Traditionally these two, large states use a “system of systems” approach. While on one hand, the measure may be imperfectly designed to
designate the placement of these boards, yet on the other, their placement is in alignment with McGuinness’ parsing of the coordinating board category. For the sake of illustration, I further explore why California is found to be such a decentralized coordinating board. Of the 18 binary indicators, in 1985 California only has three: budget review and recommendation, and advisory new and existing program for 4-year institutions. This relatively weak, decentralized authority is a product of focusing on a single governing board – The University of California System – which is necessitated by my single dimension, state-level approach. In part this does reflect the existing typology, where McGuinness consistently suggests California is among the weakest of coordinating boards.

The placement of New Hampshire on the centralized end of the continuum is another confirmation that the measure succeeds. In truth, there is some disagreement as whether New Hampshire belongs in the consolidated governing board or coordinating board category as it has a University of New Hampshire system but also maintains a statutory coordinating board.

To aid in interpretation of the 1250 unknown measures in this analysis Figures 2-26 plot the states on the continuum by year. To enable comparisons between years, Figure 2 orders states from least centralized to most centralized, retaining this order through Figure 26 to highlight movement along the continuum.
Figure 2: Centralization, 1985

Figure 3: Centralization, 1986
Figure 6: Centralization, 1989

Figure 7: Centralization, 1990
Figure 8: Centralization, 1991

Figure 9: Centralization, 1992
Figure 10: Centralization, 1993

Figure 11: Centralization, 1994
Figure 14: Centralization, 1997

Figure 15: Centralization, 1998
Figure 18: Centralization, 2001

Figure 19: Centralization, 2002
Figure 20: Centralization, 2003

Figure 21: Centralization, 2004
Figure 22: Centralization, 2005

Figure 23: Centralization, 2006
Figure 24: Centralization, 2007

Figure 25: Centralization, 2008
From these figures, one immediately notices that states which completely restructured their system, moving across categories in the typology, have the most movement along the continuum. On the other hand, states that experienced governance reform, yet remained with a category of the typology experienced very little movement along the continuum. This finding, suggests that there are differences in the degree of governance reform. Though the literature provides evidence that the policy making process behind these reforms is fraught with political maneuvering, little research exists on the day-to-day differences for a state’s governance structure before and after the reform.

Interpretation of these spatial maps and an understanding of what they reveal about state governance are probably best achieved by contrasting it with the typology and the binary definition used by higher education researchers. Using the spatial map from 2009 (Figure 26) in
which the dummy variable coding of consolidated governing board equals one, all states from Michigan to New Hampshire are coded the same, which ranges on this measure from 9.13 to 31.66, a spatial distance of 22.53 points. Additionally, the spatial distance between New Hampshire and Maine is a mere 3.38 points, which is less than half of the spatial distance between Maine and Arizona (6.76) and almost seven times the spatial distance between New Hampshire and Michigan.

As an alternative to the spatial maps above, Figures 27 and 28 present chloropleth maps for the 48 continental U.S. states from 1985-2009. In these “heat maps,” darker areas indicate greater levels of centralization, which enables one to interpret the geo-spatial relationship in the “patchwork of centralization.”
Figure 27: Chloropleth maps of state centralization 1985-1996
Figure 28: Chloropleth maps of state centralization 1997-2009
Recall that Marcus (1997) suggested that states conform to the governance structures in their region. From figures 27 and 28, I find mild support for this hypothesis. The Western region is dominated by highly centralized structures, followed by a region of slightly less centralization in the Southeast. The Midwest has mostly moderate levels of centralization, and the Northeast tends towards decentralization. Confirming Marcus’ hypothesis, we observe a dramatic change in Nebraska from 1989 to 1990, seeing it adopt a level of centralization comparable to its neighbors.

Despite these broad generalities, several states are remarkably different from their regional neighbors. California’s relative decentralized structure is distinctive from other Western states. However, California has a distinctive economy, size, and postsecondary educational system.

Taken as a whole, the measure succeeds in placing the states along a continuum, though I hesitate to label this a “finding” in the traditional sense. What underscores the model’s success is the placement of many states on a continuum that reflects McGuinness’ parsing of the coordinating board category. While the model could easily be specified to include this in the prior information, it was incorporated because a) the elements used by McGuinness to differentiate between states in this category are indicators in the model and b) it serves as a check that the model has some success at differentiating beyond the informative priors.

Results from the predictive model

Beyond the measure itself, I test the hypotheses outlined in Chapter 3 on the dependent variable change in centralization. Due a lag in the National Center for Education statistics reporting the indicator used to derive the variable “Percent change in enrollment at public
institutions,” data were unavailable for the years 2008 and 2009. Also, because this model attempts to ascertain the factors influencing change, 1985, the first year of the measure, is removed from the analysis. As is typical of comparative state studies in the political science literature, because the state of Nebraska has a unicameral legislature, it was also removed from the analysis as it precludes the testing hypotheses associated with the partisan balance of these institutions. The final sample is 49 states over 22 years, with a total of 1078 state-year observations. The analysis of change in centralization uses three specifications: pooled, fixed-effects, and random effects regression. Table 10 presents the results from the pooled, fixed and random effects models.
Table 10: Results from the predictive models for change in centralization

<table>
<thead>
<tr>
<th>Model</th>
<th>Pooled</th>
<th>Fixed Effects</th>
<th>Random Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Republican take-over of state legislature</td>
<td>0.10</td>
<td>0.08</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td>[0.12]</td>
<td>[0.13]</td>
<td>[0.12]</td>
</tr>
<tr>
<td>Democratic take-over of state legislature</td>
<td>-0.05</td>
<td>-0.09</td>
<td>-0.06</td>
</tr>
<tr>
<td></td>
<td>[0.14]</td>
<td>[0.14]</td>
<td>[0.14]</td>
</tr>
<tr>
<td>Percent change in Republican legislators</td>
<td>-0.45**</td>
<td>-0.40*</td>
<td>-0.44**</td>
</tr>
<tr>
<td></td>
<td>[0.17]</td>
<td>[0.17]</td>
<td>[0.17]</td>
</tr>
<tr>
<td>Republican governor</td>
<td>0.39</td>
<td>0.59+</td>
<td>0.40</td>
</tr>
<tr>
<td></td>
<td>[0.29]</td>
<td>[0.32]</td>
<td>[0.29]</td>
</tr>
<tr>
<td>Governor's institutional powers</td>
<td>-0.01</td>
<td>-0.00</td>
<td>-0.01</td>
</tr>
<tr>
<td></td>
<td>[0.06]</td>
<td>[0.10]</td>
<td>[0.06]</td>
</tr>
<tr>
<td>Interaction of R governor &amp; Gov power</td>
<td>-0.13</td>
<td>-0.19*</td>
<td>-0.13+</td>
</tr>
<tr>
<td></td>
<td>[0.08]</td>
<td>[0.09]</td>
<td>[0.08]</td>
</tr>
<tr>
<td>Percent change in citizen ideology</td>
<td>0.17</td>
<td>0.17</td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td>[0.11]</td>
<td>[0.11]</td>
<td>[0.11]</td>
</tr>
<tr>
<td>Percent change in tuition</td>
<td>-0.13</td>
<td>-0.12</td>
<td>-0.13</td>
</tr>
<tr>
<td></td>
<td>[0.31]</td>
<td>[0.32]</td>
<td>[0.31]</td>
</tr>
<tr>
<td>Percent change in enrollment at public institutions</td>
<td>0.51</td>
<td>0.49</td>
<td>0.51</td>
</tr>
<tr>
<td></td>
<td>[0.63]</td>
<td>[0.65]</td>
<td>[0.63]</td>
</tr>
<tr>
<td>Percent change in state appropriations</td>
<td>0.71*</td>
<td>0.67*</td>
<td>0.71*</td>
</tr>
<tr>
<td></td>
<td>[0.33]</td>
<td>[0.33]</td>
<td>[0.33]</td>
</tr>
<tr>
<td>Out-migration</td>
<td>0.11</td>
<td>1.15+</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td>[0.18]</td>
<td>[0.66]</td>
<td>[0.19]</td>
</tr>
<tr>
<td>Percent change in GSP per capita</td>
<td>1.32*</td>
<td>1.45*</td>
<td>1.33*</td>
</tr>
<tr>
<td></td>
<td>[0.63]</td>
<td>[0.64]</td>
<td>[0.63]</td>
</tr>
<tr>
<td>Constant</td>
<td>0.02</td>
<td>-0.20</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>[0.20]</td>
<td>[0.38]</td>
<td>[0.21]</td>
</tr>
</tbody>
</table>

