

**A GRATEFUL RESPONSE TO COMMENTS ON
*FRAMING ENVIRONMENTAL POLICY
INSTRUMENT CHOICE***

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I. INTRODUCTION

It is a rare pleasure to have the benefit of thoughtful comments from so many outstanding colleagues. I am glad that the article, *Framing Environmental Policy Instrument Choice*, was sufficiently stimulating to warrant such careful attention and comment.

The commentators found several areas in which the new framework and its explication introduced new and useful—or at least thought-provoking—ideas. I am grateful for the positive comments that reinforce the contributions of the article, including those recognizing that the framework provides:

- a taxonomy of instruments that recognizes a greater breadth of policy instruments¹ than most studies and provides insight into the relation among the instruments;²
- a means to restructure the evaluation criteria that are commonly applied to the instrument choice exercise into a cost-minimization approach;³
- recognition that cost-minimization requires looking beyond cost-of-compliance only,⁴ expanding the cost factors to include public

1. See Daniel H. Cole, Comment, *Environmental Instrument Choice in a Second-Best World: A Comment on Professor Richards*, 10 DUKE ENVTL. L. & POL'Y F. 285, 289 (2000); Nathaniel O. Keohane, Comment, *Evaluating Instruments of Environmental Policy: A Comment on Professor Richards*, 10 DUKE ENVTL. L. & POL'Y F. 389, 389, 397(2000); Robert M. Friedman et al., Comment, *Environmental Policy Instrument Choice: The Challenge of Competing Goals*, 10 DUKE ENVTL. L. & POL'Y F. 327, 331 (2000).

2. See Keohane, *supra* note 1, at 389.

3. See Sidney A. Shapiro & Robert L. Glicksman, Comment, *Goals, Instruments, and Environmental Policy Choice*, 10 DUKE ENVTL. L. & POL'Y F. 297, 298, 307 (2000); Friedman et al., *supra* note 1, at 331-32.

4. See Cole, *supra* note 1, at 289.

- finance impacts⁵ and costs of implementation;⁶
- insight into the important dimensions of instrument choice, particularly the degree to which various instruments vest control over abatement production decisions;⁷
 - explicit recognition of legal constraints on the range of instruments available to policymakers;⁸
 - insight into the duality relation between subsidies (price-based payments) and contracts (quantity-based payments), a simple observation that had been previously overlooked;⁹
 - a structure for understanding the significance of several important observations, including the “greater attractiveness of incentive-based instruments where the range of technology options is greatest;”¹⁰ the potential desirability of paying interest on saved allowances;¹¹ the relation between measurement costs and private discretion;¹² and who bears the burden of residual pollution harm;¹³
 - a means to use New Institutional Economics to provide new insights into the importance of credible commitment in environmental policy, and that the importance of credible commitment is not uniform across all instruments;¹⁴ and
 - an approach that could be extended to include natural resources management.¹⁵

If positive comments reinforce the contribution of the article, the criticisms help sharpen the analysis by focusing on potential improvements in the development of the framework. For those I am also grateful.

The critical comments fall into three categories: (1) those related to how the evaluation criteria were restructured as a constrained cost-minimization approach; (2) those addressing the new taxonomy of policy instruments; and (3) criticisms of the overall framework and its

5. See *id.* at 292; Friedman et al., *supra* note 1, at 332.

6. See Friedman et al., *supra* note 1, at 353-54.

7. See Shapiro & Glicksman, *supra* note 3, at 307.

8. See *id.* at 315; Cole, *supra* note 1, at 290-92.

9. See Keohane, *supra* note 1, at 414.

10. Shapiro & Glicksman, *supra* note 1, at 297.

11. See *id.* at 298.

12. See *id.* at 297.

13. See Cole, *supra* note 1, at 290.

14. See *id.* at 293.

15. See Friedman et al., *supra* note 1, at 331.

potential applicability. Some of the comments stem, no doubt, from my own imperfect exposition. In these areas we have no fundamental disagreements. Other comments bring new insight to the issue and will be incorporated in future work as the framework is refined and applied to specific problems. Finally, there are some comments that reflect a fundamental disagreement between my own approach and those of the commentators. While it is impossible to reply exhaustively to all the comments, I will attempt to respond to some of the suggestions and criticisms in this brief note, even recognizing that only over time will it be possible to fully address these issues. The next section of this response addresses comments falling in each of the three categories listed above and tries to address them where possible.

