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VOLUNTARY DECENTRALIZATION IN ENVIRONMENTAL POLICY: "COOPERATIVE FEDERALISM" AS A STRATEGIC INTERACTION

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ABSTRACT

Under most U.S. environmental laws and some health and safety laws, states may apply to implement and enforce the law, through a process known as authorization or primacy. This paper presents a simple model of the strategic interaction between the federal and state governments with such voluntary decentralization. The model suggests that the federal government may design the policy so that states that desire stringent regulation authorize, whereas other states remain under the federal program. We then test the implications of this model using data on U.S. water pollution and hazardous waste regulations, two of the most important environmental programs to allow authorization. Consistent with the results of our model, states with stronger environmental preferences authorize more quickly under both policies. The evidence runs counter to concerns that states use control of their programs to undercut federal environmental standards.

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States may voluntarily take control of implementation and enforcement of most U.S. environmental regulations, through a process known as "authorization" or "primacy". Authorization gives states substantial control over the effects of federal environmental policies. For example, the U.S. General Accounting Office (U.S. GAO, 1996) examined the stringency of water pollution permits issued by different states; for similar size facilities, it found that allowable pollution varied by more than one order of magnitude. Authorized states have considerable discretion over enforcement as well; it is rare for the federal government to impose penalties on facilities in an authorized state where enforcement actions have been deficient (Helland, 1998).[1] Some observers argue that authorization allows states to undercut federal standards (U.S. GAO, 1995; Flatt, 1997) or to free ride on their neighbors (Sigman, 2005). Thus, understanding this "cooperative federalism" is central to evaluating the effects of U.S. environmental policy in practice.

We build a simple model of the strategic interaction between the states and the federal government with endogenous federal regulatory stringency and state prerogative in authorization. This model suggests some conditions under which states will want to authorize that we then test using data on two U.S. environmental policies. We also explore the concern that states use authorization to undercut federal standards.

We study decentralization under the Clean Water Act (CWA), which regulates water pollution, and the Resource Conservation and Recovery Act (RCRA), which regulates hazardous and solid waste. Our empirical analysis evaluates the factors that explain whether a state receives authorization under each of the laws early, late, or not at all.

Our principal focus is on the role of preference heterogeneity in determining authorization. If, as some claim, authorized states use their discretion to weaken environmental protection,

[1]For example, in 1999, the U.S. Court of Appeals for the Eight Circuit ruled that the federal EPA could not take enforcement action over Harmon Industries' violations of the RCRA where the State of Missouri had already acted, even though the EPA found the state penalties to be lax (Harmon Industries, Inc. v. Browner 191 F3d 894 (8th Cir. 1999)).

less "green" states would authorize earlier. However, in our incomplete contract model of authorization, states with stronger preferences for environmental control authorize sooner in response to endogenously-set federal environmental stringency. This prediction is tested empirically. We also test for a "U-shape" relationship in which states with median preferences are most content with centralized regulations, whereas those with preferences far from the median in either direction tend to authorize sooner.[2] Our empirical results are consistent with the effect predicted by our model: states with relatively high environmental preferences authorize sooner under both CWA and RCRA.

In addition to exploring the role of environmental preferences, we test a few other hypotheses about the determinants of authorization. We do not find evidence that states authorize earlier to take advantage of opportunities to free ride. We also do not find evidence that the size or capacity of state governments speed authorization.

The rest of this paper is structured as follows. Section 1 gives background on authorization under CWA and RCRA, as well as a discussion of previous literature. Section 2 develops a model that is consistent with some stylized facts of authorization. Section 3 describes the proposed main determinants of authorization and the variables chosen to represent them in our empirical analysis. Section 4 presents the empirical results of duration models of the time until authorization. Section 5 concludes with policy implications.

1 Authorization under CWA and RCRA

CWA and RCRA are two of the most important environmental policies that allow authorization.[3] Under both of these acts, the federal and regional EPA offices act as the default

[2]Studying state liquor control laws, Strumpf and Oberholzer-Gee (2002) test the hypothesis that greater preference heterogeneity across districts within a state increases the likelihood that the state chooses to decentralize its policy. We test a related proposition: the more a jurisdiction's tastes differ from the median, the more it wishes to control its policy.

[3]The third major environmental program that allows authorization is the Clean Air Act (CAA). However, the CAA differs from the CWA and the RCRA in that the default implementation responsibility lies with

administrator; a state must take initiative to apply for authorization. If states can demonstrate to the EPA that they will adopt legislation that is at least as stringent as the federal standards and have the means to fund the implementation and enforcement of the policy, they can receive authorization. Since the EPA's criteria for acceptance are public knowledge, states will only incur the cost of applying for authorization if they have met all of the requirements. The EPA usually requires amendments to a state's proposed implementation plan and holds public hearings on the application throughout the state before it grants authorization (Freeman, 2000; Helland, 1998). A search of the *Federal Register* did not turn up any instances of a state's application being denied.

Once authorization is granted, it is seen as infeasible to retract and has never been retracted in practice, although the EPA is legally entitled to do so. For example, Arkansas refuses to impose federal discharge limits and monitoring requirements for municipal water pollution sources on the grounds that they are too strict, but the regional EPA office says that taking responsibility back from Arkansas is "an unrealistic option" (GAO, 1996, p. 6).

