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Market-Based Policies for Pollution Control in Latin America

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Abstract

Rapid urbanization and increased industrialization have led to high pollution levels throughout Latin America. Economists tout policies based on market-based economic incentives as the most cost-effective methods for addressing a wide variety of environmental problems. This chapter examines market-based incentives and their applicability to Latin America. We first review the market-based incentives traditionally used to address pollution – emissions taxes, environmental subsidies, tax and subsidy combinations, tradable pollution permits, and hybrid instruments – and compare these instruments to command-and-control policies. We then discuss two sets of factors that affect how feasible and efficient pollution control policy will be in Latin America. We focus on practical considerations such as monitoring and enforcement, distributional issues, political feasibility, institutional considerations, administrative costs, and compliance costs. We also examine what the violation of standard modeling assumptions implies for the success of pollution control policy. In particular, we focus on non-competitive market structures, imperfect information or uncertainty, the effects of regulation on global competitiveness, and the compatibility of environmental goals with the goals of growth and development. Finally, we compare Latin American experiences with market-based incentives with those in the U.S. and Europe, and conclude with several policy recommendations.

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Resumen

En toda América Latina, la acelerada urbanización y creciente industrialización han generado altos niveles de contaminación. Según los economistas, las políticas basadas en incentivos de mercado son los métodos con mejor relación costo-beneficio para enfrentar una gran variedad de problemas ambientales. En este capítulo se examinan tales incentivos y su pertinencia en América Latina. Primero revisamos los incentivos de mercado utilizados tradicionalmente para enfrentar la contaminación - impuestos sobre las emisiones, subsidios ambientales, combinaciones de impuestos y subsidios, permisos transferibles de contaminación, e instrumentos híbridos - y los comparamos con las políticas regulatorias de mando y control. Luego analizamos dos conjuntos de factores que influyen en la viabilidad y eficacia de las políticas de control de la contaminación en América Latina. Nos centramos en consideraciones prácticas como supervisión y aplicación de la ley, aspectos de equidad, viabilidad política, consideraciones institucionales, costos administrativos y costos por cumplimiento. También examinamos cómo el incumplimiento de las suposiciones de los modelos estándar afectan el éxito de las políticas de control de la contaminación. En particular, nos centramos en las estructuras de mercado no competitivas, información imperfecta o incertidumbre, el efecto de las reglamentaciones sobre la competitividad global, y la compatibilidad de las metas ambientales con los objetivos de crecimiento y desarrollo. Finalmente, comparamos las experiencias de los incentivos de mercado en América Latina con las de Estados Unidos y Europa, y concluimos con diversas recomendaciones sobre políticas.

I. Introduction

Rapid urbanization and increased industrialization have led to high levels of air, water, and land pollution throughout Latin America. As economic development continues, household incomes will increase and domestic firms will increasingly participate and compete in the global economy. As these changes occur, Latin Americans and their governments will be willing to dedicate more funds to the alleviation of pollution. Since most Latin American countries have little in the way of institutional pollution control infrastructure, they still have the opportunity to determine exactly how to allocate funds and approach their pollution problems. They have the opportunity to decide whether to base their pollution abatement strategies on centralized standard-oriented, command-and-control approaches, on market-based incentives, or on some combination of both.

Policies based on market-based economic incentives have long been touted by economists as the most cost-effective method for addressing a wide variety of environmental problems. Successful application of such policies, in contrast to implementation of command-and-control regulations, is of much more recent vintage and has largely been accomplished in developed countries. Research on these experiences confirms that in the United States and Europe, incentives can often attain pollution reduction goals at much lower costs.

This chapter examines market-based incentives and their applicability to the Latin American context. We first review the market-based incentives traditionally used to address pollution and compare these instruments to command-and-control policies. Such incentives include emissions taxes, environmental subsidies, tax and subsidy combinations, tradable pollution permits, and hybrid instruments.

We then discuss two sets of factors that affect how feasible and efficient pollution control policy will be in Latin America. We focus on practical considerations such as monitoring and enforcement, distributional issues, political feasibility, institutional considerations, administrative costs, and compliance costs. We also examine what the violation of standard modeling assumptions implies for the success of pollution control policy in Latin America. In particular, we focus on non-competitive market structures, imperfect information or uncertainty, the effects of regulation on global competitiveness, and the compatibility of environmental goals with the goals of growth and development.

The third section examines countries' experiences with market-based instruments. We begin with a discussion of the use of five types of incentives – taxes, subsidies, tax-subsidy combinations, tradable permits, and the use of information as regulation – in the United States and Europe. We then extend this discussion to examine Latin America's experience with these same incentive-based policies. While market-based instruments have been used more extensively in the United States and Europe, interest in the use of such instruments in Latin America is growing and several experiences are highlighted.

Finally, based on our comparison of Latin American experiences with those in the U.S. and Europe, we conclude with several policy recommendations.

II. Command-and-Control Regulations and Market-Based Instruments

When firms or consumers decide how much to produce or consume, they weigh the costs of their activity against its benefits. Without proper incentives, however, producers and consumers will not include the costs that they impose on the environment and others in their decision of how much and what to produce or consume. This failure to include these "external"

costs in decisions results in a market failure: polluters engage in an inefficiently high amount of polluting activities. When market failure occurs, usually a case can be made for government intervention.[1] Governments have typically used both command-and-control (CAC) regulation and market-based incentives to resolve environmental market failures. We discuss each of these below as well as the possibility of combining aspects of CAC and market-based incentives in a hybrid policy instrument.

A. Command-and-Control Regulations

Prior to 1990 virtually every environmental regulation in the U.S. and elsewhere took the form of command-and-control regulations, and they are still commonly used. These regulations are so named because they "command" that emissions be "controlled" to meet a given minimum quality or maximum emissions standard. As such, they tend to be either technology-based or performance-based.

Technology-based regulations mandate the control technology or production process that polluters must use to meet the emissions standard set by the government. One problem with this type of CAC regulation is that it applies a one-size-fits-all policy to firms that may differ widely in size and cost structure. Thus, while pollution is abated to the desired level, it is accomplished at a higher cost to firms and consumers than might have occurred if firms were allowed to determine the most cost-effective means for meeting the standard. Alternatively, if more flexible policies were used, *higher* environmental quality could be achieved at the same cost.

[1] Only in a narrow set of circumstances is government intervention unwarranted. In 1960 Ronald Coase in "The Problem of Social Cost", published in *The Journal of Law and Economics,* listed three conditions that must be met for an externality problem to be resolved without government intervention. There must be well-established property rights, a willingness of affected parties to bargain, and a small number of parties affected. In many cases, one or more of these conditions are not met in the context of environmental problems.

Technology-based CAC policies do not encourage firms to find new and innovative abatement strategies nor do they provide incentive to firms to abate beyond the set level.

Performance-based regulations are more flexible CAC policies; they mandate that polluters reach an emissions standard but allow them to choose the method by which to meet the standard. Still, once polluters have reached the level specified by the standard, they face little incentive to reduce pollution any further.

B. Market-Based Instruments

Market-based policies are regulations that "encourage behavior through market signals rather than through explicit directives regarding pollution control levels or methods."[2] Many market-based instruments function as follows: A polluting firm or consumer faces a potential penalty in the form of a tax or permit price per unit of emissions. The polluter can choose to pay for existing emissions via the tax or permit or reduce emissions to avoid paying the penalty. Other market-based policies subsidize pollution abatement or combine taxes and subsidies.

