5 Implications of the US experience with market-based environment strategies for future climate policy

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Introduction

Perspectives in the United States regarding potential public policies to address the threat of global climate change have developed over time within the context of domestic US environmental policies and public and private attitudes toward those policies. Over the past two decades, as market-based environmental policy instruments have been proposed and implemented in the United States, the concept of harnessing market forces to protect the environment has evolved from political anathema to being politically correct. In this chapter, I reflect on these experiences, and assess their implications for current considerations of potential domestic climate policies.[1]

Environmental policies typically combine the identification of a goal with some means to achieve that goal. Although these two components are often linked within the political process, I focus here exclusively on the second component, the means – the "instruments" – of environmental policy. Market-based instruments are regulations that encourage behavior through market signals rather than through explicit directives regarding pollution control levels or methods. These policy instruments, such as tradable permits or pollution charges, can reasonably be described as "harnessing market forces,"[2] because if they are well designed and implemented, they encourage firms or individuals to undertake pollution control efforts that are in their own interests and that collectively meet policy goals.

By way of contrast, conventional approaches to regulating the environment are often referred to as "command-and-control" regulations, since they allow relatively little flexibility in the means of achieving goals. Such regulations tend to force firms to take on similar shares of the

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pollution-control burden, regardless of the cost. Command-and-control regulations do this by setting uniform standards for firms, the most prevalent of which are technology- and performance-based standards. Technology-based standards specify the method, and sometimes the actual equipment, that firms must use to comply with a particular regulation. A performance standard sets a uniform control target for firms, while allowing some latitude in how this target is met.

Holding all firms to the same target can be expensive and, in some circumstances, counterproductive. While standards may effectively limit emissions of pollutants, they typically exact relatively high costs in the process, by forcing some firms to resort to unduly expensive means of controlling pollution. Because the costs of controlling emissions may vary greatly among firms, and even among sources within the same firm, the appropriate technology in one situation may not be appropriate (cost-effective) in another. Thus, control costs can vary enormously on account of a firm's production design, physical configuration, the age of its assets, or other factors. One frequently cited survey of eight empirical studies of air pollution control found that the ratio of actual aggregate costs of the conventional, command-and-control approach to the aggregate costs of least-cost benchmarks ranged from 1.07 for sulfate emissions in the Los Angeles area to 22.0 for hydrocarbon emissions at all domestic DuPont plants (Tietenberg, 1985).[3]

Furthermore, command-and-control regulations tend to freeze the development of technologies that might otherwise result in greater levels of control. Little or no financial incentive exists for businesses to exceed their control targets, and both technology-based and performance-based standards discourage adoption of new technologies. A business that adopts a new technology may be "rewarded" by being held to a higher standard of performance and not given the opportunity to benefit financially from its investment, except to the extent that its competitors have even more difficulty reaching the new standard.[4]

In theory, if properly designed and implemented, market-based instruments allow any desired level of pollution clean-up to be realized at the lowest overall cost to society, by providing incentives for the greatest reductions in pollution by those firms that can achieve these reductions most cheaply.[5] Rather than equalizing pollution levels among firms (as with uniform emission standards), market-based instruments equalize the incremental amount that firms spend to reduce pollution – their marginal cost (Montgomery, 1972, Baumol and Oates, 1988, Tietenberg, 1995). Command-and-control approaches could – in theory – achieve this cost-effective solution, but this would require that different standards be set for each pollution source, and, consequently, that policy-makers obtain detailed information about the compliance costs each firm faces. Such information is simply not available to government. By contrast, market-based instruments provide for a cost-effective allocation of the pollution control burden among sources without requiring the government to have this information.

In contrast to command-and-control regulations, market-based instruments have the potential to provide powerful incentives for companies to adopt cheaper and better pollution-control technologies. This is because with market-based instruments, particularly emission taxes, it always pays firms to clean-up a bit more if a sufficiently low-cost method (technology or process) of doing so can be identified and adopted (Downing and White, 1986, Malueg, 1989, Milliman and Prince, 1989, Jaffe and Stavins, 1995, Jung *et al.*, 1996, Jaffe *et al.*, 2002).

In the next section of the chapter, I examine the normative implications of US experience with market-based environmental policies over the past thirty years.[6] And in the final section, I offer some critical caveats and tentative conclusions.