Several earlier studies consider the revealed preference for voluntary decentralization in different policy contexts. Cutter and DeShazo (2007) study a policy in which California counties could devolve responsibility for enforcement of an underground storage tank program (under RCRA) to cities; they conclude that higher enforcement effort in delegated cities is the result of selection by both parties (the counties and the cities) and that predictions about the effect of decentralization should consider this selection. Meyer and Konisky (2007) find that a number of characteristics cause local communities to take control under a Massachusetts wetland protection program. These applications do not consider transboundary spillovers or the strategic problem for the central government when it lacks veto power

the states, which are required to develop State Implementation Plans; states opt-in for enforcement, but not implementation. Other federal environmental regulations, such as the Federal Insecticide, Fungicide and Rodenticide Act and the Safe Drink Water Act (1976), also allow authorization (ECOS, 2010), but are much smaller programs than RCRA and CWA in terms of costs.

over authorization.

A few empirical previous studies have explored federal-state authorization. Sigman (2003) reviews the literature on authorization and provides less formal tests of some of the hypotheses tested formally here. Woods (2006) conducts a factor analysis of authorization dates in a cross-section and concludes that they are not related to the "innovativeness" of states environmental policies. Helland (1998) finds an insignificant effect of authorization on the probability of inspection of paper and pulp facilities under the CWA. Sigman (2005) presents evidence that authorization under CWA allows free riding between states. Outside the environmental area, Morantz (2007) finds delegated states enforce federal employment safety laws less aggressively than the federal government.

1.1 The Clean Water Act

Under the Water Pollution Control Act of 1948, individual states had sole responsibility for setting, implementing and enforcing standards, while the federal role was oversight. Over time, this arrangement became viewed as problematic for a number of reasons. One reason was that "states varied enormously in their commitment to pollution control objectives" (Freeman 2000, p. 173). The 1972 Federal Water Pollution Control Act (which later became known as CWA) gave the federal government control over establishing minimum effluent limits (restrictions on quantities, rates and concentrations of chemical, biological and physical pollutants that can be discharged into navigable waters) and issuing permits under the National Pollutant Discharge Elimination System (NPDES). Industrial facilities and sewage treatment works need an NPDES permit to discharge pollutants into navigable waters. The 1972 act also included a provision allowing authorization. Once a state is granted the right to issue NPDES permits, it follows the guidelines it has established under its authorizing

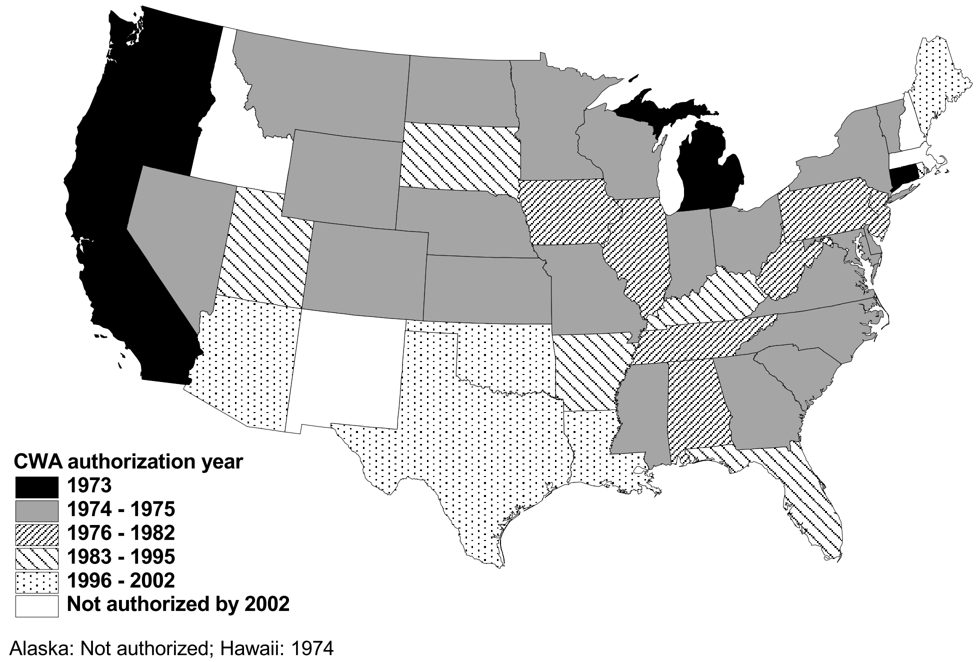

Figure 1: Year of base CWA authorization

legislation, rather than the federal standards.[4]

Forty-five states have authorization over NPDES and general permitting; New Mexico, Alaska, Massachusetts, New Hampshire and Idaho are not currently authorized. Figure 1 maps the year of authorization by state. Over half of the states were authorized under the base NPDES policy in the first three years.