II. SUGGESTIONS AND CRITICISMS

A. *The Constrained Cost-Minimization Criteria*

Dr. Friedman, Ms. Downing, and Professor Gunn raise the provocative issue of whether it is appropriate to focus on cost-minimization as the driving force in evaluating the merits of environmental policy instruments.¹⁶ They advance as an alternative approach a set of criteria arranged in three broad categories with nineteen separate factors to consider.¹⁷ It is a detailed, if not exhaustive,¹⁸ list of criteria that was first developed in a report Dr. Friedman managed for the U.S. Office of Technology Assessment.¹⁹ Where other studies have provided lists of instruments and evaluation criteria, the OTA Report develops a true framework—a systematic way to think about the relations among the instruments.

The contrast between the OTA approach and the cost-minimization formulation proposed in my framework is marked. Friedman, Downing, and Gunn have a list of criteria that explicitly accommodates a wide range of priorities, giving primacy to none. This has the advantage of clearly recognizing that “each decision-maker or stakeholder may prefer a different instrument choice de-

16. *See id.* at 327-28, 332.

17. *See id.* at 332, 344-45.

18. The list Friedman et al. provide does not include differential public finance impacts or legal constraints.

19. *See* OFFICE OF TECH. ASSESSMENT, U.S. CONGRESS, REP. NO. OTA-ENV-634, ENVIRONMENTAL POLICY TOOLS—A USER’S GUIDE (1995) [hereinafter OTA REPORT].

pending on his or her values.”²⁰ Not only does this help the decision-maker evaluate instruments in light of his or her belief about the importance of each criterion, it also “presents a way for those who seek to promote a particular instrument for political or ideological purposes to scope out the advantages and disadvantages of their choice, given other stakeholders’ preferences.”²¹

In contrast, framing the evaluation process as a constrained cost-minimization exercise provides the conceptual analog of the “reduced form” approach to thinking about the criteria. While it sacrifices detail, it gains simplicity and aids conceptualization. It more clearly identifies the cost factors (cost-of-compliance or production costs, PC; implementation costs, IC; and the public finance costs, TX) than a simple list of criteria, and suggests that instrument choice requires recognizing the tradeoffs among those costs. It also accommodates, in simple form, most of the factors listed in the OTA study and demonstrates that they will constrain the degree to which cost-reductions, defined broadly, can be achieved. Moreover, the cost-minimization approach invites further definition of those constraints where the decision-maker or stakeholder believes they are important, without requiring that detail at the outset. Far from suggesting that “cost-minimization is the only criterion that should guide the choice of policy instruments” as Professors Shapiro and Glicksman assert it does,²² it could just as well be argued that the framework actually gives primacy to the political, legal, and efficacy considerations by making them constraints. Only after non-cost goals are satisfied can cost-minimization take place.

The comments by Friedman, Downing, and Gunn and by Shapiro and Glicksman bring out one real weakness in framing the evaluation criteria as a simple deterministic cost-minimization problem.²³ It assumes that there is a clear environmental goal, a particular amount of pollution abatement that must be achieved. In contrast, the OTA Report recognizes the fuzziness with which environmental goals can be set. The evaluation criterion “assurance of meeting goals”²⁴ acknowledges the uncertain performance of some instruments and invites decision-makers to consider how important a well-defined quantity target actually is. In the new framework the issue of

20. See Friedman et al., *supra* note 1, at 327-28.

21. *Id.* at 328.

22. Shapiro & Glicksman, *supra* note 3, at 322.

23. See *id.* at 302; Friedman et al., *supra* note 1, at 322, 343, 345-47.

24. Friedman et al., *supra* note 1, at 344 (Table 2).

uncertainty is recognized in the discussion comparing price-based and quantity-based instruments, but it is not easily accommodated in the cost-minimization approach, suggesting that additional attention is needed to this aspect of the framework.

