Policy Devolution and Cooperation Dilemmas*

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Abstract

We argue that the imposition of administrative boundaries on a policy domain has the potential to exacerbate cooperation and coordination dilemmas conditional on the extent to which these boundaries either dissect natural environmental borders or introduce heterophily (i.e., the extent to which stakeholders are different from each other in a policy domain). We test our expectations using a newly-constructed dataset of U.S. state regional offices charged with water pollution control responsibilities. The subjects of the analysis are about 6,000 major water pollution sources regulated under the U.S. Clean Water Act for which we have detailed historical data on compliance and regulatory activity.

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Introduction

Environmental problems do not obey political boundaries. When pollution varies systematically with natural environmental features, these borders often cut across relevant political and administrative boundaries. This spatial mismatch is not inconsequential. Effective policy responses to pollution necessitate cooperation and coordinated effort, both of which erode in the presence of a fragmented policy domain (Konisky and Reenock 2013). When such fragmentation occurs, individual governments and administrative units face both incentives to free ride on the relative contributions of others as well as increased costs of coordinating strategies between units (Konisky and Woods 2010; 2012, Oates 2002, Revesz 1996, Sigman 2004; 2005). The result is a weaker and more uneven policy response to pollution, resulting in potential risks to human health and the environment.

We argue that the imposition of administrative boundaries on a policy domain has the potential to exacerbate cooperation and coordination dilemmas conditional on the extent to which these boundaries either 1) dissect natural environmental borders and 2) introduce heterophily (i.e., the extent to which stakeholders are different from each other in a policy domain).

We test our expectations using a newly-constructed dataset of U.S. state regional offices charged with water pollution control responsibilities. More specifically, these are regional administrative offices created by state environmental agencies to implement activities under the U.S. Clean Water Act, such as permitting and compliance assurance. For each regional office, we identify and then use GIS to spatially define its jurisdiction (these are usually coterminous with a set of counties) and then its overlap with watersheds. In addition, for each regional office we collect data on its political and demographic characteristics, which serve as a proxy for measuring regional network heterophily.[1]

To test our hypotheses, we use regression analysis to investigate the degree to which higher levels of fragmentation of environmental resources boundaries (i.e., watersheds) by administrative boundaries results in less regulatory effort from regional agents. [In subsequent analysis, we will also examine whether this is attenuated by either formal (centralized decision-making authority) or informal institutions (i.e., watershed partnerships).] The subjects of the analysis are about 6,000

[1] See Gerber, Henry and Lubell (2013) on network heterophily.

major water pollution sources regulated under the U.S. Clean Water Act for which we have detailed historical data on compliance and regulatory activity. We believe the results of this analysis will make contributions to both theoretical and empirical literatures on institutions, policy coordination, and environmental politics. In addition, the research has significant implications for environmental governance by examining the effects of fragmented institutions on regulatory effort, and ultimately risks to public health and the environment.

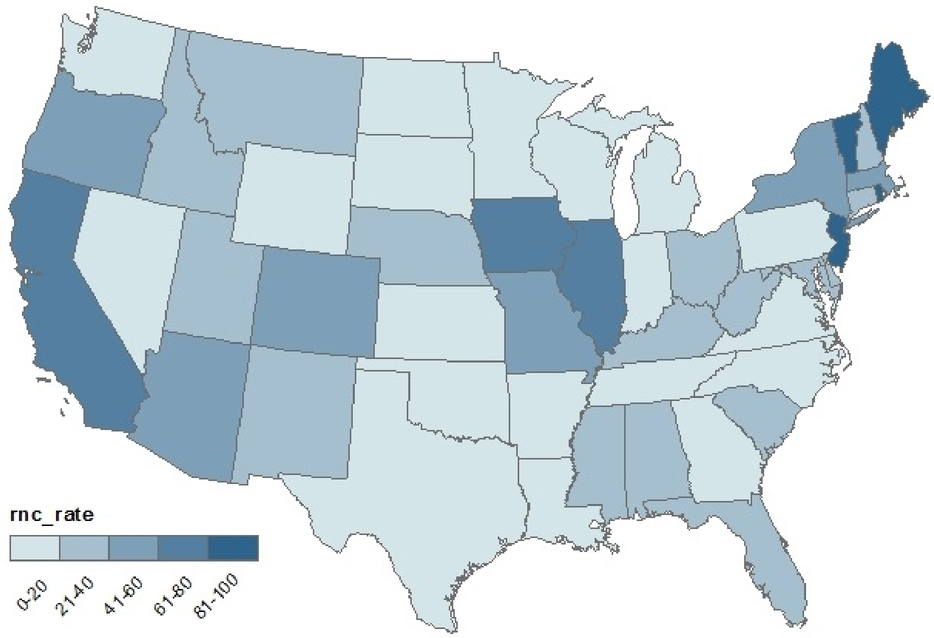
Policy Devolution, Geography and Cooperation Dilemmas

Over 90% of the environmental enforcement in the United States is generated by state pollution control agencies rather than the EPA (ECOS 2001; 2006). Given the states central role in implementing federal pollution control laws, it is unsurprising that states feature prominently in scholarly treatments of environmental regulation (e.g. Hunter and Waterman 1996, Lowry 1992, Potoski 1999, Ringquist 1993, Wood 1991; 1992). In fact, much of what we have learned over the past three decades about the effects of politics, economics, and administrative features on environmental implementation rests on the foundation that states are the most relevant policy delivery system. Consider how environmental outcomes vary across the states.