1.2 The Resource Conservation and Recovery Act

RCRA first emerged as amendments to an older law (1965 Solid Waste Disposal Act) in 1976 and was substantially strengthened by Congress with the Hazardous and Solid Waste

[4]The CWA allows partial delegation. In 1972, the only section of the CWA for which states could be authorized was base NPDES permitting. As new sections were added to the CWA, state authorization became available for them as well. Currently, states can receive authorization under five sections of the CWA: base NPDES permitting, general permitting, regulation of pretreatment programs and standards for sewage treatment works, NPDES permits for federal facilities, and the management of biosolids (sewage sludge) disposal. All authorized states have responsibility for at least base NPDES permitting.

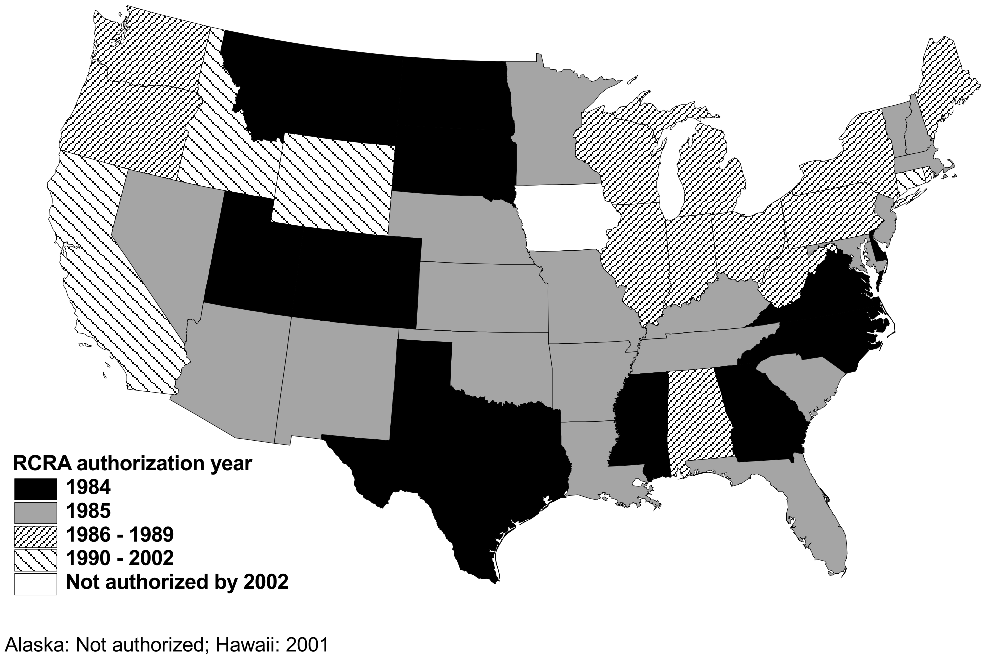

Figure 2: Year of initial RCRA authorization

Amendments (HSWA) in 1984. The EPA first allowed state delegation under the base RCRA program in 1982. This base program governs the permitting of hazardous waste facilities and establishes requirements for safe recycling, composting, storage and disposal of waste. Permits issued under RCRA are more standardized than NPDES permits, as they rely more heavily on federal technology standards. Thus, authorization under RCRA gives states less discretion than under CWA to adjust emission limits. Authorization still provides control over the inspection of facilities and enforcement.

Figure 2 maps the years that states first received RCRA authorization. Two states, Alaska and Iowa, are not currently authorized under any part of RCRA. As with CWA, this paper focuses on the initial decision to seek authorization under the base RCRA policy. The vast majority of the states (80%) received authorization in the first 4 years.

Certain states are authorized under RCRA but not under CWA and vice versa. The correlation between the time to authorization under the two laws is only 0.04. The number of sections for which a state is authorized under CWA and the percentage of the RCRA for which it is authorized have a correlation of 0.20. These low correlations suggest the importance of policy-specific factors to authorization.

2 A Model of Authorization

As background for our empirical analysis, we consider a model of authorization as a strategic interaction between the EPA and the states. For simplicity, there are only two states, i and j, and one central official, the EPA. The EPA and each of the states play the following two-stage game repeatedly until the state decides to authorize.

In the first period, the EPA chooses a uniform level of regulatory stringency for states that do not authorize, R_{Nt}, and a fixed cost of applying for authorization, C_t^A. R_{Nt} represents not just the regulatory standards, but also the effective stringency resulting from policy implementation, monitoring, and enforcement.[5] As under the pure form of Oates' Decentralization Theorem, the central regulation and authorization costs are uniform across states, perhaps because the EPA has limited information or faces other political or legal constraints. However, the EPA does have information about the distribution of environmental preferences and other characteristics across states.

In the second period, each state simultaneously and independently decides whether or not to apply for authorization. In deciding to apply for authorization, the state will compare its expected utility under the centralized regulation to its expected utility under authorization. If the latter is greater, the state will choose to authorize.

[5]Thus, our model does not distinguish between standard-setting and enforcement, but subsumes both functions into a single overall stringency. For studies that distinguish these activities in the context of a federal system, see CBO (1997), Lin (2006), and Hutchinson and Kennedy (2008). The latter consider strategic standard-setting by the federal government when states will control enforcement and may free-ride.

