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Climate Policy Design under Uncertainty

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RESOURCES FOR THE FUTURE

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Abstract

The uncertainty surrounding both costs and benefits associated with global climate change mitigation creates enormous hurdles for scientists, stakeholders, and decisionmakers. A key issue is how policy choices balance uncertainty about costs and benefits. This balance arises in terms of the time path of mitigation efforts as well as whether those efforts, by design, focus on effort or outcome. This paper considers two choices—price versus quantity controls and absolute versus relative/intensity emissions limits—demonstrating that price controls and intensity emissions limits favor certainty about cost over climate benefits and future emissions reductions. The paper then argues that in the near term, this favoritism is desired.

Key Words: carbon, climate, policy, intensity, global warming, uncertainty, price, quantity

JEL Classification Numbers: D81, Q54, Q58

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Introduction

The uncertainty surrounding the costs and benefits associated with global climate change mitigation creates enormous obstacles for scientists, stakeholders, and especially policymakers seeking a practical policy solution. Scientists find it difficult to accurately quantify and communicate uncertainty; business stakeholders find it difficult to plan for the future; and policymakers are challenged to balance competing interests that frequently talk past each other.

Most emissions trading programs to date have focused on absolute caps that either remain fixed or decline over time. Examples include the U.S. SO_2 trading program and NO_x Budget Program, the EU Emissions Trading Scheme (EU ETS), Southern California's NO_x RECLAIM program, and a host of other regional pollutant trading schemes in the United States.[1] Even the Kyoto Protocol, by most accounts, is viewed as a first step in capping emissions that must then lead to even lower levels in subsequent periods.

Yet, the uncertainty surrounding climate change suggests that such an approach to regulating greenhouse gas emissions is problematic. On the one hand, we are unsure about what atmospheric concentrations need to be in the long run to prevent dangerous interference with the climate system.[2] And regardless of the stabilization target, considerations of the global economic system and its dependence on fossil fuels suggests that optimal global emissions trajectories will continue to grow for some time (Manne and Richels 1999; Wigley et al. 1996). On the other hand, economic analysis suggests that for most plausible assumptions, price-based policies—rather than quantitative caps—are more efficient for addressing the problem of climate change in the face of uncertainty (Pizer 2002; Newell and Pizer 2003).

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[1] Fuel taxes do exist (e.g., gasoline) but are typically motivated by revenue concerns. There is also a jurisdictional problem that tax-based environmental regulation would likely fall under the purview of the Finance/Ways and Means Committees, rather than Environment and Public Works/Environment and Natural Resource Committees. Perhaps most importantly, viewing environmental regulation as a tax is clearly seen as a negative—and is used that way by stakeholders seeking to diminish support for such regulations (National Mining Association 2005).

[2] This is the language used in the UN Framework Convention on Climate Change to describe the eventual goal of global cooperation on climate change mitigation.

From an economic point of view, then, emissions caps—and in particular non-increasing emissions caps—may be less desirable in the near term. Other arguments arise in the non-economic rhetoric against caps, positing that we do not know enough to proceed with limits on carbon dioxide emissions, that such limits would otherwise impede economic growth, and that the most prudent action is technology policy.

With concern over simple emissions caps and the consequences of uncertainty as a backdrop, this paper explores how two mechanisms—an intensity-based emissions target and a price-based safety valve—can attenuate some of the economic downsides of emission caps. Importantly, the discussion does not start and end with a neo-classical economics perspective. The most simple and elegant solution may not, in fact, satisfy key stakeholder concerns. Without trying to fully explain these concerns, the paper considers how policy design can disarm the non-economic rhetoric.

Background on Market-Based Programs: Experience with Cost Uncertainty

Market-based programs have a long and varied history in the United States. While the SO_2 trading program is perhaps the best known example, trading programs have been used to regulate NO_x emissions, halibut and sablefish fisheries, lead in gasoline, and even pollution from heavy-duty engines (see Chapter 6 of Council of Economic Advisers 2002). Some, including the regulation in lead in gasoline and pollution from heavy-duty engines, are examples of tradable performance standards. That is, pollution allowances are given out in relation to production; more production means more allowances and more pollution—an idea we will come back to a little later.

Historically, major policy actions typically follow after a convergence of opinions about costs and benefits. In the case of the 1990 Clean Air Act Amendments creating the SO_2/acid rain trading program, there was a remarkable alignment of science on both the cost and benefits of controls (Kete 1993). Both suggested that a 50 percent reduction in emissions was scientifically justified and economically reasonable. On top of that, there was a remarkable determination within the White House to implement these reductions using a flexible cap-and-trade program.

