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# Environmental governance for whom? Examining the political, institutional, fiscal, and legal determinants of state environmental agency budget policy in the US

Andrew R. Duggan

# ENVIRONMENTAL GOVERNANCE FOR WHOM? EXAMINING THE POLITICAL, INSTITUTIONAL, FISCAL, AND LEGAL DETERMINANTS OF STATE ENVIRONMENTAL AGENCY BUDGET POLICY IN THE US

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University

by

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**List of Abbreviations**

BEA – Bureau of Economic Analysis
CAA – Clean Air Act
CO – Carbon Monoxide
$CO_2$ – Carbon Dioxide
DOE – Department of Energy
ECOS – Environmental Council of the States
EIA – Energy Information Administration
FE – Fixed-Effects
FHWA – Federal Highways Administration
GCC – Global Climate Change
GDP – Gross Domestic Product
GHGs – Greenhouse Gases
GSP – Gross State Product
IPCC – Intergovernmental Panel on Climate Change
LCV – League of Conservation Voters
Ln – Natural Log
OLS – Ordinary Least Squares
NAAQs – National Ambient Air Quality Standards
NASA – National Aeronautics and Space Administration
NCSL – National Conference of State Legislatures
$NO_x$ – Nitrogen Oxides
$O_3$ – Ozone
Pb – Lead
PM – Particulate Matter
PCA – Principle Components Analysis
RE – Random-Effects
RGGI – Regional Greenhouse Gas Initiative
$SO_x$ – Sulfur Oxides
SIP – State Implementation Plan
SPI – State Personal Income
TTR – Total Taxable Resources
USEPA – United States Environmental Protection Agency
USDHS – United States Department of Homeland Security

**Abstract**

ENVIRONMENTAL GOVERNANCE FOR WHOM? EXAMINING THE POLITICAL, INSTITUTIONAL, FISCAL, AND LEGAL DETERMINANTS OF STATE ENVIRONMENTAL AGENCY BUDGET POLICY IN THE US

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Budgets are a prospective tool of governance, and appropriations are a planning vehicle reflecting: bureaucracies' values, complex interactions, collective preferences, political influences, and available resources. Research spanning 30 years finds that environmental pollution is a key determinant of environmental budgets in the US, though myriad factors, actors, and subsystems are important to consider. Due to federalism and devolution of responsibilities and authorities, environmental governance falls largely to the states. While the dynamics that shape state environmental budget policy have received scholarly interest, theoretically-driven examinations of environmental appropriations remain limited within the public budgeting and environmental policy literature.

Using panel data from 2010 to 2015, this dissertation examines the legal, political, institutional, and fiscal factors that influence state own-source environmental funding drawing from several theories. Given the key relationship between environmental pollution and environmental budgets—as stressed by previous scholarship—findings reveal the effects are conditioned on business interests from polluting sectors.  While the interaction effect holds across funding sources, the negative budgetary influence depends on the type of air pollution modeled.  Fiscal capacity is found to increase appropriations from state general funds but not appropriations from fees and other sources.  Mandatory climate policies have a positive influence on budgets, though the evidence is inconsistent between models.  Given cuts to federal environmental funding, flat trends in state funding, what factors influence the financing of environmental protection are of critical importance for civil society, practitioners, and public officials; therefore, this dissertation concludes with policy implications and avenues for future research.

# Chapter 1: Introduction

## 1.1. Background and Purpose

State environmental agencies play a substantial role in US environmental governance—tasked with environmental protection responsibilities and faced with challenging budgetary conditions (Environmental Council of the States [ECOS], 2010; 2017a; 2018; Rabe, 2007; Scheberle, 1997; Smith, Corvalán, & Kjellström, 1999). Setting agency appropriations involves contextual factors, elected officials, public agency managers, interest groups, and the public at large, each of whom "have marked preferences about what government should and should not spend money on" (Rubin, 2010, p. 183). This dissertation examines those budgetary determinants posited to influence appropriations to environmental agencies across the states. Despite over 40 years of research into myriad predictors of governments' fiscal commitment to environmental protection, considerable gaps remain in state-level environmental public budgeting analysis hindering understanding of this complex public policy output (Aidt, 1998; Bacot & Dawes, 1996; Balint & Conant, 2013; Clark & Whitford, 2011; Lester & Bowman, 1989; Lowry, 1992; Newmark & Witko, 2007; Sacco & Leduc, 1969). As the spending instrument for environmental decision-making, state environmental budgets offer a portal into the contemporary health of environmental governance in the US—a governance that seeks to reconnect with citizens during the formulation, implementation, and evaluation of environmental policy through configurations of institutions, organizations, and laws (Durant, 2017; Kettl, 2000; Lee, Johnson, & Joyce, 2013).

This study rests on a normative ideal—that increasing appropriations in response to pollution problems ought to be a core principle of environmental governance—however aspirational that may be in practice. Rooted in this perspective and drawing from several theoretical traditions, I will investigate whether state environmental agency budget policy *is*: responsive to environmental pollution; inured to business interests in polluting sectors *and* political partisanship; and positively influenced by: civic environmentalism, climate policies, fiscal capacity, and professionalism across state legislatures. Despite mounting environmental problems, underfunding of environmental protection in the US is not a new phenomenon. Historically, environmental agency budgets have failed to keep pace with expanded responsibilities and ever-increasing state-level expectations particularly with respect to air quality (Scheberle, 1997; Woods & Potoski, 2010). Examining the linkages between budgetary determinants and appropriations is salient given environmental budget reductions such as those proposed by the Trump administration while environmental protection responsibilities continue to accrue on state governments (Congressional Research Service, 2019; ECOS, 2012).

Air pollution is the cause of nearly seven million deaths per year worldwide and is forecasted to increase due to proliferating megacities and further expansion of industrialization (Wang et al., 2016). In the US alone, emissions from a single *criteria air pollutant*—particulate matter—account for over 100,000 to 200,000 premature deaths each year (Caiazzo, Ashok, Waitz, Yim, & Barrett, 2013; Goodkind, Tessum, Coggins, Hill, & Marshall, 2019). Basu and Devaraj (2014) noted citizens are particularly "proactive about cleaning up the air they breathe" (p. 936) and air quality policy—in one form or another—has remained a fixture for governments and civil society (Chen, Shofer, Gokhale, & Kuschner, 2007).

Air quality policy in the US involves a multitude of functions—(e.g. standard setting, monitoring, compliance and enforcement) (Rosenbaum, 2017), and of the environmental agency programs—(e.g. waste, water, remediation)—states play an outsized role in carrying out the requirements of the Clean Air Act. Thus, the focal independent variables of this dissertation are from criteria air pollution—comprised of pollutants that provided the impetus for the Clean Air Act and greenhouse gas emissions, namely of carbon dioxide ($CO_2$), that contribute to global climate change (Intergovernmental Panel on Climate Change, 2018; Ringquist, 1993).

This dissertation asks two questions:

**Research Question 1:** Does the influence of air pollution on state environmental appropriations vary according to the magnitude of polluting business interests?

**Research Question 2:** What are the effects of political, institutional, fiscal, and legal factors on state own-source appropriations to state environmental agencies and do the effects vary based on the funding source or air pollutant type?

How this dissertation addresses each research question involves both theory *and* methodology. Pertaining to theory, despite previous contributions of environmental budgets and spending—(e.g. Agthe, Billings, & Marchand, 1996; Clark & Whitford, 2011; Davis & Feiock, 1992; Stanton & Whitehead, 1994)—much of the literature to-date has been atheoretical, and this gap in the academic literature is addressed in two ways. *First*, I apply a theoretical framework to summarize factors that explain state environmental policy from a broad perspective (Schneider, 2006). *Second*, three individual theories are drawn upon to depict and establish the logical associations between the independent variables—(i.e. budgetary determinants)—and agency appropriations—(i.e. budgetary outputs)—in the *empirical* models (Jaccard & Turrisi, 2003; Konisky & Woods, 2012; Lester, 1995). Pertaining to methodology, I will examine the interaction of business interests and two types of air pollution on environmental agency budgets *and* the direct effects between the remaining political, institutional, fiscal, and legal factors on two separate sources of state own-source appropriations. Thus, the empirical analysis will employ multiple methodological approaches to further extend this strand of public budgeting and environmental policy scholarship.

The remainder of this chapter is structured as follows. First, I provide a summary of the theoretical framework and theories *and* how they are specifically applied. Second, the conceptual model *and* research design and methodology is introduced followed by key variables and hypotheses. To add context and underscore the importance of this study, historical state environmental budget trends and performance lapses are reviewed along with the terms and state agencies examined. Lastly, several contributions are then summarized.

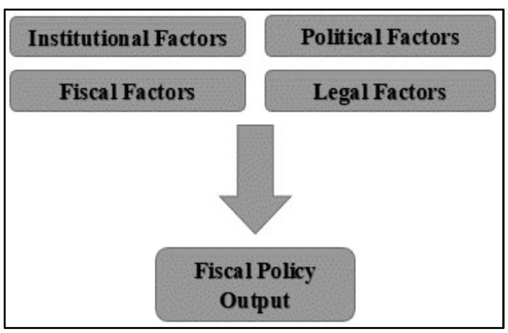
**1.2. Theoretical Foundations**

The *integrated theory of state policymaking*—(*integrated theory*)—is drawn upon to provide thematic coherence to the conceptual model by summarizing and isolating factors that influence state environmental public policy (Ringquist, 1994). The *integrated theory* is rooted in three traditional theories of public policymaking: the *economic* model—socioeconomic factors are the primary drivers of state policy outputs; the *political* model—political variables drive state policymaking; and the *group influence* model—industrial groups or pluralist competition among groups drive state policymaking. These original three sets of factors do not place emphasis on budgetary outcomes, thus required a minor digression to emphasize characteristics anticipated to be explanatory of *fiscal* policy outputs vice *programmatic* outputs—with the latter being Ringquist's original focus. Other differences in my framework include an emphasis on legal factors; focus on air quality; and inclusion of a political factor represented by partisan ideology.

Synthesizing the *integrated theory* with literature from the public budgeting and environmental policy literature results in a framework with the four sets of factors depicted in Figure 1. As shown in Figure 1, the following conditions influence budgetary decision-making based on the logic of representative governance: *political*—(e.g. citizen and partisan involvement and performance); *institutional*—(e.g. professionalization); *fiscal*—(e.g. fiscal health); and *legal*—(e.g. regulations and policies) (Bland, 2007; Lester & Lombard, 1990; Mikesell, 2018; Stanton & Whitehead, 1994). Characteristics within these preceding contexts are viewed as determinants to budget policy—offering a perspective differing from budget policy analysis perceived through a stochastic lens (Rubin, 1989) given the latter's limited utility in explicating public budgeting behavior (Smith & Bertozzi, 1998; Willoughby & Finn, 1996).

Figure 1.

*Theoretical Framework of Dissertation*




*Note.* Inspired by Ringquist (1994)

While the *integrated theory* serves as the framework, the three theories drawn upon to further specify the conceptual and empirical models include: *technocracy theory*, *rational self-interest theory,* and *ecological citizenship theory*. *First,* technocracy theory underscores a prominent function of environmental agency personnel in informing appropriations requests given their role in measuring, monitoring, and characterizing the magnitude and extent of pollution (Gunnel, 1982). The theory explicates the motivation of technocratic personnel to be responsive to environmental pollutants given a heritage in US public administration that values technical competence and instrumental rationality over partisan political influence and lobbying pressures from particularized—(e.g. business)—interests (Goodsell, 2014; Wilson, 1989).

Technocracy theory focuses this analysis on the norms and values of contemporary regulatory environmental governance in the US—particularly how they are shaped by *technical rationality* applied to help translate "political issues into technically defined ends that can be pursued through administrative means" (Fischer & Forester, 1993, p. 22). Though characterized as either a bureaupathology (Adams & Balfour, 2014; Arendt, 1971; Thompson, 1961), or a prerequisite necessary to achieve a "utopian social vision" (Goodsell, 2015; Gunnell, 1982, p. 392; Taylor, 1967), technical rationality serves a prominent role in US bureaucracies. I posit that environmental agencies function as technocracies attuned to environmental metrics, such as air pollution. While critiques of scientific rationality in the context of environmental pollution are covered elsewhere—(e.g. Beck, 1992; Steinemann, 2000)—a responsive bureaucracy applies technical rationality to ensure fiscal resources requested are commensurate with pollution problems. Technocracy theory informs the decision, for example, to evaluate the role of *environmental pollution*—and *climate policies*—as expected legal factors and budgetary determinants.

*Second*, firm-level expenditures for environmental regulatory compliance are made by businesses, particularly in the polluting industrial sectors—(e.g. utilities, manufacturing, and mining) (Anderson, 2011; Falke, 2011). Closely related to group theory (Dahl, 1961), rational self-interest theory (Olson, 1965) suggests that over time these "regulatory cost bearers" are cognizant of regulatory actions that impact their business operations and expenditures (Ringquist, 1993, p. 27). In response, polluting business interests act to reduce environmental agency budgets through the political process, or more directly, by lobbying against specific regulations that would create additional firm-level costs, particularly at the state level (Cline, 2003; Williams & Matheny, 1984).

Following Olson's (1969) theoretical perspective, rational self-interest theory explains why business interests have influence in the public policy process. In a study of environmental policy which drew on rational self-interest theory, Lyons (1999) found the "balance of group power will be relatively favorable to resource users and to industry" (p. 281). This association is attributable to the political self-interest of elected public officials to respond favorably to specific business group constituencies who are themselves acting rationally by applying political pressure. Rational self-interest theory is useful in explaining why the relationship between environmental pollution and environmental appropriations may be conditional upon *business interests* among the states. Since the interaction of business interests and pollution on appropriations is a central focus of this dissertation, greater detail will be provided on this theory, and how it informs the hypothesized relationships, in the sections that follow.

*Lastly*, ecological citizenship theory (Dobson, 2007) informs the linkage between citizen involvement through political participation—(i.e. civic environmentalism); inclusion of $CO_2$ emissions, and consideration of climate policies which require funding to implement (Abel & Stephan, 2000). Ecological citizenship theory derives from the political science field and explains political activity through civic duties related to the environment that are incumbent upon individuals to achieve social equity (Jagers, Martinsson, & Matti, 2016). Ecological citizenship theory includes an expansive spatial extent for environmental awareness and responsibility; it suggests that pro-environmental behavior is influenced not only by pollutants that are more spatially-delimited—(e.g. ground-level ozone, particulate matter)—but also global—(e.g. greenhouse gases)—in order to promote the common good (Dobson, 2007). This feature of the theory supports the decision to include multiple indicators taking into account not only pollutants typically associated with more local and regional effects—(e.g. criteria air pollutants)—but also those categories of pollution that have profound impacts on the global community as well—$CO_2$ emissions. Ecological citizenship theory informs also the decision to evaluate civic environmentalism *and* climate policies as budgetary determinants.

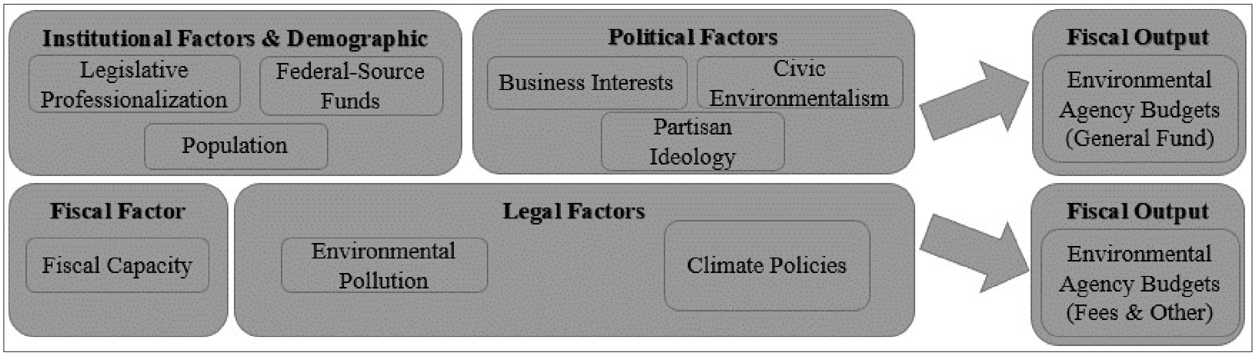
**1.3. Conceptual Model**

The conceptual model in Figure 2 is consistent with previous perspectives of budget models (Bland, 2007; Mikesell, 2018; Schick, 1966) that recognize "states operate within political, economic, fiscal, and organizational contexts that, in turn, influence…[the] budget management exhibited" (Willoughby, 2008, p. 432). The conceptual model that follows includes the following independent variables:

- environmental pollution;
- business interests (of polluting sectors);
- civic environmentalism;
- climate policies;
- partisan ideology;
- legislative professionalization;
- fiscal capacity;
- federal-source funds; and
- population.

Figure 2.

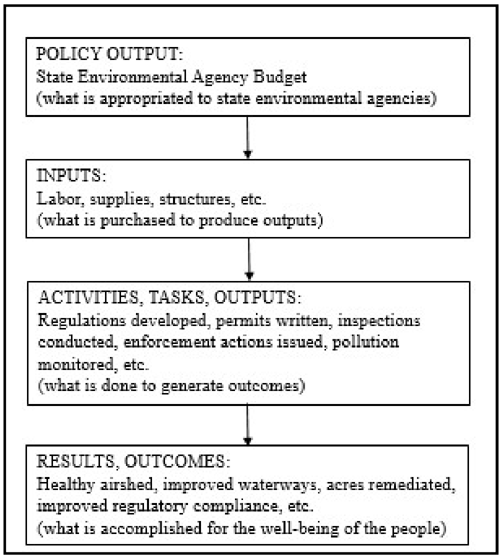
*Conceptual Model of Dissertation*




As depicted in the model, the dissertation conceptualizes annual appropriations to state environmental agencies as *policy outputs*, thus the empirical focus is on the policy attribute exogenous to the policy *outcome* following a policy stages heuristic (Lasswell, 1956; Lee et al., 2013). That is, this dissertation is *not* a study about environmental policy outcomes, agency performance, or the innovation and effectiveness of environmental bureaucracies or pollution control programs in the US—all topics addressed in previous scholarship and certain to garner on-going attention (Grant, Bergstrand, & Running, 2014; Heckman, 2012; Ringquist & Clark, 2002; Sapat, 2004; Woods, Konisky, & Bowman, 2008). Instead, the dependent variables consist of *environmental agency budget policy*. This financial measure is drawn from the environmental policy and public budgeting literature and reflect what bureaucracies plan to do, or not do, based on past and current conditions. Figure 3 represents the provision of government services that reflects a policy stages heuristic specific to this dissertation.

Figure 3.

*Provision of Government Services*




*Note.* Adapted from Mikesell (2018).

Though the linear diagram in Figure 3 represents a reality that is, in practice, more iterative and complex, it is offered at the outset to situate and convey the public policy *output* focus of this study.

**1.4. Research Design and Methodology**

This study uses a quantitative non-experimental research design to provide an exploratory empirical analysis of secondary data. The hypotheses—provided below—are derived from the theoretical foundations—that is, this study uses a deductive rather than an inductive approach. As noted above, the analysis will include exploring the differential influence of criteria pollutant emissions and $CO_2$ emissions on environmental budgets. More specifically, while both air pollutant types are hypothesized to increase environmental appropriations, their influence could be unequal given the more recent regulation of $CO_2$ emissions relative to those of criteria pollutants, and this will be empirically tested. Additionally, the *first* dependent, or budgetary outcome variable, is appropriations derived from fees and other sources—(e.g. permitting and compliance user charges)—while the *second* consists of states' general funds. Despite these two components of state-level environmental appropriations, research attention has remained focused on either federal, or total state agency appropriations *or* on combined natural resource *and* environmental spending representing a gap in the scholarship.

From a methodological perspective, the conceptual model provided in Figure 2 is analyzed, as detailed in Chapter 4, using a panel—(i.e. longitudinal)—structure with data for the nine variables—listed in the previous section—from 2010 to 2014, and those data are lagged one year and matched with state environmental agency appropriations from 2011 to 2015. This methodological approach assesses the effects of factors in a given year on the environmental agency budget policy in the subsequent year for a national sample of states. The analysis plan and research design includes econometric models specified by the environmental agency budget dependent variables and budgetary determinant independent variables in Table 1.

Table 1.

*Study Variables*

| Name | Conceptualization | Type of Variable |
|---|---|---|
| Environmental (Air) Pollution | Emissions to the ambient atmosphere from pollutants known to have local, regional, and global impacts (i.e. emissions of criteria pollutants and greenhouse gases—$CO_2$). | Legal |
| Business Interests | Prevalence of business collectivities (i.e. pressure groups / pressure participants) within the state as represented by major polluting sectors of the states' economies. | Political |
| Civic Environmentalism | Construct that represents environmentally-focused concerns of the polis expressed by environmental constituencies and subconstituencies through electoral preferences. | Political |
| Climate Policies | Represents the extent to which states have implemented mandatory policies to mitigate $CO_2$ emissions. | Legal |
| Partisan Ideology | The ideology of a state legislature based on partisan identification as reflected by the major political parties' relative control over state government. | Political |
| Legislative Professionalization | Concept that represents the institutional capacity of the state legislature. | Institutional |
| Fiscal Capacity | The capacity of a state to raise revenue to pay for governmental programs that implement public policies. | Fiscal |
| ***Dependent Variables*** | | |
| Environmental Agency Budget-Fees & Other | State Source Budgeted Funding (Fees & Other)-Fiscal Year 2011 through Fiscal Year 2015 | Fiscal |
| Environmental Agency Budget-General Fund | State Source Budgeted Funding (General Fund)-Fiscal Year 2011 through Fiscal Year 2015 | Fiscal |

Table 1 indicates also into what set of factors the variable fits within the conceptual model provided above in Figure 2. While the classification of the majority of variables is intuitive, environmental pollution is viewed as a *legal* factor given that regulations and applicable legal requirements underpin air pollution abatement policy in the US. The US Code, specifically set forth within *40 C.F.R. 64, Protection of the Environment*, contains a multitude of legal requirements regulating the operating, monitoring, recordkeeping, reporting, notification, and testing of facilities that emit air pollutants.

Numerous studies indicate that state population *and* the flow of intergovernmental revenue sources (e.g. federal-source funding) can influence agency appropriations (e.g. Bacot & Dawes, 1996; Clark & Whitford, 2011; Gamkhar & Oates, 1996). Thus, these two additional *control* variables—population and federal-source funding—are included within the models. The two research questions and six hypotheses are provided in Table 2 as a prelude to Chapter 2 which reviews the supporting academic literature.

Table 2

*Research Questions and Hypotheses*

| Research Questions | Hypotheses |
|---|---|
| Does the influence of air pollution on state environmental appropriations vary according to the magnitude of polluting business interests? | **H1:** Air pollution severity will increase environmental agency budgets, if levels of polluting business interests of states are sufficiently low. |
| What are the effects of political, institutional, fiscal, and legal factors on state own-source appropriations to state environmental agencies and do the effects vary based on the funding source or air pollutant type? | **H2:** Civic environmentalism will have a positive influence on environmental agency budgets.<br>**H3:** Mandatory climate policies will have a positive influence on environmental agency budgets.<br>**H4:** Legislative professionalization will have a positive influence on environmental agency budgets.<br>**H5:** Liberal ideology will have a positive influence on environmental agency budgets.<br>**H6:** State fiscal capacity will have a positive influence on environmental agency budgets. |

Additional design and methodological details regarding limitations of this design for assessing causality as well as interpretation of coefficients; assessing heteroscedasticity; and serial—(i.e. autocorrelation)—are discussed within the statistical analysis plan in Chapter 3.

### 1.5. State Environmental Budget Trends and Proportions

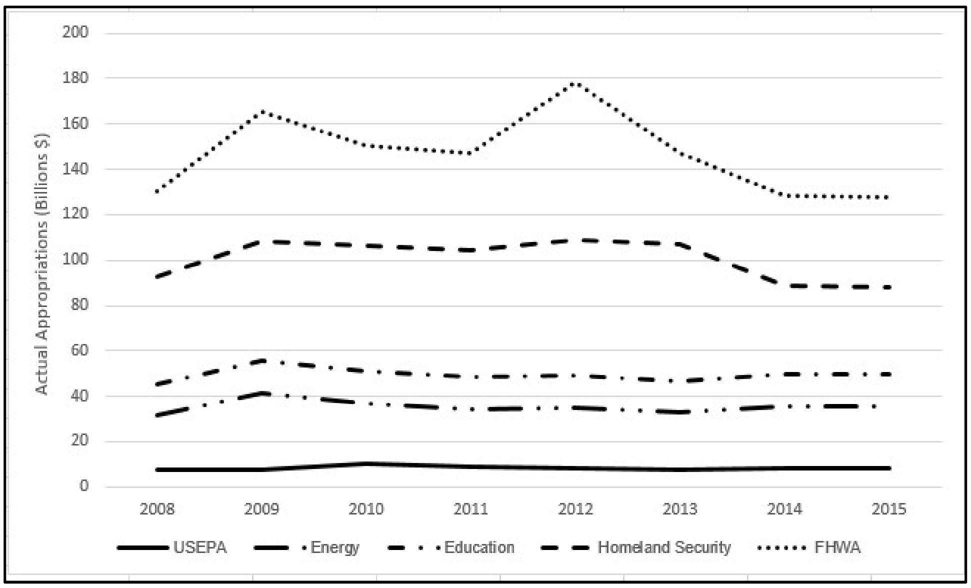
Enhanced knowledge of environmental agency budgets can help public managers, and researchers, ascertain to what extent this policy output is: a "mechanism for setting goals and objectives" (Lee et al., 2013, p. 3); "responsive to the citizenry" (Mikesell, 2018, p. 45); or reflects public policymaking ideals (Nice, 2002). While the preceding excerpts lay-out commonly held views from the public budgeting literature, they all give rise to a fundamental question. Is it logical to propose agency administrators, legislators, and chief executives consider environmental pollution, business interests, and climate policies, for example, when legitimating appropriations bills? To the extent that agency budget cost estimation involves attention to fulfilling a functional and coherent plan to address current and future environmental challenges, the answer ought to be a resounding *yes*! Normatively, elected, and unelected public officials, observe the conditions including the perceived needs of their clientele; determine the intentions and required resources to deliver on those needs; and estimate the costs to supply what is believed to be necessary to meet organizational objectives (Mikesell, 2018).

Despite the potential benefits of sufficiently-funded environmental agencies, state environmental budgets in the US have not kept pace with the challenges—not unlike budgetary trends besetting international environmental organizations and institutions (Axelrod & VanDeveer, 2017). Therefore, importance for this study derives from the view that fiscal resources for environmental agencies in the US have long been inadequate (Lowry, 1992). Securing sufficient environmental budgets in competitive budgetary environments is a challenge particularly when considering the drastic cuts that beleaguer these agencies (Rabe, 2007) and for which the current federal executive branch administration has perennially proposed drastic cuts and historic reductions (LaRoss, 2017; Office of Management and Budget, 2018; 2019; 2020).

Underscoring these challenges are the negligible proportions of total state expenditures dedicated to environmental protection. For example, in 2015, environmental spending as a percent of the entire state budget hovered around 0.5% for Michigan and Virginia (Michigan, 2015; Virginia Department of Planning and Budget, 2015). A similar picture emerges at the federal-level. The following figure displays the enacted budget appropriations of USEPA; Department of Energy (DOE); Department of Education; the Department of Homeland Security (USDHS); and the Federal Highways Administration (FHWA) to illustrate the USEPA budgets between 2008 and 2015 relative to other federal agencies and departments.

Figure 4.

*Budget Trends in Federal Agencies and Departments, 2008 - 2015*



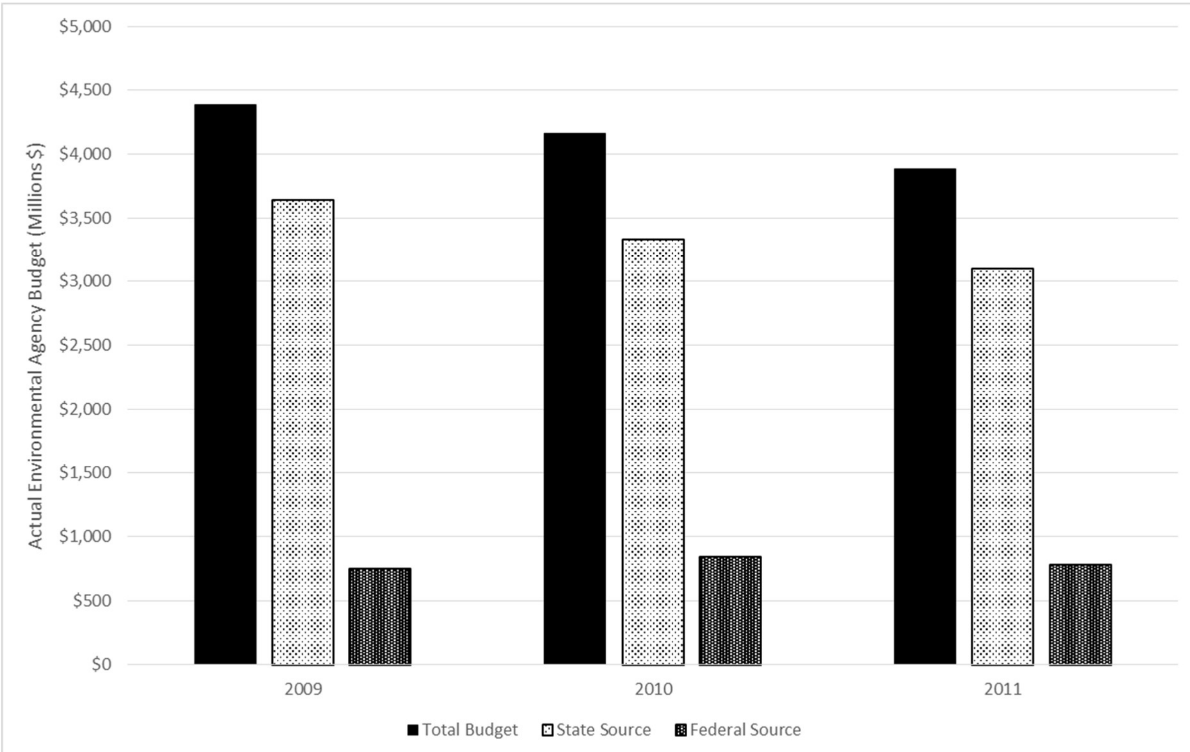

*Note.* Compiled by author from FHWA (2009, 2010, 2011, 2012, 2013, 2014, 2015); USDHS (2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016); U.S. Department of Education (2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015); USDOE (2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017); & USEPA (2017).

The USEPA budgets depicted in Figure 4 are consistent with changes to the USEPA workforce resulting from an "EPA operating budget [that] was not much higher in the early years of the twenty-first century than it was in the 1980s" (Durant, 2017, p. 358). An analysis of environmental budget data collected from the mid-2000s reveal that short-term trends in both federal and state-source funding to state environmental agencies have been either flat, or declining; however, reliable data for environmental agency budgets are difficult to obtain on a recurring annual basis.

The Environmental Council of the States (ECOS) is a national non-profit organization that represents environmental agencies of states and territories of the US on matters ranging from coordination among the branches of state and federal governments to data collection efforts such as the projects ECOS funded to collect budget data to be used in this study (ECOS, 2017b). As displayed in Figure 5, during the period from fiscal years 2009 extending through 2011, total budgets *and* environmental budgets derived from state-source revenues declined. The federal-source revenues, among the 25 states analyzed during the survey, remained flat. This decline may be partially-attributable to either the financial crisis, which began in 2007, or it could be indicative of a prolonged downward trend (ECOS, 2010; Federal Reserve, 2016). More specifically, these declining trends may have resulted from a neoliberal economic agenda that have "[hived] off their functions to private and nonprofit actors who presumably have the will and capacity" to protect the environment (Durant, 2017, p. 359). Further, what little federal-source dollars *do* flow to states are not for discretionary use but are either dedicated clean-up funds, or intended to resource specific grant programs (USEPA, 2018a). Less than 40 percent of federal-source funds to state environmental agencies are unobligated (LaRoss, 2017). Though informative, the 2010 ECOS survey analyzed to develop Figure 5 is nearly two decades old, and was limited to only a subset of states.

