A Comparative Institutional Approach to Environmental Regulation: The Case of Environmental Degradation Along the U.S.-Mexico Border

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Abstract

This paper proposes a simple heuristic model of environmental regulation choice, incorporating both market failure and government failure. It relates the comparative costs of alternative forms of environmental regulation to measurement difficulty and matches appropriate regulatory responses in a discriminating way. The model is then applied to the concrete problems of transboundary environmental pollution encountered by the United States and Mexico. The implications for business, public policy, and research are developed.

Keywords: *transaction costs, environment, regulation, border*

Introduction

Considerable controversy exists with respect to the extent to which market-based or command-and-control mechanisms should be used to regulate economic activity that produces environmental pollution. The problem becomes more delicate along international borders where governments vary significantly with respect to their ability to regulate economic activity associated with transboundary pollution.[2] As countries attempt to legislate appropriate rules to control business behavior with undesirable consequences for the environment, critics claim that they are erecting new forms of non-tariff barriers (Economist 1992). In addition, although the evidence is mixed, differing environmental standards have been argued to effectively eliminate from competition products from countries with stricter standards and thus create "pollution havens" (Whalley 1991; Cole 2000; Xing and Kolstad 2002; Eskeland and Harrison 2003; Rivera 2003).

In the past, nations have been able to pursue different environmental policies without regard to the actions of their neighbors. However, as closer commercial ties emerge among the nations of the European Union and the North American Free Trade Area, the question of the incompatibility of environmental laws becomes more apparent. The issue is even greater when two countries that share a common border are at different stages of development. One obvious solution is to negotiate a common transboundary environmental policy. But the realignment of environmental laws often means that less powerful nations follow the standards of their more powerful neighbors even though they may not be appropriate for their particular circumstances (Sánchez 1991a). Poor nations complain that rich nations are in a position to dedicate resources to high-tech solutions for environmental protection, while they need to focus on low-tech solutions appropriate for their economic circumstances (Ramírez Granados 1992). A common regulatory design can create political opposition within the less powerful nation as it is viewed as a significant cession of sovereignty (Goldsmith and Yoo 1999; Solis 1993). As a result, only token attempts are made to enforce and comply with regulations that are seen as undesirable imitations of standards developed in other countries.

In this paper, I argue that these conflicts of sovereignty and of laws can be minimized by reducing reliance on solutions based on a common environmental regulatory policy and allowing each jurisdiction to develop an appropriate legal response that matches the nature of the transaction created by the particular pollution problem (Ackerman and Hassler 1981) and the relative capabilities of its own regulatory apparatus. The transaction-cost perspective asks us to minimize the transaction costs involved by matching the appropriate regulatory approach to the particular kind of transboundary pollution problem in question.

Three kinds of regulatory responses are commonly used: market-based regulation, command-and-control regulation, and mixed responses. As part of a common environmental policy along an international border, the command-and-control type of response is criticized as involving a reduction of national sovereignty. However, by distinguishing these three kinds of responses and applying them to those areas where

they are most appropriate, concerns about sovereignty associated with the command-and-control response can be reduced to a minimum, while promoting free trade and environmental responsibility on both sides of the border.

In earlier work, Bucholtz (1991) similarly identified three basic approaches to trans-boundary environmental regulation. Using Coase's logic, she argued that the appropriate regulatory solution depends on the context. Unfortunately, she did not follow Coase's logic rigorously enough to be able to specify under what conditions a certain regulatory approach would be appropriate. By looking at a wide variety of transboundary pollution problems, we can match different regulatory approaches to specific kinds of pollution problems.

This paper will develop a comparative institutional approach to environmental regulation in the following manner. The first section builds a theoretical framework for looking at the comparative efficacy of command-and-control or market-based regulation from the perspective of transaction-cost economics. In the second section, the theoretical framework is applied to problems of environmental degradation in a trans-boundary context. Specifically, the model is applied to the case of environmental regulation along the U.S.-Mexico border. In the third section, I develop some of the implications of this model for firm-level behavior along the border. Finally, a concluding section discusses some of the implications of this framework for policy and future research.

Theoretical Framework

The debate concerning the proper mix of market and government in a free society continues unabated (Wolf 1988; Freeman 1989). Increasingly, governments are experimenting with private incentives to regulate business and social activity. An often disappointing experience with public organizations and their regulation of economic activity has resulted in a desire to look for ways to make regulatory mechanisms more flexible and develop market-based solutions (Bardach and Kagan 1982b). In some countries such as Mexico, this search has led to the privatization of some regulatory enforcement activities and even such "public" goods as highways. In other countries, such as Great Britain (Vogel 1986) and Japan (Chinloy 1989), governments regulate economic activity more effectively. The proper mix of market-based and command-and-control solutions must take a comparative institutional approach, which incorporates the strengths and weaknesses of these regulatory approaches in different jurisdictions.