An important feature in the SO_2 cap-and-trade program was its banking provision: Allowances that remained unused at the end of any compliance period could be saved for use in any future compliance period without any limitations. Figure 1 shows the pattern of allowance use and banking through 2003. Most analyses find that this feature accounted for a large part of cost-savings (Carlson et al. 2000; Ellerman et al. 2000). In addition to smoothing out the path of emissions between the two phases of the program, allowance banking also created a large reserve that could accommodate annual fluctuations in emissions levels. Starting with more than 3 million allowances after the first year and rising to more than 10 million in 1999, there were 8.6 million allowances in the bank at the end of 2003 (U.S. E.P.A. 2004a).

Figure 2 shows SO_2 allowance prices from the beginning of the program until the present. Despite large (10 percent) fluctuations in annual emissions, allowance prices remained in a fairly narrow range of $100–$200 per ton until this year, when expectations of further reduction requirements under the Clean Air Interstate Rule (CAIR) began to incite additional abatement and banking.[3] The same cannot be said for other trading programs in which banking is not allowed or has not developed.

For example, Figure 3 shows the path of allowance prices in the RECLAIM market in the South Coast Air Quality Management District surrounding Los Angeles. The RECLAIM program included one-year compliance periods with no banking. But because the compliance periods were overlapping for different sources—some ended in December and others in June—it would have been possible to create a bank through trading. However, no such bank developed, and when the California energy crisis struck in the fall of 2000 and NO_x-emitting, gas-fired electricity generation increased to fill the gap caused by abnormally low hydroelectric generation, prices skyrocketed from about $3,000 per ton to more than $70,000.

Figure 4 shows the price of allowances in the NO_x Ozone Transport Commission (OTC) market and subsequent State Implementation Plan (SIP) call market (after 2003; jointly referred to as the NO_x Budget Program). The NO_x market allows use of banked allowances up to 10 percent of annual allocations without penalty; after 10 percent, banked allowances must be retired 2:1 for every ton emitted (referred to as "flow control"). This occurred, for example, after a large number of allowances were banked in 1999. Also, when the OTC program was subsumed into the SIP call program in 2003, banked allowances could only carry over in 2003 with considerable restrictions and limits. This banking constraint, coupled with concerns about high natural gas prices, explains why prices jumped in 2003. The jump in 1999, the first compliance

[3] Under the proposed rule, current allowances could be banked and used to comply with tighter emissions limits in the future.

year, occurred because of uncertainty about allocation and participation as the program started—again without a bank.[4]

The lesson from all of these market-based programs regarding cost uncertainty is fairly clear: a large and unrestricted bank substantially buffers prices, as it has in the SO_2 program. Prices in that program remained in the $100–$200 range for nearly 10 years, until expectations of a tighter program in the future have drove prices up to $700, close to their expected level under a future program. In contrast, a restricted or absent bank creates circumstances where prices can spike up by a factor of 5, 10, or even 20 times in the face of a shortage.

Uncertainty about Climate Change Mitigation Benefits

Among the many features that distinguish climate change mitigation from conventional pollution control, two loom large. One is the time scale: while SO_2 and NO_x controls are focused on immediate concentration levels related to current emissions, greenhouse gas controls are focused on long-term concentration levels related to accumulated emissions over many decades. The other is uncertainty: we have relatively strong epidemiological evidence on fine particulates that has allowed us to estimate benefits on the order of $500–$2,300 for NO_x and $3,700–$11,000 for SO_2.[5] At the same time, a recent summary of various studies of climate change mitigation found estimated benefits of between $3 and $20 per ton of CO_2—a slightly higher high-to-low estimate ratio of six compared to the three-five range associated with SO_2 and NO_x.[6] Yet broader studies find wider ranges for CO_2; Tol (forthcoming) finds estimates as high as $450.

Distinct from these cost-benefit analyses, decisionmakers and scientists can alternatively describe a “safe” level of greenhouse gases in the atmosphere and seek an emissions trajectory that preserves it. This is the approach suggested by the United Nations Framework Convention on Climate Change, whose goal is to stabilize concentrations at levels that avoid “dangerous anthropogenic interference with the climate system,” and in the United States Clean Air Act, which sets air quality standards for conventional pollutants that “are requisite to protect the

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[4] Here, a key question was whether Maryland, an expected net seller, would participate in the program. With the risk they would not participate, prices spiked, reflecting the expected loss of market supply; once it was clear they would be part of the program, prices returned to normal.

[5] See page 46 of OMB (2000).

[6] See table 13 of Gillingham et al. (2004).

public health."[7] Unfortunately, this adds additional hurdles to climate policy design: not only must a safe level be chosen, but also the corresponding emissions must be allocated across nations and time.[8]

This uncertainty about mitigation benefits has been the major reason why the Bush administration has avoided mandatory emissions controls for greenhouse gases. On February 14, 2002, President Bush noted that compared to conventional pollution of SO_2 and NO_x, "the science [of climate change] is more complex, the answers are less certain, and the technology is less developed" (White House 2002). Earlier, in a March 13, 2001 letter to Senator Hagel, President Bush stated, "I do not believe … that the government should impose on power plants mandatory emissions reductions for carbon dioxide, which is not a 'pollutant' under the Clean Air Act … This is especially true given the incomplete state of scientific knowledge of the causes of, and solutions to, global climate change and the lack of commercially available technologies for removing and storing carbon dioxide" (White House 2001).