Figure 1 below highlights regulatory noncompliance rates with NPDES permitted facilities under the Clean Water Act aggregated to the state for 2013. The map demonstrates rather clearly state discretion in water enforcement implementation. We see wide variance in the level of regulatory compliance obtained by state pollution control agencies. But are states the most relevant institution for environmental policy delivery? Very few states deliver policy via the state capitol. Instead, the great majority of states have devolved policy delivery to regional offices geographically distributed throughout the state. The logic of such devolution is in part driven by the need to manage more demanding policy workloads and to be more responsiveness to local needs (Woods and Potoski 2010). Nevertheless, most work on environmental regulation neglects state regional offices as unique policy devliery institutions in their own right.

Consider Figure 2 below. The Figure displays the 257 regional water pollution control offices across the U.S. states. Some states, like Nevada and the Dakotas, make no use of regional offices, preferring to handle implementation centrally. Most, however have devolved implementation au-

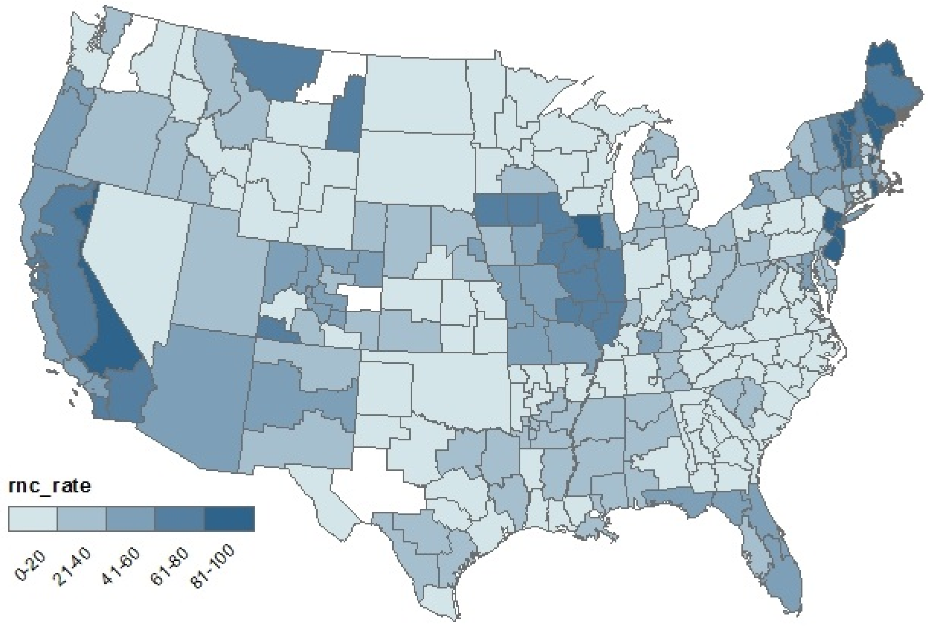
Figure 1: State CWA Noncompliance Rate for Clean Water Act, 2013



thority to regional offices. But these regional offices vary considerably in number. Oregon and New Mexico, for example, make use of three regions, Florida and Pennsylvania use six and a few states make use of a large number of offices, including Colorado with 14 and Arkansas with 10. The choice to devolve authority to regional offices has potential policy consequences. When we compare Figure 2 with Figure 1 we can see wide variance below the level of the state on regulatory noncompliance. Within states that perform relatively well on water outcomes, we can see a few regional "hotspots," where compliance rates are markedly higher than the state average. As a result the picture that one has of a state's performance on environmental outcomes depends quite strongly on where one looks.

What may be driving these regional variations? The literature provides a host of usual suspects. Whether local stakeholders, regional problem severity or variations in bureaucratic discretion across agency structures, there is no shortage of standard explanations. Yet, these standard accounts all seem to ignore a common feature – policy geography.