2.1 State decision-making

If a state does not authorize, it accepts the federal stringency and does not incur any monitoring costs, although it still incurs some compliance costs. The utility function for state i if it does not authorize (N) is

$$U_{it}^N(R_{Nt}) = V(q(R_{Nt} + \delta R_{jt}), \gamma_{it}, X_{it}) - C^I(R_{Nt}, X_{it}),$$

where $V(q(R_{Nt} + \delta R_{jt}), \gamma_{it}, X_{it})$ is state i's benefit from regulation and $C^I(R_{Nt}, X_{it})$ is the compliance cost associated with the regulatory stringency. The benefit of regulation, $V(q(R_{Nt} + \delta R_{jt}), \gamma_{it}, X_{it})$, is increasing and concave in q, the quality of the environment. It also depends on γ_{it}, state i's preference for environmental quality, and X_{it}, a matrix of state and time-varying characteristics.

The quality of the environment, q, depends on the stringency of regulation, R_{Nt}, the expected regulation in the other state, R_{jt}, and the level of spillover effects (externalities) from state j to state i, δ ($0 \leq \delta \leq 1$). If $\delta = 0$, regulation provides a local public good; if $\delta = 1$, regulation provides a pure public good; and if $0 < \delta < 1$, regulation has local spillover effects.[6] The compliance cost function, $C^I(R_{Nt}, X_{it})$, is increasing and convex in the stringency of the relevant regulation and other state characteristics.

If the state receives authorization, it may implement a different level of regulatory stringency but will incur the monitoring costs. If the state is not authorized, this cost is borne by the EPA. The state's utility under authorization (A) has nearly the same form as above

$$U_{it}^A(R_{it}) = V(q(R_{it} + \delta R_{jt}), \gamma_{it}, X_{it}) - C^I(R_{it}, X_{it}) - C^M(X_{it}),$$

[6]Spillovers are common for water pollution because interstate rivers carry pollution into downstream states. Hazardous waste can also cause interstate environmental spillovers, for example through air pollution or migration of contaminants in groundwater.

except that the state's own regulation, R_{it}, substitutes for the federal one and we add the monitoring cost, $C^M(X_{it})$, which can depend on state characteristics.

State i will decide to apply for authorization if its utility under authorization, which is its authorized utility minus the cost of achieving authorization, is greater than its utility with no authorization,

$$U_{it}^A(R_{it}) - C_t^A \geq U_{it}^N(R_{Nt}). \tag{1}$$

If inequality (1) holds, the state will apply for authorization by sending the EPA its proposed regulation under authorization: $\tilde{R}_{it}$. This proposed policy may or may not equal the actual regulation it will set once granted authorization, R_{it}. The states know that the EPA will only authorize a state whose proposed policy is at least as stringent as the EPA's. States whose preferred regulation under authorization is less stringent ($R_{it} < R_{Nt}$) could still apply for and receive authorization by sending the appropriate proposal to the EPA ($\tilde{R}_{it} \geq R_{Nt}$). The EPA may not be able to differentiate $\tilde{R}_{it}$ from the actual R_{it} or may face political constraints on doing so. As discussed in Section 1, authorization has never been rescinded, and authorized states are not typically punished for lax implementation and enforcement. Thus, states have no incentive to tell the truth when applying.

2.2 The EPA's behavior

Although the EPA cannot directly select which states authorize, it does control the centralized alternative R_{Nt} and the authorization cost C_t^A. Through these variables, it can prevent certain types of states from applying for authorization.

The EPA might have many possible objectives, but we start by assuming that it seeks to maximize the welfare of all states. The EPA faces two conflicting effects in designing an efficient policy (Oates, 2002). On the one hand, pure decentralization (i.e. setting a very low C_t^A so that every state authorizes to adjust its stringency even slightly from R_{Nt}) provides the usual flexibility advantages and is efficient in the absence of spillovers ($\delta = 0$). On the other hand, pure centralization (or a prohibitively high C_t^A) provides a response to spillovers and is efficient if $\delta > 0$ and all states are identical.

By providing an intermediate policy between pure centralization and pure decentralization, the authorization process can provide some of the advantages of each extreme. To reduce the costs of spillovers, the EPA can force states that create the highest interstate external costs to have more stringent regulation than they would choose under decentralization: it can choose R_{Nt} greater than R_{it} of the worst free riders and C_t^A high enough to prevent them from applying for authorization. However, a very high C_t^A or R_{Nt} may raise costs by preventing any state from wanting to authorize and imposing too much uniformity. To avoid these costs, the EPA may have to limit its controls on spillovers, by setting R_{Nt} not too much above R_{it} of the highest polluting states.