Uncertainty has had exactly the opposite effect in Europe (Majone 2002) where, in addition to ratifying the Kyoto Protocol, the European Union initiated its Emissions Trading Scheme in January 2005, creating the largest emissions trading market in the world (Kruger and Pizer 2004). While the reduction requirements, allowance price, and overall stringency remain unclear, there is no arguing that the EU has taken the question of immediate emissions reductions more seriously than the United States. The July 2005 price of allowances in the European market was €30 per ton of CO_2 (Point Carbon 2005).

Price-Based Approaches

Environmental policies, despite appearances to the contrary, typically revolve around economic costs. Even where the law requires standards set to protect the public health, without regard to cost, some notion of reasonableness enters the analysis. Often, this may be an attempt to identify the "knee" of the cost curve—the point where further environmental controls quickly

[7] Article 2, UNFCCC and Section 109(b)(1), Clean Air Act.

[8] While cost-benefit analysis may involve debate over the correct measurement of benefits (and costs), it remains a well-defined paradigm. The determination of a "safe" level requires an initial debate over what constitutes "safety" before then connecting concentration (and eventually emission levels) to that definition. See also discussion in Kopp 2004.

become more expensive (Sagoff 2003). Or, there is some basic notion of what society will bear in terms of dislocation and burden.

As President Bush noted above, there are no proven technologies for controlling greenhouse gas emissions from fossil fuel combustion; the only alternative to is turn burn less fuel.[9] This means switching from coal to gas, or gas to nuclear and/or renewables, or using less energy overall. It also means that emissions reductions are necessarily modest—there are no scrubbers or catalysts to reduce emissions with otherwise modest changes in behavior. Indeed, as countries have been forced to enact actual emissions limits in Europe, their National Allocation Plans have focused on levels at, or slightly above, current levels (Forrester 2004). The proposal by the National Commission on Energy Policy similarly suggests a gradual deflection from an otherwise business-as-usual emissions path (NCEP 2004b).

The problem with seeking such modest emissions reductions is that they do not naturally allow creation of the kind of allowance bank that has arguably been so important in many existing programs. In the SO_2 program, the bank equaled half the annual emissions limit after the first year. In the NO_x OTC program, the bank equaled about 20 percent of the annual limit after the first year.[10] Modeling of modest CO_2 policies suggest a bank of perhaps 2–3 percent after the first year.[11] While an eventual bank of 10 percent or more is possible—this is the range suggested in the NO_x Budget Program based on potential emission increases owing to temporary reductions in nuclear generation—it is unlikely to happen immediately.

This raises the question of whether and how one might avoid the risk of price spikes seen in the RECLAIM and NO_x Budget Programs. Some degree of temporarily high prices may be acceptable and even desirable as a way to preserve a given expected allowance price and to induce desired actions. However, price spikes up to 20 times the typical level are hard to justify. The highest estimate of NO_x benefits was $2,300 per ton—yet prices went to $7,000 in the Budget Program and $90,000 in the RECLAIM program.

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[9] Capture and sequestration is theoretically possible at central power stations but at estimated costs of $50–70 per ton of CO_2 (Anderson and Newell 2004). Despite small projects and trials, large-scale projects have yet to demonstrate the practicality of such options.

[10] Some of this reflects early reduction credits given out for activities prior to the first year of the program; during the first few years of the program, abatement continued to be 5 to 10 percent below the required emissions level, and the bank continued to grow (U.S. E.P.A. 2004b).

[11] See Table B20 in EIA 2004 (2004) and Figure 5 in NCEP (2004a).

A transparent way to address these risks is to provide additional allowances at a fixed price. This so-called "safety valve" limits price spikes in much the same way that governments might intervene in currency and bond markets to limit fluctuations. The difference here is that the government is intervening in a market that was, itself, created by the government.[12] Such mechanisms have already been used in markets for individual fishing quotas and renewable portfolio standards. They were also proposed in the Bush administration's Clear Skies Initiative to reduce NO_x, SO_2 and mercury (Hg) emissions and included in the recommendations of the National Energy Commission to control greenhouse gas emissions. In some cases, the price is set at a level that is expected to be achieved, in which case the safety valve is effectively setting the market price; in other cases, the price is set a level somewhat above the expected market price and functions more as an emergency mechanism.