Observations 1078 1078 1078

Standard errors in brackets
+ significant at 10%; * significant at 5%; ** significant at 1%

Except for the positive finding for the influence of Out-migration in the fixed effects model, there is little substantive difference in the results between the models. Because of the lack of cross model confirmation for the effect of out-migration, I am hesitant to draw inference on the influence of out-migration and which will not be discussed. To adjudicate, between the fixed and random effect models, I first ran both a fixed-effects and random-effects model and ran a Hausman test to determine the preferred model. The Hausman produced a $\chi^2$ of 6.26,
probability $> \chi^2$ of 0.93. From this, I fail to reject the Null hypothesis that of differences in the coefficients, and prefer the more efficient random-effects model. The rest of the section will interpret the results of the random effects model, though as the three specifications are substantively similar, one would obtain comparable inference regardless of the model chosen for discussion.

The random effects model has a $\chi^2$ of 29.84 with a probability $> \chi^2 = 0.003$. In this model, several political and postsecondary environmental factors are found to predict states’ changes in centralization. The influence of “Percent change in Republican Legislators” is negative and statistically significant at the $p<.05$ level, providing support for Hypothesis 3. The finding suggests that, when Republicans are rapidly gaining control of a state’s legislature, it increases the probability that a state will decentralize its postsecondary governance system.

We may interpret the main effect of governor’s institutional powers as the effect of this variable for Democratic governors. However, because of the large standard error, I cannot draw inference towards the effect of Democratic governor’s institutional powers. Turning to the partial, Republican interpretation, as no governor has zero powers it is necessary to interpret the main effects and interaction term together. Though the effects themselves are not significant at the $p<.05$ level, a joint F-test produces a $\chi^2$ of 8.94, with a p-value of 0.03, indicating joint significance. Further, to investigate the Hypothesis 4, recall that the hypothesis is “States with powerful Republican governors will decentralize their postsecondary governance structure,” which indicates that the specific values for Governor’s institutional powers are essential to test the hypothesis.

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44 For further discussion of the interpretation of joint significance in regression models see Wooldridge (2006), Chapter 6.
Table 11 produces the influence of Republican governors at different levels of institutional powers and Figure 29 provides a graphical display of this effect. Note that Table 11 and Figure 29 use all hypothetical levels of power for the predictions, reflecting the 5 point scale Beyle uses across his various gubernatorial power rankings. For the years of the analysis, the variable Governor’s institutional powers ranges from 2 to 4.8 with a median of 3.6.

Table 11: Effect of Republican governor on change in centralization at different levels of gubernatorial power

<table>
<thead>
<tr>
<th>Level of Governor's power</th>
<th>Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.27</td>
</tr>
<tr>
<td></td>
<td>[0.21]</td>
</tr>
<tr>
<td>2</td>
<td>0.13</td>
</tr>
<tr>
<td></td>
<td>[0.13]</td>
</tr>
<tr>
<td>3</td>
<td>-0.00</td>
</tr>
<tr>
<td></td>
<td>[0.06]</td>
</tr>
<tr>
<td>4</td>
<td>-0.13*</td>
</tr>
<tr>
<td></td>
<td>[0.05]</td>
</tr>
<tr>
<td>5</td>
<td>-0.27*</td>
</tr>
<tr>
<td></td>
<td>[0.12]</td>
</tr>
</tbody>
</table>

+ significant at 10%; * significant at 5%; ** significant at 1%
The interaction effect becomes significant at the p<.05 level when a Republican governor has the institutional power rating of 3.6 and remains significant at this level through the extent of the measure. As Figure 29 demonstrates, when Republican governors have low power ratings, the partial effect of Republican governors on change in centralization is indistinguishable from zero. However, as institutional power increases, the effect becomes negative. This suggests that there is a partisan influence, but only governors with the requisite level of power are able to decentralize the postsecondary governance arrangement. This combined effect confirms Hypothesis 4 and underscores the complex influence of the executive branch on changes in postsecondary governance; in the state executive branch, partisanship is only part of the story. Whereas the model predicts that weak Republican governors would have no direct influence on change in centralization, it predicts that states with strong Republican governors will decentralize their postsecondary governance system, which is in accord with Republicans’ hypothesized policy preference.
To illustrate the effect of these political variables, I propose a hypothetical prediction for the year 1987. In this year Connecticut saw the percentage change in Republican legislators decrease by 43.37%, among the lowest in all years of the analysis. At the same time, it had a Democratic governor. To understand the influence of the political variables, I generate a prediction for Connecticut, replacing the variable for Percent change in Republican Legislators with 115%, that of Louisiana, the greatest value in 1987. Additionally, I include the gubernatorial indicators for Utah in 1987, which had a Republican governor with an institutional power ranking of 4.4. For this prediction, the rest of Connecticut’s 1987 values remain the same. The resulting prediction is a change in centralization of -0.58 with a p-value of p<0.067. While not significant at the p<.05 level, this prediction underscores how an extreme change in a state’s political landscape would likely lead to a change in a state’s postsecondary education system.

While it is unconventional to discuss findings that fail to reject the null hypothesis, as this specification draws from McLendon et al. (2007), one notable difference emerges. In their binary model for “any governance change” they found that instances of “legislative control change” to yield a 1115% change in the odds a state will experience governance reform, which was significant at the p<.0001 level. In contrast this profound evidence of the impact of legislative control change on governance change, my model found no support for either Republican or Democratic take-over of state legislature. I propose two explanations for these contrasting findings. First, as opposed to McLendon et al., my dependent variable is specified as movement along the continuum rather than a binary indicator for change. Changes that my model observes as nominal do not carry the same influence as large, expansive changes, where in their model specification all governance change is equal. Second, instead of simply legislative

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45 The value 1115% was computed be using their reported exp(β) (12.15) and using the equation that a % change in the odds Y=1 is 100[exp(β)-1].
take-over, I specify two variables that account for partisan captures of state legislatures. It may be that it is simply and legislative take-over leading to any change rather than a partisan centered specifications. To synthesize their findings and mine, it may be that in any proposed change in postsecondary governance, this core test of the political instability hypothesis is supported. However, when accounting for direction and degree of change, the variance in the dependent variable is different and the influence of legislative control change becomes muted. I do not see these findings as mutually exclusive, which is a matter that will be discussed in the Chapter 6.