Figure 5.

*State Environmental Agency Budgets, 2009 - 2011*

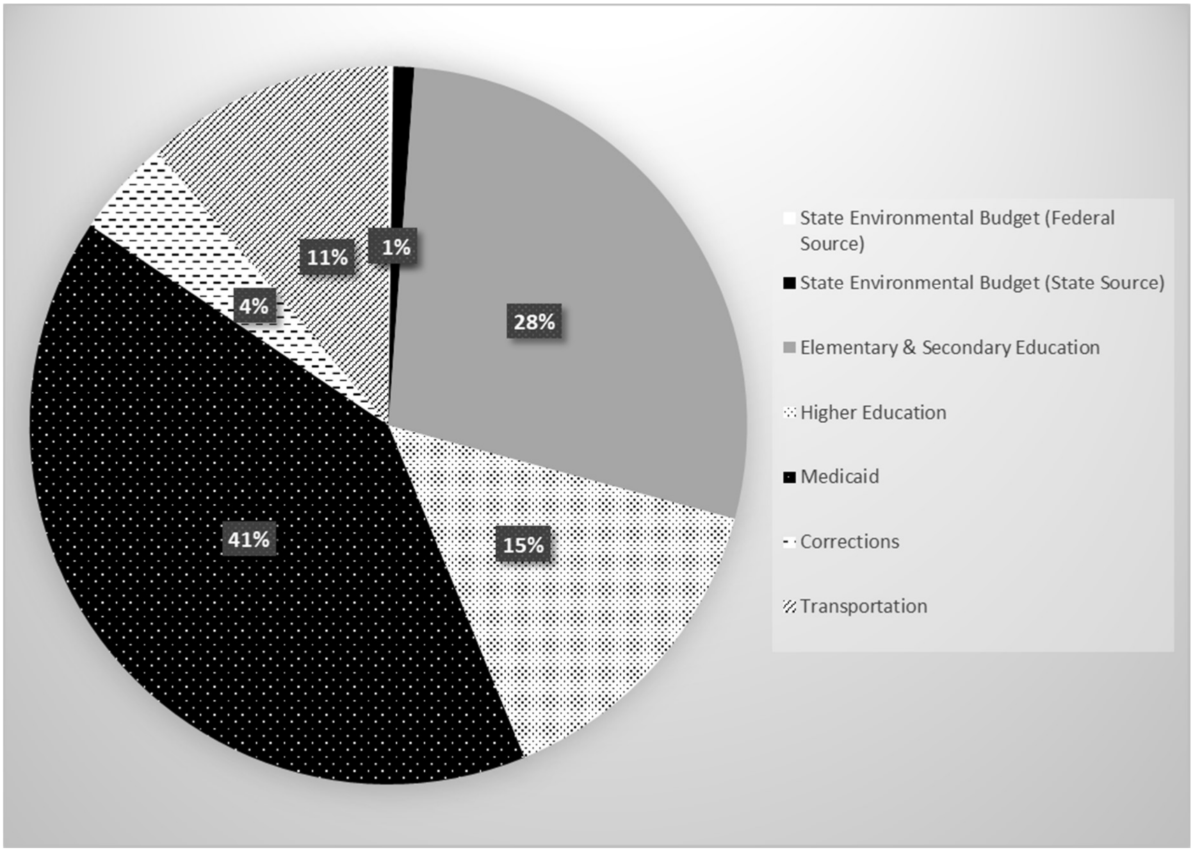



*Note.* Compiled by author from ECOS (2010) data.

Figure 5 provides the state environmental agency budgets for the years reported separately as the: state-source; federal-source; and total—(i.e. combination of the state-source and federal-source) budgets. These budget trends over this timeframe are brought into further focus when considered in the context of state spending on other government functions. Figure 6 provides the state environmental agency budget—broken-up by federal and state-source funding; percentage of funds spent on elementary and secondary education; percentage of funds spent on higher education; percentage spent on Medicaid; percentage spent on corrections; and percentage spent on transportation. As the following figure reveals, state environmental budgets reflect a smaller proportion relative to other budgeted functions.

Figure 6.

*State Environmental Budgets as Proportions of Total State Expenditures, 2015*




*Note.* Compiled by author from ECOS (2017b); National Association of State Budget Officers (2016). Federal-source funding of state environmental budgets is not discernable given its miniscule share of the total.

### 1.6. State Environmental Budgets and Environmental Performance

While the vigor of state environmental agency programs can be measured by policy outputs other than budgets—(e.g. enforcement actions, pollution reduction)—examples of inadequate environmental program strength and performance are often braided with observations of inadequate financing for environmental protection. "Environmental program quality is directly related to spending" (Agthe et al., 1996, p. 29). That is, environmental budgets shape the performance of state environmental agencies, thus identifying what factors determine appropriations can be revelatory of state governments' focus on environmental issues (Bacot &

Dawes, 1996; Konisky & Woods, 2012; Lombard, 1993). Furthermore, while previous studies—(e.g. Lester, Franke, Bowman, & Kramer, 1983; Ringquist, 1993; Williams & Metheny, 1984)—have analyzed the performance of specific environmental programs—(e.g. waste and water programs)—this dissertation diverges from these previous analyses by examining agency appropriations versus individual program budgets.

The connection between budget policy antecedents and fiscal responsiveness holds is an important one given the challenges created by inadequate budgets, such as USEPA audits that revealed underperforming state agency performance outcomes in air quality (USEPA, 2016a). Though related to water quality *not* air quality, a salient example highlighting the connection between insufficient appropriations *and* environmental agency performance is the Flint, Michigan water crisis (Mettler, 2017). As the Flint Water Advisory Task Force observed:

> Budgets for public health activities at federal, state, and local levels [are needed] to ensure that highly skilled personnel and adequate resources are available. The consequences of underfunding include insufficient and inefficient responses to public health concerns, which have been evident in the Flint water crisis (Michigan, 2016, p. 4).

Along a similar vein, Wood (1991) found that after the 1982 federal budget cuts, enforcement actions by the USEPA against Clean Air Act (CAA) violators abruptly decreased and once these funds were restored, enforcement activity rebounded with the states executing five times more enforcement actions than the USEPA. In another study analyzing the effects of state environmental spending and enforcement, Konisky (2009) found that states which increased spending on the environment experienced higher rates of enforcement of their environmental laws. Yet another analysis found that in response to drastic cuts in federal grants, some state environmental agencies were so adversely impacted, they did not execute the functions delegated by the USEPA (Lester, 1986).

The findings demonstrate that when state environmental agencies encounter downward fiscal pressures, the capacity to perform their delegated duties is hollowed-out; this leads to lapses such as inadequate compliance oversight. For example, 81 percent fewer environmental enforcement cases were brought in Florida in 2015 than in 2010, with the lowest fines since 1988 (Public Employees for Environmental Responsibility, 2015). A review of USEPA's compliance and enforcement tracking system suggests this decline in enforcement is not attributable to a more compliant regulated community. USEPA's on-line enforcement and compliance history reporting website recently listed 8,400 facilities with significant violations which includes 2,000 instances of significant violations of the CAA (USEPA, 2016b). These facilities have air emissions that cause injury and premature death particularly in states that have grown increasingly dependent upon petrochemical *and* oil and gas industries—(e.g. Texas, Pennsylvania, Illinois, and Louisiana). Notably, these are all states identified as having slashed their environmental budgets in recent years (Environmental Integrity Project, 2019).

**1.7. Definitions of Terms**

Most terms are included throughout the dissertation in the context of their operational definitions; therefore, this section includes only a brief background of three terms used frequently throughout. While this section provides definitions, operationalization is included in Chapter 3, methodology.

*Civic environmentalism* represents the environmentally-focused concerns expressed by environmental constituencies and subconstituencies as reflected by their voting preferences of states' delegations to the U.S. Congress. Individual citizens and environmentally-minded firms, coordinate to enhance environmental outcomes, such as improving air quality or planning and building sustainable communities (Agyeman & Angus, 2003; Knopman, Susman, & Landy, 1999). It has historically been the case that civil society expresses environmental demands through electoral preferences. For example, environmental group membership has been found to positively influence pro-environmental voting behavior of members of Congress (Anderson, 2011).

*Polluting business interests* can be defined in several ways. Fundamental to the notion of business interests, however, is the idea of a collectivity—(i.e. "a pressure group")—whose existence is rooted in a commonality of purpose and the wherewithal to promote and advance efforts, through the political process, that materially affect policy outputs and outcomes that maximize their utility (Buchanan & Tullock, 1999, p. 204). Though there is ambiguity in the conceptualization of this term in the social sciences, for the purposes of this study, *business interests*—which will be the shorthand oftentimes applied for this variable throughout—refers to larger non-formal organizations rather than individual membership bodies. Business interests act with uniformity, through collective action and determine ways to effectively lobby policy makers, or bureaucracies, so as to benefit their constituent members (Olson, 1965). In this dissertation, business interests refer to the prevalence of business collectivities within the state as represented by major polluting sectors of states' economies—(e.g. utilities, manufacturing, and mining) (Anderson, 2011; Falke, 2011).

Lastly, *environmental agency budget policy* refers to the overall purposive courses of action that groups of policy makers and stakeholders make, or choose not to make, on some consistent and reliable recurring basis, to be responsive to an environmental public problem or issue—air pollution in the context of this study—as reflected by fiscal measures. This conceptualization is drawn from Heclo's (1972) definition of public policy and is synthesized from previous scholars (Dye, 2006; Friedrich, 1963; Lasswell & Kaplan, 1950). The term, *environmental agency budget policy* is used in this dissertation to concurrently reflect the multiple fiscal components that exist in the ECOS (2017b) dataset which will be used for this study. This terminology derives also from the theoretical framework which is focused on state policy outputs, hence addition of the term "policy" to the phrase "environmental agency budget." This manner of describing of environmental budgets as a policy output is useful for theoretical and narrative purposes *and* extends from previous research that employs similar terminology (Bacot & Dawes, 1996).

**1.8. State Environmental Agencies**

Analyzing policy at the state agency level derives from the enormous roles these bureaucracies serve in US environmental governance and the need to reconceptualize their purpose and impact on public policy in addressing domestic *and* global pollution challenges (Durant et al., 2017). The unit of analysis for this study is the state environmental agency budget, and this section provides an overview of the agency structure and functions.

Many state environmental agencies are organized similar to the USEPA—by environmental media (e.g. air, water); function (e.g. compliance, enforcement, research & development); and geography (e.g. regions, regional offices) (Sinclair & Whitford, 2012). State environmental funds support compliance and enforcement efforts; air quality monitoring; research and development; projects to safeguard clean water and clean-up bays and estuaries, environmental justice and education; and compliance support to the regulated community including environmental restoration of contaminated sites for redevelopment. While some state environmental agencies fall under a state's Department of Health (e.g. Colorado and Hawaii), many are stand-alone organizations situated within the state's secretariat of natural resources or the equivalent (e.g., Virginia). Most states have interrelated functions that pertain to human health and the environment split between several agency types which may include a department of health; department of natural resources; department of conservation; game and fish department; and a department of environmental quality or management. Due to the various institutional organizational structures and core missions, research in this area of public policy requires the identification of the agency whose budget is being analyzed. The following table provides a list of those agencies.

Table 3

*State Environmental Agencies*

| State | Agency Name | State | Agency Name |
|---|---|---|---|
| Alabama | Department of Environmental Management (DEM) | Montana | DEQ |
| Alaska | Department of Environmental Conservation (DEC) | Nebraska | DEQ |
| Arizona | Department of Environmental Quality (DEQ) | Nevada | DEP |
| Arkansas | DEQ | New Hampshire | Department of Environmental Services |
| California | Environmental Protection Agency (EPA) | New Jersey | DEP |
| Colorado | Department of Public Health and Environment | New Mexico | Environment Department |
| Connecticut | Department of Environmental Protection (DEP) | New York | DEC |
| Delaware | Department of Natural Resources and Environmental Control | North Carolina | Department of Environment and Natural Resources |
| Florida | DEP | North Dakota | Department of Health-Environmental Health Section |
| Georgia | Environmental Protection Division | Ohio | EPA |
| Hawaii | Department of Health | Oklahoma | DEQ |
| Idaho | DEQ | Oregon | DEQ |
| Illinois | EPA | Pennsylvania | DEP |
| Indiana | DEM | Rhode Island | DEM |
| Iowa | Department of Health | South Carolina | Department of Health and Environmental Control |
| Kansas | Department of Health and Environment | South Dakota | Department of Environment and Natural Resources |
| Kentucky | DEP | Tennessee | DEC |
| Louisiana | DEQ | Texas | Commission on Environmental Quality |
| Maine | DEP | Utah | DEQ |
| Maryland | Department of the Environment | Vermont | DEC |
| Massachusetts | DEP | Virginia | DEQ |
| Michigan | DEQ | Washington | Department of Ecology |
| Minnesota | Department of Natural Resources (DNR) | West Virginia | DEP |
| Mississippi | DEQ | Wisconsin | DNR |
| Missouri | DNR | Wyoming | DEQ |
| | | D.C. | Department of Energy and Environment |

Though ultimately environmental agencies develop media—(e.g. water, air, land)—based programs to address environmental pollution (Sapat, 2004), differentiations in their structures are driven by the extent to which the state decides to combine, or separate, public health and environmental functions. Within this literature regarding the structure of state environmental agencies, there is broad consensus that the organizational structural designs can fit into three groups: 1) a health department model including expenditures on healthcare unrelated to environmental protection (Rabe, 1988); 2) a super agency model that incorporates natural resource oversight and management functions (Gale, 1986); and 3) mini-USEPA structures that "emulate their federal counterpart"—(i.e. organized by environmental media and function). (Bacot & Dawes, 1997, p. 358; Burke, Tran, & Shalauta, 1995).

Previous literature reveals that roughly 90% of environmental protection efforts are executed within the environmental agencies versus health departments (Gordon, 1998) with public health expenditures representing a negligible percentage of spending to promote environmental health (Burke et al., 1995; Sinclair & Whitford, 2012). In a comprehensive study of various determinants of state environmental performance rankings, organizational structure of the agency (i.e. mini-USEPA versus superagency), the structure was not found to be a statistically significant factor in the analysis (Bacot & Dawes, 1997). The extant research on environmental agency structure, functions, and expenditures was drawn upon to inform the decision to focus the analysis on the budgets of agencies listed in Table 3.

**1.9. Contributions of this Dissertation**

This dissertation offers four contributions. *First*, this study contributes to the theoretical foundations with the *integrated theory of state policymaking* as the theoretical framework *and* drawing upon *technocracy theory*, *rational self-interest theory,* and *ecological citizenship theory* to further specify the conceptual and empirical models. Despite previous research contributions (e.g. Stanton & Whitehead, 1994), there is a need for expanding the application of theory in agency budgeting scholarship related to environmental policy (Rubin, 1989; Ryu, Bowling, Cho & Wright, 2008). This observation is shared by state environmental policy scholars (Lester & Lombard, 1990)—that research on environmental policy outputs requires consideration of more than a single theoretical perspective and ought to move beyond a systems framework as the dominant metatheoretical approach. While conceptual models derived from the *integrated* *theory of state policymaking* framework have been used to examine environmental policies (e.g. Kim & Verweij, 2016; Ringquist & Clark, 2002; Vachon & Menz, 2006), this dissertation marks its first application to environmental agency budgets.

*Second*, in the case of state environmental agencies, intergovernmental financing occurs via two sources: the main one, originating from the state government (i.e. *state-source*), and another from the national government (i.e. *federal-source*). By disaggregating total state environmental appropriations into the two sources of state own-source funding, I contribute to the literature by exploring the differential effects of the same set of determinants on two separate sources of appropriations while controlling for the effects of federal-source funding. More specifically, while examining general fund appropriations can reveal the influence of budgetary determinants on the overall budgeting process, separately modeling fees and other sources allows for an investigation into the contributing factors of this growing revenue structure. Despite prior research suggesting federal and state policy, within the same functional areas of governance, have different antecedents (Clark & Whitford, 2011), the environmental budget policy measure with resonance in the literature consists of the *total* fiscal resources appropriated to state environmental agencies (Bacot & Dawes, 1996; Konisky & Woods, 2012). This focus persists despite state governments increasingly relying upon general funds and user charges drawn from the regulated community—the two sources of state own-source funding. In the face of continuing cuts to federal revenues, state-source funding now exceeds three-quarters of state agency budgets making it the focus of this dissertation (ECOS, 2018).

*Third*, this dissertation contributes by focusing on whether the effect of environmental pollution on environmental appropriations is conditioned by—i.e. interacts with—*business interests*. This statistical approach addresses concerns of state environmental policy scholars to move beyond analyzing bivariate relationships and regression coefficients interpreted as only direct effects (Lester & Lombard, 1990). As observed by Willoughby and Finn (1996), the public budgeting process involves the "interaction of numerous players", and these stakeholders have varying allegiances and values that can condition this complex process (p. 524).

*Fourth*, this dissertation offers a methodological contribution to increase the construct validity by examining the effects of air pollutant emissions in two ways. First, I examine the influence of six criteria pollutants to move beyond single indicator measures (Bacot & Dawes, 1996, 1997) which, while useful, do not include the broad array of pollutants regulated under the Clean Air Act (CAA). Second, the effect of $CO_2$ emissions on environmental agency budgets is separately assessed given the evolving focus of environmental governance in the US on climate policy (Martin & Saikawa, 2017).

**1.10. Outline of the Dissertation**

Chapter 2 begins with an overview of the theoretical foundations, prior environmental policy *and* budgeting research supporting each hypothesis before moving onto describe the essential role of federalism in US environmental governance. Chapter 3 picks-up with the research design and methodology and includes the statistical analysis plan before turning to the empirical findings—and limitations—in Chapter 4. Chapter 5 includes the summary and discussion of results, contributions, and avenues for future research.

## Chapter 2: Theory & Literature Review

Chapter 2 is organized as follows. The preliminary sections of this chapter provide an expanded discussion of the theoretical framework and perspectives. This is followed by the literature supporting environmental budget analysis including the six strands of scholarship organized by each hypotheses *and* the supporting academic literature. Existing knowledge gaps are then discussed. The last section of the chapter describes the essential role of federalism in US environmental governance to further establish the level, and unit, of analysis.

### 2.1. Theoretical Framework

Environmental policy efforts reflect “divergent social, political, economic, and environmental conditions across the country” (Durant et al., 2017, p. xi). To achieve environmental outcomes citizens demands of civil society, such as clean air, Abramson, Breul, and Kamensky (2007) observed policy implementation requires governmental institutions to add legitimacy; provide the regulatory authority; and to allocate the necessary resources. That is, environmental governance involves “actors from a variety of public and private organizations who are actively concerned with a policy problem or issue such as air pollution control” (Fishkin, 1991; Hajer, 1993; Sabatier, 1988, p.131). Budget policy preparation, especially on technical issues such as air pollution, involve collaboration between legislators, agency officials, special interest groups, and other actors involved in policy formulation and implementation similar to the perspectives in collaborative governance theory (Ansell & Gash, 2008) and the advocacy coalition framework (Sabatier, 1988).

Theoretical frameworks in the social sciences often help produce conceptual models to help identify factors thought to explain a social phenomenon from a broad perspective (Schneider, 2006). As noted in Chapter 1, this dissertation applies the *integrated theory* to summarize and isolate the factors to explain environmental agency budgetary phenomenon from a broad perspective (Schneider, 2006).

While acknowledging the progression of theoretical advancements in state policy theory (e.g. Dye, 1966; Erikson, Wright, & McIver, 1989), Ringquist (1994) advanced the *integrated theory* in response to previous critiques over state policymaking theories which fell short of offering a comprehensive view of political and fiscal influences. The framework, rooted in environmental public policy, was developed to validate theories across several policy domains and proposes that state policy strength (i.e. responsiveness) can be explicated by actors and institutions within the political system. The resulting framework holds that responsiveness of state governments can be explained by political, institutional, legal, and fiscal factors. The theory was used by Ringquist and Clark (2002) to guide their study on environmental justice which assessed state policymaking based on external and internal factors drawing on "consistent findings from thirty years of state politics research" (p. 363). While conceptual models derived from the *integrated theory* have been used to explain policy matters in other environmental policy research (e.g. Kim & Verweij, 2016; Ringquist & Clark, 2002; Vachon & Menz, 2006), this is the first study to apply it to environmental agency budgeting.

The framework is based on varying sociological conceptions including that of the outcome variable—environmental agency budget policy—at the organizational level (i.e. meso-level) (Neuman, 2009). Since the level of analysis—"the unit to which the data are assigned for hypothesis testing and statistical analysis" (Rousseau, 1985, p. 4)—is at the state-level, the theoretical perspective is focused at the macro level—aimed at analyzing state environmental policy from a largely institutional perspective. In addition to its application to environmental policy research over many years, the *integrated theory* includes the factors scholars have declared essential to public policy and administration analyses. In particular, Roberts (2008) argued that frameworks drawn upon to help explain macro-level policy outputs ought to include a broad range of factors including economic, political, and social.

Before turning to the individual theories, there are four details regarding the framework that merit attention. *First*, the *integrated theory* is rooted in political science and based on *three* sets of factors—economic-ideological; organized interests-pressures; and political systems characteristics—my framework provides a thematic inventory including *four* sets of factors drawing upon multiple disciplines particularly public budgeting. The original three sets of factors do not place emphasis on fiscal factors and required a minor digression to emphasize characteristics anticipated to be explanatory of *fiscal* policy outputs. *Second*, the original framework focused on environmental policy in the context of water quality and hazardous waste management whereas my study focuses on air quality. Therefore, a minor rework included a *legal* factor to provide a logical inventory for two variables—climate policies and environmental pollution from $CO_2$ emissions.

*Third*, where the original model described environmental pollution as an *organized interest / pressure* variable based on single measures of environmental pollution, this dissertation includes this variable as a *legal* factor using a composite measure—for criteria pollutant emissions *and* an individual indicator—$CO_2$—for GHG emissions. Lastly, while the original model included a variable—state opinion liberalism, as a type of *economic-ideological* variable, the adapted framework includes state partisan ideology as a *political* factor as it relates to elected officials in state legislatures.

## 2.2. Theories

While the extant literature offers methodological contributions relevant to environmental budgets, it offers comparatively less in theory application and testing specific to environmental policy—representing a wide gap in the literature recognized by previous academic scholarship (Lester & Lombard, 1990). As mentioned in Chapter 1, three additional theories are drawn upon to help establish the hypothesized associations between specific independent variables—budgetary determinants—and environmental budget policy. Further, as noted by Stanton & Whitehead (1994), this approach helps address model misspecification on account of omitted variables. Thus, Gunnell's (1982) *technocracy theory,* Olson's (1969) theoretical perspective on *rational self-interest, and* Dobson's (2007) *ecological citizenship theory* are drawn from to analyze, explicate, and provide a logical accounting of the relationships between key study variables, thus helping to establish hypotheses tested by the empirical models (Jaccard & Turrisi, 2003). The following sections describe each theory before turning to a summary of the theoretical, empirical, and methodological details justifying examination of each variable and hypothesis.

### 2.2.1. Technocracy theory.

The term, technocracy, was used in the US first within the engineering field in the early-1900s; however, it can be traced back to the 1800s to early theorists of rational planning and social order including Henri de Saint-Simon (Gunnell, 1982). The theory refers to the influence that technical personnel (e.g. scientists, engineers) have on society, and it is defined as the "the exercise of political authority by virtue of technical competence and expertise in the application of knowledge" (Gunnell, 1982, p. 392). Technocracy theory is a variant of the conflict theory paradigm advanced by C. Wright Mills who describe the roles of the *power elite* writing in the context of the hegemony that bureaucratic elites demonstrated throughout World War II (Barratt, 2011) and beyond (Goodsell, 2015; Sunstein, 2015).

Dye and Zeigler (1970) observed that elites play a prominent role in public policy through a mutual-benefit association that regards the public's concerns. A technocratic tenor in public policy making is also evidenced in the writings of Key (1967) who observed that mature democracies translate the needs of the governed into policies that address these needs. Technocracy in the US plays a meaningful role in public policy given the complexity of the society and relative lack of domain knowledge civil society has compared to the bureaucracy across a wide range of technically intricate government functions. Fiorina observed that "as ordinary citizens we do not know the proper rate of growth of the money supply, the appropriate level of the federal deficit, the advantages of the [missile eXperimental] MX over alternative missile systems, and so forth" arguing that the role of understanding and making policy sense out of sometimes disparate information is delegated to policymakers—both elected and as non-elected bureaucrats (1980, p. 26).

In addition to the inherent complexity of governance, the move towards professionalized bureaucracies was to answer the challenge in public administration in the nineteenth century. These agencies were needed to "replace partisan patronage and machine politics" (Goodsell, 2015, p.182). Environmental agencies function as technocracies—structured with programs that have specific goals and performance standards which are based on environmental metrics, such as pollution severity. As Stone (2014) observes, "Policy makers need clear thresholds to set program goals, define eligibility, and measure performance…[they] emphasize the measurable" (p. 94). This observation is similar to Wilson's who noted how government agencies often focus their efforts on those activities that can be discretely observed and counted (1989).

Technocracy theory suggests that environmental agency personnel characterize the magnitude, and type, of pollution which is conveyed to the appropriate members of their organization who pass the budgetary requests to their funding sources as either a nudge, or technocratic requests for more funding based on the magnitude of pollution severity. A normative premise of this dissertation is that increased funding results from environmental agencies' empirical knowledge of air pollution—facilitated by their collection and analysis of pollutant data—and consequent brokering of that information during the budget process. As applied to my study, technocracy theory holds that states increase environmental appropriations in response to air pollution to fund the necessary permitting, compliance, and enforcement programs requested by the environmental agency to address pollution.

This theory also holds that climate policy adoption will have a positive influence on budgets, since additional technical personnel are needed to develop and implement the necessary programs to achieve the policy goals of $CO_2$ mitigation. This anticipated relationship between pollution *and* climate policies to environmental appropriations is rooted in a theory of social science that reinforces "public officials who can use scientific information, design optimal policies and achieve planned outcomes" to justify demanding responsiveness in the form of appropriations (Agyeman & Angus, 2003, p. 351).

While the environmental technocracy applies technical means to make the rationales and repercussions on inaction more detailed and better explained during the budget process, their input is necessary but not sufficient to address *wicked* problems. Rittel and Webber (1973) called into question the ability for so-called experts or political elites to solve certain societal problems. Fiscally responding to environmental problems involves institutions, competing interests, and multiple stakeholders including the ecological concerns articulated by civil society (Weible, Sabatier, & Lubell, 2004).

**2.2.2. Rational self-interest theory.**

Rational self-interest theory goes to the core of addressing the so-called "second question" relevant to public policy and administration—for *whom* is environmental governance working (i.e. civil society or business interests?) (Frederickson, 2005). Following Olson's (1965) seminal work, Lyons (1999) explicated the behavior and motivations of business interest groups through rational self-interest theory derived from the economics literature and closely related to the market-based *social choice by collectives*—or *public choice*—theoretical perspective (Buchanan, 1954). Following this theory, where other interests may essentially fail at achieving unity, cohesive messaging, and ultimate impact on policies, business interests demonstrate aptitude particularly when the group's focus is trained at policies that have localized and specific interests. Lyons (1999) adds that that the "balance of group power will be relatively favorable to resource users and to industry" (p. 281). This, in-turn, engenders a responsive legislative, and bureaucratic, orientation that attends to the demands of business interests which ultimately impedes what would otherwise be increasing budgets in response to pollution.

Rational self-interest theory informs my decision to examine the interaction effect between business interests and environmental pollution on environmental agency appropriations rather than analyzing for unconditional effects. Drawing from rational self-interest theory, business and industrial communities maintain awareness of environmental policy developments which could impact their business operations. Such developments might include a state proposed rulemaking for more stringent air pollution control technologies or a general policy to bolster compliance and enforcement efforts, either of which could impact (i.e. increase) firm-level capital and operating expenses.

It follows, logically, and has been examined empirically (e.g. Newmark & Witko, 2007) that as levels of specialized interests are greater in a state, the more intense is the filtering of pollution severity information throughout the budgetary process. With business interests, this process involves pressure to stymie appropriations for environmental protection. Taken together, per technocracy theory, state governments ought to appropriate more in response to pollution; however, per rational self-interest theory, fiscal responsiveness may be evident only when business interests conditions are sufficiently accommodative (i.e. low).

**2.2.3. Ecological citizenship theory.**

Ecological citizenship theory suggests civic environmentalism is not limited to individual environmentally-friendly behaviors though these have clear importance (e.g. recycling behavior or "green" transportation preferences), but the concept extends to the political arena where civil society has an opportunity to positively influence environmental policy outputs (Jagers et al., 2016). Thus, ecological citizenship acts at the level of political institutions. Accordingly, environmental citizenship can be conceptualized as an interest in domestic legislative efforts to address domestic and global environmental challenges of which there has been an increased tempo in the US. One example is the rise in legislation since the Supreme Court's ruling in *Massachusetts v. United States Environmental Protection Agency* (2007) which "accelerated a cascade of climate-warming bills, resolutions, and amendments already emerging from Congress" with proposals doubling between 2007 and 2008, alone (Rosenbaum, 2017, p. 370).

Though there is ambiguity over the term *environmental citizenship,* Dobson (2007) suggests that the theory includes sustainable lifestyle behaviors and practices extending to the democratic and decision-making structures (e.g. elected bodies) that may be reproducing environmental injustices pointing-towards an underlying connection between environmental citizenship and political—electoral—preferences. Stern (2000) differentiated this type of electoral-based environmental citizenship from environmental behavior expressed through environmental organization participation (i.e. environmental activism) noting empirical evidence that the former may lead to comparatively larger societal effects, because "public policies can change the behaviors of many people and organizations at once" (p. 410). While Stern, Dietz, Abel, Guagnano, and Kalof (1999) were advancing a separate theory termed the value-belief-norm theory, that contemplates a more expansive consideration of related concepts such as personal norms and belief systems, ecological citizenship theory can be thought of as a derivation of the value-belief-norm theory.

Ecological citizenship theory emerged from the political science literature explaining political activity through the relationship between citizens and the state and posits that civic duties are incumbent upon individuals, related to the environment, and these obligations must be fulfilled in order to promote social justice and equity (Jagers et al., 2016). Ecological citizenship thus enables the hypothetical expectation of an empirical linkage between civic environmentalism—*and* climate policies—and environmental agency budgets.

This theory also suggests that pro-environmental behavior is influenced not only by criteria pollutant emissions to ambient air, but also by GHGs (i.e. those pollutants that have both local *and* global impacts) (Dobson, 2007). Accordingly, the civil ecological perspective informs a methodological decision to conceptualize and operationalize pollution severity based upon indicators that encompass several classes of pollutants thus addressing a gap in environmental budgeting research noted by others (e.g. Lombard, 1990).

