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Climate Policy Instruments: The Case for the Safety Valve

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I. Introduction

The Kyoto Protocol of the United Nations Framework Convention on Climate Change -- which governs the greenhouse gas (GHG) emissions of participating industrial nations for the period 2008-2012 – has been the subject of great debate over the past decade. Central to this debate is whether the Protocol represents a viable architectural mechanism for the global management of GHG emissions. Notwithstanding much higher expectations for near-term emission reductions when the negotiations began in the early 1990s, the lack of participation by the United States and the revisions of the rules introduced over the past few years have clearly softened the impacts of the Protocol. As currently drafted, the Protocol will likely result in reductions of 1-2 percent in global emissions by the year 2050, well within the bounds of prediction error (Bohringer 2002). Thus, even if the Protocol were to meet the numerical requirements for entry into force sometime soon, there is still a great deal of work to be done to develop a viable international approach to the control of GHG emissions.

From a policy perspective, the Protocol represents a model for addressing a global environmental problem with two key dimensions: 1) all members of the United Nations General Assembly participate as equal partners in the negotiations, even though binding emission requirements only apply to the industrial nations; and 2) despite the use of a number of flexibility mechanisms, the Protocol involves strict targets and timetables.

Clearly, alternative approaches exist on both counts. A smaller number of nations, such as a leaders' level forum like the "L20" concept that has been advanced by Canada's Paul Martin, could allow for a less universal and possibly more flexible forum for setting commitments. Similarly, alternatives to Kyoto-style strict targets and timetables may exist; among such mechanisms are those that can accommodate surprises in economic growth, the failure of new carbon mitigation technologies to perform as anticipated, or other unexpected events that could cause the cost of complying with climate change commitments to be higher than expected.

The focus of this paper is on the use of a price cap or safety valve to avoid unpleasant cost surprises for nations attempting to reduce their emissions in carbon dioxide (CO2) or other GHGs. In the context of a mandatory cap and trade system, a safety valve would specify a maximum market price at which additional emission allowances would become available to prevent the price from rising any further. Although the safety valve has potential application in both domestic and international policies – and has already seen some limited application outside the U.S. – most of the debate has focused on domestic applications in the U.S.

This five-part paper reviews the case for the safety valve in both domestic and international systems and presents the arguments pro and con. It argues that despite the excellent record of the use of fixed quantity systems to control emissions of sulfur dioxide and certain other pollutants in the U.S., concerns that costs of compliance could rise to unexpectedly high levels are legitimate. Indeed, we have already seen skyrocketing allowance prices for control of nitrogen oxides during the California energy crisis and, most recently, on the East Coast of the U.S. In the U.S. Congress, the fear of unexpected high costs of a mandatory program for GHGs has clearly been a deterrent to action.

While the concept of a safety valve continues to gain support among business and environmental groups in the U.S., significant opposition to the idea remains. Yet, the true strength of the opposition is difficult to gauge. Some see the absence of a safety valve in the proposal introduced in the 108th Congress by Senators McCain and Lieberman (Climate Stewardship Act, S.139) as a sign that the concept is not politically viable. Others, citing discussions with key interest groups, suggest that a safety valve-type mechanism will prove essential to any final agreement. .

The safety valve has important implications for international architecture and thus requires careful choices should the L20 purse climate change as one of its issues. In essence, the safety valve requires governments to frame commitments with close attention to the level of effort required and not simply the level of emissions that they would attempt to achieve. Thus the safety valve is more easily incorporated into a so-called ‘policies and measures’ approach – whereby individual nations adopt specific mitigation policies -- rather than in a strict quantity-based architecture. However, there are also ways in which a safety-valve can be used to facilitate a Kyoto-style agreement as well.

Following this introductory section, section II of the paper presents the basic economic logic of the safety valve. Section III considers a number of the objections that have been raised to the use of this mechanism in the domestic context. Section IV extends the discussion to the international arena and considers how the safety valve might be used in either a policies and measures type of system or in a Kyoto-style agreement, whether or not such agreements are pursued at the global level (as in Kyoto) or in a smaller forum such as L20. Section V offers some overall conclusions.