Turning from the political variables to postsecondary environment, unlike the studies which find overwhelming support for the political nature of governance change, I also find support for the influence of one of the measures of states’ postsecondary environment: the percent change in state appropriations. Here, the annual percent change in state appropriations is found to have a positive influence on change in centralization, significant at the p<.05 level. Increasing appropriations increases the probability that a state will centralize its system. A potential explanation is that increased support for postsecondary education compels systems and policymakers towards increased coordination and structure in response to the fiscal investment.

That is, as a state’s investment in postsecondary education is increasing, it may compel policymakers to centralize the structure in an effort to manage these increasing costs.

State wealth was also found to influence the probability that a state will centralize, with a $\beta$ of 1.33 and significant at the p<.05 level. While the interpretation of appropriations suggests the need for greater coordination and management, increasing state wealth may suggest a state has the means to enhance coordination or, if state wealth is decreasing, that decentralization may be viewed as a method of cost control. To have a centralized system typically requires a certain degree of investment in a bureaucratic structure, which in turn is more expensive than having
little central management. Thus, states whose wealth is increasing may, *ceteris paribus*, be able to centralize their structure in the hopes of gaining long-term efficiencies. This effect is only part of the interpretation, where the counter interpretation may be more compelling. States with decreasing wealth will decentralize their governance system. Decentralization not only carries with it the policy rationale of New Public Management, but also the tangible cost savings of a smaller staff and less bureaucracy. This raises the question as to whether the cost savings of decentralization is through system wide efficiency or from the direct savings of a smaller structure.

Interpreting the models as a whole creates an interesting picture of state governance change, finding support for both the rational and irrational explanations of policymaking. The partisan indicators overwhelmingly demonstrate that Republicans favor decentralization. While the effect of Democratic governors was indistinguishable from zero, the absence of their influence may be attributable to the time period in the study which saw increasing Republican influence in state politics. Beyond this partisan influence, there is partial support for the rationale and rhetoric that typically accompanies governance reform. The influence of increasing appropriations suggests that as state investment in higher education increases, an accompanying managerial structure of greater centralization and coordination emerges. Additionally, the belief that decentralization may ameliorate extant state financial issues also finds support.
CHAPTER 6

CONCLUSION

The final chapter will begin by reviewing the measurement model, the primary purpose of the study. Following this, the limitations of the model are discussed. Following, I will discuss the implications for theory and research. I extend this beyond the implications that stem from the particular results of this model, also proposing the implications that the Bayesian approach to analysis and measurement will have on the field of higher education and social science in general. Next I outline the potential policy implications of this study, followed by the limitations of the study. This chapter then concludes with a brief summary of the more explicit contributions to the study of state postsecondary governance.

Review of the study

This study was motivated by the dissonance stemming from researchers’ description of a continuum of centralization and their instrumental use of the long standing typology when studying state-level postsecondary governance. While the contributions of studies using the typology cannot be overstated, the lack of alignment between theory and the typology makes an understanding of state governance structures’ effectiveness and influence on policy outcomes muddled. As Chapter 2 showed, the field of higher education’s interest in state-level policy has waxed and waned over the decades, with the most recent decade experiencing an outpouring of studies at the state level. Still, it is striking that, despite the many theoretical and methodological
advancements since Paltridge’s seminal work, there has been no systematic, longitudinal rethinking of state postsecondary governance.

To rectify this problem and place states on a continuum of centralization this study employed a latent variable model. Despite this, I recognized that over time, the work of researchers, consultants, and policymakers has made great contributions to the understanding of state postsecondary governance and, to utilize any statistical model that does not incorporate this information would be to lose the most valuable information on these structures. As a result, this study was driven both conceptually and technically by a Bayesian approach to data analysis. Through this paradigm, the measurement model allowed for the explicit incorporation of 71 pieces of state-level qualitative information. 50 of these came from a single source – McGuinness’ 1985 *State Postsecondary Education Structures Handbook*, the predominant source that the field uses to identify the governance arrangement of states, information that the random walk prior perpetuated through the temporal portion of the analysis. The other 20 pieces of existing research and policy briefs that I systematically introduced through truncation points and new priors came from case studies, surveys, policy organizations, and McLendon et al.’s 2007 study of governance reform. While not a statistical test, the model succeeded in placing states on a continuum, with many placements confirming what one would expect. I then illustrated the utility of the measurement through a predictive model using change in centralization as a dependent variable, using many of the theoretical rationales from McLendon et al.’s 2007 article to “re-test the political instability hypothesis.” By moving from a dichotomous variable indicating any change to a continuous measure, I showed how the measure

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46 While arguably the identification of “no governance change” is also information that was introduced into the model, the 19 mentioned pieces are: AGB (2010a, 2010b); ECS (2010); Leslie and Berdahl (2008), Leslie and Novak (2003); Marcus (1997); McGuinness (1988, 1994, 1995, 1997, 2001, 2003); McLendon (2003a, 2003b, 2003c); McLendon et al. (2007); McLendon and Hearn (2009); McLendon and Ness (2003); Mills (2007); Richardson et al. (1999); and Van Der Silk (2001).
allowed for the testing of more nuanced hypotheses and, through its ability to account for the
degree of change, yield new insight into the factors that not only drive change, but what kind of
change. The following section will outline the practical implications for future comparative
state-level studies, but will also discuss the important theoretical implications that extend beyond
this topical area, arguing that the approach used in this research has implications for the very act
of doing research, be it quantitative or qualitative, state-level or student-level, and so forth.

Implications for theory and research

The continuous measure for the level of centralization of state postsecondary governance
structures has theoretical implications for the comparative state postsecondary research, the study
of policy adoption and impact, as well as organizational studies writ large. In a larger sense, the
use of Bayesian statistics has theoretical implications for the way in which social scientists
approach and understand the process of doing research.

While it is the predominant characterization of state postsecondary governance,
centralization is one of many possible dimensions that researchers may use to distinguish
between states’ postsecondary systems. Measurement, as a research end in itself, is an
underused tool in the higher education policy literature, which typically favors reliable secondary
data, or simplified, non-parametric indicators to test complex, elaborate hypotheses. While for
some research questions these approaches may be appropriate, to better understand the more
abstract and less easily identifiable theories and constructs necessitates more complex
techniques. In the past two decades, the fields of political science and public policy – fields from
which the comparative state higher education literature has traditionally heavily drawn – have
gravitated towards the use of these complex measures, ironically often borrowing techniques
from the sub-field of educational testing. For political science, elusive concepts such as ideology and democracy are among the core issues of the field and in recent years have experienced an outpouring of new research. Some have adapted these research questions for higher education (e.g. Doyle, 2010), yet this research utilizes the same techniques and research questions with a slant towards higher education. Where the field stumbles is in adapting these measurement techniques for measurements that are measures that are the providence of postsecondary education researchers. That is, as we begin to understand the techniques, it provides an opportunity to generate the measures that test theories that come from the higher education field. For example, researchers almost exclusively test Slaughter and Rhoades (2004) theory of academic capitalism through qualitative approaches; there is no measure for academic capitalism. However, one could theoretically utilize the techniques from this study to generate just such a measure, leveraging the existing qualitative work. If we are to refine and correct our theories, should we not attempt to test them in a myriad of rigorous ways?

