ENVIRONMENTAL GOVERNANCE IN FEDERAL SYSTEMS: THE EFFECTS OF CAPITAL COMPETITION AND LOBBY GROUPS

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We argue that centralized and decentralized environmental governance yield equivalent environmental regulations. We model worker, environmental, and capital owner lobby groups that seek influence by offering political contributions. Worker lobbying in the decentralized case has an effect on environmental regulations identical to that of capital owner lobbying in the centralized case. This is because the aggregate effects of environmental regulations on income are equivalent under the two institutional designs. Whereas workers carry the full burden in the decentralized case when capital competition occurs, the burden is shared with the capital owners in the centralized case. We present evidence consistent with our theory. (*JEL* Q28, F21, R38, D72, D78)

I. INTRODUCTION

As the demand for efficient environmental policies increases, the ambit of political power in a federation must be determined. Cumberland [1981] suggests that uniform federal rules avoid the economic competition between jurisdictions in order to attract investment that may result in an excessively low environmental quality. As discussed by Burtraw and Portney [1991], central decision making may be highly inefficient, however, because federal regulations fail to take into account the heterogeneity of local environments.[1] This article develops a theory of decentralized and centralized environmental policy making in federal systems that incorporates the political forces determining the outcomes under the two alternative regulatory designs.

The empirical evidence on the effects of interjurisdictional capital competition on environmental policies is inconclusive and mainly anecdotal. Esty [1996] gives an overview of the available evidence and finds that "rent-seeking behavior undoubtedly affects national as well as state environmental policy making, but there is no evidence that public decision-making is systematically more distorted at the federal level than at state and local levels."[2] In a study of packaging waste regulation in the European Union (EU), Paul [1994/95] describes how the move from decentralized to centralized regulation "remains controversial. Some Greens bitterly criticize the directive as a sellout to industry. It is true that industry aggressively lobbied Parliament to stop the efforts of the Greens to tighten the directive" and that

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1. Examples of decentralized and centralized environmental governance in the United States are the *Clean Air Act* of 1970, which sets uniform national standards for air quality, and the *Clean Water Act* which was enacted in 1972 and allows states to determine their own standards for water quality (Oates [1996]).

2. However, Esty [1996, 650] goes on to argue that "...given the general popular indifference to many state and local environmental decisions, as well as greater media attention to federal-level activities, one might suggest precisely the opposite."

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"[i]t is tempting to describe this debate as one more example in which the regulatory authority was captured by industry."[3] Evidently, the move to centralized regulation stimulated industry lobbying.

The present paper provides an explanation for why industry lobbying may be stronger at the federal level and discusses the implications for environmental policy under decentralized and centralized environmental policy making.[4] The current literature lacks a formal comparison of politically determined environmental regulations under the different institutional arrangements that may exist in federal systems.[5] While we couch our argument in terms of environmental policy-making that could be undertaken either at the national level or at lower levels in a federal structure, we believe that the central ideas extend to regulatory policy carried out at both the highest and lowest levels of multi-country federations such as the EU.[6] Extensions of our theory may apply more generally to several forms of regulation, for example, worker safety standards and product liability legislation, as well as to firm taxation.

A key concern of environmental policy makers in federal systems is interjurisdictional capital mobility. We model a decentralized system of regulation with a mobile capital stock. Consideration of the effects of environmental regulations on capital is important; van Beers and van den Bergh [1997] find no significant negative effect of environmental regulation on export flows in polluting industries except when restricting their data to sectors with high capital mobility.[7] Moreover, Revesz [1992] argues that the fear of capital competition explains why the Clean Air Act in the United States is a federal regulation.[8] While capital mobility is a relevant consideration at the sectoral level, we argue that at the federal or national level, the capital stock can be viewed as (relatively) fixed.[9]

3. We describe Paul's empirical findings in greater detail in section IV below. Esty and Geradin [1998] report that in the mid-1990s, the EU faced strong political pressure from several industry lobbies to revise the legislative framework on waste and biotechnology and to substitute binding legislation for voluntary environmental agreements. Revesz [1992] reports that eight Northeastern states in the United States adopted environmental regulations more stringent than the corresponding federal regulations. This suggests that the political pressures at the federal level may have been relatively greater.

4. The issue of institutional design is highly contentious, see for example, Stewart [1990], Revesz [1992], and Esty [1996].

5. Oates and Schwab [1988] study decentralized policy making under majority rule voting and show that environmental policy is distorted by politics. Rauscher [1994] studies "ecological dumping" in a model with jurisdictionally immobile and intersectorally mobile factors of production. The export industry lobby's objective is to maximize output and the government cares about both output and welfare. Rauscher finds that the export industry has ambiguous lobbying incentives. Markusen, Morey, and Olewiler [1993] analyze the effects of environmental regulations on firm location decisions in a model of imperfect competition. Both plant location and market structure are shown to depend on environmental policy. Chao and Yu [1997] study the interaction of capital taxes, international tax credits, government spending, and environmental policy. They predict that due to the ability of capital to simply relocate across borders, lax environmental policies aimed at mitigating capital outflows will emerge. Fredriksson [2000] compares centralized and decentralized designs of the process for the siting of hazardous waste facilities in federal systems. The centralized system yields a lower level of treatment capacity because of free-riding problems.