II. The Economic Logic for the Safety Valve

The age-old conflict over binding targets (quantity instruments) vs. emissions taxes (price instruments) has become central to the climate debate. Do quantity and price instruments really yield the same environmental results and, if so, is there any reason to prefer one over the other as a mechanism to control GHGs? While most of the discussion on instrument choice has focused on political, legal, and revenue concerns, environmentalists' desire for fixed emissions targets have combined with a long-standing U.S. aversion to energy taxes to give the rhetorical edge to pure quantity-based instruments as the leading method for implementing climate policies.

In a tradable permit system where each permit gives the holder the right to emit a specified amount of CO2 into the atmosphere one can, in principle, precisely control CO2 emissions. However, the cost of control, in terms of higher prices for fuel and reduced productivity, is uncertain. Although the experience with sulfur dioxide trading suggests that the actual costs may be lower than expected, recent Congressional debates indicate a clear concern that mandatory carbon mitigation policies may become quite costly– even those involving modest targets. Part of the cost uncertainty arises from uncertainty about the level of future baseline emissions that would occur even in the absence of new policies. There are also uncertainties about the cost of reducing emissions below baseline, and about the overall efficiency of the emissions trading system. Simulations developed by the Stanford Energy Modeling Forum, for example, suggest that the costs of the Kyoto Protocol may vary by almost an order of magnitude, depending on the particular models used (Weyant and Hill, 1999). Not surprisingly, this wide range of estimates is routinely exploited by opponents of Kyoto and other types of fixed quantity approaches to CO2 mitigation.

In general, when the cost of limiting emissions is known with certainty and the benefits of reduced emissions are similarly known, the price and quantity approaches are perfect policy substitutes. However, as Martin Weitzman (1974) demonstrated thirty years ago, when abatement costs (or benefits) are uncertain the situation can be quite different. On the one hand, quantity restrictions can be beneficial when incremental damages increase rapidly with the level of emissions or when marginal costs are relatively flat and predictable. In that case quantity restrictions are preferred because they prevent emissions from rising above a “safe” level without a risk of cost surprises. On the other hand, when health or environmental damages are not sensitive to short term emission levels or when concerns exist about potentially high costs, the undesirable side effects of quantity restrictions may dominate. In that case price based instruments are preferred.

Which of these situations is most relevant to the case of GHG control? The central observation is that GHGs represent a canonical example of what is known as a "stock pollutant," one in which the damages are a function of total accumulation in the environment over long periods of time. As a result, strict adherence to a short term emissions cap is less important from an environmental perspective than the long term effort to reduce emissions more substantially.

Using broad economic criteria, my colleague William Pizer demonstrated analytically several years ago that price instruments are preferable to quantity targets for the abatement of CO2 emissions (Pizer 1997). Following from Weitzman's intuition that relatively flat marginal benefits/damages favors taxes, Pizer finds that an optimal tax designed to control CO2 yields gains significantly higher than the optimal permit policy.

It is, of course, possible to combine price and quantity policies in a hybrid approach that establishes binding emissions targets as long as costs remain reasonable and allows the target to rise somewhat if costs are unexpectedly high. What is needed is a penalty, specified in advance, to be paid by the source in case its emissions exceed the quantity restrictions set for that source. Such a hybrid policy (1) fixes emissions targets that are binding as long as costs remain reasonable and (2) allows the target to rise somewhat if costs are unexpectedly high. In practical terms the hybrid or "safety valve" would involve an initial allocation of permits followed by the subsequent sale of additional permits to be made available at a fixed trigger price.

The original application of the safety valve to climate change issue arose from both the desire to use a price instrument to control what is essentially a stock pollutant and the apparent political attractiveness of a quantity-based approach. In the run-up to Kyoto, papers by McKibbin and Wilcoxen (1997) and by Kopp et al (1997) introduced the idea. Subsequent refinements have been introduced in a number of papers.[1]

[1] See Kopp et al (1999), Kopp et al (2000).

