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**FIRMS' CHOICE OF REGULATORY INSTRUMENTS TO REDUCE POLLUTION: A
TRANSACTION COST APPROACH***

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Abstract

This paper extends transaction costs economics to analyze relationships between firms and regulatory agencies. It compares the economic efficiency of firm -agency governance structures for dealing with pollution reduction. The transaction costs of three ideal type governance structures are analyzed: command and control regulation, market based mechanisms, and negotiated agreements. We propose that the choice of governance structure will depend on the strategies firms are pursuing given their transaction attributes and market opportunities.

Keywords: transaction cost economics, business strategy, governance structure, non market strategy, lobbying, environmental regulation, command and control regulation, market based mechanisms, negotiated agreements.

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Our question in this paper is under what circumstances should a firm favor different policy instruments to reduce pollution -- command and control, various types of market mechanisms (such as taxes and tradable permits), and negotiated agreements or covenants. As Williamson has sketched the parameters of the make or buy decision for inter-firm transactions (Williamson, 1985; 1991; also see Popo and Zenger, 1998), we aim to sketch the parameters of firm choice with respect to these policy instruments.

In the management literature, transaction cost theory is well developed (Hill, 1990). It has been applied to such issues as manager-shareholder relations (Oviatt, 1988) and customer-service organization relations (Bowen and Jones, 1986). It has been used to investigate questions of alliance formation and restructuring (Parkhe, 1993, Oxley, 1997; Delmas, 1999), joint venture performance and survival (Pearce, 1997), organizational design (Roberts and Greenwood, 1997), and external labor arrangements (Masters and Miles, 2002). It also has been broadened to be more inclusive of history (Argyres and Lieberman, 1999). It has been integrated with institutional theories (Roberts and Greenwood, 1997), with the strategic positioning framework (Nickerson, Hamilton and Wada, 1999), and the resource-based view of the firm (Popo and Zenger, 1998; Heiman and Nickerson, 2002). It also has been heavily criticized (Ghoshal and Moran, 1996), and efforts have been made to make it more balanced and realistic (Noorderhaven, 1996), and to assimilate within it ideas about variable risk preferences and trust (Chiles and McMackin 1996). However, to this point no one has extended transaction cost theory to the issue of a firm's choice of regulatory instrument to reduce pollution.

Firms are subject to different types of regulatory instruments to reduce pollution, not just command and control regulation (Schultze, 1977). In some instances, governments have provided them with the right to choose these instruments. In other instances, firms can influence

the governments' choice of these instruments, or choose jurisdictions where they locate facilities based on the instruments that government offers. The selection of policy instruments has implications for firm strategy, but has not been studied or analyzed as such. The purpose of this paper, therefore, is to trace out the parameters of the choice regulatory instruments to reduce pollution within a transaction cost perspective. In this paper, we extend the transaction cost economics framework to analyze the transactions between firms and environmental regulatory agencies.

For the firm, the primary purpose of these interactions is to acquire the right to operate, i.e. a permit. Additional purposes are to limit damage to humans and the environment, avoid future liabilities, not incur reputational loss, and maintain good will. Based on these concerns, which regulatory instruments should a firm seek? Transaction cost economics starting with Coase (1960) not only analyzed transaction costs as they exist within and between firms, but also explored the question of the most efficient means for resolving disputes about pollution. Scholars have considered the question from the perspective of a state agency administering a program (Kelman, 1981; Hahn and Noll, 1983). Public bureaucracies have been analyzed through the lens of transaction costs economics and there has been extensive discussion of the make or buy decision with regard to government services (Williamson, 1999), but investigating the efficiency of different environmental policy instruments from the point of view of the firm has not occupied a prominent place in the literature. Our investigation would extend the transaction cost perspective to the firm's choice of a regulatory instrument.

With regard to environmental protection, mainstream economics has been preoccupied with the issue of social welfare, not transaction efficiency. The transaction cost implications of policy alternatives from the perspective of the firm have not been considered. Investigating these

choices from the firm's perspective, hence, has promise. The costs of compliance with environmental regulation are high (Jaffe, Peterson, Portney and Stavins, 1995; Rutledge and Vogan, 1994) and they include transaction costs such as negotiating a deal with the government and administering this deal once it is in place (Levy and Spiller, 1994; Delmas and Heiman, 2001). Delays associated with negotiating a deal and complying with it once it is in place may translate into high opportunity costs for companies operating in rapidly changing market conditions. Thus, minimizing these costs can have an important effect on a firm's performance. Thus, it is our intent to contribute to the strategy literature as well as to literature on transaction costs. Given a firm's aim to minimize transaction costs, what should it do? Which policy instrument (command and control, taxes/tradable permits, and negotiated agreements) should it favor? Answering this question can help managers make better decisions about regulatory instruments in a specific jurisdiction, or across jurisdictions if they choose to relocate. It also can help them lobby for better government policies.

We organize this paper as follows. Part one describes the characteristics of the transactions between firms and regulatory agency -- the transaction costs and the factors that breed uncertainty in this relationship. Part two analyzes the attributes of the governance structures -- command and control, taxes/tradable permits, and negotiated agreements -- that are available to firms in acquiring the right to operate (a permit) from regulatory agencies. Part three analyzes the transaction costs of each of these governance structures according to the attributes of the transaction. It develops hypotheses about the specific transaction costs associated with each governance structure. Part four discusses the implications for firm strategy.

TRANSACTION COSTS AND EXTERNALITIES

Textbooks on law and economics typically treat pollution as an externality. A factory that engages in otherwise socially beneficial activities brings about negative side effects such as the emission of smoke or wastewater. The Coase theorem maintains that when property rights are well defined and there are no, or very few, transaction costs, economic agents will freely contract with each other to achieve efficient outcomes (Coase, 1960). In this instance, the parties bargain with one another; each offers the other some form of compensation, and each is free to accept or reject what is offered until an equilibrium is achieved. With few or no transaction costs, the potential gains from trade lead the agents to internalize the external costs without government intervention.