George Stigler (1971, 3) once suggested that "[t]he central tasks of the theory of economic regulation are to explain who will receive the benefits or burdens of regulation, what form regulation will take, and the effects of regulation on the allocation of resources." Stigler's own work, followed by that of Peltzman (1976) dealt with the first of those questions regarding who will receive the benefits and burdens of regulation. Others have examined the impact of regulation on the allocation of resources (Carman and Harris 1986) as well as the procedures for evaluating the impact of regulation on resource allocation (Williamson 1981). This paper is primarily concerned with the second of the tasks of a theory of regulation: namely, that of determining what form environmental regulation will take or, in the words of James Q. Wilson (1985, 357), "explain[ing] why one alternative rather than another is chosen."

In very general terms, there are two basic kinds of costs that exist in an economic system: production and transaction costs. Production costs include any of a number of costs involved in the production of goods and services. Such costs often include social costs, which, like pollution, are borne by society, rather than the individual producer. When the emission of pollutants exceeds the absorptive capacity of the environment, then policy makers must consider both the damage created by these excess emissions and the costs associated with pollution control. When control is high, emissions are low and the damage caused (e.g. health problems or loss of livelihood) is relatively minor. As control decreases, emissions increase and so does the marginal damage created by each additional unit of emissions. As a result, control costs are low when large amounts of emissions are permitted and increase sharply as emissions are reduced (Tietenberg 2000; Palmer, Oates, and Portney 1995). Along the U.S.-Mexico border, the lack of control has resulted in high levels of pollution with such consequences as unusually high levels of birth defects, miscarriages, cancers, and other health problems (Varady, Lankao, and Hankins 2001). Maquiladoras (assembly plants) for auto parts in Reynosa and Matamoros, which comply with environmental regulation, have incurred significant control costs (Vazquez and Cueva 2002).

Transaction costs are all the costs associated with economic transactions. Ronald Coase (1988, 114) described these costs in his famous essay, "The Problem of Social Cost." He writes:

> *In order to carry out a market transaction, it is necessary to discover who it is that one wishes to deal with, to inform people that one wishes to deal and on what terms, to conduct negotiations leading up to a bargain, to draw up the contract, to undertake the inspection needed to make sure that the terms of the contract are being observed, and so on.*

The selection of economic institutions or governance structures to order such transactions largely depends upon their capacity to economize on transaction costs (Williamson

1996). This transaction-cost reasoning has been extended to such areas as cable television regulation by construing the relationship between the regulated cable company and regulator as a "highly incomplete form of long-term contracting" (Williamson 1985, 347). Although environmental regulation has not generally been viewed through the lens of transaction costs, the logic is quite similar. An important exception is work by Delmas and Marcus (2003), which examines these questions from the perspective of the firm. One crucial point not covered by cable television regulation that must be included in any consideration of the comparative advantages of different institutional forms of environmental regulation are the production costs, including social costs, involved in a particular problem.

Both Williamson and Coase have shown how the existence of transaction costs results in the alternative institutions of markets and firms through which economic transactions take place. A similar argument has been made for the choice between the market and governmental regulation. According to Coase (1988, 117):

> *The government is, in a sense, a super-firm (but of a very special kind) since it is able to influence the use of factors of production by administrative decision.... [However], the government is able, if it wishes, to avoid the market altogether, which a firm can never do....It is clear that the government has power which might enable it to get some things done at a lower cost than could a private organization (or at any rate one without special governmental powers). But the governmental administrative machine is not itself costless.*

Governmental regulation is only justified when the "transaction costs of state activity are lower than the private transaction costs by an amount at least as great as the benefits of the transaction" (Layard and Walters 1978, 192).

Similarly, there exists a choice between command-and-control and market-based regulation based on transaction-cost differences. Command-and-control regulation involves significant transaction costs. Problems are associated with both gathering information to set detailed standards as well as with enforcing such standards (Breyer 1982). The costs associated with transactions involving the use of the judicial apparatus such as the expense of educating the court and its officers to a theoretically handcrafted case by specialists (lawyers) are significant (Leff 1970, 8). Measurement is especially relevant in a consideration of regulatory transactions because such measurement problems contribute greatly to transaction costs (Williamson 1996).