Just as the Federal Reserve protects against wide swings in bond and currency prices, a safety valve incorporated into a GHG mitigation policy would prevent sharp increases in energy prices. In daily life, most individuals like to avoid unpleasant surprises: hence the popularity of insurance. Similarly, the ideal climate policy is one that sets an upper limit on GHG mitigation expenditures. Most consumers are interested in reducing their out-of-pocket expenditures for energy as well as other goods and services, while most businesses are interested in maintaining a stable environment for purposes of planning and investment. The risk of unexpectedly high compliance costs under a strict permit system threatens that stability.

The hybrid approach guarantees that emissions will not exceed the target as long as the price of the tradable permits (i.e., the marginal cost of GHG control) does not rise above the trigger price. It differs in important respects from a well-known provision in the 1990 Clean Air Act Amendments that establishes a $2000 per ton penalty (1990$) for violations of the stipulated sulfur dioxide emissions standards. Since the Clean Air Act penalty is far above the expected marginal control cost, it has a very low probability of being invoked. The notion of a safety valve as articulated herein is for a price cap that reflects the society's willingness to pay for carbon mitigation. It is not intended strictly as a punitive measure. For environmental advocates who believe that the costs of reducing GHG emissions are low, permit prices will never reach the trigger level and emissions would remain capped.

III. Domestic Implementation Issues

A number of issues affecting the design of any broad-based efforts to control GHGs are also relevant to the design of a mandatory cap and trade system which includes a safety valve. Our focus is on an economy-wide or near economy-wide emissions trading program. S. 139 (McCain-Lieberman) is a convenient starting point for describing such a system. Modeled after the successful 1990 sulfur dioxide emissions trading program, S. 139 would cap carbon dioxide emissions at year 2000 levels for most large emissions sources beginning in the year 2010. Under such a program, a limited number of emissions allowances are given out or sold, and emissions sources are required to hold an allowance for each ton they emit. Whereas an ideal tradable permit program administered upstream on fossil fuel production would address 100 percent of national CO2 emissions, the McCain-Lieberman proposal covers more than 70 percent of emissions, excluding households, farms, and other small sources. In October 2003, S. 139 was defeated by a bi-partisan vote of 55-43, with opponents stressing the potential high costs of the measure, along with the economic and environmental consequences of unilateral actions to reduce emissions.

Although certain offsets for nonCO2 GHGs are allowed in S. 139, there is no provision for a safety valve to protect against price shocks. The sponsors of S.139 considered a provision for a safety valve in their bill, but ultimately rejected it in favor of a strict quantity based limit. The sponsors also considered more ambitious environmental goals, including a second budget period with tighter targets. That, too, was rejected – reportedly because of concerns expressed by some Senators about high costs.

The rejection of the safety valve in this early legislative round was doubtlessly driven by multiple factors. Yet, throughout the debates, four principal arguments have been advanced:

- Potential for adverse environmental impacts
- Fear of stifling research and development of new carbon mitigation technologies
- Belief that a safety valve is unnecessary as long as banking and offsets are allowed
- Political concerns that a safety valve would look too much like a tax

Potential for adverse environmental impacts

It has been argued that reliance on a safety valve would undermine mitigation efforts, because additional permits to release GHGs could be issued beyond those that would otherwise be available. Of all the arguments against the safety valve, this is probably the strongest. However, support for this view depends partly on how the issue is framed and, specifically, on what assumptions are made about current policies, and on the likelihood that an ambitious cap and trade system would be adopted in the U.S. in the absence of a safety valve If one starts with the proposition that an ambitious fixed target system is attainable in the U.S. in the near term, then it is certainly true that the sale of any safety valve credits represents a weakening of the environmental goal. Alternatively, if one acknowledges that uncertainty about future costs associated with a fixed target system is a major deterrent to a new policy, then adoption of a safety valve may not represent a weakening. In fact, it may actually be seen as pro-environmental, since the proper comparison would be either to the status quo – that is to no mandatory system at all -- or else to a very weak system. Compared to no binding controls or to a weak policy, almost any nonzero carbon price would be pro-environmental.