For a simple case, consider a model in which there are two types of states that differ only in environmental preferences, γ_{it}: some states desire a high level of environmental protection (high type) and the other desire a low level of protection (low type). With no other heterogeneity and pure decentralization, the low type states are the source of the greatest external costs, both because they produce the highest pollution and because their high type neighbors experience higher disutility for any given amount of pollution when $\delta > 0$. Thus, the EPA might wish to set R_{Nt} and C_t^A such that only the high type authorizes. In this simple example, it would set R_{Nt} such that $R_{Lt} < R_{Nt} < R_{Ht}$, where R_{Lt} and R_{Ht} represent the privately-optimal regulation of the low and high type states, respectively. In particular, it could set R_{Nt} at the globally optimal (efficient) level for the low type state (conditional on R_{Ht}, which will be lower than the efficient level because of free riding) and C_t^A just slightly above the welfare gains that a low-type state could achieve with authorization,

$$U_{Lt}^A(R_{Lt}) - U_{Lt}^N(R_{Nt}) < C_t^A.$$

If the high type still wants to authorize, i.e. if

$$U_{Ht}^{A}(R_{Ht}) - U_{Ht}^{N}(R_{Nt}) \geq C_t^A,$$

then the decision to set R_{Nt} at its efficient level for the low type state may be optimal. If, however, the required C_t^A to keep the low type state from authorizing (and thus free riding) is so high that it also keeps the high type from authorizing, R_{Nt} may need to be lowered below its optimum. Alternatively, if the externalities are severe enough (δ is close to 1), the EPA may choose an effectively centralized system by setting a high C_t^A and suitably adjusting R_{Nt}.

With real-world heterogeneity across states, the strength of externalities and environmental preferences are not directly linked, but tend to be correlated for the same reasons as above. Thus, efficient policy will likely target states with lower demand for environmental quality for federal control and allow states with higher demand to authorize. The federal government accomplishes this separation by setting its stringency, R_{Nt}, toward the low end of the range of R_{it} that states would choose under pure decentralization, so that the gains to authorization are small for these states and C_t^A may be kept low. The chosen level of R_{Nt} is probably lower than the level the EPA would set under pure centralization. The EPA expects authorizing states to set high standards, partially offsetting the social costs from lower stringency for those that do not authorize.

With low correlation between external costs and desired stringency or great diversity in state preferences, authorization may not be monotonic in environmental preferences. Even with endogenously set R_{Nt} and C_t^A, states may authorize on either side of the preference distribution because the gains to doing so exceed C_t^A for both extremely high and low type preferences. This pattern could give rise to a U-shape, for which we test later.[7]

[7] A U-shape might also arise if the federal stringency, R_{Nt}, is set to reflect federal median voter preferences, making authorization most attractive to states whose preferences differ most from the median.

All of the variables in the model can depend upon time. If inequality (1) does not hold for a state in period 1, the state chooses not to apply for authorization. In the next period, those states that have not yet authorized will play the same two-stage game with the EPA. The decision of a state to authorize at time t depends upon its preferences and costs, as well as the centralized alternative at that time.

3 Empirical implementation

Thus, the decision to apply for authorization at time t depends on several variables: the centralized alternative to authorization R_{Nt}, the cost of applying for authorization C_t^A, state characteristics X_{it}, and environmental preferences, γ_{it}. Since these variables can change over time, we employ a duration model with time-varying covariates for our empirical analysis. Our empirical work examines only the decision to seek authority; this revealed preference provides a test of the model, while avoiding the strong assumptions needed to identify the effects of authorization separately from its causes.

The principal hypotheses concern the role of environmental preferences, γ_{it}. The model presented in Section 2 indicates that the EPA may establish an authorization policy such that only the high γ_{it} states want to authorize. However, the model also suggests the possibility that states with extreme preferences should authorize quickly, so we test for this possibility as well.

To measure the level of concern about the environment, γ_{it}, the estimated equations use the adjusted League of Conservation Voters (LCV) score averaged for the state's Congressional delegation each year. The LCV score is the percentage of times a legislator voted with the LCV's position on environmental legislation in a particular year. Groseclose et al. (1999) present a method to adjust these scores for the changing slate of legislation, creating an estimate of the legislator's parameter that is consistent (but not invariant) over time;

Groseclose (2010) generously provides up-to-date adjusted LCV scores. The LCV score has been used frequently in the empirical literature to indicate environmental preferences (e.g., Gray and Shadbegian, 2004) because it is available for all states annually since the 1970s. Levinson (2000) reports that state average LCV score has a high positive correlation with several major cross-sectional environmental scores. For our purposes, the LCV score has the advantage of representing the views of the influential voters because it results from a political process.

Alternatively, we include dummy variables indicating whether a state ranked in the bottom or top thirds of the distribution of LCV score in a given year. These dummy variables can capture nonlinearity in the relationship between LCV score and authorization, such as the U-shape hypothesis above. They also provide a less parametric adjustment to the LCV scores than the Groseclose et al. (1999) adjustment, which does require some restrictive assumptions.

As another measure of green preferences, γ_{it}, we use environmental group membership in the state. The variable is membership in the World Wildlife Fund, Nature Conservancy, Natural Resources Defense Council, and 7 smaller organizations per 1,000 residents (Wikle, 1995). We have a single cross-section for the year 1993. This variable is not our preferred measure because it is not available over time and may capture the frequency of views far enough in the extreme of the distribution that they are not decisive politically.