Measurement difficulty has been discussed in terms of both economic transactions generally (Milgrom and Roberts 1992) and, more specifically, in terms of work organization (Alchian and Demsetz 1972). In the context of environmental externalities, measurement of the contribution of industrial activity to pollution, for example, can be very difficult. Measurement difficulties arise both in terms of the sources and the consequences of pollution. For sources, measurement is made difficult by the type of pollution and the number of sources. Pollution may come in small increments from a large number of sources. Moreover, there are times when a factory's output is, in and of itself, not noxious; however, in combination with the by-products of other production processes, it can be toxic. In contrast, there are many cases, such as the spilling of waste material from the property of one company to that of another, which are quite measurable and legal responsibility can be established.

In terms of consequences, measurement depends upon the type of effect and the number of victims and other affected entities. If there is only one source and one victim, a Coasian bargain might be reached. But where there is one source and millions of victims, each of whom suffers to a different degree (e.g. those affected by toxic pollution that spreads to a different degree over space and has differential effects on sensitive vs. non sensitive populations), transaction costs are excessively high. As the measurement of the sources and consequences of an externality being regulated becomes more difficult, so the problem of its regulation becomes more complex — hence, this paper speaks of measurement difficulty as a crucial dimension underlying the choice between market-based, command-and-control, or mixed modes of regulation.

In order to see the relation between market-based and command-and-control regulation from a transaction-cost viewpoint, we shall develop a simple heuristic model. The basic decision faced by the state is how best to regulate economic transactions that at times produce social costs. It has two basic options: a market-based solution based on the operation of market incentives or a command-and-control approach using power (Lotspeich 1995). Command-and-control regulation establishes emission standards, often reducing the discretion of decision-makers by requiring specific end-of-pipe or environmental technologies. Market-based approaches typically include transferable emission permits, emission charges (taxes), or private liability schemes. These approaches shape the decision environment, but managers are free to develop appropriate responses within those constraints. Such systems tend to foster greater environmental innovation on the part of firms (Sharfman, Mea, and Ellington 2000). Market-based regulation also enables greater discrimination of the control costs borne by the polluter and the costs of damage borne by the victims than does command-and-control regulation. A third option, based on a mixture of these two basic options may also be possible. For example, emission

standards can be combined with emission charges (Lotspeich 1995). We will look at the comparative advantages of both command-and-control and market-based regulation when faced with increasing conditions of measurement difficulty, where μ is the level of difficulty of a given measurement.

This framework treats both market failure and government failure in a unified way (Daneke 2001). Let us begin by assuming only market failure, without taking into account bureaucratic failure of government agencies, which we will take up in a second step. An externality occurs when total social costs (TC_s) of production are not accounted for entirely in the total private cost of production (TC_p). Let us define E as the environmental externality or damage to society of a given productive activity. Expressing E as a function of measurement difficulty (μ, E will be negative throughout. Thus at a given level of measurement difficulty, we can say that $E = TC_p(\mu)-TC_s(\mu)$, which is the difference between total private and total social costs for a given level of measurement difficulty. According to Coase (1988), private and social costs are equal in the absence of transaction costs because it is always possible to attribute social costs to a specific source and victim. Thus in Figure 1, we see that the curve labeled E begins at the origin because the damage to society is equal to zero where transaction costs due to measurement difficulty are also zero. For all μ greater than zero, we would expect by definition that $TC_s(\mu) > TC_p(\mu)$.

Furthermore, we assume that the rate at which social costs increase as a function of measurement difficulty exceeds the rate at which private costs increase as a function of measurement difficulty, $TC_s'(\mu) > TC_p'(\mu)$ evaluated at all μ. As the measurement of and attribution of specific forms of pollution becomes more difficult, the costs associated with cleanup also increase. As measurement difficulty increases, it becomes more and more difficult to assign responsibility because of the difficulty of identifying the sources of pollution, the affected parties, and/or measuring damage. Measurement difficulty is itself a function of the nature of the activity being regulated. In the case of environmental pollution, those types that are more difficult to measure are also, by definition, more difficult to regulate. Hence E slopes downward at an increasing rate since private production costs remain constant regardless of the difficulty of measurement of externalities.

Let us now include bureaucratic failure in the model by representing the governance costs associated with the command-and-control approach of government bureaucracy $G_B(\mu)$ as a function of measurement difficulty and the governance costs of market-based approaches $G_M(\mu)$, also as a function of measurement difficulty. Under conditions where measurement is possible, we take it that the governance costs of the command-and-control approach are greater than the costs of market-based approaches $G_B(0) > G_M(0)$. In terms of environmental degradation where μ=0, the sources of certain forms of pollution are easily identifiable, sometimes referred to as "point" sources, and can be separated from other sources.