## 2.3. Literature Review

A review of the environmental policy literature reveals the shifting of environmental protection responsibilities from the national government to the states which helped stoke research interest in state environmental agency policy particularly in the 1980s—(Crotty, 1987; Davis & Lester, 1987; Lester et al., 1983; Lester & Bowman, 1989; Williams & Metheny, 1984; Rabe, 2007). Subsequent to this shift, the study of environmental budgets and spending proliferated in the public policy and environmental literature throughout the 1990s—(Agthe et al., 1996; Bacot & Dawes, 1996; 1997; Davis & Feiock, 1992; Hays, Esler, & Hays, 1996; Lester, 1995; Lester & Lombard, 1990; Ringquist, 1993; 1994; 1995). A more recent strand of scholarship focuses on the impacts of Clean Air Act pollutants on local jurisdiction revenues (Carr, 2011a); expenditure patterns in response to increased federal regulations (Carr, 2011b); and the impact of environmental regulations on subnational governments' economic performance (Yan & Carr, 2013). These preceding studies hi-light the theoretical and empirical linkages between environmental (e.g. air pollution) and subnational public budgeting providing a foundation upon which this study builds.

Many of the early environmental agency scholarship focused on either national *and* subnational government dynamics in particular (e.g. environmental federalism) (Crotty, 1987), or on specific programs within environmental agencies, such as air and water quality (Lombard, 1993; Stanton & Whitehead, 1994) or hazardous waste (Lester et al., 1983). While there was heightened academic literature on environmental budget policy, the literature was followed-up by only a dearth of related scholarship at the state-level (e.g. Clark & Whitford, 2011; Konisky & Woods, 2012; Newmark & Witko, 2008). Table 4 summarizes key literature along with the theoretical, empirical, and methodological details of each variable and hypothesis.

Table 4

*Key Literature, Study Variables, and Basis for Investigating*

| Variable Name | Type of Variable | Basis / Justification for Investigating | Hypotheses |
|---|---|---|---|
| Environmental Pollution | Legal | **Theoretical:** Technocracy Theory<br>**Empirical:** Previous Findings Support Inclusion<br>**Key Literature:** Agthe et al. (1996); Bacot & Dawes (1996); Martin & Saikawa (2017) | Environmental pollution is the focal independent variable—see H6 for hypotheses involving the interaction effects. |
| Business Interests | Political | **Theoretical:** Rational Self Interest Theory<br>**Empirical:** Unstudied with Interaction of Pollution on State Own-source Environmental Budgets<br>**Key Literature:** Buchanan & Tullock (1999); Jordan, Halpin, & Maloney (2004); Newmark & Witko, (2007) | **H1:** Air pollution severity will increase state environmental agency budgets, if levels of polluting business interests of states are sufficiently low. |
| Civic Environmentalism | Political | **Theoretical:** Ecological Citizenship Theory<br>**Empirical:** Understudied Despite Previous Findings Suggesting Related Constructs are a Determinant<br>**Key Literature:** Dewitt (2006); Knopman et al. (1999); Konisky & Woods (2012) | **H2:** Civic environmentalism will have a positive influence on state environmental agency budgets. |
| Climate Policies | Legal | **Theoretical:** Technocracy Theory & Ecological Citizenship Theory<br>**Empirical:** Unstudied in Context of State Environmental Agency Budgets<br>**Key Literature:** Grant et al. (2014); Rabe (2007) | **H3:** Mandatory climate policies will result in higher state environmental agency budgets. |
| Legislative Professionalization | Institutional | **Empirical Findings:** Previous Findings Support Inclusion<br>**Key Literature:** Mooney (1995); Konisky & Woods (2012); Squire (2012; 2017) | **H4:** Legislative professionalization will have a positive influence on state environmental budgets. |
| Partisan Ideology | Political | **Empirical:** Previous Findings Support Inclusion<br>**Key Literature:** Alt & Lowry (2000); Anderson (2011); Clark & Whitford (2011); Fowler & Breen (2013) | **H5:** Liberal ideology will have a positive influence on environmental agency budgets. |
| State Fiscal Capacity | Fiscal | **Empirical:** Unstudied in Context of State Environmental Agency Budgets with Indicator Used (TTR)<br>**Key Literature:** Agthe et al. (1996); Bacot & Dawes (1996); Hays et al. (1996) | **H6:** State fiscal capacity will have a positive influence on environmental agency budgets. |

#### 2.3.1. Literature emphasizing environmental budgets.

While several approaches are available to assess the strength of environmental public policy at the state level (e.g. pollution outcomes, enforcement actions, quantity of delegated programs from USEPA), a branch of scholarship emphasizes budgetary output analysis over alternative metrics (Agthe et al., 1996; Bacot & Dawes, 1996; Kraft & Vig, 2013). For example, Balint and Conant (2013) conceptualized agency operating budgets as the "principal indicator of the agency's vitality and influence" (p. 23). In explaining the linkage between environmental pollution and budgets, Patten (1998) suggested environmental problems inevitably lead to deliberation on increasing expenditure levels.

While Lester and Lombard (1990) cautioned researchers against interpreting budgets as interchangeable with state environmental agency *performance*, analysis of environmental agency financial indicators has resonance in state environmental policy research. These economic-based measures provide a way to capture "a state's commitment to environmental protection" (Clark & Whitford, 2011; Konisky & Woods, 2012, p. 545). Bacot and Dawes (1997) observed "since legislative and programmatic goals are only as effective as their funding levels permit them to be, it appears that the expenditure approach may be the most suitable method for estimating states' environmental efforts" versus empirically assessing related concepts (p. 366). Previous research reveals that investigating agency budget policy versus state political and administrative rankings offers a robust approach and reflects environmental agency effort (Bacot & Dawes, 1997; Woods et al., 2008). "We can be confident that a state's real environmental effort is being approximated with this [fiscal] type of dependent variable" (Bacot & Dawes, 1996).

### 2.3.2. Factors that influence environmental agency budget policy.

Throughout the years, studies find associations between the factors within the *integrated theory* (i.e. political, institutional, legal, and fiscal) and environmental financial measures (e.g. appropriations and expenditures). The next sections provide brief reviews of six strands of literature; identification of gaps in the scholarship that this dissertation helps fill; and expands upon the hypotheses. This chapter concludes with a discussion of environmental federalism that situates the state-level of analysis in this dissertation.

#### *2.3.2.1. Air pollution and business interests influencing budgets.*

Air *pollution* is an externality—that is, it "arises when a person [or firm] engages in an activity that influences the well-being of a bystander but neither pays nor receives compensation for that effect", since it remains outside—or *external* to—the underlying transaction (Mankiw, 2015, p. 196). Negative externalities, such as air pollution, involve *legal* instruments (e.g. regulations) aimed at reducing (i.e. mitigating) emissions which is the case with air pollution abatement in the US, and these programs carry production and governance costs. Further, state environmental agencies have exercised ever-increasing autonomy and efforts to curb air pollution over the past several decades (Chubb, 1985; Crotty, 1987; Goulder & Stavins, 2011). As Basu and Devaraj (2014, p. 936) noted, society is "more proactive about cleaning up the air they breathe" due to the disproportionate negative impacts on children and elderly populations *and* transboundary nature of air pollution spillover effects (Woods & Potoski, 2010).

Environmental governance in the US has traditionally been achieved through the promulgation of regulations based on quantitative standards derived from toxicity and risk assessment information. In the US "the best example is the National Ambient Air Quality Standards set under the Clean Air Act (CAA), which must protect the most sensitive parts of the population with an adequate margin of safety" (Fiorino, 2017, p. 316; Johnson & Graham, 2005). The USEPA establishes these national ambient air quality standards (NAAQs) for the following six air pollutants termed *criteria air pollutants*, since the NAAQS are established on health-based criteria (Al-Kohlani & Campbell, 2016; Martineau & Novello, 2004; Simon, Reff, Wells, Xing, & Frank (2015); 40 CFR, Part 50: Nitrogen Oxides ($NO_x$); Sulfur Oxides ($SO_x$); Carbon Monoxide (CO); Particulate Matter (PM) as $PM_{10}$ and $PM_{2.5}$; Ozone ($O_3$); and Lead (Pb). Table 5 provides a summary of the known, and suspected, human health effects due to exposure to criteria pollutants. Although it is a highly toxic heavy metal—especially to children—lead is excluded from Table 5, since lead emissions will not be empirically assessed within this study due to its comparatively minute contribution to overall criteria pollutant emissions after its required phase-out from gasoline mandated by the USEPA in 1974 (USEPA, 1998).

Table 5

*Criteria Air Pollutants and Known Human Health Effects*

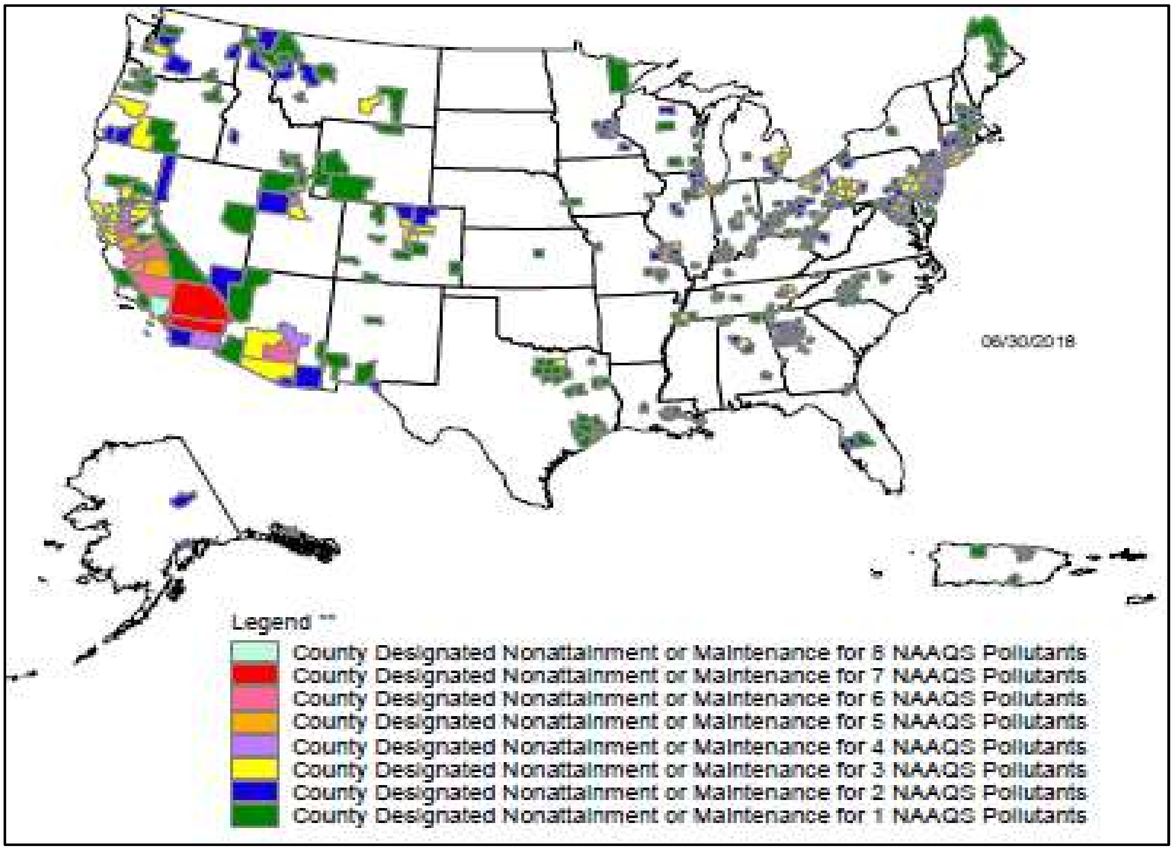
| Pollutant | Description | Health Effects |
|---|---|---|
| Nitrogen Oxides ($NO_x$) | $NO_x$ are gaseous pollutants emitted as NO and react in the atmosphere to form nitrogen dioxide ($NO_2$); the primary source of $NO_x$ are combustion sources (e.g. power plants and automobiles). $NO_x$ are ozone precursors. | Exposure to $NO_x$ has been associated with bronchoconstriction and respiratory infections especially in people with asthma via systemic inflammation oxidative stress pathways (Chauhan, Krishna, Frew, & Holgate, 1998; Kagawa, 1985; Kampa & Castanas, 2008; Peel, Haeuber, Garcia, Russell, Neas, 2013) |
| Sulfur Oxides ($SO_x$) | $SO_x$ are gaseous pollutants for which the primary anthropogenic source is also combustion of fossil fuels. | $SO_x$ exposure has been associated with reduced fetal growth; bronchospasms; acute myocardial infarctions (Hansen, Barnett, & Pritchard, 2008; Kermani, Jokandan, Aghaei, Asl, Karimzadeh, & Dowlati, 2016) |
| Carbon Monoxide (CO) | CO is a gaseous pollutant that is formed as a byproduct of incomplete combustion. | CO exposure has been linked to cardiovascular effects including impaired mental activity; impaired neural development in children (Badman & Jaffe, 1996; Levy, 2016). |
| Particulate Matter (PM) as $PM_{10}$ and $PM_{2.5}$ | PM is a mixture of particles that are suspended in ambient air produced by a variety of activities including combustion of fuel and construction activity. $PM_{10}$ has an aerodynamic diameter of ≤ 10 microns, and is also known as particulate matter. $PM_{2.5}$ has an aerodynamic diameter of ≤ 2.5 microns, and is also known as fine particulate matter. | $PM_{2.5}$ has been associated with heart and lung diseases at the lower respiratory regions including asthma (Brook, Franklin, Cascio, Hong, Howard, & Lipsett, 2004; Pope, 2000). $PM_{10}$ has been associated with lung damage especially in the upper-respiratory regions, heart disease, cancer, and myocardial infarctions (Al-Kohlani & Campbell, 2016; Mustafic, Jabre, Caussin, Murad, Escolano, & Tafflet, 2012). |
| Ozone ($O_3$) | Rather than being directly emitted, it is formed through sunlight that reacts with photoreactive chemicals—called precursors— of which $NO_x$ and VOC are the dominant precursor pollutants and will be used to calculate the composite measure. | Ozone exposure in humans has been associated with cardiopulmonary effects including inflammation of the respiratory system and decreased lung capacity as well as reduced fetal growth (Hansen et al., 2008; USEPA, 2013; Uysal & Schapira, 2003). |

The legal mechanism Congress established to meet the NAAQS—the state implementation plans (SIP)—are developed by each state; reviewed; and approved by the USEPA. Though these SIPs are set forth in the code of federal regulations, state environmental agencies "have spent many resources redoing and revising their SIPs ever since" and share responsibility with the USEPA for ensuring attainment and maintenance once the NAAQs are established (Martineau & Novello, 2004, pp. 6, 13). The SIPs establish the states' legal responsibility to ensure each air quality control region of the state achieves, or maintains, the NAAQS. A large part of the state-level oversight of the NAAQS program is the network of ambient air monitoring stations that states operate to assess compliance with USEPA standards (Johnson & Graham, 2005). Despite meaningful reductions, emissions from fine particulate matter accounts for over 100,000 to 200,000 premature deaths per year (Caiazzo et al., 2013; Goodkind et al., 2019). Therefore, the monitoring of criteria pollutant emissions remains a key focus, and cost, for state environmental agencies.

To keep track of the air pollution severity among the states, the USEPA compiles the Green Book (USEPA, 2018b). Figure 7 provides a map of the counties that are currently designated as in non-attainment or maintenance with the NAAQs as of June, 2018 (USEPA, 2018b). As Figure 7 depicts, nearly every state has an air quality control region that is either in nonattainment or maintenance with the NAAQs and many regions are in nonattainment, or maintenance, for more than one pollutant. As Durant (2017) observed, "nearly two-thirds of US citizens still live in nonattainment areas for dangerous ozone and particulate matter" (p. 18).

Figure 7.

*Counties Designated as Nonattainment or Maintenance with Clean Air Act's NAAQs*




*Note.* Figure from USEPA (2018c).

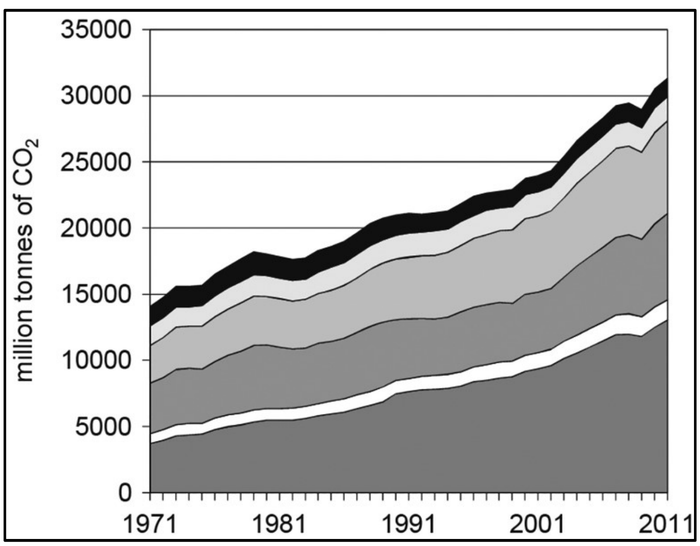
The persistent prevalence of NAAQS nonattainment across the US and the regulatory-based approach—implemented at the state level—to reduce criteria pollutant emissions, supports thematically categorizing *environmental pollution* as a *legal* factor in the conceptual model (Souza, Davis, & Shire, 2011, p. 62).

Despite the previous academic literature on criteria pollutants, there is an extant gap in research on the influence of $CO_2$ emissions and environmental budgets while "GHG emissions have increased roughly 61 percent since 1990 and the amount of $CO_2$ in the atmosphere has doubled" (Durant, 2017, p. 5). Through the seminal case of *Massachusetts v. United States*

*Environmental Protection Agency* (2007), the Supreme Court facilitated a reshaping of the contours of environmental governance in the US ascribing legitimacy to the nation's attempts to address GHG emissions. Leading up to *Massachusetts*, USEPA had not issued an endangerment finding for GHGs; therefore, the agency had not promulgated emissions standards to mitigate $CO_2$ emissions—the primary cause of GCC (Hansen, Sato, Kharecha, & von Schuckmann, 2011). $CO_2$ is the most prevalent GHG pollutant accounting for 75% of global GHG emissions and 82% of domestic GHG emissions (USEPA, 2018d). Figure 8 demonstrates the increases in global $CO_2$ which are projected to double by 2020 and double again by 2050 (Nejat, Jomehzadeh, Taheri, Gohari, Majid, 2015).

Figure 8.

*Growth in Global $CO_2$ Emissions, 1971 - 2011*

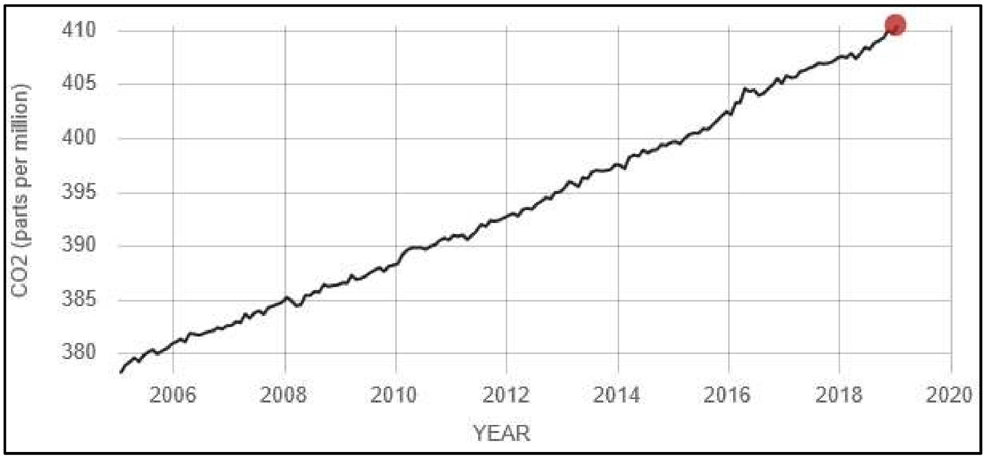



*Note.* From Martin & Saikawa (2017).

Further, data from the National Aeronautics and Space Administration (NASA), provided in Figure 9, show the ambient atmospheric concentrations of $CO_2$ are well above the highest historical levels.

Figure 9.

*Growth in Concentrations of $CO_2$, 2006 – 2019*




*Note.* From NASA (2019).

Nearly all air pollutant data in USEPA databases are collected by states; most of the financial requirements for enforcement are funded by the states; and more than three-quarters of resources needed to address air quality are derived from state-source revenues (Heckman, 2012; Potoski & Woods, 2002; Rabe, 2007). Thus, the underlying driver for appropriations to grow in response to air pollution is due to public sector costs to implement programs necessary to carry-out statutory requirements and policy initiatives (e.g. NAAQS air monitoring, writing permits, managing programs, conducting inspections, and pursuing enforcement actions). From the literature, we learn that "states tailor the vigor of their enforcement programs [thus costs] to fit the scope of the pollution problem" (Potoski & Woods, 2002, p. 213). Evidence from the academic literature supports this proposition revealing that states tend to enact more stringent pollution control regulations based on the pollution severity within the state (Lester et al., 1983; Lester & Lombard, 1990; Ringquist, 1994). The increased regulations and increased personnel costs represent approximately 70 percent of subnational government expenditures across state government functions (Globerman & Vining, 1996; Mikesell, 2018).

A fundamental argument in this dissertation is that the fiscal responsiveness of environmental agencies ought to be increasing in response to the persistence of elevated criteria pollutant emissions and exorbitant ambient concentrations of $CO_2$ (NASA, 2019). However, as O'Hare (2006) pointed-out, it is up to the public agency to make their case for increased appropriations; as one legislator observed "we can't justify giving them more money, when there's no analytic basis for that justification" (p. 529). Along a similar vein, it is argued the political pressure created by environmental problems are matched by governmental responses but only when conditions are conducive (Bacot & Dawes, 1997; Hays et al., 1996; Konisky & Woods, 2012; Lowry, 1992; Newmark & Witko, 2007; Potoski & Woods, 2002).

Studies of the connection between pollution and environmental budgets proliferated in the 1990s (Agthe et al., 1996; Davis & Feiock, 1992; Lester, 1995; Lester & Lombard, 1990; Ringquist, 1993; 1994; 1995). One study found pollution "to be the most substantial determinant" of environmental expenditures among the states analyzed out of the ten variables assessed (Bacot & Dawes, 1997, p. 129). Though informative, these studies were followed by only a few studies (e.g. Clark & Whitford, 2011; Konisky & Woods, 2012; Newmark & Witko, 2008). Based on a review of the literature, there is a research consensus on the relationship between pollution and environmental spending which supports pollution severity as a key focal variable. However, a review of the literature reveals a lack of research on the influence of business interests and budgets despite our understanding of the polluting sectors' overwhelming impact on US environmental policy.

Rosenbaum (2017) observed "no interest has exploited the right to take part in the governmental process more pervasively or successfully than has business" (p. 45). In the early literature on private firms and environmental policy, the disproportionate role of business interests in policymaking was hi-lighted (Buchanan & Tullock, 1975). Olson (1965) attributed the aptitude of business interests to impact public policy to their capacity to unify and share resources to achieve specific policy objectives. This perspective was reinforced by Baumgartner and Leech (2001) who found business interests were the most politically active; had the largest membership across all interest group categories; and spent roughly 85% of their funds on lobbying efforts. Moreover, special interests are often concentrated at the state-level, thus are expected to apply pressure on state governments in particular (Lee et al., 2013; Ringquist, 1994).

Supporting an emphasis at the state-level, Rabe (2017) observed business interests composed of heavily-polluting activities were very active, and largely successful, in lobbying state legislators for reduced industry taxes. This reduced tax revenue has a consequent effect on the states' general funds, thus resources available for environmental agency budgets. In another study of business interests and public policy, O'Hare (2006) found that business groups lobby for reduced user fees for permits which consequently reduces agency funds. This study argued when business interests are active, governments' fiscal responsiveness to pollution severity is undermined due to politically-motivated, and connected, interests seeking to minimize their share of the fixed and variable costs associated with environmental compliance. Thus, rational self-interested member firms join business interest groups to achieve material benefits despite their individual firm-level costs of joining which, Olson observed, would generally be a dissuasive force to joining (Lyons, 1999).

The costs businesses seek to reduce with this lobbying activity include regulatory compliance costs estimated at over $200 billion per year—60 percent of which "are borne by corporations seeking to meet their statutory obligations" (Kraft, 2017, p. 78). As it relates to pollution abatement regulations, it has been found that worsening air quality and nonattainment status leads to increased firm-level costs for regulatory compliance (Becker, 2005; Carr, 2011b). For example, these increased industrial sector costs are partly attributable to the technology-based regulations set forth under the Clean Air Act (e.g. New Source Performance Standards and National Emissions Standards for Hazardous Air Pollutants).

Durant (2017) noted that environmental agency's authority to promulgate pollution abatement regulations is impeded by business interests via lawsuits that either delay rulemaking; perpetuate the status quo; or result in carve-outs for politically powerful industries. Along a similar vein, business interests have an effect on budget policy through their efforts, and success, at blocking these environmental regulations—particularly those aimed at reducing greenhouse gas emissions (Baumgartner & Leech, 2001; Falke, 2011). To the extent lobbying by business interests prevents rule promulgation, this places downward pressure on environmental budgets given a reduced need for additional personnel for implementation.

Given these influences, the impacts of business interests on environmental public policy has been the focus of research for several decades (Davies & Davies, 1975; Dell, 2009; Hays et al., 1996; Moore & Giovinazzo, 2011). While Bacot and Dawes (1997) found no meaningful direct influence between business interests and environmental policy, other research found business interests had a negative influence on state agency funding, spending, and effort (Clark & Whitford, 2011; Konisky & Woods, 2012). Despite the theoretical and practical justifications for examining the interaction effects of business interests and environmental pollution on appropriations, business interests have mostly been hypothesized to exert only "simple main effects" on appropriations (Bacot & Dawes, 1997; Clark & Whitford, 2011; Jaccard & Turrisi, 2003, p. 4; Konisky & Woods, 2012). Of these studies, all coefficients were in the expected direction—(i.e. negative)—with the coefficient on the regression term statistically significant in two of the three studies.

Though this previous literature revealed the importance of business interests as an important political factor, only one study examined the interaction of business interests and pollution on environmental appropriations. In that study, Newmark and Witko (2007) did not find evidence environmental problems led to greater expenditures directly though their analysis did highlight the interaction between special interests and pollution, thus marking a key scholarly contribution regarding the conditional nature of the relationship between pollution and funding. More specifically, the authors found the coefficient on the interaction term was not significant thus concluded no interaction which differs from the statistical analysis interpretation and approach used in this dissertation. It deserves mentioning that Newmark and Witko's (2007) study was based on only one year of data; used a different fiscal measure; and relied upon business registrants versus business interest measures with greater representation in the academic literature (Bacot & Dawes, 1996; 1997; Clark & Whitford, 2011; Konisky & Woods, 2012).

To review, this dissertation does not examine the *direct* effect of pollution on appropriations, since environmental agencies are but one actor in budget proposal formulation. After all, public budgeting involves the "interaction of numerous players", and stakeholders have varying values and objectives that indirectly condition this complex process (Lindblom, 1982; Willoughby & Finn, 1996, p. 524). While environmental public managers have a sense of the pollution severity in their state and, presumably, broker that knowledge to public budgeters for the funding that would otherwise be appropriated to another agency (O'Hare, 2006), I posit that business interests conditions must be sufficiently low so as not to undermine fiscal responsiveness.

Rational self-interest theory, together with the academic literature, informs my decision to posit the relationship between environmental pollution and environmental appropriations is *moderated*—depending on the prevalence of polluting business interests among the states. That is, I expect agency appropriations in response to air pollution will vary across the continuum of business interests. Providing theoretical support for an interactive effect is Lyons (1999) who pointed-out the influence of industrial interest groups as explicated through rational self-interest theory drawing from Olson's seminal work.

Again, from the academic literature, Bromley-Trujillo (2016) posited, and found, that states with a higher concentration of business interests, such as in the mining sector, would be less likely to support environmentally proactive policies. It follows that business interests condition the relationship between pollution and budgets given that public-sector remedies for negative externalities involve imposing firm-level expenditures "equal to the marginal cost of pollution" to achieve socially desirable outcomes (Stiglitz, 1986, p. 185). Thus, the effect of pollution on environmental budgets is such that as business interest levels increase so too does lobbying pressure to stymie legislative and regulatory efforts to curb pollution. After all, these pollution abatement regulations increase costs for those industrial sectors that contribute the most to air pollution (e.g. utilities, manufacturing, and mining sources) which include increased capital expenditures for pollution control equipment. This increased lobbying by business interests is hypothesized to undermine what would otherwise be a more responsive association between pollution and agency budget policy reflective of an aspirational principle of fiscally responsive environmental governance. That is, state environmental agencies appropriate more in response to pollution severity but only when business interest conditions are sufficient to accommodate this fiscal responsiveness.

*H1:* Air pollution severity will increase environmental agency budgets, if levels of polluting business interests of states are sufficiently low.

#### *2.3.2.2. Civic environmentalism influencing budgets.*

Linking the allegiances that emerge in civil society (Wapner & Kantel, 2017) to environmental concerns, John (2004) conceptualized civic environmentalism as a participatory embodiment of environmental governance focused on environmental protection. Including this variable does not require that citizens are particularly focused on pollution and environmental budgets. After all, "for many agencies, many citizens will not have very clear ideas regarding the agency's current level of funding or what funding would be suitable for next year" (Nice, 2002, p. 59). However, as Basu and Devaraj (2014) noted, citizens are notably "proactive about cleaning up the air they breathe", thus establishing a logical connection between civil society and environmental budget policy (p. 936). It has been argued that this civil support is needed by "decisionmakers– who may be less able to steer society in a hierarchical way" in setting environmental agency budget policy (Glucker, Driessen, Kolhoff, & Runhaar, 2013).

Also referred to as decision-making "environmentalism" (Clark & Whitford, 2011), or "legislative greenness" (Konisky & Woods, 2012), civic environmentalism is represented by the voting records on environmental legislation and is indicative of how favorable a states' citizenry is to environmental protection policy (Clark & Whitford, 2011; Fowler, 2016). Civic environmentalism relates to the environmental political climate existing during the budget deliberation phase (Willoughby & Finn, 1996). In this dissertation, the concept reflects the extent to which the federal legislative delegation for a state is formulating and legitimating environmentally proactive policy.

From the public budgeting literature, it is offered "decisions must be made by the populace and their elected leaders to provide these resources" (Lee et al., 2013, p. 618).

Academic research shows when civil society demands specific environmental outcomes, for example, enhanced air quality or stricter regulations on lead in drinking water, civic environmentalism influences public policy (Fukuyama, 2001; Hays, 2000; Li & Reuveny, 2006; List & Sturm, 2006). Previous researchers observed citizens exert control over environmental conditions through their voting preferences for "political candidates with strong environmental agendas" underscoring the importance of empirically assessing this variable (Takahashi, Tandoc, Duan, Van Witsen, 2017). Butler and Nickerson (2011) explained this linkage between constituents and voting behavior as a function of the elected officials' attempts to avoid, or at least minimize, electoral retribution, or backlash which finds support in the political science literature (Arnold, 1992; Kim & Urpelainen, 2017).

Findings from previous research on the association between civic environmentalism and state environmental agency budgets are limited and mixed. While some studies observe that citizen greenness (i.e. civic environmentalism) and involvement had limited, or even negative, impacts on governmental policy-making (Fiorino, 1989; Steinemann, 2000; Ventriss & Kuentzel, 2005), other scholarship revealed the positive influence of citizen involvement (Bingham, Nabatchi, & O'Leary, 2005; Neshkova & Guo, 2012). For example, while Clark and Whitford (2011) found legislative greenness increased funding, research by Konisky and Woods (2012) revealed an inverse relationship. The latter study offers a particularly interesting finding, since it implies states with citizens who elect a "greener" federal legislative delegation fund their environmental agencies less than states with environmentally-laggard federal legislators. Basu and Devaraj (2014) analyzed the association between civil greenness and environmental policy stringency through the preferences voiced by a similar concept—termed the 'green voter'—

finding that, on the whole, this variable had the largest positive impact on air pollution abatement spending compared to other programs.