Mr. Keohane suggested that it would be better to view the cost-minimization problem in explicitly dynamic terms.²⁵ He offers what is essentially a dynamic optimization expression, in which the integral of the discounted stream of costs (PC, IC, and TX) over an infinite time horizon is minimized, subject to meeting a trajectory of abatement requirements and remaining within the feasible set of instruments, defined by possibly changing constraints arising from politics, legal requirements, and experience. While I understand, and identify with, Mr. Keohane's appreciation of the beauty of a precisely stated formulation, I do not accept the mathematical pedantry reflected in his comments. The simpler formulation is more accessible to a wider range of colleagues—particularly practitioners—without sacrificing recognition of the dynamic nature of the optimization. The discussions of existing evaluation criteria,²⁶ technological innovation,²⁷ intertemporal flexibility,²⁸ and adaptability of the transaction in the face of uncertainty²⁹ all reflect dynamic considerations in the cost-minimization problem. To these Mr. Keohane usefully adds several important observations. First, monitoring costs may change over time as new technologies become available.³⁰ Second, governance costs may decline (or rise) as the regulator and regulated party each become familiar with the other.³¹ Finally, political and legal constraints may change as experience with the range of instruments increases.³² All of these observations can be understood even in the absence of an unnecessarily complex—and to some important audiences, intimidating—formulation of the constrained cost-minimization problem that raises barriers between disciplines.

The treatment of the political and legal constraints raised objections from both Professor Cole and Professors Shapiro and

25. See Keohane, *supra* note 1, at 389, 391-394.

26. See Kenneth R. Richards, *Framing Environmental Policy Instrument Choice*, 10 DUKE ENVTL. L. & POL'Y F. 221, 226-230 (2000).

27. See *id.* at 255-56, 278-79.

28. See *id.* at 248-49.

29. See *id.* at 246, 260-65.

30. See Keohane, *supra* note 1, at 392.

31. See *id.* at 393-94.

32. See *id.* at 393.

Glicksman.³³ They do not object to the explicit inclusion of legal constraints; in fact, they gladly accept this extension of the criteria.³⁴ Their reservation is in the details of the illustrations. For example, Cole objects that the restrictions on federal regulation of land use, used as an example of a legal constraint, may have been better included in the category of political constraints.³⁵ He asserts, correctly, that under an expansive interpretation of the Commerce Clause, Congress has the legal power, if not the political will, to further regulate land use.³⁶ In contrast, Shapiro and Glicksman suggest that in the post-*Lopez*³⁷ wake, the federal government may be further limited in its ability to intervene in land use issues.³⁸ While I accept both of these observations, they seem to miss the larger point: policy analysts generally have not explicitly recognized that our legal system imposes important constraints on the range of policy instruments for implementing environmental policies. This is reflected in the fact that none of the descriptions of evaluation criteria, including the OTA Report, mention legal constraints. Perhaps the most important of these constraints is the prohibition on legislative entrenchment that limits the ways in which the federal government can make credible commitments.³⁹

B. *The Policy Instrument Taxonomy*

Many of the comments provide suggestions that will add significantly to the taxonomy and will be simple to incorporate. Mr. Keohane, for example, correctly pointed out that there is no reason to limit the scope of the analysis, or “locus of regulation,” to performance measures based on outputs of emissions or inputs to the polluting process.⁴⁰ One achieves a more robust taxonomy of instruments by recognizing the existence of ambient taxes and tradable allowances.⁴¹ This observation can be carried even further. Friedman, Downing, and Gunn describe harm-based standards that “prescribe the end results of regulatory compliance . . . based on health and envi-

33. See Cole, *supra* note 1, at 290, 292; Shapiro & Glicksman, *supra* note 3, at 298, 314-322.

34. See Cole, *supra* note 1, at 290, 292-93; Shapiro & Glicksman, *supra* note 3, at 315.

35. See Cole, *supra* note 1, at 292.

36. See *id.*

37. *United States v. Lopez*, 514 U.S. 549 (1995).

38. See Shapiro & Glicksman, *supra* note 3, at 318-320.

39. See Richards, *supra* note 26, at 276-78.

40. See Keohane, *supra* note 1, at 397-400, 413-14.

41. See *id.* at 398-400.

ronmental effects.”⁴² These harm-based standards are “widely used, primarily in combination with design standards.”⁴³ It should also be possible to expand the “locus of regulation” beyond the simple input versus output dichotomy in analysis of the enterprise instruments. For example, while subsidies can be applied to either the inputs or outputs of the polluting process, they also can apply to mitigation of the actual impacts of the environmental damage, for example restoration projects.