6. However, we abstract from the issue of tax competition and local public goods provision (see Wilson [1986], Wildasin [1988], and Edwards and Keen [1996], for example).

7. The existing evidence on the effects of environmental regulation on plant location is somewhat mixed, see Jaffe *et al.* [1995]. Bartik [1992] found a small but significant adverse effect of state environmental regulations on small firm start-up attempts. In a study of foreign multinationals, Friedman, Gerlowski, and Silberman [1992] examined the effects on plant location of environmental stringency, measured as the ratio of state pollution abatement capital expenditures to state manufacturing gross product. Aggregating all foreign firms, the effect on plant investments was negative but insignificant. However, when considering Japanese companies only, the effect was negative and significant.

8. Pashigian [1985] shows that the Federal prevention of significant deterioration policy in the United States was the result of regional competition between the Northern states and those of the South and West. The latter two regions had superior air quality, so that the more stringent regulations aided the North in restricting the loss of its mobile factors. This could also explain why, under the Reagan administration in the early 1980s, industry showed little interest in decentralization of stationary industrial pollution source policies (see Crandall [1983, 145]).

9. Agglomeration benefits or ready access to the national market may explain why firms wish to produce within the borders of a federation. In addition, the national market may be protected by trade barriers, which further increase the incentive to be located within the federation. See also Feldstein and Horioka [1980] and Gordon and Bovenberg [1996].

It is now well known that policy outcomes may be distorted when the decision-making authority is subject to political pressure exerted by special interests. In our model, a lobby group representing labor interests seeks to increase or secure the capital base in its own jurisdiction by obtaining a lax regulation of pollution from production. Naturally, this effort is opposed by the environmental lobby group. Capital owners have an incentive to lobby against environmental regulation only when the aggregate national capital stock is fixed and the return to capital then depends on the level of environmental regulation.[10] On the other hand, when owners can move capital to jurisdictions in which the rate of return is higher, there is no need to expend valuable resources on influencing environmental policy.

A novel finding of our model is that environmental regulation is likely to be independent of institutional design. Capital competition in a decentralized regime has an equivalent effect on government policy making, as does capital owner lobbying in the centralized case. Essentially, since capital flight does not occur in the centralized case, workers reduce their lobbying effort compared to the decentralized case. This decrease in workers' political pressure is replaced by capital owner lobbying instead. We present anecdotal and econometric evidence as well as voting records on environmental policy in support of our theory.

The paper is organized as follows. Section II outlines the model and briefly characterizes the political equilibrium. Section III presents the results for the decentralized and centralized systems, and studies the impact on environmental policy of lobbying by capital owners. Section IV discusses empirical support for our model and presents evidence from U.S. state legislatures, congressional and senate voting records on environmental policy, and econometric evidence using cross-country data on capital controls. Section V concludes.

10. Ulph [1996] notes that for countries that wish to impose tighter environmental regulations than their strategic competitors there is policy pressure to impose countervailing tariffs on imports on countries with laxer environmental standards. Needless to say, the policy pressure comes from the industries in the traded goods sector. A qualitatively similar set of issues arise with respect to the setting of uniform minimum wages and other health and safety regulations affecting labor in an economic union such as the EU (as well as a free trade area such as NAFTA). For example, "[s]ome argue that the failure to require any minimum standard will lead to unfair competition, the exploitation of workers abroad, and ultimately a decline in a nation's own minimum wage standard as the nation seeks to keep jobs fleeing abroad. Others argue, however, that attempts to require trading partners to increase their minimum wages do not reflect concern for the welfare of workers abroad, but are really protectionist attempts to preserve employment at home" Ehrenberg [1994, 44–45].

II. A MODEL OF ENVIRONMENTAL REGULATION

Consider an economy with a large number of jurisdictions, in each of which a large number of individuals live and work. Further, each jurisdiction contains one firm that produces a private good, Q, for a perfectly competitive national market. Production requires inputs of capital (K), labor (L), and polluting waste emissions (θ); the last is treated as a non-purchased input. There is no spillover of pollution into other jurisdictions. The production technology exhibits constant returns to scale, is concave and increasing in all inputs, and is twice continuously-differentiable:

$$Q = F(K, L, \theta). \tag{1}$$

In the case of decentralized environmental governance, the local authority sets the standard for environmental quality; more specifically, it determines the aggregate waste emissions for its jurisdiction. By linear homogeneity, (1) can be rewritten as

$$Q = Lf(k, \alpha), \tag{2}$$

where $k = K/L$ is the capital-labor ratio and $\alpha = \theta/L$ is the emissions–labor ratio. Suppressing arguments and using subscripts to denote partial derivatives, the marginal products of capital, emissions, and labor are given by f_k, f_α, and $(f - kf_k - \alpha f_\alpha)$, respectively. The marginal products are diminishing, i.e., $f_{kk} < 0$, $f_{\alpha\alpha} < 0$, and we assume that $f_{k\alpha} > 0$, i.e., increases in α raise the marginal product of capital.