Figure 2: State Regional Office CWA Noncompliance Rate for Clean Water Act, 2013

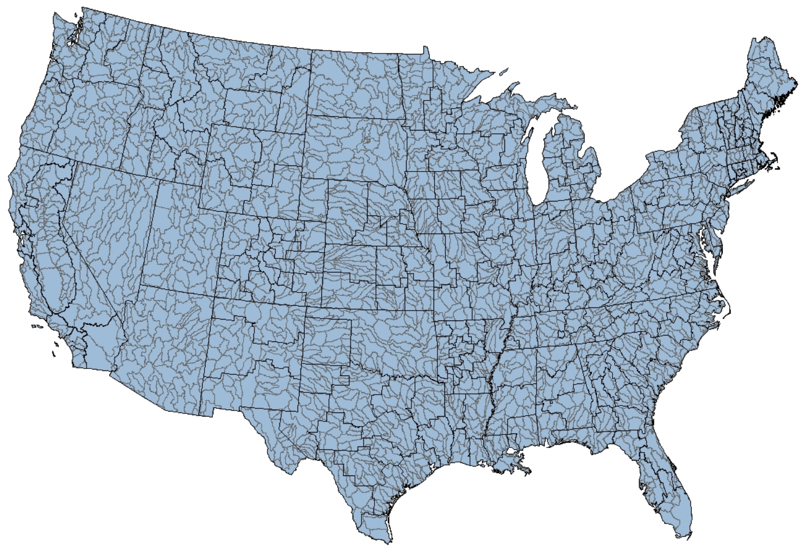


We believe that one of the critical and overlooked consequences in state devolution to regional offices is that by scoring off administrative policy boundaries, devolution, as a matter of course, also imposes boundaries over important environmental resources. In doing so, the use of regional offices raises the propensity of dissecting environmental resources and along with it weakening the uniform policy authority over those resources.

Consider Figure 3 below. Figure 3 overlays U.S. watershed boundaries with state regional water pollution control offices. We can see from the map that it is rare for state regional offices to follow the contour of watershed boundaries. In fact, California stands alone in its effort to consider watershed boundaries drawing regional offices boundaries.

We believe that the devolution of state authority into regional offices introduces at least two core theoretical challenges for the delivery of environental policy. First, the imposition of regional boundaries that dissect watersheds at varying rates may induce a cooperation dilemma between regional officers who share jurisdiction over facilities and watershed. Second the imposition of regional boundaries over existing political boundaries endogenously create local level principals

Figure 3: State Regional Offices and Watershed Boundaries



whose preferences may deviate substantially from the state median. In this paper, we are concerned with examining to extent to which the former occurs. In the next section, we outline a theory of how unique combinations of administrative and environmental boundaries generate cooperation dilemmas for regulatory officers.

Our Approach

Our theoretical approach is situated in the Institutional Analysis and Development (IAD) framework (Ostrom 1990; 2005; 2007, Ostrom, Gardner and Walker 1994), which has been widely-adopted to analyze the role of institutions and norms, and their effects on individual decision-making. The framework's core is the action-arena, which is the geographic unit where choices are made, and is defined by three sets of variables: institutions, community characteristics, and the physical environment's attributes (Ostrom 1990; 2005). For our purposes, the IAD framework emphasizes the importance of correctly identifying the boundaries of policy action (the "action arena"), the relevant policy stakeholders ("community of interest"), the agency design features that shape the incentives of actors ("institutions"), and the relevant environmental risks ("physical environment"). Within this framework, government action in the form of both policy and implementation manages the environmental risk that communities experience. By altering inputs such as detection and abatement, government shapes firms' decision-making calculus over compliance (Scholz 1991). Our goal is to understand how aspects of policy geography shape stakeholder incentives to generate these governmental inputs.

When states create and devolve implementation authority to sub-state governing jurisdictions, they carve out new "action arenas," which delineate relevant stakeholders and alter their incentives. These regional offices also intersect in unique ways with the boundaries of the environmental risks being managed. Collectively, the resulting spatial overlap of administrative and political jurisdictions along with environmental problems comprises what we refer to as policy geography, the nature of which shapes several policy implementation challenges, including political responsiveness, coordination dilemmas, and equity. We will use the IAD framework and our notion of policy geography to examine how state policy devolution affects various features of the action area: stakeholders, institutions, and the physical environment. In the balance of this section, we generate several hypotheses about how policy geography shapes government policy outputs. On the whole, our expectations are relevant to two flavors of outputs: level and variance that is, policy geography may induce changes in either the production (e.g., more/less stringent regulatory action) or the variance of policy outputs. We also examine the consequences of such features for relevant policy outcomes including compliance rates and risk reductions.

Policy Geography and Officer Incentives

We begin by assuming that a regulatory agency's task is to manage a public environmental resource. These resources can exist either as a watershed, an air quality control region or a common pool resource. We follow the standard literature on delegation and begin by assuming that a principal of a regulatory agency contracts with lower-level officers (agents) to produce policy. Policy production exists on two dimensions policy outputs and policy outcomes. The principle offers agents compensation for their joint production over these two dimensions. Agents also prefer to substitute leisure for production, and accordingly, effort is costly. We further assume that an agent's effort is not perfectly observable. Principals use performance indicators of regulatory outputs and outcomes to gauge "regulatory effort" by officers. Such indicators are vulnerable to goal displacement, where officers pursue optimal metric quotas rather optimal targeting of the public good. To this point, our story maps onto a standard agency relationship.

We assume that regulatory agencies develop implementation targets for regulatory officers. These implementation targets reflect a mixture of policy and political demands placed upon a regulatory agency (Carpenter 1996). These targets are conveyed, imperfectly, to lower-level regulatory officers responsible for implementation.

Regulatory officers are interested in maximizing the political benefits of successfully generating their target regulatory output, while minimizing the political costs of missing their targets. Political benefits stem from being responsive to policy demands such as managing the aggregate consequences of non-compliance (e.g., pollution levels, accident rates) and political demands including the preferences of political principals and relevant stakeholders. Missing their targets has consequences. Programs that miss their targets are exposed to greater political scrutiny (Carpenter 1996, Shipan 2004). Officers housed within those programs risk the potential for reductions in budgets and shuttered offices, lost merit pay, career advancement (Whitford 2009, Wilson 1989).