At the same time it is possible to work in the other direction—up the production stream. Where there is a high degree of correlation between production inputs, pollution outputs, and damages, it is entirely possible to achieve a satisfactory result by targeting regulation at a “pre-input” party. For example, in the case of carbon dioxide emissions, targeting coal mines, oil refineries, and natural gas distributors rather than fossil fuel consumers’ outputs might substantially reduce the administrative burden (an element of implementation costs) relative to making actual emissions of carbon dioxide the “locus of regulation.”⁴⁴ In general, then, the input versus output dichotomy, like the command-and-control versus incentive-based instrument dichotomy,⁴⁵ is narrow and can be usefully expanded to recognize the range of useful loci of regulation.

Professors Shapiro and Glicksman raise the question of whether the instrument taxonomy might leave the reader with the mistaken impression that performance standards are a typical hierarchical arrangement, largely vesting discretion with the government regulator.⁴⁶ That was not the intent of the article, although it may have been the effect. In fact, given that Shapiro and Glicksman refer to the “locus of discretion” dimension of the taxonomy as dichotomous⁴⁷ rather than continuous raises the question of whether an important element of the taxonomy was too easy to miss. The important message here is that there is a continuum of instruments from design (technology) standards, to performance standards, to tradable allowances, to bankable tradable allowances. Within this continuum there are a multitude of adaptations that define the degree to which the regulator and

42. Friedman et al., *supra* note 1, at 338.

43. *Id.* at 334 (Table 1).

44. See Kenneth Richards, Integrating Science, Economics and Law into Policy: The Case of Carbon Sequestration in Climate Change Policy 118-24 (1997) (unpublished Ph.D. dissertation, Univ. of Pennsylvania) (on file with author).

45. See Richards, *supra* note 26, at 224 & n. 9.

46. See Shapiro & Glicksman, *supra* note 3, at 305-07.

47. See *id.* at 305.

private parties share discretion. They vary in the extent to which they provide flexibility over how, where, and when polluters abate pollution. Performance standards at least nominally provide more flexibility than design standards, inasmuch as they accommodate multiple technologies, but they do not provide flexibility to polluters with respect to where or when abatement will occur. Thus, performance standards combine elements of the hierarchical and incentive-based approaches.

Professors Barnett and Terrell also find fault with the taxonomy because, in discussing the distribution of costs, it distinguishes between firms that pollute and the larger society that bears the pollution. They observe that “firms are owned by people, they employ people, and people buy the products produced by these firms.”⁴⁸ In an attempt to obfuscate the distinction between polluters and pollutees, they conclude that “members of society pay abatement costs and members of society bear the costs of unabated emissions,” with the obvious implication that the two groups are the same. In fact, they are not. Not all members of society are equal owners in polluting firms, nor do all members of society equally consume the products of polluting firms. The distinction between polluting firms (and their owners and consumers) and the members of society that bear the cost of residual pollution is important, even if there is some overlap between the two sets of individuals.

For more useful comments on the issue of cost distributions described by the taxonomy, we can look to Mr. Keohane’s observations. First, he notes that the “payments by polluters do not represent compensation to the victims of pollution.”⁴⁹ This is true if the damages from pollution are borne by a subset of society (which is generally the case), while the revenues from taxes or auctions are recycled to the government coffers (an explicit assumption of the taxonomy). In this sense, the compensation is imperfectly aligned with the burden of residual pollution costs. It is, however, the case that a system under which polluters not only bear the costs of their abatement, but also make payments to society for the damages associated with their unabated pollution, is more consistent with the polluter-pays-principle (one fairness principle), than a system in which no such compensation to society takes place.

48. A.H. Barnett & Timothy Terrell, Comment, *Framing Environmental Policy Instrument Choice: Another View*, 10 DUKE ENVTL. L. & POL’Y F. 415, 421-22 (2000).