While a related concept of pro-environmental behavior of citizens has been evaluated in previous research (Bacot & Dawes, 1996; Clark & Whitford, 2011; Davis & Feiock, 1992; Hall & Kerr, 1991), the operationalization often involves datasets that are either not continuously updated, or are unavailable for empirical analysis—(e.g. current environmental group membership data are often not shared by the groups) (Anderson, 2011). In addition to the practical obstacles (e.g. data availability and reliability), the concept *civic environmentalism* is used to provide an electoral-based linkage of similar attributes that *environmental interest group* membership captures. For example, Anderson (2011) noted the congruence between League of Conservation Voter (LCV) scores—used to operationalize the concept in this dissertation—and environmental groups, supporting the notion that these concepts, though different, are capturing overlapping, similar, dimensions.

Previous research finds state-level environmental and natural resource spending is positively influenced by state environmental group activism, and states' congressional delegation positions on environmental issues corresponded to increased funds (Clark & Whitford, 2011). That study, however, focused on natural resource spending combined with environmental protection spending *and* analyzed civic environmentalism through a surrogate measure that relied upon the per capita membership in environmental groups (e.g. Sierra Club membership). Alternatively, this dissertation applies a concept that affords examination of the linkages between states' civic-legislative environmental demands with state-source funding (Agyeman & Angus, 2003; Knopman, et al., 1999) leading to the hypothesis that follows.

> ***H2:*** Civic environmentalism will have a positive influence on environmental agency budgets.

#### *2.3.2.3. Climate policies influencing budgets.*

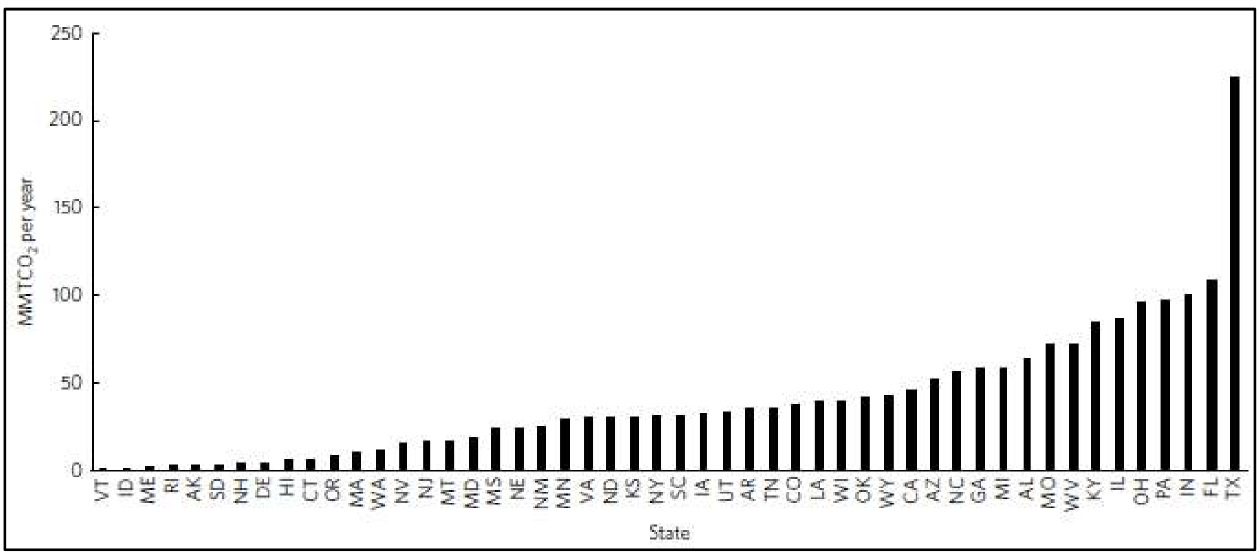
Fiack and Kamieniecki (2015) observed in response to federal government inaction, states have taken the lead at formulating and implementing climate change policies. States often compensate for a lack of federal climate change policy "by developing, replicating, and collaboratively implementing climate change policies" (Bromley-Trujillo et al., 2016, p. 544). Despite these trends, "while research on the policy and politics of state-level climate change policymaking has grown in recent years, the amount and scope of research has not kept pace with growth in the saliency and urgency of the climate change issue" (Rabe, 2010, p. 264). Since there has been no prior literature on the influence of climate policies on environmental agency budgets, this section will summarize efforts taken to mitigate $CO_2$ emissions; will provide justification for the measure of state-level policies used; and will conclude with the hypothesis.

Global climate change is caused by anthropogenic GHG emissions, and the impacts are extensive involving: increasing mean sea levels; increasing ambient temperatures; increasing frequency and severity of storms; changes in biodiversity; species migration; changing of climate patterns; and increased foodborne pathogens and illnesses (Axelrod & VanDeveer, 2017; Lake & Barker, 2018; Lesnikowski et al., 2013; Neumann et al., 2015). These endpoints, the United Nations Intergovernmental Panel on Climate Change (IPCC) points out, "have significant implications for extreme weather events, development, economic stability, and population and economic health" (IPCC, 2000; IPCC, 2007; Lesnikowski et al., 2013).

Despite the advent of meaningful federal regulations to reduce GHG emissions, in November, 2015 the US Senate blocked the Clean Power Plan—the rule promulgated under the Obama-era USEPA which mandated $CO_2$ emissions reductions to address global climate change in *West Virginia et al. USEPA et al.* (2016). The Supreme Court went on to issue a stay of the Clean Power Plan in 2016 marking the first issuance of a Supreme Court stay to block implementation of a USEPA rule in the Court's history. The torpid pace by which the national government has legitimated policies aimed at curbing GHG emissions contrasts with an increased tempo in mandatory climate policy legitimation at the subnational levels of government to address these emissions—predominately of $CO_2$ (Nelson, Rose, Wei, Peterson, & Wennberg, 2015; Posner, 2010). As Figure 10 depicts, the $CO_2$ emissions vary by state.

Figure 10.

*$CO_2$ State-Level Emissions from Power Generation Sector, 2014*




*Note:* From Martin & Saikawa (2017).

With an Executive Order signed on March 28, 2017, the Trump (2017) administration directed the recension and revocation of several Obama administration environmental policies aimed at curbing emissions and building greater understanding about the impacts of GHGs. These steps, and steps like them at the federal level leave a policy-vacuum that states continue to fill. The cascade of state energy and GHG reduction policies that ramped-up just after the case of *Massachusetts* was decided underscores the role that compensatory federalism plays in US environmental governance. For example, within a few years after the ruling in *Massachusetts*, 35 states had climate action plans with mandatory emissions reduction targets (Randolph, 2012).

The Regional Greenhouse Gas Initiative (RGGI) gained relevance as one of a few market-based cap-and trade emissions reduction programs. The current structure of RGGI sets a mandatory cap for participating states and requires a 2.5% decrease in $CO_2$ emissions, each year, from 2015 to 2020 (RGGI, 2017). If Virginia joins the current group of participating states, there will be 11 member states participating in RGGI. A similar GHG reduction program is underway in the western US (Western Climate Initiative, 2018). "All told, a total of 20 states have adopted explicit emissions reduction targets, 34 have adopted climate action plans to guide future initiatives and meet goals, and 30 states have binding [Renewable Performance Standard] RPS targets to increase the share of renewables in their energy grids" (Cyrs, 2018, p. 2).

Subnational governments have largely taken the lead in GHG mitigation policies post-*Massachusetts* (Martin & Saikawa, 2017; Yi & Feiock, 2015). Cyrs (2018) observes, state governments continue to set policies "on-par with that of the most ambitious EU countries" (p. 1). The trend of state governments filling ever-expanding roles will require a commensurate level of financial commitment to formulate and implement the necessary environmental policies. Accordingly, this dissertation focuses on the category of policies state policymakers have advanced to mitigate GHG emissions—that is, the climate policies that will "change the energy landscape in ways that have implications for GHG emissions and climate change" and that have been "easier to garner bipartisan support" (Martin & Saikawa, 2017, p. 912).

Within the conceptual model, this variable is a legal factor that represents the extent to which states have adopted mandatory policies to mitigate $CO_2$ emissions. As noted, the lack of national government policies to curb these emissions has been partially-offset by an increase in climate action through subnational policies due to compensatory federalism (Posner, 2010; Nelson et al., 2015). "States are likely to have primary implementation authority for most economy-wide and sector-level federal climate policies, such as power plant combustion efficiency standards" (Nelson et al., 2015, p. 98). Given the extent to which states have taken great strides in recent years to mitigate GHG emissions through regulatory programs which require government revenues to administer, I hypothesize a positive influence of these policies on environmental appropriations.

***H3:*** Mandatory climate policies will result in higher environmental agency budgets.

***2.3.2.4. Legislative professionalization influencing budgets.***

The uncertainties in the scientific understanding of environmental pollution and the risks it poses (Steinemann, 2000), create tensions that make setting an appropriate level of environmental appropriations as much a political as a scientific endeavor (Stone, 2014). As Rosenbaum observed, resolving these issues within the political process that "arise in making scientific and political judgements compatible are two of the most troublesome characteristics of environmental politics" (2016, p. 133). *Legislative professionalization* reflects the "institutional capacity within state legislatures and legislators" (Squire, 2017, p. 1). This political factor represents the capacity of state legislatures to analyze and process information related to formulating and legitimating public policy (Squire, 2012; 2017).

Mooney (1995) observed that increased professionalism of legislators enhances their ability to broker information; facilitates engagement with other actors in the budgeting process; and results in greater control and influence over the budget. Previous research (e.g. Hays et al., 1996) found states with more professionalized legislatures have more protective environmental policies; however, this variable remains under-examined with only a single study investigating the influence on environmental agency funding. In that study, Konisky and Woods (2012) found no statistically significant association between professionalization and state environmental spending and revealed an unanticipated inverse relationship between professionalism and the stringency of state environmental agencies. This is a somewhat surprising result given that one might expect more professionalized state legislatures to increase appropriations in response to pollution problems to avoid preemption by USEPA (Heckman, 2012; Wood, 1991). Preemption is taken by USEPA when “subnational government performance is unsatisfactory” (Wood, 1991, p. 852), and is avoided by states given the resulting consolidation of power at the national level (i.e. loss of agency autonomy) (Nelson et al., 2015).

While scientific uncertainty can make the process of identifying adequate appropriations levels more difficult, higher levels of organizational capacity should “theoretically yield more effective program management” and, consequently, increasingly responsive budget policy (Bacot & Dawes, 1996, p. 125). Also, a positive association between professionalism and environmental budgets reflects an assertiveness by state legislators to champion budget policy that pursues constituent benefits related to environmental protection (Abney & Lauth, 1998; Ryu et al., 2008). Taken together, professionalism of the legislature reflects the institutional capacity across the states to interpret the complex demands from the political process in response to environmental pollution, thus is hypothesized to have a positive influence on appropriations (Cline, 2003).

> ***H4:*** Legislative professionalization will have a positive influence on environmental agency budgets.

***2.3.2.5. Partisan ideology and environmental budgets.***

The public budgeting scholar Robert Bland (2007) described the effect of partisan, or political, ideology on public budget policy succinctly—“budgets are political” (p. 6). Politics in public budgeting operate along a continuum—ranging from an intrusion on what ought to be a wholly technical process—to a necessary feature needed to attenuate conflict between groups and bring about resolution (Rubin, 2010). As it relates to this section, politics refer to the ideology of state legislatures reflected by each party's relative control over state government following a two-party model (i.e. Republican or Democrat).

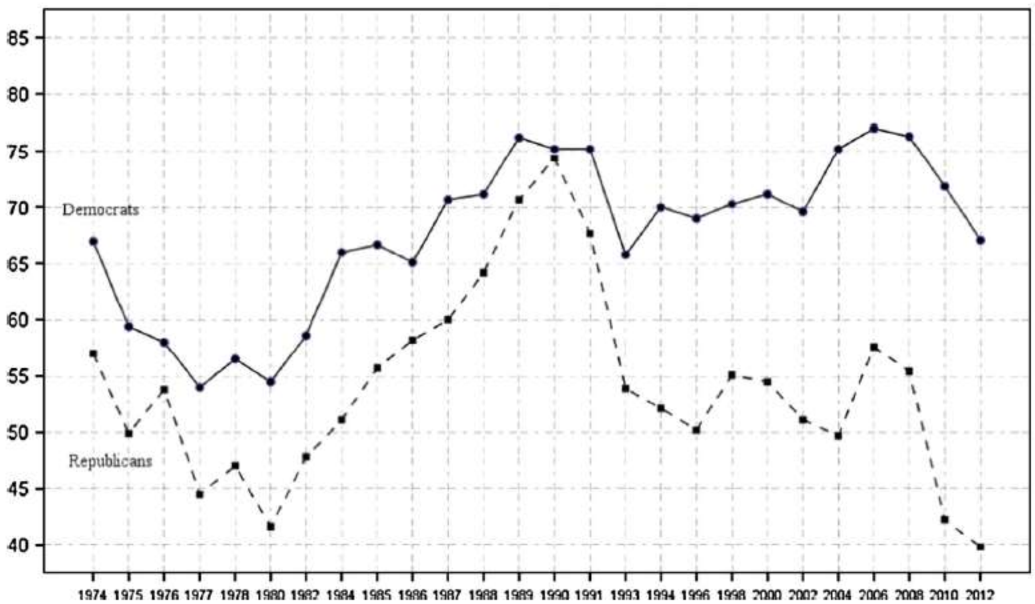
Numerous academic studies suggest liberal and Democrat-identifying individuals tend to express greater support for environmental programs and policies than Republicans (Davis & Fisk, 2014; Dunlap, Xiao, & McCright, 2001; Fowler & Breen, 2013; Konisky, Milyo, & Richardson, 2008). That is, while environmental protection had been a relatively "politically consensual" issue area for elected officials for many decades, Democrats have become more supportive of environmentally proactive policies compared to Republicans particularly with regard to public policies aimed at addressing air pollutants (Bromley-Trujillo, Butler, Poe, & Davis, 2016; Davis & Fisk, 2014; Dunlap & Gale, 1974; Jacques, Dunlap, & Freeman, 2008; McCright, Xiao, & Dunlap, 2014, p. 251). A growing body of research underscores the direct role that partisan identification has on public policy (Cragg, Zhou, Gurney, & Kahn, 2013; Elazar, 1984; Kraft & Furlong, 2015). In their analysis of the effects of partisan ideology on USEPA budgets, Balint and Conant (2013) advanced a conceptual model that included a prominent role for partisan political factors. Other research, however, suggests the influence of partisan identification on environmental policy is inconsistent at best (Bacot & Dawes, 1997; Ringquist, 1993).

Considered a political factor in the conceptual model for this dissertation, political ideological orientations impact public budgeting along several points in the policy process. For example, at the budget deliberation stage, political ideology informs how elected leaders might spend increased revenues forecasted by their budget offices (Bland, 2007). More specifically, cutting taxes is often sought by conservatives, or Republicans, while increasing spending for government programs is typically associated with Democrat control of government (Lee et al., 2013). Supporting assertions of these direct effects from the public budgeting literature, are empirical findings that reveal an inverse relationship between Republican-control and state agency appropriations (Ryu et al., 2008).

McCright et al. (2014) observed that political preferences have become one of the most powerful predictors of environmental policy based on their review of survey data from the general public and their canvassing of previous research. Adding to the studies that show overall liberal and Democrat-identifying individuals express greater support for environmental programs and policies, Wan, Shen, and Choi (2017) found similar linkages between partisan ideology and environmental support observed in their cross-national study of European countries. Instead of being a "politically consensual" issue as it was in the late 1980s and early 1990s, McCright et al. (2014) found the percentage of respondents who perceived the government spends *too little* on the environment decreased substantially for Republicans between 1974 and 2012 while such a downward trend was not observable among Democrat respondents (p. 251). Notably, the responses between the survey participants who self-identified as liberal rather than conservative highly corresponded to the Democrat versus Republican self-identification. The survey responses in Figure 11 depict the percentages of self-identified Republicans and Democrats reporting on their perception that national government spending on the environment is "too little" from 1974 - 2012 (McCright et al., 2014).

Figure 11.

*Perceptions of Environmental Spending by Party-Affiliation*




*Note.* From McCright et al., 2014.

While some literature found no empirical evidence of ideology impacting environmental policy based on the partisan-control of state government (Anderson, 2011; Balint & Conant, 2013) other scholarship revealed an important influence (e.g. Clark & Whitford, 2011; Konisky & Woods, 2012; Woods et al., 2008). More specifically, Clark and Whitford (2011) found that "the demand for environmental spending is met with resistance by republican unified control of state legislative and executive branches" (p. 149). Similarly, Konisky and Woods (2012) found states under Democrat control realized higher environmental spending and more environmental enforcement, *ceteris paribus*. Overall, despite the literature highlighting the influence of partisan ideology on state environmental policy (Dunlap & Gale, 1974; Hays et al., 1996; Lombard, 1990), there are only a few studies that examine to what extent partisan ideology of the state legislatures influences appropriations. For example, Clark and Whitford (2011) found that under Democrat control of the state legislature, environmental and natural resource spending was higher—an increase of $10.8 million—than under Republican control—a decrease of $24.1 million at the state-level. This effect was observable only at the state-level of funding (i.e. there was no significant relationship at the federal-level)—a finding that provides further support for the following hypothesis.

> ***H5:*** Liberal ideology will have a positive influence on environmental agency budgets.

The role of political partisanship on public budgeting decisions is particularly distinctive in democracies due to the comparative openness of the budgetary decisions allowing the process to be shaped by external factors including by political parties (Nice, 2002; Rubin, 2010). How precisely political ideology influences appropriations, however, is less clear. For example, it has been argued that "[environmental] problem severity does not directly influence spending, but instead, the severity of environmental problems is filtered through the political process" suggesting an interaction, or conditional, effect of political ideology on appropriations versus a main effect (Newmark & Witko, 2007, p. 303). Further complicating the picture, is another possibility.

Partisan ideology *could* act as a mediator in the relationship between pollution and appropriations—representing a discernable process that helps explain the causal relationship between pollution and budgets. Hypothesis 5 has been developed with sufficient attention to these ambiguities (e.g. viewing partisan ideology as a moderator, or mediator) *and* with deference to the academic literature where examining the *main effect* has resonance. While I do not deny either of these alternatives (e.g. moderation or mediation) are appropriate ways in which to view the role of partisan ideology in the context of air pollution and appropriations, it is also defensible to test for the existence of a relatively straightforward direct relationship (i.e. that, across the states, Democrats tend to appropriate more to environmental agencies than

Republicans). Nevertheless, future avenues for research, discussed in Chapter 5, includes an alternative to examining the direct effects of political ideology on appropriations.

***2.3.2.6. Fiscal capacity influencing budgets.***

State fiscal capacity is defined as the "ability of a state to raise revenues to meet its spending requirements", and it is categorized as a fiscal factor in the conceptual model for this dissertation (Lee et al., 2013, p. 553). Environmental regulations require compliance and enforcement efforts at the state-level which cost money, so a state's wealth can determine the resources regulators have to implement policy. In public budgeting, revenues are a driving force behind expenditures, thus policymakers, particularly chief executives, can be expected to a "set broad budget ceiling for overall spending and revenues based on…the overall availability and certainty of…expected resources" particularly for state-source funding (Ryu et al., 2008).

Long-term economic forces, such as the wealth of a state's economy can have enduring effects on spending for public programs—that is, patterns suggest that, *ceteris paribus*, a rich state will often spend more than a poorer state (Nice, 2002). "Fiscal and economic climates of the state and nation perhaps most overtly influence state budget management capacity; a poor economy generates fewer revenues and greater expenditure needs of governments" (Willoughby, 2008, p. 433). Similarly, in a seminal work on state agency budgets, Sharkansky (1968) found high levels of expenditures and debt among the states caused appropriations committees to provide less funds to the acquisitive agencies.

Kraft and Furlong (2015) observed that though states have achieved greater economic capacity for environmental policy over the past four decades, there remain large variations in funding. Considered together, these observations justify consideration of whether states *can* be fiscally responsive to pollution when analyzing whether they *will* be. As observed by Bacot and

Dawes (1996), the financial resources a state has speaks to the capacity of that state to implement policies and programs that ensure compliance with the regulations promulgated under the enabling legislation (e.g. Clean Air Act).

Based on a closer examination of the environmental policy literature, it has been suggested, and sometimes demonstrated, the capacity to raise revenue can either enable, or constrain environmental spending and protection efforts (Agthe et al., 1996; Bacot & Dawes, 1997; Newmark & Wiko, 2007; Ringquist, 1993). That is, even though environmental agency public managers are quantifying and conveying the pollution problem *and* presuming legislators are grasping what these agencies require, oftentimes "there's [just] not enough to go around" (O'Hare, 2006, p. 529). In other words, public budgets are sensitive to the certainty and availability of expected revenues (Ryu et al., 2008). Also from the environmental policy literature, we have learned the demand for public goods—like environmental protection—tends to rise with state wealth (Bacot & Dawes, 1997; Hays et al., 1996; Konisky & Woods, 2012; Lowry, 1992; Potoski & Woods, 2002). Relatedly, "regulation costs money"; therefore, I hypothesize as fiscal capacity is higher across the states, so too will be appropriations for environmental protection (Ringquist, 1993, p. 88).

**H6:** Fiscal capacity will have a positive influence on environmental agency budgets.

The next section will begin by describing the role of *fiscal federalism* as it relates to the level of analysis in this dissertation.

**2.4. Literature Emphasizing State-Level of Analysis**

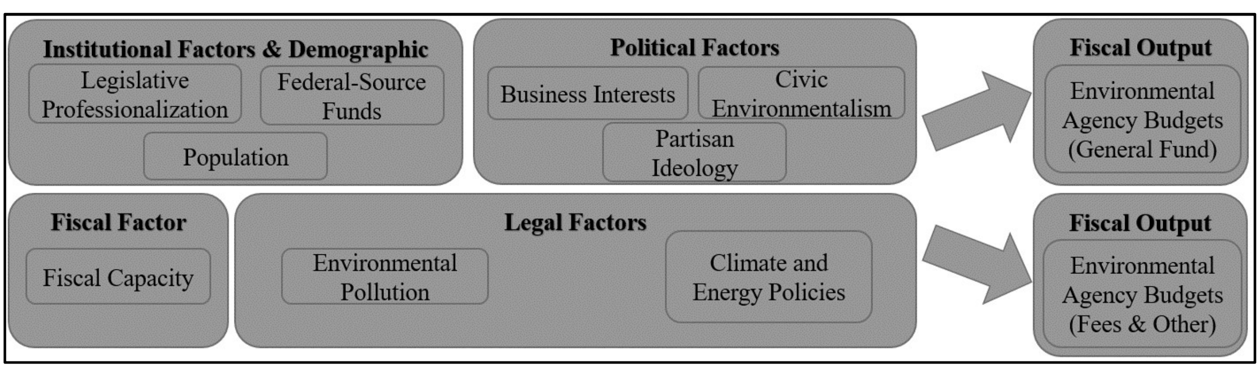
*Fiscal federalism* informs the focus on state own-source funding in my study. This "subfield of public finance" involves fiscal decentralization based on a belief that state governments, "being closer to the people", will be more responsive, since it is macroeconomic policy functions (e.g. growth, unemployment, inflation) for which federal government control is preferred (Oates, 1999, p. 1120). Oates (1999) is further instructive in relating fiscal federalism to environmental governance noting that the system enabled states to experiment and innovate on air pollution control where there was "serious doubt" such actions would have been taken at the national level (p. 1132). As Greer and Denison (2016) observed, fiscal federalism involves decentralization and devolution of authorities and is driven in "large part by political institutions and fiscal traditions that change slowly over time" and for which a preference grows by civil society to demand greater responsiveness from subnational levels of government (p. 126).

The dynamics and factors that influence state and federal-source funding of state agencies are not identical with states acting much more as "fiscal free agents" having more discretion over their fiscal policy than the central government (Endersby & Towle, 1997; Mikesell, 2018, p. 215; Sharkansky, 1968). Similarly, Nice (2002) observed, "most states permit agencies to submit their original budget requests to the state legislature, along with the governor's budget recommendation. That practice probably gives [state] agency personnel more opportunities to be advocates for their programs, in contrast to the national government's use of central clearance" (p. 65). When considered together, the research suggests that while state-source and federal-source environmental budget policy are related, they are not identical (Clark & Whitford, 2011); therefore, should not be aggregated in empirical analyses. A closer look at federal-source environmental funding reinforces this latter point.

Two decades ago, 70 percent of the budgetary requirements of state environmental agencies was provided by the federal government; by the early 2000s, this level shrank to only 30 percent (Woods et al., 2008), and continues to decrease (ECOS, 2017a). Moreover, between 1981 and 2005, federal government contributions to state governments for education and health increased 415% and 980%, respectively, while transfer funding to environmental agencies decreased 12% (Gormley, 2006). In addition, historically states have had to either spend more of their own general funds, or to raise revenue through additional industry fees to meet federal pollution laws (Davis and Lester, 1987). Moreover, what little federal-source dollars *do* flow to the environmental agencies are not for discretionary use but are either dedicated clean-up funds, or to resource specific grant programs (USEPA, 2018a). Overall, state funding sources contribute nearly 80% of state environmental budgets (ECOS, 2017b) and most of the discretionary environmental funding.

Lester and Lombard (1990) observed, state environmental policy research continues to specify models on the assumption federal-level variables will not affect state policy outputs, or vice versa. Offering several examples that dispel this conventional wisdom, they concluded that future state environmental policy research would be improved by considering the national *and* subnational levels of government in explaining state policy outputs. Thus, federal-source funding, along with state population, is included within the conceptual model revisited in Figure 12, to control for its effects on state own-source funding.

Figure 12. *Conceptual Model of Dissertation*




Further supporting the state-level of analysis are two additional concepts—*federalism*, which refers to the "division of jurisdictions to decentralize government" (Wills, 2001, p. 169), and *devolution*—"the shift in functions or responsibilities from one jurisdiction to another" (Woods & Potoski, 2010, p. 722). While the USEPA develops policy through rulemakings to implement the environmental laws enacted by Congress, many USEPA authorities are delegated to the states. Given that the majority of states are Dillon's Rule states and major environmental regulations are codified in federal and state statues, the devolution of power to local governments is limited across a range of environmental protection functions (Stenberg, 1985). For example, while there is an array of networks and initiatives at the local jurisdictional level, no official authorities are granted to localities through the Clean Air Act (Bacot & Dawes, 1996; Bardach & Patashnik, 2016; Fowler, 2016).

The CAA confers authority to the USEPA to establish mandatory air emissions standards; directs the USEPA to establish programs to control and reduce air emissions from stationary (e.g. factories and power plants) and mobile (e.g. cars and trucks) sources; and grants certain limited discretionary authorities to the USEPA regarding when it must, and when it may refrain from, regulating specific air pollutants (Reitze, 2005). Implementing the CAA at the federal and state level has come to involve a multi-layered environmental governance that derives from the US government's federalist structure. This structure accommodates a continuum of national versus state-level control over environmental policy (e.g. *contested federalism*, *cooperative federalism*, and *compensatory federalism*) having implications for designing research of state environmental policy (Durant et al., 2017).

For example, though emissions standards for air pollutants are almost exclusively established through rules promulgated by the USEPA, the authority to formulate and implement environmental public policy, including compliance and enforcement activities, is shared with state environmental agencies (Grant et al., 2014; Wood, 1991). This arrangement—also referred to as *cooperative federalism*—requires state governments to be active participants that request authorization from USEPA to administer their own environmental agencies. Over the past 45 years, there has been an overarching period of cooperative federalism which started with the federal government exercising its authority to set various national performance standards that all states must meet—minimum standards, or *federal floors*, that promote alignment with national environmental policy goals (ECOS, 2017a; Nelson et al., 2015). Cooperative federalism involves an active role for states that request authorization from USEPA to address environmental pollution. All 50 American states have received USEPA authorization to operate environmental agencies structured to achieve the national pollution standards, or state-specific pollution standards should the latter be equally, or more, protective (Konisky & Woods, 2016; Woods, 2006).

Despite a period during the George W. Bush Administration in the 2000s where conflict between the federal and state environmental agencies over centralized authorities was the highest in the previous two decades (i.e. *contested federalism*) the decentralization of responsibilities from the central government to the states has been the general trend (Rabe, 2007). Particularly noteworthy was the accelerated delegation of decisions regarding permitting and enforcement authority, responsibility, and accountability during the George H.W. Bush and Clinton administrations (Rabe, 2007). This acceleration of devolution was aided by the National Academy of Public Administration (1995) that found increasing the role of state environmental agencies, in partnership with the federal government, would be crucial for effective, flexible, and accountable environmental governance. Though there have been "ebbs and flows", this devolution began in the late-1970s and continues despite efforts by the Trump-era USEPA at redirecting environmental policy by contesting state air pollution control efforts (e.g. California) (Davis & Lester, 1987; Konisky & Woods, 2012, p. 544; 2018; Rabe, 2017).

As an alternative to cooperative federalism, or the contested federalism that has recently welled-up again in environmental governance, Derthick (2010) noted that states have compensated for the lack of federal government action on pressing environmental issues, such as global climate change, ushering in a period of *compensatory federalism*—an environmental governance outcome facilitated by the courts, as the Supreme Court case of *Massachusetts v. United States Environmental Protection Agency* (2007) laid bare. The devolution of authority, responsibility, and accountability from the federal to the state environmental agencies has resulted in notable policies at the state-level which establish requirements that are more stringent than federal requirements (Chupp, 2011).

Because of this decentralization, state environmental agencies, and their frontline workers, now execute 96 percent of the environmental workload; operate 75 percent of the environmental programs; and "collect nearly 95 percent of the data used by the USEPA" (ECOS, 2017b; Rabe, 2007, p. 422; Rinfret & Pautz, 2013). Their role is robust in carrying out the requirements of the CAA. Though only 25% of the revenue to state air quality programs comes from federal-source funds, the majority of compliance and enforcement activities are executed by the state agencies as it relates to the control and abatement of criteria air pollutant emissions (Heckman, 2012). All 50 states have been delegated authority to implement clean air policy—more than any other program (Fowler, 2016).

# Chapter 3: Methodology

## 3.1. Research Design

This dissertation is based on a quantitative non-experimental research design using secondary data. The following subsections provide more information on the unit of analysis, the time dimension, and research design. These subsections are followed by the statistical analysis plan; validity and limitations before concluding with advantages, limitations and a restatement of the implications and contributions of this study.

## 3.2. Time Dimension & Unit of Analysis

The cases of research interest are the states, and the unit of analysis is the state environmental agency budget—for which each state has only one—and are listed in Table 2. Environmental agency budget data are either not available, or were reported as $0.00 for the following states: Florida, Louisiana, Iowa, North Carolina, New Jersey, and New Mexico. The sample, is consequently reduced for *general funds* and *fees and other sources* according to the state environmental agencies that *did* respond with appropriations data to ECOS across the five years—2011, 2012, 2013, 2014, and 2015—which represent the years for which the most complete funding records are currently available (ECOS, 2012; 2017b). The unit of analysis is each individual state environmental agency budget each year it is observed. The quantity of entities, $n = 47$ (states); the time period $t = 5$ (2011 - 2015); and the quantity of observations $T$ ranges from 250 to 232 given the aforementioned lack of data for certain years for the budget data particularly for appropriations from the general fund.