While at first measurement may seem like a means to end - simply a method for generating an indicator for future empirical testing - I believe that frontier techniques like the Bayesian latent variable model of this study lie squarely between the empiricism of parametric statistics and theory. If part of the power of theory is its fecundity, we must recognize that, as theories become more complex, they are in danger of shifting towards the inductive reasoning of the humanities and away from the deductive, predictive centered, reasoning of the physical sciences. While this mode of theory building proves useful, it may lead to methodological silos. Though this tension will continue to persist in the social sciences, it is my belief that measurement can provide some unity between the two. Specifically, the Bayesian use of priors, conditioned on data places the prior theory and observations in a model and then conditions it on
data. This is opposed to both the frequentist approach that does not incorporate previous probability beliefs into modeling and the qualitative theory testing approaches that limit themselves to a handful of cases. This methodological unification is underscored by this study’s blurring of the conventional sections of research papers. Chapter 2 detailed the literature concerning governance structures, with the specific citations given in the References section. In some form or another, 25 of the listed references are reflected in probability statements in the code in Appendix A. The further epistemological implications of this are discussed at the end of this section.

This research also raises a theoretical question for the future study of policy: Are policies latent variables? As mentioned, postsecondary state governance structures are discussed as an attribute of states, yet at the same time, change in these structures is generally discussed as a change in policy. This duality provides one with the opportunity to see how the latter affects the former. That is, how does discreet change in a policy alter the underlying characteristic of a state’s postsecondary governance structure? While relatively intuitive in this case, I argue that most, if not all, policies may be thought of as continuous. To illustrate this example, one needs to look no further than the frequently studied case of state-level, broad based merit aid programs. Numerous studies look at the impact of or factors affecting the adoption of state merit aid policies (e.g. Doyle, 2006). Despite its prominence in the literature, there is disagreement on which states have a policy, ranging from as few as 9 to as many as 21, with peer reviewed articles indicating a total of 24 different states as having a merit-aid program (Delaney and Ness, forthcoming). To address this confusion within the literature, Delaney and Ness (forthcoming) constructed a typology of merit-aid programs, identifying three characteristics that may aid in discriminating between the programs: program characteristics, magnitude, and rigor. In
constructing the typology, they found significant heterogeneity across these programs, yet using a typology only leverages a small portion of the information regarding these programs. For example, for the indicator “Merit-Only Expenditures per Undergraduate,” the authors report that Arkansas’ expenditures for academic year 2007-2008 was $0.13 while Georgia’s expenditures per undergraduate was over 10,000 times greater ($1,346.59). In this extreme case, Arkansas’ $11,000 in total expenditures is much closer to zero than to Georgia’s $354,076,000, yet over a third of the reported studies mark them as merit aid states. For Delaney and Ness’ dimension of rigor, the amount of variance is just as great. For example, Indiana requires High School graduation with “college courses” and eligibility for free/reduced price lunch, requirements which are much less stringent requirements than Mississippi’s 3.5 GPA and 29 or more on the ACT. To further underscore the heterogeneity, I argue that even the federal Pell Grant program is, technically speaking, merit-aid. If one can hypothetically enroll at a 2-year institution without a Graduate Equivalency Degree, yet not receive a Pell Grant, it is merit-aid by definition. In light of this, it would be illogical to assume that the factors influencing the adoptions of all of these policies could be the same, yet, when state-level policy adoption is studied, the variables are discrete, binary indicators. Due to its frequent study, identifying the potential continuous nature of broad based merit aid is relatively easier than with other policies, yet future research may wish to approach the study of policy adoption and impact through this lens.

Beyond the study of policy, this research has theoretical implications for the study of higher education organization and governance. By measuring state governance centralization, I show that one can leverage statistical techniques to measure the purported differences in organizations. Typically, organizational theory in postsecondary education does not become operationalized in a manner that leads to parametric, empirical testing. That is, scholars of
organization and governance, at best, rely on typologies and, more frequently, give elaborate
theories of organization that are not immediately falsifiable. However, I have demonstrated that
centralization is an organizational concept that is measurable. If one is to name and list
characteristics that distinguish organizations, they can be measured and then incorporated in to
statistical modeling. Further, the Bayesian approach enables researchers to incorporate prior
beliefs, regardless if they come through existing research or intuition. Through the ability to
measure organizational constructs, this branch of the literature will be able to refine its theories
towards a better understanding of the concepts of interest.

Within the study of higher education, we use multiple categories like control and sector
to describe institutions but, traditionally governance, in the form of the McGuinness typology, is
the only state level higher education organizational characteristic used in statistical models.
However, at the state level, centralization is but one attribute researchers use to characterize the
postsecondary landscape. For example, absent from this model are indicators describing states’
orientations to the market. Do market indicators contribute to our understanding of
centralization or do they describe a different dimension of state governance? I believe that
states’ higher education landscape is multifaceted, with centralization and orientation to the
market only two of many potential dimensions.

Turning from the more abstract implications to those on future research on postsecondary
governance, state-level higher education researchers have a new tool with which new and
existing hypotheses are testable. The predictive model illustrated how a more refined measure
may reveal new findings related to governance reform; being able to account for the degree and
direction of governance reform revealed that it was not politics alone, but politics,
appropriations, and state wealth that predicted reform. Beyond its use a dependent variable, with
the increased precision, future researchers may test more complex specifications of governance’s influence on the areas of policy adoption and state appropriations. Further, by unpacking the dimension of governance centralization, a more pointed assessment of this exact construct can be tested and more direct interpretations made. That is, a positive finding for consolidated governing boards is simply that, a finding of the influence of these governance structures; it is only a proxy for centralization. With the refinement, the influence of centralization would be more apparent.

Beyond the simple refinement, a continuous measure allows individuals to incorporate more complex interactions both with other variables and with polynomial terms for centralization. For example, a researcher may believe that for certain policies, high levels of both decentralization and centralization increase the probability that a state adopt a policy. Others may suggest the probability of adoption does not increase linearly with centralization. In these situations, the inclusion of polynomial terms can test these hypotheses, taking advantage of the need to no longer use a dichotomous indicator.

Other utilizations may include the testing of the interaction of centralization with other state-level factors. One can envision a scenario in which gubernatorial power and state centralization interact to create favorable conditions for the adoption or non-adoption of postsecondary policies. In the current state of the art, the meaning of an interaction with a dummy variable for consolidated boards is less clear.

Qualitative state postsecondary researchers may also find utility from the measure. In the selection of case study sites, the continuous measure may provide more aid in sample selection than the existing typology. For example, if one wishes to include a heterogeneous sample of governance, then the spatial maps inform this sampling mechanism, allowing one to stratify not
only across board types, but within types as well. On the contrary, if qualitative researchers wish to observe some additional state level phenomenon and hold governance constant, they may sample states that are clustered together on the continuum.

Beyond these substantive and theoretical research implications, the study also attempts to make a methodological contribution to the study of higher education through the use of Bayesian statistics with informed priors. While recent uses of multi-level modeling software has exposed some researchers, unknowing or not, to estimation through empirical Bayesian methods, these studies lack the flexibility and expansion that one may implement through programs that use Gibbs sampling and enable the researcher to employ a broad class of prior specifications.