Descriptive statistics for the adjusted LCV scores, environmental group membership, and other covariates are shown in Table 1 separately for the CWA and RCRA datasets. To weight each state equally, means of the variables were first taken over all of the years each state is in the dataset (a state is only in the dataset until it authorizes) and then the presented statistics were calculated from these state means. The levels of variables differ between the CWA and RCRA datasets because a given state is in each data set during different periods. Most states were candidates for CWA authorization only in the 1970s and for RCRA authorization in

Table 1: Descriptive statistics

	CWA dataset		**RCRA dataset**	
	Mean	Standard deviation	Mean	Standard deviation
Adjusted League of Conservation Voters (LCV) score	42.0	14.4	46.4	15.6
Environmental group membership per 1,000 (1993)	.924	.568	.924	.568
State population (millions)	4.5	4.6	4.8	5.2
Personal income per capita (thousand 2005$)	20.2	3.4	23.5	3.7
State land area	.072	.087	.072	.087
Coastal state	.460	–	–	–
Number of permitted facilities (CWA or RCRA)	18.3	39.2	10.5	23.4
Ideological distance from president	.261	.127	.353	.190
Tax capacity index	99.0	15.0	98.0	22.4
State employees per 1,000 people	16.9	5.6	17.2	6.0
Index of legislature's professionalization (1986–88)	.221	.144	.221	.144
Year	1977	5.3	1985	2.3

Note: Standard deviations are shown for continuous variables only.

the 1980s.

In addition to γ_{it}, we examine other possible determinants of the authorization decision. Similarity between the state's preferences and that of the federal government may affect the desire of states to control their environmental programs. This hypothesis is addressed by looking for authorization in states that deviate most from median environmental preferences. To look at this hypothesis from another angle, we consider the match between federal and state political preferences. Poole (1998, 2010) provides an ideological score (liberal-conservative) on a single scale for both the President and members of Congress, based on the positions they take on legislation. Our "ideological distance" variable is the square of the difference between the President's score and the average score for the state's Congressional delegation in a year.

Our model emphasizes the importance of interstate spillovers as a motivation for the federal government to retain control over state programs. We consider two variables that might indicate the extent of spillovers. First, almost all watersheds in interior states are upstream of another state, so interior states have more opportunity to free ride under the CWA than coastal states. As a result, the CWA equations include a dummy variable that equals one for states on the coast and zero otherwise. Second, the potential for spillovers is greatest in border regions (Kahn, 2004; Helland and Whitford, 2003). States with larger land areas have a smaller share of border regions and may be less likely to free ride or to experience harm from spillovers. Thus, we hypothesize that these states would authorize later or not at all.

The equations also include variables for the personal income per capita and population of the state. Both of these measures are included to control for the availability of resources that might facilitate the state taking control of environmental programs. More populated and wealthier states may have better organized state governments and thus shorter times to authorization. We would like to separate these effects from the effects of environmental preferences, with which they may be correlated. In Table 1, income is much higher for the RCRA than the CWA dataset, largely reflecting the later period of the RCRA dataset.

The size of the task confronting the authorized state is represented by the number of permitted facilities under the relevant statute. A larger number of facilities means higher monitoring and enforcement costs, $C^M(X_{it})$. As these costs increase, states could choose to authorize later. Alternatively, a larger number of facilities could indicate a large lobbying organization for (or against) authorization, influencing the local government's decision. In Table 1, the average number of regulated facilities per state is small for both programs because many states authorized before a lot of permits had been issued; the large standard deviations reflect much higher numbers of permits by end of the period.

Finally, we include several measures of the overall legislative and administrative capacity of the state government, which may facilitate their management of these environmental programs. The state's ability to finance regulatory activities is measured by its "tax capacity," an index based on twenty-seven common state tax bases.[8] This well-established measure provides a summary of revenue available to state policy-makers that is comparable across states with potentially very different current tax structures.

The number of full-time equivalent state employees provides an indication of the size of the state government and perhaps its ability to address new tasks. The variable derives from the Census Bureau's regular *Census of State Governments*. This variable seems a better measure of the state's ability to administer a program than revenues or spending, which introduce complexities of distinguishing debt service and intergovernmental transfers.

Authorization requires action by the state legislature, so some equations also include a variable to measure the "professionalization" of the legislature (Squire, 1997). This index considers the legislature's time in session, legislative staff levels, and legislators' salary, based on data from 1986–88. A more professional legislature is likely to take up promptly technical matters, such as the legislation necessary to secure authorization. The index ranges from .042 (New Hampshire) to .659 (New York).

Each estimated equation includes dummies for the EPA region. The ten regional EPAs undertake implementation and enforcement when states are unauthorized and oversight when they are. The dummies may thus capture heterogeneity across the regions in the "centralized" alternative to authorization, as well as more general geographic heterogeneity.[9]

[8]The Advisory Council on Intergovernmental Relations (ACIR) calculated the measure periodically until ACIR was disbanded. Berry and Fording (1997) fill the missing years through 1991. We predict values for the small number of state-years in our data after 1991. The tax capacity index captures the relative status of the states only, not aggregate trends. Not surprisingly, this variable is highly correlated with state income.