In the case of point sources, polluting substances enter the air or a body of water at a discernible point; with non-point sources, the entrance of pollutants into the air and water systems is more diffuse and cannot be as easily identified. Smoke from a chimney is a point source, while runoff from a field is a non-point source. Other things being equal (number of victims), measurement difficulty is considerably greater for non-point sources than for point sources. Measurement difficulty increases with respect to the transfer of pollution to another party where the source of pollution is no longer identifiable. In addition, for pollution that disperses widely into air or water once it is released, whether from a point or a non-point source, one must rely on the cooperation of numerous parties for cleanup. Such cooperation involves negotiation costs, which also increase under such circumstances. The fact that the source can often be identified only means that market-based solutions are feasible, but not without substantial governmental support.

At μ=0, command-and-control regulation is more costly than market-based mechanisms because the governmental control systems depend entirely on the bureaucratic apparatus of the state. Although market-based mechanisms also depend partially on the bureaucratic apparatus of the state in order to impose charges or create markets (Daneke 2001), their reliance on market incentives helps to reduce their cost relative to ordinary command-and-control regulation.

Despite the initially greater costs associated with command and control at low levels of measurement difficulty, the rate of increase in the costs of bureaucracy are lower than the rate of increase in the costs of market-based mechanisms as measurement difficulty increases, so $G_M'((\mu) > G_B'((\mu)$, for all μ>0. This relation holds because command-and-control regulation involves the use of the government's unique access to force in order to ensure compliance, which can reduce costs considerably (Coase 1988). In addition, market-based mechanisms have a comparative disability in regulating non-separable externalities because the costs of negotiation and enforcement of voluntary agreements increase as the identification of the sources, types, and victims of pollution become more difficult.

In the area of environmental pollution, measurement difficulty is closely related to the indefiniteness of property rights. Indeed, it is the lack of well-defined property rights that often forecloses common-law actions such as nuisance suits, which are based on private economic incentives. Arrow (1970, 17) mentions both information costs and exclusion costs as important sources of transaction costs. With respect

to environmental contamination, Demsetz explains (1967, 348-9): "The familiar smoke example is one in which negotiation costs may be too high (because of the large number of internalizing parties) to make it worthwhile to internalize all the effects of smoke." It is precisely the difficulty of exclusion that causes negotiation costs to increase and makes smoke and many other forms of pollution difficult to deal with in terms of market solutions.

As suggested earlier, we must look at the total costs associated with market-based approaches or command-and-control regulation in order to decide which form of regulation is better. Thus we take ΔG as the difference between the governance costs associated with the command-and-control mechanisms based on governmental fiat and those approaches based on market incentives, $\Delta G = G_B(\mu)-G_M(\mu)$. The comparative social and governance costs are indicated in Figure 1. The line $\Delta G+E$ is the sum of these costs.

As we look at Figure 1, it is evident that the market-based approaches are the best solution until $\mu = a$ is reached, where high measurement difficulty makes the externality greater, increases negotiation costs, and thus increases the need for the bureaucratic control systems of the government to implement solutions. For all $\mu > b$, there is no advantage to using the market-based solutions.

What happens between $\mu = a$ and $\mu = b$? At $\mu = a$, the damage to society or the difference between the social and private costs just equals the difference in the disabilities of the command-and-control regulation and the market-based approaches. In addition, the ability of private incentives to deal with the problem at hand has declined considerably in comparison with the disabilities of the more intensive use of bureaucracy in command-and-control regulation. Mixed or hybrid solutions might be appropriate because the governance costs of the market-based approaches have increased considerably. Solutions might include combining emission standards with emission charges. Mixed solutions would be useful until $\mu = b$ where the governance costs of using private solutions are now equal to the governance costs of command-and-control mechanisms.

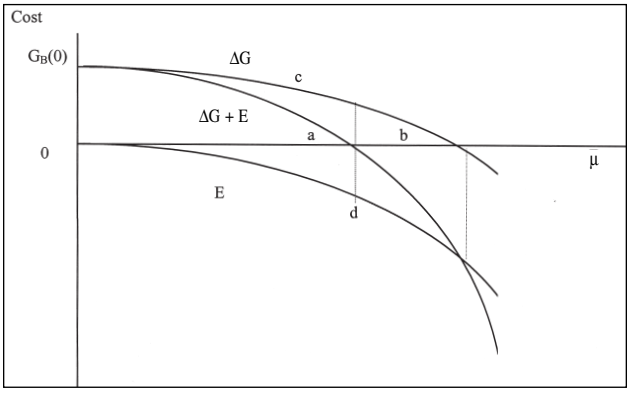

Figure 1. Comparative governance and social costs.
E: environmental externality
G_B: governance costs associated with the command-and-control approach of government bureaucracy
ΔG: difference between the governance costs associated with the command-and-conttrol mechanisms based on governmental fiat and those approaches based on market incentives
μ: measurement difficulty