As noted in Pizer (2002) and Newell (2003), there are clear economic arguments for favoring a price-based approach to regulating greenhouse gas emissions. Emissions accumulate gradually over time, making particular emissions levels in a given year less important than long-term downward pressure. Empirical estimates of damage functions are also hard-pressed to justify strict emissions limits. Yet more convincing, in many ways, is the common sense argument that preserving the cap at all costs is simply not worth it. Two questions logically follow: how likely is it that the cost will rise to unbearable levels, and should there be an automatic mechanism to deal with it? While allowance banking often provides a cushion that significantly reduced the likelihood of such events, the fact that a bank may be slow to develop raises concerns about whether that particular cushion will arise and how quickly. Price-based mechanisms provide an obvious and transparent alternative.

Intensity Targets: Disarming Long-Term Concerns

A safety-valve mechanism can either be set at a level that will become the market price or at a level that reduces its chances of being activated. For example, in the Clear Skies Initiative, the safety-valve prices for NO_x, SO_2, and Hg were set at about three times the estimated market price of allowances. In contrast, the National Commission on Energy Policy recommended a safety-valve price for CO_2 that would quickly become the market price under the reference case modeling.

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[12] See Newell et al (2005) and Pizer (2002).

This raises an interesting question: What is the best way to set the safety-valve level and/or the associated quantitative emissions target? With well-defined costs and benefits, it is straightforward to determine the welfare-maximizing solution. This was the general question examined by Weitzman (1978) and Roberts and Spence (1976), while Pizer (2002) focused specifically on climate change. Pizer concluded that the welfare-maximizing choice for climate change set the safety valve at the expected marginal benefit and the emissions target substantially below the otherwise "optimal" target without a safety valve—that is, a fairly aggressive emissions target that will trigger the safety valve most of the time.

Of course, economic optimization is not the only criteria for policy. One reason for preferring an emissions trading program with a safety valve over a simply carbon tax is that the government can give out most of the emissions rights rather than making emitters pay for them.[13] This is itself not without economic consequence, as the revenues could be used to reduce the burden of the existing tax system (Parry 1995). However, the interest among emitters in receiving those rights is quite strong (Braine 2003) and efforts to use them in other ways creates additional opposition to the proposed policy (Samuelsohn 2003). This is true despite studies suggesting that only a fraction of the allowances are needed to make key emitting sectors equally well off (Goulder and Bovenberg 2002).

This further suggests that setting a reasonable emission target may be just as important as setting a reasonable safety valve. In addition to this concern over allowance allocation, there are two other reasons the target is important. First, even if a safety valve is proposed, stakeholders may be concerned that the safety valve mechanism will be removed—either before the policy is finalized or phased out at some point in the future (Peabody Energy 2005). Indeed, as pointed out all along, the presence of a sufficiently large bank could serve the same insulating purpose, making the safety valve less important in the future. Second, as a negotiating tool, the emissions target has important symbolic and practical consequences, given uncertainty about future targets. Namely, it becomes a natural focal point for discussions of both future targets and, in an international setting, targets in other nations. Were there no uncertainty about mitigation costs

[13] Note that this would not be true for an extremely aggressive cap—say one tending toward zero—where there are no emissions rights to distribute. For CO_2, however, even an aggressive cap implies only a 10 percent or so reduction from businesss-as-usual forecasts in the near term (see Weyant (1999) for a summary of the relationship between emissions prices and abatement levels).

and benefits and the likely level/path of future emissions reductions, this would be much less important.

As it is, there is tremendous uncertainty surrounding future reductions. Part of this uncertainty is over future technological developments and economic growth, and the concern is whether an emissions limit, however modest, will in time become unduly onerous. Such concern underlies the Byrd-Hagel resolution, reflecting the U.S. Senate's reluctance to consider any climate treaty that would adversely affect the U.S. economy (U.S. Senate 1997). Similarly, a common theme among critics of any action, however modest, is that it is simply a vehicle to force much more aggressive reductions in the future—the proverbial camel's nose under the tent (Payne 2001). If past policies for SO_2 and NO_x are any guide, that tendency to reduce, rather than slow the growth of, emissions would certainly seem plausible. Yet most economic analysis suggests optimal trajectories with rising emissions for the next decade or two (Manne and Richels 1999; Wigley et al. 1996). Note that the issue here is not whether historic emissions trajectories for SO_2 and NO_x were or were not optimal, or whether future emissions trajectories for greenhouse gases will be optimal—the issue is that existing policy tools inevitably carry with them the history and associations related to their past use.

This is where an intensity target may be able to help. An intensity target, analogous to the tradable performance standards used in some domestic pollution programs, would target emissions levels in relation to aggregate economic activity. As the economy grows, an intensity target would naturally allow more emissions. In fact, because economies typically grow faster than their use of energy and emissions of greenhouse gases, an intensity target would likely come in the form of a rate of decline, rather than an absolute level. For example, the Bush administration called for an 18 percent decline in emissions intensity over 10 years (Bush 2002). The National Commission on Energy Policy recommended a 2.4 percent annual decline (NCEP, 2004b, 14).