However, as Coase (1960) makes clear, these trades can be blocked or sharply curtailed if the transaction costs are high. For instance, if the parties harmed by pollution are numerous and/or dispersed and the harm done to each is slight, their ability to organize is low. Even if the harm they collectively suffer is great, they are in no position to bargain with a concentrated party that has much to lose. In these circumstances, for markets to be efficient, Coase admits that some kind of state intervention might be needed, but he cautions that the transaction costs of administering a state-run program might negate its benefits. Coase's analysis suggests that the best outcome is if the transaction costs can be reduced to facilitate private solutions. If private solutions are not possible, then government intervention is necessary, but Coase is not optimistic that the government can improve matters since the costs of administration may exceed the benefits (Coase, 1988:175).

What is a Transaction?

The unit of analysis in situations that Coase describes is the transaction (Williamson 1985: 1) —the transaction between the regulatory agency and the firm. The firm's primary purpose is to acquire a right to operate, or a permit. To do so, it must comply with conditions the agency sets forth with respect to the release of various pollutants. The regulatory agency represents the public and thereby owns property rights it transfers to the firm. The transactions the firm has with the regulatory agency are in the form of a *quid pro quo* -- firms agree to meet the conditions set forth by the regulatory agency in exchange for the right to operate. In these transactions, the actors are boundedly rational and opportunistic (Williamson 1985), attributes that are at the origin of the costs associated with writing, monitoring, and enforcing incomplete contracts that they establish. The problems the contracts engender for harmonizing potentially conflicting interests are central concerns.

What is a Transaction Cost?

Coase's analysis makes it clear that it is important to assess the transaction costs of alternative contractual arrangements for pollution control. But what is a transaction cost? Transaction costs have been defined in various ways. Coase's original formulation refers to the cost of using the price mechanism (Coase, 1937, 1961). As he explains: "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" (Coase, 1961:15).

Williamson extends these ideas to include the ex-ante costs of drafting, negotiating and safeguarding an agreement, the ex-post costs of haggling, the costs of governance, and the bonding costs needed to secure commitments (Williamson, 1985).

Transaction costs also include the costs a damaged party has in recovering claims from a party that causes the harm. Therefore, we are interested in (1) the ex-ante negotiation costs, (2) the compliance costs associated with environmental regulation, (3) the ex-post negotiation costs that might require renegotiating an agreement once it is in place, and (4) the opportunity costs the parties forego by engaging in this process.

Prior to some type of arrangement being in place, there are the costs of negotiating the level of the emissions that the firm has to reach. After the arrangement is in place, there are the compliance costs incurred in finding the appropriate technology to comply with the regulation, in monitoring performance levels, and in reporting these levels back to a regulatory agency. Additional costs may involve the legal costs of renegotiating an agreement if necessary. The entire process is costly because firms, by engaging in it, are shut off from other profitable options they otherwise could have pursued.

As in conventional economics, we define opportunity costs as the benefits foregone by engaging in one activity as opposed to another. There is the cost of the pollution control technology the firm chooses to use, or is mandated by the government to employ, versus the next best technology it could have used. There also are potentially profitable activities in which the firm could have engaged but does not because it is negotiating with the government. As opposed to concentrating on its core business activities, it searches for means to satisfy government's requirements. Though it is possible that pollution control mandates, if properly designed, can save money by eliminating waste, the money the firm saves must be greater than the money it

otherwise would earn. Opportunity costs are exacerbated in the case of delay, when there is general or prolonged uncertainty about the terms of an arrangement.

Another cost the firm must bear is the time it spends waiting for permitting decisions to be made. During this time, the firm may miss important market opportunities. For example, it can take 12 to 18 months to get a new production facility approved under the New Source Review requirements of the Clean Air Act (Marcus, Geffen, and Sexton 2002). This time can be critical if the firm is trying to introduce a new product. It may not be able to establish itself as first to market, gain customer loyalty, or capture a large percentage of valuable early adopters, thereby foregoing substantial revenue and profits. These costs can be significant, especially in dynamic, growth-oriented businesses where time to market is a distinguishing feature of successful product introductions.

The concept of demoralization costs (Michelman, 1967) captures this sense of loss. Demoralization is not just a disutility that accrues to losers and those aligned with them when an opportunity is not pursued or is not pursued as thoroughly or in as timely a fashion as possible. According to Williamson, there also are the “secondary” costs endured by those subject to what they consider to be a “capricious” redistribution (Williamson 1970: 119). Redistribution is viewed as “capricious” when it originates in bureaucratic processes that the parties feel could have been avoided. These processes cause delays that lead to frustration and breed demoralization or a reluctance to take on and carry out similar projects in the future. As developed here, transaction costs are a multifaceted concept, whose many aspects must be recognized when considering the efficiency of alternative policy instruments for pollution control.

What Breeds Uncertainty?

As we have indicated, it is because of uncertainty that incomplete contracts are hard to develop and administer. Why do firms find it difficult to predict government behavior and why does government have trouble knowing what firms will do? We would argue that legal and institutional differences are among the most important causes of this uncertainty. Let us be precise about what we mean by these differences. As a rule, business managers value efficiency, while government executives value equity, accountability, and responsiveness, as well as efficiency (for example, see Marcus, Geffen, and Sexton, 2002; Wilson, 1989 and Marcus, 1984). Business executives must operate according to quantifiable and discrete financial targets with their performance evaluated using indicators such as market share, profits, and return on investment, while regulatory officials have goals that are more vague and indefinite and not as easily measured (e.g., improving environmental quality). The performance of the regulators is judged according to more subjective criteria, such as the status of public health and the general state of the environment.

In general, one can say that risk taking is more valued by business executives and is more prevalent in business than in regulatory agencies. Business managers have increasingly adopted organizational structures designed to allow them to respond quickly to rapid changes in the marketplace, while government executives—reflecting the checks and balances in the U.S. Constitution—have complicated, bureaucratic, and overlapping structures, which operate at a more measured pace. Government executives must cope with distributional conflicts that arise among diverse interests operating in a republic, and the institutional reward typically goes to those who can forge compromises in this setting. Business managers, on the other hand, must cope with the needs of their customers and the expectations of shareholders. Though they too must

forge compromises, typically they are rewarded for taking quick action in the market place rather than waiting for the best compromise to emerge.