[9]Several possible covariates were excluded from the empirical specification of the model because of endogeneity concerns. The state budget for environmental regulation is one example. If a state is preparing to apply for authorization or has already received authorization, it will have to increase the resources devoted to environmental policy. Thus the path of this variable will depend upon the duration.

4 Empirical Results

This section presents the estimates of states' "hazard" rates for initial authorization of the base policies under the CWA and RCRA. The first states authorized in 1973 under the CWA and in 1984 under the RCRA, so these mark the start of the "at-risk" period in our analysis. The analysis extends through 2002, the most recent year that any state authorized under either program.[10]

The models presented below are estimated using a multi-period discrete-choice model that allows a very flexible specification of the baseline hazard rate. This approach "stacks" states at risk of authorizing in any year and estimates a binary response model for whether the state authorizes in that year. Based on a proportional hazard model, the binary response model estimated has a complementary log-log binary form (Cameron and Trivedi, 2005).[11] The model estimates determinants of the likelihood of authorization by a state in a given year; thus a positive coefficient reflects a higher hazard rate and a shorter expected time to authorization.

The estimates for the hazard for initial CWA authorization are in Table 2 and for RCRA authorization are in Table 3. For both sets of equations, the parameters representing a third-degree polynomial in time are statistically significant, indicating that the probability of authorizing depends upon time in a non-linear way. All equations in the tables also include dummies for nine of the ten EPA regions. The first three columns in each table focus on the effects of γ_{it} and the last two add other covariates.

[10] Although a state applies for authorization some time before it actually receives it, we use the time until the state receives authorization as the dependent variable because it is more readily available. The delay is usually short, within the year that we use as the period for our analysis. For example, Florida submitted its application for authorization under the CWA on November 21, 1994 and it was accepted on May 1, 1995 (*Federal Register*, 1995). Texas submitted its CWA authorization application on February 2, 1998 and it was approved on September 14, 1998 (*Federal Register*, 1998). We cannot use cross-state variation to understand the time between application and acceptance because all states are subject to the same federal process.

[11] We tried including a gamma-distributed heterogeneity across states, using the Stata routine "pgmhaz8" by Jenkins (2004). However, tests never rejected the absence of this heterogeneity. For many specifications, the model with heterogeneity did not converge.

4.1 CWA Authorization

In the first column of Table 2, the coefficient on the adjusted LCV score is positive, suggesting faster authorization of "greener" states, but is not statistically significant. In column (2), the high LCV dummy (top third of the distribution) is positive and significant, whereas the low LCV dummy (bottom third) is not significant. This pattern is consistent with our model in which the federal government discourages authorization by states whose anticipated stringency is below a certain threshold; this model would suggest monotonicity — but possible nonlinearity — in the relationship.

In column (3), an alternative measure of green preferences, environmental group membership, also has a coefficient with a positive point estimate. This coefficient is statistically significant at the 10% level. Thus, it provides additional support for the hypothesis that greener states see greater benefits of authorization.

Column (4) tests the robustness of the basic result that high LCV score states authorize earlier by including additional explanatory variables. The pattern of coefficients on the LCV dummies remains the same; the high LCV dummy remains statistically significant at 5% in column (4).

The coastal dummy is significant and positive, which means that states on the U.S. coasts are more likely to authorize sooner. This coefficient is not consistent with our initial hypothesis that inland states authorize faster in order to free ride. An alternative hypothesis is that the federal government erects fewer barriers to authorization when free riding is not a concern, facilitating authorization by coastal states. On the other hand, states with greater land area (and thus a small share of their land near borders) are slower to authorize, which is consistent with the hypothesis that states authorize to free ride, but the coefficients are not statistically significant at the 10% level.

The number of permitted facilities in the state has a statistically significant (at the 10% level) and positive effect on the hazard. Thus, states with programs that are potentially more

Table 2: Semi-parametric discrete-choice hazard models: CWA authorization

	(1)	(2)	(3)	(4)	(5)
Adjusted LCV score	.019	–	–	–	–
	(.013)				
Bottom third LCV score	–	.150	–	.152	.249
		(.443)		(.495)	(.514)
Top third LCV score	–	1.055	–	1.000	.904
		(.426)		(.461)	(.489)
Conservation group membership	–	–	.834	–	–
			(.474)		
State population	–	–	–	.061	.093
				(.053)	(.086)
Personal income per capita	–	–	–	-.109	-.161
				(.085)	(.104)
State land area	–	–	–	-5.01	-4.41
				(3.71)	(3.64)
Coastal state	–	–	–	1.422	1.251
				(.631)	(.697)
Number of permitted facilities (100s)	–	–	–	.115	.107
				(.067)	(.069)
Ideological distance from president	–	–	–	.043	.105
				(.879)	(.895)
Tax capacity	–	–	–	–	.0066
					(.0100)
State employees	–	–	–	–	.050
					(.053)
Legislative professionalization	–	–	–	–	.444
					(2.15)
Log likelihood	-128	-126	-128	-120	-119

Notes: All equations include a cubic in time and dummies for the EPA regions.
Observations: 486 state-years.
Standard errors in parentheses.

costly to run authorize earlier. One possible explanation is that regulated facilities lobby for authorization, expecting it to yield more acceptable controls and enforcement policies, and are successful if their numbers are sufficient.