While labor is immobile, the capital stock is assumed to be perfectly mobile between

jurisdictions but immobile internationally.[11] This implies that the rate of return on capital, denoted by r, is equalized across all jurisdictions. This feature of our model is central for the comparison of the effects of centralized versus decentralized policy making. A local policy maker is concerned about the impact of more stringent local environmental standards on investment and capital flows from their jurisdiction. A national policy maker sets a uniform environmental code and need not be concerned with capital flight. In the latter case, however, the return to capital depends on the stringency of environmental standards.

We assume that there are three types of individuals in the jurisdiction: workers, environmentalists, and capital owners. While the first two groups are always present in each jurisdiction, this may not be true for the last group. However, for production to occur, at least one of the jurisdictions has capital owners residing within its borders. Normalizing the population in each jurisdiction (or in the economy, when appropriate) to unity, let β^W, β^E, and β^K represent the proportion of the population that are workers, environmentalists, and capital owners, respectively.

The income of environmentalists is exogenously determined, e.g., gained from employment in white-collar jobs unaffected by environmental policy. Workers supply one unit of labor and are paid a wage equal to the gain from employing an additional worker. This is equal to the sum of the marginal product of labor plus the additional output arising from the increase in allowable pollution emissions, αf_α, hence, wage income is

$$w = f - kf_k. \tag{3}$$

All individuals gain utility from consuming the polluting good, but environmentalists also suffer disutility from the pollution associated with production. Individuals are assumed to have additively separable utility functions of the form

$$U^i = c^i - \lambda^E \theta, \tag{4}$$

where $i = W, E$, and K index workers, environmentalists, and capital owners, respectively, and $\lambda^E = 1$ for environmentalists (and 0, otherwise).

We assume that the workers, environmentalists, and capital owners in at least some of the jurisdictions have sufficient incentives to overcome free-rider problems and form lobby groups. Following Grossman and Helpman [1994], the organized lobby groups offer political contribution schedules $C^i(\alpha)$, $i = W, E, K$, that relate prospective contributions to the environmental policy chosen by the government. The gross welfare functions for the lobby groups are given by

$$\begin{aligned} V^W(\alpha) &\equiv \beta^W(f - kf_k) \\ V^E(\alpha) &\equiv Y^E - \beta^E\theta \\ V^K(\alpha) &\equiv Kr, \end{aligned} \tag{5}$$

where Y^E denotes the aggregate income of environmentalists.

The government is assumed to derive utility from a weighted sum of campaign contributions and aggregate social welfare, i.e.,

$$V^G(\alpha) \equiv \sum_{i=W,E,K} [aV^i(\alpha) + \delta^i C^i(\alpha)], \tag{6}$$

where $a \geq 0$ represents the weighting that the government places on the social welfare relative to the campaign contributions of lobby groups, and δ^i is an indicator variable which takes a value of 1 if lobby group i is organized, and 0 otherwise.[12]

The Political Equilibrium

The equilibrium emissions standard is determined as the outcome of a two-stage, noncooperative game. In stage one, each lobby group offers the government a schedule that promises a specific contribution for each feasible choice of emissions regulation.

11. See Gordon and Bovenberg [1996]. Alternatively, one might think of jurisdictions as countries between which capital flows freely. Globally, of course, capital is fixed.

12. Political contributions can be used by a government to sway voters' preferences (by campaign advertising, pre-election public spending, etc.) and so to increase the prospect of re-election. The average welfare of the community also affects re-election chances because disgruntled voters are more likely to vote for the political opposition (see Grossman and Helpman [1994]).

In the second stage, the government selects a policy and collects the associated contributions from the lobby groups.

When the policy maker's welfare function is described by equation (6), Grossman and Helpman [1994] show that they actually end up maximizing a weighted sum of the interest groups' objective functions, i.e.,

$$(7) \quad V^G(\alpha) = \sum_{i=W,E,K} (a + \delta^i)V^i(\alpha).$$

Assuming an interior solution, the first-order condition is

$$(8) \quad \sum_{i=W,E,K} (a + \delta^i)V^i_\alpha(\alpha) = 0.$$

Equation (8) represents the characterization of the equilibrium emissions–labor ratio for each jurisdiction. If all or no groups are organized, note that equation (8) implicitly defines the emissions standards set by a utilitarian social planner. If one or two of the three groups fail to organize, then political distortions arise, in a similar fashion to Grossman and Helpman [1994].

III. THE EFFECTS OF LOBBYING AND CAPITAL COMPETITION

Decentralized Regulation

The effect of a change in the pollution emissions ratio on the gross welfare of workers is simply

$$(9) \quad V^W_\alpha(\alpha) = \beta^W f_\alpha > 0.$$

Recall that the jurisdictional capital stock is mobile and adjusts until $f_k = r$. Thus, labor unambiguously gains from an easing of the emissions policy (i.e., a higher α). The wage effect of a policy change is simply equal to the marginal product of emissions weighted by the number of workers in the jurisdiction.

By determining the impact of a policy change on those individuals who do not earn wage income but are affected by changes in local environmental quality, we are able to consider the opposing interests of different groups within a community and allow for an explicit characterization of their environmental policy preferences. Since the environmentalists' income is exogenous, the partial derivative of the environmentalists' welfare with respect to a small change in policy is

$$(10) \quad V^E_\alpha(\alpha) = -\beta^E\beta^W < 0,$$

noting that $\beta^W = L$.