Using this framework, we can compare the effectiveness of two different governments. Countries and even states vary widely in terms of their abilities to develop, implement, and enforce environmental policies (Lotspeich 1995; Feiock and Stream 2001). In Figure 2, Government 1 is more efficient than Government 2 in its regulatory effectiveness. This comparative efficiency is indicated on the vertical axis by $G_{B_2}(0) > G_{B_1}(0)$. Interestingly, the consequence is that the more efficient government may more appropriately use mixed and command-and-control regulatory measures over a broader range of measurement difficulty ($\mu > a$) than the less efficient government ($\mu > c$). The ability to rely on command-and-control mechanisms thus varies according to the government's relative efficiency. Weak administrative capacity is a particularly significant problem in the area of environmental policy performance in developing countries generally and in Mexico specifically (Mumme, Bath, and Assetto 1988). Although some scholars have called for a common border environmental policy (Drumbl 2002), this analysis would support the current NAFTA approach, which emphasizes "the effective enforcement of national regulations" (Rugman, Kirton, and Soloway 1999, 83), rather than regulatory harmonization as sought in the European Union. Regulatory harmonization can only occur with a corresponding convergence in administrative capacity. The reality of differential administrative capacities for the U.S. and Mexican government calls for a significant degree of decision-making autonomy in which each sovereign nation may implement the combination of market-based and command and control regulation best adapted to its capabilities and needs. Certainly cooperation is called for, but regulatory harmonization will only be possible when convergence in administrative efficiency has occurred.

Transboundary Environmental Pollution and Regulation Along the U.S.-Mexico Border

In order to look at problems of transboundary pollution, let us examine more concretely the situation facing Mexico and the United States. In a study of environmental degradation along the U.S.-Mexican border, Sánchez (1991b) mentions the following problems: toxic wastes either exported to Mexico from the United States or generated in Mexico by

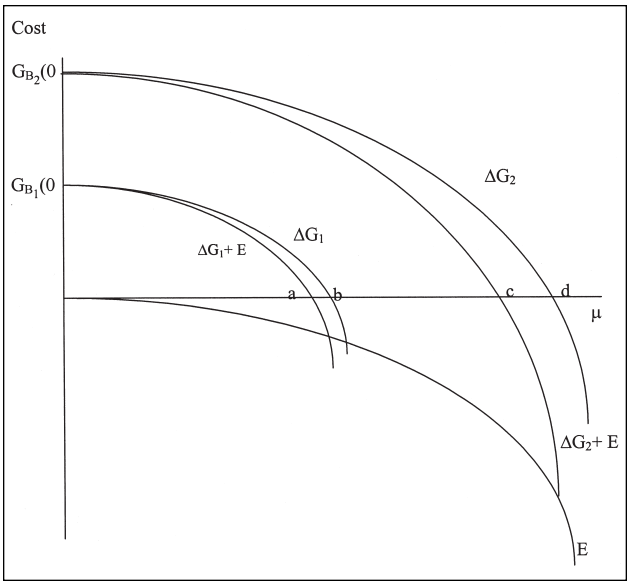

Figure 2. Comparative statics comparing governance costs for two nations.
E: environmental externality
G_{B_1}: governance costs associated with the command-and-control approach of government bureaucracy for government 1
G_{B_2}: governance costs associated with the command-and-control approach of government bureaucracy for government 2
ΔG_1: difference between the governance costs associated with the command-and-control mechanisms based on governmental fiat and those approaches based on market incentives for government 1
ΔG_1: difference between the governance costs associated with the command-and-control mechanisms based on governmental fiat and those approaches based on market incentives for government 2
μ: measurement difficulty

foreign-owned maquiladoras, agricultural toxic wastes, problems in solid waste management, the discharge of domestic, industrial, and agricultural waste water into bodies of water, polluting emissions released into the air, degradation of natural resources and ecosystemic alterations. In addition to these specific problems, which affect the two countries, there are also more global problems of pollution originating in one country, which affect the other such as depletion of the ozone layer and global warming due to the greenhouse effect (Buchholz 1993).

Let us begin our examination of the different kinds of transboundary pollution with solid waste and toxic waste. Here is an area where measurement difficulty is relatively low due to the clear-cut nature of the property rights (Hamilton 1993). Waste, whether toxic or solid, has an owner. It can often be contained and transported. Moreover, much waste has a potential use as an input to someone else's production process and can sometimes be sold. The main transaction costs are related to the information costs of discovering a potential purchaser for waste. In a situation of low measurement difficulty, one would recommend market-based solutions with government support of such markets.