Even if one is concerned that a safety valve would undermine the environmental integrity of a GHG control program, there are several possible responses. The actual level of the safety valve is clearly an issue and, more importantly, the time path of the safety valve price matters a great deal. Most proposals involving a safety valve would have the trigger price ratchet up in real terms at a healthy rate, typically at 3-7% per annum. At these escalation rates even a low initial trigger price would have relatively strong incentive effects after only a few years.

Another response to those concerned about the environmental impacts concerns the permanence of a safety valve. A key attraction of a price cap mechanism is that it can help build confidence that the indicated goals are achievable at cost levels that the body politic finds acceptable. This is particularly important at the outset, before any mandatory system is implemented. Currently, the model estimates are the most credible sources of cost information. The fact that these cost estimates range so widely has been invoked as a rationale against mandatory actions. Once a binding system is up and running, of course, a lot more information will be available about the true costs of GHG mitigation. It is entirely possible that after a period of operating a mandatory cap and trade program with a safety valve it may be feasible to drop the price cap altogether and move to a fixed quantity system.

Fear of stifling research and development of new carbon mitigation technologies

It is widely recognized that effectively addressing the climate change problem requires large-scale changes in our energy system over many decades. In the short term, it is probably true that higher prices for carbon permits will stimulate more rapid development and deployment of new GHG mitigation technologies. At the same time, the longer term story is more complex. Carbon prices that rise too high or too fast may slow economic growth and/or alter the composition of investment. Research has demonstrated that both individuals and firms making decisions about long-lived capital focus as much on future energy prices, as they do on current ones. As noted, most safety valve proposals recognize this phenomenon by setting an initial trigger price and then stipulating fairly rapid (real) price increases thereafter.

Even this argument, however, ignores the long history of federal government support for energy-related technology research and development, based in part on the positive economic spillovers and other so-called market imperfections associated with new, more efficient energy technologies and, more recently, on the global environmental benefits of avoiding climate change. Yet, this support has not kept pace with the increased need for technological solutions, nor has it always been consistent and well spent. The key to a long term research and development strategy is both a rising carbon price, and some form of government supported research program to compensate for market imperfections. Any safety valve induced reduction in the development or deployment of new climate mitigation technologies is not likely to be terribly large once an escalating price cap and stronger government support are put in place.

Belief that a safety valve is unnecessary as long as banking and offsets are allowed

This issue has been widely debated in both the environmental and the economics communities and there seem to be two views on the matter. The environmental view, bolstered in part by an influential academic article, is that either a phased-in program or a banking provision could provide the necessary flexibility to implement a mandatory cap and trade system (Jacoby and Ellerman, 2002). Citing the successful sulfur dioxide trading system, unexpected events of the type that doomed the nitrogen oxides trading system in California are dismissed as the product of a flawed design –namely, the absence of a provision for banking -- rather than as any inherent problem of applying a fixed quantity trading system to control carbon emissions.

The alternative view, espoused by other experts, is that offset or banking systems cannot reasonably adapt to unexpected events such as higher energy demand or inadequate technology as effectively as a safety valve (Hubbard and Stiglitz, 2003). According to this view offsets can reduce the expected cost of a particular goal, but they cannot address concerns about unexpected events. In fact, if the system becomes dependent on such offsets, their inclusion can actually increase uncertainty about program costs if the availability and cost of the offsets themselves is not certain. As regards the banking or borrowing of emissions, it is argued that "…[the]…features that…provide additional allowances when shortages arise…are helpful, but only to the extent they can ameliorate sizeable, immediate and persistent adverse events."[2] In other words, offsets or banking systems can reduce the seriousness of the problem but they may not be sufficient to address all the uncertainties arising from unexpected spurts in economic growth or other events.

While there is not yet complete agreement within the economics profession on these different views, the size of the emission reductions to be undertaken is clearly a critical factor. If only modest reductions are undertaken, a system of banking and offsets is likely to be adequate in preventing price spikes. In order to achieve more ambitious targets, however, the safety valve is clearly preferred. Ironically, the environmental community seems more comfortable with banking and offsets than a safety valve. Yet, that preference, in effect , undercuts the case for more ambitious targets.