This reduced sample size —and correspondingly larger standard errors—makes goodness of fit and detecting statistically significance more challenging which reinforces the need for careful specification of the models. Larger standard errors essentially makes it less likely to detect statistical significance on the regression and interaction terms. Despite not having a large sample size, the sample *is* compatible with the recommendation of Tabachnick and Fidell (2007) who recommended $N > 50 + 8m$ (where $m$ = quantity of independent variables). That is, with nine variables, the threshold of 122 is exceeded suggesting adequacy of the sample size.

This dataset structure is panel (i.e. longitudinal data); the values for the variables are for the same units (i.e. states) over several time periods (i.e. years) which is a useful data structure when investigating the behavior—in this case budgeting policy—of the same entities over time (Kennedy, 2008). The preference of researchers to analyze panel data versus cross-sectional data derives from the increased variability and less collinearity between variables as well as opportunities to handle heterogeneity (Baltagi, 2001). Though the periods for which the variable data are available are common to all panels (i.e. states), as noted above, each panel *does not* have the same quantity of observations; therefore, the panels are unbalanced. Other than for the lack of appropriations data for a small quantity of states, each state does have the identical quantity of observations for the remaining variables across the five year panel.

**3.3. Variables, Datasets, Indicators, Hypotheses**

This study includes variables selected based on the *integrated theory*; inclusion of additional theories; consideration of public budgeting literature; and previous state environmental policy research. The regression analysis provides an examination of the effects of independent variables on the dependent variable—environmental agency budgets. Table 6 provides data sources and variable descriptions that are relevant to the analysis—(e.g. datasets and indicators)—further explanations for the variables, including equations, are included within the individual variable subsections.

Table 6

*Study Variables, Units, and Operationalization*

| ***Independent Variables*** | | | |
|---|---|---|---|
| **Name** | **Conceptualization** | **Explanation / Units** | **Source** |
| Air Pollutant Emissions | Emissions from criteria pollutants *and* $CO_2$ emissions) | Pounds of Pollutants (ln) | Calculated from (EIA, 2018; USEPA, 2018e; USEPA, 2018f) |
| Business Interests | Business lobbying interests within the state as represented by polluting sectors (manufacturing, mining, utilities) | Proportion of State GDP Contributed by Polluting Industrial Sectors as a Share of Total State GDP [0 – 1] | Calculated from Bureau of Economic Analysis Data (BEA, 2018a) |
| Civic Environmentalism | Environmentally-focused concerns of the state expressed by electoral preferences. | Average LCV Score of State Delegation to Federal Legislature [0 – 100] | Calculated from League of Conservation Voters Data (LCV, 2018) |
| Climate Policies | Mandatory state policies that directly mitigate GHGs. | Raw Count [0 or 1] | Compiled from Martin & Saikawa (2017); National Conference of State Legislatures (NCSL, 2019) |
| Partisan Ideology | Ideology of state legislature based on major party's relative control over state government. | Composite Measure (Index) of Democrat Control of State Government [0 – 1] | Calculated from (NCSL, 2010; 2011; 2012; 2013; 2014); ProQuest, 2008; 2010; 2012; 2016; 2019) |
| Legislative Professionalization | Institutional capacity of the state legislature. | Composite Measure (Index) [0 – 1] | Squire (2012; 2017) |
| Fiscal Capacity | Capacity to fund government as reflected by revenue generating potential. | Unduplicated Sum of Gross State Product and State Personal Income in U.S. Dollars (TTR) (ln) | U.S. Treasury (2019) |
| ***Controls*** | | | |
| Population | Quantity of people in state. | Millions (People) | United States Census (2019) |
| Environmental Agency Budget – Federal-Source Funds | State environmental agency budget derived from federal-source funding. | U.S. Dollars (ln) | ECOS (2012; 2017b) |
| ***Dependent Variables*** | | | |
| Environmental Agency Budget - General Fund | State environmental agency budget derived from the general fund. | U.S. Dollars (ln) | ECOS (2012; 2017b) |
| Environmental Agency Budget – Fees & Other | State environmental agency budget derived from fees and other sources. | U.S. Dollars (ln) | ECOS (2012; 2017b) |

Each of the following subsections are followed by a brief overview of the literature that supports the proposed hypothesis for each of the study variables.

**3.3.1. Air pollutant emissions.**

Environmental pollution is a negative externality produced by transactions between consumers and firms. The lack of a profit motive for industries to address environmental pollution on their own leads to a public problem, since environmental pollution contaminates *common resources* (e.g. clean air and water). The need for environmental agencies to be responsive to air pollution, in particular, is not confined to only one type of air pollutant. In addition to criteria pollutant emissions, there has emerged a policy goal among states to mitigate anthropogenic (i.e. human-caused) GHG emissions—principally $CO_2$ emissions from industrial sectors of the economy.

Konisky and Woods (2012) concluded "that the time has come for scholars to develop new measures whenever possible, with close consideration of how they can be used in a theoretically informed fashion to better our understanding of the factors that shape state environmental politics and policy" (p. 565). To answer the call from previous scholarship, environmental pollution is measured in this study using two measures. The first measure of air pollution is an interval-level composite index constructed from indicators comprised of six criteria air pollutants. The second measure of air pollution is a ratio-level measure of $CO_2$ emissions.

The emissions from criteria pollutants are obtained from USEPA's National Emissions Inventory (USEPA, 2018e). Following the approach of previous researchers, only the anthropogenic (i.e. human-caused) criteria pollutant emissions are included (Simon et al., 2015). As Heckman (2012) observed in an investigation of Clean Air Act policy outcomes, *point source* criteria pollutant emissions versus *nonpoint source* emissions are commonly employed indicators in studies involving air pollution. This methodological decision is further justified given that criteria pollutant emissions are mostly impacted by state implementation efforts given the large emphasis on SIPs as previously discussed. Moreover, control and abatement of mobile source emissions—the largest contributor to nonpoint source emissions—are largely the result of federal efficiency standards with the exception of California that has the authority to set its own vehicle engine standards.

To take into account the large variability in the magnitudes of the six criteria pollutants, a *criteria air pollution severity index* (*CAPSIDX*) is developed by calculating a *Z*-score for each pollutant in each state-year. Standardizing the criteria pollutant emissions transforms each value into comparable scores allowing the different pollutant emissions to be put on the same scale. The calculation of the standardized values involves subtracting the mean emissions for each pollutant for each state-year from each data point (i.e. emissions) following by dividing the result by the standard deviation. The resulting *Z*-scores, or re-scaled, values are summed across each state-year creating a criteria air pollution severity index. Principal components analysis—a specific technique of factor analysis—is used to group the pollutants for which the emissions strongly correlate. Essentially, PCA allows assessment of whether the emissions for each of the pollutants load onto a single factor, thus provide an empirical summary of the data (Tabachnick & Fidell, 2007). The PCA results indicate the presence of one factor. Two statistical measures assess the adequacy of the PCA which include the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. The KMO index value is 0.82 above the suggested minimum of 0.6, and the Bartlett's test of sphericity reached statistical significance ($p < 0.001$) (Tabachnick & Fiddell, 2007). The correlation matrix was also inspected with all correlation coefficients within the range of $r = 0.45$ to $r = 0.89$—above the recommended value of $r = 0.3$ (Pallant, 2010). The composite score (i.e. reliability coefficient) of the composite measure for criteria air pollution is also high (Cronbach's $\alpha = 0.91$) and above a recommended cutoff of 0.7 (DeVellis, 2003; Lance, Butts, & Michels, 2006).

The following equation was used to calculate the values for this measure of air pollution with $NO_x$ emissions as the example:

$$ZNOx_{it} = \frac{(NOx_{\ it}) - (\mu\ NOx_{\ i})}{(\sigma\ NOx_{\ i})} \quad \textbf{(1)}$$

Where $ZNOx_{it}$ is the standard score for $NO_x$ of the ith state in period t,

$NO_{x\ it}$ is the quantity of $NO_x$ emissions of the ith state in period t,

$\mu\ NO_{x\ i}$ is the mean $NO_x$ emissions of the ith state, and

$\sigma$ is the standard deviation of $NO_x$ emissions of the ith state.

The following equation gives the formula used to calculate the summed $Z$ score calculated for each pollutant for each state-year:

$$CAPSIDX_{\ it} = Z_{NOx\ it} + Z_{CO\ it} + \ Z_{PM-\quad it} + Z_{PM-2.5\ it} + Z_{SO2\ it} + Z_{VOC\ it}$$

**(2)**

Where $CAPSIDX_{\ it}$ is the criteria air pollution severity index (i.e. summed standard score of each constituent criteria pollutant $Z$-score of the ith state in period t),

$Z_{\ NOx\ it}$ is the standard score of $NO_x$ emissions from the ith state in period t,

$Z_{\ CO\ it}$ is the standard score of CO emissions from the ith state in period t,

$Z_{\ PM\text{-}10\ it}$ is the standard score of PM-10 emissions from the ith state in period t,

$Z_{\ PM\text{-}2.5\ it}$ is the standard score of PM-2.5 emissions from the ith state in period t,

$Z_{\ SO2\ it}$ is the standard score of $SO_2$ emissions from the ith state in period t, and

$Z_{\ VOC\ it}$ is the standard score of VOC emissions from the ith state in period t.

GHG emissions are a composite of $CO_2$, methane, nitrous oxide, perfluorocarbon, hydrofluorocarbon, sulfur hexafluoride, and nitrogen trifluoride (USEPA, 2018f). Since $CO_2$ emissions represent the most prevalent—over 80%—of GHG emissions in the US, $CO_2$ emissions are assessed in this study (USEPA, 2018d). The decision to use emissions inventory data of $CO_2$ emissions is justified based also upon the currency of this methodological approach in the academic literature (Grant et al., 2014; Martin & Saikawa, 2017). These data are available for each state, and each year, from the U.S. Energy Information Administration (EIA) (EIA, 2018).

#### 3.3.2. Business interests.

While measurement of this variable ranges from indicators based on industry self-policing (Lombard, 1993) to industry group membership (Bacot & Dawes, 1997; Newmark & Witko, 2007), studies use also macroeconomic productivity indicators. More specifically, Konisky and Woods (2012) assessed business interests as the share of state gross domestic product (GDP) generated by the manufacturing sector from each state based on total state-GDP. In this dissertation, business interests are measured as the state GDP generated by polluting industrial sectors as a share of total state GDP. The sector-specific and state-total GDP estimates are calculated using data obtained from the Bureau of Economic Analysis (BEA) (BEA, 2018a).

BEA defines GDP as "market value of goods and services produced by the labor and property located in a state. GDP by state is the state counterpart to the national GDP, and it is "the Bureau's featured and most comprehensive measure of U.S. economic activity" (BEA, 2018b). These data are available for each of the states for each year. A higher score on this variable is interpreted as a state having a greater level of business interests in the polluting sectors. Moving beyond the single-sector measure for business interests as applied by Konisky and Woods (2012), Anderson (2011) observed additional sectors affected by environmental regulations thus also exert influence on environmental policy.

Building upon Anderson's (2011) research, the manufacturing and mining sectors were selected, because these sectors of the economy are those that "may be disproportionately burdened by environmental regulations", since they have the greatest influence on state emissions of pollutant emissions (p. 553). Additionally, given the impacts the utilities sector has on anthropogenic emissions, particularly emissions of $CO_2$, that sector is added to produce a measure comprised of three sectors (Falke, 2011). To provide a sufficiently, though not overly, expansive proxy of business interests, the measure was devised to incorporate the sectors of the economy with the greatest linkages to environmental pollution—in terms of emissions magnitude thus perceived regulatory burden—and to exclude those sectors which would not have an appreciable contribution (e.g. warehousing, publishing, professional services). Values for business interests (*BUSINT*) are calculated with the following equation:

$$BUSINT_{it} = \frac{(GDPMFG_{it}) + (GDPMNG_{it}) + (GDPUTL_{it})}{(GDPALL_{it})} \quad \textbf{(3)}$$

Where $BUSINT_{it}$ is the proportion of GDP contributed by manufacturing, mining, and utilities from total GDP of the ith state in period t,

$GDPMFG_{it}$ is the gross domestic product from the manufacturing sector of ith state in period t,

$GDPMNG_{it}$ is the gross domestic product from the mining sector of ith state in period t,

$GDPUTL_{it}$ is the gross domestic product from the utilities sector of ith state in period t, and

$GDPALL_{it}$ is the gross domestic product from all polluting industrial sectors of ith state in period t.

#### 3.3.3. Civic environmentalism.

Civic environmentalism reflects the extent to which the federal legislative delegation for a state is legitimating environmentally proactive policy based upon electoral preferences. This indicator provides a score developed for each state by the LCV calculated from the environmental legislation voting records—roll call votes—of all members in Congress. These scores “reflect the views of the environmental community in the US. Votes coded as pro-environmental by the LCV typically support “renewable energy, oppose nuclear power, encourage pollution abatement, and call for the conservation of wildlife and habitats” (Kim & Urpelainen, 2017). Hays (2000) observed that environmental-preferences in civil society helped enhance the influence this voting segment had on attracting Congressional delegations of the states; that is, the political pressure these groups applied was key to their success at attracting the attention of, and action by, Congress.

This measure is based on a ratio level of data calculated by the LCV, and is available for each of the years included in this study (LCV, 2018). The scores are on a scale from 0 to 100 and are calculated by dividing the total quantity of pro-environment votes cast by the total quantity of legislation scored by LCV for a given year as to their pro-environment content. Higher scores are interpreted as greater prevalence of civic environmentalism. The following equation is used to calculate the values for civic environmentalism (*CIVENV*):

$$CIVENV_{it} = \frac{(LCV\ Score\ House\ _{it}) + (LCV\ Score\ Senate\ _{it})}{(2)} \quad \textbf{(4)}$$

Where $CIVENV_{it}$ is the civic environmentalism value of the ith state in period t,

*LCV Score-House* is the LCV score for the lower-chamber of the legislature of the ith state in period t, and

*LCV Score-Senate* is the LCV score for the upper-chamber of the legislature of the ith state in period t.

The higher the value, the greater the level of civic environmentalism in a state. It is posited that lower scores on this variable indicate there is either less awareness, and/or less electoral interest in environmental pollution. This, in turn, results in downward pressure on demand for environmental spending by civil society. As noted by Basu and Devaraj (2014), as environmental activism increases, however, these connections between pollution and impacts are recognized consequently leading to increased spending. While there is a level of subjectivity inherent in processes such as that used by the LCV, the organization's reliance on environmental and legal professionals to inform the scoring; resonance in the environmental policy scholarship; and given the transparency as to how the LCV develops their scoring, further justifies the use of the indicator as a measure of civic environmentalism.

**3.3.4. Climate policies.**

The variable represents the extent to which states have implemented mandatory policies to address climate change (i.e. climate policies) directed at reducing $CO_2$ emissions from power plants—the largest single source of $CO_2$ emissions in the US (Martin & Saikawa, 2017). Policies that affect the energy landscape, such as providing incentives for green technologies *and* voluntary policies that do not have formal compliance and enforcement mechanisms—which require state environmental agency programmatic and personnel support, thus funding—are excluded. Since there is no mandatory $CO_2$ emissions mitigation policy required at the federal-level, the only mandatory requirements that are evaluated are state-level climate policies aimed at reducing $CO_2$ emissions. Table 7 provides a summary of the policies that will be measured along with their description.

Table 7

*Description of Climate Policies*

| Name | Policy Type | Description |
|---|---|---|
| Greenhouse Gas Targets | Climate | Establishes targets for $CO_2$ emission reductions within proscribed time periods |
| Mandatory GHG Registry / Reporting | Climate | Requires power plants to register and record *and* report (i.e. inventory) their greenhouse gas emissions |
| Regional Greenhouse Gas Initiative (RGGI) | Climate | RGGI was the first US cap-and-trade program to reduce GHG emissions from the power sector |
| Emissions Performance Standards | Climate | Performance standards designed to reduce $CO_2$ emissions |
| California Global Warming Solutions Act | Climate | Establishes mandatory requirements based on a cap-and-trade program to reduce GHG emissions to 1990 levels by 2020 |

*Note*. From Martin & Saikawa (2017).

Since the climate policy data are based on the year the policy was signed into law, to account for policy diffusion, the policy data, consistent with the other independent variables, are lagged by one year. The climate policy variable, *CLMTP*, will be coded as follows:

0 = Absence of Climate Policy for a State-year

1 = Presence of Climate Policy for a State-year.

The presence of a climate policy, does not necessarily correspond to the year the policy actually took effect given that environmental agencies require time between policy adoption and final regulatory implementation. Assessing the appropriations after a one-year lag helps allow time for the budgeting process to reflect the programmatic and personnel needs for adequate compliance and enforcement of the climate policy. This approach offers two benefits—first, it acknowledges previous findings that mandatory policies are more effective at reducing GHG emissions compared to voluntary requirements and, second, coding based on before-and-after adoption, provides "a standard that can be easily determined" (Martin & Saikawa, 2017, p. 918). To summarize, the climate policy dummy variable indicates the presence or absence of a climate and/or energy policy for each state for each year of the study. That is, the value for each state was set to 0—pre-adoption—and to 1—post-adoption per Martin & Saikawa (2017) for 2010 - 2014. Climate policy data for 2015 was obtained through the National Conference of State Legislatures (NCSL, 2019), again based upon the policies described in Table 7.

#### 3.3.5. Partisan ideology.

This variable is the identifiable ideology of a state legislature based on partisan, or party, identification as it relates to that party's relative control over state government. Partisan ideology does not have a definition that is universally consistent among the states. As Heckman (2012) observed, "Democrats in Texas are more likely to be ideologically similar to Republicans in Massachusetts rather than Democrats [in Massachusetts]" (p. 483). However, partisan ideology identification among elected officials may be expected to be more consistent than across the general population which is one possibility this way of conceptualizing the characteristic is commonly employed in the literature previously reviewed. Furthermore, as revealed by the findings of McCright et al. (2014), notable differences in perceived national environmental spending exist between Democrats and Republicans that are congruent with differences between liberal and conservative respondents suggesting a similarity between partisan identity and political ideology.

As King (1989) notes, the Ranney index is a measure of state-level partisanship. The calculation of this variable is based on the partisan composition of the state government as a function of the governorship and both chambers of the state legislature and for each of the 50 states in the US. Based on the operationalization provided by Bose and Brower (2018), the indicator for this variable is based on the proportion of Democrat control of the upper and lower chambers of the state legislature; percentage vote for Democrat's gubernatorial candidate; and a control variable which takes into account whether Democrats have control over all or only some of the branches.  The scores could, hypothetically, range from 0 to 1.0 with higher scores on this variable indicative of a state being more Democrat-leaning than Republican-leaning in their overall partisan ideological preference for those in state elected office.  The following equation will be used to calculate the values for this measure of partisan ideology (PARTID):

$$PARTID_{it} = \frac{((DEMGV_{\ it}) + (DEMHS_{\ it}) + (DEMSN_{\ it}) + (control))}{(4)} \quad \textbf{(5)}$$

Where $PARTID_{it}$ is the partisan ideology value of the ith state in period t,

$DEMGV_{it}$ is the percent vote for Democrat's Candidate for Governor of the ith state in period t,

$DEMHS_{it}$ is the percentage of Democrat party seats in the lower legislative chamber of the ith state in period t,

$DEMSN_{it}$ is the percentage of Democrat party seats in the upper legislative chamber of the ith state in period t, and

$Control_{it}$: is determined as follows:

Democrats control house, senate, and governorship = 1 (i.e. 100%);

Democrats control only some branches (i.e. divided control) = 0.5 (i.e. 50%); or

Otherwise = 0 (i.e. 0%).

While the inclusion of this control dimension in the calculation of the Ranney index value for each state-year was not part of the original Ranney (1965) methodology, as King (1989) and Tucker (1982) describes further, it resolves multiple assumptions made in the original methodology.

**3.3.6. Legislative professionalization.**

This indicator provides a composite measure based on "legislative salary, staff, and time in session" (Konisky & Woods, 2012, p. 558).  Higher values of this indicator are interpreted as a state having a greater level of legislative professionalization. Where data were either not available from the NCSL—(e.g. Alabama, Connecticut, and New Mexico)—or determined based on state-specific sources (e.g. California, Illinois) the developer of the index obtained data from multiple other sources further described in Squire (2017).

There are three dimensions, or components, which form the basis of this index which are: compensation (member pay); time in session (total days in session); and staff resources (staff members per legislator). Each state legislator score for each of these attributes is calculated as a percentage of the U.S. Congress score on the same attributes. The average score for each state is then calculated from these three percentages which leads to a scale ranging from 0.0 to 1.0. That is, the components, are all equally weighted. A higher score is interpreted as a state having a greater total resemblance to the state delegation to the U.S. legislature—that is, a score closer to 0.0 would represent very little consistency (i.e. U.S. Congress is used as the baseline).

Based on Squire (2012) and Squire (2017), only values from 2009 and 2015 are actual discrete measurements for those state-years; therefore linear interpolation was used to calculate the values for the years in-between 2009 and 2015. The following equations provide used to calculate the legislative professionalization (*LEGISP)* values for 2010 through 2014.

$$LEGISP_{i2010} = 1 * \frac{((LEGISP2015_{\ i}) - (LEGISP2009_{\ i}))}{(6)} + LEGISP2009_{\ i} \quad \textbf{(6)}$$

$$LEGISP_{i20} \quad = 2 * \frac{((LEGISP2015_{\ i}) - (LEGISP2009_{\ i}))}{(6)} + LEGISP2009_{\ i} \quad \textbf{(7)}$$

$$LEGISP_{i2012} = 3 * \frac{((LEGISP2015_{\ i}) - (LEGISP2009_{\ i}))}{(6)} + LEGISP2009_{\ i} \quad \textbf{(8)}$$

$$LEGISP_{i2013} = 4 * \frac{((LEGISP2015_{\ i}) - (LEGISP2009_{\ i}))}{(6)} + LEGISP2009_{\ i} \quad \textbf{(9)}$$

$$LEGISP_{i2014} = 5 * \frac{((LEGISP2015_{\ i}) - (LEGISP2009_{\ i}))}{(6)} + LEGISP2009_{\ i} \quad \textbf{(10)}$$

Where $LEGISP_{i2010}$ is the legislative professionalization value of the ith state in period 2010,

$LEGISP2015_{i}$ is the legislative professionalization value of the ith state in 2015,

$LEGISP2009_{i}$ is the legislative professionalization value of the ith state in 2009,

$LEGISP_{i2011}$ is the legislative professionalization value of the ith state in period 2011,

$LEGISP_{i2012}$ is the legislative professionalization value of the ith state in period 2012,

$LEGISP_{i2013}$ is the legislative professionalization value of the ith state in period 2013, and

$LEGISP_{i2014}$ is the legislative professionalization value of the ith state in period 2014.

#### 3.3.7. Fiscal capacity.

Anticipated revenue availability often frames budget deliberations throughout the preparation and legislative phases (Bland, 2007), thus revenue proxies such as state income are often used to guide budget policy. In the academic literature, studies frequently operationalize fiscal capacity by wealth indicators, such as household income on either a total, or per capita basis (Hays et al., 1996; Konisky & Woods, 2012). Another way state fiscal capacity has been evaluated with respect to environmental agency funding is related to the ability of a state to raise revenue, for example, through taxation (Agthe et al., 1996; Lester, 1986). However, issues have been raised with certain measures of fiscal capacity such as income tax. For example, it has been estimated that less than 60 percent of capital gains are reported underscoring a need to explore alternative measures for fiscal capacity (Stiglitz, 1986, p. 415).

While household income data has been used in public budgeting research for nearly 90 years, from a measurement standpoint, it has been criticized as not adequately capturing fully the capacity states have to pay for services (Lee et al., 2013).  To address this challenge, fiscal capacity is measured using the total taxable resources (TTR) which provides a relative estimate of a state's fiscal capacity based on the states' gross product (i.e. goods and services) *and* income sources (U.S. Treasury, 2019).  This approach to measuring state fiscal capacity has not been used in prior research on state environmental appropriations.

Originating from an analysis of national and subnational fiscal relations conducted in the late 1980s (U.S. Treasury, 1986), TTR is required to be calculated by the U.S. Treasury on an annual basis and is used to develop federal fund allocations to government functions including substance abuse and mental health services (U.S. Treasury, 2002).  The general purpose of the TTR is to provide an improvement over earlier related measures, such as the state personal income (SPI) over concerns that the latter measure did not reflect the ability of state governments to generate revenue in the provision of public services given its exclusion of: corporate retained profits, out-of-state resident revenues (e.g. dividend income), and earned income by residents in one state while living in another state (i.e. commuter income) (U.S. Treasury, 2002).  To help ensure that measures of revenue generating capacity took all income flows into account, the TTR was developed to provide "the unduplicated sum of the income flows produced within a state [Gross State Product] (GSP) and the income flows received by its residents (SPI) which a state can potentially tax" (U.S. Treasury, 2002, p. 2) as outlined in Figure 13.

Figure 13.

*Total Taxable Resources Estimation*

$$TTR_s = GSP_s - (EMPLOYEE_s + EMPLOYER_s + FIBT_s + FCES_s) + (DIV_s + MINT_s + SIT_s + NCAP_s + COM_s)$$

where for states:

$TTR_s$ = total taxable resources
$GSP_s$ = gross state product
$EMPLOYEE_s$ = employee contributions to social insurance
$EMPLOYER_s$ = employer contributions to social insurance (unpublished data)
$FIBT_s$ = federal indirect business taxes (unpublished data)
$FCES_s$ = federal civilian enterprises surplus/deficit (unpublished data)
$DIV_s$ = dividend income
$MINT_s$ = monetary interest
$SIT_s$ = select social insurance transfers
$NCAP_s$ = net realized capital gains (parts of this series are unpublished data)
$COM_s$ = commuter income, residents from outside state borders (unpublished data)

*Note.* From U.S. Treasury (2002).

**3.3.8. State environmental agency budget policy.**

ECOS (2010) describes their approach to collecting environmental agency budget data from each respondent state—on a voluntary basis—as follows:

> When states provide "budget" numbers (instead of "actual expenditures"), they are listing the maximum possible expenditures for the agency. That is, such budgets are the optimum spending plan for the agency. It is quite possible that many states will be unable to generate enough revenue in 2011 to cover the expenditures laid out in their budgets. If that happens, the states will cut the general fund portion of the budgets during the fiscal year. Thus, the numbers we have are essentially the best case scenarios for state budgets. Such a scenario is very unlikely for EPA, as a comparison. Once Congress and the President have agreed on an agency budget, it is rare that it is modified during the course of the

year. This is a major difference between states and the federal government in the manner in which environmental agency budgets are handled (p. 3).

The functional classifications of environmental appropriations are key to selecting the appropriate measure. For example, while natural resource spending, on its face, may appear virtually identical to environmental spending, the two, from a functional perspective, are quite different. This is one reason why U.S. Census data on natural resource spending, while comprehensive and available for many years, was ultimately dismissed for use in this study. Many agencies contribute to more than a singular function, and any single agency is likely to contribute to a multitude of governmental functions; the data from ECOS addresses, at least partly, this functional classification challenge.

While expenditures, or outlays, flow from an appropriations bill—both from the national and state governments—that provides the budget authority for the agency over a given fiscal year, agency spending is a function of appropriations made from multiple preceding years. Again, ECOS data are helpful regarding operationalization, since they represent the budget authority appropriated rather than expenditures for which a focus on the latter "…renders an inaccurate view of the cost of government" (Mikesell, 2018, p. 76). The focus on appropriations, versus final expenditures—(e.g. obtained through state comprehensive annual financial reports)—has extensive currency in the public budgeting literature as observed by Smith and Bertozzi (1998).

Environmental agency budgets are a combination of total revenue transfers from the federal government and own-source (i.e. state-source) revenues (e.g. raised through regulated community fees and transfers from the general funds). Notably, ECOS (2017b) data do not include transfers to other subnational entities (i.e. local governments). The general trend in environmental appropriations is for state governments to rely more on charges and fees over time, thus further justifying an empirical approach based on a disaggregated measure of state own-source funding. While the benefits of regressing multiple dependent variables on identical predictors have been discussed elsewhere (Heckman, 2012), simply stated—what factors best explain state-source funding from *fees and other sources* may not necessarily explain state-source funding from the *general fund*.

Despite the incorporation of fiscal measures in previous research, the use of agency budget policy data in many studies is characterized by empirical limitations. Instead of setting a robust research agenda, these prior analyses are inherently complicated by the "… paucity of reliably and continuously updated datasets that capture current state environmental policy efforts. This is not surprising, "given the laborious nature of collecting such information" (Konisky & Woods, 2012, p. 545). Data for state environmental agency funding is not systematically tracked by the USEPA on a recurring basis, and it is only sporadically collected by private institutions (Environmental Integrity Project, 2019). Accordingly, the datasets needed to measure the outcome variable are neither available for all years, nor for all states. ECOS recently released state-level environmental agency spending data in September, 2012 and, again, in April, 2017.

State environmental agency budget data represent the fiscal resources appropriated for each year included in this study—2011, 2012, 2013, 2014, and 2015 (ECOS, 2017b).

> "This amount should not include funds for parks, natural resource management (e.g., forestry, fish and wildlife). The amount should include all delegated or authorized (e.g., RCRA) federal programs and related state programs that address air, water, drinking water, waste/land issues. Only include programs within your agency. ECOS realizes this may exclude drinking water, pesticides, and other

programs for some states agencies and thus will not be fully captured by this budget update" (ECOS, 2017b, p. 39).

This dataset of state environmental agency budgets is complete for the majority of states. ECOS reported that data were not provided by Louisiana, North Carolina, New Jersey, and New Mexico.

***State-Source revenues.*** State own-source funding of environmental agency budgets is a function of two discrete sources—general funds appropriated by each state legislature *and* from fees. Of the state-source revenues, or funds, the majority are derived from *fees and other sources* with the remainder appropriated from the general operating funds of states' treasuries—so called *general funds* (ECOS, 2017b). The state-source revenues generated by *fees and other sources* are categorized as either *direct* or *indirect* user fees. Direct fees refer to those costs which are imposed through the traditional command-and-control regulatory schemes (e.g. Title V air permit program) *and* market-based approaches to pollution abatement (e.g. 1990 Clean Air Amendments which resulted in cap-and-trade for certain criteria pollutants).

Direct fees are essentially charged to the regulated community due to the pollution firms (e.g. electric generating utilities, chemical plants) add to the environment as a result of market failure (Kraft & Furlong, 2015). A certain portion of the direct fees are *regulatory program fees* that can be proportionate to either the magnitude of pollution emitted (e.g. air emissions fees), or to the agency's administrative efforts to process non-recurring, or one-off, regulatory actions that require environmental agency review and issuance (e.g. air permit fees). ECOS (2012) notes the majority of this portion of the budget is comprised of permit fees. For example, under the Title V air program, the fee set by, and due payable to, the state government, is $51.06 per ton of emissions (USEPA, 2018g). The revenue generated from this fee is put back into the state treasury and helps fund the environmental agency's administration of the program for current or out-year budget cycles. That is, these fees—or user charges—are meant to cover all, or at least some portion, of the cost of providing the regulatory services and often vary based on the nature and complexity of the operation. For example, the fee to build and permit a new large landfill in Oregon is $10,000 while the fee to permit a cranberry bog in Maine is $240 (Maine Department of Environmental Protection, 2018; Oregon Department of Environmental Quality, 2019).

### 3.4. Statistical Analysis Plan

The initial stage of the analysis provides a brief descriptive analysis of state own-source appropriations to environmental agencies between 2011 and 2015. In particular, state-source funding from fees and other sources *and* general funds are briefly summarized. The remainder of this section refers to the regression analyses performed and additional details regarding the structure of the dataset that inform the various options for empirical analysis.

Unlike with cross-sectional data which provide observations on states at the same period in time (i.e. for a particular year), a panel design—unbalanced panel specifically is used. A panel data structure is generally preferred over cross-sectional data given the additional variation within the values of the variables due to the temporal dimension of the longitudinal data. As mentioned previously, the independent variable data are lagged by one-year and matched to data on state environmental agency appropriations from 2011 to 2015. This methodological approach allows assessment of the possible effects of factors in a given year on the environmental agency budget policy in the subsequent year for a national sample of states.