A number of market-based solutions seem to be operative currently. Interestingly, the U.S. Environmental Protection Agency (EPA) has supported the development of markets for waste by investing in a computer exchange that files information on potential buyers and sellers of waste (Buchholz 1993). In the United States, the Superfund attaches liability to the parties producing hazardous wastes, requiring them to either remove such waste or remedy the situation in order to internalize social costs. It also taxes current production of some chemicals in order to finance cleanup of abandoned sites. Finally, Title III of the Superfund Amendments and Reauthorization Act of 1989 creates a public database called the Toxic Release Inventory (TRI), which contains information on toxic substances released by companies. In each case, there is an effort to reinforce market-based incentive mechanisms.

Mexican law prohibits the importation of toxic waste, the purpose of which is only to deposit it within Mexican territory and requires maquiladoras to return hazardous waste to the country of origin (Diario Oficial 1988, 50). During the Zedillo administration (1994-2000), authorities applied life-cycle analysis to hazardous waste and reformed the 1988 law so as to emphasize reuse and recycling, imposing liability on the generators of hazardous waste. Unfortunately, information requirements regarding hazardous wastes are unevenly enforced and such information is not available to the public (Varady, Lankao, and Hawkins 2001). Now Mexico is inaugurating obligatory right-to-know regulation with its own version of the TRI called the "Registry of Pollutant Emissions and Transfer" ("Registro de Emisiones y Transferencia de Contaminantes") or RETC. Right-to-know legislation fits the framework well because it provides diverse stakeholders with information about toxic wastes produced by firms so that they may make decisions on the basis of such information. This kind of legislation overcomes information barriers in order to take advantage of market forces and thus affect firm behavior (Lyndon 1989).

With respect to waste management in the US-Mexico border context, the 1986 amendments to the U.S.-Mexico Agreement for Environmental Protection and Improvement of the Border Zone control the movement of hazardous substances across the border (Herrera Toledano 1992). This agreement includes the return of toxic wastes generated by maquiladoras in Mexico to their country of origin — usually the United States. Unfortunately, it appears that only a minimal amount of waste has returned to the United States due to the Mexican government's inability to enforce the agreement (Sánchez 1991a; Varady, Lankao, and Hankins 2002). If measurement difficulty is relatively low, the largely public en-

forcement solution based on command-and-control regulation and subject to high enforcement costs would suffer a comparative disadvantage with respect to market-based solutions (Mumme, Bath, and Assetto 1988). Given these conditions, it would be wise for Mexican authorities to attach Superfund-type liability to maquiladoras with enforcement based on private individuals or groups as contemplated under current law (Diario Oficial 1988). The offending company should be obligated to pay such groups a reward or commission for the identification of illegal hazardous waste sites in order to internalize enforcement costs. In addition, the Commission on Environmental Cooperation (CEC), set up by the NAFTA side agreement on the environment, is using the right-to-know programs of the U.S., Canada, and Mexico to develop and disseminate information on toxic wastes at a North American level (Ferretti 2003). By using the market-based incentives inherent in these different mechanisms, the Mexican government could economize on transaction costs associated with its own bureaucratic administrative system.

With water and air pollution, the transaction costs associated with regulation increase significantly because of the higher level of measurement difficulty. Two types of air and water pollution can be identified: point and non-point sources (Buchholz 1993). In the case of point sources, the government can use market-based solutions by imposing a tax on the source of pollution (Breyer 1982) or by implementing a system of tradable pollution discharge permits (Tietenberg 1980). Such efforts are appropriate for both water and air pollution due to point sources, which represent low levels of measurement difficulty. Unfortunately, in Mexico and to a lesser extent the United States, the usual response to point source of pollution has been an orientation toward command-and-control types of regulation (See, for example, the Mexican law in the Diario Oficial (1988)).

With respect to the transboundary air and water pollution problem, there are several aspects to be considered. For cases of non-point sources of air and water pollution along the border, joint administrative mechanisms may be essential. In San Diego, for example, ozone flows south toward Mexico, while dust and ash from Tijuana flow north. San Diegans also complain of sewage from industrial and domestic sources as well as from storm sewers, which has contaminated the beaches of south San Diego County (Sánchez 1991a). An International Water and Border Commission was created to oversee the joint construction of sewage treatment plants. However, considerable dissatisfaction exists on the Mexican side as U.S. interests essentially imposed solutions on Mexico that were neither economically nor technologically optimal. These joint measures were viewed as an indication of a lack of confidence in the ability of Mexican engineers to operate effectively a water treatment plant on their own (Sánchez 1991a). Bilateral institutions like the CEC, which was established to develop cooperative solutions to these border pollution problems, have been received more positively because of their reliance on the local administrative and judicial apparatus of the different jurisdictions. However, because of this reliance on local mechanisms, some commentators are concerned that the CEC may lack power to improve environmental conditions (Dunn 2002).