Market-based policies give polluters more flexibility than most command-and-control policies. First, the method for reducing pollution is not specified, giving polluters with heterogeneous costs the flexibility to use the least costly abatement method. Polluters that face the same regulation may reduce pollution by recycling, installing new equipment, switching fuels, using labor-intensive methods, or reducing production or consumption. Second, when abatement is relatively costly, polluters can opt not to abate and to instead pay for their higher emissions. Polluters with relatively high costs continue to pollute at a higher level but pay more

[2] Stavins, Robert N. "Market-Based Environmental Policies," in Paul Portney and Robert N. Stavins, eds, *Public Policies for Environmental Protection*. Washington, DC: Resources for the Future. 2000: 31-76.

in taxes or on permits. Those with relatively low costs reduce their pollution when it is cheaper than paying the tax or permit price and pay for residual emissions that are more costly to abate.

Since market-based incentives force polluters to pay taxes, buy permits, or forgo subsidies when they pollute, they provide an always-present incentive to abate. Such incentives therefore also promote innovation in pollution control technologies.[3]

In the remainder of this section, we examine five commonly prescribed market-based incentives: emissions taxes, environmental subsidies, tax and subsidy combinations, tradable permits, and hybrid policy instruments. In each section we describe the principal advantages and disadvantages of using each incentive.

1. The Emissions Tax

An emissions tax is exacted per unit of pollution emitted and forces a firm or consumer to internalize the external cost of its emissions. The tax is set so that, for each unit of pollution emitted, a polluter pays the value of the marginal (additional) external damage caused by that unit of pollution. These external damages may include the costs, for example, of worsened human health, reduced visibility, lower property values, and loss of crop yields or biodiversity. To avoid the emissions tax a polluter finds the cheapest way to reduce pollution. For any residual pollution, the polluter pays the tax. In addition, the government earns revenue that it can use to reduce other pollution or to reduce other taxes.[4]

[3] Studies of the effect of market-based policies on technological innovation include Jaffe, A.B. and R.N. Stavins. "Dynamic Incentives of Environmental Regulations: The Effects of Alternative Policy Instruments on Technology Diffusion." *Journal of Environmental Economics and Management*. 1995: S43-S63; Laffont, J.J. and J. Tirole, "Pollution Permits and Environmental Innovation." *Journal of Public Economics*. 1996: 127-140; and Parry, I. "Pollution Regulation and the Efficiency Gains from Technology Innovation." *Journal of Regulatory Economics*. 1998: 229-254.

[4] In particular, environmental tax revenue can be used to reduce labor taxes and thereby reduce the distortion in the labor market caused by these taxes. See Goulder, L., I. Parry, and D. Burtraw. "Revenue Raising vs. Other

Despite the apparent usefulness of such a tax, true "Pigovian" emissions taxes – those set equal or close to marginal external damages – are relatively rare.[5] Often it is impossible to tax emissions directly because they are difficult to measure. It is also difficult to define and monetarily value the marginal external damages of a unit of pollution. Another reason why policymakers do not often use emissions taxes is that they are difficult to enforce since they are often exacted on goods that are not directly bought and sold. In addition, attempts to measure and tax emissions may lead to illegal dumping.[6]

2. Environmental Subsidies

A subsidy per unit of pollution abatement establishes incentives for emission reductions identical to a tax per unit of pollution. For instance, if use of a cleaner fuel or purchase of control technology is subsidized at the appropriate level it induces firms to switch from a dirtier fuel or to install control technology until the same level of abatement is reached as under the emissions tax. Unlike an emissions tax, however, the subsidy distorts long-run economic incentives of firms. Since a subsidy adds to firms' revenue streams, firms have an incentive to enter the industry or to appear "dirtier" to qualify for the subsidy. The result could conceivably be that, while each individual firm decreases its pollution, the overall level of pollution actually increases.[7] Because of these long-run effects, subsidies are usually recommended for use over limited periods of time. Once subsidies have been given, however, they are often quite difficult

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Approaches to Environmental Protection: The Critical Significance of Pre-Existing Tax Distortions." *RAND Journal of Economics*. Winter 1997.

[5] These taxes are called "Pigovian" taxes after the economist, Arthur Pigou, who first formalized them. See Pigou, A.C. *The Economics of Welfare*. 4th edition. London: MacMillan and Company. 1932.

[6] Fullerton, Don. "Why Have Separate Environmental Taxes?" in James Proterba, ed., *Tax Policy and the Economy*. Cambridge: MIT Press. 1996.

[7] Baumol, W., and W. Oates. *The Theory of Environmental Policy*. Second Edition. Cambridge: Cambridge University Press. 1988.

to take away. Another potential disadvantage is that instead of collecting revenue, as with a tax, the government pays firms or consumers and funds it through another revenue-raising device.

3. Tax and Subsidy Combinations

A tax and subsidy also can be combined to achieve an efficient level of pollution. In the case of a firm, the tax is applied to output under the presumption that all production processes pollute. A subsidy is then provided to the extent that a firm provides proof of the use of a cleaner form of production. The tax increases the cost of output and induces the firm to reduce its use of both clean and dirty inputs. The subsidy provides the firm with an incentive to switch into cleaner forms of fuel or install more control technology.

Policy makers can also use tax and subsidy combinations to induce pollution reduction on the part of consumers. For instance, a bottle bill requires a deposit on all glass bottles or aluminum cans under the presumption that consumers will litter or throw them away. A refund is provided when the bottle or can is returned for recycling. The bottle bill does not just provide incentives to consumers of the goods packaged in glass or aluminum. It also provides incentives to individuals to pick up litter and return it for the refund.

The main advantage of a tax-subsidy combination is that both parts apply to a market transaction. Instead of attempting to monitor emissions and control illegal dumping, which may be difficult or infeasible, policy makers can immediately observe the taxed and subsidized items. Also, polluters have an incentive to reveal information on abatement activity to qualify for the subsidy instead of hiding information to cover up illegal activity. Disadvantages include potentially high implementation and administrative costs and the political temptation to set the tax or subsidy too low to induce proper behavior.

4. Permits

While an emissions tax sets the price of pollution, a permit system allows policy makers to set the quantity of allowable emissions. Permits are distributed or auctioned, generally to firms, and represent the right to pollute some set amount of pollution. Firms then buy and sell permits to each other as needed. The market-clearing price is established through this buying and selling and, if the government chooses the optimal level of pollution, will be the same amount as an emissions tax. As in the case of a tax, a firm can reduce pollution to avoid the cost of purchasing permits. For any residual pollution, the firm purchases the needed number of permits. If they are auctioned to firms, then the government collects the proceeds of the auction. If permits are allocated to firms, then there is no government revenue. Instead, firms are given a one-time subsidy equal to the value of the permits if sold to other firms.

Permits have several advantages over emissions taxes. First, they do not require a policy maker to measure the marginal external damages of a unit of pollution. Instead, the policy maker decides what is the acceptable level of pollution. If after its establishment policy makers decide that the policy is too lax or too stringent, the government can buy up or issue more permits. Second, unlike an emissions tax or environmental subsidy, permits allow policy makers to determine with certainty the level of pollution that will result. In cases where pollution over a certain amount potentially causes a lot of damage, certainty regarding the quantity of pollution is a desirable quality of a policy instrument.[8]

Permits also have a number of disadvantages. First, since the government sets the quantity of pollution, there is some degree of uncertainty regarding price. If abatement measurement and permit purchases are much more expensive than expected, they can have large

[8] Weitzman, M. "Prices versus Quantities." *Review of Economic Studies*. 1974: 477-491.

and costly effects on particular industries.[9] Second, permits can be interpreted as giving firms a license to pollute, particularly when permits are allocated to firms for free.[10] Third, transaction costs to complete a trade may be high. Significant search costs or strategic behavior could seriously inhibit the permit trading that would normally ensure the least-cost outcome. Careful attention to the design of a permit trading system may help to minimize transaction costs. Permit systems tend to work best when there is a sufficiently large market in which firms can trade, they are designed as simple systems that apply to either inputs to production or emissions, and when government acts to reduce regulatory uncertainty and barriers to trade. [11]

C. Hybrid Instruments

In addition to the four market-based instruments discussed above, two hybrid policies – those that combine aspects of CAC and market-based policies - are often found in the literature and in practice. These hybrid policies are: combining standards and pricing approaches, and the use of information as regulation.