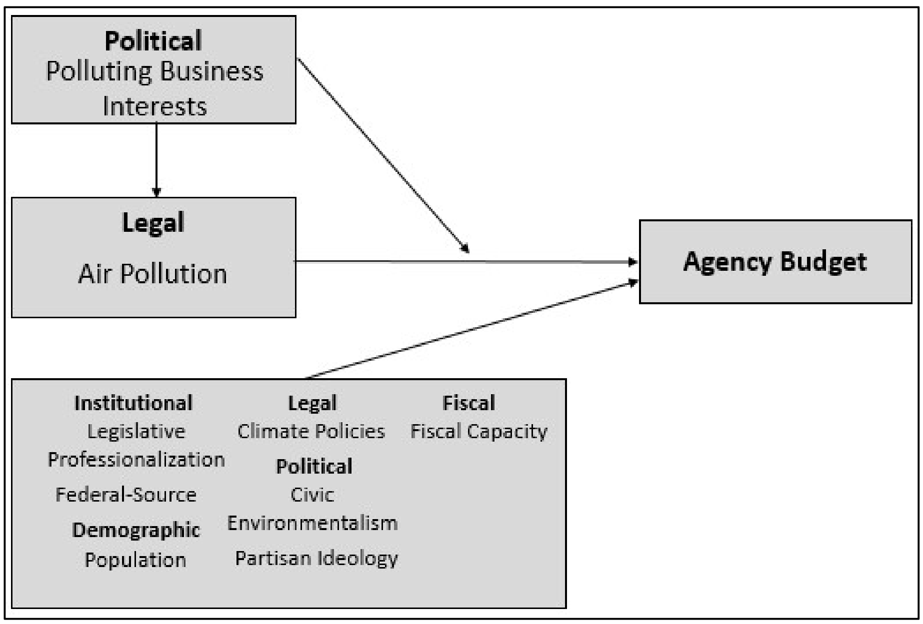
While using a standard linear regression model with aggregate data was considered, it is ultimately not chosen as an estimation technique across *all* models. Fitting such a model would be based on an assumption that all the states are identical and can be combined, or pooled, into one sample population. This can be methodologically problematic given that, particularly in panel data, there can be, and often is, both variance between the states and variance within the states. Put another way, that type of *standard* OLS estimation would not take into account the hierarchical structure of the dataset (Arceneaux & Nickerson, 2009). Alternatively, fixed effect and random effect estimates in linear models provide estimation methods to account for: "clustering or dependence in a dataset, and differing relationships within and between clusters" (Bell, Fairbrother, & Jones, 2019, p. 1052). Since this interdependence characterizes panel data, it is important to recognize there can be *within* effects (i.e. effects that occur within the states themselves) and *between* effects (i.e. effects that occur between the states).

As previously mentioned, since not all 50 states responded to the budget survey, the sample size—in terms of state-year observations—is reduced to ($n$ = 171) and ($n$ = 183) for *general funds* and *fees and other sources* (ECOS, 2017b). The smaller sample size makes research decisions regarding model specification particularly important given the nature of regression analysis. Specifically, "there is a real danger of overfitting a model, building in component that really capture random variation, rather than systematic regularities in behavior" (Menard, 2002, p. 90). Additionally, running the models with lagged values for the independent variables can help to alleviate the concern of endogeneity.

As Figure 14 depicts, moderation analysis (i.e. multiplicative interaction) is quite similar to a statistical model that does not include a moderator. One of the challenges with developing a conceptual model for a study is balancing the need to provide a representation of reality that is not so complex so as to challenge the empirical models used to estimate the hypothesized effects (Fisher-Owens et al., 2007). No doubt there are other conceptual models that can be proposed—some of which I discuss in Chapter 5 as opportunities for future research. Nevertheless, the conceptual model that follows in Figure 14 attempts to capture the complexity of associated relationships while acknowledging it is not representative of the full gamut of causal relationships, contingencies, and intervening processes.

Figure 14.

*Conceptual Model of Dissertation (Indicating Moderation by Business Interests)*




The analysis includes four regression models given the two pollution metrics (e.g. criteria air pollution severity index and $CO_2$ emissions) *and* the two sources of state own-source funding (e.g. fees & other sources *and* general funds). This approach permits an exploratory examination of the influence of fiscal, legal, institutional, and political factors on fees and other sources *or* on general funds. The following table describes the four models; identifies the two dependent variables; *and* the two interaction terms.

**Table 8. Regression Models with Interaction Terms**

| | Overall Model & Interaction Terms | | Overall Model & Interaction Terms |
|---|---|---|---|
| **DV** | Funding (Fees & Other Sources) | **DV** | Funding (General Fund Appropriations) |
| **Model 1** | Criteria Air Pollution* Business Interests | **Model 3** | Criteria Air Pollution * Business Interests |
| **Model 2** | $CO_2$ Emissions * Business Interests | **Model 4** | $CO_2$ Emissions * Business Interests |

Equation 11 provides the functional equation to estimate appropriations.

$$Agency\ Budget_{it} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 (X_1 * X_2) + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \varepsilon \tag{11}$$

Where, for each application of the model, *Agency Budget* $_{it}$ represents the environmental agency appropriations for state *i* in year *t*, and

$\beta_0$ = [least squares estimate of] the Y-intercept or what the environmental agency budget would be if all the scores (i.e. values) of the variables of interest were equal to 0,

$\beta_1$ = regression coefficient, or slope of regression line, of the environmental pollution metric—the first constitutive term,

$\beta_2$ = the coefficient on the regression term of the moderator—the second constitutive term,

$\beta_3$ = coefficient on the interaction term,

$\beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9, \beta_{10}$ = regression coefficients, or slopes, for: fiscal capacity; partisan ideology; civic environmentalism; climate policies; legislative professionalization; federal-source funding; population); and

ε = Expresses difference between the value of the actual appropriations and the appropriations estimated by the regression model.

### 3.4.1. Interpreting regression coefficients.

The regression coefficient of either environmental pollution metric (i.e. criteria air pollution or $CO_2$ emissions), represents the first constitutive term of the subsequent interaction term. Since this coefficient is for a constitutive term, it is not directly interpretable as a direct effect (Brambor, Clark, & Golder, 2006; Hayes, 2018). Similarly, the coefficient on the regression term of the moderator (i.e. the second constitutive term after $\beta_1$ also is not interpreted as a main effect. That is, $\beta_2$ estimates the effect of business interests on budgets when pollution is 0, and the coefficient, $\beta_1$, estimates the effect of pollution on budgets when business interests is 0. Since a value of zero for either variable is not within the bounds of the datasets, the aforementioned coefficients are not interpretable. The remaining regression coefficients (i.e. $\beta_4$, $\beta_5$, $\beta_6$, $\beta_7$, $\beta_8$, $\beta_9$, $\beta_{10}$) reflect the magnitude environmental agency appropriations go up, or down, (i.e. main effects) for each additional unit increase in that variable of interest (e.g. fiscal capacity; partisan ideology; civic environmentalism; climate policies; legislative professionalization; federal-source funding; and population).

Similar to the regression coefficient of $\beta_1$ and $\beta_2$, the coefficient on the interaction term, $\beta_3$, is also not directly interpretable from the magnitude and statistical significance of the coefficient. The marginal effect of pollution on agency budgets could be statistically significant across reasonable, or practical, values of business interests even absent a statistically significant coefficient on the interaction term (Brambor et al., 2006). Conditional marginal effects graphs are developed to ascertain—and visualize—the relevant range of the marginal effect, if any, of the modifying variable that is statistically significant (i.e. to visualize the reductive effect of business interests on the relationship between pollution and agency budgets). This is exhibited with a downward sloping line where the upper and lower bounds of the CI "are both above (or below) the zero line" (Brambor et al., 2006, p. 76). The results will be examined, for example, to evaluate the range of moderator values for which the relationship between pollution and budgets is statistically significant by constructing confidence bands around the slopes (Dawson, 2014).

Since the scores of the indicators used to operationalize the concepts may have too high a correlation with each other to offer statistical utility in the regression analysis, multicollinearity will be evaluated. While "high multicollinearity does not cause bias… it increases standard errors and so can cause overlap in the estimator for highly correlated variables that have similar coefficient magnitudes" (Al-Kohlani & Campbell, 2016, p. 482). The correlations between variable pairs are examined prior to regression analysis. In addition, assumptions related to autocorrelation and heteroscedasticity are evaluated to assess whether scores on the dependent variable exhibit a fairly uniform distribution across all levels of the predictor variables scores *and* between panels. Moreover, details regarding the results of data screening and data transformations are summarized in Chapter 4.

#### 3.4.2. Advantages & limitations of the design & statistical analysis plan.

While regression analysis provides advantages over analyzing bivariate relationships, there are certain limitations that deserve mentioning. Though the ECOS data represent a comprehensive source of state environmental budget data, this analysis could benefit from a longer panel of historical data. The lack of a robust collection of time series data has been a long standing challenge in state environmental policy research (Lester & Lombard, 1990). The panel data structure is, however, preferred for econometric analysis when compared to either cross-sectional (i.e. a data structure with multiple states over a single year), or time-series (i.e. a data structure with a single state over multiple years).

In terms of whether, or not, the endogenous variable—appropriations—that is regressed onto the independent variables, comes before, or after (i.e. is the cause or effect) in the model, there is no test that would definitively rule-out such a possibility. The causal relationship underpinning the hypotheses is rooted in theory and from existing scholarship regarding the expected associations between budgetary predictors and budget policy reviewed in Chapter 2. Kennedy (2008) provides further discussion of endogenous variables and their modeling including various types of endogeneity.

Due to the multi-dimensional nature of budgetary preferences, the key variables proposed in this study do not capture the entirety of all determinants that may be related to state environmental agency budgets. Since this dissertation proposes the use of indicators to empirically assess attributes that characterize concepts, construct validity is limited to the extent these measures fall short of measuring the concepts (Gerring, 2015). If the construct validity is low, it would serve to limit the "real-life applicability" of the findings and to make "valid research claims" based on any findings (Gorard, 2013, p. 159). These variables, and their indicators, were selected based on their face validity.

Analyzing agency funding as the consequent variable is not without criticism. For example, researchers have pointed-out that using funding as the outcome variable biases the researcher to select input variables that are also economically-based; therefore, they appear on both sides of the equation (Lester & Lombard, 1990); this can increase the risk of committing a Type I error. This is a concern from both a theoretical and methodological perspective, thus to minimize the impact from this potential weakness, no variables are proposed in this analysis, other than one antecedent—fiscal capacity—and one control—federal-source appropriations—as economic input measures.

The measure of climate policies does not take into account the stringency of the policy in terms of the expected magnitude with which it will be successful in reducing GHG emissions (i.e. not all policies will be equivalent in their effectiveness in reducing emissions). A dichotomous measure for this concept does not capture whether states have multiple mandatory $CO_2$ mitigation requirements in-place, or only one policy. Presumably, states that have more than one policy, program in-place would be appropriating more than states with less. Moreover, given the short timeframe of this analysis relative to public policymaking timelines, the values for this variable are time invariant meaning they will be dropped in a fixed effects model—a limitation which is addressed further in Chapter 4.

Lastly, and related to the above weakness, "the problem with fiscal policy is its slowness" (Mikesell, 2018, p. 18). While the source of appropriations data for this dissertation was made after considering data from the U.S. Census; state comprehensive annual financial reports; and individual budget documents, it could be the short panel of data provided from ECOS does not fully accommodate the policy diffusion process. Combined with budget data from subsequent periods, a longer panel (e.g. over 10 years, or more) could enable analysis of the extent to which environmental agency budgets have responded, fiscally, to the promulgation of mandatory climate policies across the states.

# Chapter 4: Results & Findings

This chapter provides the empirical models, results, and findings. The first section revisits the research questions and hypotheses and provides the conceptual model. The second section provides a brief descriptive analysis of state environmental agency appropriations during the study period followed by key details regarding data screening. The final section provides the estimation of linear models using fixed effects (FE) and random effects (RE) techniques; the regression results; and concludes with findings.

## 4.1. Research Questions, Hypotheses, and Conceptual Model

As discussed in the previous chapters, the dependent variable is state own-source appropriations to state environmental agencies disaggregated into two measures—*fees and other sources* and *general funds*. Table 9 reviews each hypothesis and research question to which each hypothesis aligns.

Table 9

*Research Questions and Hypotheses*

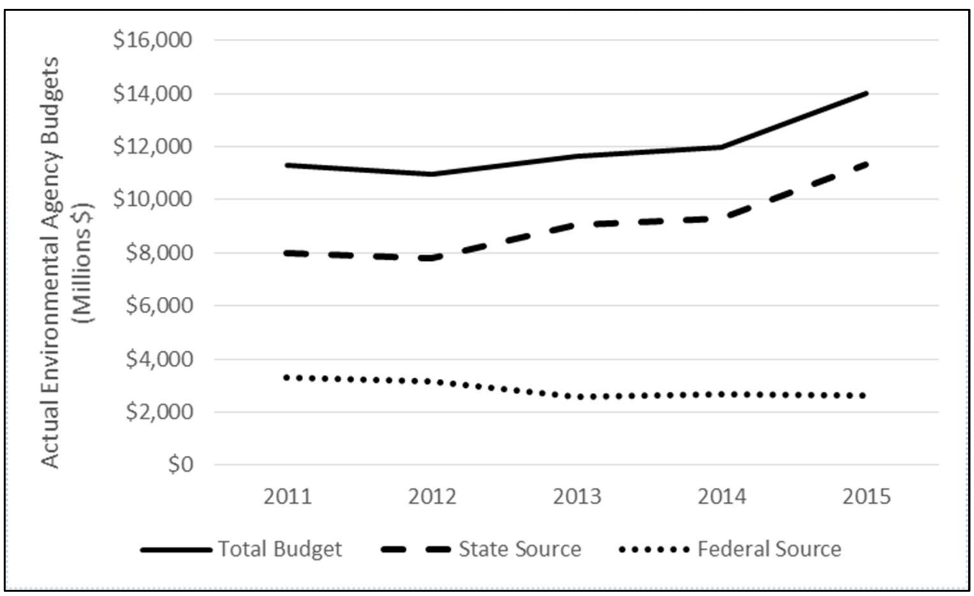
| Research Questions | Hypotheses |
|---|---|
| Does the influence of air pollution on state environmental appropriations vary according to the magnitude of polluting business interests? | **H1:** Air pollution severity will increase environmental agency budgets, if levels of polluting business interests of states are sufficiently low. |
| What are the effects of political, institutional, fiscal, and legal factors on state own-source appropriations to state environmental agencies and do the effects vary based on the funding source or air pollutant type? | **H2:** Civic environmentalism will have a positive influence on environmental agency budgets.<br>**H3:** Mandatory climate policies will have a positive influence on environmental agency budgets.<br>**H4:** Legislative professionalization will have a positive influence on environmental agency budgets.<br>**H5:** Liberal ideology will have a positive influence on environmental agency budgets.<br>**H6:** State fiscal capacity will have a positive influence on environmental agency budgets. |

**4.2. Environmental Agency Budget Patterns**

Disaggregating the dependent variable takes into account the budgetary reality that less-and-less funds flow from the federal government to state environmental agencies and that permit fees, emissions charges, and registration fees provide an ever-increasing component of state own-source funding. For both this pattern analysis, and the regression analyses that follow, the state and local government price index values were used to deflate the budget data from BEA's National Income and Products Account datasets; the default base year for these data is 2012 (BEA, 2019). By converting the appropriations, as well as the values for the TTR variable, from nominal to real dollars, the influence that inflation could have on the results is removed.

Figure 15.

*State Environmental Agency Budgets, 2011 - 2015*




*Note.* Compiled by author from ECOS (2012; 2017b) data.

Between 2011 and 2015, the proportion of state environmental appropriations derived from state own-source funding ranged from 70%, in 2011, to over 80%, by 2015 with the majority of growth attributed to fees and other sources compared to modest increases in general fund appropriations. On average, of the state-source funding, fees and other sources comprise over 60% during this period. The proportion of environmental appropriations from the federal government declined from a high of nearly 30%, in 2011, to just above 18% in 2015—a percentage decrease of over 10%. Figure 15 provides a line chart depicting the pattern of increasing state-source funding and declining federal-source funding over the same period. Overall, states are continuing to draw more from state-sources of revenue in the absence of federal-source funding. These findings are consistent with ECOS (2017b)—the source of the 2013 through 2015 agency budget data—which noted a marked increase in fees and other sources *and* the concurrent decline in federal funding due to stagnant grant funding to states from the USEPA.

Further, the patterns apparent in the budget dataset used in this dissertation are consistent with previous observations in the academic literature. For example, Davis and Lester (1987) found that states augmented their budget policies (i.e. increased environmental agency funding) when federal-source allocations were reduced. Specifically, they found that "a third to one half of the states have replaced or will replace federal budget cuts with state-generated revenues within the foreseeable future, although this number could easily increase as the result of well publicized "environmental crises" (Davis & Lester, 1987, p. 563). Wood (1991) also found that agencies sought out additional funding from their state legislators when federal source funds declined. Thus, the findings are consistent with previous scholarship.

### 4.3. Preliminary Data Analysis

To begin, the panel data structure allows me to aggregate budget data from the states at the environmental agency level and estimate coefficients on the regression and interaction terms to examine the direct and interaction effects of all study variables. Data for all variables were inspected visually through the use of histograms, scatterplots, and boxplots which suggested the presence of extreme, and missing, values requiring further examination and screening prior to empirical analysis.

#### 4.3.1. Extreme values.

To identify extreme values, upper and lower bounds are calculated using the interquartile range (IQR) (i.e. the difference between the first and third quartiles) using the Tukey fences approach (Hoaglin, 2003). The first quartile is calculated to identify the 25% of data that are below the first quartile then the third quartile is calculated in the same manner for the 25% of data that are above the third quartile. The IQR is calculated and used to identify extreme values either below the first quartile, or above the third quartile. Extreme values were detected for all variables except civic environmentalism, and the values were associated with California, New York, and Texas—consistent with expectations given the unique features of these states (e.g. large populations, high levels of economic activity, significant pollution). No values were dropped from the dataset, since all outliers were found to be true values after accounting for data entry errors. Further, logarithmic transformation helped eliminate the influence outliers could have on estimating coefficients especially given the small sample size (Warner, 2013).

#### 4.3.2. Missing data.

As noted in Chapter 3, there were several data points missing from the ECOS datasets as well as some states that reported receiving no appropriations from the state general fund for certain years. Tables 10 and 11 provide the details in the reduction of state-years as a result of states either not reporting appropriations data, or reporting zero funds received from general fund sources, respectively.

**Table 10: Non-Reported State-Years**

| | Year | | | | | Total |
|---|---|---|---|---|---|---|
| **State** | **2011** | **2012** | **2013** | **2014** | **2015** | |
| Florida | X | X | X | | | |
| Iowa | X | X | X | | | |
| Louisiana | | | X | X | X | |
| North Carolina | | | X | X | X | |
| New Jersey | | | X | X | X | |
| New Mexico | X | X | X | X | X | |
| **Total** | 3 | 3 | 6 | 4 | 4 | **20** |

**Table 11: State-Years with Zero Appropriations from General Fund**

| | Year | | | | | Total |
|---|---|---|---|---|---|---|
| **State** | **2011** | **2012** | **2013** | **2014** | **2015** | |
| Arizona | | | X | X | X | |
| Illinois | X | X | X | X | X | |
| Louisiana | X | | | | | |
| Nevada | X | X | X | X | X | |
| Ohio | | | X | | | |
| **Total** | 3 | 2 | 4 | 3 | 3 | **15** |

### 4.3.3. Correlational analysis.

A correlational analysis was performed to examine the linear association between values of each of the independent variables which resulted in dropping population given its extremely high correlation (above 0.9) with fiscal capacity (Berry, 1993). The correlations of civic environmentalism and legislative professionalization were also elevated which was further inspected with collinearity diagnostics leading to the retention of both variables as they were well below the commonly cited variance inflation factor of 10 (Hair, Anderson, Tatham, & Black, 1995). Regardless of their inclusion in the models, it is acknowledged that these elevated bivariate correlations suggest the values for both civic environmentalism and legislative professionalization could be providing redundant information about environmental agency budgets with a consequent impact on the standard errors and estimation of coefficients. The correlational analyses, with $CO_2$ emissions replacing criteria air pollution, were similar; therefore, Table 12 reports those correlations inclusive of only the criteria air pollutant index.

**Table 12. Zero-Order Correlations**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Criteria Air Pollution Index (1) | 1.0 | | | | | | | | |
| Real Fiscal Capacity (2) | .60 | 1.0 | | | | | | | |
| Population (3) | .66 | .99 | 1.0 | | | | | | |
| Partisan Ideology (4) | -.26 | .19 | .12 | 1.0 | | | | | |
| Business Interests (5) | .38 | -.11 | -.07 | -.49 | 1.0 | | | | |
| Climate Policies (6) | -.22 | .21 | .16 | .61 | -.49 | 1.0 | | | |
| Civic Environmentalism (7) | -.27 | .17 | .11 | .78 | -.58 | .82 | 1.0 | | |
| Legislative Professionalism (8) | .37 | .74 | .72 | .35 | -.22 | .36 | .35 | 1.0 | |
| Real Budget – Federal Source (9) | .27 | .61 | .62 | .21 | -.18 | .20 | .18 | .61 | 1.0 |

*Notes.* Population highly correlated with fiscal capacity; fiscal capacity will control for the influence of state size

### 4.4. Empirical Models

The analysis plan and deductive research design involves a total of four empirical models given the two sources of state own-source funding and two measures of pollution severity. This approach permits an examination of whether the overall influence of the fiscal, legal, institutional, and political factors on overall state own-source appropriations is attributable to an influence on fees and other sources *or* on general fund appropriations while taking into account pollution problems caused by either criteria air pollutants, or greenhouse gases. The following Table 13 describes the four models.

**Table 13. Regression Models with Interaction Terms**

| | **Overall Model & Interaction Terms** | | **Overall Model & Interaction Terms** |
|---|---|---|---|
| **DV** | Funding<br>(Fees & Other Sources) | **DV** | Funding<br>(General Fund Appropriations) |
| **Model 1** | Criteria Air Pollution* Business Interests | **Model 3** | Criteria Air Pollution * Business Interests |
| **Model 2** | $CO_2$ Emissions * Business Interests | **Model 4** | $CO_2$ Emissions * Business Interests |

Each of the four econometric models within Table 13 follows the same regression equation to estimate the appropriations provided per Equation 12. The variable description for each variable label in Equation 12 is provided below in Table 14.

$$Agency\ Budget_{it} = \beta_0 + \beta_1(Pollution) + \beta_2(BUSINT) + \beta_3(Pollution*BUSINT) + \beta_4(FISCAP) + \beta_5(PARTID) + \beta_6(CIVENV) + \beta_7(CLMTP) + \beta_8(LEGISP) + \beta_9(EABF) + \varepsilon \quad \textbf{(12)}$$

**Table 14. Variable Information for Environmental Agency Budget Policy Estimation**

| Variable | Description & Unit of Measure |
|---|---|
| EABFO | State-source appropriations derived from fees and other sources (US$M) |
| EABGF | State-source appropriations derived from general fund sources in (US$M) |
| CAPSIDX | Air emissions measured by the criteria air pollution severity index |
| CO2Em | Emissions of $CO_2$ |
| BUSINT | Business interests measured by proportion of GDP contributed by manufacturing, mining, utilities of total of state GDP |
| PARTID | Partisan ideological preference for state elected officials measured by Ranney Index |
| FISCAP | Fiscal capacity measured by TTR |
| CIVENV | Civic environmentalism measured by LCV scores |
| CLMTP | Policies to address climate change through $CO_2$ emissions mitigation |
| LEGISP | Institutional capacity of state legislature measured by Squire Index |
| EABF | State-source appropriations derived from federal fund revenues in (US$M) |

*Notes*. All fiscal variables, and CO2Em, were log transformed using the natural log (ln) to address extreme values and obtain normal distributions. For climate policies, the value for each state was set to 0—pre-adoption—and to 1—post-adoption per Martin & Saikawa (2017) for 2010 - 2014. Climate policy data for 2015 was obtained through the National Conference of State Legislatures (NCSL, 2019). All financial data (e.g. EABFO, EABGF, FISCAP, and EABF) were converted to constant (base-year 2012) dollars.

There are many ways to contemplate, and empirically investigate budgetary determinants on appropriations. The challenge is to develop conceptual and empirical models that are realistic while having a feasible scope—models that are not either overly simplistic, or too complex so as to challenge estimation methods and impede understanding. I have developed these four models as that "middle path, one that is comprehensible yet sophisticated enough to add value" (Fisher-Owens et al., 2007, p. 516).

**4.4.1. Model 1. Criteria air pollution & fees and other sources.**

Prior to running diagnostics to determine whether a fixed-effects (FE) or random-effects (RE) model is the preferred technique for estimation of the linear model, two tests were performed to test for the existence of serial correlation and heteroscedasticity, respectively. To examine whether the structure of the dataset would lead to biased results due to less efficient parameter estimates, the Wooldridge test for serial correlation was run wherein the null hypothesis is no serial correlation (Drukker, 2001). The null hypothesis of no serial correlation is rejected suggesting there is correlation between the values of the variables over time; therefore, further attention is given to ensure the preferred model is used to produce consistent estimates. More specifically, this finding—which is not surprising given the longitudinal nature of the dataset—suggests the use of a regression model to fit panel data with either a random or fixed-effects model (i.e. a panel technique).

Another assumption of the regression modeling is the distribution of variable values predicted by the model (i.e. predicted values) is relatively constant across the range of residuals (Stock & Watson, 2003). The null hypothesis of the Breusch-Pagan test is the residuals are homoscedastic (i.e. no heteroscedasticity) (Breusch-Pagan, 1980). Upon running the test, the null hypothesis of constant variance is rejected suggesting there is evidence of heteroscedasticity in Model 1. Along with the serial correlation, this heteroscedasticity will be accommodated using heteroscedasticity-robust standard errors (Stock & Watson, 2003).

Per Wooldridge (2002), based on the panel structure of the dataset, it is possible to control for heterogeneity through the use of a state FE estimator to control for unobserved characteristics that could vary over time. To determine whether a FE or RE model was preferred, a Hausman test is run where, under the null hypothesis, individual effects are random (i.e. the RE model is preferred). Though use of the Hausman test to decide on whether a FE or RE model provides the preferred specification of data is not without its criticism (Bell et al., 2019), it is applied in this study given currency in the econometrics literature (Greene, 2012; Wooldridge, 2002). More on these two estimation techniques is discussed in section 4.4.3.

In all four models, there are eight continuous independent variables and one categorical—binary—independent variable which is time invariant (i.e. it stays constant throughout all five years). The results of the Hausman test for fixed effects for Model 1 suggests the linear model should be estimated with fixed (within model) effects regression (i.e. prob>chi2 was significant (i.e. $p < 0.05$) to improve the goodness-of-fit. The FE estimation method for Model 1 recognizes the panel structure of the dataset by not considering all observations independent from one another. Per Cameron & Trivedi (2009), given that the within standard deviation of climate policies is zero (i.e. it is time invariant), this variable is not carried forward as one of the regressors in the FE model. That is, since this FE model will fix, or control-out, the average effects of the states, these results of Model 1 do not provide an indication as to the influence climate policies has, or not, on environmental appropriations.

Given the inclusion of climate policies among my research hypotheses, however, standard ordinary least squares (OLS), with robust standard errors, was also used to estimate Model 1. Given that standard (i.e. pooled) OLS treats all observations as independent, this estimation method fails to account for the panel structure of the dataset. Further, this estimation method leads to regression coefficient estimates that are a weighted average of the within and between effects *and* underestimates standard errors making it more likely that statistical significance will be detected (i.e. it increasing Type I error) (Arceneaux & Nickerson, 2009). Given these limitations, while the results from the OLS estimation method are provided in Table 17, a brief discussion of only the climate policy variable accompanies the empirical results following the results of the FE model provided in Table 16. Summary statistics for untransformed variables are now reported in Table 15.

**Table 15. Summary Statistics**

| Variable | Count | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Real Budget – Fees & Other (millions $) | 233 | 168.12 | 397.34 | 0 | 4137.26 |
| Real Budget – General Fund (millions $) | 233 | 27.10 | 38.90 | 0 | 270.78 |
| Criteria Air Pollution Index | 250 | 0.04 | 4.86 | -5.60 | 20.63 |
| $CO_2$ Emissions | 250 | 1.43e+11 | 1.51e+11 | 2.43e+09 | 1.00e+12 |
| Real Fiscal Capacity (millions $) | 250 | 350,997 | 421,533 | 31,267 | 2,437,219 |
| Population (millions) | 250 | 6.26 | 6.97 | 0.56 | 38.79 |
| Partisan Ideology | 250 | 0.45 | 0.20 | 0.12 | 0.85 |
| Business Interests | 250 | 0.17 | 0.07 | 0.01 | 0.41 |
| Climate Policies | 250 | 0.48 | 0.50 | 0 | 1 |
| Civic Environmentalism | 250 | 48.00 | 28.46 | 1 | 100 |
| Legislative Professionalism | 250 | 0.21 | 0.11 | 0.04 | 0.62 |
| Real Budget – Federal Source (millions $) | 233 | 61.73 | 72.88 | 0 | 415.79 |

*Notes.* All independent variables except Ranney Index, Business Interests, and Population are logged in the models. The descriptive statistics above pertain to the estimated parameters in all models.

Regarding the FE regression of Model 1 listed in Table 16—as predicted by technocracy theory—absent any influence by business interests, there is evidence criteria air pollution has a positive relationship with environmental budgets. In other words, pollution from criteria air pollutants positively influences appropriations derived from fees and other sources when there is an absence of business interests that would otherwise undermine fiscal responsiveness.

However, this coefficient is not directly interpretable, since it is describing the influence of pollution on appropriations at levels of business interests not within the range of the dataset (i.e. business interests = 0) (Braumoeller, 2004). Therefore, to gain further insight into the interaction effect, the conditional marginal effect of criteria air pollution on appropriations is provided in Table 18.

Contrary to expectations, no other coefficients on the regression terms, in the FE model, were statistically significant at either the 0.10, or the 0.05 significance level ($p < 0.1$, $p < 0.05$). From this model, there is insufficient evidence that fiscal capacity, partisan ideology, civic environmentalism, or legislative professionalization have a significant, direct, influence (i.e. main effect) on appropriations from fees and other sources. In regards to the control variable, federal-source appropriations to environmental agencies are not found to increase, or decrease, budgets derived from fees and other sources. While the climate policies variable is dropped from the FE results, the results estimated by the OLS regression model, as shown in Table 17, provide evidence that climate policies positively influence environmental appropriations. This result suggests that environmental budgets are higher in response to the quantity of mandatory climate policies, as hypothesized. Also as expected, the standard errors estimated by the OLS model are smaller than those of the FE model.