Equations (9) and (10) indicate the direction and strength of lobbying activity for labor and environmentalists, respectively. In the decentralized case, the capital owners respond to a policy change by moving their capital and thus the rate of return on capital can be treated as exogenous. Since lobbying is likely to be a costly exercise, the capital owners have no incentive to organize a lobby group when capital is perfectly mobile.

The interaction of the various political pressures and the actions of the government help to determine the policy outcome. Equations (9) and (10) can be substituted into equation (8) to yield a condition for the equilibrium emissions policy. Specifically, we find that in equilibrium,

$$(11) \quad \beta^W\left((a + \delta^W)f_\alpha - (a + \delta^E)\beta^E\right) = 0.$$

Note that when both lobby groups are organized, or both not organized, i.e., $\delta^W = \delta^E$, then $f_\alpha = \beta^E$. In equilibrium, the local policy maker selects an emissions policy so that the marginal product of emissions, f_α, equals the number of environmentalists in that jurisdiction. The environmental policy is efficient because the marginal benefit of increased pollution is equal to its marginal social cost. From equation (9), the gross gain to society from a rise in α is the increase in aggregate wage income allowed by higher waste emissions. The cost of greater pollution is borne entirely by the environmentalists, as they are the only group who suffer disutility from the rise in pollution associated with an increase in α.

Overall, the decentralized policy outcome is efficient as long as either both or neither of the lobby groups are organized. This contrasts with Oates and Schwab [1988] in which the policy outcome with a heterogeneous

community is *always* sub-optimal.[13] When both lobbies are organized, the policy outcome is efficient since the political pressure of one lobby is effectively offset by the other.

Regulation with Immobile Capital

We now turn to the case in which capital does not cross national borders. Not only is this a standard assumption in the literature, but Feldstein and Horioka [1980] and Gordon and Bovenberg [1996] document the considerable amount of evidence supporting the notion of international capital immobility.

With immobile capital, the only effect on wage income of a change in the pollution regulation is the direct effect, i.e., that resulting from the effect of a change in α on the marginal product of labor. The aggregate effect of a change in the pollution emissions ratio on labor is therefore

$$V_\alpha^W(\alpha) = \beta^W(f_\alpha - kf_{k\alpha}). \tag{12}$$

Compare equations (12) and (9), noting that the effect of eased standards on the welfare of labor is now smaller. This is due to the fact that with a uniform national standard, capital no longer flows to jurisdictions with relatively lower emissions standards.

A useful characterization of the equilibrium emissions standard is given Proposition 1 which summarizes the key results so far (Proofs are left to the Appendix).

PROPOSITION 1. *Regulation without lobbying by capital owners.*

(i) *In equilibrium, the emissions regulation satisfies*

$$\alpha^* = [(a + \delta^W)\psi^* w^*]/[(a + \delta^E)\beta^E],$$

where $\psi^* = \alpha^* w_\alpha^*/w^*$, *with*

$$w_\alpha^* = \begin{cases} f_\alpha, & \text{if capital is mobile} \\ f_\alpha - kf_{k\alpha}, & \text{otherwise.} \end{cases}$$

(ii) *Ceteris paribus, the equilibrium emissions regulation* α^* *is weaker*:

(a) *the higher is the emissions standard elasticity of wage income,* ψ^*,

(b) *the higher is the labor income,* w^*,

(c) *given the existence of a worker lobby group,* $\delta^W = 1$;

and is stronger:

(d) *the greater the number of environmentalists in the jurisdiction,* β^E,

(e) *given the existence of an environmental lobby group,* $\delta^E = 1$.

(iii) *When only labor and environmentalists lobby,* α^* *is stronger if environmental governance is centralized.*

Interpretation:

(a) In equilibrium, the more elastic wage income is with respect to the emissions level, the more workers are directly affected by a given change in the regulation. A higher equilibrium value of ψ^* means that a less stringent environmental regulation will have a greater positive impact on wages. This raises the benefit of such a policy to labor and makes a less stringent emissions standard more attractive to the government;

(b) A higher level of wage income implies that the emissions standard will be weaker, ceteris paribus. For a given change in policy, the larger the initial wage level, the greater the effect on output and wage income.

(c) The existence of a worker lobby group raises the influence of worker concerns;

(d) Similarly, the larger the number of environmentalists, the greater the pressure exerted on the policy maker to choose a more stringent environmental policy;

(e) The existence of an environmental lobby group raises the influence of environmental concerns.

More importantly, note that ψ^* is *lower* in the centralized case with immobile capital compared to the decentralized case with mobile capital. In particular, when capital is immobile, the impact on wage income caused by a relaxed environmental standard is smaller. Consequently, emissions regulations are more stringent at the national level.

13. Oates and Schwab [1988] study a model of local jurisdictions with mobile capital, capital taxation, environmental standards, and majority voting. They find that interjurisdictional competition is efficiency-enhancing except when the local government is a budget-maximizer or if the population is extremely heterogeneous. In our model there is no discontinuity when either population group increases from, say, 49%–51% of the population. This implies a small change in the level of regulation.