Pursuing implementation targets also involves any number of transaction costs. These appear in the form of search and information costs, bargaining costs, policing and enforcement costs, as well as the cost of not being able to substitute leisure for effort. As a result, despite even the best intensions (not withstanding evidence that public bureau employees are more dedicated to pursuing public policy targets e.g. Crewson (1997)), such costs may inhibit officers from achieving their targets. We are interested in a particular set of transaction costs – those that arise due to the cooperation dilemmas generated from administrative institutional arrangements.

Occasionally, administrative jurisdictions map onto resource settings in a way that does not dissect the resource. In these settings, the bureaucrat is solely responsible for both regulatory outputs and outcomes in the region and, as such, the sole agent responsible for production in his region. However, administrative jurisdictions also dissect resources. This results when an administrative boundary cleaves through an environmental resources boundary. For example, there are more than 2000 watersheds (i.e., USGS cataloging units) in the United States. Each watershed represents a natural topographical basin within which surface water drainage exits via a single outlet. Yet, many of these watersheds are dissected by state regional administrative boundaries.

We believe that regional regulatory officers will have less incentive to exert high regulatory effort of dissected watersheds within their region.

When dissection occurs, the agent is presented with a challenge. In this setting, the bureaucrat is no longer solely responsible for his production at the resource level. While retaining authority over regulatory output production, he now shares production over regulatory outcomes. In essence, the shared resource induces an interesting quasi-team production function. The agent external to the region can contribute to production in the watershed. The logic is straightforward officers with sole responsibility for watersheds can be identified and rewarded (or punished) for their effort and regulatory strategies are more easily coordinated within a given regional office with lower transaction costs. Officers who share watersheds with other regions face not only incentive to free ride on other regions but also higher costs in coordinating enforcement strategies. Of course, the principal of the original agent cannot offer a contract to the quasi-agent. The problem for the agent in such a setting is how to dedicate their regulatory activity for the shared resource, when some portion of their evaluation is in the hands of another agent. Do they abdicate effort over that resource, double their effort, or something else? On average, we believe that such shared resources present costs to cooperative behavior and therefore incentivize the agent to dedicate effort elsewhere in their region. Therefore, we expect:

Hypothesis 1 *Regulatory officers will produce lower and more variant regulatory activity in the presence of regional boundaries that dissect watersheds.*

However, not all agents face equivalent bargaining costs over shared resources. Formal government institutions are not the only device that may encourage (or exacerbate) agents' ability to overcome coordination dilemmas induced by the mismatch between administrative and watershed boundaries. A growing literature on local partnerships suggests that decentralized nongovernmental organizations can encourage cooperation and communication among stakeholders (Gerber, Henry and Lubell 2013, Leach and Pelkey 2001, Lubell et al. 2002, Lubell, Robins and Wang 2014, Scholz and Wang 2006). By increasing demand on local government for stringent enforcement of permitted facilities and by increasing reputational costs associated with violations, effective local networks can transform the regulatory incentives in policy domains (**?**). Given the potential of local policy networks to encourage cooperation and coordination, we believe that these benefits will be most tangible in the presence of fragmented policy domains. Therefore we expect that the extent to which dissected watershed negatively impact regulatory activity will be attenuated by the presence of extensive local watershed partnerships.

Second, administrative boundaries shape the diversity of political and demographic features of the policy domain. Recent work suggests that policy domain heterophily, decreases the likelihood that stakeholders will form social network ties with each other. Heterophilic ties decrease the prospects of policy collaboration by raising the transaction costs associated with collective and coordinated action (Gerber, Henry and Lubell 2013). To the extent that two or more regions share implementation authority over a given watershed, their ability to successfully develop coordinated responses to watershed pollution will be conditioned by regional network heterophily.

Hypothesis 2 *The effect of watershed dissection on regulatory activity will attenuate in the presence of regional offices that are more similar in political and demographic characteristics.*

Research Design

U.S. state implementation of federal pollution control programs provides a particularly rich context to examine the importance of policy geography on policy implementation. Major federal programs such as the Clean Air Act (CAA) and Clean Water Act (CWA) are largely implemented at the state level under a model of cooperative federalism in which the federal government sets emissions or technology-based standards, but then hands over implementation responsibilities to willing state governments. States in turn organize their implementation activities in a manner such that there is tremendous variance in the both the geographic organization and decision-making structures of the administrative agencies implementing the programs, including within states across environmental media. This paper focuses on state implementation of the CWA, which is a good policy context to examine given that water resources vary in their propensity to obey geographic and political boundaries and their vulnerability to collective action and coordination dilemmas.[2] In the balance of this section, we describe the data we have collected and the analysis that we will conduct to test the hypotheses developed in the previous section.

[2]In subsequent research, we intend to study similar questions in the context of the CAA, which will enhance the external validity of our analysis, since it will allow us to consider areas that vary widely on salience, severity, and complexity across and within states (Gormley 1986).