Rather than seeking a common environmental policy, these institutions should take into account differences in governmental effectiveness and allow each country to choose the appropriate mix of regulatory mechanisms according to the administrative effectiveness of each government. In the United States, command-and-control regulation for non-point source pollution may be feasible, while in Mexico the multiplicity of businesses, both large and small, contributing to non-point-source pollution makes enforcement by overwhelmed and sometimes ineffective governmental agencies impossible. Again, given the lesser administrative capacity of the Mexican environmental institutions, it makes sense to privatize enforcement in Mexico by providing incentives to private actors to pursue polluters through legal means.

Finally, there are global problems of pollution that affect both the United States and Mexico such as ozone depletion and global warming. Measurement of the sources and consequences of these types of pollution is extremely difficult because they arise from a very large number of individual products and users. To the extent that measurement may be feasible, tradable emission permits and taxes could be used as in the case of other types of air pollution. Ozone depletion, for example, can be attributed to the use of chlorofluorocarbons in air conditioners, refrigerators, solvents, aerosols, and insulation (Buchholz 1993). However, to the extent measurement is not feasible, negotiation costs would be extremely prohibitive among parties that use such products. Consequently, international environmental regulation is appropriate under these circumstances. Such was the case in the approval of the Kyoto Protocol, which called for developed nations to limit their greenhouse gas emissions, relative to levels emitted in 1990. Some greenhouse gases are from point sources and would be amenable to market-based solutions. However, other non-point sources would entail a high degree of measurement difficulty and there would be a need for greater governmental intervention with command-and-control types of regulation. In any kind of agreement, it would be necessary to support autonomous decision making by each country, which respects national sovereignty and differential administrative capacities, rather than a common solution in the design of regulations and enforcement.

Table 1 summarizes this discussion of efficient environmental regulation in the context of the U.S.-Mexico border.

Table 1. Efficient environmental regulation along the U.S.-Mexico border.

Environmental challenge	Measurement difficulty	Solutions
Waste (solid and toxic)	Low to intermediate	-Computer exchange -"Superfund" -Private enforcement -"Right-to-know" legislation
Water and air pollution		
a. Point sources	Low to Intermediate	-Government-supported markets for emission rights -Joint sewage treatment plants -Environmental decision-making autonomy
b. Non-point sources	High	-Command and control approaches
Global problems (ozone depletion, global warming)	Low to high	-International environmental regulation (Kyoto Protocol) -Depends on nature of sources of greenhouse gases. -Environmental decision-making autonomy

Implications for Multinational Firm Behavior Along the U.S.-Mexico Border

Appropriate environmental regulation is vital because firm environmental behavior is largely a response to governmental regulation (Henriques and Sadorsky 1996). Evidence from U.S. firms in the border region and in Latin America confirms this result. In a study of U.S. maquiladoras located in Mexico, researchers found that the principal motivation for these firms to invest in environmentally clean technologies was to comply with regulation (Vasquez and Cueva 2002). Another study of multinational firms in Mexico also found that the multinationals generally decided to make environmental investments in response to government regulation (Husted and Rodriguez 1998). Finally, a study of voluntary participation of hotels in a certification program for sustainable tourism in Costa Rica highlighted the role of governmental monitoring in stimulating corporate environmental protection (Rivera 2002).

Firms engaged in business along the U.S.-Mexico border should consider a number of competitive and political strategies in light of the unique binational regulatory regime of the region. Given the genius of NAFTA and its side agreements to focus on the development of institutions like the CEC, which help to administer trade and environmental issues, firms should seek to lobby their home governments to strengthen these institutions, as well as the local judicial and regulatory units upon which they depend. It is precisely this binational regime that should provide multinational firms operating in the region with the opportunity to develop advantages with respect to their non-border region competitors.

Clearly, the regulatory regimes prevailing in the U.S. and Mexico differ considerably. This paper in fact argues that the regimes should be different (command-and-control vs. market-based regulation) given different national administrative capabilities. Firms operating under different regimes can find ways to exploit such differences in order to create first mover advantages. For example, operation under market-based regulation is especially useful for enabling the firm to develop green capabilities that can help it to compete internationally because of the flexibility it provides firms to develop appropriate environmental solutions (Nehrt 1998). Similarly, a firm with a home regime that involves command-and-control regulation requiring a specific kind of environmental technology (as opposed to simply end-of-pipe technology) for certain environmental problems can develop advantages with respect to firms from a home country with no environmental regulation in the area.