Unlike a cap, an intensity target does not automatically become more onerous as time passes: rather, a conscious choice must be made to lower the target. Thus, while an intensity target can achieve the same results as an ordinary emissions cap, it does not have the same natural tendencies to do so and, in fact, tends to be less aggressive. In an uncertain world where targets are being set and then revised, this changes expectations about what future targets might look like and, to those concerned about a modest policy evolving into an aggressive one, could assuage critics' fears. It is worth noting that these uncertainties and concerns about the consequences of an ordinary emissions cap, as well as the potential advantages of an intensity target, are only amplified for developing countries.

It is also worth noting that an intensity approach is in no way an alternative to the safety valve in terms of ameliorating short-term price spikes. There is a tendency, after recognizing that some amount of cost uncertainty hinges on fluctuations in annual economic growth, to imagine emissions intensity targets as a way to naturally hedge against such fluctuations. Unfortunately, while emissions growth is tied to economic growth, so is improvement in technology—so much so that intensity targets could lead to higher price spikes. Worse, those price spikes occur in the face of low growth rather than high growth (Pizer 2004; Ellerman and Sue Wing 2003). For these reasons, it makes sense to think about intensity targets as a way to frame long-term goals but not as way to accommodate short-term economic fluctuations.

Thinking about intensity targets simply as a way to frame long-term goals rather than a mechanism to respond to revised estimates of economic activity implies that they can, at a practical level, be implemented as an ordinary emissions trading program. That is, the intensity target is applied to forecasts of economic activity over a fixed horizon (say 10 years). The resulting emissions levels then become the target in an ordinary trading program. This is exactly the formulation under a recent proposal by Senator Jeff Bingaman (Senate Energy Committee 2005).

Finally, whether one views intensity targets as a good thing hinges on both positive and normative arguments—none of which are as clear from an economics point of view as the price/quantity distinction. On the positive side, the argument is that equivalent intensity and emissions targets are likely to lead to different targets in the future. The Bush administration, for example, has a target of reducing intensity by 18 percent over 2002–2012 to 150 tons per million dollars of GDP. That is equivalent to an absolute target of 2,173 million tons (Bush 2002). Ignoring for a moment the voluntary nature of the target, the point is that framing the 2012 target as 150 tons per million dollars of GDP will likely lead to a different choice of targets after 2012 compared to a target described as 2,173 million tons—even though they are equivalent in 2012.

To a dispassionate analyst, this may sound crazy: Why would the way the initial target is described—given that either achieves precisely the same emissions and cost outcome—lead to a different target choice in the future? The answer is that this choice of description may, in fact, *not* lead to a different target choice. But if stakeholders *believe* it might make a difference, much the way people may believe certain types of advertising make a difference, it can affect their support for the policy. In particular, stakeholders may be concerned that to show progress, the numbers "need to go down." Because GDP is growing, emissions can go up while intensity goes down. The same is not true for an ordinary emissions target.

If one agrees with this positive argument that there is a difference, or at least people believe there is a difference, the question becomes practical—which formulation brings together the necessary people? For those convinced that emissions need to start going down immediately, perhaps because of preferences for a particularly low concentration goal, it would be absolute targets. For those concerned more about protecting the economy, the ability to fine-tune the target without jumping to emission decreases makes intensity targets appealing.

Conclusions

The uncertainty surrounding the costs and benefits of climate change mitigation make it particularly challenging for policymakers: we are unsure about the appropriate response, we are unsure how the appropriate response will change over time, and we are unsure how much any particular response—viewed in terms of an emissions level—will cost. While early work in the area of uncertainty and climate change focused on the role of sequential decisionmaking and learning (Kelly and Kolstad 1999; Nordhaus 1994), this paper has emphasized more recent thinking about the policy design at a particular decision point.

One key observation has been that the economics and politics of greenhouse gas mitigation argue for policies based on allowance prices rather than allowance quantities. Hearkening back to Weitzman (1974), marginal benefits are relatively flat compared to costs. But more to the point, stakeholders are unlikely to stomach substantial price risk regardless of academic debates about relative slopes. While banking has proved to be a useful mechanism to hedge price risks in many emissions trading markets, a bank may be less effective in the climate change context, at least initially, because the small abatement levels make accumulation of a bank more difficult. This is true even with the relatively generous allocation schemes considered in recent proposals. One transparent solution would be a price-based safety valve—that is, a price at which the government would sell addition emissions permits in order to keep allowance prices and costs from rising above acceptable levels.