Data and Measures

The dataset we have compiled combines administrative data on regulatory compliance and enforcement from the EPA, watershed boundary data from the USGS, and state administrative boundary information we compiled from state government agencies. We discuss each in turn.

Regulatory Compliance and Enforcement The EPA maintains extensive historical records on facility-level compliance with most major pollution control laws, as well as regulatory actions taken by federal and state officials to enforce these laws. In the case of the CWA, we use data from the EPA's Integrated Compliance Information System-National Pollution Discharge Elimination System (ICIS-NPDES) dataset[3] The ICIS-NPDES archives facility-level violations of and compliance with the CWA (i.e., not all violations result in an determination of noncompliance as defined by EPA guidance), and individual enforcement actions taken by the EPA and state government agencies (e.g., compliance monitoring inspections, punitive measures). The data include a diverse set of facilities that are required to have NPDES permits under the CWA (under the law, any source discharging pollutants directly into a U.S. waterway is required to have a NPDES permit), but, since reporting is only required for "major" NPDES sources, we limit the scope of our study to these facilities.[4] There are currently about 6,000 facilities that have major NPDES permits, although we were only able to secure complete information for 5,779.

We create several measures using the ICIS-NPDES data for the years 2010-2013.[5] First, the dependent variables we analyze come from the regulatory output data included in ICIS-NPDES. Specifically, we create annual counts of the number of state-led inspections and state-led enforcement actions directed toward each major NPDES permitted facility.[6] In the case of enforcement actions, we aggregate "informal" actions which include notices of violations and "formal" actions which include administrative orders and financial penalties. These types of measures are frequently used in the social science literature to capture the regulatory effort of government agencies to en-

[3]These data are available to download at the following EPA website: http://echo.epa.gov/tools/data-downloads.

[4]Major NPDES sources include large publicly owned treatment works, privately owned treatment works, industrial dischargers, concentrated animal feeding operations, and other facilities deemed significant by EPA, state, and/or tribal officials.

[5]The most recent ICIS-NPDES data are complete through October 17, 2014, so the data are complete for 2014.

[6]The EPA also conducts actions, but these are mostly in an oversight capacity, except for in the states to which the EPA has not delegated authority to implement the NPDES program: Alaska, Arizona, Idaho, Maine, Massachusetts, New Hampshire, New Mexico, and Texas).

force the CWA (Gray and Shadbegian 2004, Helland 1998, Konisky 2007, Konisky and Reenock 2013, Scholz and Wang 2006).

The ICIS-NPDES database also contains facility-level compliance data. In addition to providing information on specific instances of violations, the data also include quarterly determinations of a facility's noncompliance status with the CWA. In particular, the EPA tracks two types of noncompliance: reportable noncompliance and significant noncompliance. Beginning with the latter, significant noncompliance is the more serious designation, and can be triggered by a variety of violations including effluent violations (i.e., discharges that exceed permitted limits), failure to submit a discharge monitoring report, violation of a previously-set compliance schedule, or a violation identified during a government inspection. Reportable noncompliance are instances of noncompliance that do not rise to the level of significant noncompliance. In the analysis that follows, we create dichotomous measures of each type of noncompliance for each major NPDES facility for each year.

In sum, we create a facility-year level dataset of compliance and regulatory actions for the 5,783 major NPDES sources for which we have complete information. These facility-level data are then combined with the geographic data we describe next.[7]

Watershed Boundaries and Regional Office Boundaries To examine our hypotheses regarding the dissection of watershed boundaries and policy coordination, we require two sets of additional geographic data. First, we need data on watershed boundaries, which we have collected from the U.S. Geological Survey (USGS) Watershed Boundary Dataset. The USGS classifies all watersheds in the United States using a numerical coding system that assigns each a unique hydrologic unit code (HUC). In our analysis, we use cataloging units, which are geographic areas that represent part or all of a surface drainage basin, a combination of drainage basins, or a distinct hydrologic feature. There are 2,264 such cataloging units in the United States.

Second, we require data on the geographic organization of the state administrative agencies responsible for CWA implementation. As was evident in Figure 2, states vary both in whether they utilize regional offices, and if they have regional offices, how many there are. To determine the

[7]The facility information in ICIS-NPDES do not include precise geospatial identifiers (i.e, longitude and latitude) for facilities. For this reason, we used geospatial information available for facilities contained in EPA's Facility Registry System (FRS) and them merged this with the ICIS-NPDES data. These datasets contain different lists of major NPDES facilities, so those studied here are those that were 1) included in FRS and 2) had matching compliance and enforcement information in ICIS-NPDES.