[2] Hubbard and Stiglitz (2003).

Political concerns that a safety valve would look too much like a tax

Clearly, any policy which leads to an increase in the price of carbon-intensive goods could be labeled a tax. Higher electricity prices resulting from the sulfur dioxide trading program or higher pump prices resulting from the phase down of lead in gasoline can also be construed as tax hikes. In the case of carbon, which involves economy-wide impacts, the magnitudes are likely to be much larger and the corresponding political resistance much greater. While the history of the failed Btu tax a decade ago serves as a stark reminder of the political resistance to any efforts to raise energy prices, the critical issue is not really whether you include a safety valve in the design of the cap and trade system. Rather, the issue involves the true magnitude of the costs imposed on society—many of which will be borne, at least initially, by electric utilities and other carbon intensive industries. At the same time, since many of these industries will be able to pass along their increased costs to consumers in the form of higher prices for electricity, gasoline and other energy intensive products, the political problem created by any new policy is potentially quite complex.

Rather than continuing to argue that a GHG mitigation policy will not lead to any increases in energy prices, it is time to recognize the importance of mitigating the impacts of these increases. Fortunately, there is a growing body of economics literature on this subject. Research by Goulder (2000) and Burtraw and Palmer (2000), for example, suggests that, in a general equilibrium framework, only a small portion of the allowances need be distributed gratis to the utility and industrial sectors to fully compensate them for any loses they might incur, since they will recover most of the costs of a cap and trade system by raising prices to their customers. The remaining allowances would be available to mitigate fiscal impacts on affected households or other concerns. Interestingly, even without a safety valve, S. 139 establishes a system whereby some of the allowances are given to the affected industrial sectors and others are targeted to consumers and specific segments of society particularly hard hit by the expected increases in energy prices. The political implications of a safety valve represent only a minor complication to such a scheme.

Although an increasing number of prominent individuals have endorsed the safety valve concept, the idea has not yet gained widespread support in the U.S. Outside the U.S., the idea has been embraced in a number of smaller countries, including Denmark and New Zealand, and in the Dutch solicitation for joint implementation credits.[3] As the domestic debate continues, it is useful to turn to the issue of international architecture. Specifically, how could the safety valve be used in an international agreement controlling GHGs?

IV. Applying a Safety Valve in an International Architecture

Climate change is a global problem that ultimately requires a global response. The domestic application of a safety valve discussed in the previous section can only be meaningful if it is ultimately linked to an international framework with significant participation by other key nations. This section considers whether it is possible to incorporate a safety valve directly into the international architecture itself. There are, in fact, a number of different ways of introducing a mechanism to limit costs into an international framework. This section considers two such approaches. The first involves a case where a single, large nation – for example the U.S. – would proceed with an initial domestic program including a safety valve and then makes subsequent increases in the price cap conditional on specific commitments by other large emitters. The second approach – a version of which was originally advanced by Kopp et.al (2000) – is more consistent with a Kyoto-style agreement that stipulates quantity based targets for individual nations. To assure compliance – a soft element of the existing Protocol – a predetermined compliance penalty could be established at a level agreed to by the signatory nations. Each of these options is discussed below.

Initial Domestic Action with International Contingency

If the Kyoto Protocol formally enters into force, expected sometime in 2005, the complex international architecture developed over the past decade will become operational. While myriad details of national policies still remain to be worked out in

[3] See Jacoby and Ellerman (2002) for details.

the European Union and other signatory countries, it appears that significant efforts will be made to meet the requirements established for the first budget period, ending in the year 2012.