1. Combining Standards and Emissions Taxes

Pollution standards set specific emissions limits, and thereby reduce the chance of excessive health and environmental damages. Such standards, however, may impose large costs

[9] For instance, the Regional Clean Air Management program (RECLAIM) in Los Angeles, California experienced an astronomical increase in the price of SO_2 permits in the summer of 2000 due to a marked increase in the demand for electricity. When electric utilities increased production to meet this demand, emissions also increased and the demand for permits rose. Prices for SO_2 permits increased from $4,284 per ton in 1999 to $39,000 per ton in 2000. For more information on RECLAIM, see Goldenberg, E. "The Design of an Emissions Permit Market for RECLAIM: A Holistic Approach." *UCLA Journal of Environmental Law and Policy* 1993:297-328; and the South Coast Air Management District website at www.aqmd.gov.

[10] A command-and-control system involves permits that are distributed to polluters (but are not tradable). In this sense CAC systems also serve as licenses to pollute.

[11] Stavins, Robert. "Transaction Costs and Tradeable Permits." *Journal of Environmental Economics and Management.* 1995: 133-148.

on polluters. Emissions taxes, on the other hand, restrict costs by allowing polluters to pay a tax rather than undertake excessively expensive abatement. Such taxes, however, do not set a limit on emissions, and leave open the possibility that pollution may be excessively high.

Might there be a policy that sets a limit on both costs and pollution? Some researchers suggest a "pressure-valve" approach to regulation that combines standards with emissions fees.[12] Such a policy combination imposes the same emissions standard on all polluters but is set such that the average polluter does not face excessive abatement costs. The policy then subjects all polluters to a unit tax for emissions in excess of the standard.

This policy combination has several attractive features. First, if the standard is set properly, proper protection of health and the environment will be assured. This feature of the policy maintains the great advantage of standards: protection against excessively damaging pollution levels. Second, high abatement cost polluters can defray costs by paying the emissions fee instead of cleaning up. This feature preserves the flexibility of emissions taxes: overall abatement costs are lower because polluters with low abatement costs reduce pollution while polluters with high abatement costs pay taxes.

2. Information as Regulation

An instrument that has been used increasingly in industrialized countries as a method for regulation is the requirement that firms provide the government and public with information on pollution and abatement activities. These reporting requirements attempt to minimize inefficiencies in regulation associated with asymmetric information, where the firm typically has

[12] Roberts, Marc J. and A. Michael Spence, "Effluent Charges and Licenses Under Uncertainty." *Journal of Public Economics* 1976: 193-208; Spence, A. Michael and Martin L. Weitzman, "Regulatory Strategies for Pollution Control," in Ann F. Frielander, editor, *Approaches to Controlling Air Pollution*. Cambridge, MA: The MIT Press, 1978.

more and better information on what and how much it pollutes than the government or public.[13] When expensive emissions monitoring is required to collect such information, switching the burden of proof for monitoring and reporting from the government to the firm can increase the effectiveness of government regulation while substantially lowering the cost. If accompanied by spot checks to ensure that monitoring equipment functions properly and that firms report results accurately, this can be an effective form of regulation.

Use of information as regulation also creates a role for the community. A community with information on a nearby firm's pollution activities can exert pressure on it to internalize at least a portion of the costs of pollution, even when formal regulations are weak or nonexistent.[14] This type of "private enforcement" effectively increases a firm's expected penalty of polluting, and the firm will react as if it were being inspected and fined by a government agency.[15] As in the case of a pure market-based instrument, plants still have the flexibility to respond to community pressure for emission reductions by abating in the cheapest way possible. At the same time, while reporting requirements need not be tied explicitly to a pollution standard, they are consistent with a standard-based approach since upon receipt of information a community can easily assess the level of emissions.

Still, it is important to keep in mind two caveats when discussing the use of information as regulation. First, the use of information as regulation is not costless: U.S. firms spend about $346 million/year to monitor and report releases. Any required investments in pollution control

[13] Tietenberg, T. and D. Wheeler (2001). "Empowering the Community: Information Strategies for Pollution Control." *Frontiers of Environmental Economics*. H. Folmer, H. Gabel, S. Gerking and A. Rose, editors. Cheltenham, UK, Edward Elgar: 85-120.
[14] Pargal, S. and D. Wheeler (1996). "Informal Regulation of Industrial Pollution in Developing Countries: Evidence in Indonesia." *Journal of Political Economy*, vol. 104, no. 6: 1314-1327.
[15] See Naysnerski, N. and T. Tietenberg. "Private Enforcement of Federal Environmental Law." *Land Economics*. 1992: 28-48 for analysis of this and other kinds of private enforcement.

are in addition to this amount.[16] Second, the amount of pressure a community exerts on a plant is related to socioeconomic status. Poorer, less educated populations tend to exert far less pressure than communities with richer, well-educated populations.[17]

III. The Conditions in Latin America: Implications for Pollution Control Policy

Two sets of factors affect how feasible and efficient the use of CAC or market-based incentives will be in Latin America. The first section below discusses a number of practical considerations that should be integrated into any evaluation of policy options. The second section examines the implications of numerous violations of the basic modeling assumptions in the Latin American context.

A. Practical Considerations

Any discussion of pollution control policy options must account for a number of practical considerations, particularly when considering the use of such instruments in a developing country context. For example, implementation of pollution control policy may be complicated by monitoring and enforcement issues, distribution of costs and benefits, political feasibility, institutional constraints, administrative costs, or compliance costs.

1. Monitoring and Enforcement

Effective monitoring and enforcement is a basic requisite for pollution control policy. However, governments first must be able to measure emissions. In developing countries, facility-

[16] O'Connor, D. (1996). "Applying Economic Instruments in Developing Countries: From Theory to Implementation." Special Paper. Paris: OECD Development Centre.
[17] World Bank (2000). "Greening Industry: New Roles for Communities, Markets, and Governments." Oxford University Press: New York.

level emissions data are rarely available. The implementation of policies that require detailed emissions data for monitoring and enforcement are usually prohibitively expensive and therefore likely to be infeasible.[18]

Monitoring and enforcement is complicated by evasion through activities such as illegal dumping of waste, falsification of emission records, and generation of counterfeit proof of proper disposal. Evidence suggests that countries often set the number of audits and penalty levels too low to induce proper compliance. In Latin America, these difficulties are compounded by political pressure by large firms and the difficulty of monitoring a large informal sector that operates outside the legal tax structure.

A more targeted monitoring and enforcement process may allow governments with few funds and little manpower to increase the compliance of firms substantially. For instance, Brazilian regulatory agencies target firms that pollute the most. Studies in Rio de Janeiro show that by targeting only 50 plants, 60 percent of the state's industrial pollution is effectively monitored. While the smallest firms tend to be more pollution intensive per unit of output, they are dwarfed as contributors to Rio de Janiero's pollution by the scale of the largest plants.[19] Since these small plants are more numerous and more difficult to monitor, particularly those in the informal sector, policies that focus on compliance of large plants are likely to be more effective.

In addition, the number of audits and the penalty levels should account for monitoring device quality and expected returns to the firm or consumer from cheating. Market-based instruments that assess fees on goods bought and sold in markets or that provide incentives to

[18] O'Connor, D. "Applying Economic Instruments in Developing Countries…." 1996.
[19] World Bank. "Greening Industry: New Roles for Communities, Markets, and Governments." 2000.

provide proof of compliance also reduce the opportunities for cheating and require less monitoring and enforcement.