For these reasons, managers of business corporations cannot expect government officials to write carefully crafted, balanced agreements quickly, especially if these agreements set forth precedents for their ongoing relations. From the perspective of managers in the private sector, the government appears opportunistic (Levy and Spiller, 1994). Managers in the private sector must cope with regulatory change. Scientists discover new problems and members of public interest groups and the media bring them to our attention. The government accedes to demands for greater environmental improvements, resulting in more stringent regulation and onerous permitting. Private sector managers thus have to be concerned that government officials will change the terms of agreements after they have been put in place and in this way impose additional delay that takes away from the business managers' ability to respond quickly to market opportunities. When government changes regulations, it incurs high coordination costs that are passed on to private firms. There is ample empirical evidence that shows that as regulatory demands have grown the costs to businesses have increased (Jaffe, Portney and Stavins, 1995).

GOVERNANCE STRUCTURE CHOICES

Three main governance structures exist for managing the relations between business and government: command and control, market mechanism and negotiated agreements. They differ on key attributes and represent types of contracts that vary in their adaptability and use as incentive and control instruments. Our classification of them is consistent with the literature on environmental protection (Majone, 1976; Baumol and Oates, 1979; Hahn, 1989; Richards, 2000)

and includes the most frequently cited policy instruments. With regard to social welfare, we make an important assumption, that is that these instruments are equivalent in terms of pollution reduction but not in terms of transaction costs. This is a strong assumption and future analyses should relax it while continuing to consider the transaction cost implications of these three mechanisms.

Transaction cost economics holds that transactions that differ in their attributes are aligned with governance structures that differ in their costs. In this section we describe the qualities of these structures and how they are realigned with different transactional attributes.

Command and Control.

Under command and control, the firm agrees to conform to the conditions specified by a regulatory agency in exchange for the right to operate. The conditions the regulatory agency specifies may be of two types. First, a firm agrees to meet environmental performance goals such as healthy air or fishable and swimmable waters. To meet a specified target, the government limits the amount of pollution by media (i.e. water, waste, air) and type of pollutant (NO_x, SO_x etc...). Second, the government may require the firm to install a particular pollution abatement technology or use a specified industrial process to achieve its environmental performance goal. The regulatory agency sets targets or establishes technologies the firm has to use based on scientific and technical knowledge. This type of regulation is technology forcing as opposed to being performance based. The monitoring of compliance is accomplished at the process level; if the technology is in place, the firm complies. Alternatively the monitoring can be done as a function of pollution releases. However, this type of monitoring, if not based on estimated inputs and outputs and calculations, can be costly because it requires the installation of expensive monitoring equipment to capture the actual discharge levels.

Under command and control, regulatory agencies typically prefer and are most satisfied with technological solutions, since these eliminate the need for costly monitoring. A fairly standardized and uniform contract emerges that is applied to all companies using similar production methods. This form of regulation maximizes government control over production decisions as the regulatory agency decides how much pollution may be emitted and dictates the technology that may be used. The firm either agrees to the terms of the contract set by the government and puts itself on a compliance path or otherwise does not obtain a permit. There is little negotiation between the government agency and the firm. If there are negotiations, they typically take place at the industry level.

Under command and control regulation, if the firm changes its production process, it may have to apply for a new permit. For example, New Source Review under the Clean Air Act requires that companies that expand or modify their facilities have to obtain a clean air permit that demonstrates that they have installed the best available pollution control technology (BACT). The new permit in turn does not grant much flexibility to adapt to changing circumstances -- either the firm complies with the BACT provision and it can operate or it does not comply and it cannot operate. The only recourse a firm would have would be to switch to other jurisdictions, but in the U.S. with the nationalization of much environmental regulation, doing so, while not impossible, is not easy (Anderson and Kagan, 2000).

Market Mechanisms

Market mechanisms try to introduce greater flexibility. Under market mechanisms, for the firm to acquire the right to operate, the quid pro quo is modified. The prices for pollution are not uniform but vary based on actual emissions, the harm these emissions cause, or some other factor. Market mechanisms entail actual monetary payment, not installation of technologies or

proof of achieving the standard by some other means. The monetary payment is based on actual pollution or some estimate of the amount that is emitted. The more a facility emits the more it must pay. Thus, each unit of pollution reduction has the potential to translate into lower operating costs and it is in the firm's interest to reduce the amount it pollutes.

Typically, the government establishes a price per unit of pollution. The price of the unit of pollution may be based on the social damage cost of the pollution or it can be established through issuing a fixed number emission rights designed to achieve set environmental performance goals derived from health or ecological considerations. The firm either pays the regulator the price per unit of pollution or buys emission rights from another party (i.e. the government, another company or an NGO). These two instances of market-based systems need to be discussed separately.

Pollution Charge Systems . Pollution charge systems assess a fee or a tax on the amount of pollution that a company generates (Pigou, 1938; Repetto, 1993). The fee or charge is calibrated to actual emissions. Unlike command control, it is not one-dimensional (either the facility complies or it does not comply), but there are gradations in how much the facility emits based on how much it is willing to pay. The facility reduces pollution to the point where the cost of doing so equals what it otherwise would pay in pollution charges or taxes.

Taxes or green fee programs have been successfully employed. For example, they have been used to phase out production of CFCs and other ozone-layer-harming chemicals (Stavins and Whitehead, 1997). From the perspective of the firm, taxes and charges provide certain advantages that command and control cannot match. The main advantage is that firms have greater flexibility; their releases can move up and down in accord with changes in technology, market conditions, and costs. In the command and control system, anything above a threshold of

environmental pollution is in violation of the “contract,” which results in enforcement actions that can lead to the termination of the “contract.” In the tax or charges system, if the firm pollutes above the threshold it pays a higher price but still can operate. A tax or charges system provides more flexibility for the firm to adapt to changing circumstances than command and control, and in the end it might result in less pollution, but this is uncertain because society cannot be guaranteed a set amount of pollution reduction. This is the main limitation of a charges system.

Tradable Permits. Tradable permits are meant to guarantee a set amount of pollution reduction. Under this system, policy-makers first set a target of how much pollution will be allowed for an industry or a geographical area. Companies generating the pollution then receive permits giving them a share of the total. Firms that keep their emission levels below the allotted levels can sell their surplus permits to other firms. Firms that run out of allowances must buy them from other companies or face legal penalties. The flexibility of tax or charge systems is retained and the incentive still exists for companies to reduce pollution below a prescribed limit (Oates, 1988; OECD, 1989; Tietenberg, 1990).