Implications

Although there has been considerable experience in the United States with market-based instruments for environmental protection, this relatively new set of policy approaches has not replaced nor come anywhere close to replacing conventional, command-and-control approaches. Further, even when and where these approaches have been used in their purest form and with some success, they have not always performed as anticipated. Therefore, I ask what implications arise from our experiences. In particular, I consider normative implications for design and implementation of market-based instruments, analysis of prospective and adopted systems, and identification of new applications.[7]

Implications for design and implementation

The performance to date of market-based instruments for environmental protection provides compelling evidence for environmentalists and others that these approaches can achieve major cost savings while accomplishing their environmental objectives. The performance of these systems also offers lessons about the importance of flexibility, simplicity, the role of monitoring and enforcement, and the capabilities of the private sector to make markets of this sort work.

In regard to flexibility, it is important that market-based instruments should be designed to allow for a broad set of compliance alternatives, in terms of both timing and technological options. For example, allowing flexible timing and intertemporal trading of permits – that is, banking allowances for future use – played an important role in the SO_2 allowance trading program's performance (Ellerman *et al.*, 1997), much as it did in the US lead rights trading program a decade earlier (Kerr and Maré, 1997). One of the most significant benefits of using market-based instruments is simply that technology standards are thereby avoided. Less flexible systems would not have led to the technological change that may have been induced by market-based instruments (Burtraw, 1996, Ellerman and Montero, 1998, Bohi and Burtraw, 1997, Keohane, 2001), nor the induced process innovations that have resulted (Doucet and Strauss, 1994).

With regard to simplicity, transparent formulae – whether for permit allocation or tax computation – are difficult to contest or manipulate. Rules should be clearly defined up front, without ambiguity. For example, requiring prior government approval of individual trades may increase uncertainty and transaction costs, thereby discouraging trading; these negative effects should be balanced against any anticipated benefits due to requiring prior government approval. Such requirements hampered EPA's Emissions Trading Program in the 1970s, while the lack of such requirements was an important factor in the success of lead trading (Hahn and Hester, 1989). In the case of SO_2 trading, the absence of requirements for prior approval reduced uncertainty for utilities and administrative costs for government, and contributed to low transaction costs (Rico, 1995).

While some problematic program design elements reflect miscalculations of market reactions, others were known to be problematic at the time the programs were enacted, but nevertheless were incorporated into programs to ensure adoption by the political process. One striking example is the "20 percent rule" under EPA's Emissions Trading Program. This rule, adopted at the insistence of the environmental community, stipulates that each time a permit is traded, the amount of pollution authorized thereunder must be reduced by 20 percent. Since permits that are not traded retain their full quantity value, this regulation discourages permit trading and thereby increases regulatory costs (Hahn, 1990).

Experience also argues for using absolute baselines, not relative ones, as the point of departure for credit programs. The problem is that without a specified baseline, reductions must be credited relative to an unobservable hypothetical one – what the source would have emitted in the absence of the regulation. A combined system – where a cap-and-trade program is combined with voluntary "opt-in provisions" – creates the possibility for "paper trades," where a regulated source is credited for an emissions reduction (by an unregulated source) that would have taken place in any event (Montero, 1999). The result is a decrease in aggregate costs among regulated sources, but this is partly due to an unintentional increase in the total emissions cap. As was experienced with EPA's Emissions Trading Program, relative baselines create significant transaction costs by essentially requiring prior approval of trades as the authority investigates the claimed counterfactual from which reductions are calculated and credits generated (Nichols *et al.*, 1996).

Experiences with market-based instruments also provide a powerful reminder of the importance of monitoring and enforcement. These instruments, whether price- or quantity-based, do not eliminate the need for such activities, although they may change their character. In the many programs reviewed in this chapter where monitoring and/or enforcement have been deficient, the results have been ineffective policies. One counterexample is provided by the US SO_2 allowance trading program, which includes (costly) continuous emissions monitoring of all sources. On the enforcement side, the Act's stiff penalties (much greater than the marginal cost of abatement) have provided sufficient incentives for the very high degree of compliance that has been achieved (Schmalensee *et al.*, 1998, Stavins, 1998).

In nearly every case of implemented cap-and-trade programs, permits have been allocated without charge to participants. The same characteristic that makes such allocation attractive in positive political economy terms – the conveyance of scarcity rents to the private sector – makes allocation without charge problematic in normative, efficiency terms (Fullerton and Metcalf, 1997). It has been estimated that the costs of SO_2 allowance trading would be 25 percent less if permits were auctioned rather than allocated without charge, because revenues can be used to finance reductions in pre-existing distortionary taxes (Goulder *et al.*, 1997). Furthermore, in the presence of some forms of transaction costs, the post-trading equilibrium – and hence aggregate abatement costs – are sensitive to the initial permit allocation (Stavins, 1995). For both reasons, a successful attempt to establish a politically viable program through a specific initial permit allocation can result in a program that is significantly more costly than anticipated.