The coefficient on the ideological distance between the President and the state's congressional delegation does not have a statistically significant coefficient in any of the equations for CWA, or below, for RCRA.[12]

Column (5) adds variables to reflect state government's legislative, bureaucratic, and financial resources. None of these variables — tax capacity, the size of state government, or the legislative professionalism index — yield statistically significant coefficients, although the coefficients on all three have the expected positive point estimates.[13]

LCV scores and conservation group membership are correlated with party affiliation and with political ideology. For example, the correlation by state between adjusted LCV score and Poole (1998)'s liberal-conservative dimension is -.69 (Poole's left-wing scores are negative). To test whether ideology rather than green preferences is driving the results, we also estimated the equations with the average ideology score of the Congressional delegation included as an explanatory variable (not shown). The ideology variable was not statistically significant and did not much change the point estimates on either the LCV score variables or environmental group membership for either CWA or RCRA.

4.2 RCRA Authorization

Table 3 contains discrete-choice models for the hazard rate for initial RCRA authorization. The only covariate from Table 2 that is not included in the RCRA models in Tables 3 is the

[12]In earlier versions of the paper the equations included another variant of this measure, a dummy variable for whether the dominant party in the state legislature was the president's party. This dummy variable also did not have a statistically significant coefficient.

[13]To test whether states with more resources were more willing to take on large programs, equations were also estimated with an interaction between the tax capacity variable and number of NPDES facilities. The interaction had a substantively small and statistically insignificant coefficient. A similar interaction was also insignificant in the RCRA equations below.

Table 3: Semi-parametric discrete-choice hazard models: RCRA authorization

	(1)	(2)	(3)	(4)	(5)
Adjusted LCV score	.038	–	–	.037	.051
	(.017)			(.019)	(.020)
Bottom third LCV score	–	-.340	–	–	–
		(.439)			
Top third LCV score	–	.047	–	–	–
		(.527)			
Conservation group membership	–	–	.431	–	–
			(.502)		
State population	–	–	–	-.033	-.157
				(.067)	(.097)
Personal income per capita	–	–	–	-.017	-.011
				(.062)	(.073)
State land area	–	–	–	-1.37	3.888
				(2.93)	(4.04)
Number of permitted facilities (100s)	–	–	–	.876	.199
				(1.24)	(1.30)
Ideological distance from president	–	–	–	.015	.879
				(1.00)	(1.14)
Tax capacity	–	–	–	–	.0043
					(.0091)
State employees	–	–	–	–	-.0169
					(.0053)
Legislative professionalization	–	–	–	–	.236
					(2.39)
Log likelihood	-86	-89	-89	-86	-81

Notes: All equations include a cubic in time and dummies for the EPA regions.
Observations: 184 state-years.
Standard errors in parentheses.

coastal indicator variable; interior states are no more likely to free ride than coastal states under RCRA.

In Table 3, the adjusted LCV score has a positive and statistically significant coefficient at 5% in column (1). This result is consistent with states authorizing faster with higher γ_{it}. In column (2), the dummy variables for state's relative LCV ranking do not yield statistically significant coefficients, although the point estimates are consistent with a monotonic relationship. Environmental group membership variable in column (3) has a positive coefficient, again consistent with the greener states authorizing first, but it is not statistically significant.

In column (4) of Table 3, the adjusted LCV score remains statistically significant at 10% with the basic set of state characteristics included. The results for other determinants of RCRA authorization differ from the results for CWA, perhaps indicating that the sources of voluntary decentralization are fairly specific to the particular policy. None of the other explanatory variables are statistically significant in column (4).

When state government capacity variables are added in column (5), the LCV coefficient is again statistically significant at 5% and somewhat larger in magnitude. The coefficients on population and the number of state employees per capita are both negative (and the latter is statistically significant at 5%), which is surprising, since these variables indicate states that have more resources to manage their RCRA programs. Perhaps these states choose to adopt independent legislation to strengthen their regulation rather than authorization under the federal policy; authorization under RCRA may give them less discretion than they desire.

5 Conclusion

This paper studies the factors that cause states to seek control of their environmental policy. Our simple model of authorization as a strategic interaction between the federal government and the states suggests that the factors that determine whether or not a state authorizes, and when it chooses to do so, can also determine the effects of authorization on the state's environmental standards.

Using econometric models of duration, we then explore the determinants of the speed with which states authorize, focusing particularly on the role of environmental preferences. The results support the model's prediction that the stronger the environmental preferences are in the state, the sooner the state will authorize. This association arises for authorization under both the CWA and RCRA. Although our main finding contradicts the conventional wisdom that authorization worsens the environment, it is consistent with other empirical literature, which often fails to find evidence that decentralization in the U.S. harms the environment (List and Gerking, 2000; Millimet, 2003; Levinson, 2003). Thus, the paper suggests that this form of cooperative federalism may improve efficiency, by giving states flexibility to respond to their conditions while allowing the federal government to control free riding or provide a minimum level of environmental quality. It does not support the concern that states use authorization primarily to undermine federal controls.

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