With policy coordination, aggregate social welfare is maximized and the equilibrium emissions policy is Pareto optimal in the sense that some individuals would lose if the policy were to deviate from that described in Proposition 1. However, the efficiency condition is qualitatively different from the case in which interjurisdictional competition and the fear of capital flight yield a lower level of environmental protection. When capital is immobile, the national policy maker is able to exploit this fact by setting a stricter environmental regulation.

Lobbying by Capital Owners

We now consider the impact of capital owners who may lobby the central government. Clearly, there is no such incentive in the decentralized case since the available rate of return is equalized globally, but it does exist in the centralized case when capital is immobile. This insight is straightforward; the owners of *any* immobile factor whose return is affected by a policy intervention have an incentive to influence the direction of that policy. In our model, we assume that free-rider problems can be overcome and that factor owners form lobby groups.

When policy is determined at the federal level and capital is fixed at the national level and, by implication, immobile internationally, the return to capital is affected by changes in α. The welfare of capital owners now plays a role in the aggregate social welfare function. Treating the national capital stock K parametrically, the effect of α on the aggregate welfare of capital owners equals

$$V_\alpha^K(\alpha) = \beta^W k f_{k\alpha} > 0. \tag{13}$$

Easing environmental regulations unambiguously increases the welfare of capital owners.

We now show that when all groups lobby, the optimal emissions standard is equal to the regulation for the decentralized case. First, the characterization of the political equilibrium needs to be modified to allow for capital owner lobbying. This simply involves adding $(a + \delta^K)$ times equation (13) to equation (8). For $i = E, W, K$, substitution yields

$$\begin{aligned}(14)\qquad &\beta^W\big((a+\delta^W)(f_\alpha - kf_{k\alpha})\\ &-(a+\delta^E)\beta^E\\ &+(a+\delta^K)kf_{k\alpha}\big) = 0.\end{aligned}$$

Clearly, when $\delta^E = \delta^W = \delta^K$ we have $f_\alpha = \beta^E$, i.e., the efficiency condition under decentralized decision-making. Thus, capital owner lobbying reintroduces an effect similar to that of capital competition in the decentralized case.

Note that lobbying by capital owners *must* yield a weaker policy. Rearranging equation (14), the political equilibrium is characterized in the following Proposition:

PROPOSITION 2. *Centralized case with lobbying by capital owners.*

Assume that all individuals are organized into lobby groups. Then

(i) *the equilibrium emissions regulation under centralized policy making, α^o, satisfies*

$$\begin{aligned}(15)\qquad \alpha^o = &[(a+\delta^W)\psi^o w^o\\ &+(a+\delta^K)\gamma^o\pi^o]/\\ &[\beta^E(a+\delta^E)]\end{aligned}$$

where, $\psi^o = \alpha^o w_\alpha^o / w^o$, $\pi^o = kf_k = f - w^o$, and $\gamma^o = \alpha^o \pi_\alpha^o / \pi^o$.

(ii) *the emissions regulations under decentralized and centralized governance are equivalent.*

As before, the political determination of α is driven by the impact of the regulation on environmentalist and labor interests. For example, the lower the emissions standard elasticity of marginal labor productivity, ψ^o, i.e., when the impact on labor income of environmental regulation is less, the stricter the resulting regulation. What is different about Proposition 2 is the existence of lobbying by capital owners. Since centralized policy making does not induce flows of capital between jurisdictions, the returns to capital owners are influenced by the emissions regulation. The impact on capital owners is captured by the second term in the numerator of equation (15). First, the lower the emissions standard elasticity of marginal capital productivity, γ^o, i.e., the smaller the effect

on capital income, the stricter the regulation. Secondly, this effect is weighted by π^o, capital owner profitability.

In equilibrium, the effects of the emissions standard on all constituents are internalized by the government's welfare maximization. Interestingly, the resulting policy outcome is equivalent to the efficient decentralized case with capital competition, even though capital is immobile. This is due to the fact that the total income effect of the regulation is equal in both cases. In the decentralized case, the capital owners can move capital between jurisdictions and labor bears the full burden of adjustment. In the centralized case, labor and capital owners share the costs of environmental regulation. The capital owners' burden in the centralized case is equivalent to the effect of capital flight on workers in the decentralized case.[14]

IV. DISCUSSION AND EMPIRICAL EVIDENCE

The preceding section examined two institutional settings in which the pollution associated with industrial production is regulated. In a decentralized setting, environmental regulations are primarily shaped by the influence of environmental and labor interest groups. That is, environmental regulations are politically determined and are therefore likely to be influenced by special interests. However, capital owners are unlikely to engage in costly lobbying activities if they can move some or all of their capital to other jurisdictions with more lenient environmental standards. The concomitant capital competition is often thought to engender a "race to the bottom" in industry regulatory policies. If capital is immobile, however, federal or central policy makers may be able to stiffen the regulation of industry without the fear of capital flight. The relative immobility of capital is a linchpin for the traditional support for federal environmental regulations and the proposals to eliminate "downward competition in environmental policy" by harmonizing environmental regulations, as discussed by Ulph [1995] and Esty and Geradin [1998].[15] However, the owners of immobile factors of production will generally have an incentive to lobby the government for more favorable regulations. Finally, in a fashion similar to Persson and Tabellini [1992], the immobility which leaves capital exposed to stricter regulation of its production may be offset by a "lobbying effect" that creates increased political pressure for more lenient regulation. Overall, the stringency of environmental policy is completely independent of institutional design.