Improvements in instrument design will not solve all problems. One potentially important cause of the mixed performance of implemented market-based instruments is that many firms are simply not well equipped to make the decisions necessary to utilize these instruments fully. Since market-based instruments have been used on a limited basis only, and firms are not certain that these instruments will be a lasting component on the regulatory landscape, most companies have chosen not to reorganize their internal structure to exploit fully the cost savings these instruments offer. Rather, most firms continue to have organizations that are experienced in minimizing the costs of complying with command-and-control regulations, not in making the strategic decisions allowed by market-based instruments.[8]

The focus of environmental, health, and safety departments in private firms has been primarily on problem avoidance and risk management, rather than on the creation of opportunities made possible by market-based instruments. This focus has developed because of the strict rules companies have faced under command-and-control regulation, in response to which companies have built skills and developed processes that comply with regulations, but do not help them benefit competitively from environmental decisions (Reinhardt, 2000). Where significant changes in structure and personnel are absent, the full potential of market-based instruments will not be realized.

Implications for analysis

When assessing market-based environmental programs, economists need to employ some measure by which the gains of moving from conventional standards to an economic-incentive scheme can be estimated. When comparing policies with the same anticipated environmental outcomes, aggregate cost savings may be the best yardstick for measuring the success of individual instruments. The challenge for analysts is to make fair comparisons among policy instruments: either idealized versions of both market-based systems and likely alternatives; or realistic versions of both (Hahn and Stavins, 1992).

It is not enough to analyze static cost savings. For example, the savings due to banking allowances should also be modeled (unless this is not permitted in practice). It can likewise be important to allow for the effects of alternative instruments on technology innovation and diffusion (Milliman and Prince, 1989, Doucet and Strauss, 1994, Jaffe and Stavins, 1995), especially when programs impose significant costs over long time horizons (Newell *et al.*, 1999). More generally, it is important to consider the effects of the pre-existing regulatory environment. For example, the level of pre-existing factor taxes can affect the total costs of regulation (Goulder *et al.*, 1997), as indicated above.

Implications for identifying new applications

Market-based policy instruments are considered today for nearly every environmental problem that is raised, ranging from endangered species preservation to what may be the greatest of environmental problems, the greenhouse effect and global climate change.[9] Experiences with market-based instruments offer some guidance to the conditions under which such approaches are likely to work well, and when they may face greater difficulties.

First, where the cost of abating pollution differs widely among sources, a market-based system is likely to have greater gains, relative to conventional, command-and-control regulations (Newell and Stavins, 2002). For example, it was clear early on that SO_2 abatement cost heterogeneity was great, because of differences in ages of plants and their proximity to sources of low-sulfur coal. But where abatement costs are more uniform across sources, the political costs of enacting an allowance trading approach are less likely to be justifiable. Given the exceptional diversity of anthropogenic sources of greenhouse gas emissions, this first implication argues strongly for the use of market-based instruments for addressing global climate change.

Second, the greater is the degree of mixing of pollutants in the receiving airshed or watershed, the more attractive will a market-based system be, relative to a conventional uniform standard. This is because taxes or tradable permits, for example, can lead to localized "hot spots" with relatively high levels of ambient pollution. This is a significant distributional issue, and it can also become an efficiency issue if damages are non-linearly related to pollutant concentrations. In cases where this is a reasonable concern, the problem can be addressed, in theory, through the use of "ambient permits" or through charge systems that are keyed to changes in ambient conditions at specified locations (Revesz, 1996). But despite the extensive theoretical literature on such ambient systems going back to Montgomery (1972), they have never been implemented, with the partial exception of a two-zone trading system under Los Angeles' RECLAIM program. Because greenhouse gases are uniformly-mixed pollutants, this second implication also recommends the use of market-based instruments in the climate change context.

Third, the efficiency of price-based (tax) systems compared with quantity-based (tradable permit) systems depends on the pattern of costs and benefits. If uncertainty about marginal abatement costs is significant, and if marginal abatement costs are quite flat and marginal benefits of abatement fall relatively quickly, then a quantity instrument will be more efficient than a price instrument (Weitzman, 1974). Furthermore, when there is also uncertainty about marginal benefits, and marginal benefits are positively correlated with marginal costs (which, it turns out, is not uncommon), then there is an additional argument in favor of the relative efficiency of quantity instruments (Stavins, 1996).