Beyond the technical use of Bayesian estimation, the study sought to challenge the false belief in a methodological dichotomy that dominates the field. If one is takes the espoused epistemological arguments of the two “conflicting” methodological approaches, one can see that through the application of Bayes’ rule researchers can incorporate both simultaneously. In truth, the measurement portion of this study has as much in common with qualitative research as with classical statistical approaches. In truth, many view the act of doing any research, qualitative or quantitative, as inherently Bayesian in the metaphorical sense. In reference to qualitative case studies, McKeown (2004) notes:

The selection of cases for investigation is guided by the researcher’s beliefs regarding the prior probability of a given explanation being correct in a certain kind of setting, coupled with that researcher’s assessments of being wrong in that assessment. A “hard case” for a theory… then would be one where the prior probability of a theory being a correct explanation is low, but the degree of confidence in that prior assessment is also low. A “crucial case” would be one where the prior probability is an intermediate value, such that either a confirmation or a disconfirmation will produce a relatively large difference between the prior and posterior probabilities. One might also select a case in which the expected cost of being wrong was low and then proceed to more demanding tests only if the initial results were encouraging. (McKeown, 2004, p.159).
While I stop short at saying the qualitative researchers are Markov-chains exploring the posterior that is the combination of their mind and social science data, from an epistemological standpoint, the similarities are striking.\footnote{For an example of the application of McKeown’s “Folk Bayesianism” in the higher education literature, see Lane, 2007.}

**Implications for policy**

In creating the measure, I made explicit decisions with the hope that it will find utility not only for postsecondary researchers, but for policymakers as well. The scale was designed so that all states would approximately fall in the 0 to 50 range, generating values that contain whole numbers which should have greater meaning for policymakers. As a researcher, I believe that a scale ranging from -1 to 1 logically makes more sense, though I believe that psychologically distinguishing between decimal places poses greater difficulty than whole numbers. With Appendix A, one can anchor the scale to his or her personal preferences, however, I advocate for a unified measure for researchers and policymakers alike, however, drawing from the success of the National Center for Public Policy and Higher Education’s “Measuring Up: The National Report Card on Higher Education,” I believe that measures that are easy to communicate will have the most impact.

The issue of centralization and decentralization is of paramount importance to policymakers and state officials, evidenced by the amount of writing done by state higher education executive officers and members of national associations on this very issue (e.g. MacTaggart, 1996, 1998). This new measure may aid policymakers in better understanding their board’s orientation, as well as enable national (e.g. ECS, AGB, SHEEO) and regional (e.g. SREB, WICHE) associations to better understand how governance is manifested in their member
states. Acknowledging one’s “nearest neighbors” on the continuum of centralization may enable states to better assess their governance structures, aid in development of new agendas, and so forth.

The issue of centralization and decentralization is as salient as ever. In “More than management: Guidelines for state higher education system governing boards and their chief executives,” Elbert Fretwell, a former chancellor of the University of North Carolina system states “Issues of centralization vs. decentralization continue to need clarification” (Fretwell, 2001, p.3). As recently as in 2010, the Association of Governing Boards released its action report, indicating that the tension between these two organizational principals is currently “playing out in several states,” again indicating that state officials view both as the vehicle for efficiency and cost control (AGB, 2010).

**Study limitations**

There is an adage in quantitative, social science research that goes, “All models are wrong, but some are useful.”

48 With that, I acknowledge that this measure of centralization is far from perfect – the uncertainty around the estimates demonstrates this – though many may find this measure more useful than a dummy variable for consolidated governing board, a measure for which one would expect far greater uncertainty. For the sake of comparison, Figure 30 plots this dummy variable along the continuum, with circles indicating consolidated governing board and squares other, non-consolidated governing board states.

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48 Some have attributed this quote to Box and Draper, 1987.
While throughout this study I have discussed at some length the limitation of the typology, I focused on its limitations as a measure for centralization. Beyond the latent variable of centralization, the typology may better proxy other constructs of governance than the continuum of centralization. For example, alternative interpretations of findings for a dummy variable for consolidated governing board may be their increased analytical capacity and, as the “fourth branch of government,” the ability to buffer public postsecondary institutions from the political process. If these are important hypotheses for researchers, then greater utility may be found with the use of the typology.\textsuperscript{49} Similar to these limitations, this measure does not reflect the totality of state governance. As outlined in the section discussing the implications for theory

\textsuperscript{49} Despite this, I would argue that these are latent variables in their own right and likely suffer from the same issues as using the typology as a measure of centralization. For example, while consolidated governing boards may buffer institutions from political pressures, one might hypothesize that this may be less so in states where the governor has greater appointment powers over the executive officer and board.
and research, centralization is but one of countless dimensions which one might use to describe state postsecondary governance. The latent variable in this study is also only one potential measure of “centralization.” Because of the typical limitations and ambiguities of language when confronted with this term, others may think not of the structural components used by this analysis, but other forms of centralization. In two separate, unpublished works, Deaton (2006) and Warne (2008) both studied states’ adoptions of “tuition decentralization” policies, policies that alter the locus of tuition-setting authority in a given system. While the terms centralization and decentralization are used, these policies are markedly different from a state-level structural measure, incorporating both the previously mentioned market measure and a conception of centralization as a multi-level construct. In the latter idea, centralization becomes not only a measure of degree, but at what level (institutional, sector, state) a state’s postsecondary governance authority rests. In light of this, future work may wish to account for not only the multi-dimensional nature of governance, but its multi-level characteristics as well.

Turning toward the technical limitations, I revisit the limitations briefly touched upon in Chapter 4. The study identifies 19 indicators that relate to the latent variable of centralization. While these are the only powers and authorities I was able to identify throughout the 25 years of the study, these do not represent the totality of qualitative indicators that researchers might use to adjudicate between the levels of centralization of boards. While the most obvious missing factors are those Berdahl called de facto, collection of these in for all 50 states across 25 years would prove difficult, if not impossible. Beyond this, there are likely other identifiable indicators that others would identify as missing, suggestions I welcome. Despite this, recall that the model is used to differentiate between boards and the addition of another factor or two would
be unlikely to dramatically alter the placement on the continuum as much as it would shrink the variance.

Another limitation of the measure is the *ad hoc* manner in which I specified the priors. In his work, McGuiness never described a scale or the intervals between different classes of the typology, forcing me to choose from an infinite number of ranges. For example, it may be that coordinating boards are not precisely in the middle of the continuum, equidistant from planning agencies and consolidated governing boards. Additionally, the variance of the priors was chosen from among numerous possibilities. While a criticism may be that the variance was too small, the alternative would be an operationalization of complete doubt of the history of state-level postsecondary research. In an effort to address this I included Appendix A in this dissertation which enables anyone with a rudimentary knowledge of object-oriented programming to reconfigure the measure.

Because the measure is subjective, I wish to allow any user to specify priors for each state and include other qualitative knowledge into the model. As the use of informative priors is limited by the imagination of the researcher and available resources, there are more elegant ways that one could use this approach to leverage information concerning state governance structures. While this study utilized the familiar and convenient McGuiness typology, I fully acknowledge many individuals have extensive historical knowledge of state postsecondary governance, knowledge that could serve to improve any attempt to measure the centralization of governance. To create an improved prior, one might first identify postsecondary governance “experts” and ask them to give their rating of states’ levels of centralization on a given continuum. These measures could then be averaged for each state, and the means and standard deviations used for more refined prior specifications. Future researchers should consider the

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50 The data are available upon request and were not included for reasons of space.
potential that the inclusion of these “elicited expert priors” could contribute to measurement models. Of course, similar efforts could be made for prior specifications in any studies using Bayesian data analysis.