A second issue is that while historically emissions caps have been used to reduce emissions levels rather than slowing emissions growth, in the case of climate change, optimal emissions paths typically involve a period of slowed growth before absolute levels decline. Popular criticism, as well as criticism from developing countries, focus on the related fear that caps will become a limit to growth and pose an undue economic burden on domestic economies. While a safety valve technically addresses the issue by allowing emissions to increase above any specified cap if costs are too high, there is still political uncertainty about whether the safety valve will always remain in place and, in turn, whether current or future emissions caps will become more relevant. Targets based on improvements in aggregate intensity—emissions per volume of economic activity—might be more suitable for trajectories that initially slow, rather than halt, emissions growth and could attenuate this fear by more naturally accommodating emissions growth alongside economic growth.

When thinking about the uncertainty surrounding climate change, many people focus on the uncertainties surrounding the consequences of greenhouse gas emissions—temperature and precipitation, sea-level rise, agricultural impacts, vector-born diseases, etc. However, it is arguably not those uncertainties (at least entirely) that have limited action in many countries. Uncertainty about costs, as well as whether targets over the next decade or two should slow growth or reduce absolute emissions levels, implies that the use of traditional (non-growth) emissions cap-and-trade programs is not an innocuous design choice. Economic theory is not entirely silent on the normative consequences of these choices. Perhaps more importantly, this paper posits that a practical obstacle to market-based domestic climate policies could be concern about whether a reasonable, meaningful step is possible in response to the current threat without risking excessive near-term costs or landing on a slippery slope to more costly and burdensome efforts in the future.

This paper has suggested modifications to the traditional cap-and-trade approach that reduce the uncertainty surrounding immediate costs as well as the possibility (or stakeholder belief in the possibility) that modest near-term policies could promote unduly onerous efforts in the future. To economists, most normative work on the trade-off between cost and benefit uncertainty as well as optimal emissions trajectories supports such modifications. To those more concerned about achieving environmental improvements, these modifications may seem counterproductive: They introduce the possibility of above-target emissions via the safety valve as well as a weaker position for proposing further reductions based on emissions intensity. However, from a practical political standpoint, these or similar modifications may be necessary to reach an agreement in the near term. The question then becomes, is getting started quickly a more effective long-term strategy than waiting for a consensus for stronger action?