Table 1: Watershed Dissection by State Regional Offices

	Not dissected	Inter-region	Inter-state	Inter-region and Inter-state
Watersheds				
Number	680	758	286	387
Percent	32.2%	35.9%	13.6%	18.3%
Major NPDES facilities				
Number	1,278	2,214	2,291	1,606
Percent*	22.1%	38.3%	39.6%	27.8%

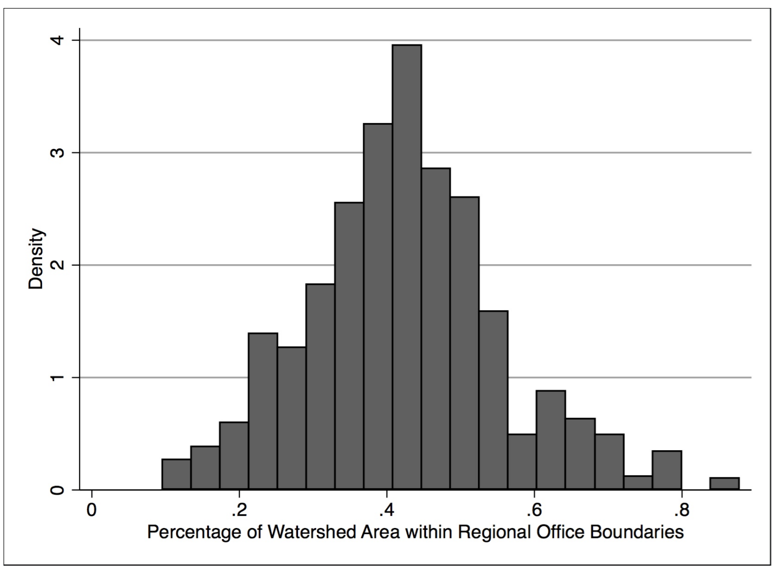
Note: *Percents don't add to 100 because facilities that are located in both inter-region and inter-state are a subset of those in the inter-region and inter-state categories.

geographic organization of each state agency, we compiled information from state agency websites or other information and documents we collected from contacting state agency officials. We then used GIS software to delineate the jurisdiction of each office. For most states, this is a straightforward task because regional office boundaries correspond to other political boundaries such as counties or towns. In the small number of cases where the regional office boundaries fall along watershed or other boundaries or comprised of partial counties, we delineated each regional office boundary using ArcGIS tools.

With these data, we can illustrate the degree that state regional offices dissect watersheds, and how major NPDES facilities are located within different types of situations. For example, it is possible to characterize individual watersheds by the degree of their fragmentation. Using GIS, we determined whether each watershed was in one of four categories: 1) not dissected, or wholly contained within a single state regional office, or in the case of state with no regional offices, within the state; 2) inter-region, or dissected by at least two regional offices within the same state; 3) inter-state, or dissected by at least two regional offices in different states; or 4) inter-region and inter-state, or dissected by both at least two regional offices within a state and an additional regional office in another state. The top panel of Table 1 displays the distribution of watersheds across these different designations, and the bottom panel shows shows the disposition of the major NPDES facilities in our data across the different types of watersheds.

In the analysis that follows, we use the geospatial data we created for state regional office boundaries and the USGS watershed boundary data to create a measure that captures the degree of overlap for each regional office. This is the key explanatory variable in our regression analysis. More specifically, using GIS software, we determined the percentage of each watershed's area that is contained within each state regional office. Higher values on this measure therefore represent watersheds that have less dissection, and lower values reflect those with more dissection. The mean value of this area-based measure of watershed dissection is 0.43, and the standard deviations is 0.13. Figure 4 below displays a histogram to show the full distribution of this measure. The central idea for using this variable is that state regulatory officers make strategic choices about where to allocate their enforcement effort within their regional office based on the types watershed that they manage. As the percentage of the watershed within state regional office increases (decreases), we would expect more (less) dedication of enforcement effort.

Figure 4: Percent Watershed Area within Regional Office Boundaries



Political and Demographic Data Last, we need political and demographic data to generate our policy domain heterophily measures. Recall that we hypothesize that state regional offices that are more similar in politics and demographic attributes, will be more likely to overcome coordination problems. We are presently collecting political data at the state legislative district level as well as the county level, which we will use to develop political participation rates, partisanship and ideological measures at the regional office level. In terms of demographics, we have compiled U.S.

Census data at the county level. With these data, we create weighted averages of population density, percentage of the population that is minority, percent of households that are owner-occupied (as opposed to renter occupied), median household income, and percentage of the population that falls below the federal poverty line, where the weights are the geographic areas of each county divided by the area of the total regional office jurisdiction. We will use these newly-developed regional office level indicators to measure inter-regional heterophily.

[We have not concluded compiling these data, so this version of the paper does not include analysis testing the heterophily hypothesis.]