We now consider existing evidence that bears upon these features and we also present some empirical results pertinent to the principal themes of our model. Ideally, the most direct test of our model would be facilitated by an institutional shift in which environmental governance were suddenly centralized. Rather than regulations becoming more stringent, on the basis of our model we would predict that "new" centralized regulations would be similar to the "average" stringency of regulations that had existed at the decentralized level. The study of packaging waste regulation in the European Union, discussed by Paul [1994/95], comes closest to providing this type of experiment. He describes how the EU moved from decentralized regulation to a centralized directive in 1994. There were five-year recycling targets of 25–45% for total packaging waste, a 15% recycling rate for each type of material, and a prohibition of national requirements above 45%. The EU directive was less stringent than the existing German, Danish, and Dutch laws, but was significantly stricter than the existing Greek, Irish, and Portuguese requirements. The preagreement national recycling rates for the EU members are given in Table I.

Golub [1996] describes how the initial proposal immediately came under political fire from various industry groups and how

14. Our result is qualitatively similar to the key finding in Persson and Tabellini [1992]. In a model of tax competition, they show that an "economic effect" which causes downward pressure on rates of capital taxation is offset by a "political effect" manifested by a leftward shift in voters' preferences.

15. While a recent OECD report has argued for "some convergence" of the requirements and standards for the pollution associated with the production process ("non-product related PPM's") it also notes that "[h]armonization of non-product related PPM requirements may be less desirable or feasible in the case of local environmental problems. Because environmental conditions and preferences differ widely among countries, environmental process-related requirements for local problems may be best tailored to local circumstances." (Quoted by Ulph [1995, 4]).

TABLE I
European Union National Recycling Rates (%)

	Paper and Board (1990)	Aluminum (1987)	Glass (1993)
Belgium	36*	4	55
Denmark	35	31	64
France	46	25	46
Germany	40	31	65
Greece	21	25**	27
Ireland	3	na	29
Italy	25	36	52
Netherlands	50	47	76
Portugal	39	4	29
Spain	51	28	29
United Kingdom	31	19	29
Average	34	25	46

Source: Golub (1996).

Notes: No data were available for Luxembourg, or for aluminum recycling in Ireland. * denotes (1988), ** denotes (1990).

the new drafts of the regulations were successively less demanding, until the directive described above was finally adopted.[16] The adopted targets were significantly lower than the targets initially proposed by the EU Commission.[17]

In a similar vein, the centralization of environmental policy may simply reify an existing pattern of environmental policies. For example, consider the 1987 Montreal Protocol. It may have achieved considerably less that many observers believe (or hope). According to the U.S. Environmental Protection Agency [1988] (cited by Barrett [1994]), the benefit to the United States from ratifying this treaty (originally requiring a 50% reduction of hard CFC consumption and production) was $3,575 billion, and a unilateral cut of the same magnitude would yield a benefit of $1,373 billion. These figures should be compared to the projected cost of $21 billion. Barrett [1994] provides a model that supports the conclusion that the Protocol may merely have codified what would have occurred in a noncooperative equilibrium. This view is consistent with the findings of Murdoch and Sandler [1997], who find that CFC cutbacks between 1986 and 1989 in a sample of 61 countries were in excess of the cutbacks required by the Protocol. It appears that industry lobbying may have played an important role in the design of this agreement. Haas [1992] quotes the chairman of an industry interest group, the Alliance for a Responsible CFC Policy, who stated in 1986 that "We do not believe the scientific information demonstrates any actual risk from current CFC use of emissions." However, later in the same year, the major CFC producer, DuPont, made a switch in favor of CFC controls which undermined the remaining firms' position. In 1988, DuPont announced that CFC production would be phased out by the year 2000. The initial

16. The trade and industry representatives consisted of three highly successful pressure groups: the packaging legislation ad hoc group, the packaged consumer goods industries coordination group, and the packaging chain forum (see Golub [1996]).

17. Among the original targets were a mandatory minimum "recovery" (i.e., reuse, recycling, composting, regeneration, and recovery of energy) rate of 60% (by weight) for all packaging waste materials within five years, set to increase to 90 percent after ten years; a mandatory minimum recycling (includes reuse, composting and regeneration) rate of 40% (by weight) for each type of packaging material within five years, rising to 60% after ten years; minimization of the final disposal of packaging waste (by landfill or incineration without energy recovery) to a maximum of 10% (by weight) of packaging waste after 10 years. In sum, after 10 years, 60% of packaging waste would have to be recycled, 30% recovered but not recycled, and 10% disposed of in other ways.

change in DuPont's position has been widely credited for making the Protocol possible, as argued by Benedick [1991] and Haas [1991].

We now turn to cross-country patterns in environmental policy and attempt to more explicitly assess the impact of capital controls on the stringency of environmental policy. An implication of our model is that capital controls should have no effect on the stringency of environmental policy, i.e., there are offsetting political changes that mitigate an associated rise in the stringency of environmental policy when capital controls are put in place. Underlying our test is the presumption that in the absence of capital controls, the capital stock is mobile.