49. See Keohane, *supra* note 1, at 394.

Second, Mr. Keohane points out that only in special cases (constant marginal damages) will the payment from industry equal the cost of residual pollution damages.⁵⁰ This observation can be extended by symmetry to the case of subsidies and contracts, where payments to abaters will exceed the cost of abatement except in the case of constant marginal costs of abatement. This means that, in the case of subsidies and contracts, government/society will bear the burden of abatement costs, residual pollution costs, and a transfer to abaters. To see this, consider a modification of Mr. Keohane's Figure 1,⁵¹ from which he observes that "total environmental damages are given by the area of the triangle OAE and total tax revenue by the rectangle OPAQ"⁵² so "the tax payment from the regulated industry

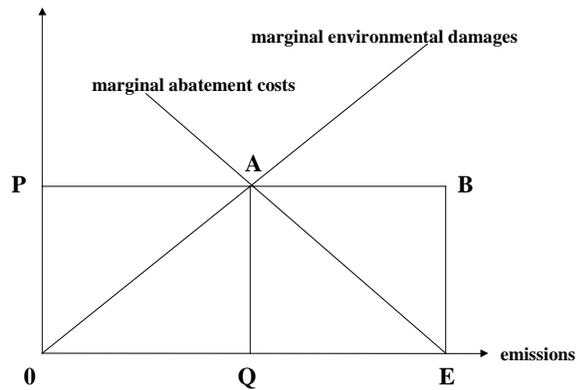


Figure 1: Taxes, subsidies, and transfers

will exceed the damages from pollution."⁵³ Similarly, in the case of subsidies or contracts, the government will make payments of QABE for abatement costs of only QAE. Whether private parties are paying for residual pollution costs in the case of zero-baseline taxes or auctioned marketable allowances or the government is paying for abatement costs in the case of subsidies or contracts, the payment includes both a compensation for actual costs and a transfer from one party to the other.

50. See *id.* at 395 & n. 13.

51. *Id.* at 395 (Table 1).

52. *Id.* at 395.

53. *Id.* at 394.

C. *The Framework and Its Applicability*

I should start this section with an admission and a *mea culpa*. Professors Barnett and Terrell correctly point out a clear error in the text⁵⁴—namely, the statement suggesting there is a difference between *allocative efficiency* and *overall efficiency*.⁵⁵ This is obviously wrong. The statement should have referred to *production efficiency* rather than allocative efficiency. The point is straight-forward. Incentive-based instruments quite clearly minimize the costs of abatement production, the PC costs. However, when the full range of costs is considered (*i.e.*, when IC and TX are added to the calculus), incentive-based instruments may no longer minimize total costs. In fact, this point is well illustrated by Barnett and Terrell's reference to the Hahn and Noll study⁵⁶ suggesting "that command-and-control regulations provide a least-cost strategy for achieving California emission standards for sulfates in Los Angeles."⁵⁷ The rationale of developing a new framework is to help identify the circumstances under which some instruments may be preferable to another, based on overall economic efficiency criteria.

Several of Barnett and Terrell's comments were more puzzling. For example, they suggest that the article "complain[s] that the traditional economic framework concentrates on production costs to the exclusion of other relevant factors."⁵⁸ This seems odd, given that they go on to state that "Richards himself notes, many economists address issues related to transaction costs, public finance, double dividend ef-

54. See Barnett & Terrell, *supra* note 48, at 422.

55. See Richards, *supra* note 26, at 225.

56. See Robert W. Hahn & Roger G. Noll, *Designing a Market for Tradeable Emissions Permits*, in REFORM OF ENVIRONMENTAL REGULATION 119 (Wesley A. Magat ed., 1982).

57. Barnett & Terrell, *supra* note 48, at 423.

58. *Id.* at 419. Part of the difficulty in understanding Barnett and Terrell's statement is that the alleged "complaining" (also referred to as "misleading...characterization," *id.* at 416) that the economics framework deals only with production costs cannot be found in the article. It is clearly not the case that economics deals only with production costs, as evidenced by my suggestion that we include other *economic* costs, such as implementation costs (transaction costs) and public finance impacts, when analyzing environmental policy instruments. It is also difficult to respond to their charge, because Barnett and Terrell never explicitly define what they mean by the "economics framework." My statements regarding the inadequacy of many instrument choice studies that deal only with production costs was not meant as an indictment of the field of economics, but rather as a recognition of the fact that certain branches of economics have heretofore been left out of the discussion of environmental policy instruments. It does not follow that a recognition that the instrument choice literature has tended to focus on production costs implies that I view that the "economic framework" focuses only on production costs and is thus lacking.

fects, and legal and political constraints.”⁵⁹ In fact, far from rejecting the economic paradigm, the new instrument choice framework is an attempt to integrate many areas of economics that previously have been treated as largely unrelated and apply the economic insights to environmental policy implementation.