Tradable permit systems also have been implemented in several instances. For example the RECLAIM tradable permits system in the Los Angeles Basin Area was set up in 1994 to meet Clean Air Act State level environmental targets and includes more than 350 companies (Fromm and Hansjurgens, 1996). A main difference between trading in emission rights and charges or taxes is that the firm under an emissions rights system eventually can make a profit out of its emission reductions by selling credits. However, there may be transaction costs in the buying and selling of credits (Stavins, 1995) as there are in setting up and running a system based on pollution charges. There may be no credits available on the market and therefore the firm is

limited by the number of permits available. Indeed, it may face legal penalties if the firm pollutes beyond its allocation and cannot buy credits on the market.

Market based mechanisms, thus, represent a contract. The firm purchases a fairly uniform uncustomized item. Unlike command and control, flexibility is included in market based mechanisms so that changes in processes do not automatically lead to the application to a new permit.

Negotiated Agreements (NAs)

Negotiated agreements also are a form of contract. Under a negotiated agreement (or covenant), a firm can acquire the right to operate for a specified period based on its performance.¹ Such a permit would not be generic in nature like a command and control requirement, but specific and made to-order. Its great advantage would be that it would be customized to a facility. Unique site-specific opportunities for low cost pollution prevention then can be identified and put in place instead of one-size-fits-all requirements.

Unlike other instruments, the negotiation of the target to be attained can be carried out at the facility level and would not be standard for all facilities of a certain type (Delmas and Terlaak, 2002). In addition, the environmental target can be negotiated for the facility as a whole instead of being negotiated by media (air, water, waste) or type of pollutant. The government must agree to an overall and comprehensive facility wide environmental performance goal instead of specific air, water or waste attainments for each different type of pollutant. Then, it is up to the firm to decide how to make trade-offs among media and pollutants to meet this overall goal. Once in place, this long-term comprehensive environmental agreement should not be changed easily. In this respect it differs from market approaches, where the tax, charge, or

market price is meant to vary perhaps on a day-to-day basis. But similar to a market system, the firm can enjoy the right to make changes without needing to obtain explicit permission from an environmental agency.

There should be benefits both to the company and the environment in such arrangements. Once agreed to, a long-term comprehensive performance-based NA should provide the flexibility to make changes at a site without recourse to further interference by pollution control officials. The firm can settle its environmental pollution issues for a specific period (let us say 10 years), reduce the behavioral uncertainty of the regulatory agency during that period, and put itself in a position where it can take advantage of market opportunities that come along. Under the arrangements previously discussed – command and control and the various market mechanisms – the firm does not have this freedom of locking in a long-term agreement.

A prominent example of the use of negotiated agreements by some U.S. firms is the US EPA's Project XL (eXcellence and Leadership). In Project XL, firms defined site-specific performance standards that were more stringent than the de facto standards implied by current regulation, but in return they had the choice of means concerning how to meet these standards for a specified period of time (Delmas and Mazurek, 2002; Marcus, Geffen and Sexton, 2002). NAs also are widely used in the Netherlands. With the introduction of the first National Environmental Policy Plan (NEPP) in 1989, NAs, next to permits, became the main element in Dutch environmental policy (OECD, 1995). Today, the Netherlands has over a 100 NAs in place (EEA, 1997). An example of a Dutch NA is the Declaration on the Implementation of Environmental Policy in the chemical industry. Every four years, participating firms must provide Company Environmental Plans outlining the tasks to meet the NEPP targets for the

chemical industry (EEA 1997). Firms producing acceptable plans are granted flexibility in permitting procedures (Börkey and Lévéque, 1998).

NAs are similar to neoclassical contract law and excuse doctrine as defined by Williamson: they are a type of hybrid arrangement (a non-standard contract) in which parties to the transaction maintain autonomy but are bilaterally dependent. In the case of changing circumstances, the parties need not go to court but can rely on informal arbitration to resolve their differences. This governance structure provides for great flexibility in the case of changes in production processes. Transaction cost economics view contracts as devices for structuring ex post adjustments. Contracting parties can choose between a secure contract that specifies how the quasi-rent generated by their relationship will be shared ex post and a flexible contract that allows them to benefit from future non-anticipated opportunities.

Summing Up So Far

To repeat our argument, the three policy instruments described above can be classified in terms of the degree to which the regulatory agency exercises control over production decisions or the degree to which firms can adapt to changing circumstance independently from the regulatory agency.² Command and control represents the extreme case, which maximizes government control. Command and control does not provide much flexibility to the firm in the case of change of production process. Changes in production processes are subject to review and the regulatory agency dictates the new abatement technology to be adopted. At the other extreme, under market mechanisms and negotiated agreements production decisions are left entirely to private parties. In these cases, the regulatory agency monitors only abatement activity or pollution output. In the case of market mechanisms if the firm is polluting beyond the threshold, it will pay a higher price but still will be able to operate. In addition, these policy instruments differ in their ability to

control regulatory opportunities during a specific time period. In the case of command and control and market based mechanisms, the regulatory agency can, in theory, change the rules of the game at any given point in time. In the case of a negotiated agreement, the duration of the contract is set beforehand. During that time period the government can only change the rules of the game under duress. The burden of proof is on the government as to why changes in the contract should be made.

From this discussion it would seem that firms would prefer instruments that provide them with more flexibility to adapt to changing circumstances and would therefore favor market based instruments and negotiated agreements to command and control. However, this flexibility comes at a cost. The negotiation and implementation costs of these policy instruments also are higher, which makes firms wary about pursuing them. Only certain firms are likely to benefit, as we shall see. Therefore, a comprehensive understanding of the transaction costs of these instruments is necessary.

Transaction costs and governance structures

We previously differentiated between ex-ante negotiation costs, compliance costs, ex-post negotiation costs, and opportunity costs. We will now analyze the three governance structures using these four categories. Table 1 summarizes the argument we make concerning the various transaction costs associated with the three governance structures.