2. Distributional Issues

Pollution control policies that induce polluters to internalize the costs of their actions and increase efficiency are not necessarily equitable. Empirical evidence indicates that environmental regulations typically favor the rich in their redistributive effects, and as such exacerbate existing income inequality.[20] The costs of environmental regulation tend to be regressive, borne disproportionately by the poor, and come in the form of job losses in the short run and higher consumer prices in the long run.

The distribution of benefits from environmental policies depend on which pollutants are targeted. For instance, policies that preserve pristine wilderness, create national parks, or clean water for recreational use usually benefit the rich comparatively more than the poor, since both the willingness-to-pay and use of these types of environmental goods increase with income levels.[21] Policies that target urban air or water pollutants tend to benefit households at the lower end of the income spectrum since such households cannot afford to move out of industrial areas or buy more expensive, privately acquired water sources.

Many countries in Latin America have highly unequal income distributions and large portions of their populations living in poverty. It is therefore particularly important to design pollution control policies that do not disproportionately affect the poor and exacerbate income inequality. Policy makers should target pollutants that have the largest effect on poor household's lives. Policy instruments that are progressive in their distribution of costs or, when

[20] Baumol, W. and W. Oates. *The Theory of Environmental Policy*. 1988.

they are not, are coupled with a redistributive subsidy will help to offset costs borne by the poor.[22]

3. Political Feasibility

Politicians often prefer command-and-control policies since they are relatively straightforward, easy to negotiate with industry, and successfully cut pollution to a pre-determined level.[23] As policy makers gain experience with market-based instruments, they are more likely to consider them as policy options alongside command-and-control. The political feasibility of market-based instruments is also complicated by the fact that they often raise prices on basic consumer necessities such as food or heating oil, or impose taxes on politically powerful firms.

Given the stringent budgetary constraints under which developing countries operate, policy instruments that rely on the existing institutional framework and infrastructure, that are self-financing, or that raise revenue for governments are likely to be preferred to those requiring substantial outlays. Earmarking revenue collected for a particular program may also increase support since it increases government accountability.[24]

4. Institutional Considerations

While most Latin American countries have environmental protection agencies, they are usually of relatively recent vintage, under-funded, and understaffed in environmental protection

[21] Although as air quality in these neighborhoods improves, the poor may be pushed out of the neighborhood as rising property values attract more affluent families.
[22] Huber, R., J. Ruitenbeek, and R. Seroa da Motta. "Market-Based Instruments for Environmental Policymaking in Latin America and the Caribbean. …" 1998.
[23] Baumol, and Oates. *The Theory of Environmental Policy.* 1988.
[24] Huber, R., J. Ruitenbeek, and R. Seroa da Motta. "Market-Based Instruments for Environmental Policymaking in Latin America and the Caribbean. …" 1998.

expertise.[25] Low salaries may lead to negligence or corruption on the part of enforcement agents and weaken the ability of the government to control pollution effectively. Given these constraints, policy instruments that do not require extensive government oversight are more feasible in a developing country context.

Market-based incentives may be more feasible because they are less likely to be constrained by a long history of reliance on CAC regulation. Environmental policy makers in developing countries may have greater freedom to experiment with market-based incentives. Within the set of available market-based incentives, instruments that tax or subsidize goods that have established markets may be more successful. For example, policy makers could take advantage of existing value-added tax systems to increase tax rates on consumption goods such as gasoline.

Effective implementation of many environmental policies may require conditions not present in some Latin American countries. For instance, many market-based instruments require that property rights are clearly assigned and enforced, taxes are collected and administered effectively, a well-functioning and stable financial system is in place, and contracts are fairly negotiated and enforced.[26]

5. Administrative Costs

Market-based instruments are used with increasing frequency in Latin America under the assumption that they do not add substantial administrative costs.[27] The administrative costs of a pollution control policy depend on the level of government involvement in emissions

[25] Environmental Department, World Bank. "Five Years After Rio: Innovations in Environmental Policy." Washington, DC: World Bank. 1996.
[26] O'Connor, D. "Applying Economic Instruments in Developing Countries…." 1996.

measurement, tax collection, and monitoring and enforcement. If the "burden of proof" lies with the government, then administrative costs tend to be high. For instance, an emissions tax requires the government to collect data on emissions of polluters, set the tax based on this information, collect revenue, and minimize tax evasion. Enforcement of a standard requires proper measurement of emissions as well as effectively established fines and regular monitoring. If the burden of proof is shifted to the consumer or firm, the administrative costs will be lower. For example, a deposit-refund system places the data and reporting requirements on the individual consumer or firm to provide proof that proper disposal has taken.

6. Compliance Costs

Relative to the United States and Europe, Latin American countries are in the early stages of environmental protection. For example, catalytic converters were required on all new automobiles in Mexico only very recently, starting in the early 1990s. Since Latin American countries have not exhausted the lower-cost methods of pollution abatement, it will generally cost them less to reduce an additional unit of pollution than it costs Europe or the United States.

Industries in Latin America have less technologically-advanced production processes than U.S. industries, and so may be able to purchase cheaper abatement technologies considered outdated in the United States. Abatement costs, however, are certainly higher relative to overall production costs than in developed country industries. In Latin America, capital, including tools, machines, and abatement technologies such as scrubbers and monitors, is more expensive relative to labor costs.

[27] Huber, R., J. Ruitenbeek, and R. Seroa da Motta. "Market-Based Instruments for Environmental Policymaking in Latin America and the Caribbean. …" 1998.

In the current regulatory environment in Latin America, other compliance costs may also be excessively high. Given the bureaucratic structures common in these countries, it is not unreasonable to expect a large amount of paperwork and other compliance requirements. The costs of maneuvering the bureaucratic mazes in Latin America can stifle economic activity.[28]

Given that abatement and compliance costs are likely to be high relative to overall production costs, the most cost-effective policies are ones that permit the maximum level of flexibility in abatement choice and require the fewest bureaucratic acrobatics.

B. Challenging the Underlying Assumptions

Economic theories of CAC regulations and market-based instruments rest on a number of assumptions that may not hold in the Latin American context. For example, implementation of pollution control policy may be complicated by noncompetitive market structures, lack of perfect information or uncertainty, effects of environmental regulations on global competitiveness, or compatibility of environmental goals with the pressing goals of growth and development. We consider each of these potentially complicating factors below.

1. Non-Competitive Market Structure

The effectiveness and efficiency of pollution-control policies depend critically on the nature of the markets in which they are implemented. Two market structure distortions that affect the efficiency of policy making in Latin America are monopoly power and the informal sector.[29]

[28] DeSoto, Hernando, *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else*. New York: Basic Books. 2000.

[29] As mentioned previously, market distortions are also created by pre-existing taxes on labor. See Eskeland and Jimenez, "Policy Instruments for Pollution Control in Developing Countries," *The World Bank Research Observer* (1992): 145-169, for a discussion of this distortion in the developing country context.

Since domestic markets in Latin America are small relative to those in the United States and Europe, it is more likely that one or a few firms in any given industry will serve the entire market. Since monopolies already restrict output relative to what would be produced in competitive markets, care must be taken to ensure that pollution control policies do not further restrict output to the point where the costs of the policy exceed the benefits. Policies that decrease total pollution through reductions in pollution per unit, rather than through reductions in output, may be a solution.