Figures

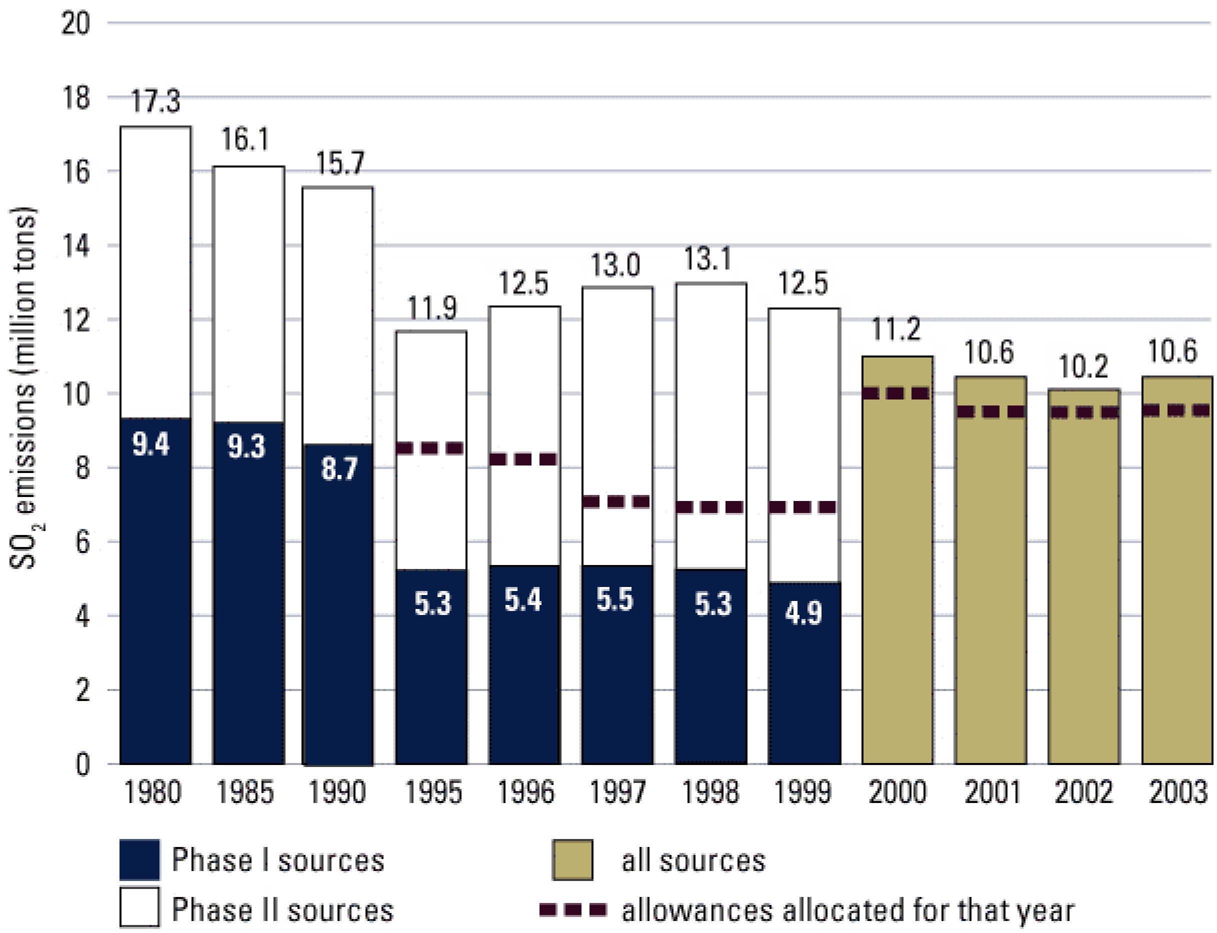

Figure 1. SO_2 Allowance Allocations and Use

Note: The increase in allocation in 2000 arose from inclusion of Phase II source allocations in that year and thereafter.

Source: U.S. EPA.