What about the U.S. and other non-signatory nations? At this writing the official U.S. policy calls for an emissions intensity target, also established for the year 2012, supported by a series of voluntary programs and proposed tax credits. However, a change in U.S. policy is always a possibility. Specifically, imagine that a modified version of S.139 is adopted, perhaps involving emission targets out to the year 2015 or so, and incorporating a safety valve. Imagine, further, that the U.S. policy lays out a timetable stretching many decades in the future, along with an escalating price cap over that period. Suppose that any increase in U.S. effort beyond 2015 – including continued escalation of the safety valve price – is made conditional on the adoption of meaningful policies by key nations that are major GHG emitters. The U.S. experience with its modified version of S. 139, combined with the experiences of Kyoto signatory nations in implementing the Protocol, could inform a new round of negotiations. Proposals for long term emission reductions and escalating price caps could then be considered in this new round.

In essence, adherence to this structure would amount to a policy and measures approach. The focus would be on specific actions that individual nations propose to adopt, rather than on stipulated emissions outcomes, as in the Kyoto Protocol. In the unlikely event that all nations adopted a U.S. style cap and trade system with a safety valve, the evaluation of these programs would be relatively easy. In the more likely case that individual nations proposed different domestic policies to be followed in the post 2015 phase, detailed evaluation of the proposed policies would be required. The level of effort (escalating price cap) established in the U.S. proposal would provide one type of framework for the negotiations. A credible, independent, technical body such as the OECD might be an appropriate organization to carry out the necessary economic and policy analyses, although institutional arrangements are also possible.. In the end, the resulting system would inevitably be more complicated than the emission targets established in the Kyoto Protocol. Yet, because it would be based on the real world experiences of key nations, it would likely be more widely accepted. The L20 could be a forum to aid in this endeavor. The U.S. might be more willing to make such a commitment to implement domestic actions within the L20 having worked in that forum to extract promises of comparable effort by other nations, including key developing countries. And a communiqué from the L20 could help focus OECD or some other accepted international organization to conduct the necessary analyses to help nations make commitments that are tuned according to level of effort rather than simply quantity of emissions.

Compliance Penalty Under Kyoto-style Agreement

A paper by Kopp et al (2000) carried the safety valve notion into the international discussion in the form of a proposal that compliance with the Kyoto Proposal might be met by paying a predetermined per ton penalty for all tons emitted in excess of the Kyoto target. The proposal had three key features: a limit on compliance costs (safety valve), assurance of domestic effort, and transparency. This section reviews that proposal and re-considers its usefulness in light of recent events.

Under the Kopp et al. proposal, Parties with excess emissions would be permitted to pay a fixed per ton amount in order to come into compliance. The per ton payment would be made during the true-up period following the first budget period. The proposed compliance payment would create significant incentives for Parties to undertake domestic mitigation activities in order to avoid paying the penalty. Revenues collected would be earmarked in a so-called 'virtual fund' for the purchase of emission reductions in the second commitment period. A novel 'reverse auction' was proposed wherein purchases of emission reduction in the next commitment period would be made by soliciting offers for project-based credits in which all nations ratifying the Protocol could participate. Put forth at a time when the U.S. was still considering ratification of Kyoto, the authors argued that inclusion of such a penalty mechanism would increase the likelihood of both ratification and implementation, despite the potential for relaxation of the Kyoto limits for the first budget period. Similar to the case of a domestic-based safety valve, it was argued that the proposed penalty mechanism could accelerate progress toward the longer-term goal of reducing global emissions.

Viewed with the perspective of hindsight there are a number of clear disadvantages of this proposed penalty system. The most notable is the requirement for nations to make international payments to cover their excess emissions. At the same time, such a system would create a clear set of incentives for compliance via either domestic mitigation or the purchase of approved project-based credits from abroad. Once those actions were undertaken – presumably up to point where the marginal cost of further reductions exceeded the established penalty -- a nation could avoid the stigma of noncompliance by paying the penalty which, in turn, would be used to purchase additional credits in the future. In essence, this approach would shift the negotiations from the quantity targets to the appropriate level of the penalty, that is, to the maximum amount that a nation would have to pay to remain in compliance with the Protocol. As such, it might encourage ratification and acceptance of the terms of a quantity-based agreement by overcoming opposition based on the risk of unacceptably high costs.