**Summary of the contributions of the study**

In closing, I wish to highlight the substantive, methodological, and theoretical contributions this study makes to the field of higher education. Substantively, this analysis provides an alternative measure for state postsecondary governance structures, mending the gap between researchers’ use of the typology of planning agency, coordinating board, and governing board and their identification of an underlying continuum of centralization. Despite the utility many researchers and policymakers have found in using typology, future studies using this new, refined measure may better explicate the complex role state governance structures play in postsecondary educational policy. With this indicator, future researchers may uncover novel findings for existing questions and test alternative, dynamic hypotheses for these structures’ effects on state-level outcomes. Likewise, policymakers may benefit from a measure that offers a characterization of state postsecondary governance more useful to planning and evaluation and better informing them regarding how states relate to one another in the larger national landscape.

Methodologically, this study’s use of Bayesian data analysis is also a contribution to the field. Though the recent postsecondary literature has seen the emergence of a handful of papers using this statistical approach, as of yet, none utilize informed priors from the qualitative literature. As this study demonstrates, researchers using Bayesian data analysis can systematically incorporate more information into quantitative modeling, thus obtaining greater leverage over the totality of available data. Beyond the use of informed priors, a Bayesian
approach allows for the estimation of statistical models previously considered intractable to quantitative researchers. Just as this analysis is analytically impossible with classical statistical approaches, there are questions in the field beget by theory that are analytically difficult with traditional approaches.

This study’s theoretical contributions stem directly from its results and methodological advances. By moving governance from a typology to a latent variable, this study results in a theory of postsecondary governance. That is, it argues that a continuum of centralization exists and is a product of identifiable components. As a result, it raises questions as to how one might measure other theories that could characterize governance, pointing toward a method for their analysis. Emanating from the literature’s use of governance as an attribute of states and governance change as a policy, this study leads to questions regarding the nature of the study of policies. While the policy adoption literature uses qualitative, dichotomous or polychotomous indicators, one may conceive of many policies as latent variables. Though there may not be as numerous elements for many policies as there are for the construct of governance centralization, policies’ impacts and origins can only be better understood through paying mind to this perspective. Lastly, as previously discussed in this chapter, Bayesian data analysis raises epistemological questions for both quantitative and qualitative social science researchers; one can apply a Bayesian approach to problems where the data are quantitative, qualitative, or both. Though arguments for methodological unity are normative in nature, across many social science fields there exists a fissure along methodological grounds which may contribute to the isolation of otherwise likeminded researchers. Though attempts to mend similar issues in other fields (e.g. King et al., 1994; Gill and Walker, 2005) are, at best, still works in progress, acknowledging similarities in systematic approaches can do no harm.
Concluding, one needs to ask the question: “With this additional measure, do we now know more about state postsecondary governance than before?” Because the typology was explicitly incorporated into the continuous measure of centralization, states cluster around the categories of planning agency, coordinating board, and consolidated governing board. However, as discussed in Chapter 5, the spatial distance along the continuum of some states is closer to those that populate a different governance type. Further, examining within-category differences reveals the nature of the variation between states. The results from the predictive model examined here are just one of many possible uses of the measure. That it both confirms existing findings and yields new insights is indicative of this measure’s utility for future studies. To directly answer the question, it remains to be seen how much a continuous measure of centralization will contribute to new insights regarding the workings of state postsecondary education. As the existing literature suggests that governance “matters” in state-level postsecondary educational policy, it is my hope that researchers interested in this phenomenon will draw from the substantive, methodological, or theoretical contributions of this study in understanding these structures’ influences.
REFERENCES


APPENDIX: BUGS CODE TO RUN THE MEASUREMENT MODEL

model{
  for (i in 1:N){
    for (j in 1:yr){
      y1[i,j] ~ dbern(p.bound1[i,j])
      p.bound1[i,j] <- max(0.0001, min(0.9999999, mu1[i,j]))
      logit(mu1[i,j]) <- b[1]*x[i,j]
      y2[i,j] ~ dbern(p.bound2[i,j])
      p.bound2[i,j] <- max(0.0001, min(0.9999999, mu2[i,j]))
      logit(mu2[i,j]) <- b[2]*x[i,j]
      y3[i,j] ~ dbern(p.bound3[i,j])
      p.bound3[i,j] <- max(0.0001, min(0.9999999, mu3[i,j]))
      logit(mu3[i,j]) <- b[3]*x[i,j]
      y4[i,j] ~ dbern(p.bound4[i,j])
      p.bound4[i,j] <- max(0.0001, min(0.9999999, mu4[i,j]))
      logit(mu4[i,j]) <- b[4]*x[i,j]
      y5[i,j] ~ dbern(p.bound5[i,j])
      p.bound5[i,j] <- max(0.0001, min(0.9999999, mu5[i,j]))
      logit(mu5[i,j]) <- b[5]*x[i,j]
      y6[i,j] ~ dbern(p.bound6[i,j])
      p.bound6[i,j] <- max(0.0001, min(0.9999999, mu6[i,j]))
      logit(mu6[i,j]) <- b[6]*x[i,j]
      y7[i,j] ~ dbern(p.bound7[i,j])
      p.bound7[i,j] <- max(0.0001, min(0.9999999, mu7[i,j]))
      logit(mu7[i,j]) <- b[7]*x[i,j]
      y8[i,j] ~ dbern(p.bound8[i,j])
      p.bound8[i,j] <- max(0.0001, min(0.9999999, mu8[i,j]))
      logit(mu8[i,j]) <- b[8]*x[i,j]
      y9[i,j] ~ dbern(p.bound9[i,j])
      p.bound9[i,j] <- max(0.0001, min(0.9999999, mu9[i,j]))
      logit(mu9[i,j]) <- b[9]*x[i,j]
      y10[i,j] ~ dbern(p.bound10[i,j])
      p.bound10[i,j] <- max(0.0001, min(0.9999999, mu10[i,j]))
      logit(mu10[i,j]) <- b[10]*x[i,j]
      y11[i,j] ~ dbern(p.bound11[i,j])
      p.bound11[i,j] <- max(0.0001, min(0.9999999, mu11[i,j]))
      logit(mu11[i,j]) <- b[11]*x[i,j]
      y12[i,j] ~ dbern(p.bound12[i,j])
      p.bound12[i,j] <- max(0.0001, min(0.9999999, mu12[i,j]))
      logit(mu12[i,j]) <- b[12]*x[i,j]
      y13[i,j] ~ dbern(p.bound13[i,j])
      p.bound13[i,j] <- max(0.0001, min(0.9999999, mu13[i,j]))
    }
  }
}
logit(mu13[i,j]) <- b[13]*x[i,j]
y14[i,j] ~ dbern(p.bound14[i,j])
p.bound14[i,j] <- max(0.0001, min(0.9999999, mu14[i,j]))
logit(mu14[i,j]) <- b[14]*x[i,j]
y15[i,j] ~ dbern(p.bound15[i,j])
p.bound15[i,j] <- max(0.0001, min(0.9999999, mu15[i,j]))
logit(mu15[i,j]) <- b[15]*x[i,j]
y16[i,j] ~ dbern(p.bound16[i,j])
p.bound16[i,j] <- max(0.0001, min(0.9999999, mu16[i,j]))
logit(mu16[i,j]) <- b[16]*x[i,j]
y17[i,j] ~ dbern(p.bound17[i,j])
p.bound17[i,j] <- max(0.0001, min(0.9999999, mu17[i,j]))
logit(mu17[i,j]) <- b[17]*x[i,j]
y18[i,j] ~ dbern(p.bound18[i,j])
p.bound18[i,j] <- max(0.0001, min(0.9999999, mu18[i,j]))
logit(mu18[i,j]) <- b[18]*x[i,j]
y19[i,j] ~ dnorm(mu19[i,j], tau[1, j])
mu19[i,j] <- b[19]*x[i,j]
}
}
x[1,1] ~ dnorm(40, tau.a)  #AK
x[2,1] ~ dnorm(25, tau.b)  #AL
x[3,1] ~ dnorm(25, tau.b)  #AR
x[4,1] ~ dnorm(40, tau.a)  #AZ
x[5,1] ~ dnorm(25, tau.b)  #CA
x[6,1] ~ dnorm(25, tau.b)  #CO
x[7,1] ~ dnorm(25, tau.b)  #CT
x[8,1] ~ dnorm(10, tau.a)  #DE
x[9,1] ~ dnorm(40, tau.a)  #FL
x[10,1] ~ dnorm(40, tau.a) #GA
x[11,1] ~ dnorm(40, tau.a) #HI
x[12,1] ~ dnorm(40, tau.a) #IA
x[13,1] ~ dnorm(40, tau.a) #ID
x[14,1] ~ dnorm(25, tau.b) #IL
x[15,1] ~ dnorm(25, tau.b) #IN
x[16,1] ~ dnorm(40, tau.a) #KS
x[17,1] ~ dnorm(25, tau.b) #KY
x[18,1] ~ dnorm(25, tau.b) #LA
x[19,1] ~ dnorm(40, tau.a) #MA
x[20,1] ~ dnorm(25, tau.b) #MD
x[21,1] ~ dnorm(40, tau.a) #ME
x[22,1] ~ dnorm(10, tau.a) #MI
x[23,1] ~ dnorm(25, tau.b) #MN
x[24,1] ~ dnorm(25, tau.b) #MO
x[25,1] ~ dnorm(40, tau.a) #MS
x[26,1] ~ dnorm(40, tau.a) #MT
x[27,1] ~ dnorm(40, tau.a) #NC
x[28,1]~dnorm(40,tau.a)  #ND
x[29,1]~dnorm(10,tau.a)  #NE
x[30,1]~dnorm(25,tau.b)  #NH
x[31,1]~dnorm(25,tau.b)  #NJ
x[32,1]~dnorm(25,tau.b)  #NM
x[33,1]~dnorm(40,tau.a)  #NV
x[34,1]~dnorm(25,tau.b)  #NY
x[35,1]~dnorm(25,tau.b)  #OH
x[36,1]~dnorm(25,tau.b)  #OK
x[37,1]~dnorm(40,tau.a)  #OR
x[38,1]~dnorm(25,tau.b)  #PA
x[39,1]~dnorm(40,tau.a)  #RI
x[40,1]~dnorm(25,tau.b)  #SC
x[41,1]~dnorm(40,tau.a)  #SD
x[42,1]~dnorm(25,tau.b)  #TN
x[43,1]~dnorm(25,tau.b)  #TX
x[44,1]~dnorm(40,tau.a)  #UT
x[45,1]~dnorm(25,tau.b)  #VA
x[46,1]~dnorm(10,tau.a)  #VT
x[47,1]~dnorm(25,tau.b)  #WA
x[48,1]~dnorm(40,tau.a)  #WI
x[49,1]~dnorm(40,tau.a)  #WV
x[50,1]~dnorm(40,tau.a)  #WY