In light of different national competencies for the implementation of different regulatory systems, firms that operate on both sides of the border need to be considerably flexible in order to adjust to different policies in the U.S. and in Mexico. But it is this flexibility that helps firms to develop capacities for innovation. In Mexico, firms should lobby the government to implement market-based systems in cases where they are able to accurately measure their emissions. Market-based regulation permits the firm much greater flexibility to make decisions about environmental investments based on its own cost function than does command-and-control regulation (Nehrt 1998). Although firms are generally more capable of measuring their own cost functions than are government agencies (Rugman and Verbecke 1998a), problems of bounded rationality in the government's capacity to gather and interpret relevant information are especially severe in Mexico. Thus, the advantage of market-based regulation would be even greater in Mexico than in the United States.

A final comment should be made with respect to the possibility of firms taking advantage of different regulations on either side of the border in order to create pollution havens. Despite this concern, the binational regulatory regime creates a situation in which all multinational firms, whether U.S. or Mexican, face a dual set of environmental standards. It is highly unlikely, according to Rugman and Verbeke (1998b) that firms that develop environmental capabilities to meet a strict regulatory regime in either the home country or the host country, would then move to a host country on the basis of lax environmental regulation. Thus, a binational regime should foster environmental investment by these multinational firms rather than the creation of pollution havens.

Conclusion

This paper contributes to the literature in a number of ways. First, it contributes to the literature of transaction-cost economics by emphasizing the role that transaction costs and measurement difficulty play in the selection of efficient environmental regulation. Second, the paper provides support for the NAFTA approach to transboundary environmental regulation through the use of national and local administrative agencies and laws, rather than through a regulatory harmonization on both sides of the border, which would seek a common environmental policy. Finally, the paper discusses how firms may actually benefit from a binational regulatory regime based on a transaction-cost logic.

In terms of public policy, it makes clear that the imposition of mechanisms inappropriate to the situation will severely distort behavior in many ways. In Mexico, for example, the General Ecological Balance and Environmental Protection Law (Diario Oficial 1988) is a comprehensive piece of legislation providing for governmental regulation of all aspects of the environment. Unfortunately, use of the command mechanisms of the state has resulted in the corrupt subversion of those same mechanisms by the parties they were meant to regulate. The result is an environmental situation that continues to deteriorate (Logsdon and Husted 2000; SEMARNAT 2002; Maniam, Leavell, and Thaler 2003). The weaknesses of governmental fiat must be recognized in some jurisdictions. If the governmental apparatus can be corrupted (Livas 1983; El Norte 1993; Vera 2003), then attempts to deal with the effects of the problem will be circumvented. Concerned groups must attack the causes and take into account the transaction costs related to governmental mechanisms if they are to hope for an effective solution to environmental problems.

By looking at the problem of command-and-control or market-based regulation from a transaction-cost perspective, this paper sheds light on the design of appropriate environmental regulation. In a very broad way, it has shown how current U.S. environmental policy is beginning to conform to a transaction-cost logic. Certainly, there is a very great need to examine environmental regulation in a more nuanced way. Using the transaction-cost approach, we have discovered some potential mismatches between the binational environmental regulatory regime and that which would minimize transaction costs. Obviously, different jurisdictions are involved and questions of national sovereignty may be called into play. Since each country has different advantages and disadvantages in the use of command-and-control and market-based mechanisms, it is essential that sovereign nations have the greatest possible freedom to deal with environmental problems in their own way. The transaction-cost approach employed in this paper demonstrates the need for environmental decision-making autonomy as long as administrative capacities differ.

Clearly, more work needs to be done. Economists could aid this effort by developing the mathematical logic of the model more rigorously. In addition, the concept of measurement difficulty needs to be operationalized more precisely. Finally, the approach taken in this paper suggests a way in which other forms of regulation might be fruitfully analyzed. Regulations dealing with health, food, and safety, for example, should be amenable to this type of analysis. Furthermore, the simple descriptive model could be adapted to questions such as privatization or nationalization of such services as the postal and highway systems. By posing the provision of different types of regulation and governmental services as a variation on the market-and-hierarchies question, transaction costs may go a long way in explaining the preferred structure for governmental regulations.

Endnotes

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2. Transboundary pollution is used to encompass all types of environmental problems that cross international borders: air, water, species, etc.

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