On the other end of the spectrum sits the informal sector, composed of literally millions of very small firms. This sector produces legal goods but avoids government regulation and taxation. The value of Latin American countries' informal sector outputs range from 25 to 60 percent of Gross Domestic Product (GDP).[30] This sector also includes a number of industries that are quite pollution-intensive, which means that the potential environmental effects of informal sector production may be large.[31] The size and importance of Latin American informal sectors presents three main problems for environmental regulators. First, since polluters in the informal sector are very practiced at avoiding government fees, it is nearly impossible to impose direct regulations or taxes on informal sector polluters. Second, taxes or regulations that are successfully implemented in the formal sector may push more polluters into the informal sector. Third, firms in this sector often support families at the low end of the income distribution, meaning that even small increases in the costs to the firm may mean large impacts on the poor.

[30] Schneider, Friedrich and Dominik H. Enste, "Shadow Economies: Size, Causes, and Consequences." *Journal of Economic Literature* 2000: 77-114.
[31] Blackman, A. "Informal Sector Pollution Control: What Policy Options Do We Have?" World Development. 28:12 (December 2000): 2067-82.

Indirect taxes on polluting inputs that are produced in formal markets but used in informal sector production may be one way of inducing pollution reduction among firms that can easily evade direct regulation or taxation.

2. Imperfect Information and Uncertainty

Environmental policy makers in both developed and developing countries may face a significant amount of uncertainty regarding the costs and benefits of pollution reduction. Since regulatory structures in developing countries are generally not as well-developed as those in the United States and Europe, and since limited resources may preclude extensive quantification of costs and benefits, policy makers in Latin America will likely face an even greater level of uncertainty about the relative costs and benefits of pollution reduction.[32]

Weitzman (1974) provides criteria for choosing between "price" and "quantity" based policies in the face of uncertainty.[33] If policy makers are uncertain about the costs of abatement and fear that polluters (and the economy) may be saddled with high costs as a result of regulation, they can limit these costs by using a price instrument such as an emissions tax or a tax on polluting goods. If, on the other hand, policy makers are more uncertain of the benefits of controlling pollution and fear that excessively high environmental damages may occur, they can limit these damages by using a quantity instrument such as tradable pollution permits. Alternatively, policy makers may opt for the certainty of a standard. Concern for the cost-effectiveness of the policy should lead them to consider a performance-based standard or a hybrid policy that combines a market-based instrument with a pollution limit.[34]

[32] O'Connor, D. "Applying Economic Instruments in Developing Countries…." 1996.
[33] Weitzman, M. "Price vs. Quantities." Review of Economic Studies. 1974: 477-91.
[34] See Eskeland, G., and S. Devarajan, *Taxing Bads by Taxing Goods: Pollution Control with Presumptive Charges.* Washington, DC: The World Bank. 1996; Eskeland, G., and E. Jimenez, "Policy Instruments for Pollution Control

3. Global Competitiveness

Pollution control policy that involves significant compliance costs for firms may alter the international structure of relative costs and affect patterns of specialization and world trade. In particular, economic theory predicts that in a country that forces firms to internalize an environmental externality, production costs increase and domestic firms' comparative advantage in the production of pollution-intensive goods decreases. Domestic firms then have difficulty competing internationally, particularly with firms that do not face these costs.[35] In the case where a country has little or no effect on world price, passage of environmental regulations that increase firm production costs may result in reduced revenue and increased unemployment in the short run.[36] In the long run, increased environmental regulation may means decreased competitiveness and growth.

Less-developed countries that have neglected pollution control to focus on more pressing development concerns are often said to develop a comparative advantage in pollution-intensive industries. As trade barriers decline these countries become "pollution havens" for industrialized countries' dirtiest industries and may set low environmental goals to attract firms to relocate there. Only limited evidence of this effect has been found.[37] Usually differences in labor and capital costs and concerns over political and economic stability outweigh differences in environmental costs.

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in Developing Countries,"and Roberts, M., and M. Spence, "Effluent Charges and Licenses Under Uncertainty." *Journal of Public Economics* 1976: 193-208.

[35] O'Connor, David. "Applying Economic Instruments in Developing Countries…." 1996.

[36] Baumol, W. and W. Oates. *The Theory of Environmental Policy.* 1988.

[37] See Birdsall, N. and D. Wheeler (1993). "Trade Policy and Industrial Pollution in Latin America: Where are the Pollution Havens?" *Journal of Environment and Development*. vol. 2, no. 1; Levinson, A. (1996). "Environmental Regulations and Industry Location: International and Domestic Evidence" in *Fair Trade and Harmonization: Prerequisite for Free Trade?* J. Bagwati and R. Hudec, eds. Cambridge: MIT Press.; Xing,Y. and C. Koldstad

4. Dynamic Considerations

Since the successful implementation of environmental policies requires significant funding, environmental sustainability requires faster economic growth. Air and water pollution in cities can be reduced only through increased public investment, while high rates of soil erosion and deforestation are "unlikely to be reversed without a rapid improvement in living conditions in rural areas."[38] Without economic growth, pollution in cities and degradation in rural areas will worsen.

But are Latin America's current growth and development policies conducive to environmental protection? And what kinds of pollution control policies might better complement current economic growth policies? Given the focus that most Latin American governments currently place on balancing federal budgets and paying down debt, their Ministries of the Environment will be hard pressed to obtain large funding increases in the short run. To the extent that fiscal responsibility keeps interest rates low and promotes economic growth, federal tax revenues will increase in the long run, and some of these new revenues may be channeled into environmental protection. Pollution control policies that generate revenue as they reduce pollution seem to be most complementary to the goal of fiscal responsibility.

Huber et al. (1998) find "that public firms are least accountable and have little internal incentive to meet even their own environmental standards and guidelines."[39] Since government-owned firms are able to insulate themselves from regulatory oversight, they tend to be more

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(2002). "Do Lax Environmental Regulations Attract Foreign Investment?" *Environmental and Resource Economics* (forthcoming).

[38] Ros, Jaime, Joost Draisma, Nora Lustig, and Adriaan Ten Kate, "Prospects for Growth and the Environment in Mexico in the 1990s." *World Development* 1996: 308.

[39] Huber, R., J. Ruitenbeek, and R. Seroa da Motta. "Market-Based Instruments for Environmental Policymaking in Latin America and the Caribbean. …" 1998.

polluting than privately-owned firms.[40] Privatization would therefore appear to be very conducive to pollution control initiatives. While firms may prefer the certainty of command-and-control regulations, market-based incentives may allow these newly profit-oriented firms to stay competitive while they reduce pollution.

IV. Experience with Market-Based Incentives in the U.S., Europe, and Latin America

Market-based instruments have only been recently considered alongside command-and-control regulations as options for reducing pollution. This is true in the United States, Europe, and Latin America. However, as policy makers become more familiar with these instruments, witness their successful implementation, and notice some advantages over CAC regulation, they become more open to the use of market-based instruments. This section briefly discusses some examples of the use of taxes, subsidies, tax and subsidy combinations, permits, and information as regulation for solving market failures related to pollution in the United States and Europe, and throughout Latin America.[41]

A. Experiences in the United States and Europe

Until relatively recently, governments did not consider market-based instruments as an option to solve pollution problems. Recognition of their usefulness began slowly in the policy arena. In the U.S., the Environmental Protection Agency (EPA) first allowed plants to "trade" emissions in 1975 with a simple offset program: new or existing plants that made major modifications were allowed to locate in non-attainment areas if they made more than equivalent

[40] Blackman, A., and W. Harrington "The Use of Economic Incentives in Developing Countries: Lessons from International Experience." *Journal of Environment and Development*. 2000: 5-44.
[41] Standard-and-pricing approaches are discussed in the context of the market-based instrument with which the examples are most closely associated.