On the other hand, the regulation of stock pollutants will often favor price instruments when the optimal stock level rises over time (Newell and Pizer, 2000). It should also be recognized that despite the theoretical efficiency advantages of hybrid systems – non-linear taxes, or quotas combined with taxes – in the presence of uncertainty (Roberts and Spence, 1976, Kaplow and Shavell, 1997),[10] virtually no such hybrid systems have been adopted. The stock pollutant nature of greenhouse gases argues in favor of price-based mechanisms.

Fourth, the long-term cost-effectiveness of taxes versus tradable permit systems is affected by their relative responsiveness to change. This arises in at least three dimensions. In the presence of rapid rates of economic growth, a fixed tax leads to an increase in aggregate emissions, whereas with a fixed supply of permits there is no change in aggregate emissions (but an increase in permit prices). In the context of general price inflation, a unit (but not an *ad valorem*) tax decreases in real terms, and so emissions levels increase; whereas with a permit system, there is no change in aggregate emissions. In the presence of exogenous technological change in pollution abatement, a tax system leads to an increase in control levels, i.e. a decrease in aggregate emissions, while a permit system maintains emissions, with a fall in permit prices (Stavins and Whitehead, 1992). These implications regarding responsiveness to change suggest that a national preference between taxes and tradable permits will reasonably depend upon specific domestic circumstances.

Fifth, tradable permits will work best when transaction costs are low, and experience demonstrates that if properly designed, private markets will tend to render transaction costs minimal. Sixth, a potential advantage of tradable permit systems in which allocation is without charge, relative to other policy instruments, is associated with the incentive thereby provided for pollution sources to identify themselves and report their emissions (in order to claim their permits).

Seventh, it is important to keep in mind that in the absence of decreasing marginal transaction costs (essentially volume discounts), the equilibrium allocation and hence aggregate abatement costs of a tradable permit system are independent of initial allocations (Stavins 1995). Hence, an important attribute of a tradable permit system is that the allocation decision can be left to politicians, with limited normative concerns about the potential effects of the chosen allocation on overall cost-effectiveness. In other words, cost-effectiveness or efficiency can be achieved, while distributional equity is simultaneously addressed with the same policy instrument. This is one of the reasons why an international tradable permit mechanism is particularly attractive in the context of concerns about global climate change. Allocation mechanisms can be developed that address legitimate equity concerns of developing countries, and thus increase the political base for support, without jeopardizing the overall cost-effectiveness of the system.[11]

Eighth and finally, considerations of political feasibility point to the wisdom (more likely success) of proposing market-based instruments when they can be used to facilitate a cost-effective, aggregate emissions reduction (as in the case of the SO_2 allowance trading program in 1990), as opposed to a cost-effective reallocation of the status quo burden. Policy instruments that appear impeccable from the vantage point of research institutions, but consistently prove infeasible in real-world political institutions, can hardly be considered "optimal."

Caveats and conclusions

Some eighty years ago, economists first proposed the use of corrective taxes to internalize environmental (and other) externalities (Pigou 1920). But it was a little more than a decade ago that the portfolio of potential economic-incentive instruments was expanded to include quantity-based mechanisms – tradable permits – and these incentive-based approaches to environmental protection began to emerge as prominent features of the US policy landscape.

Given that most experience with market-based instruments has been generated quite recently, one should be cautious about drawing conclusions from these experiences. Important questions remain. For example, relatively little is known empirically about the impact of these instruments on technological change. Also, much more empirical research is needed on how the pre-existing regulatory environment affects performance, including costs. Moreover, the great successes with tradable permits have involved air pollution: acid rain, leaded gasoline, and chlorofluorocarbons. Experience (and success) with water pollution is much more limited, and in other areas there has been no experience at all. Even for air pollution problems, the differences between SO_2 and acid rain, on the one hand, and the combustion of fossil fuels and global climate change, on the other, suggest that a rush to judgment regarding global climate policy instruments is unwarranted.

Furthermore, the experiences reviewed in this chapter are of *domestic* US policies, and to whatever degree they offer implications for potential future climate policies such implications would be for *domestic* policies (and primarily for the United States). But climate change is fundamentally a global problem, and successful policies to address it will need to feature international, if not fully global, dimensions. Unfortunately, international versions of domestic policy instruments, such as tradable permit systems, cannot be based upon simple extrapolations to the multinational realm. When economists consider domestic environmental problems, they ordinarily put aside participation and compliance issues, because the existence of an effective government vested with effective coercive powers is assumed. In the international domain, however, full national sovereignty for individual nations means that free-rider problems make it unlikely that adequate participation and compliance will be achieved (Barrett and Stavins, 2002).[12]

There are sound reasons why the political world has been slow to embrace the use of market-based instruments for environmental protection, including the ways economists have packaged and promoted their ideas in the past: failing to separate means (cost-effective instruments) from ends (efficiency); and treating environmental problems as little more than "externalities calling for corrective taxes." Much of the resistance has also been due, of course, to the very nature of the political process and the incentives it provides to both politicians and interest groups to favor command-and-control methods instead of market-based approaches.