tau.a<-pow(sigma.a,-2)
sigma.a<-(15/1.96)
tau.b<-pow(sigma.b, -2)
sigma.b<-(25/1.96)

for (i in 1:N){
  for (j in 2:2){
    x[i,j]~dnorm(x[i, j-1],3.0)
  }
}

for (i in 1:42){
  for (j in 3:3){
    x[i,j]~dnorm(x[i, j-1],3.0)
  }
}

for (i in 43:43){
  for (j in 3:3){
    x[i, j]~dnorm(x[i, j-1],3.0)I(tx.87[i,j-1],)
  }
}

for (i in 44:50){
  for (j in 3:3){
    x[i,j]~dnorm(x[i, j-1],3.0)
  }
}
for (i in 1:19) {
  for (j in 4:4) {
    x[i, j] ~ dnorm(x[i, j-1], 3.0)
  }
}

for (i in 20:20) {
  for (j in 4:4) {
    x[i, j] ~ dnorm(x[i, j-1], 3.0) I(md.88[i, j-1],)
  }
}

for (i in 21:50) {
  for (j in 4:4) {
    x[i, j] ~ dnorm(x[i, j-1], 3.0)
  }
}

for (i in 1:1) {
  for (j in 5:5) {
    x[i, j] ~ dnorm(x[i, j-1], 3.0) I(ak.89[i, j-1],)
  }
}

for (i in 2:48) {
  for (j in 5:5) {
    x[i, j] ~ dnorm(x[i, j-1], 3.0)
  }
}

for (i in 49:49) {
  for (j in 5:5) {
    x[i, j] ~ dnorm(x[i, j-1], 3.0) I(wv.89[i, j-1])
  }
}

for (i in 50:50) {
  for (j in 5:5) {
    x[i, j] ~ dnorm(x[i, j-1], 3.0)
  }
}

for (i in 1:27) {
  for (j in 6:6) {
    x[i, j] ~ dnorm(x[i, j-1], 3.0)
  }
}

for (i in 28:28) {
  for (j in 6:6) {
    x[i, j] ~ dnorm(x[i, j-1], 3.0) I(nd.90[i, j-1],)
  }
}
for (i in 29:29){
for (j in 6:6){
x[i, j]~dnorm(25, sigma.b) #NE, now a CB
}
}
for (i in 30:50){
for (j in 6:6){
x[i, j]~dnorm(x[i, j-1], 3.0)
}
}
for (i in 1:18){
for (j in 7:7){
x[i, j]~dnorm(x[i, j-1], 3.0)
}
}
for (i in 19:19){
for (j in 7:7){
x[i, j]~dnorm(25, sigma.b) #MA, now a CB
}
}
for (i in 20:22){
for (j in 7:7){
x[i, j]~dnorm(x[i, j-1], 3.0)
}
}
for (i in 23:23){
for (j in 7:7){
x[i, j]~dnorm(x[i, j-1], 3.0)I(mn.91[i, j-1],)
}
}
for (i in 24:50){
for (j in 7:7){
x[i, j]~dnorm(x[i, j-1], 3.0)
}
}
for (i in 1:19){
for (j in 8:8){
x[i, j]~dnorm(x[i, j-1], 3.0)
}
}
for (i in 20:20){
for (j in 8:8){
x[i, j]~dnorm(x[i, j-1], 3.0)I(md.92[i, j-1],)
}
}
for (i in 21:50){
for (j in 8:8){