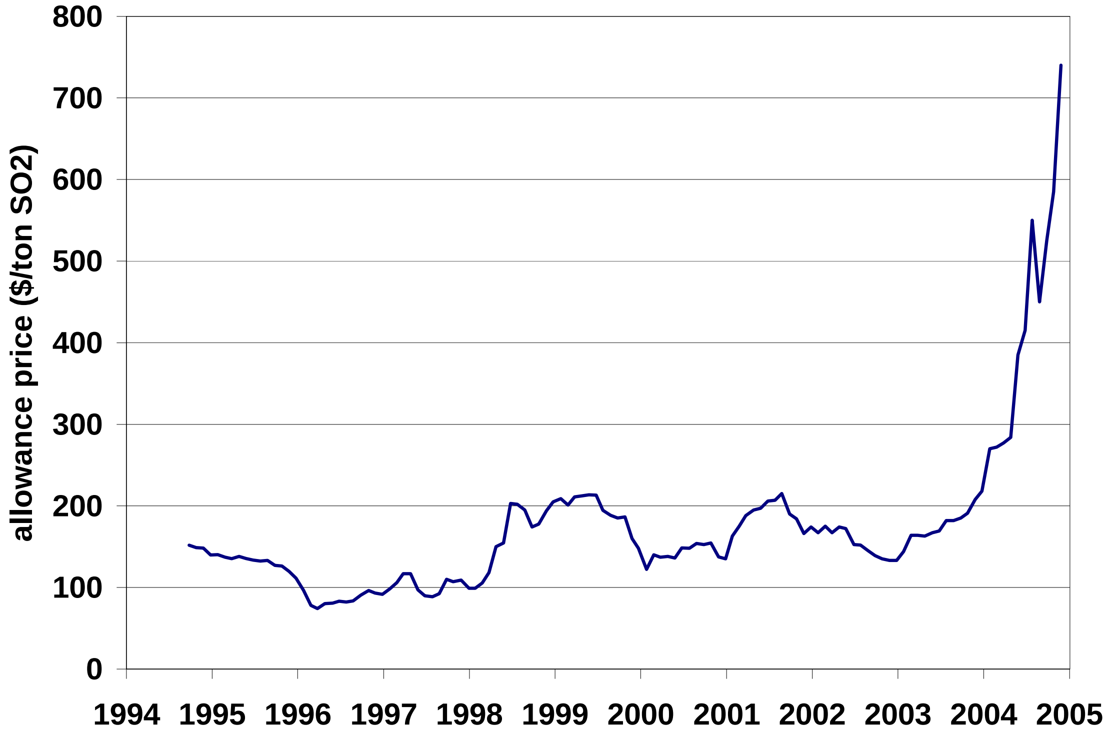

Figure 2. SO_2 Allowance Price

Source: Cantor Fitzgerald Environmental Brokerage

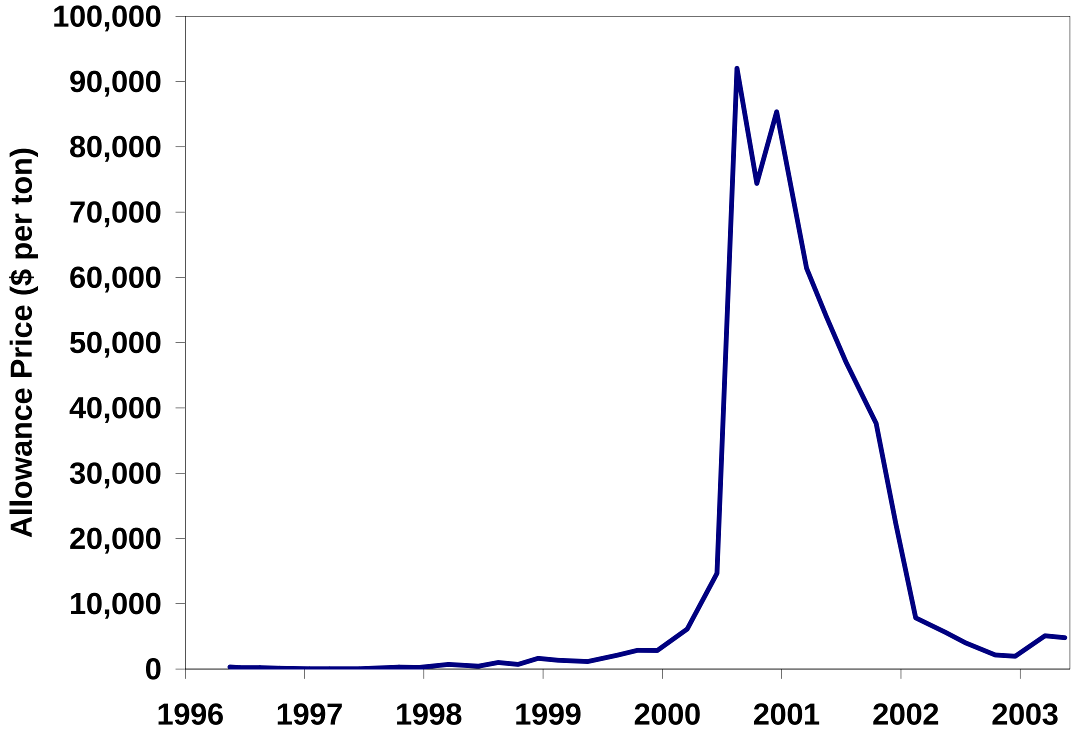

Figure 3. RECLAIM Allowance Price

Source: Cantor Fitzgerald Environmental Brokerage

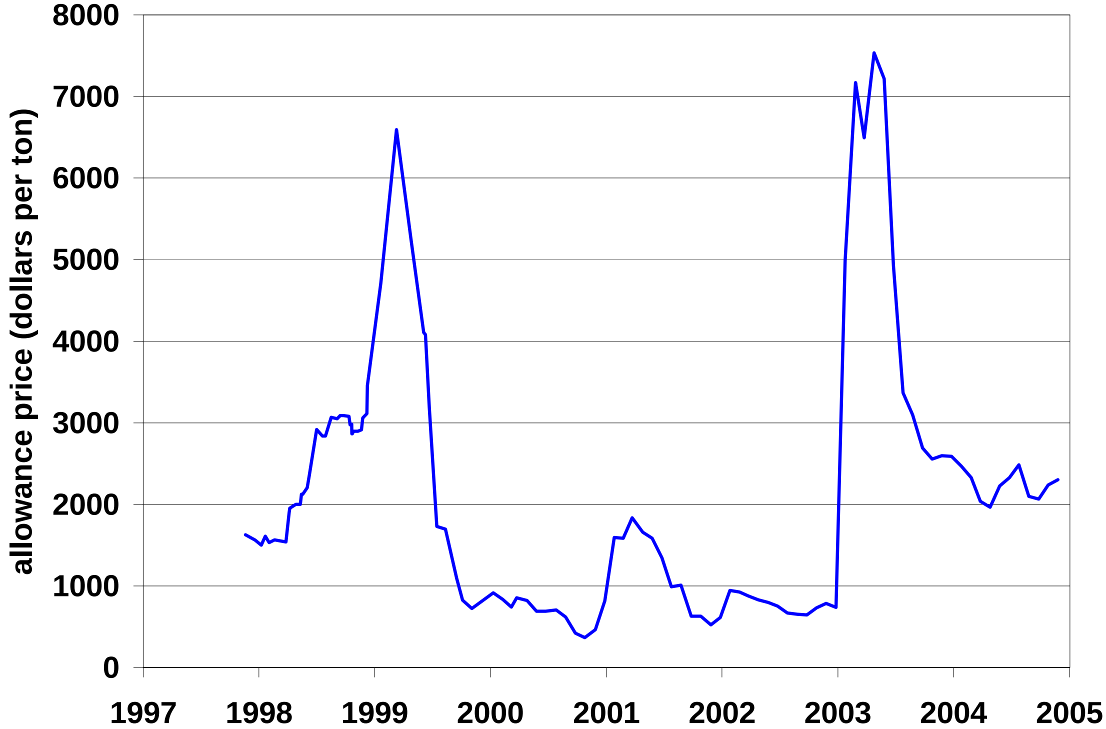

Figure 4. NO_x OTC Current Vintage Allowance Price

Source: Cantor Fitzgerald Environmental Brokerage

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