But, despite this history, market-based instruments have moved center stage, and policy debates look very different from the time when these ideas were characterized as "licenses to pollute" or dismissed as completely impractical. Market-based instruments are considered seriously for each and every environmental problem that is tackled, ranging from endangered species preservation to regional smog to global climate change. Market-based instruments – and, in particular, tradable permit systems – will enjoy increasing acceptance in the years ahead.

No particular form of government intervention, no individual policy instrument – whether market-based or conventional – is appropriate for all environmental problems. Which instrument is best in any given situation depends upon a variety of characteristics of the environmental problem, and the social, political, and economic context in which it is being regulated. There is clearly no policy panacea. Indeed, the real challenge for bureaucrats, elected officials, and other participants in the environmental policy process comes in analyzing and then selecting the best instrument for each situation that arises.

Notes

1 Note that I consider the potential implications of US experiences with market-based environmental strategies for possible future *domestic* climate policies. The normative and positive lessons that can be drawn for the *international* dimensions of climate policies (for example, for the architecture

permit systems, cannot be based upon simple extrapolations to the multinational realm. When economists consider domestic environmental problems, they ordinarily put aside participation and compliance issues, because the existence of an effective government vested with effective coercive powers is assumed. In the international domain, however, full national sovereignty for individual nations means that free-rider problems make it unlikely that adequate participation and compliance will be achieved (Barrett and Stavins, 2002).[12]

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1 Note that I consider the potential implications of US experiences with market-based environmental strategies for possible future *domestic* climate policies. The normative and positive lessons that can be drawn for the *international* dimensions of climate policies (for example, for the architecture

or specific policies employed in current or future international agreements) are much more tenuous and are outside the scope of this analysis. I comment on this in the concluding section of the chapter.

2 See Organization for Economic Cooperation and Development (1989, 1991, 1998), Stavins (1988, 1991), and US Environmental Protection Agency (1991, 1992, 2001). Another strain of literature – known as "free market environmentalism" – focuses on the role of private property rights in achieving environmental protection.

3 These numbers are subject to misinterpretation. *Actual* command-and-control instruments are being compared with *theoretical* benchmarks of cost-effectiveness, i.e. what a perfectly functioning market-based instrument would achieve in theory. A fair comparison among policy instruments would involve either idealized versions of both market-based systems and likely alternatives; or realistic versions of both (Hahn and Stavins, 1992).

4 When more stringent standards are put in place for new sources relative to existing ones, a common practice in US environmental law (under so-called "new source review"), the result is a particularly perverse set of incentives that act to retard technological change (Gruenspecht and Stavins, 2002).

5 In this chapter, I focus on market-based policy instruments in the environmental realm, chiefly those instruments that reduce concentrations of pollution, as opposed to those that operate in the natural resources realm. This means, for example, that tradable development rights, wetlands mitigation banking, and tradable permit systems used to govern the allocation of fishing rights are not reviewed. The distinction between environmental and natural resource policies is somewhat arbitrary. Some policy instruments which are seen to bridge the environmental and natural resource realm, such as removing barriers to water markets, are considered.

6 Experiences in the United States with market-based environmental policy instruments have been both numerous and diverse, and can be considered within four major categories: pollution charges; tradable permits; market friction reductions; and government subsidy reductions. For a comprehensive survey, see Stavins (2003).

7 For an examination of positive political economy implications, see Keohane *et al.* (1998).

8 There are some interesting exceptions. See Hockenstein *et al.* (1997).

9 See, for example, Goldstein (1991) and Bean (1997) on species protection, and Fisher *et al.* (1996), Hahn and Stavins (1995), Schmalensee (1996), and Stavins (1997) on applications to global climate change. More broadly, see Ayres (2000).

10 In addition to the efficiency advantages of non-linear taxes, they also have the attribute of reducing the total (although not the marginal) tax burden of the regulated sector, relative to an ordinary linear tax, which is potentially important in a political economy context.

11 See, for example, the proposal for "growth targets" by Frankel (1999).

12 There are also a host of other, more specific problems that arise in the international domain. For example, the theory of tradable permits assumes the existence of profit-maximizing or cost-minimizing agents who have

knowledge of their own marginal abatement cost functions. Such a simple objective function cannot be assumed in the case of national governments, nor can satisfaction of the related information requirement. This is examined in detail by Hahn and Stavins (1999).

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