Table II presents some representative regression specifications that build on a reasonably standard model for the stringency of environmental regulations. The index of environmental regulations and enforcement, *STRINGENCY*, developed by Dasgupta *et al.* [1995] for the industry sector for a total of 31 countries, measures policies addressing air, water, land, and living resources. Briefly, a standard model predicts that stringency should increase with real GDP per capita, i.e., environmental quality is a normal good.[18] In addition, the more people there are in urban centers, the greater is the exposure to industrial pollution and thus the marginal disutility of pollution, so *STRINGENCY* should be positively related to *URBAN*. Also, recent research by, e.g., Congleton [1992], Murdoch and Sandler [1997], and Fredriksson and Gaston [2000], indicates that greater political freedoms give rise to stronger pressure for stricter environmental policies. Our dummy variable *RIGHTS* takes a value of one if a country is classified as having political freedoms, zero otherwise. The variable is

18. See, e.g., Shafik [1994], Antle and Heidebrink [1995], Grossman and Krueger [1995].

TABLE II

The Effect of Capital Controls on the Stringency of Environmental Regulations

Variable	Label	Mean (Std. Dev.)	(1)	(2)	(3)	(4)	(5)	(6)
STRINGENCY	Stringency of Regulations (Industry)	113.26 (39.81)						
GDPPC	GDP per capita, thousands $US (1987)	3.80 (6.77)	0.026† (0.014)	0.018* (0.006)	0.016* (0.007)	0.022* (0.008)	0.027* (0.013)	0.017* (0.006)
URBAN	Urbanization % (1990)	44.80 (23.34)	0.008* (0.002)	0.008* (0.002)	0.008* (0.002)	0.008* (0.002)	0.008* (0.002)	0.008* (0.002)
RIGHTS	Political Rights	0.39 (0.50)	0.122 (0.088)	0.151† (0.079)	0.135 (0.084)	0.139† (0.079)	0.135 (0.079)	0.146† (0.077)
CC1	Capital Control Type 1	0.29 (0.46)	0.055 (0.074)	0.045 (0.068)	*	*	*	*
CC2	Capital Control Type 2	0.74 (0.44)	−0.066 (0.113)	*	−0.041 (0.106)	*	*	*
CC3	Capital Control Type 3	0.90 (0.30)	0.070 (0.201)	*	*	0.118 (0.163)	*	*
CC4	Capital Control Type 4	0.87 (0.34)	0.133 (0.288)	*	*	*	0.186 (0.232)	*
Intercept			4.032* (0.282)	4.190* (0.071)	4.240* (0.114)	4.078* (0.163)	4.011* (0.251)	4.204* (0.067)
Adj. *R*-sq.			0.754	0.772	0.770	0.773	0.774	0.777
F			14.107	26.452	26.103	26.568	26.714	35.885

Sources: STRINGENCY: Dasgupta *et al.* [1995]; *GDPPC* ($US [1987]: World Bank [1992]; *URBAN* [1990]: World Bank [1998]; *RIGHTS:* Freedom House [1993]; *CC1-CC4:* International Monetary Fund [1998]. Data are available from the authors upon request.

Notes: Observations for 31 countries. Columns labelled (1)–(6) contain OLS estimates (standard errors). Dependent variable is natural logarithm of *STRINGENCY*.

*Significance at 5% level.

†Significance at 10% level.

based on a classification of freedoms in countries. Finally, and most importantly for our purposes, we augment this model with various measures of capital controls used by Grilli and Milesi-Ferretti [1995]. We use four different measures for the year 1990; the dummies take the value of one if a restriction is in place, and zero otherwise. CC1 measures the existence of multiple exchange rate practices; CC2 measures restrictions on current account transactions; CC3 measures restrictions on capital account transactions; and CC4 indicates whether or not exporters need to surrender exports proceeds. Our theory predicts that they should not affect *STRINGENCY*, because we expect environmental stringency to be independent of capital mobility.

Table II indicates that the estimated models yield sensible results for the standard variables. There is strong support for the expected effects of per capita income and urbanization on environmental stringency and moderate support for the view that political and civil freedoms lead to greater political support for policies that protect the environment. However, the capital control measures lack statistical significance, when entered either individually or jointly.[19] Hence, greater restrictions on capital are not associated with the stringency of environmental policies. We interpret these findings as providing support, albeit somewhat indirect, for our model's predictions.

The question remains, of course, about effects of environmental policy on industry and the consequent incentives for capital and industry to lobby for more favorable environmental regulations and policies. Fortunately, anecdotal evidence is strong. For example, in 1997 the provincial government in Ontario, Canada, amended the majority of its statutes concerned with the environment or natural resources to make them less stringent. The main beneficiaries were the agribusiness, forestry, home-building, and mining industries, according to Esty and Geradin [1998]. These industries can be classified as sectors with relatively immobile capital. In comparing the United States and the EU, Kimber [1995, 1,688] argues that "opposition to central regulation makes it difficult to enact central measures at all or of sufficient stringency to protect the environment adequately." At the same time, she also argues for centrally established policies. For Germany, Rose-Ackerman [1995] finds that farmers and the chemical industry have virtual "veto power" over environmental policy (organic and inorganic chemicals industries are classified as having immobile capital stocks by UNIDO [1982]). Similarly, Bosso [1987] and Cropper *et al.* [1992] report that for the United States, pesticide manufacturers and farmers have had a significant impact on the regulation of pesticides in agriculture.