Insert Figure 1. about here

Ex-ante negotiation costs. The ex-ante negotiation costs are the costs of negotiating the level of the target that the firm has to reach. These may include information and search costs on

what is acceptable for a firm or an industry. In the case of command and control regulation or market-based mechanisms, the targets to be achieved are decided by regulatory agencies based on information provided by scientific and technical experts and the lobbying of interested parties. Firms generally participate in this process through delegation to their trade associations, not individually. Thus, the negotiating costs of the individual firm are likely to be below.

Transaction costs under a charge system still exist despite the fact that contracting arrangements are standard; that is, a unit of pollution costs a set amount. The main ex ante transactions costs are considerable and involve identifying the cost of a pollution unit. As scientific knowledge about the damage caused by each pollution unit is uncertain and changing, settling the controversies that will arise about how much a unit of pollution is worth are likely to be continuous and very difficult to resolve. Considerable bargaining and negotiating costs are likely to be incurred both by the regulatory agency and industry as they mobilize experts to make different claims. There are also additional transaction costs involved in negotiating tradable permits between firms (Stavins, 1995). However, these costs are likely to be borne by the industry, not the firm.

In negotiated agreements, firms are directly involved in the negotiation of targets for their facilities. The burden of providing information is considerably higher in negotiated agreements than in command and control regulation. Firms must arrive at a realistic appraisal of their ability and cost to control pollution. They not only need to know currently what might be feasible but also need to project market and technological developments to be able to assess their future ability to control emissions (Marcus, Geffen, and Sexton, 2002). Furthermore, in the case of negotiated agreements, legal fees associated with writing the contract between firms and regulatory agencies are higher than in the case of passing a law or issuing a regulation where

there is no private contractual arrangement. In addition, these negotiations may include a large number of stakeholders from whom consensus has to be reached. This just adds to the transaction costs. For example, in Project XL firms had to negotiate not only with community stakeholders and NGOs but also with state and local government as well as regional and the various offices of the federal EPA. The average costs of negotiating a project XL are estimated to be \$320,000 with an average negotiation time of 26 months per firm (Delmas and Mazurek, 2002). 3M spent approximately \$1 million and more than a year's time and failed to reach an agreement with the government at its Hutchinson, Minnesota tape facility (Marcus, Geffen, and Sexton, 2002). Thus, we formalize the link between ex-ante negotiation costs and governance structures as follows:

Proposition 1: The ex-ante negotiation costs for the individual firm will be higher for negotiated agreements than for command and control regulations or for market mechanisms.

Compliance costs. Compliance costs are all the costs incurred in finding the technology to comply with the regulation (search and information costs), in monitoring the performance levels and in reporting these levels to the regulatory agency (reporting and monitoring costs). The search and information costs with respect to the technology to adopt to abate pollution are likely to be higher for market mechanisms and negotiated agreements than for command and control. Because in market mechanisms and negotiated agreements the firm has the flexibility to implement the technology of its choice as long as it achieves the target environmental performance goal, the search cost will be the responsibility of the firm. In technology based command and control regulations, the regulator sets the technology to be used and incurs the search and information costs on the best available technology. Often, the government decides on the technology that a firm will use under this type of command and control regulation.

Reporting and monitoring costs are likely to be higher under market-based systems and negotiated agreements than under command and control. Where private parties have significant discretion with respect to how to abate emissions, accurate quantitative assessments of performance are particularly important to the government. That is, the amount of information the government needs to monitor performance is often positively related to the level of discretion the government vests in the private party. Under negotiated agreements there will be complex calculations where the burden of proof is on the regulated party to show to the regulator that it is achieving the goals that it set for itself. There also will be complex trade-offs between different types of pollution. In the case of command and control firm managers just have to provide information about the firm performing below a specified threshold, or about the abatement technology in place. The link between compliance costs and governance structures can be hypothesized as follows :

Proposition 2: Overall, the compliance costs for the firm are higher for market mechanisms and negotiated agreements than for command and control mechanisms.

Ex-post negotiation costs. Ex-post transaction costs include the costs of renegotiating the contract or the legal fees in case of a change in the agreement (in Williamson's terms "breach of the contract"). These changes in the agreement can originate from the firm, which may change its production process or from the regulatory agency which may adopt more stringent regulations.

Under command and control, which is media specific and pollutant specific, every change in an industrial process within a facility is subject to new permit approval to re-establish the right to operate. If the firm does not comply with the command and control system, it will be a breach of contract resulting in fines and the potential loss of the right to operate. Under market

transactions, as long as the regulatory agency does not change its targets by changing the price or limiting the supply of emission rights, the firm is free to operate without additional permitting costs. Under negotiated agreements, as long as a performance goal is met, no new permit is required. Command and control regulation is not an efficient governance structure to reduce the potential opportunistic behavior of the regulatory agency. The same can be said about taxes and tradable permits. The regulator is likely to change the charges or the amount of permits available without the involvement of the firm in the negotiation. The only ultimate recourse is for the firm to go to court to challenge the decision of the regulatory agency.

In contrast, negotiated agreements are likely to have a fixed goal of long duration, which provides certainty and predictability during the length of the contract. Furthermore, with negotiated agreements firms negotiate environmental performance goals on a long-term basis. In addition, within the negotiated contract, mechanisms have been set for flexible adaptation to many contingencies. So NAs provide flexibility in terms of conflict resolution and the firm is less likely to renegotiate the contract. NAs therefore are a more efficient governance structure to reduce the potential opportunistic behavior of the regulatory agency.

In conclusion, we hypothesize the following relationship between ex-post transaction costs and governance structures:

Proposition 3: The ex-post negotiation costs for the firm are higher for command and control regulations and for market mechanisms than for negotiated agreements.

Opportunity costs. In the case of market mechanisms, the firm has the flexibility to adopt the most efficient technology. However, the opportunity cost of pursuing a more efficient pollution control technology may preclude the firm from allocating resources to opportunities in its core business. The firm can decide to either allocate resources to find and implement the most

efficient technology for pollution reduction purposes and/or to maximize returns from its core businesses. Command and control has also high opportunity costs concerning the timing of the permitting processes when the company alters its production processes. With respect to market mechanisms, adjustments can be made instantaneously if the firm chooses to pay the tax or the charge required. If it needs to buy emission credits, the adaptation may take longer because of the time it may take to find a seller of credit (Stavins, 1995).