V. Conclusions

The magnitude, difficulty and diversity of the public policy challenges posed by the threat of global climate change are enormous. Yet, one message stands out above all others: the most viable policy solution involves a long term commitment, more analogous to a distance run than to a sprint, and there is little environmental gain associated with expensive efforts to meet a short-term target. The real challenge is to craft and put in place a set of incentives that will bring down GHG emissions over a period of decades – largely via the use of technologies that are not now in commercial operation. Tough short term efforts can waste resources and, equally important, run the risk of undermining public support for the more serious long-term efforts needed to do the job.

Absent a safety valve, a cap and trade program could lead to price spikes in the face of unexpected energy demands, the failure of new technologies to operate as anticipated, or other events. And, as has already been demonstrated, large price spikes – or the fear of such spikes – can impede efforts to impose mandatory control policies. A safety valve is the simplest, most sure-fire, and most transparent mechanism for both signaling the market that such price shocks will not be tolerated and indicating the appropriate level of effort to meet stated short term goals.

To date, a number of arguments have been raised against the use of a safety valve mechanism, all invoking various economic specters. Yet, fear of economic disruption has proven a formidable argument by those who have sought to delay the adoption of any mandatory domestic policies on GHGs. At the same time, the scientific (and global security) arguments for reducing our emissions of GHGs have mounted. Despite the growing evidence of the importance of reducing GHGs, no mandatory policy has been adopted in the U.S. At this writing, none is on the horizon. Adopting a safety valve to limit price shocks offers an opportunity to get started down the long road of GHG mitigation. It may not be the perfect answer. And it may not be the answer for mitigation policies implemented in 2030. But for now it seems like a reasonable way to start what all acknowledge will be a long process. Whether the safety valve could ultimately be a useful as a formal element of an international agreement remains to be seen.

Bibliography

Bohringer, Christoph. 2002. "Climate Policies from Kyoto to Bonn: From Little to Nothing," Energy Journal, 23 (2), pp 61-71.

Burtraw, Dallas, Karen Palmer, Ranj T. Bharvikar, and Anthony Paul. 2001. "The Effect of Allowance Allocation on the Cost of Carbon Emissions Trading,: RFF Discussion Paper 01-30, Washington, D.C.

Goulder, Lawrence.2001. "Mitigating the Adverse Impacts of CO2 Abatement Policies on Energy Intensive Industries," Papers Presented at RFF Workshop on the Distributional Impacts of Carbon Mitigation Policies, Washington, D.C., December 11.

Hubbard, R. Glenn and Joseph E. Stiglitz. 2003. "Letter to Honorable John McCain and Honorable Joseph Lieberman," June 12.

Jacoby, Henry D. and A. Denny Ellerman. 2002. "The Safety Valve and Climate Policy," Report No. 83. MIT Joint Program on the Science and Policy of Global Change.

Kopp, Raymond J., Richard D. Morgenstern, and William Pizer.1997."Something for Everyone: A Climate Policy that Both Environmentalists and Industry Can Live With" (co-author) Weathervane, September 29.

Kopp, Raymond J., Richard D. Morgenstern, William Pizer, and Michael Toman.1999. "A Proposal for Credible Early Action in U.S. Climate Change Policy," Weathervane, February 16.

Kopp, Raymond J., Richard D. Morgenstern, and William Pizer. 2000. "Limiting Cost, Assuring Effort, and Encouraging Ratification: Compliance under the Kyoto Protocol," Weathervane, June 26.

McKibbin, Warwick J. and Peter J. Wilcoxen.1997.""A Better Way to Slow Global Climate Change," The Brookings Institution *Policy Brief*, July (available at http://www.brookings.edu/comm/policybriefs/pb17.htm).

Pizer, William A. 1997. "Prices vs. Quantities Revisited: The Case of Climate Change," Discussion Paper 98-02, Resources for the Future, Washington, D.C.

Weitzman, Martin L.1974. "Prices vs. Quantities," Review of Economic Studies, XLI, October: 477-91.

Weyant, John P. and Jennifer N. Hill.1999. "Introduction and Overview," Energy Journal, Kyoto Special Issue, pp vii-xvii.