Control Variables To account for confounding factors related to regulatory enforcement outcomes, our models include numerous facility, regional, and state level control variables. At the facility level, we include facility age (based on the date the facility received its first NPDES permit, a series of dichotomous variables to distinguish publicly owned treatment works (POTWs), federal facilities, and industrial dischargers that are either in the electric power sector or in the manufacturing sector. In addition, we created "neighborhood" level demographic measures for each facility. Specifically, we used an areal apportionment method common to the environmental justice literature (Konisky and Schario 2010, Mohai and Saha 2006), in which, with GIS software, we estimate the percentage of the population within a one-mile radius circle of each facility that is African-American, Hispanic, below the federal poverty level, and college educated. Also at the facility level, we control for whether the facility was in either reportable or significant noncompliance status during the year, since regulatory enforcement activity is likely to be more likely if a facility is determined to be in violation of the CWA. At the region office level, we include two variables to account for state regulators overall task environment: the total number of major NPDES facility in the region and the total number of all (major and minor) NDPDES facilities in the region.[8] Last, we control for a set of state level factors that are commonly included in models of state regulatory enforcement to account for economic and political factors that may influence overall enforcement efforts: state unemployment rate, gross state product, the partisan identification of the governor (coded one for a Democrat, and zero otherwise), and the percentage of the lower chamber

[8]Geospatial data available from the EPA does include complete latitude and longitude information for all minor NPDES facilities; information is missing for about 20% of these facilities. In subsequent work, we will attempt to specify the location of these sources based on their street address.

of the state legislature that are Democrats. In addition, we control for whether the state has been delegated authority to implement the CWA by the EPA.

Results

We estimate multilevel random-intercept models to estimate the relationship between watershed dissection and state enforcement effort. These mixed level models account for the fact that we have nested data over two levels – facilities within regional offices within states. In subsequent research, we anticipate using techniques such as propensity score matching to address the possibility of non-random assignment and instrumental variables analysis to address endogeneity concerns.

In Column (1), we report estimates from a model with the total compliance inspections at the facility level as the dependent variable. Focusing first on the variable of central interest, *Percent Watershed area in region*, the negative coefficient is unanticipated. We had expected that, as the percentage of the watershed within state regional office increases, we would observe more, not less, inspection activity directed at major NPDES facilities. At first glance, this result might suggest that state regional officers are not hampered by coordination problems, or at least, that watershed dissection does not result in less compliance monitoring activity. This estimate of assumes a linear relationship between Inspections and shared watershed area. In column 2, we consider whether this relationship is non-linear by including a squared value of our key watershed dissection measure.

The parameter estimates in Column (2), suggest a different conclusion. First, the AIC in the non-linear model is lower than the linear model, suggesting that the non-linear model offers a better fit to the data. Moreover, we see a reduction in the regional level variance remaining after the inclusion of the squared term, suggesting that we are offering a better account of the variance in inspections with the term included. The coefficient on the variable measuring the proportion of the watershed within region's boundaries again is negative, and the coefficient on the squared term is positive. This suggests a U-shaped relationship between *Percent Watershed area in the region* and Inspections, with a minimum occurring at .4965 *B(linear term)/2*B(squared term)*. This suggests that the relationship between Watershed coverage and Inspections pivots around the point where about 50% of the watersheds are covered by the region. When about 50% of a region's watersheds are shared with other regions, regions, on average, produce the fewest inspections. Above this level, inspections rise as the region covers a greater share of the watersheds under their responsibility, as expected. Below this level, however, the relationship suggests that inspections also rise, as regions have *increasingly less* of their watersheds under their control. We will return to this below.

Turning now to results when considering enforcement actions, we find evidence consistent with expectations. Columns 3 and 4 in Table 2 report the model estimates for the linear and non-linear results, respectively. First, the AIC criterion suggest that the non-linear model offers no improvement over the more simple linear model. As such, the linear model suggests that regional offices with greater share of their watersheds under their control more actively pursue enforcement. In fact, a regional office with 10% more of their watersheds under its authority is expected to generate .089 more annual enforcement actions against facilities. This is a fairly large substantive effect – nearly half the standard deviation of the enforcement variable.

In terms of the control variables, we find some consistent patterns across the models. At the facility-level, older, federal, and noncompliant NPDES major sources are more likely to receive regulatory enforcement attention, while facilities in the electric power sector are less likely too. Facilities in poorer communities are also less likely to be targeted for compliance monitoring. At the state level, states delegated authority to implement he CWA perform more actions as would be expected than states where the EPA has retained implementation responsibilities. And, unexpectedly, states with Democratic governors perform fewer enforcement actions.

What are we to make of the relationship between Percentage of the Watershed and Inspections below the 50% threshold? When we combine this information with what we learned from the enforcement models, we believe that are two possible interpretations. The first interpretation is that officers in these regions may be similarly responsive to facilities as officers at the other end of the Watershed distribution. This interpretation would be wholly inconsistent with our expectations. If this interpretation were the case, then we would expect to see increased inspections also being combined with more aggressive enforcement activity. Yet, via Models 3 and 4, we do not see this pattern. Alternatively, it could be that officers in these regions are populated with more noncompliant firms that those in regions with greater Watershed coverage, but conditional analyses suggest this is not the case. There is not evidence that noncompliant firms are anymore likely in regions with lesser or greater watershed dissection. We do not find any reasonable evidence that this interpretation is valid. The second interpretation, one in line with our expectations, is that while officers in these regions may be taking more inspections as less and less Watershed area is under their control, these inspections are more symbolic than instrumental. At the highest level of regional watershed dissection, officers are more likely to carry out inspections and yet, less likely to pursue enforcement actions, while at the lowest level of regional watershed dissection, where officers are most responsible for their own resources, they are more likely to carry out inspections and to pursue enforcement actions. This lead us to posit that the inspections taken in the form case are symbolic, while the ones taken in the latter case are more instrumental.