Given our assumption that negotiated agreements are set for a long-term period, negotiated agreements minimize the opportunity costs. Indeed, the firm will have negotiated the flexibility to pursue the most efficient pollution control solution and the most efficient business solution and does not need to wait for the approval of the agency in the event of a change of a production process that was anticipated in the contract. We formalize the relationship between opportunity costs and governance structures as follows:

Proposition 4: Overall negotiated agreements have lower opportunity costs than neither command and control and market mechanisms. Market mechanisms have lower opportunity costs than command and control.

On the whole, it appears that none of these mechanisms have clear superiority over each other in terms of efficiency. The negotiated costs of negotiated agreements are greater than the other governance structures but the opportunity costs are lower.³ Command and control regulation has lower negotiation and compliance costs but higher opportunity costs. Market mechanisms are located somewhat in between these two alternatives. In conclusion, what our analysis points to is the basic trade-off between negotiation, compliance and opportunity costs. The firm can decide to increase its negotiation and compliance costs to reduce its opportunity costs or vice-versa.

STRATEGY AND FIRM CHOICE OF POLICY INSTRUMENTS

Understanding the transaction costs of the different governance structures has implications for firm strategy. The choice of instruments will depend on the strategies that managers are pursuing given the transactions attributes of their firms. Do managers want to minimize ex ante negotiation costs, ex post compliance costs, or ex post opportunity costs? This choice has a number of dimensions. In jurisdictions where the choice can be made managers can select a governance structure that best meets their needs. In jurisdictions where they have no choice, they can lobby for the structure they want. If the lobbying fails, they can threaten to move to a jurisdiction that better meets their preferences. Depending on firm specific attributes and their need to minimize different kinds of transaction costs, managers can choose the type of governance structure they want. In transaction costs economics, the exposure of a company to the potential opportunistic behavior of the transacting party (in this instance the regulatory agency) will vary with the attributes of the transaction namely asset specificity, complexity and frequency (Williamson, 1985).

Asset specificity

Specific assets are defined as assets that have been invested for the purpose of the transaction and that are non-redeployable to other transactions (Williamson, 1985). Asset specificity can take the form of investment in technology, knowledge, and facilities. A firm with site specific physical assets at stake will have a more difficult time switching jurisdictions if the terms of a contract are unfavorable. Once the firm has decided to locate in one jurisdiction and to invest in specific assets, it will make the decision to switch to another jurisdiction harder than before the location decision. The firm may therefore be subject to the opportunistic behavior of

the regulatory agency, which can change the rules of the game and impose a costly permitting procedure on the firm. However, it does not mean that the firm will automatically favor more flexible governance structures that allow for adaptation to changing circumstances since these governance structures may be associated with additional transaction costs. The decision to choose market mechanisms or negotiated agreements, will depend mostly on the complexity and frequency of the transaction.

Complexity

Complex transactions, which involve several pollution media and types, may also involve high transaction costs. For example, if a firm pollutes in air, water and solid waste it will have to deal with three transactions with the regulatory agency. Each transaction is governed by a different set of rules and different parties which increase the complexity of the interactions. Under command and control, the firm is unable to make changes within one part of its production process without having to deal with the multiple external parties that have jurisdiction over the pollution levels of the production processes. Under market-based mechanisms, the coordination of the emissions from different media can also be done internally, however, the firm has to pay separate charges or taxes or obtain separate emission rights for each media.

In negotiated agreements, the coordination of these different processes and media pollution can also be done internally. For example, under project XL, Jack M. Berry Inc., a mid-sized juice-processing facility in LaBelle, Florida, developed a facility-wide comprehensive operating plan (COP) that consolidated 23 federal, state, and local environmental permits and all operating procedures into a single manual for the facility. The Final Project Agreement was signed on July 8, 1996. The COP was a multi-media permit that is part of a streamlined permitting approach that was expected to better integrate plant operation and compliance

procedures, as well as eliminate unnecessary administrative requirements. The streamlined permitting approach was anticipated to result in cost savings that Berry could reinvest in new environmentally beneficial operating procedures. In its proposal for a project XL to ease the permitting process, Berry estimated the savings from the negotiated agreement to several million dollars (Berry, 1995:4). ⁴This type of arrangement facilitates making complex trade-offs among pollution sources and pollution abatement technologies that can increase efficiencies.

In the case of complex transactions, the coordination issues of dealing with several media will increase ex-post negotiation costs and opportunity costs. Market mechanisms and negotiated agreements will provide the most efficient governance structures as compared to command and control.

Frequency

Frequency of the transaction will vary depending on the type of industry in which the firm operates. Industries that manufacture products with short life cycles will have more frequent transactions with regulatory agencies than industries with long product life cycle. For example, semiconductor manufacturers may be required to obtain from the regulatory agency a new air emissions permit each time a manufacturing change is made, a cost they would like to avoid because of the fast-paced nature of the industry in which they are participating. The problems associated with an increase in regulatory stringency under command and control can be substantially more acute when the frequency of the transactions is high, i.e. when firms have to require permits often. Industries with short product life cycles (e.g., semiconductors) bear higher costs in the form of more stringent abatement methods or production delays because their transactions are more frequent than industries where the rate of technical change and need for

new permits is static (e.g., cement).⁵ Furthermore, companies concerned with earning quasi-rents from first-mover advantages can be adversely affected by potential permitting delays.

Of particular concern to companies that make frequent modifications to their manufacturing processes is the potential for state and local regulatory agencies to develop permit programs that subject routine process changes to review. Reviews can impose delays of several days or several months, depending on whether regulators require public notice and comment (which themselves can take up to 60 days). While no one knows for sure, some managers posit that production delays can cost a first-mover firm such as Intel Corporation a million dollars in lost revenue each day (Boyd, Krupnick, and Mazurek, 1998).

Negotiated agreements allow the firm to obtain permits for a set period of time which avoid the firm to be subject to permit renewal and changes during that time. For example, Weyerhaeuser, and Merck negotiated agreements under project XL where speed to market played a considerable role in motivating companies to apply for time-consuming and complicated negotiated agreements.⁶ Likewise, market-based instruments allow the firm to make process changes within its facilities without requiring the authorization from the regulator as long as it pays the tax or the fee required or is able to buy permits on the market. However with market-based instruments, the regulatory agency can change the rules of the game at any point of time (through for example increasing taxes or reducing the total number of permits in the market). In the case of negotiated agreements, because the firm has signed a contract with the regulatory agency, any change initiated by the agency can lead to a breach of contract that would incur cost to the agency. Consequently, negotiated agreements followed by market-based instruments should be more efficient than command and control mechanisms for firms involved in frequent transactions.