}
x[i,j]~dnorm(x[i, j-1],3.0)
}
}

for (i in 1:3){
for (j in 9:9){
  x[i,j]~dnorm(x[i, j-1],3.0)
}
}

for (i in 4:4){
for (j in 9:9){
  x[i, j]~dnorm(x[i, j-1],3.0)I(,az.93[i,j-1])
}
}

for (i in 5:50){
for (j in 9:9){
  x[i,j]~dnorm(x[i, j-1],3.0)
}
}

for (i in 1:25){
for (j in 10:10){
  x[i,j]~dnorm(x[i, j-1],3.0)
}
}

for (i in 26:26){
for (j in 10:10){
  x[i, j]~dnorm(x[i, j-1],3.0)I(mt.94[i,j-1],)
}
}

for (i in 27:30){
for (j in 10:10){
  x[i,j]~dnorm(x[i, j-1],3.0)
}
}

for (i in 31:31){
for (j in 10:10){
  x[i, j]~dnorm(x[i, j-1],3.0)I(,nj.94[i,j-1])
}
}

for (i in 32:50){
for (j in 10:10){
  x[i,j]~dnorm(x[i, j-1],3.0)
}
}

for (i in 1:13){
for (j in 11:11){
  x[i,j]~dnorm(x[i, j-1],3.0)
}
}
for (i in 14:14) {
  for (j in 11:11) {
    x[i, j]~dnorm(x[i, j-1], 3.0)I(, il.95[i, j-1])
  }
}

for (i in 15:50) {
  for (j in 11:11) {
    x[i, j]~dnorm(x[i, j-1], 3.0)
  }
}

for (i in 1:N) {
  for (j in 12:12) {
    x[i, j]~dnorm(x[i, j-1], 3.0)
  }
}

for (i in 1:2) {
  for (j in 13:13) {
    x[i, j]~dnorm(x[i, j-1], 3.0)
  }
}

for (i in 3:3) {
  for (j in 13:13) {
    x[i, j]~dnorm(x[i, j-1], 3.0)I(, ar.97[i, j-1])
  }
}

for (i in 4:16) {
  for (j in 13:13) {
    x[i, j]~dnorm(x[i, j-1], 3.0)
  }
}

for (i in 17:17) {
  for (j in 13:13) {
    x[i, j]~dnorm(x[i, j-1], 3.0)I(, ky.97[i, j-1])
  }
}

for (i in 18:20) {
  for (j in 13:13) {
    x[i, j]~dnorm(x[i, j-1], 3.0)
  }
}

for (i in 21:21) {
  for (j in 13:13) {
    x[i, j]~dnorm(x[i, j-1], 3.0)I(me.97[i, j-1],)
  }
}

for (i in 22:50) {
for (j in 13:13) {
    x[i,j]~dnorm(x[i, j-1], 3.0)
}
for (i in 1:10) {
    for (j in 14:14) {
        x[i,j]~dnorm(x[i, j-1], 3.0)
    }
}
for (i in 11:11) {
    for (j in 14:14) {
        x[i, j]~dnorm(x[i, j-1], 3.0) I(, hi.98[i,j-1])
    }
}
for (i in 12:50) {
    for (j in 14:14) {
        x[i,j]~dnorm(x[i, j-1], 3.0)
    }
}
for (i in 1:15) {
    for (j in 15:15) {
        x[i,j]~dnorm(x[i, j-1], 3.0)
    }
}
for (i in 16:16) {
    for (j in 15:15) {
        x[i, j]~dnorm(x[i, j-1], 3.0) I(ks.99[i,j-1],)
    }
}
for (i in 17:50) {
    for (j in 15:15) {
        x[i,j]~dnorm(x[i, j-1], 3.0)
    }
}
for (i in 1:8) {
    for (j in 16:16) {
        x[i,j]~dnorm(x[i, j-1], 3.0)
    }
}
for (i in 9:9) {
    for (j in 16:16) {
        x[i, j]~dnorm(30, sigma.b) # FL, superboard
    }
}
for (i in 10:48) {
    for (j in 16:16) {
        x[i,j]~dnorm(x[i, j-1], 3.0)
for (i in 49:49)
for (j in 16:16)
  x[i, j]~dnorm(30, tau.b) #WV, Now a CB

for (i in 50:50)
for (j in 16:16)
  x[i,j]~dnorm(x[i, j-1],3.0)

for (i in 1:50)
for (j in 17:17)
  x[i,j]~dnorm(x[i, j-1],3.0)

for (i in 1:20)
for (j in 18:18)
  x[i,j]~dnorm(x[i, j-1],3.0)

for (i in 21:21)
for (j in 18:18)
  x[i, j]~dnorm(x[i, j-1],3.0)I(me.02[i,j-1],)

for (i in 22:50)
for (j in 18:18)
  x[i,j]~dnorm(x[i, j-1],3.0)

for (i in 1:5)
for (j in 19:19)
  x[i,j]~dnorm(x[i, j-1],3.0)

for (i in 6:6)
for (j in 19:19)
  x[i, j]~dnorm(x[i, j-1],3.0)I(co.03[i,j-1],)

for (i in 7:50)
for (j in 19:19)
  x[i,j]~dnorm(x[i, j-1],3.0)
for (i in 1:50) {
    for (j in 20:20) {
        x[i, j]~dnorm(x[i, j-1], 3.0)
    }
}
for (i in 1:44) {
    for (j in 21:21) {
        x[i, j]~dnorm(x[i, j-1], 3.0)
    }
}
for (i in 45:45) {
    for (j in 21:21) {
        x[i, j]~dnorm(x[i, j-1], 3.0) I(, va.05[i, j-1])
    }
}
for (i in 46:50) {
    for (j in 21:21) {
        x[i, j]~dnorm(x[i, j-1], 3.0)
    }
}
for (i in 1:50) {
    for (j in 22:23) {
        x[i, j]~dnorm(x[i, j-1], 3.0)
    }
}
for (i in 1:18) {
    for (j in 24:24) {
        x[i, j]~dnorm(x[i, j-1], 3.0)
    }
}
for (i in 19:19) {
    for (j in 24:24) {
        x[i, j]~dnorm(30, tau.b) #MA, another superboard
    }
}
for (i in 20:50) {
    for (j in 24:24) {
        x[i, j]~dnorm(x[i, j-1], 3.0)
    }
}
for (i in 1:20) {
    for (j in 25:25) {
        x[i, j]~dnorm(x[i, j-1], 3.0)
    }
}
for (i in 21:21) {
    for (j in 25:25) {
x[i, j]~dnorm(x[i, j-1], 3.0)I(oh.09[i, j-1],)
}
}
for (i in 22:50){
for (j in 25:25){
  x[i, j]~dnorm(x[i, j-1], 3.0)
}
}
### Truncation points
for (i in 1:50){
for (j in 1:25){
  tx.87[i, j]<-x[i, j]-2
  md.88[i, j]<-x[i, j]-2
  ak.89[i, j]<-x[i, j]-2
  wv.89[i, j]<-x[i, j]+2
  nd.90[i, j]<-x[i, j]-2
  mn.91[i, j]<-x[i, j]-2
  md.92[i, j]<-x[i, j]-2
  az.93[i, j]<-x[i, j]+2
  mt.94[i, j]<-x[i, j]-2
  nj.94[i, j]<-x[i, j]+2
  il.95[i, j]<-x[i, j]+2
  ar.97[i, j]<-x[i, j]+2
  ky.97[i, j]<-x[i, j]+2
  me.97[i, j]<-x[i, j]-2
  hi.98[i, j]<-x[i, j]+2
  ks.99[i, j]<-x[i, j]-2
  me.02[i, j]<-x[i, j]-2
  co.03[i, j]<-x[i, j]+2
  va.05[i, j]<-x[i, j]+2
  oh.09[i, j]<-x[i, j]+2
}
}
### Parameter priors
for (i in 1:2){
  b[i]~dgamma(3, 3)
}
for (i in 3:18){
  b[i]~dgamma(1, 1)
}
for (i in 19:19){
  b[i]~dgamma(3, 3)
}
for (i in 1:1){
  for (j in 1:yr){
    tau[i, j]~dgamma(1, 1))}}})