reductions in emissions at other existing plants.[42] In 1988 two U.S. senators sponsored a report that identified innovative policy approaches to environmental policy including the use of economic incentives. And in 1990 amendments to the Clean Air Act were passed with a tradable permit system outlined to control acid rain.[43]

Europe's first experiences with market-based instruments occurred in the 1970s, when many countries used "cost-covering charges," designed to cover the cost of monitoring or controlling an environmental asset.[44] Environmental taxes were introduced in the 1980s and their use has accelerated over the last decade. By 2001, for example, eight countries in the European Union had carbon taxes, up from four in 1996.[45]

1. Emissions Taxes

The U.S. Internal Revenue Service defines only four U.S. taxes as emissions taxes: these taxes are on petroleum, chemical feedstocks, ozone-depleting chemicals, and motor fuels.[46] Many of these are not direct taxes on emissions but taxes on another input under the presumption that the input is directly related to the amount of pollution produced. At the state and local level, there are numerous examples of water discharge and user fees. However, most of these are motivated by the need to raise revenue to cover the cost of supplying the service. Most local communities also charge fees for disposal of solid waste either through variable rates (also referred to as pay-as-you-throw) or fixed fees. Unlike the case of fixed fees, which are unrelated

[42] Tietenberg, T. *Emissions Trading: An Exercise in Reforming Pollution Policy*. Washington, DC: Resources for the Future. 1985.
[43] Environmental Law Institute. *The United States Experience with Economic Incentives in Environmental Pollution Control Policy*. August 1997.
[44] European Environment Agency. *Environmental Taxes: Implementation and Environmental Effectiveness.* 1996. Environmental Issues Series Report No. 1, p. 21.
[45] European Environment Agency. *Environmental Taxes: Recent Developments in Tools for Integration*. 2000. Environmental Issues Series Report No. 18.
[46] Fullerton, D. "Why Have Separate Environmental Taxes?" 1996.

to the amount of waste a household disposes, variable rates are based on volume and designed to charge a positive marginal cost for collection and disposal. One state, Minnesota, mandates that all of its communities use a variable rate system. Allegations have been made, however, that variable rate systems increase the incidence of illegal dumping.[47]

In Europe, there are many instances of taxes on air and water pollutants and for the purpose of noise abatement, although many of these are not actually designed to limit emissions but to raise revenue. In such cases, the taxes are often far too low to illicit serious reductions in pollution and are often combined with command-and-control policies that lessen economic incentives to switch fuels or invest in innovative control technologies.[48]

Some European countries, however, have had noted success in reducing pollution. For instance, Norway experienced up to a 21 percent reduction in carbon emissions in certain industries as a result of its tax. Sweden taxes the sulfur content of fuel and refunds it to plants when a scrubber is installed. Since the tax is calculated to reflect the marginal cost of abatement, it is noticeably higher than similar taxes in other countries and has had a significant effect: the average sulfur content of fuel declined from 0.65 to 0.40 percent between 1991 and 1993. Sweden also has a tax on NOx that, in an attempt to be revenue-neutral, refunds revenues from the tax to plants in proportion to the amount of energy produced. Total emissions fell by 40 percent in the first two years that plants were subject to the tax.[49] In other countries tax exemptions have muted the possible impact on emissions.[50]

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[47] EPA. *The United States Experience with Economic Incentives for Protecting the Environment*. 2001.
[48] Cropper, and Oates. "Environmental Economics: A Survey." *Journal of Economic Literature*. 1992.
[49] Blackman and Harrington, "The Use of Economic Incentives in Developing Countries…." *Journal of Environment and Development*. 2000 ; Stavins, R. "Experience with Market-Based Environmental Policy Instruments." RFF Discussion Paper, 2000.
[50] OECD. *Economic Instruments for Pollution Control and Natural Resources Management in OECD Countries: A Survey*. 1999.

2. Environmental Subsidies

Environmental subsidies in the U.S. include grants to local government and businesses for proper waste management and recycling, grants to public bus systems and businesses for use of alternative fuel vehicles, subsidies to purchasers of alternative fuels, and cost-sharing with property owners for land conservation. The largest conservation subsidy program pays farmers up to $50,000 annually to take land out of cultivation and to place it in a conservation "reserve" for ten to fifteen years. The payment is designed to cover all foregone rents from alternative uses of the land as well as half the cost of soil erosion control measures. While much land has been successfully put aside for conservation purposes, the program does not give preference to croplands in environmentally sensitive areas. As of 1992, 36.5 million acres – almost 10 percent of all U.S. land used for agriculture – had been placed in the conservation reserve. The U.S. Department of Agriculture estimates the net social benefits from conserving these acres as between $4 billion and $9 billion.[51]

Other industrialized countries have used subsidies to encourage a variety of abatement activities. Canada has a subsidy in place to encourage the reuse and recycling of used tires.[52] Germany, Finland, Norway, and Sweden subsidize farmers if they convert from traditional to organic farming. Belgium, the United Kingdom, Finland, Portugal, Spain, and Turkey all have programs in place that are designed to subsidize reforestation.

[51] Environmental Law Institute. *The United States Experience with Economic Incentives.*.. 1997.
[52] OECD. *Economic Instruments for Pollution Control and Natural Resources Management.*.. 1999.

3. Tax and Subsidy Combinations

In the U.S., ten states have bottle bills.[53] Return rates range from 75 percent to 90 percent.[54] Litter has reportedly decreased by 79 to 83 percent. However, deposit-refund systems can be quite costly to implement and administer. The design of the system is therefore of paramount importance and is the primary determinant of a system's success or failure. The U.S. General Accounting Office reports that firms face increased costs of between 2.4 and 3.2 cents per container in states other than California, where individual stores are responsible for collecting bottles and refunding money to customers.[55] In California the state government has organized redemption centers within convenience zones of a half-mile radius, so that retailers do not have to be directly involved in the redemption of cans and bottles. As a result, costs in California are much lower than in other states, approximately 0.2 cents per can or bottle.[56] Deposit-refund systems in the U.S. have also been applied to used motor oil and lead-acid car batteries.

Deposit-refund systems have been used in Europe to promote proper disposal and recycling of bottles, plastic containers, car hulks, motor oil, and car batteries. Return rates are between 40 and 100 percent. Often refunds are too small to induce the desired amount of returns. For instance, Sweden has attempted to mandate a 75 percent return on car hulks without much success. Because promised refunds are low, other alternatives such as storing and selling parts and then dumping the remaining hulk are preferred to returning it for a refund. Norway's deposit-refund system on car hulks performs quite well due to a much higher refund. The return rate is between 90 and 99 percent.

[53] Container Recycling Institute. *Beverage Container Deposit System in the United States*. 1992.
[54] Wahl, M. Letter to State Representative Lisa Naito. Oregon Dept. of Environmental Quality. Portland, 1995.
[55] US GAO. *Trade-Offs Involved in Beverage Container Deposit Legislation*. 1990.

Other countries impose presumptive charges on water pollutants based on their process and equipment. Polluters that reduce their emissions below the presumed level and can prove it by supplying acceptable monitoring data can get a refund based on the size of the reduction. This system has the advantage of shifting the monitoring burden onto the polluter. One such system in the Netherlands resulted in dramatic reductions in water pollution.[57]

Despite the fact that bottle bills and other deposit refund systems have been quite successful, they have yet to be applied in broader contexts. For example, a tax-subsidy combination could be used to control vehicle pollution with a tax on either gasoline or miles traveled, and a subsidy for newer, smaller (and thus cleaner) vehicles.[58]

4. Permits

While Europe makes greater use of taxes, the United States has extensive experience with tradable permit systems. The original Emissions Trading Program, introduced in 1975, was based on a system of credits, each of which allow one ton per year. Later programs allowed for the trade of pollution allowances defined in tons. Permit systems for leaded gasoline phasedown, water pollutants, ozone-reducing chlorofluorocarbons, and the Regional Clean Air Incentives Market provide valuable lessons for the development of current and future permit systems.