Thus, for frequent and complex transactions, the firm is likely to bear high ex-ante transaction costs through negotiated agreements in order to minimize its ex-post transaction costs and opportunity costs. Therefore in our framework, with an increase in the frequency and/or the complexity of the transaction, command and control becomes less efficient than market based mechanisms or negotiated agreements.

Our framework can be summarized in Figure 1. Let $CC = CC(FCX, \theta)$, $MKT = MKT(FCX, \theta)$, and $NA = NA(FCX, \theta)$ denote the governance costs of Command and Control, Market based instruments and negotiated agreements that denote costs as a function of (FCX) frequency and complexity and a vector of shift parameter (θ) . $CC(0) < MKT(0) < NA(0)$ and $CC' > MKT' > NA'$. The first inequality reflects the fact that the ex-ante negotiation costs and compliance costs of command and control are less than those of market based mechanisms and negotiated agreements when frequency and complexity is set to zero. The second inequality reflects the disability of command and control and to a lesser extent market mechanisms as compared to negotiated agreements to respond to adaptation for frequent and complex transactions. In Figure 1., we represent these relationships. If FCX is the level of frequency and complexity, the rule for the most efficient governance structure is as follows: 1) use market for $FCX < FCX_1$; 2) use market based mechanisms for $FCX_1 < FCX < FCX_2$; 3) use negotiated agreements for $FCX > FCX_2$.

 Insert Figure 1. about here

DISCUSSION OF THE FRAMEWORK AND CONCLUSION

Economists have long argued that market based approaches are more efficient than command and control instruments. We argue that the efficiency of various governance structures

varies with firms' transaction attributes and market opportunities. If there is a choice of instruments, our model shows to the firm's manager which instrument is the most efficient according to the particular attributes of the transaction and market opportunities. If there is no choice available, it suggests potential rationales to lobby for specific instruments. As economies evolve and become more dynamic, market based and negotiated agreements need to be available options. From a public policy perspective, a mixed regime provides firms with choices to match a regulatory governance structure with their firms' specific attributes (Gunningham, Grabosky, and Sinclair, 1998; Lyon and Maxwell, 2002).

We treated the institutional environment as a constant. Although this is not the focus of this paper, it is important to recognize that the comparative efficiency of policy instruments will vary with the institutional context in which they are implemented (Delmas and Terlaak, 2002). In particular, the probability of government's opportunistic behavior may vary according to the institutional environment at stake. Previous literature has described how institutional mechanisms can constraint the opportunistic behavior of the government (Delmas and Heiman, 2001; Levy & Spiller, 1994; Weingast, 1995; Williamson, 1984). Most of these studies point out that stable markets and credible regulation develop when governmental discretion is constrained (Henisz, 2000; Levy and Spiller, 1994; Weingast, 1995). They argue that the fewer the constraints, the greater the risk that agreements made between private actors and governments today will be repudiated tomorrow (Levy and Spiller, 1994). One factor constraining governmental behavior is the separation between legislative, executive, and judicial branches of the government (Levy and Spiller, 1994; Vogel, 1993). For example, a strong and independent judiciary can limit administrative discretion by developing laws constraining administrative action through administrative procedures. Likewise, a federal system limits central government

authority by increasing the number of veto points of state and local governments (Henisz, 2000). This structure contrasts with a centralized system, in which the authority of local governments is limited. Furthermore, fragmentation of power provides multiple access points for public interests, which can restrain governmental behavior.

However, too many constraints limit a government's ability to adapt regulations to changing circumstance. The elements that may provide credibility to regulation by limiting a government's abilities to change rules arbitrarily are the same elements that could hamper the implementation of flexible regulations such as NAs. To be credible in their commitment to NAs, regulators require discretion. The regulator must have the authority to change existing rules and permit procedures. It must also ensure that the NA does not conflict with local or state regulations. Too many (and potentially conflicting) constraints through congressional controls, judicial review, and third-party access can therefore make difficult the implementation of the agreements and in particular increase the negotiation costs of such agreements (Barth & Dette, 2001; Higley, Convey & L  v  que, 2001: 8). For example, the execution of EPA's Project XL is hampered by uncertainties concerning EPA's authority to relax regulatory standards enacted by Congress (Mazurek, 1998). Similar problems originally plagued the Dutch NAs when a few licensing authorities initially were unwilling to relax permit procedures for firms participating in NAs (Wallace, 1995).

Because the comparative efficiency of policy instruments varies according to the institutional environment in which they are implemented, further research could test our hypotheses in various jurisdictions. This important question needs additional investigation.

There are some other limitations to our analysis. We discussed these governance structures outside of the historical context of their development and as if they were independent

choices. In the real world companies and regulatory agencies are already committed to existing permitting arrangements. There may be switching costs associated with the changes from one governance structure to another. Companies and governments are going to compare these systems not in the abstract but will also integrate the costs of moving from one system to another. Furthermore, regulators of health and safety are often reluctant to rely on a model where all firms would not be treated similarly because of equity concerns.

There is more experience in dealing with command and control mechanisms as compared to market mechanisms and negotiated agreements. Therefore, in the real world, there is more uncertainty associated with the use of market mechanisms and negotiated agreements as compared to command and control. This kind of uncertainty, will affect the comparative efficiencies calculations.

We did not overly concern ourselves with the transaction costs incurred by regulatory agencies with each of these instruments. Further research could address this question as it may have implications on the feasibility of the implementation of these various governance structures. For example, the transaction costs of negotiating agreements with firms individually may add up to be extremely high as compared to instruments that are more standard and can be applied to a greater number of firms.

Conclusion

In this paper, we have compared the economic efficiency of different governance structures between firms and regulatory agencies to deal with the reduction of pollution. Rather than looking at the social welfare of governance structures, we focus on the micro economic level i.e. firms' transaction. This allows us to build a framework around the micro economic

efficiency of various governance structures, an endeavor that has not been previously undertaken.