Table 16. Fixed-effects Estimates for Appropriations from Fees & Other Sources (Criteria Air Pollution) (Model 1)

| Variable | Coefficient | Robust Standard Error | t | P>\|t\| |
|---|---|---|---|---|
| CAPSIDX | 0.20** | 0.09 | 2.24 | 0.030 |
| FISCAP | -0.50 | 0.56 | -0.90 | 0.371 |
| PARTID | 0.28 | 0.41 | 0.68 | 0.499 |
| BUSINT | -0.71 | 3.19 | -0.22 | 0.825 |
| CAPSIDX * BUSINT | -0.76* | 0.39 | -1.95 | 0.057 |
| CIVENV | -0.08 | 0.09 | -0.90 | 0.374 |
| LEGISP | -0.58 | 1.10 | -0.53 | 0.600 |
| EABF | -0.01 | 0.03 | -0.51 | 0.613 |
| Constant | 10.96 | 6.57 | 1.67 | 0.101 |

Observations = 183
Groups (States) = 49
R-squared (overall) = 0.37
R-squared (within) = 0.06
R-squared (between) = 0.37
F (8,48) = 1.81
Prob>F = 0.099
rho = 0.97

Fixed year effects; Independent variables are lagged
$^{*}p < .10$, $^{**}p < .05$, $^{***}p < .01$

Table 17. OLS Estimates for Appropriations from Fees & Other Sources (Criteria Air Pollution) (Model 1)

| Variable | Coefficient | Robust Standard Error | t | P>\|t\| |
|---|---|---|---|---|
| CAPSIDX | 0.11** | 0.04 | 2.57 | 0.011 |
| FISCAP | 0.41*** | 0.12 | 3.51 | 0.001 |
| PARTID | 1.59*** | 0.40 | 4.03 | <0.001 |
| BUSINT | -1.12 | 0.95 | -1.17 | 0.243 |
| CAPSIDX * BUSINT | -0.16 | 0.16 | -1.02 | 0.311 |
| CLMTP | 0.32** | 0.16 | 2.01 | 0.046 |
| CIVENV | -0.13 | 0.11 | -1.19 | 0.235 |
| LEGISP | -0.33 | 0.75 | -0.43 | 0.664 |
| EABF | 0.44*** | 0.10 | 4.51 | <0.001 |
| Constant | -2.52 | 1.55 | -1.62 | 0.107 |

Observations = 183
R-squared = 0.71
F (9, 173) = 61.52
Prob>F = 0.0000

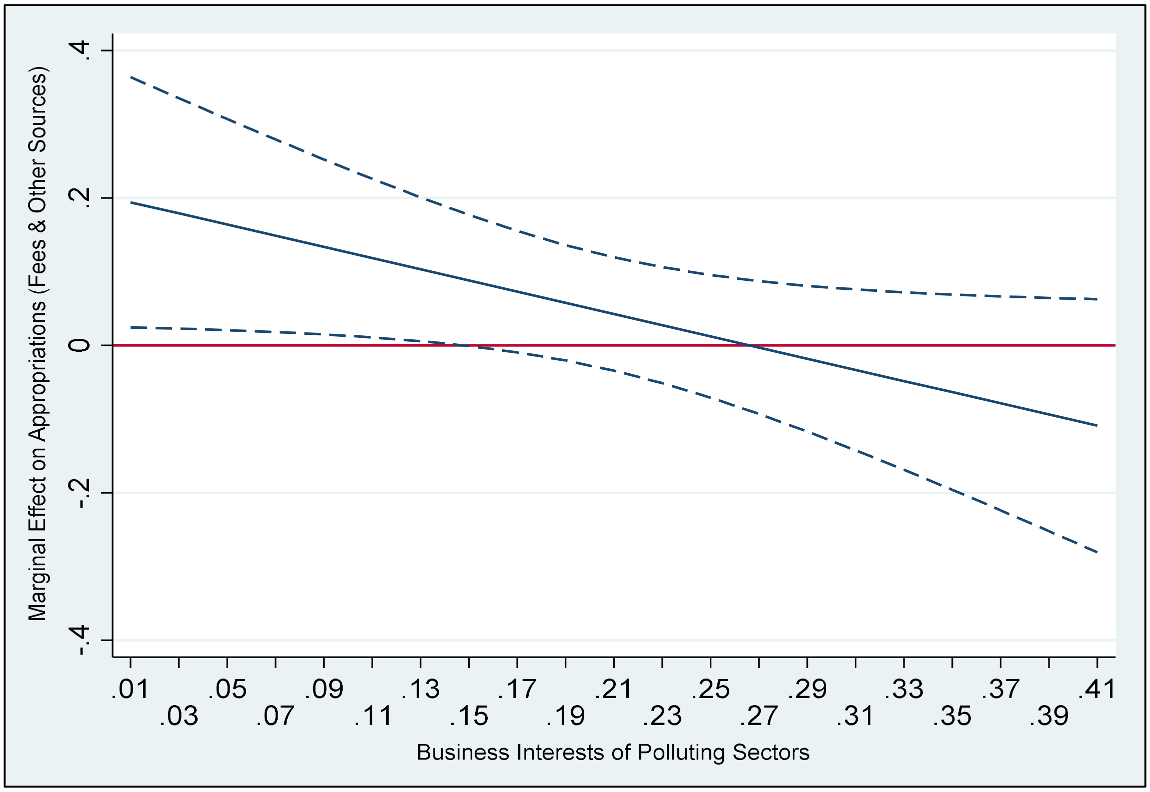
$^{*}p < .10$, $^{**}p < .05$, $^{***}p < .01$

Returning to the Model 1 results estimated from the FE model, these findings could be explained by the duration it takes for budgetary determinants to diffuse through the budgeting process. Put another way, the short panel analyzed in this study—five years for the lagged independent variables—may not be sufficient time for any characteristic but the most impactful forces (i.e. business interests from polluting sectors) to affect appropriations from fees and other sources. Alternatively, it could be that environmental agency budgeting, similar to that of many governmental agencies, is best characterized as incremental with either minimal increases, or minimal decreases, over the years and throughout the states.

While the coefficient on the interaction term (*CAPSIDX*BUSINT*) provides evidence of statistically significant—and negative—interaction of business interests and criteria air pollution on agency appropriations from fees and other sources, caution must be used in directly interpreting this coefficient in isolation (Brambor et al., 2006). Since the coefficient on (*CAPSIDX*BUSINT*) is negative, this suggests that the reductive effect increases as the prevalence of business interests increases. To better visualize the impact of criteria air pollution on appropriations along the business interests continuum, multiple marginal effects points were calculated to create a graph using business interests values ranging between 0.01 and 0.41—the minimum and maximum values—calculated in increments of 0.02. Figure 16 provides a graph wherein the solid sloping line reflects how the marginal effect of criteria air pollution on appropriations is impacted by business interest conditions. The confidence intervals depicted by the bands around the sloping line allows visualization of when interaction of business interests on criteria air pollution is statistically significant at the 0.05 significance level, or not.

Figure 16.

*Marginal Effects of Increased Business Interests on Criteria Air Pollution and Appropriations from Fees & Other Sources (Model 1)*




*Note.* A statistically significant effect is represented whenever the sloping line is within the confidence intervals where both the upper and lower bounds of the confidence interval do not contain zero.

When the marginal effect of criteria air pollution on appropriations from fees and other sources is viewed across a range of business interests found among the states, the negative interaction effect of business interests becomes clearer. As shown in Figure 16, the results from Model 1 provides evidence of increased environmental budgets from fees and other sources when criteria air pollution increases in low-to-moderate business interests conditions. The statistical significance, however, of this reductive effect on fees and other sources diminishes as these interests increase. That is, at higher levels of business interests, the reductive effect of business interests on appropriations in response to criteria air pollution still increases though eventually is not within the confidence intervals. More specifically, when the level of business interests is greater than approximately 0.17, the moderation of business interests is no longer statistically significant. When considered in the context of the business interest values across the sample population, roughly 60% of business interests values throughout the states fell within this region of significance.

Table 18 provides the marginal effects of the criteria air pollution on appropriations from fees and other sources at varying percentiles of business interests.

Table 18. Marginal Effect of Criteria Air Pollution on Appropriations from Fees & Other Sources (Model 1)

| Percentiles of BUSINT | BUSINT | F-value | Prob>F | Marginal Effect of CAPSIDX |
|---|---|---|---|---|
| 1% | 0.046918 | 5.03 | 0.029 | 0.016614 |
| 5% | 0.073185 | 4.96 | 0.031 | 0.014623 |
| 10% | 0.083878 | 4.90 | 0.032 | 0.013812 |
| 25% | 0.123188 | 4.44 | 0.040 | 0.010832 |
| 50% | 0.157073 | 3.52 | 0.067 | 0.008264 |
| 75% | 0.208116 | 1.25 | 0.269 | 0.004395 |
| 90% | 0.265409 | 0.00 | 0.991 | 0.000052 |
| 95% | 0.311202 | 0.37 | 0.544 | -0.003419 |

*Note.* The marginal effect = coefficient of CAPSIDX*unit change of CAPSIDX+coefficient of the interaction term*unit change of CAPSIDX*BUSINT

Based on Table 18, the statistically significant marginal effect of criteria air pollution severity on appropriations is evident as well as the limited magnitude of the positive effect. For example, for a state that falls in the fiftieth percentile of *BUSINT* (0.157073), the marginal effect of a one standard deviation increase of *BUSINT* on *EABFO* is 0.1*0.2017-0.7580*0.1*0.157073=0.008 million dollars, or roughly $10,000. What also comes across from these results, though not statistically significant, is while there is a positive marginal effect, this marginal effect declines as business interests increase eventually phasing-out completely.

Though the magnitude of the conditional marginal effect is not substantial, the results presented in Figure 16 and Tables 16 and 18 provide evidence in support of Hypothesis 1. Criteria air pollution *does* appear to increase environmental agency budgets across the states, and this positive marginal effect is evidenced not only at low levels of business interests but also at the mid-range. Moreover, a reductive effect by business interests on states' fiscal responsiveness to criteria air pollution is observed at the high-end of the business interest spectrum though this interaction effect eventually loses statistical significance.

**4.4.2. Model 2. $CO_2$ Emissions & fees and other sources.**

Prior to running diagnostics to determine whether a FE or RE model is the preferred technique for estimating the linear model, two tests were performed to test for the existence of serial correlation and heteroscedasticity, respectively. Results from the Wooldridge test for serial correlation supported rejecting the null hypothesis suggesting the variables are correlated over time for the sample of states. The null hypothesis of the Breusch-Pagan test (i.e. no heteroscedasticity) is also rejected suggesting that there is evidence of heteroscedasticity in model one. Similar to Model 1, along with the serial correlation, this heteroscedasticity will be accommodated using heteroscedasticity-robust standard errors (Stock & Watson, 2003). Finally, results from the Hausman test suggests a FE model is preferred.

The results of the FE regression of Model 2 are listed in Table 19. Contrary to expectations, none of the regression terms prove to approach statistical significance, and the direction of many of the coefficients are inconsistent with the respective hypothesis. For example, the coefficient on the focal independent variable in the model, $CO_2$ emissions, is negative suggesting that as $CO_2$ emissions increase, there is a negative influence on appropriations. Given that there were several extreme values within this dataset, and considering the sensitivity of model results to outliers, the model was re-run by removing these values, and this resulted in no noticeable impact on the estimates. Compared to the Model 1 results, which suggest criteria air pollution problems tends to positively influence the appropriations derived from fees and other sources in accommodative business interest conditions, no such influence emerges with GHG pollution problems. Since the main effect of carbon emissions is not specifically being tested, *and* it is describing the influence of carbon pollution on appropriations at zero level of business interests, the conditional marginal effect of carbon pollution on appropriations is separately examined.

No other coefficients on the regression terms are statistically significant at either the 0.10, or the 0.05 significance level ($p < 0.1$, $p < 0.05$). From this model, there is insufficient evidence that fiscal capacity, partisan ideology, civic environmentalism, or legislative professionalization have a significant, direct, influence (i.e. main effect) on appropriations from fees and other sources. In regards to the control variable—federal-source appropriations to environmental agencies—similar to Model 1, this variable does not explain the variation in budgets.

Similar to Model 1, given the inclusion of the time invariant variable—climate policies—among my research hypotheses *and* preference indicated for a FE model, estimation of Model 2 was completed using an OLS model with robust standard errors. The results from the OLS estimation method are provided in Table 20, a brief discussion of only the climate policy variable accompanies the empirical results following the results of the FE model provided in Table 19. While the climate policies variable is dropped from the FE results, the results estimated by the standard OLS regression model, as shown in Table 20, do not provide evidence that climate policies positively influence environmental appropriations. This result suggests that environmental budgets derived from fees and other sources do not exhibit fiscal responsiveness to the quantity of mandatory climate policies when the model is specified with $CO_2$ emissions.

Table 19. Fixed-effects Estimates for Appropriations from Fees & Other Sources ($CO_2$ Emissions) (Model 2)

| Variable | Coefficient | Robust Standard Error | t | P>\|t\| |
|---|---|---|---|---|
| CO2EM | -0.05 | 0.25 | -0.21 | 0.836 |
| FISCAP | -0.29 | 0.67 | -0.43 | 0.673 |
| PARTID | -0.04 | 0.27 | -0.14 | 0.885 |
| BUSINT | -2.81 | 22.01 | -0.13 | 0.899 |
| CO2EM * BUSINT | 0.10 | 0.85 | 0.12 | 0.903 |
| CIVENV | -0.07 | 0.08 | -0.83 | 0.413 |
| LEGISP | -0.74 | 1.24 | -0.59 | 0.555 |
| EABF | -0.02 | 0.03 | -0.65 | 0.516 |
| Constant | 9.56 | 9.80 | 0.97 | 0.335 |

Observations = 183
Groups (States) = 49
R-squared (overall) = 0.58
R-squared (within) = 0.01
R-squared (between) = 0.58
F (8,48) = 0.60
Prob>F = 0.78
rho = 0.97

Fixed year effects; Independent variables are lagged
$^{*} p < .10$, $^{**} p < .05$, $^{***} p < .01$

Table 20. OLS Estimates for Appropriations from Fees & Other Sources ($CO_2$ Emissions) (Model 2)

| Variable | Coefficient | Robust Standard Error | t | P>\|t\| |
|---|---|---|---|---|
| CO2EM | 0.08 | 0.25 | 0.31 | 0.754 |
| FISCAP | 0.57*** | 0.17 | 3.30 | 0.001 |
| PARTID | 0.22 | 0.40 | 0.55 | 0.583 |
| BUSINT | 80.59*** | 28.24 | 2.85 | 0.005 |
| CO2EM * BUSINT | -3.10*** | 1.14 | -2.72 | 0.007 |
| CLMTP | 0.05 | 0.30 | 0.17 | 0.868 |
| CIVENV | -0.04 | 0.18 | -0.24 | 0.814 |
| LEGISP | 2.16** | 0.92 | 2.34 | 0.020 |
| EABF | 0.13 | 0.09 | 1.51 | 0.134 |
| Constant | -7.50 | 5.26 | -1.42 | 0.156 |

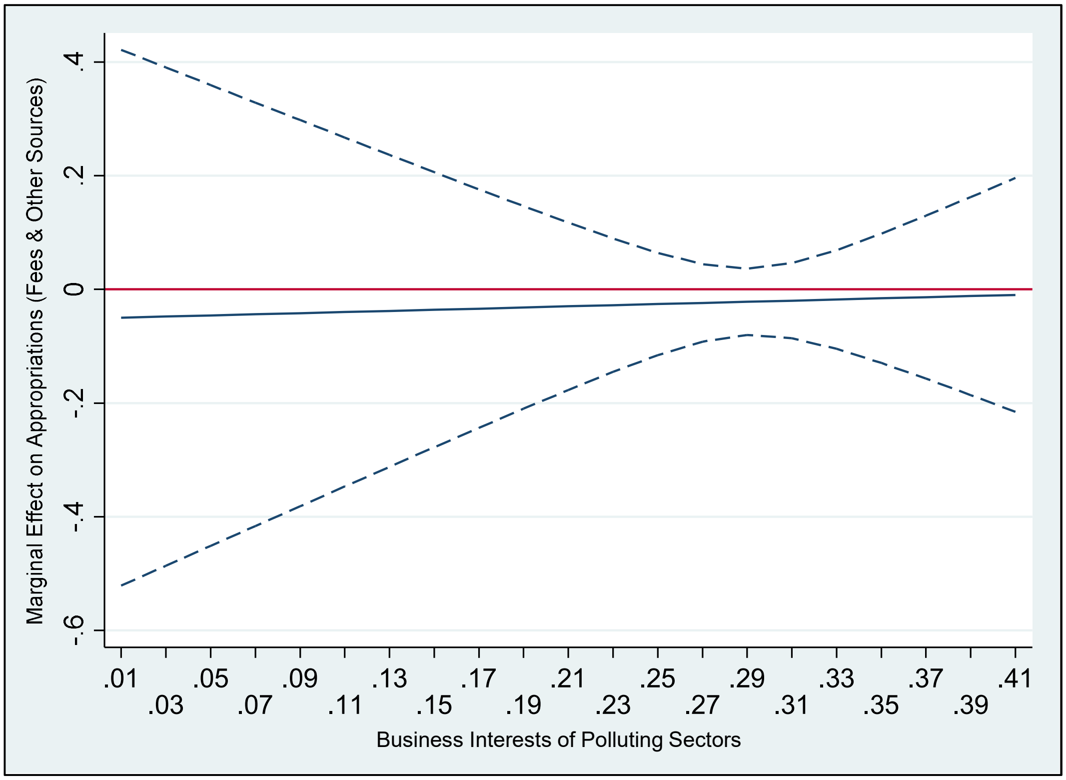
Observations = 171
R-squared = 0.40
F (9, 161) = 13.38
Prob>F = 0.0000

$^{*}p < .10$, $^{**}p < .05$, $^{***}p < .01$

Returning to the Model 2 results estimated from the FE model, while the coefficient on business interests is in the expected, negative, direction, the coefficient on the interaction term (*CO2EM*BUSINT*) is positive suggesting that business interests have an invigorating influence on the marginal effect of pollution and appropriations. Since the coefficient on (*CO2EM*BUSINT*) is positive, this suggests that there is no reductive effect by business interests—unlike the findings from Model 1. To better visualize the impact of $CO_2$ emissions on appropriations along the range of business interests, multiple marginal effects points were calculated to create a graph using business interests values ranging between 0.01 and 0.41—the minimum and maximum values—calculated in increments of 0.02. Figure 17 provides a graph wherein the solid sloping line reflects how the marginal effect of $CO_2$ emissions on appropriations is impacted by business interest conditions.

Figure 17.

*Marginal Effects of Increased Business Interests on $CO_2$ Pollution and Appropriations from Fees & Other Sources (Model 2)*




The confidence intervals depicted by the bands illustrate the absence of an interaction of business interests on $CO_2$ emissions. The coefficient on the interaction term does not reach statistical significance at the 0.05 significance level at any level of business interests within the range of possible values. Contrasting with the evidence from Model 1—that criteria pollutant emissions elicit positive fiscal responsiveness as long as business interests are sufficiently low—it appears $CO_2$ emissions have a dissimilar effect. Since inclusion of $CO_2$ emissions into the conceptual model, while informed by ecological citizenship theory, was largely exploratory in nature, these results are still intriguing. The results suggest that while states are appropriating more funds to address criteria air pollution, GHG emissions are not yet producing a similar marginal effect. Further, Model 2 results do not reinforce the evidence from Model 1 that business interests are having a reductive effect on the relationship between pollution and appropriations. Similar to Model 1, these unexpected findings with respect to the Model 2 results could be explained by the duration of time it takes for budgetary determinants to diffuse through the budgeting process especially for $CO_2$ emissions which are still not regulated by many states. While roughly half of the states do have mandatory emissions requirements for $CO_2$, based on the dataset used in this analysis, the other half of the country does not regulate $CO_2$ emissions. Arguably, it is when states have mandatory regulations that the budgetary drivers exist to fund the necessary compliance, permitting, and enforcement apparatus to implement the control and abatement policies. More on the implications of this finding is offered in the final chapter.

#### 4.4.3. Model 3. Criteria air pollution & general funds.

A foundational assumption of this study is that appropriations from fees and other sources and appropriations drawn from general funds are independently determined. Models 3 and 4 are estimated to test the same hypotheses using appropriations from state general funds. To review, general fund appropriations to state environmental agencies are a comparatively minor component of overall environmental financial resources—representing roughly 20% of the total available dollars for environmental protection. Estimating separate models using general funds allows me to explore the differential influences, if any, of the regressors on these two sources of appropriations.

Results from the Wooldridge test for serial correlation, and the results for the Breusch-Pagan test both indicated the presence of autocorrelation and heteroscedasticity in the model to be accommodated using heteroscedasticity-robust standard errors. Unlike Models 1 and 2, however, the Hausman test results suggests a RE model is preferred. To examine whether it would be preferred to run a RE model or a pooled-OLS regression, the Breusch-Pagan Lagrange multiplier (LM test) is performed. The null hypothesis for the LM test is that variation across the states is zero (i.e. there is no effect on appropriations due to differences across the states) (Breusch & Pagan, 1980). The results of the LM test were statistically significant indicating random effects in the panel data, thus a preference for selecting a RE model over pooled OLS as the estimation method.

There are several essential differences between FE and RE models that merit a brief discussion. First, where the FE model employs within-effects estimation as the method—and the *F*-statistic for the hypothesis test—the RE model uses generalized least squares (GLS) and the *Chi-squared* statistic to test model significance. Also, while the average random effects across individual units (e.g. states in this study) are fixed (i.e. controlled out) in the FE model, a RE model does not control out any time invariant heterogeneity across the groups. Per Greene (2008), when there is a random effect within the dataset that is correlated with the regressors (i.e. budgetary determinants), then the RE model can produce inconsistent results. Since the null of the Hausman test was not rejected, however, it is assumed that any individual random effects (i.e. from any unmeasured or omitted variables) *are* uncorrelated with the values of regressors in the model, indicating the preference for a RE model (Kennedy, 2008).

The results of the RE regression of Model 3 are listed in Table 21. Overall, the model is statistically significant (Wald chi-square < 0.001). With the exception of *CIVENV,* the signs on all coefficients are in the expected direction. Hypothesis 6 predicting state fiscal capacity will have a positive influence on environmental agency budgets is supported at the 0.05 significance level ($p = 0.04$). This finding suggests that an increase in the revenue generating potential of states (i.e. fiscal capacity) leads to an increase in appropriations from the general fund. When states have more revenue generating potential, it can be expected that they will appropriate more for environmental protection compared to when they have less capacity to raise such revenues. Notably, the influence of fiscal capacity on appropriations from fees and other sources was not significant suggesting a differential influence of this fiscal factor on environmental agency budgets.

The coefficient on the focal independent variable in the model, *CAPSIDX*, is positive—and statistically significant—suggesting that as criteria pollutant emissions increase, there is a positive influence on appropriations. These results are similar to the Model 1 results which reaffirms criteria air pollution positively influence appropriations regardless of the source (i.e. the effect is consistent across state own-source funding streams). Again, since the main effect of criteria air pollution is not specifically being tested, *and* it is describing the influence of pollution on appropriations in complete absence of business interests, the conditional marginal effect of pollution on appropriations is separately examined.

No other coefficients on the regression terms are statistically significant at either the 0.10, or the 0.05 significance level. From Model 3, there is insufficient evidence that partisan ideology, civic environmentalism, climate policies—which were not dropped from the FE models, or legislative professionalization have a significant, direct, influence (i.e. main effect) on appropriations from general funds. In regards to the control variable—federal-source appropriations to environmental agencies—similar to Models 1 and 2, this variable does not explain variation in appropriations from general funds.

Table 21. Random-effects Estimates for Appropriations from General Funds (Criteria Air Pollution) (Model 3)

| Variable | Coefficient | Robust Standard Error | z | P>\|z\| |
|---|---|---|---|---|
| CAPSIDX | 0.20* | 0.11 | 1.81 | 0.070 |
| FISCAP | 0.42** | 0.20 | 2.10 | 0.035 |
| PARTID | 1.00 | 0.62 | 1.60 | 0.110 |
| BUSINT | -1.74 | 1.74 | -1.00 | 0.315 |
| CAPSIDX * BUSINT | -1.00** | 0.44 | -2.27 | 0.023 |
| CLMTP | 0.35 | 0.41 | 0.85 | 0.393 |
| CIVENV | -0.08 | 0.078 | -0.98 | 0.327 |
| LEGISP | 0.39 | 1.58 | 0.25 | 0.806 |
| EABF | 0.00 | 0.05 | -0.01 | 0.993 |
| Constant | -2.40 | 2.41 | -1.00 | 0.318 |

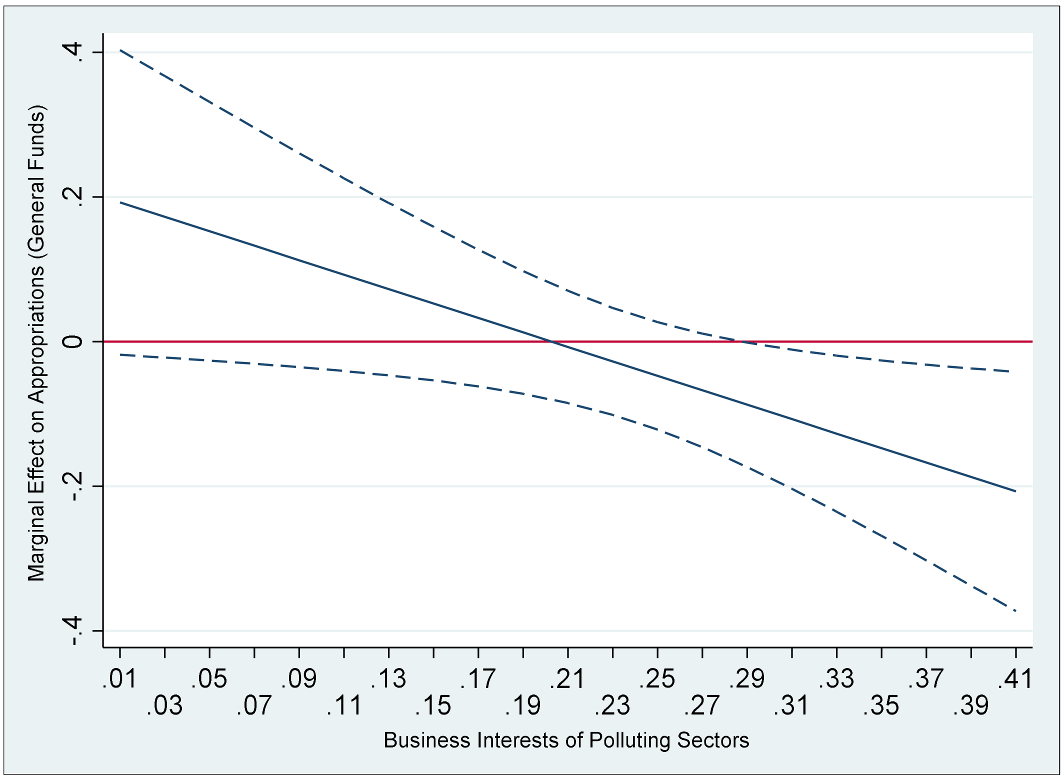
Observations = 171
Groups (States) = 47
R-squared (overall) = 0.34
R-squared (within) = 0.04
R-squared (between) = 0.40
Wald $\chi^2$ (9) = 52.73
Prob> $\chi^2$ = <0.001
rho = 0.89

Fixed year effects; Independent variables are lagged
$^{*} p < .10$, $^{**} p < .05$, $^{***} p < .01$

While the coefficient on the interaction term (*CAPSIDX*BUSINT*) provides evidence of statistically significant—and negative—interaction of business interests and criteria air pollution on agency appropriations from general funds, this coefficient is not directly interpretable—similar to Model 1. Since the coefficient on (*CAPSIDX*BUSINT*) is negative, this suggests that the reductive effect increases as the prevalence of business interests increases. To better visualize the impact of criteria air pollution on appropriations along the business interests continuum, multiple marginal effects points were calculated to create a graph using business interests values ranging between 0.01 and 0.41—the minimum and maximum values—calculated in increments of 0.02. Figure 18 provides a graph wherein the solid sloping line reflects how the marginal effect of criteria air pollution on appropriations is impacted by business interest conditions.

Figure 18.

*Marginal Effects of Increased Business Interests on Criteria Air Pollution and Appropriations from General Funds (Model 3)*




Similar to Model 1, when the marginal effect of criteria air pollution on appropriations from general funds is viewed across a range of business interests found among the states, the negative interaction effect of business interests becomes clear. As shown in Figure 18, the results from Model 3; however, provide limited evidence of increased environmental budgets from general funds compared to appropriations from fees and other sources. More specifically, as Table 18 reveals, while Model 1 found significant interaction at the lowest possible level of business interests through approximately 0.18, the points at which the interaction of business interests and pollution on appropriations is statistically significant, and positive, in Model 3, are at only the 0.10 significance level. Moreover, at higher levels of business interests, the reductive effect of business interests on appropriations in response to criteria air pollution eventually vanishes in Model 1 while, in Model 3, the negative interaction effect remains within the confidence intervals. When considered in the context of the business interest values across the sample population, just under 10% of business interest values throughout the states fell within this region of significance.

Unlike with appropriations derived from fees and other sources, the marginal effect of pollution on appropriations from general funds is negative, and statistically significant, at high levels of business interests (i.e. towards the right of Figure 18). That is, as criteria pollutants become more severe, this is having a negative influence on general funds at high levels of business interests. This finding suggests there is not only a lack of fiscal responsiveness, from general funds, among states in response to increasing criteria air pollution but a negative fiscal responsiveness when business interests are very high (i.e. states are spending less in response to pollution).

To review, in Model 1 *and* Model 3, there is evidence of interaction between business interests and criteria air pollution on appropriations from both sources. However, somewhat inconsistent between appropriations from fees and other sources (Model 1) and general funds (Model 3) is the relative lack of positive fiscal responsiveness to pollution across a large continuum of business interests in the latter model (i.e. Model 3). Additionally, there is evidence of a negative fiscal responsiveness to pollution at very high levels of business interests in Model 3. Unlike in Model 1 where the interaction effect of business interests and criteria air pollution is statistically significant across a broad range of business interest values, fiscal responsiveness to criteria air pollution is largely absent in Model 3 (the interaction is observable but only at the very lowest level of business interests).

The results of Model 3 provide support for Hypothesis 1 regarding the role of high levels of business interests in deterring funding from general funds in response to criteria air pollution. However, the results are not fully consistent with expectations of greater fiscal responsiveness at low business interest conditions such as those revealed in Model 1. Taken together, the intriguing findings from Model 3 suggest that moderation by business interests on pollution and appropriations does depend, to some degree, on the source of appropriations which will be further discussed below.

Table 22 provides the marginal effects of the criteria air pollution on appropriations from fees and other sources at varying levels (i.e. percentiles) of business interests and reveals that the interaction of business interests and pollution is statistically significant at both the lowest and highest values.

Table 22. Marginal Effect of Criteria Air Pollution on Appropriations from General Funds (Model 3)

| Percentiles of BUSINT | BUSINT | $X^2$-value | Prob> $X^2$ | Marginal Effect of CAPSIDX |
|---|---|---|---|---|
| 1% | 0.046918 | 2.83 | 0.093 | 0.015551 |
| 5% | 0.073185 | 2.49 | 0.115 | 0.012925 |
| 10% | 0.083878 | 2.32 | 0.128 | 0.011856 |
| 25% | 0.123188 | 1.57 | 0.210 | 0.007927 |
| 50% | 0.157073 | 0.76 | 0.382 | 0.004541 |
| 75% | 0.208116 | 0.02 | 0.881 | -0.000561 |
| 90% | 0.265409 | 2.55 | 0.111 | -0.006288 |
| 95% | 0.311202 | 4.84 | 0.028 | -0.010865 |

*Note.* The marginal effect = coefficient of CAPSIDX*unit change of CAPSIDX+coefficient of the interaction term*unit change of CAPSIDX*BUSINT

Based on Table 22, the statistically significant marginal effect of pollution on appropriations is absent across the continuum of business interests with the exception of very high levels where the marginal effect is negative—as indicated by the negative sign. For example, for a state that falls in approximately the ninety-fifth percentile of BUSINT (0.311202), the marginal effect of a one standard deviation increase of BUSINT on General Funds is 0.1*0.2024-0.9995*0.1*0.311202 = -0.011 million dollars, or just above $10,000. Further, while there is a detectable positive marginal effect between pollution and general funds, this marginal effect declines as business interests increase eventually phasing-out completely when business interests are most prevalent. However, at the highest levels of business interests, there is evidence of a negative fiscal responsiveness to criteria air pollution.