Discussion

Policy scholars have long recognized and debated the merits of whether to devolve to subunits. Our research, however, underlines value in considering how such devolution proceeds. Our paper suggests ways in which institutional design may exacerbate coordination and cooperation dilemmas in a policy arena. When officers have domain over their own resources and the need for cooperation with other agents is absent, officers are free to pursue their inspection and abatement activity as the firm level needs and political pressures of their offices demand. However, when officers share responsibility over a resource, they have increasing incentives to engage in symbolic enforcement, pursuing inspections that do not lead to more stringent enforcement.

If our account is correct, then we have evidence that environmental actions are undersupplied not due to the political demands of elected officials or to the requests of localized stakeholders but due to the misaligned incentives that certain institutional configurations offer regional officers. Of course, administrative design is not policy neutral – competing interests lobby political coalitions to enshrine their policy preferences within administrative features. Our study suggests yet another way in which administrative design can be combined with policy geography to enshrine flavored policy delivery. Under this interpretation, the best case interpretation is that if these configurations have 'political' origins then the flavor of the policy delivery that they induce may align with local political preferences. The worst-case interpretation is that, despite the best intentions of any political coalition that initiated these institutions, policy is suboptimally delivered due to bureaucrats having little capacity to overcome challenging cooperative barriers.

Table 2: Parameter Estimates from Hierarchical Model Estimating Regulatory Actions

	Regulatory Action			
	Compliance Inspections		Enforcement Actions	
	(1)	(2)	(3)	(4)
Facility age	0.00***	0.00***	0.01***	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)
POTW	-0.06	-0.06	0.04	0.04
	(0.10)	(0.10)	(0.13)	(0.13)
Federal	0.34***	0.34***	0.26***	0.26***
	(0.04)	(0.04)	(0.05)	(0.05)
Electric sector	-0.22***	-0.22***	-0.29***	-0.29***
	(0.05)	(0.05)	(0.06)	(0.06)
Manufacturing sector	-0.02	-0.02	-0.02	-0.03
	(0.04)	(0.04)	(0.05)	(0.05)
% Black	0.10	0.10	0.22*	0.23*
	(0.10)	(0.10)	(0.12)	(0.12)
% Hispanic	0.02	0.01	0.02	0.03
	(0.11)	(0.11)	(0.14)	(0.14)
% Poverty	-0.00***	-0.00***	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
% College educated	0.00	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
% Reportable noncompliance	0.06**	0.06**	0.17***	0.17***
	(0.02)	(0.02)	(0.03)	(0.03)
% Significant noncompliance	0.08***	0.08***	0.61***	0.61***
	(0.03)	(0.03)	(0.03)	(0.03)
% Watershed area in region	-0.86*	-6.27***	0.89**	2.58
	(0.46)	(1.78)	(0.41)	(1.58)
% Watershed area in region (squared)		6.27***		-1.96
		(1.99)		(1.76)
NPDES facilities in region	0.00	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
NPDES majors in region	-0.00	-0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Delegated state	0.50*	0.56*	1.00**	0.98**
	(0.30)	(0.30)	(0.41)	(0.41)
State unemployment rate	-0.00	-0.00	0.02	0.02
	(0.03)	(0.03)	(0.04)	(0.04)
Gross state product	0.00	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Democratic governor	0.08	0.07	-0.51***	-0.51***
	(0.11)	(0.11)	(0.14)	(0.14)
% Democrats in lower house	0.17	0.10	0.97	0.98
	(0.50)	(0.50)	(0.63)	(0.63)
Intercept	0.81*	1.81**	-1.16**	-1.45**
	(0.47)	(0.57)	(0.58)	(0.64)
Random effects regions	0.56	0.53	0.33	0.33
Random effects states	0.42	0.44	0.98	0.97
Residuals	1.95	1.95	3.07	3.07
AIC	87976.46	87967.84	98925.36	98925.99
N	20,239	20,239	20,239	20,239
N Regions	268	268	268	268
N States	47	47	47	47

Note: Coefficients are from a linear mixed model with regional office-level and state-level random effects. Standard errors are in brackets. Two-tailed tests. Statistical significance: $^{**}p < .01$, $^{*}p < .05$.

What might an ideal or optimal institutional design of state regional offices look like? The answer to this question depends upon whether waterside dissection occurs across state lines or across regional boundaries within a state. When watersheds are dissected by state boundaries, the obvious solution is greater attention by the EPA–the natural hierarchical actor to resolve state-level cooperation dilemmas. When watersheds are dissected by regional boundaries within the state, our results suggest that intra-state regional office boundaries would do better to follow watershed boundaries rather than county boundaries, the current norm. Regional offices with their watersheds when possible, states with lower the amount of dissected watersheds and enhance regional officers ownership over their resource. Another possibility, not pursued here but left to future work, is that state pollution control agencies may be able to mitigate intrastate cooperation to Lebanon by locating decision-making authority over enforcement activity at levels higher than the regional office. Such a nested hierarchical solution would incentivize a mid-level bureaucrat, with authority over competing regions, to intervene and resolve such cooperation dilemmas.

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