Similarly, Barnett and Terrell complain that the article is based upon an assumption of a welfare-seeking government agent, even as they cite a list of outstanding papers that made the same assumptions.⁶⁰ The nature of the new framework, like the analysis in those papers, is clearly normative,⁶¹ limited to the question of which instrument would be chosen by a welfare-maximizing government agent, under various circumstances.

Turning to others commentators’ suggestions and criticisms, Professor Cole made the legitimate observation that the impact of the framework suffers because it does not provide a comparative application to demonstrate the advantage of this new approach relative to more standard approaches.⁶² Even in his question he contains the answer: “[i]ncluding empirical applications would, of course, have made an already sizable paper substantially longer.”⁶³

What can be said, even in this short response, is that it was a practical application, abatement of atmospheric carbon dioxide accumulation through large-scale carbon sequestration, that precipitated development of the new framework. Carbon sequestration combines a multiplicity of characteristics—long time horizons, high initial investments, potentially separate polluters and abaters, land use and management controls, nonpoint source abatement, and potentially millions of participants—that make it difficult, and perhaps impossible, to apply traditional command-and-control or simple incentive-based instruments. This framework helps to parse through many of the challenges associated with implementing goals that involve these atypical abatement processes.

Cole is, of course, correct. A proposed new or modified approach to any problem is more instructive when supplemented with examples, and I have tried to provide those, if only sporadically. But as to full-length, unifying applications, one of the messages of the framework is that the instrument choice exercise requires a thorough

59. *Id.* at 418.

60. *See id.* at 419-20 & n. 15.

61. *See Richards, supra* note 26, at 226.

62. *See Cole, supra* note 1, at 294.

63. *Id.*

understanding of the science, technology, markets, and institutions relevant to the particular application. In the more complex problems, explication of all these aspects is a task unto itself. Thus, the process must be seen as an iterative one: identification of a problem, attempt to apply the existing framework, failure, development of a new framework, attempt to apply the new framework, revision of new framework, and so on. The next step then will be to demonstrate this framework's applicability to at least one environmental problem and then to modify the framework based on the lessons learned there. Ultimately, if the new framework is truly generalizable, it will find uses beyond the particular application that precipitated its development. That will be the test of its value.

In a related vein, Professors Shapiro and Glicksman observed that the "actual benefit of the framework . . . is a function of how readily decision-makers are able to compile the relative cost information that the framework requires."⁶⁴ In fact, one of the purposes of the framework was to help identify these very issues—what empirical studies will be required for a deeper understanding of cost tradeoffs in the instrument choice process? But the framework is also a conceptual tool intended to help both decision-makers and academics think about the many issues implicated in policy implementation. Even in a world of bounded rationality, decision-makers have impressions of the magnitude of various costs. The framework is intended first to remind them about the important cost elements, and second to help them think about how their best guesses about those elements might change as they move along the continua of instruments depicted in Figure 3.⁶⁵

Finally, the comments provide an interesting contrast between Mr. Keohane's assertion that transaction cost economics has little to contribute to environmental policy⁶⁶ and Professor Cole's enthusiastic observation that the application of New Institutional Economics to questions of environmental instrument choice is a distinctive contribution of the framework.⁶⁷ Clearly this is a discussion that will not be resolved in the space of these comments. It is worth considering,

64. Shapiro & Glicksman, *supra* note 3, at 322. Similarly, Professor Cole observes, "Empirical applications would help to assess just how difficult or easy it would be to put dollar signs on the various factors Richards' framework incorporates. If it turned out to be difficult, that might militate in favor of more limited frameworks that incorporate fewer and most easily quantified cost factors." Cole, *supra* note 1, at 294-95.

65. See Richards, *supra* note 26, at 238 (Figure 3).

66. See Keohane, *supra* note 1, at 400-401.

67. See Cole, *supra* note 1, at 290.

however, Mr. Keohane's observation that the two examples described in the article are about information revelation, not asset specificity.⁶⁸

The regulatory analog to Mr. Keohane's canonical hold-up problem⁶⁹ is a government agency that must induce a group of firms to reduce polluting emissions. There is an asymmetry of information with respect to the technological options and costs of abatement, such that the government believes that there is heterogeneity among polluters with respect to the costs of abatement, but does not know who the low-cost abaters are or what the costs of specific polluters will be. Clearly, an incentive-based trading program that achieves an equi-marginal outcome⁷⁰ would be more cost-effective than a system of uniform technology or performance standards. This is consistent with one of the goals of the government regulator. But the government regulator also operates in a political environment and will be tempted to bend to pressure from interest groups.