For example, the Fox River water permit system in Wisconsin was designed to control biological oxygen demand (BOD). Initial studies suggested that the use of a permit system would

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[56] Palmer, K., H. Sigman, and M. Walls. "The Cost of Reducing Municipal Solid Waste." Discussion Paper. Resources for the Future. 1996.
[57] Wheeler, D. *Greening Industry: New Roles for Communities, Markets, and Governments*. 1999.
[58] See Fullerton, D. and West, S. "Can Taxes on Cars and on Gasoline Mimic an Unavailable Tax on Emissions?" *Journal of Environmental Economics and Management*. 2002: 135-157.

save over $7 million per year compared to other policy alternatives.[59] However, in reality only one trade occurred over a six-year period. What went wrong? Only a small number of firms could conceivably trade with each other since the permit system was limited to pulp and paper, and municipal waste treatment plants. Transaction costs of trading were also high. Each trade required a modification or re-issuance of the existing permit. A firm had to justify its need for a permit to establish eligibility. Trades that only reduced operating costs were not allowed. Also, firms faced great uncertainty when attempting to evaluate the future value of a permit. Each permit was for a period of five years, but there was no specified allocation after the five-year period.[60]

A more successful tradable permit system for sulfur dioxide emissions was put into place in 1995 in the U.S. to address the problem of acid rain. Emissions of sulfur dioxide were limited to 10 million tons, 50 percent of 1980 levels. Of the plants that participated, most were coal-fired units located east of the Mississippi River. Permits were allocated to units on a historical basis. Units can use the permit, sell the permit to other units, or "bank" the unit for use in subsequent years. Continual emission monitoring (CEM) systems have allowed the government to easily monitor and enforce emission restrictions in accordance with the permits.[61] Any units that exceed the emissions allowed by its permits pays a $2,000 per ton penalty. The second phase of the program, begun in 2000, imposes further limits on the level of sulfur dioxide emissions and brings almost all sulfur dioxide generating units into the system.[62]

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[59] O'Neil, W. "The Regulation of Water Pollution Permit Trading under Conditions of Varying Streamflow and Temperature," in *Buying a Better Environment: Cost-Effective Regulation Through Permit Trading*. Joeres, E. and M. David, eds. Madison: University of Wisconsin Press. 1983, 219-231.
[60] Hahn, R. "Economic Prescriptions for Environmental Problems: How the Patient Followed the Doctor's Orders." *Journal of Economic Perspectives*. 1989: 95-114.
[61] Stavins, R. "What Can We Learn from the Grand Policy Experiment? Lessons from SO2 Allowance Trading." *Journal of Economic Perspectives*. 1998: 69-88.
[62] Stavins, R. "Experience with Market-Based Environmental Policy Instruments." 2000.

Initial evaluations of the first phase of this implementation suggest that it has significantly reduced emissions at a low cost. A significant level of trading has occurred resulting in savings of over $1 billion per year in comparison to command-and-control alternatives. Emissions in 1995 were almost 40 percent below the 10 million-ton limit. One reason for such large reductions in sulfur dioxide emissions below the allowable limit is the banking of permits by units for future use. [63] Overall, U.S. experience with tradable permits suggests that a market with low transaction costs and "thick" with buyers and sellers is critical if pollution is to be reduced at lowest cost.

5. Information as Regulation

One of the most touted information regulatory programs in the United States is the Toxics Release Inventory (TRI). The TRI requires that manufacturing firms report emissions to land, air, and water on an annual basis at the plant level if emissions of a toxic chemical exceeds a threshold. Evidence indicates that the most polluting firms experienced significant declines in stock prices on the day TRI emissions were released to the public.[64] Firms that experienced the largest drop in their stock prices reacted by reducing their reported emissions most in subsequent years.[65]

The United Kingdom, the Netherlands, Norway and Sweden all have publicly available pollution emission inventories in place. The European Union and many individual European countries have plans to implement their own pollution reporting systems in the near future.[66]

[63] Schmalensee, R., P. Joskow, A. Ellerman, J. Montero, and E. Bailey. "An Interim Evaluation of Sulfur Dioxide Emissions Trading." *Journal of Economic Perspectives*. 1998: 53-68.
[64] Hamilton, J. (1995). "Pollution as News: Media and Stock Market Reactions to the Toxics Release Inventory Data." *Journal of Environmental Economics and Management*, vol. 28: 98-113.
[65] Konar, S. and M. Cohen (1997). "Information as Regulation: The Effect of Community Right-to-Know Laws on Toxic Emissions." *Journal of Environmental Economics and Mangement*, vol 32: 109-124.
[66] Peter H. Sand, "The Reality of Precaution: Information Disclosure by Government and Industry," 2nd Transatlantic Dialogue on "The Reality of Precaution: Comparing Approaches to Risk and Regulation", Airlie House/VA, 15 June 2002.

B. Experiences with Market-Based Instruments in Latin America

Market-based instruments have been used far less in Latin America than in either the United States or Europe. However, their use is on the rise. Many Latin American countries have passed laws that grant the right to use emission charges or permit trading systems to address pollution problems. While these countries have encountered complications in implementing market-based incentives, they have greatly increased their understanding of the necessary conditions for success, and continue to improve implementation of incentives in policy making.

1. Emissions Taxes

The primary experiments with direct pollution taxes in Latin America are water charges. Policies in Brazil, Chile, Colombia, and Mexico, for example, set water charges to reflect use and effluent discharges. These policies have generally failed due to lack of enforcement. Local authorities, though many times constitutionally empowered to assess pollution-based water charges, find that institutional constraints and polluter opposition prevent them from properly monitoring pollution and assessing the charges. Colombia managed to implement a moderate exception to this failure. In 1993 it implemented fees related to biological oxygen demand (BOD) and total suspended solids (TSS) levels in water while maintaining a pre-existing minimum effluent standard. A small charge per kilogram of water is assessed that translates to a 5 to 10 percent increase in a household's monthly water bill. These charges are reportedly still too low to cover treatment costs for public utilities, and collection of fees is still one third of the total amount charged, but both BOD and TSS have seen moderate declines since the implementation of the program.[67]

[67] Ardila, S., and Z. Guzman. "Implementation of Water Discharges in Colombia: Problems and Achievements." Presentation. Second World Congress of Environmental and Natural Resource Economists. June, 2002.

Other than these water charge experiments, there has been little experience with direct emission taxes in Latin America. Some conventional taxes designed to generate revenue act as indirect taxes on emissions. For example, Mexico taxes older cars but does not set the tax to reflect pollution differences across car vintages. Generally, however, the Latin American public strongly opposes taxes on polluting goods on the grounds that such taxes are regressive and may stunt local economic development.

2. Environmental Subsidies

Environmental subsidies in Latin America are more common and often take the form of subsidized credit and tax relief:

> They cover abatement investments or clean technology adoption in the industrial sector in Brazil, Mexico, and Colombia, … reforestation activities in Chile and Colombia, mercury emission control in Ecuador, cleaner energy uses in … Ecuador, and Brazil (solar, wind, and gas/hydroelectricity sources, respectively) and chlorofluorocarbon (CFC) phaseout in Colombia, Chile, and Brazil.[68]

Brazil also redistributes revenue back to states from the state value-added tax in partial accordance with the land-use restrictions and conservation provisions in each state. Such policies, perhaps because they involve a transfer from the public to the private sector and not vice-versa, appear to be more successful than emissions taxes. Subsidies to abatement technology have had limited success in inducing proper behavior due to low enforcement of existing emission standards, and lack of monitoring to ensure proper investment of funds.[69]

[68] Huber, R., J. Ruitenbeek, and R. Seroa da Motta. "Market-Based Instruments for Environmental Policymaking in Latin America and the Caribbean. …" 1998.
[69] Huber, R., J. Ruitenbeek, and R. Seroa da Motta. "Market-Based Instruments for Environmental Policymaking in Latin America and the Caribbean. …" 1998.