Though the magnitude of the conditional marginal effect is not particularly strong, the results presented in Figure 18 and Tables 21 and 22 provide evidence in support of Hypothesis 1. Criteria air pollution *does* tend to increase environmental agency budgets across the states but this positive marginal effect is evidenced only at the very lowest levels of business interests (i.e. only a few cases within the dataset). What is also revealed from these results, however, is the reductive effect of business interests eventually leading to negative fiscal responsiveness to criteria air pollution at very high levels of business interests.

**4.4.4. Model 4. $CO_2$ emissions & general funds.**

The results from the Wooldridge test and the Breusch-Pagan test provided evidence of serial correlation and heteroscedasticity, respectively and will be accommodated using heteroscedasticity-robust standard errors (Stock & Watson, 2003). Similar to Model 3 which also regresses general funds onto the budgetary predictors, the results from the Hausman test suggests a RE model is preferred. The results of the RE regression of Model 4 are provided in Table 23.

Overall, the model is statistically significant (Wald chi-square < 0.001). With the exception of *CIVENV,* the signs on all coefficients are in the expected direction which is dissimilar to Model 2—which also included $CO_2$ emissions as the focal predictor; in that model several of the coefficients were not in there expected direction. Hypothesis 6 predicts state fiscal capacity will have a positive influence on environmental agency budgets is supported at the 0.10 significance level ($p = 0.08$). This finding reinforces the finding from Model 3 and further suggests that an increase in the revenue generating potential of states (i.e. fiscal capacity) leads to an increase in appropriations from the general fund regardless of the other budgetary predictors. Again, the influence of fiscal capacity on appropriations from fees and other sources was not significant suggesting a differential influence of this fiscal factor on environmental agency budgets. Compared to the Model 1 and Model 3 results, which suggest criteria air pollution tends to positively influence the appropriations derived from fees and other sources in accommodative business interests conditions, again, no such influence emerges with GHG emissions. The conditional marginal effect of pollution on appropriations is separately examined.

No other coefficients on the regression terms are statistically significant at either the 0.10, or the 0.05 significance level ($p < 0.1$, $p < 0.05$). From this model, there is insufficient evidence that partisan ideology, civic environmentalism, climate policies, or legislative professionalization have a significant, direct, influence (i.e. main effect) on appropriations from general funds. In regards to the control variable—federal-source appropriations to environmental agencies—similar to all other models, this variable does not appear to explain variation in budgets.

Table 23. Random-effects Estimates for Appropriations from General Funds ($CO_2$ Emissions) (Model 4)

| Variable | Coefficient | Robust Standard Error | z | P>\|z\| |
|---|---|---|---|---|
| CO2EM | 0.15 | 0.23 | 0.63 | 0.528 |
| FISCAP | 0.43* | 0.24 | 1.76 | 0.078 |
| PARTID | 0.77 | 0.65 | 1.17 | 0.241 |
| BUSINT | 26.85 | 23.43 | 1.15 | 0.252 |
| CO2EM * BUSINT | -1.11 | 0.95 | -1.17 | 0.240 |
| CLMTP | 0.34 | 0.41 | 0.84 | 0.402 |
| CIVENV | -0.10 | 0.09 | -1.12 | 0.262 |
| LEGISP | 1.10 | 1.81 | 0.61 | 0.543 |
| EABF | 0.01 | 0.05 | 0.17 | 0.862 |
| Constant | -6.35 | 4.61 | -1.38 | 0.168 |

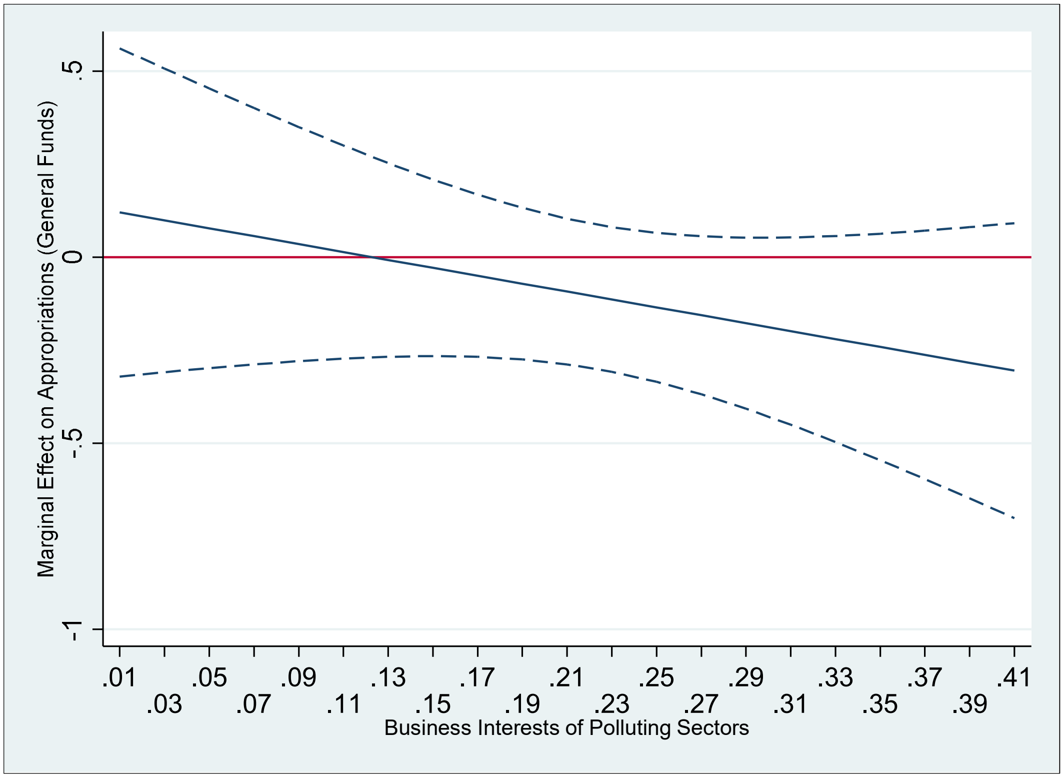
Observations = 171
Groups (States) = 47
R-squared (overall) = 0.31
R-squared (within) = 0.01
R-squared (between) = 0.34
Wald $\chi^2$ (9) = 35.30
Prob> $\chi^2$ = <0.001
rho = 0.87

Fixed year effects; Independent variables are lagged
$^{*}p < .10$, $^{**}p < .05$, $^{***}p < .01$

To visualize the dynamics of the interaction effect of business interests on $CO_2$ emissions, multiple marginal effects points were calculated to create a graph using business interests values ranging between 0.01 and 0.41—the minimum and maximum values—calculated in increments of 0.02. Figure 19 provides a graph wherein the solid sloping line reflects how the marginal effect of $CO_2$ emissions on appropriations is not conditional upon business interest conditions.

Figure 19.

*Marginal Effects of Increased Business Interests and $CO_2$ Pollution on Appropriations from General Funds (Model 4)*




The confidence intervals depicted by the bands illustrate the absence of an interaction of business interests on $CO_2$ emissions. The coefficient on the interaction term does not reach statistical significance at either the 0.05, or 0.1 significance levels at any level of business interests within the range of possible values. Considered together with the evidence from Model 2, $CO_2$ emissions do not elicit positive fiscal responsiveness from states at any level of business interests regardless of the source of appropriations. The results from Model 4 regarding the lack of support for Hypothesis 1 (i.e. an interaction effect) reinforce the notion that while states are appropriating more funds to address so-called criteria air pollution problems, GHG emissions are not yet producing a similar marginal effect on environmental budgets. Further, also consistent with Model 2 results, I do not see evidence business interests are having a reductive effect on the relationship between pollution and appropriations. Similar to the lack of significance for budgetary predictors among the other models, these findings could be explained by a longer lag than included in the current analysis which was only one year given the rather short panel of the five-year dataset.

It is generally accepted in public policy that there is a duration of time it takes for budgetary determinants to diffuse through the budgeting process which may be especially true for $CO_2$ emissions which are still not regulated by many states. While roughly half of the states do have mandatory emissions requirements for $CO_2$, based on the dataset used in this analysis, the other half of the country does not regulate $CO_2$ emissions through a regime of mandatory state-level requirements. Arguably, it is when states have mandatory regulations that the budgetary drivers exist to fund the necessary compliance, permitting, and enforcement apparatus to implement the control and abatement policies.

The results presented here provide a portrait of contemporary environmental governance consistent with expectations in certain respects (i.e. political, legal, and fiscal factors *do* influence appropriations) and contrary in other respects. When the empirical results are taken together, this dissertation adds to this strand of the public budgeting and environmental policy scholarship telling a story that aligns with the previous scholarship while offering theoretical and methodological contributions that hold promise for future avenues of research. Further interpretation of the findings revealed in the empirical results, including a comparison to findings from earlier academic literature, are summarized and discussed in Chapter 5.

## Chapter 5: Conclusion

As the arc of fiscal federalism in US environmental governance curves increasingly towards budgetary decentralization, states appear to be filling an ever-expanding budgetary void. A key purpose of this dissertation is to build knowledge and further understand the extent to which *state* own-source funding of environmental agency budgets is influenced by the political, institutional, legal, and fiscal factors informed by theory and previous scholarship.

The first section of this concluding chapter summarizes and reviews the empirical results regarding the effects of the political, institutional, legal, and fiscal factors on state own-source funding to environmental agencies with particular focus on the important interaction by business interests. The second and third sections provide the main conclusions followed by practical implications while the fourth section provides the research contributions of the dissertation before concluding with several avenues for future research.

Air pollution—a focal variable in this dissertation—represents an environmental problem which continues to "put pressure on state policymakers to generate policy responses" (Kim and Verweij, 2016, p. 509), and perhaps nowhere more is this evident than at the state-level (Mikos, 2007; Shaw & Reinhart, 2001). In addition to the political importance of air quality as a primary issue on the environmental agenda in the US (Rosenbaum, 2017), business interests are influential by "securing differential gains by political means" (Buchanan & Tullock, 1999, p. 206). Moreover, research from across the disciplines, including political science and environmental policy, reveals other factors to consider when examining variation in environmental budget policy (Aidt, 1998; Bacot & Dawes, 1996; Basu & Devaraj, 2014; Coan & Holman, 2008; Healey, 1994; O'Hare, 2006). Building knowledge of these empirical linkages is crucial given the results that occur when state environmental agencies encounter downward fiscal pressures.

Without adequate financial resources, agency capacity to perform delegated duties is hollowed-out; there are lapses that then occur due to inadequate compliance and enforcement oversight with consequent impacts on public health (ECOS, 2017a; 2018; Environmental Integrity Project, 2019; National Association of Clean Air Agencies, 2017; Steinzor, 2006; Woods et al., 2008). Setting environmental budget policy commensurate with environmental challenges might not prove sufficient to guarantee robust environmental governance; however, inadequate appropriations appear sufficient to preclude it as a reasonable possibility.

The analysis offered by this dissertation is driven by a perspective that does not view budget policy formulation as the end result of a linear progression of stages such as those offered by policy heuristics (Easton, 1965; Lasswell, 1956; Ripley, 1985). Instead, public budgeting plays-out against a backdrop of conditions that must be considered in determining *when* policies are either implemented, or not, and *why* governmental institutions take certain policy approaches rather than others. It is through this public budgeting lens that the following research questions are asked:

**Research Question 1:** Does the influence of air pollution on state environmental appropriations vary according to the magnitude of polluting business interests?

**Research Question 2:** What are the effects of political, institutional, fiscal, and legal factors on state own-source appropriations to state environmental agencies and do the effects vary based on the funding source or air pollutant type?

To address the research questions, a theoretical framework and conceptual model is applied that integrates the communicative rationality, pluralism, and collective affairs that arguably *ought to* characterize environmental policy in the US (Bingham et al., 2005; Fischer & Forester, 1993). The *integrated theory of state policymaking* framework is applied to summarize the crucial factors that explain state environmental policy from a broad perspective, and *technocracy, rational self-interest,* and *ecological citizenship* theories are drawn upon to establish the logical associations between budgetary determinants and agency appropriations in the *empirical* models. Related to the empirical features of the study, econometric models are used with an unbalanced panel design, and independent variable data from 2010 to 2014 was matched to data on state environmental agency appropriations from 2011 to 2015.

This study helps address the empirical gaps and answers the call for a theoretical-based analysis of state environmental agency funding to enhance knowledge for policy makers involved with state environmental agency budget policy. Appropriating environmental agency funds amid multiple political and policy factors that influence the decision-making process is a reality for public policymakers. Of practical importance is which of these factors help explain varying levels of general fund and fee appropriations among the states given the myriad characteristics revealed by previous research.

### 5.1. Summary & Review of Key Findings

While a limited number of the factors examined proved to be influential determinants of environmental appropriations, several meaningful findings do emerge. Table 24 offers a summary of whether the empirical evidence did, or did not, provide support for each of the six hypotheses.

Table 24. Summary of Findings by Pollution Type and Revenue Source

| Hypothesis & Key Variable | Pollution Type | Fees & Other Sources | General Funds |
|---|---|---|---|
| Hypothesis 1<br>*Business Interests Interaction* | Criteria Air Pollution | **Y** | **Y** |
| | $CO_2$ Emissions | N | N |
| Hypothesis 2<br>*Civic Environmentalism* | Criteria Air Pollution | N | N |
| | $CO_2$ Emissions | N | N |
| Hypothesis 3<br>*Mandatory Climate Policies* | Criteria Air Pollution | **Y** | N |
| | $CO_2$ Emissions | N | N |
| Hypothesis 4<br>*Legislative Professionalization* | Criteria Air Pollution | N | N |
| | $CO_2$ Emissions | N | N |
| Hypothesis 5<br>*Partisan Ideology* | Criteria Air Pollution | N | N |
| | $CO_2$ Emissions | N | N |
| Hypothesis 6<br>*State Fiscal Capacity* | Criteria Air Pollution | N | **Y** |
| | $CO_2$ Emissions | N | **Y** |

The empirical results provide support for three of the six hypotheses. There are six findings. *First*, criteria air pollution has a positive marginal effect on state environmental agency appropriations when business interest conditions range from low to slightly above the mid-range values. This finding suggests states *do* increase appropriations in response to air pollution problems when business interest conditions are sufficiently accommodative. *Second*, this pattern of fiscal responsiveness to criteria air pollution is evidenced for appropriations from fees and other sources *and* general funds reinforcing support for Hypothesis 1, albeit the influence on general funds is characterized by a less pronounced conditional marginal effect. Further, in the case of general funds, the reductive effect of business interests is such that appropriations towards addressing criteria air pollution turn negative (i.e. funding decreases) at very high levels of business interests. The conclusions to be drawn from the interaction effects by business interests are somewhat complex and will be further discussed in the sections that follow.

*Third*, when standard regression was used to estimate Model 1, there was support for Hypothesis 3 (i.e. that mandatory climate policies have a positive influence on environmental appropriations). *Fourth*, fiscal responsiveness to air pollutants is limited to criteria air pollution and does not extend to addressing $CO_2$ emissions, and this finding holds for both revenue sources of appropriations. *Fifth*, the capacity among states to raise revenue *does* matter in relation to budgetary responsiveness to pollution, and this direct effect of fiscal capacity holds across both measures of pollution but only for general funds (i.e. Models 3 and 4) providing support for Hypothesis 6. In other words, the ability for states to raise revenue does not extend to having an influence on appropriations from fees and other sources. Lastly, as modeled in this dissertation, civic environmentalism, legislative professionalization, and partisan ideology do not appear to influence, positively or negatively, appropriations derived from either source of state own-source funding. In summary, while the empirical results demonstrate support for Hypothesis 1 (interaction of business interests and pollution); Hypothesis 3 (climate policies); and Hypothesis 6 (fiscal capacity), there was a lack of empirical support for the remaining hypotheses.

**5.2. Conclusions**

There are several conclusions to draw from the empirical results. *First*, my findings support prior studies that find environmental pollution influences appropriations (Bacot & Dawes, 1996; Konisky & Woods, 2012), albeit in a relationship that is perhaps more complex than ordinarily presented, thus contributing a different way of thinking about the influence air quality has on environmental budgets. Only one study examined the interaction of business interests and pollution on environmental funding (Newmark and Witko, 2007). Contrary to the findings of that study, which relied upon a different dataset *and* methodologies, I conclude the increase in state environmental budgets in response to pollution diminishes and eventually vanishes at high values of business interests.

Viewed through the lens of rational self-interest theory, business and industrial communities appear to exert influence over the budgeting process. The costs businesses seek to reduce include regulatory compliance costs estimated at over $200 billion per year—60 percent of which "are borne by corporations seeking to meet their statutory obligations" (Kraft, 2017, p. 78). Thus, in support of technocracy theory—and Hypothesis 1—when business interests are low, the relationship between criteria air pollution and state budgets is positive. Moreover, the presence of the reductive effect of business interests on criteria air pollution and appropriations from general funds was consistent with Hypothesis 1 suggesting an affirmative answer to the first research question.

In the case of general funds, the reductive effects seem to be so strong as to elicit a negative fiscal responsiveness to criteria air pollution at very high levels of business interests as shown in Model 3. These findings suggests that when business interests are very high, there is an inflection point in the fiscal responsiveness to environmental pollution. Business interests appear to be having a more impactful influence on general funds versus fees and other sources, and this conclusion is compatible with previous literature. For example, in a survey of environmental and natural resource agencies, O'Hare (2006) found that general fund appropriations are particularly vulnerable to changes based on gubernatorial and legislative concerns rather than directly influenced by unelected environmental managers.

*Second,* with regard to Hypothesis 2, despite currency in the academic literature and theoretical support drawing from ecological citizenship theory, civic environmentalism did not have an influence on appropriations in any of the models. Despite the deep tradition of civil society participation in US policymaking, one conclusion that could be drawn is there is a democracy and legitimacy deficit in current environmental governance with citizen involvement residing at the nexus (Durant et al., 2017; Glucker et al., 2013). A far less sweeping conclusion could relate to the operationalization of civic environmentalism. More specifically, LCV scores are based upon the voting records of the states' delegations to the federal legislature *not* to the state legislatures themselves. Accordingly, it could be the lack of significance is attributable to the fiscal influence of this variable being limited to federal-source funding rather than being operant at the state-level.

*Third,* inconsistent with Hypothesis 3, climate policies failed to demonstrate a positive relationship with agency budgets derived from general funds in Models 3 and 4. However, when Model 1—which included criteria air pollution—was estimated using standard OLS, climate policies *were* found to have a positive influence on appropriations from fees and other sources. Somewhat surprisingly, a similar result was not observed when Model 2—which included $CO_2$ emissions—was estimated using standard OLS. Taken together, the results regarding climate policies were inconsistent with expectations and somewhat contradictory making it difficult to draw any meaningful conclusions for this variable.

Designing, implementing, and enforcing climate regulations will involve building robust programs to include attracting and retaining high-level professional staff all of which will require sufficient financial resources, but can state environmental agencies step up to appropriate funds for these expanded and more technically complex rolls to address $CO_2$ emissions? "A frequent question that emerges during these periods is whether states are up to the task, and it will come as little surprise to scholars of state politics that the answer is that "it depends" (Konisky & Woods, 2012, p. 544). Hypothesis 3 was established on the logic that increased regulations will cost the government more to implement, thus will drive appropriations in the positive direction. Due to the time it can take for implemented policies to diffuse and potentially account for variance in fiscal policy outputs, it could be that more time is necessary for the fiscal requirements—that will be necessitated to stand-up programs to address climate change at the state-agency level—to be detectable using a panel design.

*Fourth,* regarding Hypothesis 4, again, there was no evidence that legislative professionalization had any influence on appropriations. Similar to civic environmentalism, the available literature on this variable is limited and somewhat contradictory. For example, Konisky & Woods (2012) found that greater legislative professionalism led to less environmental stringency and had no significant influence on environmental expenditures—a finding consistent with Agthe et al. (1996) who found only a linkage between this variable and environmental program quality.

One conclusion regarding the lack of influence of legislative professionalization is state legislatures could be unaware of how reliant US environmental governance has become on state own-source revenues. While the devolution of authorities to state governments for environmental protection has transpired over several decades, there could be an institutional recalcitrance in planning and budgeting additional fiscal resources even as legislative professionalization increases across states. To the extent this holds true, it could be concluded this variable, like many of the others, is value-laden and researchers should be careful in assuming which precise values this characteristic captures. That is, it may be unjustified to assume professionalism of elected state officials provides a surrogate indication of a granular understanding of pollution, or appreciation of the reliance on state own-source funding structures to environmental agencies.

*Fifth,* the finding that Democrat-control versus Republican-control of state political institutions (i.e. partisan ideology) did not have an influence on appropriations—inconsistent with Hypothesis 5—provides an interesting contradiction to the academic literature that merits further discussion. One alternative explanation rests in party platform considerations. In their study of USEPA budgets, Balint & Conant (2013) explicated the connection between partisan ideology and environmental budget policy using a *partisan political model*. Applying that model, environmental appropriations are positively influenced when the consensus within the party (i.e. party platform) is pro-environment. Conversely, if the priorities of the majority party are misaligned with the priorities of the environmental agency, then budget policy is stifled. Thus, the relationship between partisan ideology and appropriations could incorporate platform considerations rather than only the proportion of state legislature controlled by one or the other major political parties. However, this alternative explanation is weakened by the academic scholarship that finds a consistent positive influence of liberal ideology on governmental spending, in general (e.g. Dolan, 2002; Ryu et al., 2008) and environmental funding, in particular (e.g. Clark & Whitford, 2011; Konisky & Woods, 2012). Thus, I will now explore two additional alternatives that could further explain the lack of a partisan influence.

Partisan control of state government is a function of control over the executive (i.e. governorship) *and* the legislature. Additionally, akin to the national government, control over state government can be either divided, or unified. With the measure applied in this dissertation (i.e. the Ranney Index) the effects that a unified versus divided government power dynamic might have on environmental appropriations were not estimated by the models. For example, Fowler and Breen (2013) observed that unified government can stifle legislative passage. To the extent a unified government would have had the effect of countervailing an increase in appropriations despite greater Democrat-control, this influence was left unexamined. Lastly, the academic literature finds that a Governor's budget recommendations are particularly influential on state agency budgets as explained by the chief executive office's influence on agency budget requests (Sharkansky, 1968; Ryu et al., 2008). Again, with the political variables specified in the conceptual and empirical models of this dissertation, such an influence went unincorporated. Taken together, the contradictory finding regarding partisan ideology underscores the need to exercise caution in specifying empirical models, with numerous political variables, in order to capture the wide spectrum of political influences on the budgeting process.

*Sixth,* Willoughby and Finn (1996) observed spending preferences of state policy analysts were often predicated on the long-term fiscal health which was translated to their budgetary recommendations relative to other factors. That is, public budgets are reflective of decisions made by state-level public managers based on their understanding of the financial soundness of public sector institutions and the government as-a-whole. Consistent with this, and other, academic literature, there was partial-support for Hypothesis 6. That is, findings suggested that where states had greater revenue-generating potential, general fund appropriations were higher. One conclusion is that while budget officials may be considering revenue generating capacity when setting appropriations from the general fund, the same focus does not extend to revenues from fees and other sources. It might be concluded that the fee and other source revenues are being set internally by the agency public managers versus by elected officials; this remains a speculative assertion, however, and would require further research to reveal whether such dynamics are at play. As it relates to the background literature, the positive influence of fiscal capacity on environmental funding was consistent with the majority of studies; however, it should be noted many of those studies did not detect statistically significant results (Bacot & Dawes, 1996; Konisky & Woods, 2012; Newmark & Witko, 2007).

*Lastly,* federal-source funding to state environmental agencies was retained in all models to control for its effects given the anticipated influence federal funding was thought to have on state own-source appropriations. Given previous research revealing a fly-paper effect between intergovernmental revenue sources (Clark & Whitford, 2011), federal-source funds were expected to be associated positively with both sources of state-source funding. Contrary to expectations, this influence was not supported by the empirical results suggesting a fiscal disconnect between these intergovernmental budgetary sources to environmental agencies. While federal-source appropriations are included as a control, it could also be concluded the lack of significant results from across all four models simply reflects the minute share federal-source appropriations contribute to state environmental budgets.

**5.3. Practical Implications**

Three policy implications are informed from the above findings and conclusions. *First*, previous academic research over several decades finds that business interests in the US are not idle by-standers in the public policy process (Davies & Davies, 1975; Dell, 2009; Hays et al., 1996; Moore & Giovinazzo, 2011). Normatively, environmental governance is financially responsive to pollution problems; however, evidence is herein offered that business interests are neutralizing the effects of air pollutants on environmental agency budgets given the negative interaction effect of business interests.

That is, when business interests are low, and in response to criteria air pollution, states appear to internalize the governance costs related to environmental protection functions through increased revenues derived from fees and other sources. This finding suggests states are growing increasingly reliant on these revenue structures to promote environmental governance at the state level. The practical implication here is that business interests negatively moderate the relationship between air quality and appropriations signaling an opportunity for public managers and elected officials to promote civic engagement and cultivate a plurality of interests in the budgeting process.

*Second*—and related to the first implication—business interests have a differential conditional marginal effect on the budgeting process as it relates to fees and other sources compared to general funds. More specifically, a negative conditional marginal effect was observed for general funds but *not* for fees and other sources. The practical implication of this finding is that resourcing state environmental agencies through fees and other sources may be more politically-insulated than the appropriations derived from general funds. For public budgeters involved in analyzing and setting budget policy for environmental agencies, this suggests focusing on raising revenues from these fees may be a more viable alternative compared to making policy recommendations aimed at securing increasing appropriations from general funds.

*Third*, while appropriations bills are ultimately voted-on by elected officials, the content of budget proposals is a function of a host of stakeholders, many of whom are unelected, who per technocracy theory *do* understand air pollutants. In other words, line agency managers must vie for limited resources by making arguments to public budgeters—including elected officials—supported by empirical data. These arguments and lines-of-evidence in the budget proposals are reviewed by budget office analysts and by executive and legislative branch officials. As the public budgeting scholar Irene Rubin (2010) pointed-out, to be successful, these proposals must appeal to all these stakeholders.

The lack of statistical significance across the models in this study for the majority of the political, institutional, and legal factors could reflect a state of environmental governance whereby the fiscal needs are being conveyed but are simply getting lost in the milieu of competing needs facing state governments across the US. To the extent a knowledge deficit does exist, the environmental agency officials might examine how *their* knowledge of air quality conditions is, or is not, being brokered with elected officials including the differences between criteria pollutant and carbon emissions, and the immediacy with which appropriations should increase.

**5.4. Research Contributions**

As noted in Chapter 1, a review of the literature reveals an opportunity for improving theoretical coherence, applying distinctive methodological strategies including various measures of air pollution to advance this branch of public budgeting and environmental policy research. It is with these considerations and perspectives that his dissertation offers four contributions.

*First*, the *integrated theory of state policymaking* presents a policymaking framework that state policy responsiveness can be accounted for by influences from interests groups; political ideological dispositions; ambient environmental conditions; and economic conditions. Despite the explanatory role this framework has lent to state environmental administration scholarship, it has not been used to explain state environmental agency budget policy to-date. This dissertation suggests its utility for future similar studies.

*Second*, despite prior research suggesting federal and state policy, within the same functional areas of governance, have notable differences in terms of their antecedents (Clark & Whitford, 2011), the environmental budgets are often represented by total fiscal resources, or with the budgets of natural resource agencies combined with environmental protection agencies

(Bacot & Dawes, 1996; Konisky & Woods, 2012). As Figure 15 reveals, however, state governments have increasingly relied upon general funds and user charges drawn from the regulated community—the two sources of state own-source funding. This dissertation contributes to the scholarly conversation by examining general fund appropriations separate from fees and other sources to assess the differential influence of budgetary determinants on a revenue structure upon which states are growing increasingly reliant—fees and other sources. The results suggest the two behave similarly, but not identically—(e.g. climate policies and fiscal capacity)—which holds implications for researchers, and public budgeters alike.

*Third*, while this dissertation seeks to explain budgeting of state environmental agencies through empirical modeling, it is generally understood that not all variables "operate in the same fashion" (Howell, et al., 1986, p. 88). The design of the study attends to the concerns of state environmental policy scholars to move beyond analyzing bivariate relationships and regression coefficients interpreted by focusing only on direct effects (Lester & Lombard, 1990). This dissertation contributes to the research by emphasizing the interaction effect of business interests on environmental pollution and appropriations.

*Fourth*, while pollutant emissions from criteria pollutants and $CO_2$ are formed from similar processes (e.g. fuel combustion, industrial operations), the empirical analysis of the fiscal responsiveness to their mitigation should take into account the differential influence that criteria air pollution and GHG emissions have on appropriations. The results reveal a lack of fiscal responsiveness to what is arguably the cause of the most pressing environmental challenge of our day—global climate change due to anthropogenic GHG emissions, particularly $CO_2$. While environmental agencies are fiscally responsive to criteria pollutants, the pivot has perhaps yet to be made in addressing $CO_2$ emissions.

## 5.5. Areas for Future Research

This study is built upon a framework that considers the interdependencies between pollution and budget policy at the state level to help advance research agendas in this strand of public budgeting scholarship. This dissertation concludes with four areas for future research.

*First*, a future study could involve interviewing environmental agency managers using a deductive coding scheme drawing from the theoretical framework and additional theories of this dissertation to identify key themes related to knowledge brokering by environmental agencies in the context of appropriations requests. This thematic analysis would be combined with content analysis of state budget documents to identify any systematic approaches used to convey an empirical understanding of air pollutant emissions to budget analysts, legislative staff, legislators, and other stakeholders. Such a study could provide added context to the findings by exploring the relationships implicit in the focal relationship of this article--the linkage public managers putatively make between pollution problems and agency budgets.

*Second*, while included in this dissertation to control for its effects on state own-source funding, federal-source funding is declining. Future studies could focus on the unique budgetary predictors of federal-source revenues to state environmental agencies building on previous research and extending into interviews with public budgeters at the USEPA regions and their counterparts at the state-level. Such studies could yield insights into what factors have constrained federal-source funding over the years and how, perhaps, offer paths to stem this fiscal decline.

*Third*, with respect to partisan ideology, a future study could examine the interaction of partisan ideology and pollution on budgets at partisan ideological levels including Republican-control; Democrat-control; and two-party control. This study would involve a multiplicative interaction model with two moderators—business interests and partisan ideology. In such a study, the models would depict the marginal effects of increasing air pollutants on environmental across the entire span of partisan ideology levels and varying levels of business interests ranging from very low to very high. For example, the marginal effects of increased Democratic control in state government would be calculated across values of increasing pollutant severity to assess, if environmental appropriations—from either general funds, or fees and other sources—decrease, or increase, based upon partisan control of state legislatures. Such a study could provide evidence as to what marginal effect partisan ideology has when business interests levels are accommodative (i.e. low) versus in high business interests conditions.

*Lastly*, resource dependence theory holds that organizations have dependencies with their external environments and that institutions will develop linkages to external elements so as to stabilize, or even gain resources, and reduce environmental uncertainty (Hillman, Shropshire, Cannella, 2007; Pfeffer & Salancik, 1978). This theory helps explain why state environmental agencies obtain increased autonomy and control of environmental programs by requesting authorization and programmatic delegation from the USEPA (Crotty, 1987). A line of future research could, thus, involve examining the declining reliance on federal-source revenues viewed through the lens of resource dependence theory from the state environmental agency perspective.

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