Finally, we present two separate pieces of evidence that suggest that environmental policy and the level of pollution may both be independent of institutional design. First, consider evidence from the U.S. state legislatures and congressional and senate voting records on environmental policy. The following data for roll calls on environmental bills in state legislatures and in the U.S. Senate and House are reported by Calvert [1989]. They are for Mean Support Scores which index the tendency for U.S. legislators to vote in support of policies that protect the environment. Specifically, the data are for

i. State House and Senate votes by Democrats and Republicans on environmental bills for ten states (of which none are southern states), for the years 1980–85;[20]

ii. U.S. Congress and Senate for Democrats and Republicans (excluding the South), for the years 1981–84.

Our theory suggests that there should be no differences in the support for environmental policy at different levels of policy making. Table III reveals no discernible differences in voting intentions at the Federal and State levels.

Second, the data for pollution levels reported by Rose-Ackerman [1995] are consistent with our theoretical expectations. She considers measures of environmental quality for the United States, which has centralized regulation, and for Germany, which has decentralized regulation. While acknowledging the obvious difficulties associated with mak-

19. In the latter case, the test statistic for the inclusion of all four capital control measures is $F(4,23) = 0.35$.

20. The ten states and years are Alaska (1983–84), California (1980–84), Idaho (1980–85), Illinois (1981), Montana (1981, 83, 85), Oregon (1981, 1983), New York (1981–82), Washington (1981–84), Wisconsin (1981–84), and Wyoming (1981–83).

TABLE III
Mean Support Scores

Legislature	Democrats	Republicans
State House	73.5	34.5
State Senate	71.3	34.6
U.S. House	78.2	36.7
U.S. Senate	72.9	33.1

Source: Calvert [1989].

ing cross-country comparisons, she finds no evidence that one type of institutional design yields lower pollution levels than another.[21]

V. CONCLUSION

This article examined the implications of decentralized and centralized environmental policy making. We differentiated the two levels of environmental governance by the presence or absence of capital competition. Specifically, capital was mobile between jurisdictions of a federation, but immobile at higher or more centralized levels of governance. We assumed that environmental policies are politically determined, i.e., that policies are shaped by special interests or lobby groups. Organized lobby groups offer the government political contributions in return for more favored environmental policy outcomes. The government maximizes aggregate social welfare and political contributions.

In the case of decentralized environmental governance, we found that the emissions policy is efficient. However, the regulation is affected by capital competition because workers are adversely affected by capital flight and their lobbying influences the local policy maker to reduce the level of regulatory stringency.

Next, we discussed the policy outcomes for two scenarios under centralized environmental policy making. If capital owners do not lobby for political favors, the government sets a more stringent environmental standard than in the decentralized case. This result forms the foundation for the coordinated administration of environmental policies. For example, the large tax competition literature takes seriously the possibility of noncooperative equilibria with sub-optimally low levels of capital taxation. Similarly, minimum environmental standards or abatement requirements may exhibit "race to the bottom" tendencies when the standards and requirements are determined at local levels of government. These tendencies are thought to be mitigated if policies are harmonized at the highest level of government in a federal structure.

If the capital stock is immobile, however, the owners of capital also have an incentive to lobby the policy maker. We showed that the centralized regulatory outcome may degenerate to the decentralized regulatory outcome, i.e., the emission standard is independent of institutional design. This occurs because capital owner lobbying has an effect on environmental regulation similar to that induced by capital competition when policy is determined locally. While labor bears the costs of environmental regulation in the decentralized system, the burden is shared with capital in the centralized case. A possible implication of our article is that, given the independence of environmental policy and institution design, decentralized environmental governance may be preferable if there exists significant heterogeneity of the effects of pollution across jurisdictions.

21. Benchmarking at 1975 pollution levels, the 1988 levels for the United States (Germany) were: 103 (115) for nitrogen oxides, 65 (50) for suspended particulates, 77 (63) for carbon monoxide, 84 (93) for hydrocarbons, and 115 (103) for carbon dioxide.

APPENDIX

Proof of Proposition 1: Rearrange equation (11) as

$$(A1) \qquad 1/f_{\alpha} = (a + \delta^{W})/[(a + \delta^{E})\beta^{E}].$$

Since $f_{\alpha} = w_{\alpha}^{*}$, then multiplying both sides of (A1) by $\psi^{*}w^{*}$ gives part (i). Part (ii) of the Proposition follows immediately.

Proof of Proposition 2: (i) Substitution of equations (10), (12), and (13) into equation (8) gives equation (14). Now simply substitute $\psi^{o} = \alpha^{o}w_{\alpha}^{o}/w^{o}$, $\pi^{o} = kf_{k} = f - w^{o}$, and $\gamma^{o} = \alpha^{o}\pi_{\alpha}^{o}/\pi^{o}$, to obtain the required expression. (ii) If $\delta^{E} = \delta^{W} = \delta^{K}$, equation (14) is equivalent to equation (11).

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