3. Tax-Subsidy Combinations

Taxes in combination with subsidies are used to address environmental problems in Latin America. As in the United States and Europe, these tax-subsidy instruments most often taken the form of deposit-refund systems. Huber et. al find well-developed deposit-refunds in most major Latin American countries. Most of these are voluntary systems and apply to items such as glass bottles or aluminum cans that have a high resale or reuse value. Informal systems also exist in many countries for paper, plastic, and other recyclable materials such as used motor oil and tires. Mexico is the only Latin American country that has a mandatory deposit-refund system in place, for car batteries.[70] Costa Rica also has a performance bond requirement that covers the cost of reforestation of developed or logged land.[71]

No formal evaluations of these deposit-refund systems exist, but analysts point to the feasibility of these systems due to low legal, institutional, and political barriers.[72] Deposit-refund systems in Latin America also are associated with potential employment and income benefits from collecting and returning containers, particularly for individuals outside the formal job market.

4. Permits

Several countries participate in the Clean Development Mechanism, an international offset program for carbon emissions under the Kyoto Protocol. Firms that find reducing their own carbon emissions relatively expensive can obtain carbon credits through the support of sequestration programs in countries where carbon abatement is relatively inexpensive. Costa

[70] Huber, R., J. Ruitenbeek, and R. Seroa da Motta. "Market-Based Instruments for Environmental Policymaking in Latin America and the Caribbean. …" 1998.
[71] Environmental Department, World Bank. "Five Years After Rio: Innovations in Environmental Policy."1996.

Rica has had a system of tradable offsets since 1995. It has arranged the sale of recognized offsets to both U.S. and Norwegian firms and in return has transferred pastureland into managed forest. Belize, Bolivia, Honduras, Nicaragua, and Panama are all developing similar programs.[73] Permit systems to deal with air emissions are also under consideration in both Peru and Mexico.

The only country in Latin America that has its own tradable permit system in place is Chile.[74] The permit system is for a daily allowable emissions capacity of particulate matter and is coupled with a command-and-control emissions standard. Since monitoring of plant-level emissions does not occur in Chile, these permits are based on current capacity of a plant and the type of fuel used rather than on emissions. These permits are also issued in perpetuity, so that new sources must purchase permits from existing plants already in the system.[75]

Since trading started in 1995, most of it has been within firms and not between them.[76] A number of problems with Chile's tradable permit system stem from institutional deficiencies and poor market design and development. Initial allocations of permits were not well-defined, and property rights were not well-established. Legal uncertainties exist regarding enforcement. High transaction costs and lengthy approval processes for trades, and fear on the part of plants that if they sell permits they will not be able to purchase them back when conditions change have severely limited the number of trades that actually take place.[77] In spite of these problems,

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[72] Huber, R., J. Ruitenbeek, and R. Seroa da Motta. "Market-Based Instruments for Environmental Policymaking in Latin America and the Caribbean. …" 1998.
[73] World Bank, "Five Years After Rio…."
[74] Huber, R., J. Ruitenbeek, and R. Seroa da Motta. "Market-Based Instruments for Environmental Policymaking in Latin America and the Caribbean. …" 1998.
[75] Montero, J. J. M. Sanchez, and R. Katz. "A Market-Based Environmental Policy in Chile." Working Paper. December 2000.
[76] Huber, R., J. Ruitenbeek, and R. Seroa da Motta. "Market-Based Instruments for Environmental Policymaking in Latin America and the Caribbean. …" 1998.
[77] Montero, et. al. "A Market-Based Environmental Policy in Chile." 2000.

introduction of the permit system has resulted in improved compliance with the emissions standard and better air quality for Santiago.[78]

5. Information as Regulation

Information about plants' emissions has not been used by countries in Latin America as a form of environmental regulation.[79] However, Mexico is currently developing an emission reporting system similar to the TRI in the U.S.[80] The World Bank has confirmed that stock markets in developing countries react similarly to those in industrialized countries when information about environmental performance is made public, and in fact that the response is larger than those reported for the TRI.[81]

V. Conclusions and Policy Recommendations for Latin America

While there is little direct evidence on how well market-based instruments perform in Latin America, a number of policy recommendations can be made. We base these recommendations on the experiences of the United States and Europe, on the Latin American experiences that do exist, and on how environmental policy making in Latin America differs from that in the United States and Europe.

[78] Huber, R., J. Ruitenbeek, and R. Seroa da Motta. "Market-Based Instruments for Environmental Policymaking in Latin America and the Caribbean. …" 1998.

[79] At least one developing country, Indonesia, has had wide success with the use of information as regulation. Indonesia implemented a public disclosure program of plants' environmental performance and a rating system referred to as PROPER. For more information, please see World Bank (2000), Pargal, S. and D. Wheeler (1996), and Afsah, S., A. Blackman, and D. Ratunanda. "How Do Public Disclosure Pollution Control Programs Work? Evidence from Indonesia." RFF Discussion Paper 00-44. Oct. 2000. There is limited evidence of success with "private enforcement" lawsuits, which can be a byproduct of public information on emissions, in Colombia, Chile, and Mexico. See Tietenberg, T. "Private Enforcement of Environmental Regulations in Latin America and the Caribbean: An Effective Instrument for Environmental Management?" IADB Washington DC June 1996. NO. ENV-101.

[80] For more information on the development of Mexico's reporting system, see www.cec.org.

[81] Dasgupta, S., B. Laplante, and N. Mamingi (1997). "Capital Market Responses to Environmental Performance in Developing Countries." World Bank Development Research Working Paper, 1909. World Bank: Washington, DC.

1. Because monitoring and enforcement are both difficulty and costly, pollution control policies should attempt to minimize the need for large amounts of direct monitoring. Market-based incentives such as a combined tax and subsidy that shift the burden of proof to the consumer or firm through market transactions are often superior to the use of a tax or subsidy alone.

2. Latin America governments are trying to meet important economic development goals while constrained by a decidedly limited budget. Preference should be given to policies that deliver the most benefits relative to the costs of the policy and are revenue-increasing on net, so that weak environmental protection institutions can become self-sustaining.

3. Instruments that collect environmental tax revenue may allow governments to address distributional concerns, and to increase efficiency in other markets by allowing for the option to recycle revenue (for instance, by reducing the tax burden borne by the poorest people).

4. Funding and the exchange of expertise are needed to help build the institutional capacity of environmental protection agencies throughout Latin America. This will increase effectiveness in policy-making, and allow consideration of a wider number of policy options.

5. Based on the experiences of the United States and Europe, no one policy instrument is suitable for addressing every pollution problem. In fact, political preferences may be a great determinant of the feasible use of certain instruments: for instance, permits are generally preferred in the United States, while policy makers in Europe prefer environmental taxes.

6. In many cases, hybrid instruments that combine aspects of command-and-control standards with market-based instruments allow governments to minimize large uncertainties in the distribution and magnitude of costs and benefits while dealing effectively with practical considerations. In particular, the use of information as regulation and standard and pricing approaches may have promising futures in Latin America.

Continued research into the applicability of market-based instruments to environmental problems in developing countries is needed. Systematic evaluation of Latin America's experiences with these instruments are few. However, discussions to-date indicate that policies that incorporate at least some aspects of incentive-based policies have the potential to allow for more cost-effective pollution control policy than offered by traditional command-and-control.