We analyze three different types of governance structures: command and control regulation, market based mechanisms and negotiated agreements. We propose that the comparative efficiency of these governance structures varies with the transactions attributes of the firm and its market opportunities. We suggest that firms may prefer governance structures that entail higher ex-ante negotiation costs if they can minimize their opportunity costs when dealing with frequent and complex regulatory transactions. In particular, firms in more mature, stable industries are likely to choose command and control, while firms in new, dynamic sectors are more likely to opt for market mechanisms or negotiated agreements, provided that they can negotiate these agreements in a timely way with government. Thus, frequency of transactions is likely to be a key factor in firm choice of these governance structures.

As we discussed, some costs may be positively (complements) or negatively (substitutes) correlated with other types of costs. For example, costs involved with negotiating an agreement involved in encouraging participation of stakeholders at an early stage may decrease monitoring and enforcement costs later. Our contribution to transaction cost theory is that we have described a situation where minimization of ex-ante negotiation costs might lead to higher opportunity costs. In fact, negotiation costs and opportunity costs in our framework are inversely related. In addition, we showed a difference between first order and second order transaction costs and the importance of taking both these costs into account when assessing the efficiency of governance structures. Transaction costs economics often does not make this distinction but rather treats transaction costs as one since concept. Furthermore, we have extended transaction cost

theorizing to the case of business -government relations in the spirit of Coase original contribution.

Our framework can be used to treat firm -government regulation outside of the environmental arena and should be especially relevant for health and safety issues as well as for industries highly regulated. Practitioners should find it useful. It has implications for business strategy, both as an academic endeavor and a practical one.

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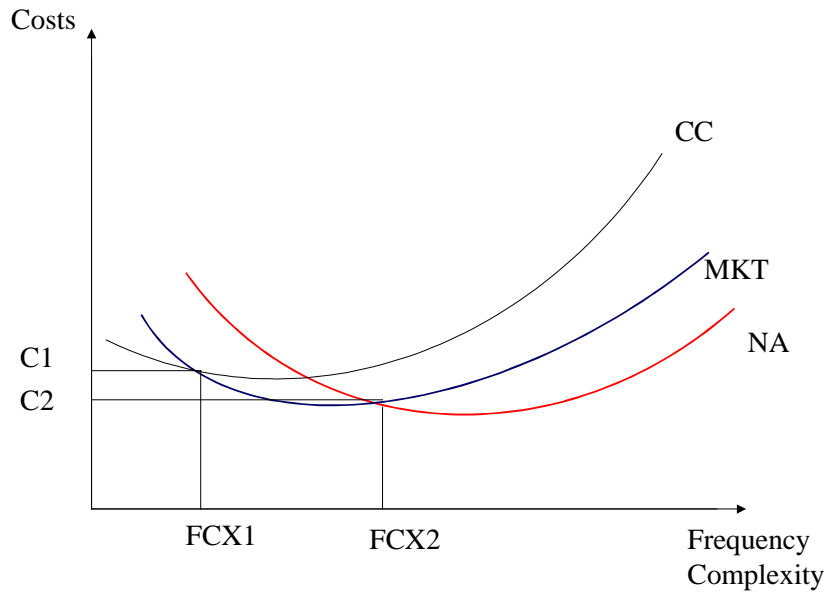
Table 1.
Governance structures and transaction costs

| | Command and Control | Taxes/Tradable permits | Negotiated Agreement |
|-----------------------------------------------------------------------------------|----------------------------|-------------------------------|-----------------------------|
| Negotiation costs with regulatory agency | - | - | + |
| Compliance costs | - ^a | + | + |
| Ex-post renegotiation costs | + | + | - |
| Opportunity cost | + | - ^b | -- ^b |
| *+=high transaction costs; -=low transaction costs; --=very low transaction costs | | | |

^aCommand and control regulation provides the information about the technology.

^bImplementation is up to the firm that chooses the type of pollution prevention method.

Figure 1.
Governance costs as a function of frequency and complexity



CC=Command and Control; MKT=Market mechanisms; NA=Negotiated Agreements

FC=Frequency and complexity

¹ Covenants is the term used in the Netherlands. The OECD recently provided a typology of voluntary agreements including the term negotiated agreements (Börkey and Lévêque, 1998). Because this typology has been widely adopted in the literature we use the term of negotiated agreement in this paper.

² In our analysis we do not consider pure hierarchy, which would be government ownership as opposed to regulation. We do not consider this alternative, as there are few Soviet-style command economies anymore and the results from a social welfare perspective of the Soviet-style system for the environment were disastrous. While researchers have explored the intricacies of these policy instruments separately, they have not compared them with respect to their transaction costs at the level of the firm (Fiorino, 1995; Portney and Stavins, 2000).

³ The opportunity costs may be more important than the transaction costs but since they are realized in the future, they have to be appropriately discounted.

⁴ The costs of preparing a single permit renewal application, once every twenty years, together with the associated costs of reviewing and approving this application by the permitting agencies will yield a cost reduction for this one facility of several million dollars over the life of the permit. Savings will accrue to both the agencies and to the permittee. The paperwork associated with the submittal and processing of the current portfolio of twenty-five permits, with a typical life of three to five years will be eliminated. It is not unreasonable to predict a reduction of over thirty thousand pages of associated paperwork from the process (Berry, 1995:4.)

⁵ For example, an average Intel semiconductor manufacturing facility using the latest process technology would introduce at least two new generations of technology; make 30 to 45 process chemical changes per year; and install five to 15 new equipment types and/or processes (Boyd, Krupnick, and Mazurek 1998). Under federal air pollution law, Intel could be required to obtain from regulators a new permit each time the firm makes a manufacturing change.

⁶ Merck's original August 1995 XL proposal said:
"Speed to market for new products, and new claims for existing products, is at the heart of the company's need to have flexible manufacturing facilities that can make a broad range of products in the same equipment, using a wide array of raw materials and solvents. Thus the ability of Merck's manufacturing plants to respond to rapidly changing market conditions and product demands is critical to Merck's ability to stay competitive in a worldwide pharmaceutical industry. To avoid a competitive disadvantage, Merck argued in its proposal that it was necessary for flexible manufacturing facilities to have flexible permits."
(Merck, 1995).