Suppose an individual firm is contemplating an investment in "over-abating" to generate salable allowances. The firm must be concerned with the safety of its abatement investments. Whether it is stated as an information revelation problem or an asset specificity problem, the firm will be vulnerable in at least two ways. First, the regulator, having induced the low-cost abaters to invest, may impose new conditions on trades, reducing the amount of trade that occurs, and thus "expropriating" the investment in the form of excess abatement. This is similar to Mr. Keohane's example, but does not require that the regulator have information about any particular firms or their investments. It is an *ex post* change in rules that firms may anticipate. Second, the firm may anticipate that a subset of regulated parties will pressure the regulator to slacken the rules. If the government gives in to this political pressure, *i.e.*, is not willing to bear the cost of its side of the regulatory relation, then the value of the abatement investment is reduced. When the government cannot credibly commit to maintaining the rules over time, the low cost abater may not invest in the efficient abatement technology. In this case, there may be little reason for the government to make the effort to extend its program from a performance-based or quota system to a full trading system.

The credible commitment problem is easily extended to the case of subsidies. In the example of carbon sequestration discussed above,

68. See Keohane, *supra* note 1, at 404-06.

69. See *id.* at 402-04.

70. An equimarginal outcome is one in which all polluters abate to the point where their marginal costs of abatement are equal.

the government may want to induce private investment in low cost carbon sinks by subsidizing carbon capture—a process that spans decades. Private parties, realizing that they must first invest to establish carbon sink projects, will also understand that the government may be tempted for reasons of politics, budgetary constraints, or other programmatic uncertainties, to reduce or eliminate the subsidy. The problem is that if the government cannot credibly commit to maintain those payments over very long periods of time, private land owners will be unwilling to make initial investments. The government may be forced to provide carbon sequestration through government production, *i.e.*, planting on government land and acquiring more land as needed to meet programmatic goals. The hierarchical solution is perhaps more expensive in terms of producing the abatement (PC) itself but may be less expensive when governance costs (IC) of credibly committing are considered.

III. CONCLUSIONS

I am grateful for the exchange of ideas that has surrounded the instrument choice framework article. Reading and responding to the commentators provided an opportunity to sharpen my own understanding of the framework, its contributions, and its limitations. I hope the discussion has done the same for readers.

Bear in mind that the framework is a synthetic, conceptual work. It does not propose much in the way of new theory *per se*, though several of the reviewers spotted helpful insights. Rather, the work is an attempt to integrate existing theory from environmental economics, public finance economics, New Institutional Economics, and law. The result should be useful to decision-makers, analysts, and academics in organizing their own thoughts about the relative merits and limitations of the many environmental policy instruments.

As is always the case with an undertaking of this nature, the process of developing the framework is iterative. Many of the excellent comments discussed above will be incorporated directly as the framework continues to develop. For example, Mr. Keohane's observation that the loci of regulation can be extended to include ambient effects can be applied directly. Some of the comments, particularly related to the role of New Institutional Economics in the framework, suggest that there are concepts that need to be expanded and explored in separate work. Finally, there is clearly room for improvement in the exposition of the framework. I look forward to another

iteration with these and other reviewers as the concepts develop and their exposition improves.

The process is also iterative in a sense foreshadowed by Professor Cole's comment. Ultimately, the purpose of the new framework is to help analyze real-world problems. It is time to put the concepts to the test. For example, current work describing a mechanism to implement a carbon sequestration program for the United States is based on this framework. Inevitably, attempts to apply this approach will reveal additional opportunities to improve and expand the framework.

Finally, the framework is interdisciplinary in nature. It attempts to meld concepts from economics and law, and to a lesser extent, science and technology. Such a task requires an open mind, a degree of tolerance, and a real effort at communication. My own rather motley training and experience has convinced me that no single field has the monopoly on truth. This is not to suggest in any way that disciplinary training is not important—far from it. But many opportunities for constructive exchange across disciplines are missed by rigid insistence on disciplinary purity. If the academic fields are truly to benefit from each others' insights, we must avoid the balkanization of the disciplines. It is important to find both language and means of communication that are accessible across disciplines. I am grateful to the Duke Environmental Law and Policy Forum for its contribution to that effort.